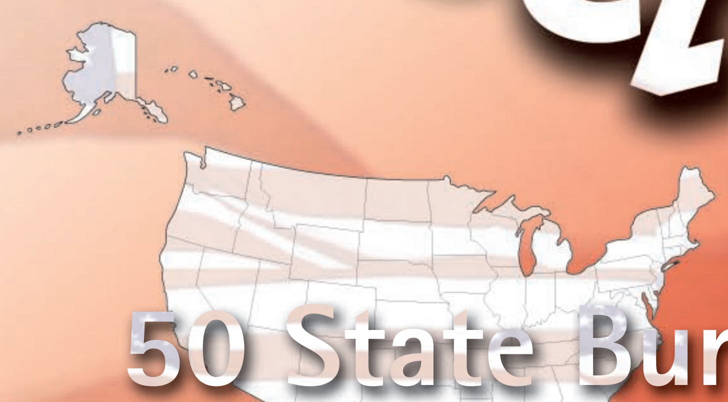
Make It Real Learning

States by the Numbers

place value
rounding
estimation
fractions
percents



50 State Bundle

Make It Real Learning

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percents

Alabama

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Alabama is projected to be 4,596,330 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Alabama changed by 151,679 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 375,808 births in Alabama. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Alabama in 2006 who were high school graduates was 82%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Alabama was 1,198 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Alabama is 50,744 square miles and the total water area is 1,675 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Alabama is 50,744 square miles and the total water area is 1,675 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Alabama was $32,236. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Alabama. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Alabama was $34,598. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Alabama in 2000 was $23,764. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Alabama ranked number 44. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Alabama ranked number 44. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Alabama was 200 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Alabama had 43,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Alabama that were sold was 67,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Alabama in 2003 was 2,014 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 2,014 in expanded form.

17. The number of home sales in Alabama in 2000 was 67,000. What is the digit in the ten thousands place?

18. The number of children in Alabama who enrolled in Prekindergarten to Grade 8 was 522,000 children in 2004. In what place value is the rightmost 2 in 522,000?

19. The number of children in Alabama who enrolled in Grade 9 to Grade 12 in 2004 was 208,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,883,000 people in Alabama voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

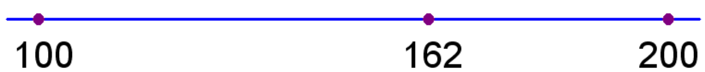
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

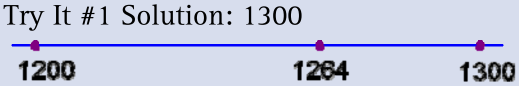


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Alabama is projected to be 4,596,330 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Alabama changed by 151,679 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 375,808 births in Alabama. We round this number to 400,000 . To what place value did we round the number?

4. The number of hospitals in Alabama in 2000 was 108. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Alabama was 1,198 dollars. We round this number to 1,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Alabama is 50,744 square miles and the total water area is 1,675 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Alabama is 50,744 square miles and the total water area is 1,675 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Alabama was $32,236. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Alabama was $34,598. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Alabama in 2000 was $23,764. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 23,800. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Alabama ranked number 44. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Alabama ranked number 40. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Alabama was 200 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Alabama had 43,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 67,000 homes. We round this number to 70,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Alabama in 2003 was 351 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 351 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Alabama in 2003 was 330 trillion BTU. (For some states, this amount will be 0.) Write 330 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Alabama who enrolled in Prekindergarten to Grade 8 was 522,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Alabama who enrolled in Grade 9 to Grade 12 was 208,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,883,000 people in Alabama voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Alabama used 580 trillion BTUs of energy from petroleum and 351 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Alabama.

2. The number of square kilometers of land area in Alabama is 131,426. The number of square kilometers of water area is 4,338. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 694,000 votes were cast for the Democratic candidate and 1,176,000 votes were cast for the Republican candidate in Alabama. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Alabama who voted for the two candidates.

4. The average annual pay in Alabama in 2004 was 33,414 dollars and in 2005 was 34,598. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Alabama consumed 130 trillion BTUs of energy from hydroelectric power (water) and 580 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Alabama in 2003.

6. In 2006, there were 4,599,000 people living in Alabama. In 2000, there were 4,447,000 people living in Alabama. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 375,808 births and 287,990 deaths in Alabama. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Alabama was 980 dollars. In 2005, the average cost per day was 1,198 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 67 percent of adults living in Alabama were high school graduates. In 2006, the number was 82 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 941,000 votes cast for the Republican candidate and 693,000 votes cast for the Democratic candidate in Alabama in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 50,744 square miles of land in Alabama. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,675 square miles of water in Alabama. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 47,000 farms in Alabama. The average number of acres of land on each farm was 191. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Alabama by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 43,000 farms in Alabama. The average number of acres of land on each farm was 200. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Alabama.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Alabama was 91 people per square mile. There are 50,744 square miles of land in Alabama. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 4,599,000 people living in Alabama. In 2000, there were 4,447,000 people living in Alabama. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 375,808 births and 287,990 deaths in Alabama. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Alabama was 980 dollars. In 2005, the average cost per day was 1,198 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 67 percent of adults living in Alabama were high school graduates. In 2006, the number was 82 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 121,000 people unemployed in Alabama. In 2000, there were 87,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Alabama has 1,675 square miles of water area and 52,419 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Alabama is water.

3. Alabama has 50,744 square miles of land area and 52,419 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Alabama is land.

5. Approximately 36.86% of Alabama voters chose the Democratic candidate in the 2004 election. A total of 1,883,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,176,000 citizens in Alabama who voted for the Republican candidate in the 2004 presidential election. A total of 1,883,000 citizens voted. Did more than 55% of the voters in Alabama select the Republican candidate?

7. The amount of energy consumed by people in Alabama in 2003 that came from petroleum was 580 trillion BTUs. The total amount of energy consumed from all sources was 2,014 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Alabama, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Alabama had 43,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Alabama to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Alabama? (Round your answer to the nearest farm.)

11. There were 8,600,000 acres of farmland in Alabama in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Alabama?

12. The projected population of Alabama in 2020 is 4,728,915 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Alabama population to the United States population.

13. In Alabama, 17.43% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 2,014 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Alabama in 2000 was $23,764. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $27,319. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 228,000 people in Alabama that belonged to labor unions. In 2006, the number of labor union members was 170,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 680,000 patients admitted to hospitals in Alabama. Between 2000 and 2005, this number changed by 3.82%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Alabama in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Alabama was 191 in 2000. Between 2000 and 2006, this number changed by 4.71%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Alabama in 2006?

18. The average cost per day for a hospital stay in Alabama in 2005 was $1,198. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Alabama, 21 had a college degree in 2006. If the number of adults in Alabama with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Alabama, 82 had a high school diploma in 2006 compared to 78 in 2000. What was the percentage change in the number of adults with high school diplomas in Alabama between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 6
3. 5
4. 8
5. 3
6. 2
7. 0
8. -5529; 5
9. 1
10. 20,000 + 3,000 + 700 + 60 + 4
11. 4
12. 4
13. ones place
14. 0
15. 3
16. 2,000 + 10 + 4
17. 6
18. thousands place
19. 200,000 +8,000
20. 1

Rounding Practice Answers

1. 4,596,000
2. 151,700
3. hundred thousands
4. 800
5. hundreds
6. 49,000
7. 52,400
8. 30,000
9. 39,700
10. hundreds
11. 1600
12. 120
13. 100
14. 40,000
15. ten thousands
16. 300 + 50 + 1; 350
17. 300 + 30; 300
18. 520,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 930 trillion BTUs
2. 135,000 square kilometers of total area
3. 1,900,000 people voted
4. 67,000 dollars
5. 700 trillion BTUs
6. 200,000 people
7. 100,000 more births than deaths
8. 200 dollars
9. 10 percent change
10. 200,000 votes
11. 132,600 square kilometers of land
12. 5,200 square kilometers of water
13. 9,500,000 acres of farmland
14. 8,000,000 acres of farmland
15. 4,641,000 people
16. 1.05 times larger
17. 1.31 times more births than deaths
18. 1.20 times more expensive
19. 1.14 times larger
20. 1.33 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1675/52419
2. 3.20%
3. 50744/52419
4. 96.80%
5. 694,000
6. Yes. 62.5 percent voted Republican.
7. 580/2014
8. 29%; 29 BTUs came from petroleum
9. 43,000/2,090,000
10. 0.021; 21 farms
11. 8,170,000
12. 5/336
13. 351 trillion BTUs
14. 14.96%
15. 25.44% decrease
16. 706,000
17. 200
18. 8.35%
19. 42%
20. 5.13% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Alaska is projected to be 694,109 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Alaska changed by 43,122 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 63,170 births in Alaska. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Alaska in 2006 who were high school graduates was 92%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Alaska was 2,246 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Alaska is 571,951 square miles and the total water area is 91,316 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Alaska is 571,951 square miles and the total water area is 91,316 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Alaska was $37,804. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Alaska. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Alaska was $40,216. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Alaska in 2000 was $29,865. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Alaska ranked number 15. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Alaska ranked number 15. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Alaska was 1,406 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, Alaska had 1,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Alaska that were sold was 14,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Alaska in 2003 was 762 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 762 in expanded form.

17. The number of home sales in Alaska in 2000 was 14,000. What is the digit in the ten thousands place?

18. The number of children in Alaska who enrolled in Prekindergarten to Grade 8 was 92,000 children in 2004. In what place value is the rightmost 2 in 92,000?

19. The number of children in Alaska who enrolled in Grade 9 to Grade 12 in 2004 was 41,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 313,000 people in Alaska voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

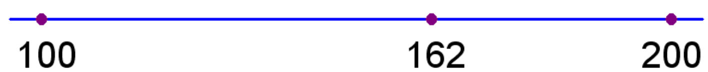
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

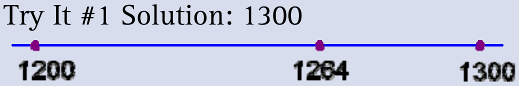


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Alaska is projected to be 694,109 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Alaska changed by 43,122 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 63,170 births in Alaska. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Alaska in 2000 was 18. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Alaska was 2,246 dollars. We round this number to 2,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Alaska is 571,951 square miles and the total water area is 91,316 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Alaska is 571,951 square miles and the total water area is 91,316 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Alaska was $37,804. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Alaska was $40,216. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Alaska in 2000 was $29,865. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 29,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Alaska ranked number 15. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Alaska ranked number 16. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Alaska was 1,406 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Alaska had 1,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 14,000 homes. We round this number to 10,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Alaska in 2003 was 446 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 446 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Alaska in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Alaska who enrolled in Prekindergarten to Grade 8 was 92,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Alaska who enrolled in Grade 9 to Grade 12 was 41,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 313,000 people in Alaska voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Alaska used 284 trillion BTUs of energy from petroleum and 446 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Alaska.

2. The number of square kilometers of land area in Alaska is 1,481,347. The number of square kilometers of water area is 236,507. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 111,000 votes were cast for the Democratic candidate and 191,000 votes were cast for the Republican candidate in Alaska. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Alaska who voted for the two candidates.

4. The average annual pay in Alaska in 2004 was 39,062 dollars and in 2005 was 40,216. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Alaska consumed 16 trillion BTUs of energy from hydroelectric power (water) and 284 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Alaska in 2003.

6. In 2006, there were 670,000 people living in Alaska. In 2000, there were 627,000 people living in Alaska. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 63,170 births and 19,342 deaths in Alaska. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Alaska was 1,495 dollars. In 2005, the average cost per day was 2,246 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 87 percent of adults living in Alaska were high school graduates. In 2006, the number was 92 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 167,000 votes cast for the Republican candidate and 79,000 votes cast for the Democratic candidate in Alaska in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 571,951 square miles of land in Alaska. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 91,316 square miles of water in Alaska. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 1,000 farms in Alaska. The average number of acres of land on each farm was 1,569. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Alaska by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 1,000 farms in Alaska. The average number of acres of land on each farm was 1,406. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Alaska.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Alaska was 1 people per square mile. There are 571,951 square miles of land in Alaska. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 670,000 people living in Alaska. In 2000, there were 627,000 people living in Alaska. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 63,170 births and 19,342 deaths in Alaska. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Alaska was 1,495 dollars. In 2005, the average cost per day was 2,246 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 87 percent of adults living in Alaska were high school graduates. In 2006, the number was 92 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 19,000 people unemployed in Alaska. In 2000, there were 20,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3,794,083 \ \cancel{\text{square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Alaska has 91,316 square miles of water area and 663,267 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Alaska is water.

3. Alaska has 571,951 square miles of land area and 663,267 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Alaska is land.

5. Approximately 35.46% of Alaska voters chose the Democratic candidate in the 2004 election. A total of 313,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 191,000 citizens in Alaska who voted for the Republican candidate in the 2004 presidential election. A total of 313,000 citizens voted. Did more than 55% of the voters in Alaska select the Republican candidate?

7. The amount of energy consumed by people in Alaska in 2003 that came from petroleum was 284 trillion BTUs. The total amount of energy consumed from all sources was 762 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Alaska, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Alaska had 1,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Alaska to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Alaska? (Round your answer to the nearest farm.)

11. There were 900,000 acres of farmland in Alaska in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Alaska?

12. The projected population of Alaska in 2020 is 774,421 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Alaska population to the United States population.

13. In Alaska, 58.53% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 762 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Alaska in 2000 was $29,865. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $32,535. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 42,000 people in Alaska that belonged to labor unions. In 2006, the number of labor union members was 62,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 47,000 patients admitted to hospitals in Alaska. Between 2000 and 2005, this number changed by 8.51%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Alaska in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Alaska was 1,569 in 2000. Between 2000 and 2006, this number changed by -10.39%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Alaska in 2006?

18. The average cost per day for a hospital stay in Alaska in 2005 was $2,246. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Alaska, 28 had a college degree in 2006. If the number of adults in Alaska with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Alaska, 92 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Alaska between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 4
2. 1
3. 4
4. 9
5. 4
6. 3
7. 6
8. 39; 0
9. 6
10. 20,000 + 9,000 + 800 + 60 + 5
11. 5
12. 1
13. ones place
14. 0
15. 0
16. 700 + 60 + 2
17. 1
18. thousands place
19. 40,000 + 1,000
20. 3

Rounding Practice Answers

1. 694,000
2. 43,100
3. hundred thousands
4. 80
5. hundreds
6. 481,000
7. 663,300
8. 40,000
9. 45,300
10. hundreds
11. 400
12. 60
13. 1,300
14. 0
15. ten thousands
16. 400 + 40 + 6; 450
17. 0; 0
18. 90,000
19. 0
20. 0

Estimation Practice Answers

1. 730 trillion BTUs
2. 1,718,000 square kilometers of total area
3. 300,000 people voted
4. 78,000 dollars
5. 300 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 700 dollars
9. 0 percent change
10. 100,000 votes
11. 1,487,200 square kilometers of land
12. 236,600 square kilometers of water
13. 0 acres of farmland
14. 0 acres of farmland
15. 572,000 people
16. 1.17 times larger
17. 3.00 times more births than deaths
18. 1.47 times more expensive
19. 1.00 times larger
20. 1.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 91316/663267
2. 13.77%
3. 571951/663267
4. 86.23%
5. 111,000
6. Yes. 61 percent voted Republican.
7. 284/762
8. 37%; 37 BTUs came from petroleum
9. 1,000/2,090,000
10. 0; 0 farms
11. 855,000
12. 1/336
13. 446 trillion BTUs
14. 8.94%
15. 47.62% increase
16. 51,000
17. 1,406
18. 4.45%
19. 56%
20. 2.22% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Arizona is projected to be 6,637,381 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Arizona changed by 1,035,686 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 564,062 births in Arizona. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Arizona in 2006 who were high school graduates was 83%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Arizona was 1,769 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Arizona is 113,635 square miles and the total water area is 364 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Arizona is 113,635 square miles and the total water area is 364 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Arizona was $35,056. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Arizona. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Arizona was $38,154. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Arizona in 2000 was $25,656. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Arizona ranked number 37. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Arizona ranked number 37. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Arizona was 2,610 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Arizona had 10,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Arizona that were sold was 105,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Arizona in 2003 was 1,371 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,371 in expanded form.

17. The number of home sales in Arizona in 2000 was 105,000. What is the digit in the ten thousands place?

18. The number of children in Arizona who enrolled in Prekindergarten to Grade 8 was 722,000 children in 2004. In what place value is the rightmost 2 in 722,000?

19. The number of children in Arizona who enrolled in Grade 9 to Grade 12 in 2004 was 321,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,013,000 people in Arizona voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

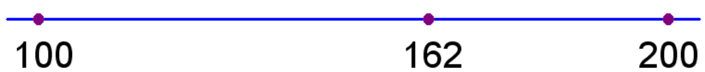
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

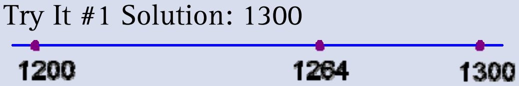


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Arizona is projected to be 6,637,381 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Arizona changed by 1,035,686 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 564,062 births in Arizona. We round this number to 600,000 . To what place value did we round the number?

4. The number of hospitals in Arizona in 2000 was 61. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Arizona was 1,769 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of Arizona is 113,635 square miles and the total water area is 364 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Arizona is 113,635 square miles and the total water area is 364 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Arizona was $35,056. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Arizona was $38,154. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Arizona in 2000 was $25,656. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 25,700. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Arizona ranked number 37. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Arizona ranked number 39. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Arizona was 2,610 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Arizona had 10,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 105,000 homes. We round this number to 110,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Arizona in 2003 was 275 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 275 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Arizona in 2003 was 298 trillion BTU. (For some states, this amount will be 0.) Write 298 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Arizona who enrolled in Prekindergarten to Grade 8 was 722,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Arizona who enrolled in Grade 9 to Grade 12 was 321,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,013,000 people in Arizona voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Arizona used 537 trillion BTUs of energy from petroleum and 275 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Arizona.

2. The number of square kilometers of land area in Arizona is 294,312. The number of square kilometers of water area is 942. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 894,000 votes were cast for the Democratic candidate and 1,104,000 votes were cast for the Republican candidate in Arizona. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Arizona who voted for the two candidates.

4. The average annual pay in Arizona in 2004 was 36,646 dollars and in 2005 was 38,154. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Arizona consumed 73 trillion BTUs of energy from hydroelectric power (water) and 537 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Arizona in 2003.

6. In 2006, there were 6,166,000 people living in Arizona. In 2000, there were 5,131,000 people living in Arizona. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 564,062 births and 266,134 deaths in Arizona. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Arizona was 1,311 dollars. In 2005, the average cost per day was 1,769 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 79 percent of adults living in Arizona were high school graduates. In 2006, the number was 83 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 782,000 votes cast for the Republican candidate and 685,000 votes cast for the Democratic candidate in Arizona in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 113,635 square miles of land in Arizona. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 364 square miles of water in Arizona. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 11,000 farms in Arizona. The average number of acres of land on each farm was 2,514. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Arizona by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 10,000 farms in Arizona. The average number of acres of land on each farm was 2,610. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Arizona.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Arizona was 54 people per square mile. There are 113,635 square miles of land in Arizona. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 6,166,000 people living in Arizona. In 2000, there were 5,131,000 people living in Arizona. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 564,062 births and 266,134 deaths in Arizona. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Arizona was 1,311 dollars. In 2005, the average cost per day was 1,769 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 79 percent of adults living in Arizona were high school graduates. In 2006, the number was 83 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 94,000 people unemployed in Arizona. In 2000, there were 100,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Arizona has 364 square miles of water area and 113,998 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Arizona is water.

3. Arizona has 113,635 square miles of land area and 113,998 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Arizona is land.

5. Approximately 44.41% of Arizona voters chose the Democratic candidate in the 2004 election. A total of 2,013,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,104,000 citizens in Arizona who voted for the Republican candidate in the 2004 presidential election. A total of 2,013,000 citizens voted. Did more than 55% of the voters in Arizona select the Republican candidate?

7. The amount of energy consumed by people in Arizona in 2003 that came from petroleum was 537 trillion BTUs. The total amount of energy consumed from all sources was 1,371 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Arizona, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Arizona had 10,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Arizona to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Arizona? (Round your answer to the nearest farm.)

11. There were 26,100,000 acres of farmland in Arizona in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Arizona?

12. The projected population of Arizona in 2020 is 8,456,448 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Arizona population to the United States population.

13. In Arizona, 20.06% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,371 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Arizona in 2000 was $25,656. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $27,461. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 125,000 people in Arizona that belonged to labor unions. In 2006, the number of labor union members was 197,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 539,000 patients admitted to hospitals in Arizona. Between 2000 and 2005, this number changed by 23.38%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Arizona in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Arizona was 2,514 in 2000. Between 2000 and 2006, this number changed by 3.82%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Arizona in 2006?

18. The average cost per day for a hospital stay in Arizona in 2005 was $1,769. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Arizona, 25 had a college degree in 2006. If the number of adults in Arizona with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Arizona, 83 had a high school diploma in 2006 compared to 85 in 2000. What was the percentage change in the number of adults with high school diplomas in Arizona between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 7
2. 6
3. 4
4. 8
5. 5
6. 3
7. 2
8. -2709; 2
9. 4
10. 20,000 + 5,000 + 600 + 50 + 6
11. 7
12. 3
13. ones place
14. 7
15. 5
16. 1,000 + 300 + 70 + 1
17. 0
18. thousands place
19. 300,000 + 20,000 + 1,000
20. 2

Rounding Practice Answers

1. 6,637,000
2. 1,035,700
3. hundred thousands
4. 20
5. hundreds
6. 114,000
7. 114,000
8. 40,000
9. 43,300
10. hundreds
11. 1600
12. 120
13. 2,500
14. 10,000
15. ten thousands
16. 200 + 70 + 5; 280
17. 200 + 90 + 8; 300
18. 720,000
19. 300,000
20. 2,000,000

Estimation Practice Answers

1. 820 trillion BTUs
2. 295,000 square kilometers of total area
3. 1,800,000 people voted
4. 73,000 dollars
5. 600 trillion BTUs
6. 1,100,000 people
7. 300,000 more births than deaths
8. 500 dollars
9. 0 percent change
10. 100,000 votes
11. 296,400 square kilometers of land
12. 0 square kilometers of water
13. 25,100,000 acres of farmland
14. 26,100,000 acres of farmland
15. 6,156,000 people
16. 1.22 times larger
17. 2.07 times more births than deaths
18. 1.38 times more expensive
19. 1.00 times larger
20. 0.90 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 364/113998
2. 0.32%
3. 113635/113998
4. 99.68%
5. 894,000
6. No. 54.8 percent voted Republican.
7. 537/1371
8. 39%; 39 BTUs came from petroleum
9. 10,000/2,090,000
10. 0.005; 5 farms
11. 24,795,000
12. 8/336
13. 275 trillion BTUs
14. 7.04%
15. 57.6% increase
16. 665,000
17. 2,610
18. 5.65%
19. 50%
20. 2.35% decrease

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Arkansas is projected to be 2,875,039 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Arkansas changed by 137,474 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 237,755 births in Arkansas. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Arkansas in 2006 who were high school graduates was 83%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Arkansas was 1,238 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Arkansas is 52,068 square miles and the total water area is 1,110 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Arkansas is 52,068 square miles and the total water area is 1,110 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Arkansas was $28,893. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Arkansas. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Arkansas was $31,266. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Arkansas in 2000 was $21,924. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Arkansas ranked number 48. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Arkansas ranked number 48. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Arkansas was 308 acres. What is the place value furthest to the right that contains the number 8?

14. In 2006, Arkansas had 47,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Arkansas that were sold was 45,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Arkansas in 2003 was 1,133 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,133 in expanded form.

17. The number of home sales in Arkansas in 2000 was 45,000. What is the digit in the ten thousands place?

18. The number of children in Arkansas who enrolled in Prekindergarten to Grade 8 was 328,000 children in 2004. In what place value is the rightmost 8 in 328,000?

19. The number of children in Arkansas who enrolled in Grade 9 to Grade 12 in 2004 was 135,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,055,000 people in Arkansas voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

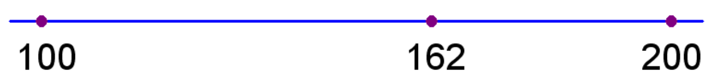
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

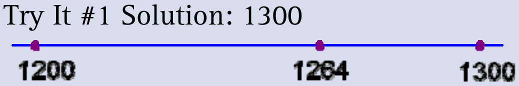


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Arkansas is projected to be 2,875,039 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Arkansas changed by 137,474 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 237,755 births in Arkansas. We round this number to 200,000 . To what place value did we round the number?

4. The number of hospitals in Arkansas in 2000 was 83. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Arkansas was 1,238 dollars. We round this number to 1,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Arkansas is 52,068 square miles and the total water area is 1,110 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Arkansas is 52,068 square miles and the total water area is 1,110 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Arkansas was $28,893. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Arkansas was $31,266. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Arkansas in 2000 was $21,924. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 21,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Arkansas ranked number 48. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Arkansas ranked number 48. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Arkansas was 308 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Arkansas had 47,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 45,000 homes. We round this number to 50,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Arkansas in 2003 was 259 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 259 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Arkansas in 2003 was 153 trillion BTU. (For some states, this amount will be 0.) Write 153 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Arkansas who enrolled in Prekindergarten to Grade 8 was 328,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Arkansas who enrolled in Grade 9 to Grade 12 was 135,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,055,000 people in Arkansas voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}
\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\
&= \frac{10 \times 10}{4} \\
&= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\
&= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\
&= 5 \times 5 \\
&= 25
\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Arkansas used 377 trillion BTUs of energy from petroleum and 259 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Arkansas.

2. The number of square kilometers of land area in Arkansas is 134,856. The number of square kilometers of water area is 2,876. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 470,000 votes were cast for the Democratic candidate and 573,000 votes were cast for the Republican candidate in Arkansas. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Arkansas who voted for the two candidates.

4. The average annual pay in Arkansas in 2004 was 30,245 dollars and in 2005 was 31,266. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Arkansas consumed 27 trillion BTUs of energy from hydroelectric power (water) and 377 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Arkansas in 2003.

6. In 2006, there were 2,811,000 people living in Arkansas. In 2000, there were 2,673,000 people living in Arkansas. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 237,755 births and 175,236 deaths in Arkansas. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Arkansas was 908 dollars. In 2005, the average cost per day was 1,238 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 66 percent of adults living in Arkansas were high school graduates. In 2006, the number was 83 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 473,000 votes cast for the Republican candidate and 423,000 votes cast for the Democratic candidate in Arkansas in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 52,068 square miles of land in Arkansas. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,110 square miles of water in Arkansas. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 48,000 farms in Arkansas. The average number of acres of land on each farm was 304. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Arkansas by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 47,000 farms in Arkansas. The average number of acres of land on each farm was 308. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Arkansas.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Arkansas was 54 people per square mile. There are 52,068 square miles of land in Arkansas. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 2,811,000 people living in Arkansas. In 2000, there were 2,673,000 people living in Arkansas. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 237,755 births and 175,236 deaths in Arkansas. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Arkansas was 908 dollars. In 2005, the average cost per day was 1,238 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 66 percent of adults living in Arkansas were high school graduates. In 2006, the number was 83 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 76,000 people unemployed in Arkansas. In 2000, there were 53,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3{,}794{,}083 \cancel{\text{ square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Arkansas has 1,110 square miles of water area and 53,179 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Arkansas is water.

3. Arkansas has 52,068 square miles of land area and 53,179 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Arkansas is land.

5. Approximately 44.55% of Arkansas voters chose the Democratic candidate in the 2004 election. A total of 1,055,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 573,000 citizens in Arkansas who voted for the Republican candidate in the 2004 presidential election. A total of 1,055,000 citizens voted. Did more than 55% of the voters in Arkansas select the Republican candidate?

7. The amount of energy consumed by people in Arkansas in 2003 that came from petroleum was 377 trillion BTUs. The total amount of energy consumed from all sources was 1,133 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Arkansas, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Arkansas had 47,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Arkansas to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Arkansas? (Round your answer to the nearest farm.)

11. There were 14,300,000 acres of farmland in Arkansas in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Arkansas?

12. The projected population of Arkansas in 2020 is 3,060,219 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Arkansas population to the United States population.

13. In Arkansas, 22.86% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,133 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Arkansas in 2000 was $21,924. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $24,385. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 82,000 people in Arkansas that belonged to labor unions. In 2006, the number of labor union members was 58,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 368,000 patients admitted to hospitals in Arkansas. Between 2000 and 2005, this number changed by 3.26%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Arkansas in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Arkansas was 304 in 2000. Between 2000 and 2006, this number changed by 1.32%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Arkansas in 2006?

18. The average cost per day for a hospital stay in Arkansas in 2005 was $1,238. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Arkansas, 19 had a college degree in 2006. If the number of adults in Arkansas with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Arkansas, 83 had a high school diploma in 2006 compared to 82 in 2000. What was the percentage change in the number of adults with high school diplomas in Arkansas between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 5
2. 4
3. 1
4. 8
5. 4
6. 3
7. 9
8. -8872; 8
9. 7
10. 20,000 + 1,000 + 900 + 20 + 4
11. 8
12. 4
13. ones place
14. 4
15. 2
16. 1,000 + 100 + 30 + 3
17. 4
18. thousands place
19. 100,000 + 30,000 + 5,000
20. 1

Rounding Practice Answers

1. 2,875,000
2. 137,500
3. hundred thousands
4. 40
5. hundreds
6. 51,000
7. 53,200
8. 30,000
9. 36,400
10. hundreds
11. 2500
12. 150
13. 200
14. 50,000
15. ten thousands
16. 200 + 50 + 9; 260
17. 100 + 50 + 3; 200
18. 330,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 640 trillion BTUs
2. 138,000 square kilometers of total area
3. 1,000,000 people voted
4. 60,000 dollars
5. 400 trillion BTUs
6. 100,000 people
7. 0 more births than deaths
8. 300 dollars
9. 10 percent change
10. 100,000 votes
11. 135,200 square kilometers of land
12. 2,600 square kilometers of water
13. 15,000,000 acres of farmland
14. 15,500,000 acres of farmland
15. 2,808,000 people
16. 1.04 times larger
17. 1.33 times more births than deaths
18. 1.33 times more expensive
19. 1.14 times larger
20. 1.60 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1110/53179
2. 2.09%
3. 52068/53179
4. 97.91%
5. 470,000
6. No. 54.3 percent voted Republican.
7. 377/1133
8. 33%; 33 BTUs came from petroleum
9. 47,000/2,090,000
10. 0.022; 22 farms
11. 13,585,000
12. 3/336
13. 259 trillion BTUs
14. 11.23%
15. 29.27% decrease
16. 380,000
17. 308
18. 8.08%
19. 38%
20. 1.22% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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- States by the Numbers series
  - One activity book per US state focusing on place value, rounding, estimation, and understanding fractions and percents.

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Make It Real Learning

States by the Numbers

place value
rounding
estimation
fractions
percents

California

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of California is projected to be 38,067,134 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of California changed by 2,585,896 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 3,375,297 births in California. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in California in 2006 who were high school graduates was 81%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in California was 1,994 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of California is 155,959 square miles and the total water area is 7,736 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of California is 155,959 square miles and the total water area is 7,736 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in California was $42,592. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in California. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in California was $46,211. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in California in 2000 was $32,458. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, California ranked number 8. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, California ranked number 8. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in California was 346 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, California had 76,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in California that were sold was 574,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in California in 2003 was 8,130 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 8,130 in expanded form.

17. The number of home sales in California in 2000 was 574,000. What is the digit in the ten thousands place?

18. The number of children in California who enrolled in Prekindergarten to Grade 8 was 4,508,000 children in 2004. In what place value is the rightmost 8 in 4,508,000?

19. The number of children in California who enrolled in Grade 9 to Grade 12 in 2004 was 1,934,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 12,421,000 people in California voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

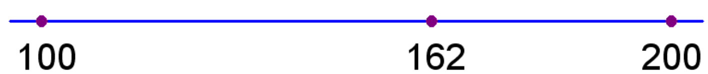
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

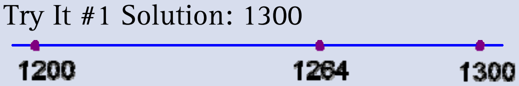


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of California is projected to be 38,067,134 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of California changed by 2,585,896 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 3,375,297 births in California. We round this number to 3,400,000 . To what place value did we round the number?

4. The number of hospitals in California in 2000 was 389. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in California was 1,994 dollars. We round this number to 2,000. What is the smallest place value to which you can round and get this number?

6. The total land area of California is 155,959 square miles and the total water area is 7,736 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of California is 155,959 square miles and the total water area is 7,736 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in California was $42,592. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in California was $46,211. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in California in 2000 was $32,458. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 32,500. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, California ranked number 8. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, California ranked number 11. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in California was 346 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, California had 76,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 574,000 homes. We round this number to 570,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in California in 2003 was 2,267 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 2,267 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in California in 2003 was 371 trillion BTU. (For some states, this amount will be 0.) Write 371 in expanded form. Then round the number to the nearest hundred.

18. The number of children in California who enrolled in Prekindergarten to Grade 8 was 4,508,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in California who enrolled in Grade 9 to Grade 12 was 1,934,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 12,421,000 people in California voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \times \cancel{10}}{\cancel{4} \times 4 \times \cancel{10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \times \cancel{2} \times 5}{\cancel{2} \times \cancel{2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, California used 3,837 trillion BTUs of energy from petroleum and 2,267 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in California.

2. The number of square kilometers of land area in California is 403,933. The number of square kilometers of water area is 20,037. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 6,745,000 votes were cast for the Democratic candidate and 5,510,000 votes were cast for the Republican candidate in California. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in California who voted for the two candidates.

4. The average annual pay in California in 2004 was 44,641 dollars and in 2005 was 46,211. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in California consumed 373 trillion BTUs of energy from hydroelectric power (water) and 3,837 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in California in 2003.

6. In 2006, there were 36,458,000 people living in California. In 2000, there were 33,872,000 people living in California. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 3,375,297 births and 1,465,929 deaths in California. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in California was 1,438 dollars. In 2005, the average cost per day was 1,994 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 76 percent of adults living in California were high school graduates. In 2006, the number was 81 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 4,567,000 votes cast for the Republican candidate and 5,861,000 votes cast for the Democratic candidate in California in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 155,959 square miles of land in California. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 7,736 square miles of water in California. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 83,000 farms in California. The average number of acres of land on each farm was 337. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in California by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 76,000 farms in California. The average number of acres of land on each farm was 346. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in California.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of California was 234 people per square mile. There are 155,959 square miles of land in California. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 36,458,000 people living in California. In 2000, there were 33,872,000 people living in California. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 3,375,297 births and 1,465,929 deaths in California. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in California was 1,438 dollars. In 2005, the average cost per day was 1,994 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 76 percent of adults living in California were high school graduates. In 2006, the number was 81 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 874,000 people unemployed in California. In 2000, there were 833,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3{,}794{,}083 \cancel{\text{ square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. California has 7,736 square miles of water area and 163,696 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of California is water.

3. California has 155,959 square miles of land area and 163,696 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of California is land.

5. Approximately 54.30% of California voters chose the Democratic candidate in the 2004 election. A total of 12,421,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 5,510,000 citizens in California who voted for the Republican candidate in the 2004 presidential election. A total of 12,421,000 citizens voted. Did more than 55% of the voters in California select the Republican candidate?

7. The amount of energy consumed by people in California in 2003 that came from petroleum was 3,837 trillion BTUs. The total amount of energy consumed from all sources was 8,130 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in California, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. California had 76,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in California to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in California? (Round your answer to the nearest farm.)

11. There were 26,300,000 acres of farmland in California in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in California?

12. The projected population of California in 2020 is 42,206,743 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the California population to the United States population.

13. In California, 27.88% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 8,130 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in California in 2000 was $32,458. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $34,006. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 2,119,000 people in California that belonged to labor unions. In 2006, the number of labor union members was 2,273,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 3,315,000 patients admitted to hospitals in California. Between 2000 and 2005, this number changed by 3.59%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in California in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in California was 337 in 2000. Between 2000 and 2006, this number changed by 2.67%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in California in 2006?

18. The average cost per day for a hospital stay in California in 2005 was $1,994. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in California, 30 had a college degree in 2006. If the number of adults in California with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in California, 81 had a high school diploma in 2006 compared to 81 in 2000. What was the percentage change in the number of adults with high school diplomas in California between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 7
2. 8
3. 5
4. 8
5. 9
6. 3
7. 2
8. 4827; 4
9. 2
10. 30,000 + 2,000 + 400 + 50 + 8
11. 8
12. 1
13. ones place
14. 3
15. 8
16. 8,000 + 100 + 30
17. 7
18. thousands place
19. 1,000,000 + 900,000 + 30,000 + 4,000
20. 1

Rounding Practice Answers

1. 38,067,000
2. 2,585,900
3. hundred thousands
4. 980
5. hundreds
6. 148,000
7. 163,700
8. 40,000
9. 51,300
10. hundreds
11. 100
12. 30
13. 200
14. 80,000
15. ten thousands
16. 2,000 + 200 + 60 + 7; 2270
17. 300 + 70 + 1; 400
18. 4,510,000
19. 1,900,000
20. 12,000,000

Estimation Practice Answers

1. 6110 trillion BTUs
2. 424,000 square kilometers of total area
3. 11,400,000 people voted
4. 89,000 dollars
5. 4200 trillion BTUs
6. 2,600,000 people
7. 1,900,000 more births than deaths
8. 600 dollars
9. 0 percent change
10. 1,300,000 votes
11. 405,600 square kilometers of land
12. 20,800 square kilometers of water
13. 27,200,000 acres of farmland
14. 28,000,000 acres of farmland
15. 36,504,000 people
16. 1.08 times larger
17. 2.30 times more births than deaths
18. 1.43 times more expensive
19. 1.00 times larger
20. 1.05 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 7736/163696
2. 4.73%
3. 155959/163696
4. 95.27%
5. 6,745,000
6. No. 44.4 percent voted Republican.
7. 3837/8130
8. 47%; 47 BTUs came from petroleum
9. 76,000/2,090,000
10. 0.036; 36 farms
11. 24,985,000
12. 42/336
13. 2267 trillion BTUs
14. 4.77%
15. 7.27% increase
16. 3,434,000
17. 346
18. 5.02%
19. 60%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Colorado is projected to be 4,831,554 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Colorado changed by 451,362 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 425,394 births in Colorado. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Colorado in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Colorado was 1,751 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Colorado is 103,718 square miles and the total water area is 376 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Colorado is 103,718 square miles and the total water area is 376 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Colorado was $38,942. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Colorado. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Colorado was $41,601. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Colorado in 2000 was $33,367. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Colorado ranked number 7. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Colorado ranked number 7. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Colorado was 1,000 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Colorado had 31,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Colorado that were sold was 112,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Colorado in 2003 was 1,352 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,352 in expanded form.

17. The number of home sales in Colorado in 2000 was 112,000. What is the digit in the ten thousands place?

18. The number of children in Colorado who enrolled in Prekindergarten to Grade 8 was 541,000 children in 2004. In what place value is the rightmost 1 in 541,000?

19. The number of children in Colorado who enrolled in Grade 9 to Grade 12 in 2004 was 225,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,130,000 people in Colorado voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

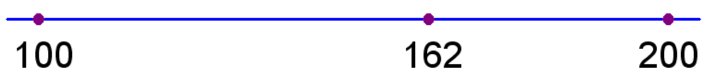
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

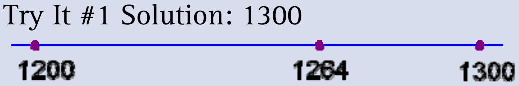


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Colorado is projected to be 4,831,554 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Colorado changed by 451,362 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 425,394 births in Colorado. We round this number to 400,000 . To what place value did we round the number?

4. The number of hospitals in Colorado in 2000 was 69. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Colorado was 1,751 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of Colorado is 103,718 square miles and the total water area is 376 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Colorado is 103,718 square miles and the total water area is 376 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Colorado was $38,942. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Colorado was $41,601. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Colorado in 2000 was $33,367. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 33,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Colorado ranked number 7. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Colorado ranked number 8. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Colorado was 1,000 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Colorado had 31,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 112,000 homes. We round this number to 110,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Colorado in 2003 was 438 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 438 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Colorado in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Colorado who enrolled in Prekindergarten to Grade 8 was 541,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Colorado who enrolled in Grade 9 to Grade 12 was 225,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,130,000 people in Colorado voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Colorado used 463 trillion BTUs of energy from petroleum and 438 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Colorado.

2. The number of square kilometers of land area in Colorado is 268,627. The number of square kilometers of water area is 974. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,002,000 votes were cast for the Democratic candidate and 1,101,000 votes were cast for the Republican candidate in Colorado. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Colorado who voted for the two candidates.

4. The average annual pay in Colorado in 2004 was 40,276 dollars and in 2005 was 41,601. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Colorado consumed 13 trillion BTUs of energy from hydroelectric power (water) and 463 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Colorado in 2003.

6. In 2006, there were 4,753,000 people living in Colorado. In 2000, there were 4,301,000 people living in Colorado. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 425,394 births and 181,115 deaths in Colorado. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Colorado was 1,280 dollars. In 2005, the average cost per day was 1,751 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 84 percent of adults living in Colorado were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 884,000 votes cast for the Republican candidate and 738,000 votes cast for the Democratic candidate in Colorado in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 103,718 square miles of land in Colorado. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 376 square miles of water in Colorado. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 30,000 farms in Colorado. The average number of acres of land on each farm was 1,053. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Colorado by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 31,000 farms in Colorado. The average number of acres of land on each farm was 1,000. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Colorado.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Colorado was 46 people per square mile. There are 103,718 square miles of land in Colorado. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 4,753,000 people living in Colorado. In 2000, there were 4,301,000 people living in Colorado. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 425,394 births and 181,115 deaths in Colorado. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Colorado was 1,280 dollars. In 2005, the average cost per day was 1,751 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 84 percent of adults living in Colorado were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 91,000 people unemployed in Colorado. In 2000, there were 65,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of}} \text{ area}} \times 3{,}794{,}083 \ \cancel{\text{square miles of}} \text{ area} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Colorado has 376 square miles of water area and 104,094 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Colorado is water.

3. Colorado has 103,718 square miles of land area and 104,094 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Colorado is land.

5. Approximately 47.04% of Colorado voters chose the Democratic candidate in the 2004 election. A total of 2,130,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,101,000 citizens in Colorado who voted for the Republican candidate in the 2004 presidential election. A total of 2,130,000 citizens voted. Did more than 55% of the voters in Colorado select the Republican candidate?

7. The amount of energy consumed by people in Colorado in 2003 that came from petroleum was 463 trillion BTUs. The total amount of energy consumed from all sources was 1,352 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Colorado, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Colorado had 31,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Colorado to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Colorado? (Round your answer to the nearest farm.)

11. There were 30,700,000 acres of farmland in Colorado in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Colorado?

12. The projected population of Colorado in 2020 is 5,278,867 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Colorado population to the United States population.

13. In Colorado, 32.40% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,352 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Colorado in 2000 was $33,367. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $34,207. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 178,000 people in Colorado that belonged to labor unions. In 2006, the number of labor union members was 165,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 397,000 patients admitted to hospitals in Colorado. Between 2000 and 2005, this number changed by 5.04%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Colorado in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Colorado was 1,053 in 2000. Between 2000 and 2006, this number changed by -5.03%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Colorado in 2006?

18. The average cost per day for a hospital stay in Colorado in 2005 was $1,751. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Colorado, 36 had a college degree in 2006. If the number of adults in Colorado with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Colorado, 90 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Colorado between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 1
2. 3
3. 0
4. 9
5. 5
6. 4
7. 3
8. 1177; 1
9. 8
10. 30,000 + 3,000 + 300 + 60 + 7
11. 7
12. 0
13. ones place
14. 8
15. 5
16. 1,000 + 300 + 50 + 2
17. 1
18. thousands place
19. 200,000 + 20,000 + 5,000
20. 2

Rounding Practice Answers

1. 4,832,000
2. 451,400
3. hundred thousands
4. 100
5. hundreds
6. 104,000
7. 104,100
8. 40,000
9. 46,700
10. hundreds
11. 100
12. 30
13. 900
14. 30,000
15. ten thousands
16. 400 + 30 + 8; 440
17. 0; 0
18. 540,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 900 trillion BTUs
2. 270,000 square kilometers of total area
3. 1,800,000 people voted
4. 81,000 dollars
5. 500 trillion BTUs
6. 500,000 people
7. 200,000 more births than deaths
8. 500 dollars
9. 10 percent change
10. 200,000 votes
11. 270,400 square kilometers of land
12. 0 square kilometers of water
13. 31,500,000 acres of farmland
14. 30,000,000 acres of farmland
15. 4,784,000 people
16. 1.12 times larger
17. 2.39 times more births than deaths
18. 1.38 times more expensive
19. 1.13 times larger
20. 1.29 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 376/104094
2. 0.36%
3. 103718/104094
4. 99.64%
5. 1,002,000
6. No. 51.7 percent voted Republican.
7. 463/1352
8. 34%; 34 BTUs came from petroleum
9. 31,000/2,090,000
10. 0.015; 15 farms
11. 29,165,000
12. 5/336
13. 438 trillion BTUs
14. 2.52%
15. 7.3% decrease
16. 417,000
17. 1,000
18. 5.71%
19. 72%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Connecticut is projected to be 3,577,490 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Connecticut changed by 99,207 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 256,735 births in Connecticut. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Connecticut in 2006 who were high school graduates was 88%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Connecticut was 1,714 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Connecticut is 4,845 square miles and the total water area is 699 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Connecticut is 4,845 square miles and the total water area is 699 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Connecticut was $48,328. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Connecticut. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Connecticut was $52,954. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Connecticut in 2000 was $41,485. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Connecticut ranked number 1. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Connecticut ranked number 1. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Connecticut was 86 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, Connecticut had 4,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Connecticut that were sold was 62,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Connecticut in 2003 was 889 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 889 in expanded form.

17. The number of home sales in Connecticut in 2000 was 62,000. What is the digit in the ten thousands place?

18. The number of children in Connecticut who enrolled in Prekindergarten to Grade 8 was 404,000 children in 2004. In what place value is the rightmost 4 in 404,000?

19. The number of children in Connecticut who enrolled in Grade 9 to Grade 12 in 2004 was 173,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,579,000 people in Connecticut voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

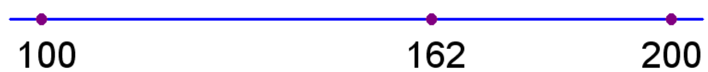
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

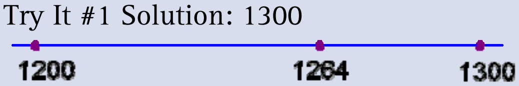


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Connecticut is projected to be 3,577,490 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Connecticut changed by 99,207 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 256,735 births in Connecticut. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in Connecticut in 2000 was 35. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Connecticut was 1,714 dollars. We round this number to 1,700. What is the smallest place value to which you can round and get this number?

6. The total land area of Connecticut is 4,845 square miles and the total water area is 699 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Connecticut is 4,845 square miles and the total water area is 699 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Connecticut was $48,328. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Connecticut was $52,954. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Connecticut in 2000 was $41,485. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 41,500. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Connecticut ranked number 1. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Connecticut ranked number 1. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Connecticut was 86 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Connecticut had 4,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 62,000 homes. We round this number to 60,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Connecticut in 2003 was 155 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 155 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Connecticut in 2003 was 168 trillion BTU. (For some states, this amount will be 0.) Write 168 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Connecticut who enrolled in Prekindergarten to Grade 8 was 404,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Connecticut who enrolled in Grade 9 to Grade 12 was 173,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,579,000 people in Connecticut voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Connecticut used 436 trillion BTUs of energy from petroleum and 155 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Connecticut.

2. The number of square kilometers of land area in Connecticut is 12,548. The number of square kilometers of water area is 1,809. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 857,000 votes were cast for the Democratic candidate and 694,000 votes were cast for the Republican candidate in Connecticut. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Connecticut who voted for the two candidates.

4. The average annual pay in Connecticut in 2004 was 51,007 dollars and in 2005 was 52,954. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Connecticut consumed 6 trillion BTUs of energy from hydroelectric power (water) and 436 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Connecticut in 2003.

6. In 2006, there were 3,505,000 people living in Connecticut. In 2000, there were 3,406,000 people living in Connecticut. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 256,735 births and 185,987 deaths in Connecticut. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Connecticut was 1,373 dollars. In 2005, the average cost per day was 1,714 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 79 percent of adults living in Connecticut were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 561,000 votes cast for the Republican candidate and 816,000 votes cast for the Democratic candidate in Connecticut in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 4,845 square miles of land in Connecticut. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 699 square miles of water in Connecticut. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 4,000 farms in Connecticut. The average number of acres of land on each farm was 86. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Connecticut by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 4,000 farms in Connecticut. The average number of acres of land on each farm was 86. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Connecticut.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Connecticut was 723 people per square mile. There are 4,845 square miles of land in Connecticut. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 3,505,000 people living in Connecticut. In 2000, there were 3,406,000 people living in Connecticut. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 256,735 births and 185,987 deaths in Connecticut. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Connecticut was 1,373 dollars. In 2005, the average cost per day was 1,714 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 79 percent of adults living in Connecticut were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 90,000 people unemployed in Connecticut. In 2000, there were 39,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3,794,083 \ \cancel{\text{square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Connecticut has 699 square miles of water area and 5,543 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Connecticut is water.

3. Connecticut has 4,845 square miles of land area and 5,543 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Connecticut is land.

5. Approximately 54.27% of Connecticut voters chose the Democratic candidate in the 2004 election. A total of 1,579,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 694,000 citizens in Connecticut who voted for the Republican candidate in the 2004 presidential election. A total of 1,579,000 citizens voted. Did more than 55% of the voters in Connecticut select the Republican candidate?

7. The amount of energy consumed by people in Connecticut in 2003 that came from petroleum was 436 trillion BTUs. The total amount of energy consumed from all sources was 889 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Connecticut, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Connecticut had 4,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Connecticut to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Connecticut? (Round your answer to the nearest farm.)

11. There were 360,000 acres of farmland in Connecticut in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Connecticut?

12. The projected population of Connecticut in 2020 is 3,675,650 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Connecticut population to the United States population.

13. In Connecticut, 17.44% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 889 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Connecticut in 2000 was $41,485. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $43,518. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 314,000 people in Connecticut that belonged to labor unions. In 2006, the number of labor union members was 248,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 349,000 patients admitted to hospitals in Connecticut. Between 2000 and 2005, this number changed by 16.05%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Connecticut in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Connecticut was 86 in 2000. Between 2000 and 2006, this number changed by 0.00%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Connecticut in 2006?

18. The average cost per day for a hospital stay in Connecticut in 2005 was $1,714. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Connecticut, 36 had a college degree in 2006. If the number of adults in Connecticut with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Connecticut, 88 had a high school diploma in 2006 compared to 88 in 2000. What was the percentage change in the number of adults with high school diplomas in Connecticut between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 7
2. 2
3. 3
4. 8
5. 4
6. 5
7. 1
8. 10563; 0
9. 9
10. 40,000 + 1,000 + 400 + 80 + 5
11. 1
12. 0
13. ones place
14. 1
15. 3
16. 800 + 80 + 9
17. 6
18. thousands place
19. 100,000 + 70,000 + 3,000
20. 1

Rounding Practice Answers

1. 3,577,000
2. 99,200
3. hundred thousands
4. 50
5. hundreds
6. 4,000
7. 5,500
8. 50,000
9. 58,100
10. hundreds
11. 0
12. 0
13. 0
14. 0
15. ten thousands
16. 100 + 50 + 5; 160
17. 100 + 60 + 8; 200
18. 400,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 600 trillion BTUs
2. 15,000 square kilometers of total area
3. 1,500,000 people voted
4. 101,000 dollars
5. 400 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 200,000 votes
11. 13,000 square kilometers of land
12. 2,600 square kilometers of water
13. 0 acres of farmland
14. 0 acres of farmland
15. 3,615,000 people
16. 1.03 times larger
17. 1.37 times more births than deaths
18. 1.21 times more expensive
19. 1.13 times larger
20. 2.25 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 699/5543
2. 12.61%
3. 4845/5543
4. 87.41%
5. 857,000
6. No. 44 percent voted Republican.
7. 436/889
8. 49%; 49 BTUs came from petroleum
9. 4,000/2,090,000
10. 0.002; 2 farms
11. 342,000
12. 4/336
13. 155 trillion BTUs
14. 4.90%
15. 21.02% decrease
16. 405,000
17. 86
18. 5.83%
19. 72%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Delaware is projected to be 884,342 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Delaware changed by 69,876 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 69,846 births in Delaware. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Delaware in 2006 who were high school graduates was 86%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Delaware was 1,715 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Delaware is 1,954 square miles and the total water area is 536 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Delaware is 1,954 square miles and the total water area is 536 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Delaware was $40,954. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Delaware. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Delaware was $44,622. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Delaware in 2000 was $30,867. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Delaware ranked number 13. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Delaware ranked number 13. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Delaware was 224 acres. What is the place value furthest to the right that contains the number 4?

14. In 2006, Delaware had 2,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Delaware that were sold was 13,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Delaware in 2003 was 313 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 313 in expanded form.

17. The number of home sales in Delaware in 2000 was 13,000. What is the digit in the ten thousands place?

18. The number of children in Delaware who enrolled in Prekindergarten to Grade 8 was 84,000 children in 2004. In what place value is the rightmost 4 in 84,000?

19. The number of children in Delaware who enrolled in Grade 9 to Grade 12 in 2004 was 35,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 375,000 people in Delaware voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

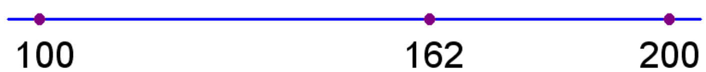
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

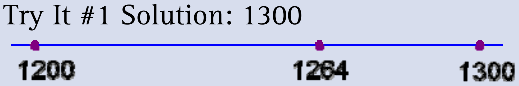


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Delaware is projected to be 884,342 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Delaware changed by 69,876 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 69,846 births in Delaware. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Delaware in 2000 was 5. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Delaware was 1,715 dollars. We round this number to 1,700. What is the smallest place value to which you can round and get this number?

6. The total land area of Delaware is 1,954 square miles and the total water area is 536 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Delaware is 1,954 square miles and the total water area is 536 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Delaware was $40,954. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Delaware was $44,622. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Delaware in 2000 was $30,867. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 30,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Delaware ranked number 13. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Delaware ranked number 10. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Delaware was 224 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Delaware had 2,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 13,000 homes. We round this number to 10,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Delaware in 2003 was 48 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 48 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Delaware in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Delaware who enrolled in Prekindergarten to Grade 8 was 84,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Delaware who enrolled in Grade 9 to Grade 12 was 35,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 375,000 people in Delaware voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Delaware used 148 trillion BTUs of energy from petroleum and 48 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Delaware.

2. The number of square kilometers of land area in Delaware is 5,060. The number of square kilometers of water area is 1,388. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 200,000 votes were cast for the Democratic candidate and 172,000 votes were cast for the Republican candidate in Delaware. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Delaware who voted for the two candidates.

4. The average annual pay in Delaware in 2004 was 42,487 dollars and in 2005 was 44,622. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Delaware consumed 0 trillion BTUs of energy from hydroelectric power (water) and 148 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Delaware in 2003.

6. In 2006, there were 853,000 people living in Delaware. In 2000, there were 784,000 people living in Delaware. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 69,846 births and 44,173 deaths in Delaware. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Delaware was 1,311 dollars. In 2005, the average cost per day was 1,715 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 78 percent of adults living in Delaware were high school graduates. In 2006, the number was 86 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 137,000 votes cast for the Republican candidate and 180,000 votes cast for the Democratic candidate in Delaware in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 1,954 square miles of land in Delaware. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 536 square miles of water in Delaware. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 3,000 farms in Delaware. The average number of acres of land on each farm was 215. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Delaware by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 2,000 farms in Delaware. The average number of acres of land on each farm was 224. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Delaware.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Delaware was 437 people per square mile. There are 1,954 square miles of land in Delaware. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 853,000 people living in Delaware. In 2000, there were 784,000 people living in Delaware. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 69,846 births and 44,173 deaths in Delaware. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Delaware was 1,311 dollars. In 2005, the average cost per day was 1,715 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 78 percent of adults living in Delaware were high school graduates. In 2006, the number was 86 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 15,000 people unemployed in Delaware. In 2000, there were 14,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Delaware has 536 square miles of water area and 2,489 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Delaware is water.

3. Delaware has 1,954 square miles of land area and 2,489 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Delaware is land.

5. Approximately 53.33% of Delaware voters chose the Democratic candidate in the 2004 election. A total of 375,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 172,000 citizens in Delaware who voted for the Republican candidate in the 2004 presidential election. A total of 375,000 citizens voted. Did more than 55% of the voters in Delaware select the Republican candidate?

7. The amount of energy consumed by people in Delaware in 2003 that came from petroleum was 148 trillion BTUs. The total amount of energy consumed from all sources was 313 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Delaware, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Delaware had 2,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Delaware to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Delaware? (Round your answer to the nearest farm.)

11. There were 515,000 acres of farmland in Delaware in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Delaware?

12. The projected population of Delaware in 2020 is 963,209 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Delaware population to the United States population.

13. In Delaware, 15.34% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 313 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Delaware in 2000 was $30,867. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $34,064. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 49,000 people in Delaware that belonged to labor unions. In 2006, the number of labor union members was 43,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 83,000 patients admitted to hospitals in Delaware. Between 2000 and 2005, this number changed by 25.30%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Delaware in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Delaware was 215 in 2000. Between 2000 and 2006, this number changed by 4.19%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Delaware in 2006?

18. The average cost per day for a hospital stay in Delaware in 2005 was $1,715. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Delaware, 26 had a college degree in 2006. If the number of adults in Delaware with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Delaware, 86 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Delaware between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 4
2. 8
3. 4
4. 8
5. 4
6. 2
7. 4
8. 3189; 3
9. 1
10. 30,000 + 800 + 60 + 7
11. 3
12. 1
13. ones place
14. 0
15. 0
16. 300 + 10 + 3
17. 1
18. thousands place
19. 30,000 + 5,000
20. 3

Rounding Practice Answers

1. 884,000
2. 69,900
3. hundred thousands
4. 10
5. hundreds
6. 1,000
7. 2,500
8. 40,000
9. 49,700
10. hundreds
11. 100
12. 30
13. 100
14. 0
15. ten thousands
16. 40 + 8; 50
17. 0; 0
18. 80,000
19. 0
20. 0

Estimation Practice Answers

1. 200 trillion BTUs
2. 6,000 square kilometers of total area
3. 400,000 people voted
4. 86,000 dollars
5. 100 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 100,000 votes
11. 5,200 square kilometers of land
12. 2,600 square kilometers of water
13. 0 acres of farmland
14. 0 acres of farmland
15. 874,000 people
16. 1.13 times larger
17. 1.75 times more births than deaths
18. 1.31 times more expensive
19. 1.13 times larger
20. 2.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 536/2489
2. 21.53%
3. 1954/2489
4. 78.51%
5. 200,000
6. No. 45.9 percent voted Republican.
7. 148/313
8. 47%; 47 BTUs came from petroleum
9. 2,000/2,090,000
10. 0.001; 1 farm
11. 489,000
12. 1/336
13. 48 trillion BTUs
14. 10.36%
15. 12.24% decrease
16. 104,000
17. 224
18. 5.83%
19. 52%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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States by the Numbers

place value
rounding
estimation
fractions
percents

Florida

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Florida is projected to be 19,251,691 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Florida changed by 2,107,064 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 1,338,458 births in Florida. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Florida in 2006 who were high school graduates was 87%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Florida was 1,497 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Florida is 53,927 square miles and the total water area is 11,828 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Florida is 53,927 square miles and the total water area is 11,828 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Florida was $33,544. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Florida. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Florida was $36,800. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Florida in 2000 was $28,507. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Florida ranked number 20. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Florida ranked number 20. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Florida was 244 acres. What is the place value furthest to the right that contains the number 4?

14. In 2006, Florida had 41,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Florida that were sold was 394,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Florida in 2003 was 4,288 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 4,288 in expanded form.

17. The number of home sales in Florida in 2000 was 394,000. What is the digit in the ten thousands place?

18. The number of children in Florida who enrolled in Prekindergarten to Grade 8 was 1,858,000 children in 2004. In what place value is the rightmost 8 in 1,858,000?

19. The number of children in Florida who enrolled in Grade 9 to Grade 12 in 2004 was 782,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 7,610,000 people in Florida voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

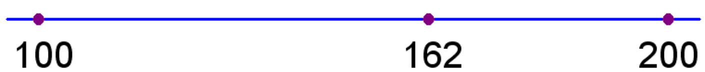
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



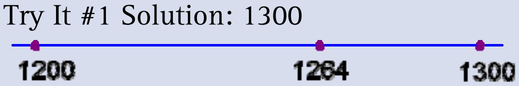
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Florida is projected to be 19,251,691 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Florida changed by 2,107,064 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 1,338,458 births in Florida. We round this number to 1,300,000 . To what place value did we round the number?

4. The number of hospitals in Florida in 2000 was 202. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Florida was 1,497 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of Florida is 53,927 square miles and the total water area is 11,828 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Florida is 53,927 square miles and the total water area is 11,828 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Florida was $33,544. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Florida was $36,800. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Florida in 2000 was $28,507. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,500. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Florida ranked number 20. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Florida ranked number 20. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Florida was 244 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Florida had 41,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 394,000 homes. We round this number to 390,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Florida in 2003 was 720 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 720 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Florida in 2003 was 323 trillion BTU. (For some states, this amount will be 0.) Write 323 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Florida who enrolled in Prekindergarten to Grade 8 was 1,858,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Florida who enrolled in Grade 9 to Grade 12 was 782,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 7,610,000 people in Florida voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food \$2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Florida used 1,940 trillion BTUs of energy from petroleum and 720 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Florida.

2. The number of square kilometers of land area in Florida is 139,670. The number of square kilometers of water area is 30,634. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 3,584,000 votes were cast for the Democratic candidate and 3,965,000 votes were cast for the Republican candidate in Florida. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Florida who voted for the two candidates.

4. The average annual pay in Florida in 2004 was 35,186 dollars and in 2005 was 36,800. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Florida consumed 3 trillion BTUs of energy from hydroelectric power (water) and 1,940 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Florida in 2003.

6. In 2006, there were 18,090,000 people living in Florida. In 2000, there were 15,982,000 people living in Florida. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 1,338,458 births and 1,056,111 deaths in Florida. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Florida was 1,161 dollars. In 2005, the average cost per day was 1,497 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 74 percent of adults living in Florida were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 2,913,000 votes cast for the Republican candidate and 2,912,000 votes cast for the Democratic candidate in Florida in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 53,927 square miles of land in Florida. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 11,828 square miles of water in Florida. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 44,000 farms in Florida. The average number of acres of land on each farm was 236. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Florida by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 41,000 farms in Florida. The average number of acres of land on each farm was 244. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Florida.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Florida was 336 people per square mile. There are 53,927 square miles of land in Florida. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 18,090,000 people living in Florida. In 2000, there were 15,982,000 people living in Florida. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 1,338,458 births and 1,056,111 deaths in Florida. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Florida was 1,161 dollars. In 2005, the average cost per day was 1,497 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 74 percent of adults living in Florida were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 405,000 people unemployed in Florida. In 2000, there were 300,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Florida has 11,828 square miles of water area and 65,755 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Florida is water.

3. Florida has 53,927 square miles of land area and 65,755 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Florida is land.

5. Approximately 47.10% of Florida voters chose the Democratic candidate in the 2004 election. A total of 7,610,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 3,965,000 citizens in Florida who voted for the Republican candidate in the 2004 presidential election. A total of 7,610,000 citizens voted. Did more than 55% of the voters in Florida select the Republican candidate?

7. The amount of energy consumed by people in Florida in 2003 that came from petroleum was 1,940 trillion BTUs. The total amount of energy consumed from all sources was 4,288 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Florida, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Florida had 41,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Florida to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Florida? (Round your answer to the nearest farm.)

11. There were 10,000,000 acres of farmland in Florida in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Florida?

12. The projected population of Florida in 2020 is 23,406,525 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Florida population to the United States population.

13. In Florida, 16.79% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 4,288 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Florida in 2000 was $28,507. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $31,249. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 394,000 people in Florida that belonged to labor unions. In 2006, the number of labor union members was 397,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 2,119,000 patients admitted to hospitals in Florida. Between 2000 and 2005, this number changed by 11.89%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Florida in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Florida was 236 in 2000. Between 2000 and 2006, this number changed by 3.39%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Florida in 2006?

18. The average cost per day for a hospital stay in Florida in 2005 was $1,497. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Florida, 27 had a college degree in 2006. If the number of adults in Florida with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Florida, 87 had a high school diploma in 2006 compared to 84 in 2000. What was the percentage change in the number of adults with high school diplomas in Florida between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 1
2. 0
3. 1
4. 8
5. 9
6. 5
7. 0
8. -4221; 4
9. 3
10. 20,000 + 8,000 + 500 + 7
11. 0
12. 2
13. ones place
14. 8
15. 9
16. 4,000 + 200 + 80 + 8
17. 9
18. thousands place
19. 700,000 + 80,000 + 2,000
20. 7

Rounding Practice Answers

1. 19,252,000
2. 2,107,100
3. hundred thousands
4. 200
5. hundreds
6. 42,000
7. 65,700
8. 30,000
9. 41,900
10. hundreds
11. 400
12. 60
13. 100
14. 40,000
15. ten thousands
16. 700 + 20; 720
17. 300 + 20 + 3; 300
18. 1,860,000
19. 800,000
20. 8,000,000

Estimation Practice Answers

1. 2660 trillion BTUs
2. 171,000 square kilometers of total area
3. 6,900,000 people voted
4. 71,000 dollars
5. 1900 trillion BTUs
6. 2,100,000 people
7. 200,000 more births than deaths
8. 300 dollars
9. 20 percent change
10. 0 votes
11. 140,400 square kilometers of land
12. 31,200 square kilometers of water
13. 9,600,000 acres of farmland
14. 9,600,000 acres of farmland
15. 18,144,000 people
16. 1.13 times larger
17. 1.26 times more births than deaths
18. 1.25 times more expensive
19. 1.29 times larger
20. 1.37 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 11828/65755
2. 17.99%
3. 53927/65755
4. 82.01%
5. 3,584,000
6. No. 52.1 percent voted Republican.
7. 1940/4288
8. 45%; 45 BTUs came from petroleum
9. 41,000/2,090,000
10. 0.02; 20 farms
11. 9,500,000
12. 23/336
13. 720 trillion BTUs
14. 9.62%
15. 0.76% increase
16. 2,371,000
17. 244
18. 6.68%
19. 54%
20. 3.57% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Georgia is projected to be 9,589,080 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Georgia changed by 1,177,125 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 849,414 births in Georgia. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Georgia in 2006 who were high school graduates was 84%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Georgia was 1,202 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Georgia is 57,906 square miles and the total water area is 1,519 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Georgia is 57,906 square miles and the total water area is 1,519 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Georgia was $36,626. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Georgia. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Georgia was $39,096. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Georgia in 2000 was $27,988. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Georgia ranked number 26. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Georgia ranked number 26. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Georgia was 220 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Georgia had 49,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Georgia that were sold was 144,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Georgia in 2003 was 3,004 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 3,004 in expanded form.

17. The number of home sales in Georgia in 2000 was 144,000. What is the digit in the ten thousands place?

18. The number of children in Georgia who enrolled in Prekindergarten to Grade 8 was 1,118,000 children in 2004. In what place value is the rightmost 8 in 1,118,000?

19. The number of children in Georgia who enrolled in Grade 9 to Grade 12 in 2004 was 435,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 3,302,000 people in Georgia voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What’s the big idea?

(Use this page to explain what you’ve learned.)

Rounding

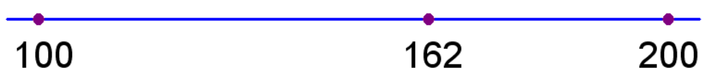
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

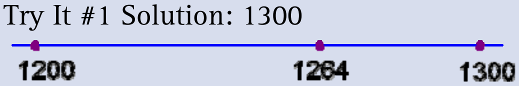


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Georgia is projected to be 9,589,080 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Georgia changed by 1,177,125 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 849,414 births in Georgia. We round this number to 800,000 . To what place value did we round the number?

4. The number of hospitals in Georgia in 2000 was 151. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Georgia was 1,202 dollars. We round this number to 1,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Georgia is 57,906 square miles and the total water area is 1,519 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Georgia is 57,906 square miles and the total water area is 1,519 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Georgia was $36,626. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Georgia was $39,096. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Georgia in 2000 was $27,988. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,000. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Georgia ranked number 26. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Georgia ranked number 38. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Georgia was 220 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Georgia had 49,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 144,000 homes. We round this number to 140,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Georgia in 2003 was 396 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 396 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Georgia in 2003 was 347 trillion BTU. (For some states, this amount will be 0.) Write 347 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Georgia who enrolled in Prekindergarten to Grade 8 was 1,118,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Georgia who enrolled in Grade 9 to Grade 12 was 435,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 3,302,000 people in Georgia voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food \$2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Georgia used 1,058 trillion BTUs of energy from petroleum and 396 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Georgia.

2. The number of square kilometers of land area in Georgia is 149,976. The number of square kilometers of water area is 3,933. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,366,000 votes were cast for the Democratic candidate and 1,914,000 votes were cast for the Republican candidate in Georgia. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Georgia who voted for the two candidates.

4. The average annual pay in Georgia in 2004 was 37,866 dollars and in 2005 was 39,096. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Georgia consumed 42 trillion BTUs of energy from hydroelectric power (water) and 1,058 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Georgia in 2003.

6. In 2006, there were 9,364,000 people living in Georgia. In 2000, there were 8,186,000 people living in Georgia. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 849,414 births and 410,475 deaths in Georgia. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Georgia was 978 dollars. In 2005, the average cost per day was 1,202 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 71 percent of adults living in Georgia were high school graduates. In 2006, the number was 84 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,420,000 votes cast for the Republican candidate and 1,116,000 votes cast for the Democratic candidate in Georgia in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 57,906 square miles of land in Georgia. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,519 square miles of water in Georgia. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 49,000 farms in Georgia. The average number of acres of land on each farm was 222. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Georgia by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 49,000 farms in Georgia. The average number of acres of land on each farm was 220. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Georgia.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Georgia was 162 people per square mile. There are 57,906 square miles of land in Georgia. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 9,364,000 people living in Georgia. In 2000, there were 8,186,000 people living in Georgia. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 849,414 births and 410,475 deaths in Georgia. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Georgia was 978 dollars. In 2005, the average cost per day was 1,202 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 71 percent of adults living in Georgia were high school graduates. In 2006, the number was 84 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 171,000 people unemployed in Georgia. In 2000, there were 148,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3,794,083 \cancel{\text{ square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Georgia has 1,519 square miles of water area and 59,425 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Georgia is water.

3. Georgia has 57,906 square miles of land area and 59,425 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Georgia is land.

5. Approximately 41.37% of Georgia voters chose the Democratic candidate in the 2004 election. A total of 3,302,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,914,000 citizens in Georgia who voted for the Republican candidate in the 2004 presidential election. A total of 3,302,000 citizens voted. Did more than 55% of the voters in Georgia select the Republican candidate?

7. The amount of energy consumed by people in Georgia in 2003 that came from petroleum was 1,058 trillion BTUs. The total amount of energy consumed from all sources was 3,004 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Georgia, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Georgia had 49,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Georgia to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Georgia? (Round your answer to the nearest farm.)

11. There were 10,800,000 acres of farmland in Georgia in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Georgia?

12. The projected population of Georgia in 2020 is 10,843,753 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Georgia population to the United States population.

13. In Georgia, 13.18% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 3,004 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Georgia in 2000 was $27,988. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $27,839. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 267,000 people in Georgia that belonged to labor unions. In 2006, the number of labor union members was 176,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 863,000 patients admitted to hospitals in Georgia. Between 2000 and 2005, this number changed by 11.36%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Georgia in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Georgia was 222 in 2000. Between 2000 and 2006, this number changed by -0.90%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Georgia in 2006?

18. The average cost per day for a hospital stay in Georgia in 2005 was $1,202. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Georgia, 28 had a college degree in 2006. If the number of adults in Georgia with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Georgia, 84 had a high school diploma in 2006 compared to 83 in 2000. What was the percentage change in the number of adults with high school diplomas in Georgia between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 9
2. 1
3. 2
4. 8
5. 4
6. 9
7. 3
8. -1139; 1
9. 5
10. 20,000 + 7,000 + 900 + 80 + 8
11. 6
12. 3
13. ones place
14. 6
15. 7
16. 3,000 + 4
17. 4
18. thousands place
19. 400,000 + 30,000 + 5,000
20. 3

Rounding Practice Answers

1. 9,589,000
2. 1,177,100
3. hundred thousands
4. 150
5. hundreds
6. 56,000
7. 59,400
8. 40,000
9. 44,200
10. hundreds
11. 900
12. 120
13. 100
14. 50,000
15. ten thousands
16. 300 + 90 + 6; 400
17. 300 + 40 + 7; 300
18. 1,120,000
19. 400,000
20. 3,000,000

Estimation Practice Answers

1. 1460 trillion BTUs
2. 154,000 square kilometers of total area
3. 3,000,000 people voted
4. 76,000 dollars
5. 1100 trillion BTUs
6. 1,200,000 people
7. 400,000 more births than deaths
8. 200 dollars
9. 10 percent change
10. 300,000 votes
11. 150,800 square kilometers of land
12. 5,200 square kilometers of water
13. 11,000,000 acres of farmland
14. 11,000,000 acres of farmland
15. 9,396,000 people
16. 1.15 times larger
17. 2.07 times more births than deaths
18. 1.20 times more expensive
19. 1.14 times larger
20. 1.13 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1519/59425
2. 2.56%
3. 57906/59425
4. 97.44%
5. 1,366,000
6. Yes. 58 percent voted Republican.
7. 1058/3004
8. 35%; 35 BTUs came from petroleum
9. 49,000/2,090,000
10. 0.023; 23 farms
11. 10,260,000
12. 11/336
13. 396 trillion BTUs
14. -0.53%
15. 34.08% decrease
16. 961,000
17. 220
18. 8.32%
19. 56%
20. 1.2% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Hawaii is projected to be 1,340,674 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Hawaii changed by 73,961 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 110,926 births in Hawaii. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Hawaii in 2006 who were high school graduates was 89%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Hawaii was 1,310 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Hawaii is 6,423 square miles and the total water area is 4,508 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Hawaii is 6,423 square miles and the total water area is 4,508 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Hawaii was $33,742. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Hawaii. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Hawaii was $36,353. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Hawaii in 2000 was $28,422. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Hawaii ranked number 22. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Hawaii ranked number 22. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Hawaii was 236 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, Hawaii had 6,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Hawaii that were sold was 22,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Hawaii in 2003 was 310 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 310 in expanded form.

17. The number of home sales in Hawaii in 2000 was 22,000. What is the digit in the ten thousands place?

18. The number of children in Hawaii who enrolled in Prekindergarten to Grade 8 was 129,000 children in 2004. In what place value is the rightmost 9 in 129,000?

19. The number of children in Hawaii who enrolled in Grade 9 to Grade 12 in 2004 was 54,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 429,000 people in Hawaii voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

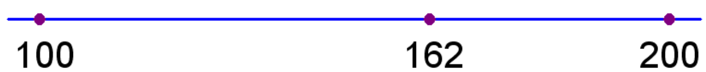
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

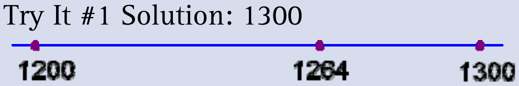


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Hawaii is projected to be 1,340,674 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Hawaii changed by 73,961 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 110,926 births in Hawaii. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Hawaii in 2000 was 21. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Hawaii was 1,310 dollars. We round this number to 1,300. What is the smallest place value to which you can round and get this number?

6. The total land area of Hawaii is 6,423 square miles and the total water area is 4,508 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Hawaii is 6,423 square miles and the total water area is 4,508 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Hawaii was $33,742. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Hawaii was $36,353. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Hawaii in 2000 was $28,422. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Hawaii ranked number 22. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Hawaii ranked number 19. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Hawaii was 236 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Hawaii had 6,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 22,000 homes. We round this number to 20,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Hawaii in 2003 was 3 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 3 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Hawaii in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Hawaii who enrolled in Prekindergarten to Grade 8 was 129,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Hawaii who enrolled in Grade 9 to Grade 12 was 54,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 429,000 people in Hawaii voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Hawaii used 270 trillion BTUs of energy from petroleum and 3 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Hawaii.

2. The number of square kilometers of land area in Hawaii is 16,635. The number of square kilometers of water area is 11,677. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 232,000 votes were cast for the Democratic candidate and 194,000 votes were cast for the Republican candidate in Hawaii. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Hawaii who voted for the two candidates.

4. The average annual pay in Hawaii in 2004 was 35,198 dollars and in 2005 was 36,353. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Hawaii consumed 1 trillion BTUs of energy from hydroelectric power (water) and 270 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Hawaii in 2003.

6. In 2006, there were 1,285,000 people living in Hawaii. In 2000, there were 1,212,000 people living in Hawaii. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 110,926 births and 54,675 deaths in Hawaii. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Hawaii was 1,088 dollars. In 2005, the average cost per day was 1,310 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 80 percent of adults living in Hawaii were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 138,000 votes cast for the Republican candidate and 205,000 votes cast for the Democratic candidate in Hawaii in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 6,423 square miles of land in Hawaii. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 4,508 square miles of water in Hawaii. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 6,000 farms in Hawaii. The average number of acres of land on each farm was 251. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Hawaii by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 6,000 farms in Hawaii. The average number of acres of land on each farm was 236. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Hawaii.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Hawaii was 200 people per square mile. There are 6,423 square miles of land in Hawaii. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,285,000 people living in Hawaii. In 2000, there were 1,212,000 people living in Hawaii. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 110,926 births and 54,675 deaths in Hawaii. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Hawaii was 1,088 dollars. In 2005, the average cost per day was 1,310 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 80 percent of adults living in Hawaii were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 13,000 people unemployed in Hawaii. In 2000, there were 24,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100\ \cancel{\text{square miles of area}}} \times 3,794,083\ \cancel{\text{square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Hawaii has 4,508 square miles of water area and 10,931 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Hawaii is water.

3. Hawaii has 6,423 square miles of land area and 10,931 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Hawaii is land.

5. Approximately 54.08% of Hawaii voters chose the Democratic candidate in the 2004 election. A total of 429,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 194,000 citizens in Hawaii who voted for the Republican candidate in the 2004 presidential election. A total of 429,000 citizens voted. Did more than 55% of the voters in Hawaii select the Republican candidate?

7. The amount of energy consumed by people in Hawaii in 2003 that came from petroleum was 270 trillion BTUs. The total amount of energy consumed from all sources was 310 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Hawaii, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Hawaii had 6,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Hawaii to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Hawaii? (Round your answer to the nearest farm.)

11. There were 1,300,000 acres of farmland in Hawaii in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Hawaii?

12. The projected population of Hawaii in 2020 is 1,412,373 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Hawaii population to the United States population.

13. In Hawaii, 0.97% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 310 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Hawaii in 2000 was $28,422. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $31,687. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 113,000 people in Hawaii that belonged to labor unions. In 2006, the number of labor union members was 139,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 100,000 patients admitted to hospitals in Hawaii. Between 2000 and 2005, this number changed by 14.00%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Hawaii in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Hawaii was 251 in 2000. Between 2000 and 2006, this number changed by -5.98%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Hawaii in 2006?

18. The average cost per day for a hospital stay in Hawaii in 2005 was $1,310. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Hawaii, 32 had a college degree in 2006. If the number of adults in Hawaii with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Hawaii, 89 had a high school diploma in 2006 compared to 87 in 2000. What was the percentage change in the number of adults with high school diplomas in Hawaii between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 9
3. 9
4. 8
5. 6
6. 0
7. 9
8. -4023; 4
9. 2
10. 20,000 + 8,000 + 400 + 20 + 2
11. 2
12. 1
13. ones place
14. 3
15. 1
16. 300 + 10
17. 2
18. thousands place
19. 50,000 + 4,000
20. 4

Rounding Practice Answers

1. 1,341,000
2. 74,000
3. hundred thousands
4. 10
5. hundreds
6. 1,000
7. 10,900
8. 30,000
9. 41,500
10. hundreds
11. 400
12. 60
13. 100
14. 10,000
15. ten thousands
16. 3; 0
17. 0; 0
18. 130,000
19. 100,000
20. 0

Estimation Practice Answers

1. 270 trillion BTUs
2. 29,000 square kilometers of total area
3. 400,000 people voted
4. 70,000 dollars
5. 300 trillion BTUs
6. 100,000 people
7. 0 more births than deaths
8. 200 dollars
9. 10 percent change
10. 100,000 votes
11. 15,600 square kilometers of land
12. 13,000 square kilometers of water
13. 2,500,000 acres of farmland
14. 2,400,000 acres of farmland
15. 1,200,000 people
16. 1.08 times larger
17. 2.20 times more births than deaths
18. 1.18 times more expensive
19. 1.13 times larger
20. 0.50 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 4508/10931
2. 41.24%
3. 6423/10931
4. 58.76%
5. 232,000
6. No. 45.2 percent voted Republican.
7. 270/310
8. 87%; 87 BTUs came from petroleum
9. 6,000/2,090,000
10. 0.003; 3 farms
11. 1,235,000
12. 1/336
13. 3 trillion BTUs
14. 11.49%
15. 23.01% increase
16. 114,000
17. 236
18. 7.63%
19. 64%
20. 2.3% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Idaho is projected to be 1,517,291 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Idaho changed by 172,509 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 135,942 births in Idaho. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Idaho in 2006 who were high school graduates was 89%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Idaho was 1,484 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Idaho is 82,747 square miles and the total water area is 823 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Idaho is 82,747 square miles and the total water area is 823 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Idaho was $28,677. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Idaho. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Idaho was $30,777. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Idaho in 2000 was $24,073. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Idaho ranked number 42. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Idaho ranked number 42. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Idaho was 472 acres. What is the place value furthest to the right that contains the number 2?

14. In 2006, Idaho had 25,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Idaho that were sold was 24,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Idaho in 2003 was 467 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 467 in expanded form.

17. The number of home sales in Idaho in 2000 was 24,000. What is the digit in the ten thousands place?

18. The number of children in Idaho who enrolled in Prekindergarten to Grade 8 was 178,000 children in 2004. In what place value is the rightmost 8 in 178,000?

19. The number of children in Idaho who enrolled in Grade 9 to Grade 12 in 2004 was 78,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 598,000 people in Idaho voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

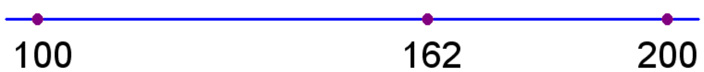
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

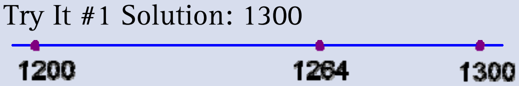


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Idaho is projected to be 1,517,291 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Idaho changed by 172,509 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 135,942 births in Idaho. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Idaho in 2000 was 42. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Idaho was 1,484 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of Idaho is 82,747 square miles and the total water area is 823 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Idaho is 82,747 square miles and the total water area is 823 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Idaho was $28,677. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Idaho was $30,777. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Idaho in 2000 was $24,073. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 24,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Idaho ranked number 42. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Idaho ranked number 43. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Idaho was 472 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Idaho had 25,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 24,000 homes. We round this number to 20,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Idaho in 2003 was 71 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 71 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Idaho in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Idaho who enrolled in Prekindergarten to Grade 8 was 178,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Idaho who enrolled in Grade 9 to Grade 12 was 78,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 598,000 people in Idaho voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Idaho used 139 trillion BTUs of energy from petroleum and 71 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Idaho.

2. The number of square kilometers of land area in Idaho is 214,314. The number of square kilometers of water area is 2,131. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 181,000 votes were cast for the Democratic candidate and 409,000 votes were cast for the Republican candidate in Idaho. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Idaho who voted for the two candidates.

4. The average annual pay in Idaho in 2004 was 29,871 dollars and in 2005 was 30,777. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Idaho consumed 86 trillion BTUs of energy from hydroelectric power (water) and 139 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Idaho in 2003.

6. In 2006, there were 1,466,000 people living in Idaho. In 2000, there were 1,294,000 people living in Idaho. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 135,942 births and 63,465 deaths in Idaho. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Idaho was 1,003 dollars. In 2005, the average cost per day was 1,484 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 80 percent of adults living in Idaho were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 337,000 votes cast for the Republican candidate and 139,000 votes cast for the Democratic candidate in Idaho in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 82,747 square miles of land in Idaho. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 823 square miles of water in Idaho. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 25,000 farms in Idaho. The average number of acres of land on each farm was 486. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Idaho by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 25,000 farms in Idaho. The average number of acres of land on each farm was 472. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Idaho.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Idaho was 18 people per square mile. There are 82,747 square miles of land in Idaho. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,466,000 people living in Idaho. In 2000, there were 1,294,000 people living in Idaho. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 135,942 births and 63,465 deaths in Idaho. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Idaho was 1,003 dollars. In 2005, the average cost per day was 1,484 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 80 percent of adults living in Idaho were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 27,000 people unemployed in Idaho. In 2000, there were 31,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Idaho has 823 square miles of water area and 83,570 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Idaho is water.

3. Idaho has 82,747 square miles of land area and 83,570 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Idaho is land.

5. Approximately 30.27% of Idaho voters chose the Democratic candidate in the 2004 election. A total of 598,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 409,000 citizens in Idaho who voted for the Republican candidate in the 2004 presidential election. A total of 598,000 citizens voted. Did more than 55% of the voters in Idaho select the Republican candidate?

7. The amount of energy consumed by people in Idaho in 2003 that came from petroleum was 139 trillion BTUs. The total amount of energy consumed from all sources was 467 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Idaho, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Idaho had 25,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Idaho to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Idaho? (Round your answer to the nearest farm.)

11. There were 11,800,000 acres of farmland in Idaho in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Idaho?

12. The projected population of Idaho in 2020 is 1,741,333 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Idaho population to the United States population.

13. In Idaho, 15.20% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 467 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Idaho in 2000 was $24,073. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $26,146. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 41,000 people in Idaho that belonged to labor unions. In 2006, the number of labor union members was 37,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 123,000 patients admitted to hospitals in Idaho. Between 2000 and 2005, this number changed by 5.69%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Idaho in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Idaho was 486 in 2000. Between 2000 and 2006, this number changed by -2.88%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Idaho in 2006?

18. The average cost per day for a hospital stay in Idaho in 2005 was $1,484. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Idaho, 25 had a college degree in 2006. If the number of adults in Idaho with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Idaho, 89 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Idaho between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 7
2. 5
3. 1
4. 8
5. 9
6. 3
7. 9
8. -9088; 9
9. 7
10. 20,000 + 4,000 + 70 + 3
11. 2
12. 4
13. ones place
14. 2
15. 1
16. 400 + 60 + 7
17. 2
18. thousands place
19. 70,000 + 8,000
20. 5

Rounding Practice Answers

1. 1,517,000
2. 172,500
3. hundred thousands
4. 20
5. hundreds
6. 82,000
7. 83,500
8. 30,000
9. 35,900
10. hundreds
11. 1600
12. 120
13. 400
14. 30,000
15. ten thousands
16. 70 + 1; 70
17. 0; 0
18. 180,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 210 trillion BTUs
2. 216,000 square kilometers of total area
3. 500,000 people voted
4. 60,000 dollars
5. 200 trillion BTUs
6. 200,000 people
7. 0 more births than deaths
8. 500 dollars
9. 10 percent change
10. 200,000 votes
11. 215,800 square kilometers of land
12. 2,600 square kilometers of water
13. 14,700,000 acres of farmland
14. 14,100,000 acres of farmland
15. 1,494,000 people
16. 1.15 times larger
17. 2.33 times more births than deaths
18. 1.50 times more expensive
19. 1.13 times larger
20. 1.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 823/83570
2. 0.98%
3. 82747/83570
4. 99.02%
5. 181,000
6. Yes. 68.4 percent voted Republican.
7. 139/467
8. 30%; 30 BTUs came from petroleum
9. 25,000/2,090,000
10. 0.012; 12 farms
11. 11,210,000
12. 2/336
13. 71 trillion BTUs
14. 8.61%
15. 9.76% decrease
16. 130,000
17. 472
18. 6.74%
19. 50%
20. 3.49% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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    - Linear Functions I
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- States by the Numbers series
    - One activity book per US state focusing on place value, rounding, estimation, and understanding fractions and percents.

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States by the Numbers

place value
rounding
estimation
fractions
percents

Illinois

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000+40,000+5000+600+70+1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Illinois is projected to be 12,916,894 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Illinois changed by 412,323 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 1,138,398 births in Illinois. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Illinois in 2006 who were high school graduates was 88%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Illinois was 1,637 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Illinois is 55,584 square miles and the total water area is 2,331 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Illinois is 55,584 square miles and the total water area is 2,331 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Illinois was $40,540. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Illinois. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Illinois was $43,744. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Illinois in 2000 was $32,182. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Illinois ranked number 9. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Illinois ranked number 9. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Illinois was 377 acres. What is the place value furthest to the right that contains the number 7?

14. In 2006, Illinois had 72,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Illinois that were sold was 247,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Illinois in 2003 was 3,918 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 3,918 in expanded form.

17. The number of home sales in Illinois in 2000 was 247,000. What is the digit in the ten thousands place?

18. The number of children in Illinois who enrolled in Prekindergarten to Grade 8 was 1,484,000 children in 2004. In what place value is the rightmost 4 in 1,484,000?

19. The number of children in Illinois who enrolled in Grade 9 to Grade 12 in 2004 was 614,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 5,274,000 people in Illinois voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

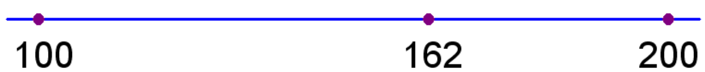
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

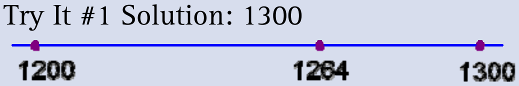


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Illinois is projected to be 12,916,894 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Illinois changed by 412,323 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 1,138,398 births in Illinois. We round this number to 1,100,000 . To what place value did we round the number?

4. The number of hospitals in Illinois in 2000 was 196. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Illinois was 1,637 dollars. We round this number to 1,600. What is the smallest place value to which you can round and get this number?

6. The total land area of Illinois is 55,584 square miles and the total water area is 2,331 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Illinois is 55,584 square miles and the total water area is 2,331 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Illinois was $40,540. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Illinois was $43,744. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Illinois in 2000 was $32,182. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 32,200. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Illinois ranked number 9. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Illinois ranked number 13. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Illinois was 377 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Illinois had 72,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 247,000 homes. We round this number to 250,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Illinois in 2003 was 1,000 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 1,000 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Illinois in 2003 was 987 trillion BTU. (For some states, this amount will be 0.) Write 987 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Illinois who enrolled in Prekindergarten to Grade 8 was 1,484,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Illinois who enrolled in Grade 9 to Grade 12 was 614,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 5,274,000 people in Illinois voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{\cancel{4 \times} 4 \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Illinois used 1,313 trillion BTUs of energy from petroleum and 1,000 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Illinois.

2. The number of square kilometers of land area in Illinois is 143,961. The number of square kilometers of water area is 6,037. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 2,892,000 votes were cast for the Democratic candidate and 2,346,000 votes were cast for the Republican candidate in Illinois. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Illinois who voted for the two candidates.

4. The average annual pay in Illinois in 2004 was 42,277 dollars and in 2005 was 43,744. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Illinois consumed 1 trillion BTUs of energy from hydroelectric power (water) and 1,313 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Illinois in 2003.

6. In 2006, there were 12,832,000 people living in Illinois. In 2000, there were 12,419,000 people living in Illinois. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 1,138,398 births and 656,599 deaths in Illinois. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Illinois was 1,278 dollars. In 2005, the average cost per day was 1,637 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 76 percent of adults living in Illinois were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 2,019,000 votes cast for the Republican candidate and 2,589,000 votes cast for the Democratic candidate in Illinois in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 55,584 square miles of land in Illinois. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 2,331 square miles of water in Illinois. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 77,000 farms in Illinois. The average number of acres of land on each farm was 357. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Illinois by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 72,000 farms in Illinois. The average number of acres of land on each farm was 377. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Illinois.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Illinois was 231 people per square mile. There are 55,584 square miles of land in Illinois. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 12,832,000 people living in Illinois. In 2000, there were 12,419,000 people living in Illinois. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 1,138,398 births and 656,599 deaths in Illinois. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Illinois was 1,278 dollars. In 2005, the average cost per day was 1,637 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 76 percent of adults living in Illinois were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 371,000 people unemployed in Illinois. In 2000, there were 291,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Illinois has 2,331 square miles of water area and 57,914 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Illinois is water.

3. Illinois has 55,584 square miles of land area and 57,914 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Illinois is land.

5. Approximately 54.84% of Illinois voters chose the Democratic candidate in the 2004 election. A total of 5,274,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 2,346,000 citizens in Illinois who voted for the Republican candidate in the 2004 presidential election. A total of 5,274,000 citizens voted. Did more than 55% of the voters in Illinois select the Republican candidate?

7. The amount of energy consumed by people in Illinois in 2003 that came from petroleum was 1,313 trillion BTUs. The total amount of energy consumed from all sources was 3,918 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Illinois, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Illinois had 72,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Illinois to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Illinois? (Round your answer to the nearest farm.)

11. There were 27,300,000 acres of farmland in Illinois in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Illinois?

12. The projected population of Illinois in 2020 is 13,236,720 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Illinois population to the United States population.

13. In Illinois, 25.52% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 3,918 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Illinois in 2000 was $32,182. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $33,359. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 1,064,000 people in Illinois that belonged to labor unions. In 2006, the number of labor union members was 931,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 1,531,000 patients admitted to hospitals in Illinois. Between 2000 and 2005, this number changed by 3.40%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Illinois in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Illinois was 357 in 2000. Between 2000 and 2006, this number changed by 5.60%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Illinois in 2006?

18. The average cost per day for a hospital stay in Illinois in 2005 was $1,637. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Illinois, 31 had a college degree in 2006. If the number of adults in Illinois with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Illinois, 88 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Illinois between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 3
3. 1
4. 8
5. 2
6. 7
7. 2
8. 2775; 2
9. 0
10. 30,000 + 2,000 + 100 + 80 + 2
11. 9
12. 1
13. ones place
14. 9
15. 2
16. 3,000 + 900 + 10 + 8
17. 4
18. thousands place
19. 600,000 + 10,000 + 4,000
20. 5

Rounding Practice Answers

1. 12,917,000
2. 412,300
3. hundred thousands
4. 690
5. hundreds
6. 54,000
7. 57,900
8. 40,000
9. 48,800
10. hundreds
11. 100
12. 30
13. 300
14. 70,000
15. ten thousands
16. 1,000 + ; 1000
17. 900 + 80 + 7; 1000
18. 1,480,000
19. 600,000
20. 5,000,000

Estimation Practice Answers

1. 2310 trillion BTUs
2. 150,000 square kilometers of total area
3. 4,900,000 people voted
4. 85,000 dollars
5. 1300 trillion BTUs
6. 400,000 people
7. 400,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 600,000 votes
11. 145,600 square kilometers of land
12. 5,200 square kilometers of water
13. 28,800,000 acres of farmland
14. 26,600,000 acres of farmland
15. 12,936,000 people
16. 1.03 times larger
17. 1.73 times more births than deaths
18. 1.23 times more expensive
19. 1.13 times larger
20. 1.28 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 2331/57914
2. 4.02%
3. 55584/57914
4. 95.98%
5. 2,892,000
6. No. 44.5 percent voted Republican.
7. 1313/3918
8. 34%; 34 BTUs came from petroleum
9. 72,000/2,090,000
10. 0.034; 34 farms
11. 25,935,000
12. 13/336
13. 1000 trillion BTUs
14. 3.66%
15. 12.5% decrease
16. 1,583,000
17. 377
18. 6.11%
19. 62%
20. 2.33% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Indiana is projected to be 6,392,139 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Indiana changed by 233,003 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 541,506 births in Indiana. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Indiana in 2006 who were high school graduates was 88%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Indiana was 1,569 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Indiana is 35,867 square miles and the total water area is 551 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Indiana is 35,867 square miles and the total water area is 551 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Indiana was $33,379. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Indiana. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Indiana was $35,431. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Indiana in 2000 was $27,130. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Indiana ranked number 31. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Indiana ranked number 31. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Indiana was 254 acres. What is the place value furthest to the right that contains the number 4?

14. In 2006, Indiana had 59,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Indiana that were sold was 111,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Indiana in 2003 was 2,913 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 2,913 in expanded form.

17. The number of home sales in Indiana in 2000 was 111,000. What is the digit in the ten thousands place?

18. The number of children in Indiana who enrolled in Prekindergarten to Grade 8 was 720,000 children in 2004. In what place value is the rightmost 0 in 720,000?

19. The number of children in Indiana who enrolled in Grade 9 to Grade 12 in 2004 was 301,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,468,000 people in Indiana voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

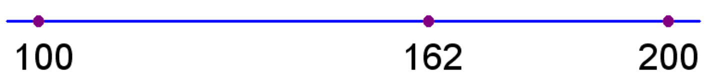
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

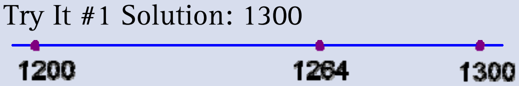


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Indiana is projected to be 6,392,139 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Indiana changed by 233,003 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 541,506 births in Indiana. We round this number to 500,000 . To what place value did we round the number?

4. The number of hospitals in Indiana in 2000 was 109. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Indiana was 1,569 dollars. We round this number to 1,600. What is the smallest place value to which you can round and get this number?

6. The total land area of Indiana is 35,867 square miles and the total water area is 551 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Indiana is 35,867 square miles and the total water area is 551 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Indiana was $33,379. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Indiana was $35,431. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Indiana in 2000 was $27,130. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 27,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Indiana ranked number 31. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Indiana ranked number 33. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Indiana was 254 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Indiana had 59,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 111,000 homes. We round this number to 110,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Indiana in 2003 was 542 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 542 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Indiana in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Indiana who enrolled in Prekindergarten to Grade 8 was 720,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Indiana who enrolled in Grade 9 to Grade 12 was 301,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,468,000 people in Indiana voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Indiana used 901 trillion BTUs of energy from petroleum and 542 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Indiana.

2. The number of square kilometers of land area in Indiana is 92,895. The number of square kilometers of water area is 1,427. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 969,000 votes were cast for the Democratic candidate and 1,479,000 votes were cast for the Republican candidate in Indiana. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Indiana who voted for the two candidates.

4. The average annual pay in Indiana in 2004 was 34,694 dollars and in 2005 was 35,431. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Indiana consumed 4 trillion BTUs of energy from hydroelectric power (water) and 901 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Indiana in 2003.

6. In 2006, there were 6,314,000 people living in Indiana. In 2000, there were 6,080,000 people living in Indiana. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 541,506 births and 344,778 deaths in Indiana. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Indiana was 1,132 dollars. In 2005, the average cost per day was 1,569 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 76 percent of adults living in Indiana were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,246,000 votes cast for the Republican candidate and 902,000 votes cast for the Democratic candidate in Indiana in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 35,867 square miles of land in Indiana. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 551 square miles of water in Indiana. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 63,000 farms in Indiana. The average number of acres of land on each farm was 240. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Indiana by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 59,000 farms in Indiana. The average number of acres of land on each farm was 254. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Indiana.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Indiana was 176 people per square mile. There are 35,867 square miles of land in Indiana. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 6,314,000 people living in Indiana. In 2000, there were 6,080,000 people living in Indiana. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 541,506 births and 344,778 deaths in Indiana. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Indiana was 1,132 dollars. In 2005, the average cost per day was 1,569 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 76 percent of adults living in Indiana were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 142,000 people unemployed in Indiana. In 2000, there were 92,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3,794,083 \ \cancel{\text{square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Indiana has 551 square miles of water area and 36,418 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Indiana is water.

3. Indiana has 35,867 square miles of land area and 36,418 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Indiana is land.

5. Approximately 39.26% of Indiana voters chose the Democratic candidate in the 2004 election. A total of 2,468,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,479,000 citizens in Indiana who voted for the Republican candidate in the 2004 presidential election. A total of 2,468,000 citizens voted. Did more than 55% of the voters in Indiana select the Republican candidate?

7. The amount of energy consumed by people in Indiana in 2003 that came from petroleum was 901 trillion BTUs. The total amount of energy consumed from all sources was 2,913 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Indiana, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Indiana had 59,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Indiana to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Indiana? (Round your answer to the nearest farm.)

11. There were 15,000,000 acres of farmland in Indiana in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Indiana?

12. The projected population of Indiana in 2020 is 6,627,008 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Indiana population to the United States population.

13. In Indiana, 18.61% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 2,913 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Indiana in 2000 was $27,130. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,393. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 503,000 people in Indiana that belonged to labor unions. In 2006, the number of labor union members was 334,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 700,000 patients admitted to hospitals in Indiana. Between 2000 and 2005, this number changed by 2.43%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Indiana in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Indiana was 240 in 2000. Between 2000 and 2006, this number changed by 5.83%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Indiana in 2006?

18. The average cost per day for a hospital stay in Indiana in 2005 was $1,569. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Indiana, 22 had a college degree in 2006. If the number of adults in Indiana with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Indiana, 88 had a high school diploma in 2006 compared to 85 in 2000. What was the percentage change in the number of adults with high school diplomas in Indiana between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 2
2. 0
3. 2
4. 8
5. 1
6. 6
7. 3
8. -4386; 4
9. 1
10. 20,000 + 7,000 + 100 + 30 + 0
11. 1
12. 3
13. ones place
14. 6
15. 5
16. 2,000 + 900 + 10 + 3
17. 1
18. thousands place
19. 300,000 +1,000
20. 2

Rounding Practice Answers

1. 6,392,000
2. 233,000
3. hundred thousands
4. 900
5. hundreds
6. 35,000
7. 36,500
8. 30,000
9. 40,500
10. hundreds
11. 900
12. 90
13. 200
14. 60,000
15. ten thousands
16. 500 + 40 + 2; 540
17. 0; 0
18. 720,000
19. 300,000
20. 2,000,000

Estimation Practice Answers

1. 1440 trillion BTUs
2. 94,000 square kilometers of total area
3. 2,400,000 people voted
4. 68,000 dollars
5. 900 trillion BTUs
6. 200,000 people
7. 200,000 more births than deaths
8. 500 dollars
9. 10 percent change
10. 300,000 votes
11. 93,600 square kilometers of land
12. 2,600 square kilometers of water
13. 14,400,000 acres of farmland
14. 15,000,000 acres of farmland
15. 6,336,000 people
16. 1.03 times larger
17. 1.59 times more births than deaths
18. 1.45 times more expensive
19. 1.13 times larger
20. 1.56 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 551/36418
2. 1.51%
3. 35867/36418
4. 98.49%
5. 969,000
6. Yes. 59.9 percent voted Republican.
7. 901/2913
8. 31%; 31 BTUs came from petroleum
9. 59,000/2,090,000
10. 0.028; 28 farms
11. 14,250,000
12. 7/336
13. 542 trillion BTUs
14. 4.66%
15. 33.6% decrease
16. 717,000
17. 254
18. 6.37%
19. 44%
20. 3.53% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Iowa is projected to be 3,009,907 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Iowa changed by 55,703 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 239,348 births in Iowa. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Iowa in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Iowa was 1,036 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Iowa is 55,869 square miles and the total water area is 402 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Iowa is 55,869 square miles and the total water area is 402 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Iowa was $30,708. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Iowa. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Iowa was $33,070. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Iowa in 2000 was $26,552. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Iowa ranked number 33. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Iowa ranked number 33. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Iowa was 356 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, Iowa had 89,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Iowa that were sold was 53,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Iowa in 2003 was 1,176 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,176 in expanded form.

17. The number of home sales in Iowa in 2000 was 53,000. What is the digit in the ten thousands place?

18. The number of children in Iowa who enrolled in Prekindergarten to Grade 8 was 324,000 children in 2004. In what place value is the rightmost 4 in 324,000?

19. The number of children in Iowa who enrolled in Grade 9 to Grade 12 in 2004 was 154,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,507,000 people in Iowa voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

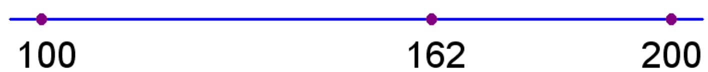
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

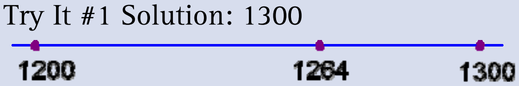


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Iowa is projected to be 3,009,907 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Iowa changed by 55,703 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 239,348 births in Iowa. We round this number to 200,000 . To what place value did we round the number?

4. The number of hospitals in Iowa in 2000 was 115. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Iowa was 1,036 dollars. We round this number to 1,000. What is the smallest place value to which you can round and get this number?

6. The total land area of Iowa is 55,869 square miles and the total water area is 402 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Iowa is 55,869 square miles and the total water area is 402 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Iowa was $30,708. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Iowa was $33,070. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Iowa in 2000 was $26,552. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 26,600. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Iowa ranked number 33. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Iowa ranked number 30. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Iowa was 356 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Iowa had 89,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 53,000 homes. We round this number to 50,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Iowa in 2003 was 232 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 232 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Iowa in 2003 was 42 trillion BTU. (For some states, this amount will be 0.) Write 42 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Iowa who enrolled in Prekindergarten to Grade 8 was 324,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Iowa who enrolled in Grade 9 to Grade 12 was 154,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,507,000 people in Iowa voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Iowa used 393 trillion BTUs of energy from petroleum and 232 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Iowa.

2. The number of square kilometers of land area in Iowa is 144,701. The number of square kilometers of water area is 1,042. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 742,000 votes were cast for the Democratic candidate and 752,000 votes were cast for the Republican candidate in Iowa. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Iowa who voted for the two candidates.

4. The average annual pay in Iowa in 2004 was 32,097 dollars and in 2005 was 33,070. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Iowa consumed 8 trillion BTUs of energy from hydroelectric power (water) and 393 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Iowa in 2003.

6. In 2006, there were 2,982,000 people living in Iowa. In 2000, there were 2,926,000 people living in Iowa. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 239,348 births and 173,795 deaths in Iowa. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Iowa was 740 dollars. In 2005, the average cost per day was 1,036 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 80 percent of adults living in Iowa were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 634,000 votes cast for the Republican candidate and 639,000 votes cast for the Democratic candidate in Iowa in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 55,869 square miles of land in Iowa. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 402 square miles of water in Iowa. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 94,000 farms in Iowa. The average number of acres of land on each farm was 346. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Iowa by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 89,000 farms in Iowa. The average number of acres of land on each farm was 356. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Iowa.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Iowa was 53 people per square mile. There are 55,869 square miles of land in Iowa. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 2,982,000 people living in Iowa. In 2000, there were 2,926,000 people living in Iowa. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 239,348 births and 173,795 deaths in Iowa. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Iowa was 740 dollars. In 2005, the average cost per day was 1,036 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 80 percent of adults living in Iowa were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 66,000 people unemployed in Iowa. In 2000, there were 45,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3{,}794{,}083 \cancel{\text{ square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Iowa has 402 square miles of water area and 56,272 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Iowa is water.

3. Iowa has 55,869 square miles of land area and 56,272 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Iowa is land.

5. Approximately 49.24% of Iowa voters chose the Democratic candidate in the 2004 election. A total of 1,507,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 752,000 citizens in Iowa who voted for the Republican candidate in the 2004 presidential election. A total of 1,507,000 citizens voted. Did more than 55% of the voters in Iowa select the Republican candidate?

7. The amount of energy consumed by people in Iowa in 2003 that came from petroleum was 393 trillion BTUs. The total amount of energy consumed from all sources was 1,176 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Iowa, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Iowa had 89,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Iowa to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Iowa? (Round your answer to the nearest farm.)

11. There were 31,500,000 acres of farmland in Iowa in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Iowa?

12. The projected population of Iowa in 2020 is 3,020,496 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Iowa population to the United States population.

13. In Iowa, 19.73% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,176 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Iowa in 2000 was $26,552. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,013. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 186,000 people in Iowa that belonged to labor unions. In 2006, the number of labor union members was 161,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 360,000 patients admitted to hospitals in Iowa. Between 2000 and 2005, this number changed by 0.83%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Iowa in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Iowa was 346 in 2000. Between 2000 and 2006, this number changed by 2.89%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Iowa in 2006?

18. The average cost per day for a hospital stay in Iowa in 2005 was $1,036. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Iowa, 25 had a college degree in 2006. If the number of adults in Iowa with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Iowa, 90 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Iowa between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 9
2. 7
3. 1
4. 9
5. 0
6. 6
7. 4
8. -7057; 7
9. 9
10. 20,000 + 6,000 + 500 + 50 + 2
11. 3
12. 3
13. ones place
14. 6
15. 2
16. 1,000 + 100 + 70 + 6
17. 5
18. thousands place
19. 100,000 + 50,000 + 4,000
20. 1

Rounding Practice Answers

1. 3,010,000
2. 55,700
3. hundred thousands
4. 510
5. hundreds
6. 56,000
7. 56,300
8. 30,000
9. 38,200
10. hundreds
11. 900
12. 90
13. 300
14. 90,000
15. ten thousands
16. 200 + 30 + 2; 230
17. 40 + 2; 0
18. 320,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 620 trillion BTUs
2. 146,000 square kilometers of total area
3. 1,400,000 people voted
4. 64,000 dollars
5. 400 trillion BTUs
6. 100,000 people
7. 0 more births than deaths
8. 300 dollars
9. 10 percent change
10. 0 votes
11. 145,600 square kilometers of land
12. 0 square kilometers of water
13. 31,500,000 acres of farmland
14. 32,400,000 acres of farmland
15. 2,968,000 people
16. 1.03 times larger
17. 1.41 times more births than deaths
18. 1.43 times more expensive
19. 1.13 times larger
20. 1.40 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 402/56272
2. 0.71%
3. 55869/56272
4. 99.28%
5. 742,000
6. No. 49.9 percent voted Republican.
7. 393/1176
8. 33%; 33 BTUs came from petroleum
9. 89,000/2,090,000
10. 0.043; 43 farms
11. 29,925,000
12. 3/336
13. 232 trillion BTUs
14. 9.27%
15. 13.44% decrease
16. 363,000
17. 356
18. 9.65%
19. 50%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Kansas is projected to be 2,805,470 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Kansas changed by 75,251 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 246,484 births in Kansas. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Kansas in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Kansas was 1,055 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Kansas is 81,815 square miles and the total water area is 462 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Kansas is 81,815 square miles and the total water area is 462 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Kansas was $31,489. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Kansas. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Kansas was $33,864. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Kansas in 2000 was $27,691. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Kansas ranked number 27. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Kansas ranked number 27. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Kansas was 738 acres. What is the place value furthest to the right that contains the number 8?

14. In 2006, Kansas had 64,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Kansas that were sold was 53,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Kansas in 2003 was 1,118 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,118 in expanded form.

17. The number of home sales in Kansas in 2000 was 53,000. What is the digit in the ten thousands place?

18. The number of children in Kansas who enrolled in Prekindergarten to Grade 8 was 321,000 children in 2004. In what place value is the rightmost 1 in 321,000?

19. The number of children in Kansas who enrolled in Grade 9 to Grade 12 in 2004 was 148,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,188,000 people in Kansas voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

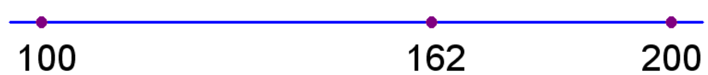
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



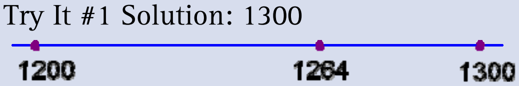
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Kansas is projected to be 2,805,470 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Kansas changed by 75,251 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 246,484 births in Kansas. We round this number to 200,000 . To what place value did we round the number?

4. The number of hospitals in Kansas in 2000 was 129. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Kansas was 1,055 dollars. We round this number to 1,100. What is the smallest place value to which you can round and get this number?

6. The total land area of Kansas is 81,815 square miles and the total water area is 462 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Kansas is 81,815 square miles and the total water area is 462 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Kansas was $31,489. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Kansas was $33,864. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Kansas in 2000 was $27,691. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 27,700. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Kansas ranked number 27. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Kansas ranked number 21. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Kansas was 738 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Kansas had 64,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 53,000 homes. We round this number to 50,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Kansas in 2003 was 293 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 293 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Kansas in 2003 was 93 trillion BTU. (For some states, this amount will be 0.) Write 93 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Kansas who enrolled in Prekindergarten to Grade 8 was 321,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Kansas who enrolled in Grade 9 to Grade 12 was 148,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,188,000 people in Kansas voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Kansas used 434 trillion BTUs of energy from petroleum and 293 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Kansas.

2. The number of square kilometers of land area in Kansas is 211,900. The number of square kilometers of water area is 1,197. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 435,000 votes were cast for the Democratic candidate and 736,000 votes were cast for the Republican candidate in Kansas. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Kansas who voted for the two candidates.

4. The average annual pay in Kansas in 2004 was 32,738 dollars and in 2005 was 33,864. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Kansas consumed 0 trillion BTUs of energy from hydroelectric power (water) and 434 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Kansas in 2003.

6. In 2006, there were 2,764,000 people living in Kansas. In 2000, there were 2,688,000 people living in Kansas. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 246,484 births and 152,585 deaths in Kansas. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Kansas was 837 dollars. In 2005, the average cost per day was 1,055 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 81 percent of adults living in Kansas were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 622,000 votes cast for the Republican candidate and 399,000 votes cast for the Democratic candidate in Kansas in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 81,815 square miles of land in Kansas. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 462 square miles of water in Kansas. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 65,000 farms in Kansas. The average number of acres of land on each farm was 736. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Kansas by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 64,000 farms in Kansas. The average number of acres of land on each farm was 738. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Kansas.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Kansas was 34 people per square mile. There are 81,815 square miles of land in Kansas. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 2,764,000 people living in Kansas. In 2000, there were 2,688,000 people living in Kansas. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 246,484 births and 152,585 deaths in Kansas. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Kansas was 837 dollars. In 2005, the average cost per day was 1,055 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 81 percent of adults living in Kansas were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 55,000 people unemployed in Kansas. In 2000, there were 53,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Kansas has 462 square miles of water area and 82,277 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Kansas is water.

3. Kansas has 81,815 square miles of land area and 82,277 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Kansas is land.

5. Approximately 36.62% of Kansas voters chose the Democratic candidate in the 2004 election. A total of 1,188,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 736,000 citizens in Kansas who voted for the Republican candidate in the 2004 presidential election. A total of 1,188,000 citizens voted. Did more than 55% of the voters in Kansas select the Republican candidate?

7. The amount of energy consumed by people in Kansas in 2003 that came from petroleum was 434 trillion BTUs. The total amount of energy consumed from all sources was 1,118 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Kansas, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Kansas had 64,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Kansas to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Kansas? (Round your answer to the nearest farm.)

11. There were 47,200,000 acres of farmland in Kansas in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Kansas?

12. The projected population of Kansas in 2020 is 2,890,566 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Kansas population to the United States population.

13. In Kansas, 26.21% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,118 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Kansas in 2000 was $27,691. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $30,328. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 125,000 people in Kansas that belonged to labor unions. In 2006, the number of labor union members was 99,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 310,000 patients admitted to hospitals in Kansas. Between 2000 and 2005, this number changed by 6.45%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Kansas in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Kansas was 736 in 2000. Between 2000 and 2006, this number changed by 0.27%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Kansas in 2006?

18. The average cost per day for a hospital stay in Kansas in 2005 was $1,055. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Kansas, 32 had a college degree in 2006. If the number of adults in Kansas with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Kansas, 90 had a high school diploma in 2006 compared to 88 in 2000. What was the percentage change in the number of adults with high school diplomas in Kansas between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 5
2. 2
3. 2
4. 9
5. 1
6. 2
7. 3
8. -6276; 6
9. 0
10. 20,000 + 7,000 + 600 + 90 + 1
11. 7
12. 2
13. ones place
14. 1
15. 2
16. 1,000 + 100 + 10 + 8
17. 5
18. thousands place
19. 100,000 + 40,000 + 8,000
20. 1

Rounding Practice Answers

1. 2,805,000
2. 75,300
3. hundred thousands
4. 920
5. hundreds
6. 82,000
7. 82,300
8. 30,000
9. 39,000
10. hundreds
11. 900
12. 60
13. 600
14. 60,000
15. ten thousands
16. 200 + 90 + 3; 290
17. 90 + 3; 100
18. 320,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 720 trillion BTUs
2. 213,000 square kilometers of total area
3. 1,100,000 people voted
4. 65,000 dollars
5. 400 trillion BTUs
6. 100,000 people
7. 0 more births than deaths
8. 300 dollars
9. 10 percent change
10. 200,000 votes
11. 213,200 square kilometers of land
12. 0 square kilometers of water
13. 51,800,000 acres of farmland
14. 44,400,000 acres of farmland
15. 2,788,000 people
16. 1.04 times larger
17. 1.67 times more births than deaths
18. 1.38 times more expensive
19. 1.13 times larger
20. 1.20 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 462/82277
2. 0.56%
3. 81815/82277
4. 99.44%
5. 435,000
6. Yes. 62 percent voted Republican.
7. 434/1118
8. 39%; 39 BTUs came from petroleum
9. 64,000/2,090,000
10. 0.031; 31 farms
11. 44,840,000
12. 3/336
13. 293 trillion BTUs
14. 9.52%
15. 20.8% decrease
16. 330,000
17. 738
18. 9.48%
19. 64%
20. 2.27% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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    - One activity book per US state focusing on place value, rounding, estimation, and understanding fractions and percents.

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Make It Real Learning

States by the Numbers

place value
rounding
estimation
fractions
percents

Kentucky

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Kentucky is projected to be 4,265,117 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Kentucky changed by 163,789 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 345,318 births in Kentucky. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Kentucky in 2006 who were high school graduates was 80%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Kentucky was 1,194 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Kentucky is 39,728 square miles and the total water area is 681 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Kentucky is 39,728 square miles and the total water area is 681 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Kentucky was $31,855. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Kentucky. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Kentucky was $33,965. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Kentucky in 2000 was $24,411. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Kentucky ranked number 40. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Kentucky ranked number 40. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Kentucky was 163 acres. What is the place value furthest to the right that contains the number 3?

14. In 2006, Kentucky had 84,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Kentucky that were sold was 66,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Kentucky in 2003 was 1,877 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,877 in expanded form.

17. The number of home sales in Kentucky in 2000 was 66,000. What is the digit in the ten thousands place?

18. The number of children in Kentucky who enrolled in Prekindergarten to Grade 8 was 486,000 children in 2004. In what place value is the rightmost 6 in 486,000?

19. The number of children in Kentucky who enrolled in Grade 9 to Grade 12 in 2004 was 189,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,796,000 people in Kentucky voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

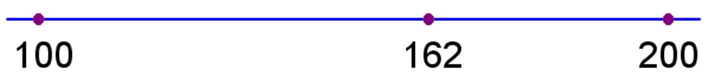
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

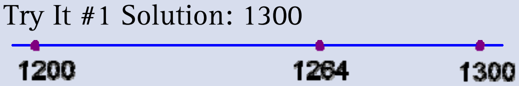


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Kentucky is projected to be 4,265,117 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Kentucky changed by 163,789 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 345,318 births in Kentucky. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in Kentucky in 2000 was 105. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Kentucky was 1,194 dollars. We round this number to 1,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Kentucky is 39,728 square miles and the total water area is 681 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Kentucky is 39,728 square miles and the total water area is 681 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Kentucky was $31,855. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Kentucky was $33,965. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Kentucky in 2000 was $24,411. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 24,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Kentucky ranked number 40. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Kentucky ranked number 46. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Kentucky was 163 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Kentucky had 84,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 66,000 homes. We round this number to 70,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Kentucky in 2003 was 230 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 230 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Kentucky in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Kentucky who enrolled in Prekindergarten to Grade 8 was 486,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Kentucky who enrolled in Grade 9 to Grade 12 was 189,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,796,000 people in Kentucky voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Kentucky used 664 trillion BTUs of energy from petroleum and 230 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Kentucky.

2. The number of square kilometers of land area in Kentucky is 102,896. The number of square kilometers of water area is 1,763. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 713,000 votes were cast for the Democratic candidate and 1,069,000 votes were cast for the Republican candidate in Kentucky. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Kentucky who voted for the two candidates.

4. The average annual pay in Kentucky in 2004 was 33,165 dollars and in 2005 was 33,965. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Kentucky consumed 40 trillion BTUs of energy from hydroelectric power (water) and 664 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Kentucky in 2003.

6. In 2006, there were 4,206,000 people living in Kentucky. In 2000, there were 4,042,000 people living in Kentucky. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 345,318 births and 246,797 deaths in Kentucky. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Kentucky was 929 dollars. In 2005, the average cost per day was 1,194 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 65 percent of adults living in Kentucky were high school graduates. In 2006, the number was 80 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 873,000 votes cast for the Republican candidate and 639,000 votes cast for the Democratic candidate in Kentucky in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 39,728 square miles of land in Kentucky. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 681 square miles of water in Kentucky. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 90,000 farms in Kentucky. The average number of acres of land on each farm was 152. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Kentucky by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 84,000 farms in Kentucky. The average number of acres of land on each farm was 163. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Kentucky.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Kentucky was 106 people per square mile. There are 39,728 square miles of land in Kentucky. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 4,206,000 people living in Kentucky. In 2000, there were 4,042,000 people living in Kentucky. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 345,318 births and 246,797 deaths in Kentucky. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Kentucky was 929 dollars. In 2005, the average cost per day was 1,194 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 65 percent of adults living in Kentucky were high school graduates. In 2006, the number was 80 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 107,000 people unemployed in Kentucky. In 2000, there were 83,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Kentucky has 681 square miles of water area and 40,409 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Kentucky is water.

3. Kentucky has 39,728 square miles of land area and 40,409 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Kentucky is land.

5. Approximately 39.70% of Kentucky voters chose the Democratic candidate in the 2004 election. A total of 1,796,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,069,000 citizens in Kentucky who voted for the Republican candidate in the 2004 presidential election. A total of 1,796,000 citizens voted. Did more than 55% of the voters in Kentucky select the Republican candidate?

7. The amount of energy consumed by people in Kentucky in 2003 that came from petroleum was 664 trillion BTUs. The total amount of energy consumed from all sources was 1,877 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Kentucky, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Kentucky had 84,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Kentucky to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Kentucky? (Round your answer to the nearest farm.)

11. There were 13,700,000 acres of farmland in Kentucky in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Kentucky?

12. The projected population of Kentucky in 2020 is 4,424,431 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Kentucky population to the United States population.

13. In Kentucky, 12.25% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,877 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Kentucky in 2000 was $24,411. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $25,622. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 224,000 people in Kentucky that belonged to labor unions. In 2006, the number of labor union members was 172,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 582,000 patients admitted to hospitals in Kentucky. Between 2000 and 2005, this number changed by 6.19%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Kentucky in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Kentucky was 152 in 2000. Between 2000 and 2006, this number changed by 7.24%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Kentucky in 2006?

18. The average cost per day for a hospital stay in Kentucky in 2005 was $1,194. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Kentucky, 20 had a college degree in 2006. If the number of adults in Kentucky with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Kentucky, 80 had a high school diploma in 2006 compared to 79 in 2000. What was the percentage change in the number of adults with high school diplomas in Kentucky between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 5
2. 7
3. 2
4. 8
5. 3
6. 0
7. 0
8. -5910; 5
9. 0
10. 20,000 + 4,000 + 400 + 10 + 1
11. 0
12. 4
13. ones place
14. 1
15. 3
16. 1,000 + 800 + 70 + 7
17. 6
18. thousands place
19. 100,000 + 80,000 + 9,000
20. 1

Rounding Practice Answers

1. 4,265,000
2. 163,800
3. hundred thousands
4. 500
5. hundreds
6. 39,000
7. 40,400
8. 30,000
9. 39,100
10. hundreds
11. 1600
12. 150
13. 100
14. 80,000
15. ten thousands
16. 200 + 30; 230
17. 0; 0
18. 490,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 890 trillion BTUs
2. 105,000 square kilometers of total area
3. 1,700,000 people voted
4. 66,000 dollars
5. 700 trillion BTUs
6. 200,000 people
7. 100,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 300,000 votes
11. 104,000 square kilometers of land
12. 2,600 square kilometers of water
13. 13,500,000 acres of farmland
14. 12,800,000 acres of farmland
15. 4,240,000 people
16. 1.05 times larger
17. 1.40 times more births than deaths
18. 1.33 times more expensive
19. 1.14 times larger
20. 1.38 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 681/40409
2. 1.69%
3. 39728/40409
4. 98.31%
5. 713,000
6. Yes. 59.5 percent voted Republican.
7. 664/1877
8. 35%; 35 BTUs came from petroleum
9. 84,000/2,090,000
10. 0.04; 40 farms
11. 13,015,000
12. 4/336
13. 230 trillion BTUs
14. 4.96%
15. 23.21% decrease
16. 618,000
17. 163
18. 8.38%
19. 40%
20. 1.27% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Louisiana is projected to be 4,612,679 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Louisiana changed by -181,190 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 410,364 births in Louisiana. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Louisiana in 2006 who were high school graduates was 80%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Louisiana was 1,293 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Louisiana is 43,562 square miles and the total water area is 8,278 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Louisiana is 43,562 square miles and the total water area is 8,278 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Louisiana was $30,782. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Louisiana. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Louisiana was $33,566. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Louisiana in 2000 was $23,079. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Louisiana ranked number 45. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Louisiana ranked number 45. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Louisiana was 291 acres. What is the place value furthest to the right that contains the number 1?

14. In 2006, Louisiana had 27,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Louisiana that were sold was 67,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Louisiana in 2003 was 3,693 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 3,693 in expanded form.

17. The number of home sales in Louisiana in 2000 was 67,000. What is the digit in the ten thousands place?

18. The number of children in Louisiana who enrolled in Prekindergarten to Grade 8 was 534,000 children in 2004. In what place value is the rightmost 4 in 534,000?

19. The number of children in Louisiana who enrolled in Grade 9 to Grade 12 in 2004 was 191,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,943,000 people in Louisiana voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

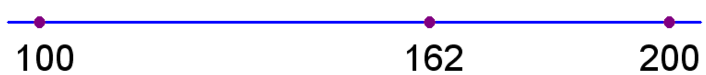
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

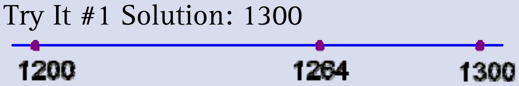


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Louisiana is projected to be 4,612,679 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Louisiana changed by -181,190 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 410,364 births in Louisiana. We round this number to 400,000 . To what place value did we round the number?

4. The number of hospitals in Louisiana in 2000 was 123. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Louisiana was 1,293 dollars. We round this number to 1,300. What is the smallest place value to which you can round and get this number?

6. The total land area of Louisiana is 43,562 square miles and the total water area is 8,278 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Louisiana is 43,562 square miles and the total water area is 8,278 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Louisiana was $30,782. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Louisiana was $33,566. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Louisiana in 2000 was $23,079. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 23,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Louisiana ranked number 45. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Louisiana ranked number 41. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Louisiana was 291 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Louisiana had 27,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 67,000 homes. We round this number to 70,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Louisiana in 2003 was 1,360 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 1,360 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Louisiana in 2003 was 168 trillion BTU. (For some states, this amount will be 0.) Write 168 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Louisiana who enrolled in Prekindergarten to Grade 8 was 534,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Louisiana who enrolled in Grade 9 to Grade 12 was 191,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,943,000 people in Louisiana voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Louisiana used 1,610 trillion BTUs of energy from petroleum and 1,360 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Louisiana.

2. The number of square kilometers of land area in Louisiana is 112,825. The number of square kilometers of water area is 21,440. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 820,000 votes were cast for the Democratic candidate and 1,102,000 votes were cast for the Republican candidate in Louisiana. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Louisiana who voted for the two candidates.

4. The average annual pay in Louisiana in 2004 was 31,880 dollars and in 2005 was 33,566. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Louisiana consumed 9 trillion BTUs of energy from hydroelectric power (water) and 1,610 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Louisiana in 2003.

6. In 2006, there were 4,288,000 people living in Louisiana. In 2000, there were 4,469,000 people living in Louisiana. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 410,364 births and 265,009 deaths in Louisiana. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Louisiana was 1,075 dollars. In 2005, the average cost per day was 1,293 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 68 percent of adults living in Louisiana were high school graduates. In 2006, the number was 80 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 928,000 votes cast for the Republican candidate and 792,000 votes cast for the Democratic candidate in Louisiana in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 43,562 square miles of land in Louisiana. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 8,278 square miles of water in Louisiana. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 29,000 farms in Louisiana. The average number of acres of land on each farm was 277. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Louisiana by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 27,000 farms in Louisiana. The average number of acres of land on each farm was 291. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Louisiana.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Louisiana was 98 people per square mile. There are 43,562 square miles of land in Louisiana. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 4,288,000 people living in Louisiana. In 2000, there were 4,469,000 people living in Louisiana. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 410,364 births and 265,009 deaths in Louisiana. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Louisiana was 1,075 dollars. In 2005, the average cost per day was 1,293 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 68 percent of adults living in Louisiana were high school graduates. In 2006, the number was 80 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 110,000 people unemployed in Louisiana. In 2000, there were 101,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Louisiana has 8,278 square miles of water area and 51,840 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Louisiana is water.

3. Louisiana has 43,562 square miles of land area and 51,840 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Louisiana is land.

5. Approximately 42.20% of Louisiana voters chose the Democratic candidate in the 2004 election. A total of 1,943,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,102,000 citizens in Louisiana who voted for the Republican candidate in the 2004 presidential election. A total of 1,943,000 citizens voted. Did more than 55% of the voters in Louisiana select the Republican candidate?

7. The amount of energy consumed by people in Louisiana in 2003 that came from petroleum was 1,610 trillion BTUs. The total amount of energy consumed from all sources was 3,693 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Louisiana, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Louisiana had 27,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Louisiana to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Louisiana? (Round your answer to the nearest farm.)

11. There were 7,800,000 acres of farmland in Louisiana in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Louisiana?

12. The projected population of Louisiana in 2020 is 4,719,160 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Louisiana population to the United States population.

13. In Louisiana, 36.83% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 3,693 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Louisiana in 2000 was $23,079. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $27,019. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 204,000 people in Louisiana that belonged to labor unions. In 2006, the number of labor union members was 107,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 654,000 patients admitted to hospitals in Louisiana. Between 2000 and 2005, this number changed by -5.20%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Louisiana in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Louisiana was 277 in 2000. Between 2000 and 2006, this number changed by 5.05%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Louisiana in 2006?

18. The average cost per day for a hospital stay in Louisiana in 2005 was $1,293. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Louisiana, 21 had a college degree in 2006. If the number of adults in Louisiana with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Louisiana, 80 had a high school diploma in 2006 compared to 81 in 2000. What was the percentage change in the number of adults with high school diplomas in Louisiana between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 2
2. 1
3. 9
4. 8
5. 5
6. 1
7. 2
8. -6983; 6
9. 0
10. 20,000 + 3,000 + 70 + 9
11. 5
12. 4
13. ones place
14. 4
15. 3
16. 3,000 + 600 + 90 + 3
17. 6
18. thousands place
19. 100,000 + 90,000 + 1,000
20. 1

Rounding Practice Answers

1. 4,613,000
2. (181,200)
3. hundred thousands
4. 320
5. hundreds
6. 36,000
7. 51,900
8. 30,000
9. 38,700
10. hundreds
11. 2500
12. 120
13. 200
14. 30,000
15. ten thousands
16. 1,000 + 300 + 60; 1360
17. 100 + 60 + 8; 200
18. 530,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 2970 trillion BTUs
2. 134,000 square kilometers of total area
3. 1,900,000 people voted
4. 65,000 dollars
5. 1600 trillion BTUs
6. -200,000 people
7. 100,000 more births than deaths
8. 200 dollars
9. 10 percent change
10. 100,000 votes
11. 114,400 square kilometers of land
12. 20,800 square kilometers of water
13. 8,400,000 acres of farmland
14. 8,700,000 acres of farmland
15. 4,312,000 people
16. 0.96 times larger
17. 1.52 times more births than deaths
18. 1.18 times more expensive
19. 1.14 times larger
20. 1.10 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 8278/51840
2. 15.97%
3. 43562/51840
4. 84.03%
5. 820,000
6. Yes. 56.7 percent voted Republican.
7. 1610/3693
8. 44%; 44 BTUs came from petroleum
9. 27,000/2,090,000
10. 0.013; 13 farms
11. 7,410,000
12. 5/336
13. 1360 trillion BTUs
14. 17.07%
15. 47.55% decrease
16. 620,000
17. 291
18. 7.73%
19. 42%
20. 1.23% decrease

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000+40,000+5000+600+70+1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Maine is projected to be 1,357,134 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Maine changed by 46,651 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 86,331 births in Maine. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Maine in 2006 who were high school graduates was 89%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Maine was 1,528 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Maine is 30,862 square miles and the total water area is 4,523 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Maine is 30,862 square miles and the total water area is 4,523 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Maine was $30,750. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Maine. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Maine was $32,701. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Maine in 2000 was $25,968. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Maine ranked number 35. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Maine ranked number 35. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Maine was 192 acres. What is the place value furthest to the right that contains the number 2?

14. In 2006, Maine had 7,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Maine that were sold was 28,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Maine in 2003 was 479 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 479 in expanded form.

17. The number of home sales in Maine in 2000 was 28,000. What is the digit in the ten thousands place?

18. The number of children in Maine who enrolled in Prekindergarten to Grade 8 was 136,000 children in 2004. In what place value is the rightmost 6 in 136,000?

19. The number of children in Maine who enrolled in Grade 9 to Grade 12 in 2004 was 63,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 741,000 people in Maine voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

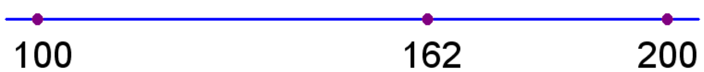
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

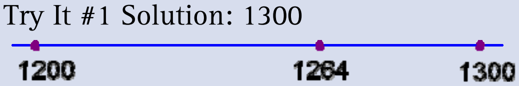


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Maine is projected to be 1,357,134 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Maine changed by 46,651 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 86,331 births in Maine. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Maine in 2000 was 37. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Maine was 1,528 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of Maine is 30,862 square miles and the total water area is 4,523 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Maine is 30,862 square miles and the total water area is 4,523 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Maine was $30,750. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Maine was $32,701. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Maine in 2000 was $25,968. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 26,000. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Maine ranked number 35. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Maine ranked number 34. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Maine was 192 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Maine had 7,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 28,000 homes. We round this number to 30,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Maine in 2003 was 75 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 75 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Maine in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Maine who enrolled in Prekindergarten to Grade 8 was 136,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Maine who enrolled in Grade 9 to Grade 12 was 63,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 741,000 people in Maine voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{\cancel{4 \times} 4 \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Maine used 262 trillion BTUs of energy from petroleum and 75 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Maine.

2. The number of square kilometers of land area in Maine is 79,931. The number of square kilometers of water area is 11,715. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 397,000 votes were cast for the Democratic candidate and 330,000 votes were cast for the Republican candidate in Maine. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Maine who voted for the two candidates.

4. The average annual pay in Maine in 2004 was 31,906 dollars and in 2005 was 32,701. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Maine consumed 33 trillion BTUs of energy from hydroelectric power (water) and 262 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Maine in 2003.

6. In 2006, there were 1,322,000 people living in Maine. In 2000, there were 1,275,000 people living in Maine. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 86,331 births and 78,414 deaths in Maine. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Maine was 1,148 dollars. In 2005, the average cost per day was 1,528 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 79 percent of adults living in Maine were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 287,000 votes cast for the Republican candidate and 320,000 votes cast for the Democratic candidate in Maine in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 30,862 square miles of land in Maine. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 4,523 square miles of water in Maine. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 7,000 farms in Maine. The average number of acres of land on each farm was 190. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Maine by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 7,000 farms in Maine. The average number of acres of land on each farm was 192. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Maine.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Maine was 43 people per square mile. There are 30,862 square miles of land in Maine. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,322,000 people living in Maine. In 2000, there were 1,275,000 people living in Maine. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 86,331 births and 78,414 deaths in Maine. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Maine was 1,148 dollars. In 2005, the average cost per day was 1,528 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 79 percent of adults living in Maine were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 33,000 people unemployed in Maine. In 2000, there were 22,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3{,}794{,}083 \cancel{\text{ square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Maine has 4,523 square miles of water area and 35,385 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Maine is water.

3. Maine has 30,862 square miles of land area and 35,385 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Maine is land.

5. Approximately 53.58% of Maine voters chose the Democratic candidate in the 2004 election. A total of 741,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 330,000 citizens in Maine who voted for the Republican candidate in the 2004 presidential election. A total of 741,000 citizens voted. Did more than 55% of the voters in Maine select the Republican candidate?

7. The amount of energy consumed by people in Maine in 2003 that came from petroleum was 262 trillion BTUs. The total amount of energy consumed from all sources was 479 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Maine, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Maine had 7,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Maine to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Maine? (Round your answer to the nearest farm.)

11. There were 1,360,000 acres of farmland in Maine in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Maine?

12. The projected population of Maine in 2020 is 1,408,665 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Maine population to the United States population.

13. In Maine, 15.66% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 479 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Maine in 2000 was $25,968. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,238. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 88,000 people in Maine that belonged to labor unions. In 2006, the number of labor union members was 69,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 147,000 patients admitted to hospitals in Maine. Between 2000 and 2005, this number changed by 2.72%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Maine in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Maine was 190 in 2000. Between 2000 and 2006, this number changed by 1.05%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Maine in 2006?

18. The average cost per day for a hospital stay in Maine in 2005 was $1,528. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Maine, 27 had a college degree in 2006. If the number of adults in Maine with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Maine, 89 had a high school diploma in 2006 compared to 89 in 2000. What was the percentage change in the number of adults with high school diplomas in Maine between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 7
2. 6
3. 6
4. 8
5. 0
6. 5
7. 3
8. -7015; 7
9. 9
10. 20,000 + 5,000 + 900 + 60 + 8
11. 5
12. 3
13. ones place
14. 4
15. 1
16. 400 + 70 + 9
17. 2
18. thousands place
19. 60,000 + 3,000
20. 7

Rounding Practice Answers

1. 1,357,000
2. 46,700
3. hundred thousands
4. 70
5. hundreds
6. 26,000
7. 35,400
8. 30,000
9. 37,800
10. hundreds
11. 1600
12. 90
13. 100
14. 10,000
15. ten thousands
16. 70 + 5; 80
17. 0; 0
18. 140,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 340 trillion BTUs
2. 92,000 square kilometers of total area
3. 600,000 people voted
4. 64,000 dollars
5. 300 trillion BTUs
6. 0 people
7. 0 more births than deaths
8. 400 dollars
9. 10 percent change
10. 0 votes
11. 80,600 square kilometers of land
12. 13,000 square kilometers of water
13. 1,900,000 acres of farmland
14. 1,900,000 acres of farmland
15. 1,333,000 people
16. 1.00 times larger
17. 1.13 times more births than deaths
18. 1.36 times more expensive
19. 1.13 times larger
20. 1.50 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 4523/35385
2. 12.78%
3. 30862/35385
4. 87.22%
5. 397,000
6. No. 44.5 percent voted Republican.
7. 262/479
8. 55%; 55 BTUs came from petroleum
9. 7,000/2,090,000
10. 0.003; 3 farms
11. 1,292,000
12. 1/336
13. 75 trillion BTUs
14. 8.74%
15. 21.59% decrease
16. 151,000
17. 192
18. 6.54%
19. 54%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Maryland is projected to be 5,904,970 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Maryland changed by 319,221 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 464,251 births in Maryland. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Maryland in 2006 who were high school graduates was 87%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Maryland was 1,831 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Maryland is 9,774 square miles and the total water area is 2,633 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Maryland is 9,774 square miles and the total water area is 2,633 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Maryland was $40,686. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Maryland. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Maryland was $44,368. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Maryland in 2000 was $34,256. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Maryland ranked number 5. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Maryland ranked number 5. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Maryland was 170 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Maryland had 12,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Maryland that were sold was 101,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Maryland in 2003 was 1,551 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,551 in expanded form.

17. The number of home sales in Maryland in 2000 was 101,000. What is the digit in the ten thousands place?

18. The number of children in Maryland who enrolled in Prekindergarten to Grade 8 was 597,000 children in 2004. In what place value is the rightmost 7 in 597,000?

19. The number of children in Maryland who enrolled in Grade 9 to Grade 12 in 2004 was 268,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,384,000 people in Maryland voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

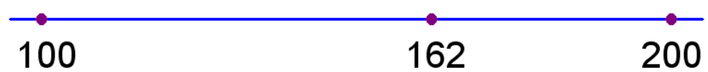
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

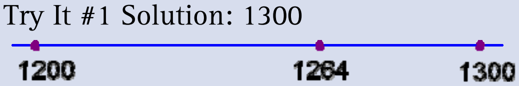


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Maryland is projected to be 5,904,970 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Maryland changed by 319,221 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 464,251 births in Maryland. We round this number to 500,000 . To what place value did we round the number?

4. The number of hospitals in Maryland in 2000 was 49. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Maryland was 1,831 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of Maryland is 9,774 square miles and the total water area is 2,633 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Maryland is 9,774 square miles and the total water area is 2,633 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Maryland was $40,686. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Maryland was $44,368. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Maryland in 2000 was $34,256. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 34,300. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Maryland ranked number 5. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Maryland ranked number 4. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Maryland was 170 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Maryland had 12,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 101,000 homes. We round this number to 100,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Maryland in 2003 was 203 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 203 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Maryland in 2003 was 143 trillion BTU. (For some states, this amount will be 0.) Write 143 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Maryland who enrolled in Prekindergarten to Grade 8 was 597,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Maryland who enrolled in Grade 9 to Grade 12 was 268,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,384,000 people in Maryland voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Maryland used 561 trillion BTUs of energy from petroleum and 203 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Maryland.

2. The number of square kilometers of land area in Maryland is 25,314. The number of square kilometers of water area is 6,819. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,334,000 votes were cast for the Democratic candidate and 1,025,000 votes were cast for the Republican candidate in Maryland. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Maryland who voted for the two candidates.

4. The average annual pay in Maryland in 2004 was 42,579 dollars and in 2005 was 44,368. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Maryland consumed 27 trillion BTUs of energy from hydroelectric power (water) and 561 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Maryland in 2003.

6. In 2006, there were 5,616,000 people living in Maryland. In 2000, there were 5,296,000 people living in Maryland. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 464,251 births and 275,093 deaths in Maryland. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Maryland was 1,315 dollars. In 2005, the average cost per day was 1,831 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 78 percent of adults living in Maryland were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 814,000 votes cast for the Republican candidate and 1,144,000 votes cast for the Democratic candidate in Maryland in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 9,774 square miles of land in Maryland. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 2,633 square miles of water in Maryland. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 12,000 farms in Maryland. The average number of acres of land on each farm was 172. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Maryland by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 12,000 farms in Maryland. The average number of acres of land on each farm was 170. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Maryland.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Maryland was 575 people per square mile. There are 9,774 square miles of land in Maryland. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 5,616,000 people living in Maryland. In 2000, there were 5,296,000 people living in Maryland. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 464,251 births and 275,093 deaths in Maryland. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Maryland was 1,315 dollars. In 2005, the average cost per day was 1,831 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 78 percent of adults living in Maryland were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 118,000 people unemployed in Maryland. In 2000, there were 100,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Maryland has 2,633 square miles of water area and 12,407 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Maryland is water.

3. Maryland has 9,774 square miles of land area and 12,407 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Maryland is land.

5. Approximately 55.96% of Maryland voters chose the Democratic candidate in the 2004 election. A total of 2,384,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,025,000 citizens in Maryland who voted for the Republican candidate in the 2004 presidential election. A total of 2,384,000 citizens voted. Did more than 55% of the voters in Maryland select the Republican candidate?

7. The amount of energy consumed by people in Maryland in 2003 that came from petroleum was 561 trillion BTUs. The total amount of energy consumed from all sources was 1,551 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Maryland, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Maryland had 12,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Maryland to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Maryland? (Round your answer to the nearest farm.)

11. There were 2,035,000 acres of farmland in Maryland in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Maryland?

12. The projected population of Maryland in 2020 is 6,497,626 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Maryland population to the United States population.

13. In Maryland, 13.09% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,551 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Maryland in 2000 was $34,256. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $38,476. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 347,000 people in Maryland that belonged to labor unions. In 2006, the number of labor union members was 342,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 587,000 patients admitted to hospitals in Maryland. Between 2000 and 2005, this number changed by 15.84%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Maryland in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Maryland was 172 in 2000. Between 2000 and 2006, this number changed by -1.16%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Maryland in 2006?

18. The average cost per day for a hospital stay in Maryland in 2005 was $1,831. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Maryland, 36 had a college degree in 2006. If the number of adults in Maryland with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Maryland, 87 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Maryland between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 4
2. 2
3. 4
4. 8
5. 6
6. 2
7. 1
8. 2921; 2
9. 0
10. 30,000 + 4,000 + 200 + 50 + 6
11. 5
12. 0
13. ones place
14. 9
15. 5
16. 1,000 + 500 + 50 + 1
17. 0
18. thousands place
19. 200,000 + 60,000 + 8,000
20. 2

Rounding Practice Answers

1. 5,905,000
2. 319,200
3. hundred thousands
4. 90
5. hundreds
6. 7,000
7. 12,400
8. 40,000
9. 49,500
10. hundreds
11. 100
12. 0
13. 100
14. 10,000
15. ten thousands
16. 200 + 3; 200
17. 100 + 40 + 3; 100
18. 600,000
19. 300,000
20. 2,000,000

Estimation Practice Answers

1. 760 trillion BTUs
2. 32,000 square kilometers of total area
3. 2,100,000 people voted
4. 85,000 dollars
5. 600 trillion BTUs
6. 300,000 people
7. 200,000 more births than deaths
8. 500 dollars
9. 10 percent change
10. 300,000 votes
11. 26,000 square kilometers of land
12. 7,800 square kilometers of water
13. 1,700,000 acres of farmland
14. 1,700,000 acres of farmland
15. 5,750,000 people
16. 1.06 times larger
17. 1.64 times more births than deaths
18. 1.38 times more expensive
19. 1.13 times larger
20. 1.20 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 2633/12407
2. 21.22%
3. 9774/12407
4. 78.78%
5. 1,334,000
6. No. 43 percent voted Republican.
7. 561/1551
8. 36%; 36 BTUs came from petroleum
9. 12,000/2,090,000
10. 0.006; 6 farms
11. 1,933,000
12. 6/336
13. 203 trillion BTUs
14. 12.32%
15. 1.44% decrease
16. 680,000
17. 170
18. 5.46%
19. 72%
20. 1.16% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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- States by the Numbers series
  - One activity book per US state focusing on place value, rounding, estimation, and understanding fractions and percents.

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States by the Numbers

place value
rounding
estimation
fractions
percents

Massachusetts

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Massachusetts is projected to be 6,649,441 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Massachusetts changed by 88,088 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 499,440 births in Massachusetts. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Massachusetts in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Massachusetts was 1,751 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Massachusetts is 7,840 square miles and the total water area is 2,715 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Massachusetts is 7,840 square miles and the total water area is 2,715 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Massachusetts was $46,323. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Massachusetts. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Massachusetts was $50,095. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Massachusetts in 2000 was $37,753. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Massachusetts ranked number 3. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Massachusetts ranked number 3. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Massachusetts was 85 acres. What is the place value furthest to the right that contains the number 5?

14. In 2006, Massachusetts had 6,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Massachusetts that were sold was 112,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Massachusetts in 2003 was 1,589 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,589 in expanded form.

17. The number of home sales in Massachusetts in 2000 was 112,000. What is the digit in the ten thousands place?

18. The number of children in Massachusetts who enrolled in Prekindergarten to Grade 8 was 682,000 children in 2004. In what place value is the rightmost 2 in 682,000?

19. The number of children in Massachusetts who enrolled in Grade 9 to Grade 12 in 2004 was 293,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,927,000 people in Massachusetts voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

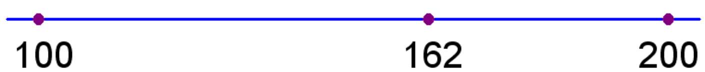
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

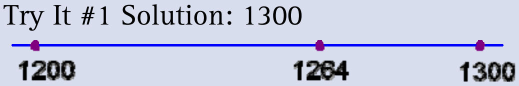


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Massachusetts is projected to be 6,649,441 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Massachusetts changed by 88,088 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 499,440 births in Massachusetts. We round this number to 500,000 . To what place value did we round the number?

4. The number of hospitals in Massachusetts in 2000 was 80. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Massachusetts was 1,751 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of Massachusetts is 7,840 square miles and the total water area is 2,715 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Massachusetts is 7,840 square miles and the total water area is 2,715 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Massachusetts was $46,323. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Massachusetts was $50,095. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Massachusetts in 2000 was $37,753. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 37,800. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Massachusetts ranked number 3. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Massachusetts ranked number 3. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Massachusetts was 85 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Massachusetts had 6,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 112,000 homes. We round this number to 110,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Massachusetts in 2003 was 471 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 471 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Massachusetts in 2003 was 52 trillion BTU. (For some states, this amount will be 0.) Write 52 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Massachusetts who enrolled in Prekindergarten to Grade 8 was 682,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Massachusetts who enrolled in Grade 9 to Grade 12 was 293,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,927,000 people in Massachusetts voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Massachusetts used 734 trillion BTUs of energy from petroleum and 471 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Massachusetts.

2. The number of square kilometers of land area in Massachusetts is 20,306. The number of square kilometers of water area is 7,031. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,804,000 votes were cast for the Democratic candidate and 1,071,000 votes were cast for the Republican candidate in Massachusetts. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Massachusetts who voted for the two candidates.

4. The average annual pay in Massachusetts in 2004 was 48,916 dollars and in 2005 was 50,095. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Massachusetts consumed 11 trillion BTUs of energy from hydroelectric power (water) and 734 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Massachusetts in 2003.

6. In 2006, there were 6,437,000 people living in Massachusetts. In 2000, there were 6,349,000 people living in Massachusetts. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 499,440 births and 349,448 deaths in Massachusetts. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Massachusetts was 1,467 dollars. In 2005, the average cost per day was 1,751 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 80 percent of adults living in Massachusetts were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 879,000 votes cast for the Republican candidate and 1,616,000 votes cast for the Democratic candidate in Massachusetts in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 7,840 square miles of land in Massachusetts. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 2,715 square miles of water in Massachusetts. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 6,000 farms in Massachusetts. The average number of acres of land on each farm was 89. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Massachusetts by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 6,000 farms in Massachusetts. The average number of acres of land on each farm was 85. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Massachusetts.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Massachusetts was 821 people per square mile. There are 7,840 square miles of land in Massachusetts. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 6,437,000 people living in Massachusetts. In 2000, there were 6,349,000 people living in Massachusetts. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 499,440 births and 349,448 deaths in Massachusetts. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Massachusetts was 1,467 dollars. In 2005, the average cost per day was 1,751 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 80 percent of adults living in Massachusetts were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 204,000 people unemployed in Massachusetts. In 2000, there were 92,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Massachusetts has 2,715 square miles of water area and 10,555 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Massachusetts is water.

3. Massachusetts has 7,840 square miles of land area and 10,555 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Massachusetts is land.

5. Approximately 61.63% of Massachusetts voters chose the Democratic candidate in the 2004 election. A total of 2,927,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,071,000 citizens in Massachusetts who voted for the Republican candidate in the 2004 presidential election. A total of 2,927,000 citizens voted. Did more than 55% of the voters in Massachusetts select the Republican candidate?

7. The amount of energy consumed by people in Massachusetts in 2003 that came from petroleum was 734 trillion BTUs. The total amount of energy consumed from all sources was 1,589 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Massachusetts, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Massachusetts had 6,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Massachusetts to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Massachusetts? (Round your answer to the nearest farm.)

11. There were 520,000 acres of farmland in Massachusetts in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Massachusetts?

12. The projected population of Massachusetts in 2020 is 6,855,546 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Massachusetts population to the United States population.

13. In Massachusetts, 29.64% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,589 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Massachusetts in 2000 was $37,753. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $40,048. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 603,000 people in Massachusetts that belonged to labor unions. In 2006, the number of labor union members was 414,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 740,000 patients admitted to hospitals in Massachusetts. Between 2000 and 2005, this number changed by 8.11%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Massachusetts in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Massachusetts was 89 in 2000. Between 2000 and 2006, this number changed by -4.49%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Massachusetts in 2006?

18. The average cost per day for a hospital stay in Massachusetts in 2005 was $1,751. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Massachusetts, 40 had a college degree in 2006. If the number of adults in Massachusetts with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Massachusetts, 90 had a high school diploma in 2006 compared to 85 in 2000. What was the percentage change in the number of adults with high school diplomas in Massachusetts between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 9
2. 0
3. 7
4. 9
5. 5
6. 0
7. 1
8. 8558; 8
9. 6
10. 30,000 + 7,000 + 700 + 50 + 3
11. 3
12. 0
13. ones place
14. 3
15. 5
16. 1,000 + 500 + 80 + 9
17. 1
18. thousands place
19. 200,000 + 90,000 + 3,000
20. 2

Rounding Practice Answers

1. 6,649,000
2. 88,100
3. hundred thousands
4. 10
5. hundreds
6. 5,000
7. 10,500
8. 50,000
9. 55,200
10. hundreds
11. 0
12. 0
13. 0
14. 10,000
15. ten thousands
16. 400 + 70 + 1; 470
17. 50 + 2; 100
18. 680,000
19. 300,000
20. 3,000,000

Estimation Practice Answers

1. 1200 trillion BTUs
2. 27,000 square kilometers of total area
3. 2,700,000 people voted
4. 96,000 dollars
5. 700 trillion BTUs
6. 100,000 people
7. 200,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 700,000 votes
11. 20,800 square kilometers of land
12. 7,800 square kilometers of water
13. 900,000 acres of farmland
14. 900,000 acres of farmland
15. 6,568,000 people
16. 1.02 times larger
17. 1.43 times more births than deaths
18. 1.20 times more expensive
19. 1.13 times larger
20. 2.22 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 2715/10555
2. 25.72%
3. 7840/10555
4. 74.28%
5. 1,804,000
6. No. 36.6 percent voted Republican.
7. 734/1589
8. 46%; 46 BTUs came from petroleum
9. 6,000/2,090,000
10. 0.003; 3 farms
11. 494,000
12. 7/336
13. 471 trillion BTUs
14. 6.08%
15. 31.34% decrease
16. 800,000
17. 85
18. 5.71%
19. 80%
20. 5.88% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Michigan is projected to be 10,428,683 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Michigan changed by 157,163 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 816,225 births in Michigan. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Michigan in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Michigan was 1,460 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Michigan is 56,804 square miles and the total water area is 39,912 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Michigan is 56,804 square miles and the total water area is 39,912 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Michigan was $39,433. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Michigan. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Michigan was $41,214. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Michigan in 2000 was $29,551. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Michigan ranked number 17. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Michigan ranked number 17. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Michigan was 191 acres. What is the place value furthest to the right that contains the number 1?

14. In 2006, Michigan had 53,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Michigan that were sold was 185,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Michigan in 2003 was 3,158 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 3,158 in expanded form.

17. The number of home sales in Michigan in 2000 was 185,000. What is the digit in the ten thousands place?

18. The number of children in Michigan who enrolled in Prekindergarten to Grade 8 was 1,211,000 children in 2004. In what place value is the rightmost 1 in 1,211,000?

19. The number of children in Michigan who enrolled in Grade 9 to Grade 12 in 2004 was 539,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 4,839,000 people in Michigan voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

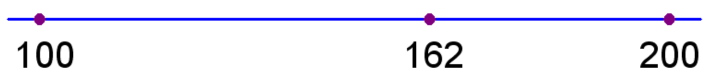
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

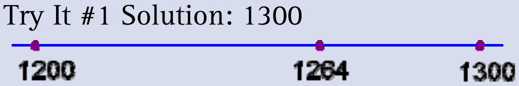


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Michigan is projected to be 10,428,683 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Michigan changed by 157,163 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 816,225 births in Michigan. We round this number to 800,000 . To what place value did we round the number?

4. The number of hospitals in Michigan in 2000 was 146. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Michigan was 1,460 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of Michigan is 56,804 square miles and the total water area is 39,912 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Michigan is 56,804 square miles and the total water area is 39,912 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Michigan was $39,433. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Michigan was $41,214. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Michigan in 2000 was $29,551. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 29,600. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Michigan ranked number 17. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Michigan ranked number 27. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Michigan was 191 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Michigan had 53,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 185,000 homes. We round this number to 190,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Michigan in 2003 was 923 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 923 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Michigan in 2003 was 291 trillion BTU. (For some states, this amount will be 0.) Write 291 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Michigan who enrolled in Prekindergarten to Grade 8 was 1,211,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Michigan who enrolled in Grade 9 to Grade 12 was 539,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 4,839,000 people in Michigan voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Michigan used 1,010 trillion BTUs of energy from petroleum and 923 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Michigan.

2. The number of square kilometers of land area in Michigan is 147,121. The number of square kilometers of water area is 103,372. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 2,479,000 votes were cast for the Democratic candidate and 2,314,000 votes were cast for the Republican candidate in Michigan. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Michigan who voted for the two candidates.

4. The average annual pay in Michigan in 2004 was 40,373 dollars and in 2005 was 41,214. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Michigan consumed 14 trillion BTUs of energy from hydroelectric power (water) and 1,010 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Michigan in 2003.

6. In 2006, there were 10,096,000 people living in Michigan. In 2000, there were 9,938,000 people living in Michigan. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 816,225 births and 543,921 deaths in Michigan. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Michigan was 1,211 dollars. In 2005, the average cost per day was 1,460 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 77 percent of adults living in Michigan were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,953,000 votes cast for the Republican candidate and 2,170,000 votes cast for the Democratic candidate in Michigan in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 56,804 square miles of land in Michigan. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 39,912 square miles of water in Michigan. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 53,000 farms in Michigan. The average number of acres of land on each farm was 192. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Michigan by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 53,000 farms in Michigan. The average number of acres of land on each farm was 191. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Michigan.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Michigan was 178 people per square mile. There are 56,804 square miles of land in Michigan. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 10,096,000 people living in Michigan. In 2000, there were 9,938,000 people living in Michigan. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 816,225 births and 543,921 deaths in Michigan. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Michigan was 1,211 dollars. In 2005, the average cost per day was 1,460 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 77 percent of adults living in Michigan were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 358,000 people unemployed in Michigan. In 2000, there were 190,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Michigan has 39,912 square miles of water area and 96,716 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Michigan is water.

3. Michigan has 56,804 square miles of land area and 96,716 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Michigan is land.

5. Approximately 51.23% of Michigan voters chose the Democratic candidate in the 2004 election. A total of 4,839,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 2,314,000 citizens in Michigan who voted for the Republican candidate in the 2004 presidential election. A total of 4,839,000 citizens voted. Did more than 55% of the voters in Michigan select the Republican candidate?

7. The amount of energy consumed by people in Michigan in 2003 that came from petroleum was 1,010 trillion BTUs. The total amount of energy consumed from all sources was 3,158 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Michigan, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Michigan had 53,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Michigan to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Michigan? (Round your answer to the nearest farm.)

11. There were 10,100,000 acres of farmland in Michigan in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Michigan?

12. The projected population of Michigan in 2020 is 10,695,993 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Michigan population to the United States population.

13. In Michigan, 29.23% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 3,158 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Michigan in 2000 was $29,551. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,546. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 1,005,000 people in Michigan that belonged to labor unions. In 2006, the number of labor union members was 842,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 1,106,000 patients admitted to hospitals in Michigan. Between 2000 and 2005, this number changed by 8.32%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Michigan in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Michigan was 192 in 2000. Between 2000 and 2006, this number changed by -0.52%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Michigan in 2006?

18. The average cost per day for a hospital stay in Michigan in 2005 was $1,460. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Michigan, 26 had a college degree in 2006. If the number of adults in Michigan with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Michigan, 90 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Michigan between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 8
2. 1
3. 9
4. 9
5. 9
6. 6
7. 8
8. 1668; 1
9. 7
10. 20,000 + 9,000 + 500 + 50 + 1
11. 7
12. 2
13. ones place
14. 0
15. 9
16. 3,000 + 100 + 50 + 8
17. 8
18. thousands place
19. 500,000 + 30,000 + 9,000
20. 4

Rounding Practice Answers

1. 10,429,000
2. 157,200
3. hundred thousands
4. 640
5. hundreds
6. 17,000
7. 96,700
8. 40,000
9. 46,300
10. hundreds
11. 400
12. 90
13. 100
14. 50,000
15. ten thousands
16. 900 + 20 + 3; 920
17. 200 + 90 + 1; 300
18. 1,210,000
19. 500,000
20. 5,000,000

Estimation Practice Answers

1. 1930 trillion BTUs
2. 250,000 square kilometers of total area
3. 4,500,000 people voted
4. 80,000 dollars
5. 1000 trillion BTUs
6. 200,000 people
7. 300,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 200,000 votes
11. 148,200 square kilometers of land
12. 104,000 square kilometers of water
13. 9,500,000 acres of farmland
14. 9,500,000 acres of farmland
15. 10,146,000 people
16. 1.02 times larger
17. 1.52 times more births than deaths
18. 1.25 times more expensive
19. 1.13 times larger
20. 1.89 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 39912/96716
2. 41.27%
3. 56804/96716
4. 58.73%
5. 2,479,000
6. No. 47.8 percent voted Republican.
7. 1010/3158
8. 32%; 32 BTUs came from petroleum
9. 53,000/2,090,000
10. 0.025; 25 farms
11. 9,595,000
12. 11/336
13. 923 trillion BTUs
14. -0.02%
15. 16.22% decrease
16. 1,198,000
17. 191
18. 6.85%
19. 52%
20. 4.65% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Minnesota is projected to be 5,420,636 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Minnesota changed by 247,609 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 432,306 births in Minnesota. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Minnesota in 2006 who were high school graduates was 93%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Minnesota was 1,300 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Minnesota is 79,610 square miles and the total water area is 7,329 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Minnesota is 79,610 square miles and the total water area is 7,329 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Minnesota was $38,610. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Minnesota. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Minnesota was $40,800. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Minnesota in 2000 was $32,014. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Minnesota ranked number 10. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Minnesota ranked number 10. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Minnesota was 346 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, Minnesota had 79,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Minnesota that were sold was 96,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Minnesota in 2003 was 1,796 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,796 in expanded form.

17. The number of home sales in Minnesota in 2000 was 96,000. What is the digit in the ten thousands place?

18. The number of children in Minnesota who enrolled in Prekindergarten to Grade 8 was 558,000 children in 2004. In what place value is the rightmost 8 in 558,000?

19. The number of children in Minnesota who enrolled in Grade 9 to Grade 12 in 2004 was 280,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,828,000 people in Minnesota voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

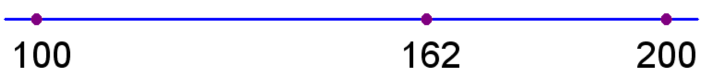
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

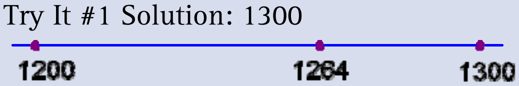


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Minnesota is projected to be 5,420,636 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Minnesota changed by 247,609 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 432,306 births in Minnesota. We round this number to 400,000 . To what place value did we round the number?

4. The number of hospitals in Minnesota in 2000 was 135. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Minnesota was 1,300 dollars. We round this number to 1,300. What is the smallest place value to which you can round and get this number?

6. The total land area of Minnesota is 79,610 square miles and the total water area is 7,329 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Minnesota is 79,610 square miles and the total water area is 7,329 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Minnesota was $38,610. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Minnesota was $40,800. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Minnesota in 2000 was $32,014. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 32,000. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Minnesota ranked number 10. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Minnesota ranked number 12. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Minnesota was 346 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Minnesota had 79,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 96,000 homes. We round this number to 100,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Minnesota in 2003 was 375 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 375 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Minnesota in 2003 was 140 trillion BTU. (For some states, this amount will be 0.) Write 140 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Minnesota who enrolled in Prekindergarten to Grade 8 was 558,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Minnesota who enrolled in Grade 9 to Grade 12 was 280,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,828,000 people in Minnesota voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}
\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\
&= \frac{10 \times 10}{4} \\
&= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\
&= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\
&= 5 \times 5 \\
&= 25
\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food \$2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Minnesota used 694 trillion BTUs of energy from petroleum and 375 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Minnesota.

2. The number of square kilometers of land area in Minnesota is 206,189. The number of square kilometers of water area is 18,982. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,445,000 votes were cast for the Democratic candidate and 1,347,000 votes were cast for the Republican candidate in Minnesota. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Minnesota who voted for the two candidates.

4. The average annual pay in Minnesota in 2004 was 40,398 dollars and in 2005 was 40,800. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Minnesota consumed 8 trillion BTUs of energy from hydroelectric power (water) and 694 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Minnesota in 2003.

6. In 2006, there were 5,167,000 people living in Minnesota. In 2000, there were 4,919,000 people living in Minnesota. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 432,306 births and 236,211 deaths in Minnesota. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Minnesota was 932 dollars. In 2005, the average cost per day was 1,300 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 82 percent of adults living in Minnesota were high school graduates. In 2006, the number was 93 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,110,000 votes cast for the Republican candidate and 1,168,000 votes cast for the Democratic candidate in Minnesota in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 79,610 square miles of land in Minnesota. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 7,329 square miles of water in Minnesota. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 81,000 farms in Minnesota. The average number of acres of land on each farm was 344. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Minnesota by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 79,000 farms in Minnesota. The average number of acres of land on each farm was 346. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Minnesota.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Minnesota was 65 people per square mile. There are 79,610 square miles of land in Minnesota. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 5,167,000 people living in Minnesota. In 2000, there were 4,919,000 people living in Minnesota. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 432,306 births and 236,211 deaths in Minnesota. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Minnesota was 932 dollars. In 2005, the average cost per day was 1,300 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 82 percent of adults living in Minnesota were high school graduates. In 2006, the number was 93 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 114,000 people unemployed in Minnesota. In 2000, there were 87,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "%" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Minnesota has 7,329 square miles of water area and 86,939 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Minnesota is water.

3. Minnesota has 79,610 square miles of land area and 86,939 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Minnesota is land.

5. Approximately 51.10% of Minnesota voters chose the Democratic candidate in the 2004 election. A total of 2,828,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,347,000 citizens in Minnesota who voted for the Republican candidate in the 2004 presidential election. A total of 2,828,000 citizens voted. Did more than 55% of the voters in Minnesota select the Republican candidate?

7. The amount of energy consumed by people in Minnesota in 2003 that came from petroleum was 694 trillion BTUs. The total amount of energy consumed from all sources was 1,796 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Minnesota, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Minnesota had 79,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Minnesota to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Minnesota? (Round your answer to the nearest farm.)

11. There were 27,400,000 acres of farmland in Minnesota in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Minnesota?

12. The projected population of Minnesota in 2020 is 5,900,769 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Minnesota population to the United States population.

13. In Minnesota, 20.88% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,796 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Minnesota in 2000 was $32,014. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $33,793. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 394,000 people in Minnesota that belonged to labor unions. In 2006, the number of labor union members was 396,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 571,000 patients admitted to hospitals in Minnesota. Between 2000 and 2005, this number changed by 11.21%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Minnesota in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Minnesota was 344 in 2000. Between 2000 and 2006, this number changed by 0.58%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Minnesota in 2006?

18. The average cost per day for a hospital stay in Minnesota in 2005 was $1,300. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Minnesota, 34 had a college degree in 2006. If the number of adults in Minnesota with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Minnesota, 93 had a high school diploma in 2006 compared to 91 in 2000. What was the percentage change in the number of adults with high school diplomas in Minnesota between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 6
3. 1
4. 9
5. 6
6. 6
7. 2
8. 845; 0
9. 7
10. 30,000 + 2,000 + 10 + 4
11. 0
12. 1
13. ones place
14. 6
15. 4
16. 1,000 + 700 + 90 + 6
17. 9
18. thousands place
19. 200,000 + 80,000
20. 2

Rounding Practice Answers

1. 5,421,000
2. 247,600
3. hundred thousands
4. 530
5. hundreds
6. 73,000
7. 86,900
8. 40,000
9. 45,900
10. hundreds
11. 100
12. 30
13. 200
14. 80,000
15. ten thousands
16. 300 + 70 + 5; 380
17. 100 + 40; 100
18. 560,000
19. 300,000
20. 3,000,000

Estimation Practice Answers

1. 1070 trillion BTUs
2. 225,000 square kilometers of total area
3. 2,500,000 people voted
4. 80,000 dollars
5. 700 trillion BTUs
6. 300,000 people
7. 200,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 100,000 votes
11. 208,000 square kilometers of land
12. 18,200 square kilometers of water
13. 27,200,000 acres of farmland
14. 28,000,000 acres of farmland
15. 5,200,000 people
16. 1.06 times larger
17. 1.79 times more births than deaths
18. 1.44 times more expensive
19. 1.13 times larger
20. 1.22 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 7329/86939
2. 8.43%
3. 79610/86939
4. 91.57%
5. 1,445,000
6. No. 47.6 percent voted Republican.
7. 694/1796
8. 39%; 39 BTUs came from petroleum
9. 79,000/2,090,000
10. 0.038; 38 farms
11. 26,030,000
12. 6/336
13. 375 trillion BTUs
14. 5.56%
15. 0.51% increase
16. 635,000
17. 346
18. 7.69%
19. 68%
20. 2.2% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Mississippi is projected to be 2,971,412 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Mississippi changed by 65,884 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 266,971 births in Mississippi. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Mississippi in 2006 who were high school graduates was 81%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Mississippi was 1,021 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Mississippi is 46,907 square miles and the total water area is 1,523 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Mississippi is 46,907 square miles and the total water area is 1,523 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Mississippi was $27,591. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Mississippi. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Mississippi was $29,763. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Mississippi in 2000 was $21,005. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Mississippi ranked number 50. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Mississippi ranked number 50. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Mississippi was 262 acres. What is the place value furthest to the right that contains the number 2?

14. In 2006, Mississippi had 42,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Mississippi that were sold was 39,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Mississippi in 2003 was 1,184 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,184 in expanded form.

17. The number of home sales in Mississippi in 2000 was 39,000. What is the digit in the ten thousands place?

18. The number of children in Mississippi who enrolled in Prekindergarten to Grade 8 was 361,000 children in 2004. In what place value is the rightmost 1 in 361,000?

19. The number of children in Mississippi who enrolled in Grade 9 to Grade 12 in 2004 was 134,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,140,000 people in Mississippi voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

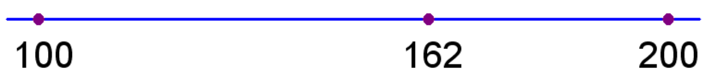
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

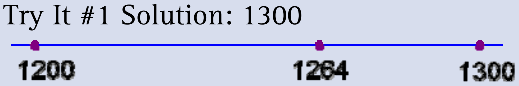


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Mississippi is projected to be 2,971,412 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Mississippi changed by 65,884 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 266,971 births in Mississippi. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in Mississippi in 2000 was 95. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Mississippi was 1,021 dollars. We round this number to 1,000. What is the smallest place value to which you can round and get this number?

6. The total land area of Mississippi is 46,907 square miles and the total water area is 1,523 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Mississippi is 46,907 square miles and the total water area is 1,523 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Mississippi was $27,591. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Mississippi was $29,763. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Mississippi in 2000 was $21,005. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 21,000. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Mississippi ranked number 50. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Mississippi ranked number 50. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Mississippi was 262 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Mississippi had 42,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 39,000 homes. We round this number to 40,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Mississippi in 2003 was 266 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 266 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Mississippi in 2003 was 114 trillion BTU. (For some states, this amount will be 0.) Write 114 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Mississippi who enrolled in Prekindergarten to Grade 8 was 361,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Mississippi who enrolled in Grade 9 to Grade 12 was 134,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,140,000 people in Mississippi voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Mississippi used 484 trillion BTUs of energy from petroleum and 266 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Mississippi.

2. The number of square kilometers of land area in Mississippi is 121,489. The number of square kilometers of water area is 3,945. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 458,000 votes were cast for the Democratic candidate and 673,000 votes were cast for the Republican candidate in Mississippi. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Mississippi who voted for the two candidates.

4. The average annual pay in Mississippi in 2004 was 28,535 dollars and in 2005 was 29,763. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Mississippi consumed 0 trillion BTUs of energy from hydroelectric power (water) and 484 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Mississippi in 2003.

6. In 2006, there were 2,911,000 people living in Mississippi. In 2000, there were 2,845,000 people living in Mississippi. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 266,971 births and 177,467 deaths in Mississippi. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Mississippi was 719 dollars. In 2005, the average cost per day was 1,021 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 64 percent of adults living in Mississippi were high school graduates. In 2006, the number was 81 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 573,000 votes cast for the Republican candidate and 405,000 votes cast for the Democratic candidate in Mississippi in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 46,907 square miles of land in Mississippi. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,523 square miles of water in Mississippi. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 42,000 farms in Mississippi. The average number of acres of land on each farm was 266. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Mississippi by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 42,000 farms in Mississippi. The average number of acres of land on each farm was 262. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Mississippi.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Mississippi was 62 people per square mile. There are 46,907 square miles of land in Mississippi. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 2,911,000 people living in Mississippi. In 2000, there were 2,845,000 people living in Mississippi. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 266,971 births and 177,467 deaths in Mississippi. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Mississippi was 719 dollars. In 2005, the average cost per day was 1,021 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 64 percent of adults living in Mississippi were high school graduates. In 2006, the number was 81 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 90,000 people unemployed in Mississippi. In 2000, there were 74,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Mississippi has 1,523 square miles of water area and 48,430 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Mississippi is water.

3. Mississippi has 46,907 square miles of land area and 48,430 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Mississippi is land.

5. Approximately 40.18% of Mississippi voters chose the Democratic candidate in the 2004 election. A total of 1,140,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 673,000 citizens in Mississippi who voted for the Republican candidate in the 2004 presidential election. A total of 1,140,000 citizens voted. Did more than 55% of the voters in Mississippi select the Republican candidate?

7. The amount of energy consumed by people in Mississippi in 2003 that came from petroleum was 484 trillion BTUs. The total amount of energy consumed from all sources was 1,184 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Mississippi, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Mississippi had 42,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Mississippi to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Mississippi? (Round your answer to the nearest farm.)

11. There were 11,000,000 acres of farmland in Mississippi in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Mississippi?

12. The projected population of Mississippi in 2020 is 3,044,812 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Mississippi population to the United States population.

13. In Mississippi, 22.47% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,184 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Mississippi in 2000 was $21,005. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $23,163. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 79,000 people in Mississippi that belonged to labor unions. In 2006, the number of labor union members was 60,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 425,000 patients admitted to hospitals in Mississippi. Between 2000 and 2005, this number changed by -2.59%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Mississippi in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Mississippi was 266 in 2000. Between 2000 and 2006, this number changed by -1.50%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Mississippi in 2006?

18. The average cost per day for a hospital stay in Mississippi in 2005 was $1,021. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Mississippi, 21 had a college degree in 2006. If the number of adults in Mississippi with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Mississippi, 81 had a high school diploma in 2006 compared to 80 in 2000. What was the percentage change in the number of adults with high school diplomas in Mississippi between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 1
2. 8
3. 4
4. 8
5. 0
6. 8
7. 3
8. -10174; 0
9. 6
10. 20,000 + 1,000 + 5
11. 0
12. 5
13. ones place
14. 9
15. 1
16. 1,000 + 100 + 80 + 4
17. 3
18. thousands place
19. 100,000 + 30,000 + 4,000
20. 1

Rounding Practice Answers

1. 2,971,000
2. 65,900
3. hundred thousands
4. 60
5. hundreds
6. 45,000
7. 48,400
8. 30,000
9. 34,900
10. hundreds
11. 2500
12. 150
13. 200
14. 40,000
15. ten thousands
16. 200 + 60 + 6; 270
17. 100 + 10 + 4; 100
18. 360,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 750 trillion BTUs
2. 125,000 square kilometers of total area
3. 1,100,000 people voted
4. 58,000 dollars
5. 500 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 300 dollars
9. 20 percent change
10. 200,000 votes
11. 122,200 square kilometers of land
12. 5,200 square kilometers of water
13. 10,800,000 acres of farmland
14. 10,400,000 acres of farmland
15. 2,914,000 people
16. 1.04 times larger
17. 1.50 times more births than deaths
18. 1.43 times more expensive
19. 1.33 times larger
20. 1.29 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1523/48430
2. 3.14%
3. 46907/48430
4. 96.86%
5. 458,000
6. Yes. 59 percent voted Republican.
7. 484/1184
8. 41%; 41 BTUs came from petroleum
9. 42,000/2,090,000
10. 0.02; 20 farms
11. 10,450,000
12. 3/336
13. 266 trillion BTUs
14. 10.27%
15. 24.05% decrease
16. 414,000
17. 262
18. 9.79%
19. 42%
20. 1.25% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Make It Real Learning

States by the Numbers

place value
rounding
estimation
fractions
percents

Missouri

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Missouri is projected to be 5,922,078 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Missouri changed by 246,030 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 480,763 births in Missouri. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Missouri in 2006 who were high school graduates was 87%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Missouri was 1,560 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Missouri is 68,886 square miles and the total water area is 818 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Missouri is 68,886 square miles and the total water area is 818 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Missouri was $33,788. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Missouri. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Missouri was $35,951. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Missouri in 2000 was $27,240. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Missouri ranked number 30. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Missouri ranked number 30. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Missouri was 287 acres. What is the place value furthest to the right that contains the number 7?

14. In 2006, Missouri had 105,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Missouri that were sold was 110,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Missouri in 2003 was 1,842 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,842 in expanded form.

17. The number of home sales in Missouri in 2000 was 110,000. What is the digit in the ten thousands place?

18. The number of children in Missouri who enrolled in Prekindergarten to Grade 8 was 629,000 children in 2004. In what place value is the rightmost 9 in 629,000?

19. The number of children in Missouri who enrolled in Grade 9 to Grade 12 in 2004 was 277,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,731,000 people in Missouri voted. If the order of the digits in this number is reversed, what is the number in the one’s place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

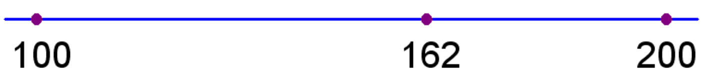
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



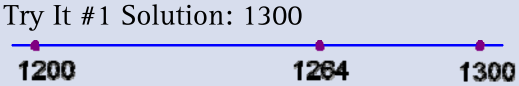
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Missouri is projected to be 5,922,078 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Missouri changed by 246,030 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 480,763 births in Missouri. We round this number to 500,000 . To what place value did we round the number?

4. The number of hospitals in Missouri in 2000 was 119. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Missouri was 1,560 dollars. We round this number to 1,600. What is the smallest place value to which you can round and get this number?

6. The total land area of Missouri is 68,886 square miles and the total water area is 818 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Missouri is 68,886 square miles and the total water area is 818 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Missouri was $33,788. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Missouri was $35,951. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Missouri in 2000 was $27,240. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 27,200. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Missouri ranked number 30. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Missouri ranked number 31. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Missouri was 287 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Missouri had 105,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 110,000 homes. We round this number to 110,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Missouri in 2003 was 267 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 267 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Missouri in 2003 was 101 trillion BTU. (For some states, this amount will be 0.) Write 101 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Missouri who enrolled in Prekindergarten to Grade 8 was 629,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Missouri who enrolled in Grade 9 to Grade 12 was 277,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,731,000 people in Missouri voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}
\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\
&= \frac{10 \times 10}{4} \\
&= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\
&= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\
&= 5 \times 5 \\
&= 25
\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food \$2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Missouri used 737 trillion BTUs of energy from petroleum and 267 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Missouri.

2. The number of square kilometers of land area in Missouri is 178,414. The number of square kilometers of water area is 2,120. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,259,000 votes were cast for the Democratic candidate and 1,456,000 votes were cast for the Republican candidate in Missouri. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Missouri who voted for the two candidates.

4. The average annual pay in Missouri in 2004 was 34,845 dollars and in 2005 was 35,951. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Missouri consumed 7 trillion BTUs of energy from hydroelectric power (water) and 737 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Missouri in 2003.

6. In 2006, there were 5,843,000 people living in Missouri. In 2000, there were 5,595,000 people living in Missouri. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 480,763 births and 343,199 deaths in Missouri. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Missouri was 1,185 dollars. In 2005, the average cost per day was 1,560 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 74 percent of adults living in Missouri were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,190,000 votes cast for the Republican candidate and 1,111,000 votes cast for the Democratic candidate in Missouri in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 68,886 square miles of land in Missouri. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 818 square miles of water in Missouri. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 109,000 farms in Missouri. The average number of acres of land on each farm was 277. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Missouri by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 105,000 farms in Missouri. The average number of acres of land on each farm was 287. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Missouri.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Missouri was 85 people per square mile. There are 68,886 square miles of land in Missouri. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 5,843,000 people living in Missouri. In 2000, there were 5,595,000 people living in Missouri. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 480,763 births and 343,199 deaths in Missouri. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Missouri was 1,185 dollars. In 2005, the average cost per day was 1,560 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 74 percent of adults living in Missouri were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 151,000 people unemployed in Missouri. In 2000, there were 98,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Missouri has 818 square miles of water area and 69,704 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Missouri is water.

3. Missouri has 68,886 square miles of land area and 69,704 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Missouri is land.

5. Approximately 46.10% of Missouri voters chose the Democratic candidate in the 2004 election. A total of 2,731,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,456,000 citizens in Missouri who voted for the Republican candidate in the 2004 presidential election. A total of 2,731,000 citizens voted. Did more than 55% of the voters in Missouri select the Republican candidate?

7. The amount of energy consumed by people in Missouri in 2003 that came from petroleum was 737 trillion BTUs. The total amount of energy consumed from all sources was 1,842 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Missouri, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Missouri had 105,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Missouri to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Missouri? (Round your answer to the nearest farm.)

11. There were 30,100,000 acres of farmland in Missouri in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Missouri?

12. The projected population of Missouri in 2020 is 6,199,882 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Missouri population to the United States population.

13. In Missouri, 14.50% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,842 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Missouri in 2000 was $27,240. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,549. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 374,000 people in Missouri that belonged to labor unions. In 2006, the number of labor union members was 284,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 773,000 patients admitted to hospitals in Missouri. Between 2000 and 2005, this number changed by 8.15%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Missouri in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Missouri was 277 in 2000. Between 2000 and 2006, this number changed by 3.61%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Missouri in 2006?

18. The average cost per day for a hospital stay in Missouri in 2005 was $1,560. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Missouri, 24 had a college degree in 2006. If the number of adults in Missouri with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Missouri, 87 had a high school diploma in 2006 compared to 87 in 2000. What was the percentage change in the number of adults with high school diplomas in Missouri between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 2
2. 0
3. 6
4. 8
5. 1
6. 9
7. 0
8. -3977; 3
9. 2
10. 20,000 + 7,000 + 200 + 40 + 0
11. 0
12. 3
13. ones place
14. 2
15. 5
16. 1,000 + 800 + 40 + 2
17. 1
18. thousands place
19. 200,000 + 70,000 + 7,000
20. 2

Rounding Practice Answers

1. 5,922,000
2. 246,000
3. hundred thousands
4. 910
5. hundreds
6. 68,000
7. 69,700
8. 30,000
9. 41,100
10. hundreds
11. 900
12. 90
13. 200
14. 110,000
15. ten thousands
16. 200 + 60 + 7; 270
17. 100 + 1; 100
18. 630,000
19. 300,000
20. 3,000,000

Estimation Practice Answers

1. 1010 trillion BTUs
2. 180,000 square kilometers of total area
3. 2,600,000 people voted
4. 70,000 dollars
5. 700 trillion BTUs
6. 200,000 people
7. 200,000 more births than deaths
8. 400 dollars
9. 20 percent change
10. 100,000 votes
11. 179,400 square kilometers of land
12. 2,600 square kilometers of water
13. 30,800,000 acres of farmland
14. 31,900,000 acres of farmland
15. 5,865,000 people
16. 1.04 times larger
17. 1.41 times more births than deaths
18. 1.33 times more expensive
19. 1.29 times larger
20. 1.50 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 818/69704
2. 1.17%
3. 68886/69704
4. 98.83%
5. 1,259,000
6. No. 53.3 percent voted Republican.
7. 737/1842
8. 40%; 40 BTUs came from petroleum
9. 105,000/2,090,000
10. 0.05; 50 farms
11. 28,595,000
12. 6/336
13. 267 trillion BTUs
14. 4.81%
15. 24.06% decrease
16. 836,000
17. 287
18. 6.41%
19. 48%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Montana is projected to be 968,598 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Montana changed by 42,437 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 70,509 births in Montana. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Montana in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Montana was 814 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Montana is 145,552 square miles and the total water area is 1,490 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Montana is 145,552 square miles and the total water area is 1,490 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Montana was $26,907. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Montana. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Montana was $29,150. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Montana in 2000 was $22,928. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Montana ranked number 46. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Montana ranked number 46. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Montana was 2,139 acres. What is the place value furthest to the right that contains the number 9?

14. In 2006, Montana had 28,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Montana that were sold was 17,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Montana in 2003 was 376 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 376 in expanded form.

17. The number of home sales in Montana in 2000 was 17,000. What is the digit in the ten thousands place?

18. The number of children in Montana who enrolled in Prekindergarten to Grade 8 was 99,000 children in 2004. In what place value is the rightmost 9 in 99,000?

19. The number of children in Montana who enrolled in Grade 9 to Grade 12 in 2004 was 48,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 450,000 people in Montana voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

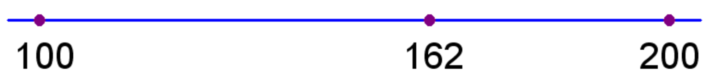
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



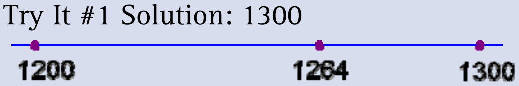
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Montana is projected to be 968,598 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Montana changed by 42,437 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 70,509 births in Montana. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Montana in 2000 was 52. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Montana was 814 dollars. We round this number to 800. What is the smallest place value to which you can round and get this number?

6. The total land area of Montana is 145,552 square miles and the total water area is 1,490 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Montana is 145,552 square miles and the total water area is 1,490 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Montana was $26,907. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Montana was $29,150. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Montana in 2000 was $22,928. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 22,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Montana ranked number 46. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Montana ranked number 42. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Montana was 2,139 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Montana had 28,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 17,000 homes. We round this number to 20,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Montana in 2003 was 68 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 68 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Montana in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Montana who enrolled in Prekindergarten to Grade 8 was 99,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Montana who enrolled in Grade 9 to Grade 12 was 48,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 450,000 people in Montana voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Montana used 161 trillion BTUs of energy from petroleum and 68 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Montana.

2. The number of square kilometers of land area in Montana is 376,979. The number of square kilometers of water area is 3,859. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 174,000 votes were cast for the Democratic candidate and 266,000 votes were cast for the Republican candidate in Montana. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Montana who voted for the two candidates.

4. The average annual pay in Montana in 2004 was 27,830 dollars and in 2005 was 29,150. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Montana consumed 89 trillion BTUs of energy from hydroelectric power (water) and 161 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Montana in 2003.

6. In 2006, there were 945,000 people living in Montana. In 2000, there were 902,000 people living in Montana. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 70,509 births and 52,472 deaths in Montana. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Montana was 579 dollars. In 2005, the average cost per day was 814 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 81 percent of adults living in Montana were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 240,000 votes cast for the Republican candidate and 137,000 votes cast for the Democratic candidate in Montana in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 145,552 square miles of land in Montana. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,490 square miles of water in Montana. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 28,000 farms in Montana. The average number of acres of land on each farm was 2,133. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Montana by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 28,000 farms in Montana. The average number of acres of land on each farm was 2,139. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Montana.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Montana was 7 people per square mile. There are 145,552 square miles of land in Montana. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 945,000 people living in Montana. In 2000, there were 902,000 people living in Montana. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 70,509 births and 52,472 deaths in Montana. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Montana was 579 dollars. In 2005, the average cost per day was 814 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 81 percent of adults living in Montana were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 25,000 people unemployed in Montana. In 2000, there were 22,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Montana has 1,490 square miles of water area and 147,042 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Montana is water.

3. Montana has 145,552 square miles of land area and 147,042 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Montana is land.

5. Approximately 38.67% of Montana voters chose the Democratic candidate in the 2004 election. A total of 450,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 266,000 citizens in Montana who voted for the Republican candidate in the 2004 presidential election. A total of 450,000 citizens voted. Did more than 55% of the voters in Montana select the Republican candidate?

7. The amount of energy consumed by people in Montana in 2003 that came from petroleum was 161 trillion BTUs. The total amount of energy consumed from all sources was 376 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Montana, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Montana had 28,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Montana to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Montana? (Round your answer to the nearest farm.)

11. There were 60,100,000 acres of farmland in Montana in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Montana?

12. The projected population of Montana in 2020 is 1,022,735 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Montana population to the United States population.

13. In Montana, 18.09% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 376 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Montana in 2000 was $22,928. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $26,789. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 50,000 people in Montana that belonged to labor unions. In 2006, the number of labor union members was 48,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 99,000 patients admitted to hospitals in Montana. Between 2000 and 2005, this number changed by 7.07%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Montana in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Montana was 2,133 in 2000. Between 2000 and 2006, this number changed by 0.28%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Montana in 2006?

18. The average cost per day for a hospital stay in Montana in 2005 was $814. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Montana, 25 had a college degree in 2006. If the number of adults in Montana with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Montana, 91 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Montana between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 8
2. 4
3. 5
4. 9
5. 6
6. 7
7. 0
8. -10858; 0
9. 5
10. 20,000 + 2,000 + 900 + 20 + 8
11. 6
12. 4
13. ones place
14. 5
15. 0
16. 300 + 70 + 6
17. 1
18. thousands place
19. 40,000 + 8,000
20. 4

Rounding Practice Answers

1. 969,000
2. 42,400
3. hundred thousands
4. 30
5. hundreds
6. 145,000
7. 147,100
8. 30,000
9. 34,300
10. hundreds
11. 2500
12. 120
13. 2,000
14. 30,000
15. ten thousands
16. 60 + 8; 70
17. 0; 0
18. 100,000
19. 0
20. 0

Estimation Practice Answers

1. 230 trillion BTUs
2. 381,000 square kilometers of total area
3. 400,000 people voted
4. 56,000 dollars
5. 300 trillion BTUs
6. 0 people
7. 0 more births than deaths
8. 200 dollars
9. 10 percent change
10. 100,000 votes
11. 379,600 square kilometers of land
12. 2,600 square kilometers of water
13. 63,900,000 acres of farmland
14. 64,200,000 acres of farmland
15. 1,022,000 people
16. 1.00 times larger
17. 1.40 times more births than deaths
18. 1.33 times more expensive
19. 1.13 times larger
20. 1.50 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1490/147042
2. 1.01%
3. 145552/147042
4. 98.99%
5. 174,000
6. Yes. 59.1 percent voted Republican.
7. 161/376
8. 43%; 43 BTUs came from petroleum
9. 28,000/2,090,000
10. 0.013; 13 farms
11. 57,095,000
12. 1/336
13. 68 trillion BTUs
14. 16.84%
15. 4% decrease
16. 106,000
17. 2,139
18. 12.29%
19. 50%
20. 1.11% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Nebraska is projected to be 1,768,997 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Nebraska changed by 57,066 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 160,471 births in Nebraska. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Nebraska in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Nebraska was 1,066 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Nebraska is 76,872 square miles and the total water area is 481 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Nebraska is 76,872 square miles and the total water area is 481 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Nebraska was $30,382. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Nebraska. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Nebraska was $32,422. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Nebraska in 2000 was $27,622. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Nebraska ranked number 29. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Nebraska ranked number 29. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Nebraska was 960 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Nebraska had 48,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Nebraska that were sold was 32,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Nebraska in 2003 was 646 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 646 in expanded form.

17. The number of home sales in Nebraska in 2000 was 32,000. What is the digit in the ten thousands place?

18. The number of children in Nebraska who enrolled in Prekindergarten to Grade 8 was 195,000 children in 2004. In what place value is the rightmost 5 in 195,000?

19. The number of children in Nebraska who enrolled in Grade 9 to Grade 12 in 2004 was 91,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 778,000 people in Nebraska voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

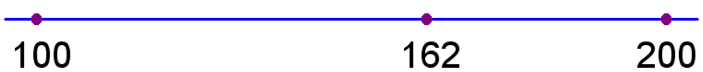
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

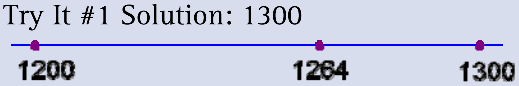


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Nebraska is projected to be 1,768,997 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Nebraska changed by 57,066 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 160,471 births in Nebraska. We round this number to 200,000 . To what place value did we round the number?

4. The number of hospitals in Nebraska in 2000 was 85. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Nebraska was 1,066 dollars. We round this number to 1,100. What is the smallest place value to which you can round and get this number?

6. The total land area of Nebraska is 76,872 square miles and the total water area is 481 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Nebraska is 76,872 square miles and the total water area is 481 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Nebraska was $30,382. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Nebraska was $32,422. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Nebraska in 2000 was $27,622. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 27,600. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Nebraska ranked number 29. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Nebraska ranked number 23. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Nebraska was 960 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Nebraska had 48,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 32,000 homes. We round this number to 30,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Nebraska in 2003 was 119 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 119 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Nebraska in 2003 was 83 trillion BTU. (For some states, this amount will be 0.) Write 83 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Nebraska who enrolled in Prekindergarten to Grade 8 was 195,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Nebraska who enrolled in Grade 9 to Grade 12 was 91,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 778,000 people in Nebraska voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Nebraska used 231 trillion BTUs of energy from petroleum and 119 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Nebraska.

2. The number of square kilometers of land area in Nebraska is 199,099. The number of square kilometers of water area is 1,247. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 254,000 votes were cast for the Democratic candidate and 513,000 votes were cast for the Republican candidate in Nebraska. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Nebraska who voted for the two candidates.

4. The average annual pay in Nebraska in 2004 was 31,507 dollars and in 2005 was 32,422. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Nebraska consumed 10 trillion BTUs of energy from hydroelectric power (water) and 231 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Nebraska in 2003.

6. In 2006, there were 1,768,000 people living in Nebraska. In 2000, there were 1,711,000 people living in Nebraska. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 160,471 births and 94,590 deaths in Nebraska. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Nebraska was 743 dollars. In 2005, the average cost per day was 1,066 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 82 percent of adults living in Nebraska were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 434,000 votes cast for the Republican candidate and 232,000 votes cast for the Democratic candidate in Nebraska in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 76,872 square miles of land in Nebraska. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 481 square miles of water in Nebraska. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 52,000 farms in Nebraska. The average number of acres of land on each farm was 887. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Nebraska by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 48,000 farms in Nebraska. The average number of acres of land on each farm was 960. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Nebraska.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Nebraska was 23 people per square mile. There are 76,872 square miles of land in Nebraska. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,768,000 people living in Nebraska. In 2000, there were 1,711,000 people living in Nebraska. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 160,471 births and 94,590 deaths in Nebraska. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Nebraska was 743 dollars. In 2005, the average cost per day was 1,066 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 82 percent of adults living in Nebraska were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 19,000 people unemployed in Nebraska. In 2000, there were 27,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3{,}794{,}083 \cancel{\text{ square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Nebraska has 481 square miles of water area and 77,354 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Nebraska is water.

3. Nebraska has 76,872 square miles of land area and 77,354 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Nebraska is land.

5. Approximately 32.65% of Nebraska voters chose the Democratic candidate in the 2004 election. A total of 778,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 513,000 citizens in Nebraska who voted for the Republican candidate in the 2004 presidential election. A total of 778,000 citizens voted. Did more than 55% of the voters in Nebraska select the Republican candidate?

7. The amount of energy consumed by people in Nebraska in 2003 that came from petroleum was 231 trillion BTUs. The total amount of energy consumed from all sources was 646 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Nebraska, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Nebraska had 48,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Nebraska to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Nebraska? (Round your answer to the nearest farm.)

11. There were 45,700,000 acres of farmland in Nebraska in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Nebraska?

12. The projected population of Nebraska in 2020 is 1,802,678 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Nebraska population to the United States population.

13. In Nebraska, 18.42% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 646 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Nebraska in 2000 was $27,622. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $30,026. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 81,000 people in Nebraska that belonged to labor unions. In 2006, the number of labor union members was 66,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 209,000 patients admitted to hospitals in Nebraska. Between 2000 and 2005, this number changed by 2.39%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Nebraska in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Nebraska was 887 in 2000. Between 2000 and 2006, this number changed by 8.23%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Nebraska in 2006?

18. The average cost per day for a hospital stay in Nebraska in 2005 was $1,066. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Nebraska, 27 had a college degree in 2006. If the number of adults in Nebraska with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Nebraska, 91 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Nebraska between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 8
2. 0
3. 4
4. 9
5. 1
6. 7
7. 3
8. -7383; 7
9. 8
10. 20,000 + 7,000 + 600 + 20 + 2
11. 9
12. 2
13. ones place
14. 5
15. 1
16. 600 + 40 + 6
17. 3
18. thousands place
19. 90,000 + 1,000
20. 7

Rounding Practice Answers

1. 1,769,000
2. 57,100
3. hundred thousands
4. 60
5. hundreds
6. 77,000
7. 77,400
8. 30,000
9. 37,500
10. hundreds
11. 900
12. 60
13. 900
14. 50,000
15. ten thousands
16. 100 + 10 + 9; 120
17. 80 + 3; 100
18. 200,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 350 trillion BTUs
2. 200,000 square kilometers of total area
3. 700,000 people voted
4. 62,000 dollars
5. 200 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 200,000 votes
11. 200,200 square kilometers of land
12. 0 square kilometers of water
13. 44,500,000 acres of farmland
14. 48,000,000 acres of farmland
15. 1,771,000 people
16. 1.06 times larger
17. 1.78 times more births than deaths
18. 1.57 times more expensive
19. 1.13 times larger
20. 0.67 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 481/77354
2. 0.62%
3. 76872/77354
4. 99.38%
5. 254,000
6. Yes. 65.9 percent voted Republican.
7. 231/646
8. 36%; 36 BTUs came from petroleum
9. 48,000/2,090,000
10. 0.023; 23 farms
11. 43,415,000
12. 2/336
13. 119 trillion BTUs
14. 8.70%
15. 18.52% decrease
16. 214,000
17. 960
18. 9.38%
19. 54%
20. 1.11% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Nevada is projected to be 2,690,531 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Nevada changed by 497,272 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 210,950 births in Nevada. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Nevada in 2006 who were high school graduates was 86%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Nevada was 1,685 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Nevada is 109,826 square miles and the total water area is 735 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Nevada is 109,826 square miles and the total water area is 735 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Nevada was $35,329. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Nevada. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Nevada was $38,763. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Nevada in 2000 was $30,433. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Nevada ranked number 14. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Nevada ranked number 14. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Nevada was 2,100 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Nevada had 3,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Nevada that were sold was 45,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Nevada in 2003 was 654 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 654 in expanded form.

17. The number of home sales in Nevada in 2000 was 45,000. What is the digit in the ten thousands place?

18. The number of children in Nevada who enrolled in Prekindergarten to Grade 8 was 289,000 children in 2004. In what place value is the rightmost 9 in 289,000?

19. The number of children in Nevada who enrolled in Grade 9 to Grade 12 in 2004 was 111,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 830,000 people in Nevada voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

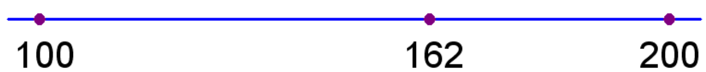
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

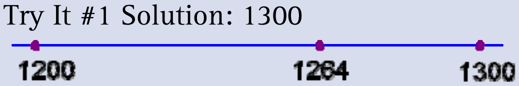


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Nevada is projected to be 2,690,531 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Nevada changed by 497,272 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 210,950 births in Nevada. We round this number to 200,000 . To what place value did we round the number?

4. The number of hospitals in Nevada in 2000 was 22. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Nevada was 1,685 dollars. We round this number to 1,700. What is the smallest place value to which you can round and get this number?

6. The total land area of Nevada is 109,826 square miles and the total water area is 735 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Nevada is 109,826 square miles and the total water area is 735 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Nevada was $35,329. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Nevada was $38,763. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Nevada in 2000 was $30,433. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 30,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Nevada ranked number 14. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Nevada ranked number 17. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Nevada was 2,100 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Nevada had 3,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 45,000 homes. We round this number to 50,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Nevada in 2003 was 190 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 190 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Nevada in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Nevada who enrolled in Prekindergarten to Grade 8 was 289,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Nevada who enrolled in Grade 9 to Grade 12 was 111,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 830,000 people in Nevada voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Nevada used 242 trillion BTUs of energy from petroleum and 190 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Nevada.

2. The number of square kilometers of land area in Nevada is 284,448. The number of square kilometers of water area is 1,903. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 397,000 votes were cast for the Democratic candidate and 419,000 votes were cast for the Republican candidate in Nevada. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Nevada who voted for the two candidates.

4. The average annual pay in Nevada in 2004 was 37,106 dollars and in 2005 was 38,763. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Nevada consumed 18 trillion BTUs of energy from hydroelectric power (water) and 242 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Nevada in 2003.

6. In 2006, there were 2,496,000 people living in Nevada. In 2000, there were 1,998,000 people living in Nevada. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 210,950 births and 107,795 deaths in Nevada. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Nevada was 1,285 dollars. In 2005, the average cost per day was 1,685 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 79 percent of adults living in Nevada were high school graduates. In 2006, the number was 86 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 302,000 votes cast for the Republican candidate and 280,000 votes cast for the Democratic candidate in Nevada in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 109,826 square miles of land in Nevada. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 735 square miles of water in Nevada. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 3,000 farms in Nevada. The average number of acres of land on each farm was 2,065. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Nevada by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 3,000 farms in Nevada. The average number of acres of land on each farm was 2,100. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Nevada.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Nevada was 23 people per square mile. There are 109,826 square miles of land in Nevada. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 2,496,000 people living in Nevada. In 2000, there were 1,998,000 people living in Nevada. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 210,950 births and 107,795 deaths in Nevada. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Nevada was 1,285 dollars. In 2005, the average cost per day was 1,685 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 79 percent of adults living in Nevada were high school graduates. In 2006, the number was 86 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 33,000 people unemployed in Nevada. In 2000, there were 48,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Nevada has 735 square miles of water area and 110,561 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Nevada is water.

3. Nevada has 109,826 square miles of land area and 110,561 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Nevada is land.

5. Approximately 47.83% of Nevada voters chose the Democratic candidate in the 2004 election. A total of 830,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 419,000 citizens in Nevada who voted for the Republican candidate in the 2004 presidential election. A total of 830,000 citizens voted. Did more than 55% of the voters in Nevada select the Republican candidate?

7. The amount of energy consumed by people in Nevada in 2003 that came from petroleum was 242 trillion BTUs. The total amount of energy consumed from all sources was 654 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Nevada, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Nevada had 3,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Nevada to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Nevada? (Round your answer to the nearest farm.)

11. There were 6,300,000 acres of farmland in Nevada in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Nevada?

12. The projected population of Nevada in 2020 is 3,452,283 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Nevada population to the United States population.

13. In Nevada, 29.05% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 654 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Nevada in 2000 was $30,433. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $32,376. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 90,000 people in Nevada that belonged to labor unions. In 2006, the number of labor union members was 167,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 199,000 patients admitted to hospitals in Nevada. Between 2000 and 2005, this number changed by 21.11%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Nevada in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Nevada was 2,065 in 2000. Between 2000 and 2006, this number changed by 1.69%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Nevada in 2006?

18. The average cost per day for a hospital stay in Nevada in 2005 was $1,685. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Nevada, 21 had a college degree in 2006. If the number of adults in Nevada with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Nevada, 86 had a high school diploma in 2006 compared to 83 in 2000. What was the percentage change in the number of adults with high school diplomas in Nevada between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 2
3. 9
4. 8
5. 3
6. 0
7. 0
8. -2436; 2
9. 5
10. 30,000 + 400 + 30 + 3
11. 4
12. 1
13. ones place
14. 0
15. 2
16. 600 + 50 + 4
17. 4
18. thousands place
19. 100,000 + 10,000 + 1,000
20. 8

Rounding Practice Answers

1. 2,691,000
2. 497,300
3. hundred thousands
4. 20
5. hundreds
6. 109,000
7. 110,500
8. 40,000
9. 43,900
10. hundreds
11. 100
12. 60
13. 2,000
14. 0
15. ten thousands
16. 100 + 90; 190
17. 0; 0
18. 290,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 430 trillion BTUs
2. 286,000 square kilometers of total area
3. 700,000 people voted
4. 74,000 dollars
5. 200 trillion BTUs
6. 500,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 0 votes
11. 286,000 square kilometers of land
12. 2,600 square kilometers of water
13. 0 acres of farmland
14. 0 acres of farmland
15. 2,530,000 people
16. 1.25 times larger
17. 1.91 times more births than deaths
18. 1.31 times more expensive
19. 1.13 times larger
20. 0.60 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 735/110561
2. 0.66%
3. 109826/110561
4. 99.34%
5. 397,000
6. No. 50.5 percent voted Republican.
7. 242/654
8. 37%; 37 BTUs came from petroleum
9. 3,000/2,090,000
10. 0.001; 1 farm
11. 5,985,000
12. 3/336
13. 190 trillion BTUs
14. 6.38%
15. 85.56% increase
16. 241,000
17. 2,100
18. 5.93%
19. 42%
20. 3.61% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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  - One activity book per US state focusing on place value, rounding, estimation, and understanding fractions and percents.

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Make It Real Learning

States by the Numbers

place value
rounding
estimation
fractions
percents

New Hampshire

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of New Hampshire is projected to be 1,385,560 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of New Hampshire changed by 79,109 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 90,680 births in New Hampshire. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in New Hampshire in 2006 who were high school graduates was 92%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in New Hampshire was 1,627 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of New Hampshire is 8,968 square miles and the total water area is 382 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of New Hampshire is 8,968 square miles and the total water area is 382 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in New Hampshire was $37,321. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in New Hampshire. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in New Hampshire was $40,551. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in New Hampshire in 2000 was $33,393. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New Hampshire ranked number 6. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New Hampshire ranked number 6. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in New Hampshire was 132 acres. What is the place value furthest to the right that contains the number 2?

14. In 2006, New Hampshire had 3,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in New Hampshire that were sold was 27,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in New Hampshire in 2003 was 328 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 328 in expanded form.

17. The number of home sales in New Hampshire in 2000 was 27,000. What is the digit in the ten thousands place?

18. The number of children in New Hampshire who enrolled in Prekindergarten to Grade 8 was 140,000 children in 2004. In what place value is the rightmost 0 in 140,000?

19. The number of children in New Hampshire who enrolled in Grade 9 to Grade 12 in 2004 was 67,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 678,000 people in New Hampshire voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

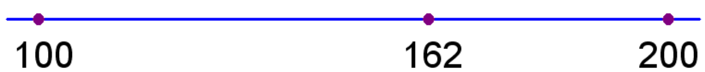
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

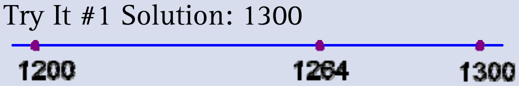


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of New Hampshire is projected to be 1,385,560 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of New Hampshire changed by 79,109 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 90,680 births in New Hampshire. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in New Hampshire in 2000 was 28. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in New Hampshire was 1,627 dollars. We round this number to 1,600. What is the smallest place value to which you can round and get this number?

6. The total land area of New Hampshire is 8,968 square miles and the total water area is 382 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of New Hampshire is 8,968 square miles and the total water area is 382 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in New Hampshire was $37,321. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in New Hampshire was $40,551. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in New Hampshire in 2000 was $33,393. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 33,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New Hampshire ranked number 6. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New Hampshire ranked number 7. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in New Hampshire was 132 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, New Hampshire had 3,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 27,000 homes. We round this number to 30,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in New Hampshire in 2003 was 55 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 55 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in New Hampshire in 2003 was 97 trillion BTU. (For some states, this amount will be 0.) Write 97 in expanded form. Then round the number to the nearest hundred.

18. The number of children in New Hampshire who enrolled in Prekindergarten to Grade 8 was 140,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in New Hampshire who enrolled in Grade 9 to Grade 12 was 67,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 678,000 people in New Hampshire voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, New Hampshire used 198 trillion BTUs of energy from petroleum and 55 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in New Hampshire.

2. The number of square kilometers of land area in New Hampshire is 23,227. The number of square kilometers of water area is 989. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 341,000 votes were cast for the Democratic candidate and 331,000 votes were cast for the Republican candidate in New Hampshire. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in New Hampshire who voted for the two candidates.

4. The average annual pay in New Hampshire in 2004 was 39,176 dollars and in 2005 was 40,551. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in New Hampshire consumed 14 trillion BTUs of energy from hydroelectric power (water) and 198 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in New Hampshire in 2003.

6. In 2006, there were 1,315,000 people living in New Hampshire. In 2000, there were 1,236,000 people living in New Hampshire. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 90,680 births and 62,189 deaths in New Hampshire. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in New Hampshire was 1,201 dollars. In 2005, the average cost per day was 1,627 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 82 percent of adults living in New Hampshire were high school graduates. In 2006, the number was 92 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 274,000 votes cast for the Republican candidate and 266,000 votes cast for the Democratic candidate in New Hampshire in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 8,968 square miles of land in New Hampshire. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 382 square miles of water in New Hampshire. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 3,000 farms in New Hampshire. The average number of acres of land on each farm was 133. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New Hampshire by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 3,000 farms in New Hampshire. The average number of acres of land on each farm was 132. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New Hampshire.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of New Hampshire was 147 people per square mile. There are 8,968 square miles of land in New Hampshire. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,315,000 people living in New Hampshire. In 2000, there were 1,236,000 people living in New Hampshire. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 90,680 births and 62,189 deaths in New Hampshire. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in New Hampshire was 1,201 dollars. In 2005, the average cost per day was 1,627 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 82 percent of adults living in New Hampshire were high school graduates. In 2006, the number was 92 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 35,000 people unemployed in New Hampshire. In 2000, there were 19,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3,794,083 \cancel{\text{ square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. New Hampshire has 382 square miles of water area and 9,350 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of New Hampshire is water.

3. New Hampshire has 8,968 square miles of land area and 9,350 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of New Hampshire is land.

5. Approximately 50.29% of New Hampshire voters chose the Democratic candidate in the 2004 election. A total of 678,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 331,000 citizens in New Hampshire who voted for the Republican candidate in the 2004 presidential election. A total of 678,000 citizens voted. Did more than 55% of the voters in New Hampshire select the Republican candidate?

7. The amount of energy consumed by people in New Hampshire in 2003 that came from petroleum was 198 trillion BTUs. The total amount of energy consumed from all sources was 328 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in New Hampshire, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. New Hampshire had 3,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in New Hampshire to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in New Hampshire? (Round your answer to the nearest farm.)

11. There were 450,000 acres of farmland in New Hampshire in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in New Hampshire?

12. The projected population of New Hampshire in 2020 is 1,524,751 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the New Hampshire population to the United States population.

13. In New Hampshire, 16.77% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 328 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in New Hampshire in 2000 was $33,393. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $34,316. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 49,000 people in New Hampshire that belonged to labor unions. In 2006, the number of labor union members was 63,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 111,000 patients admitted to hospitals in New Hampshire. Between 2000 and 2005, this number changed by 5.41%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in New Hampshire in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in New Hampshire was 133 in 2000. Between 2000 and 2006, this number changed by -0.75%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in New Hampshire in 2006?

18. The average cost per day for a hospital stay in New Hampshire in 2005 was $1,627. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in New Hampshire, 32 had a college degree in 2006. If the number of adults in New Hampshire with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in New Hampshire, 92 had a high school diploma in 2006 compared to 88 in 2000. What was the percentage change in the number of adults with high school diplomas in New Hampshire between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 5
2. 1
3. 7
4. 9
5. 2
6. 9
7. 5
8. -444; 0
9. 7
10. 30,000 + 3,000 + 300 + 90 + 3
11. 6
12. 0
13. ones place
14. 0
15. 1
16. 300 + 20 + 8
17. 2
18. thousands place
19. 60,000 + 7,000
20. 6

Rounding Practice Answers

1. 1,386,000
2. 79,100
3. hundred thousands
4. 80
5. hundreds
6. 9,000
7. 9,400
8. 40,000
9. 45,700
10. hundreds
11. 100
12. 30
13. 0
14. 0
15. ten thousands
16. 50 + 5; 60
17. 90 + 7; 100
18. 140,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 260 trillion BTUs
2. 24,000 square kilometers of total area
3. 600,000 people voted
4. 78,000 dollars
5. 200 trillion BTUs
6. 100,000 people
7. 0 more births than deaths
8. 400 dollars
9. 10 percent change
10. 0 votes
11. 23,400 square kilometers of land
12. 0 square kilometers of water
13. 0 acres of farmland
14. 0 acres of farmland
15. 1,323,000 people
16. 1.08 times larger
17. 1.50 times more births than deaths
18. 1.33 times more expensive
19. 1.13 times larger
20. 2.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 382/9350
2. 4.09%
3. 8968/9350
4. 95.91%
5. 341,000
6. No. 48.8 percent voted Republican.
7. 198/328
8. 60%; 60 BTUs came from petroleum
9. 3,000/2,090,000
10. 0.001; 1 farm
11. 428,000
12. 2/336
13. 55 trillion BTUs
14. 2.76%
15. 28.57% increase
16. 117,000
17. 132
18. 6.15%
19. 64%
20. 4.55% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of New Jersey is projected to be 9,018,231 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of New Jersey changed by 310,213 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 705,812 births in New Jersey. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in New Jersey in 2006 who were high school graduates was 87%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in New Jersey was 1,797 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of New Jersey is 7,417 square miles and the total water area is 1,304 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of New Jersey is 7,417 square miles and the total water area is 1,304 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in New Jersey was $46,351. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in New Jersey. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in New Jersey was $49,471. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in New Jersey in 2000 was $38,362. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New Jersey ranked number 2. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New Jersey ranked number 2. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in New Jersey was 81 acres. What is the place value furthest to the right that contains the number 1?

14. In 2006, New Jersey had 10,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in New Jersey that were sold was 161,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in New Jersey in 2003 was 2,578 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 2,578 in expanded form.

17. The number of home sales in New Jersey in 2000 was 161,000. What is the digit in the ten thousands place?

18. The number of children in New Jersey who enrolled in Prekindergarten to Grade 8 was 976,000 children in 2004. In what place value is the rightmost 6 in 976,000?

19. The number of children in New Jersey who enrolled in Grade 9 to Grade 12 in 2004 was 417,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 3,612,000 people in New Jersey voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

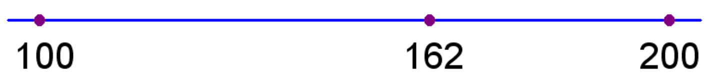
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

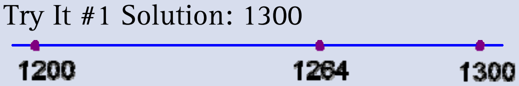


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of New Jersey is projected to be 9,018,231 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of New Jersey changed by 310,213 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 705,812 births in New Jersey. We round this number to 700,000 . To what place value did we round the number?

4. The number of hospitals in New Jersey in 2000 was 80. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in New Jersey was 1,797 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of New Jersey is 7,417 square miles and the total water area is 1,304 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of New Jersey is 7,417 square miles and the total water area is 1,304 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in New Jersey was $46,351. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in New Jersey was $49,471. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in New Jersey in 2000 was $38,362. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 38,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New Jersey ranked number 2. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New Jersey ranked number 2. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in New Jersey was 81 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, New Jersey had 10,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 161,000 homes. We round this number to 160,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in New Jersey in 2003 was 639 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 639 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in New Jersey in 2003 was 310 trillion BTU. (For some states, this amount will be 0.) Write 310 in expanded form. Then round the number to the nearest hundred.

18. The number of children in New Jersey who enrolled in Prekindergarten to Grade 8 was 976,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in New Jersey who enrolled in Grade 9 to Grade 12 was 417,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 3,612,000 people in New Jersey voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, New Jersey used 1,233 trillion BTUs of energy from petroleum and 639 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in New Jersey.

2. The number of square kilometers of land area in New Jersey is 19,211. The number of square kilometers of water area is 3,377. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,911,000 votes were cast for the Democratic candidate and 1,670,000 votes were cast for the Republican candidate in New Jersey. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in New Jersey who voted for the two candidates.

4. The average annual pay in New Jersey in 2004 was 48,064 dollars and in 2005 was 49,471. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in New Jersey consumed 0 trillion BTUs of energy from hydroelectric power (water) and 1,233 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in New Jersey in 2003.

6. In 2006, there were 8,725,000 people living in New Jersey. In 2000, there were 8,414,000 people living in New Jersey. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 705,812 births and 451,046 deaths in New Jersey. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in New Jersey was 1,299 dollars. In 2005, the average cost per day was 1,797 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 77 percent of adults living in New Jersey were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,284,000 votes cast for the Republican candidate and 1,789,000 votes cast for the Democratic candidate in New Jersey in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 7,417 square miles of land in New Jersey. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,304 square miles of water in New Jersey. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 10,000 farms in New Jersey. The average number of acres of land on each farm was 86. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New Jersey by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 10,000 farms in New Jersey. The average number of acres of land on each farm was 81. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New Jersey.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of New Jersey was 1,176 people per square mile. There are 7,417 square miles of land in New Jersey. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 8,725,000 people living in New Jersey. In 2000, there were 8,414,000 people living in New Jersey. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 705,812 births and 451,046 deaths in New Jersey. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in New Jersey was 1,299 dollars. In 2005, the average cost per day was 1,797 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 77 percent of adults living in New Jersey were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 208,000 people unemployed in New Jersey. In 2000, there were 157,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3,794,083 \ \cancel{\text{square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. New Jersey has 1,304 square miles of water area and 8,721 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of New Jersey is water.

3. New Jersey has 7,417 square miles of land area and 8,721 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of New Jersey is land.

5. Approximately 52.91% of New Jersey voters chose the Democratic candidate in the 2004 election. A total of 3,612,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,670,000 citizens in New Jersey who voted for the Republican candidate in the 2004 presidential election. A total of 3,612,000 citizens voted. Did more than 55% of the voters in New Jersey select the Republican candidate?

7. The amount of energy consumed by people in New Jersey in 2003 that came from petroleum was 1,233 trillion BTUs. The total amount of energy consumed from all sources was 2,578 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in New Jersey, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. New Jersey had 10,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in New Jersey to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in New Jersey? (Round your answer to the nearest farm.)

11. There were 790,000 acres of farmland in New Jersey in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in New Jersey?

12. The projected population of New Jersey in 2020 is 9,461,635 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the New Jersey population to the United States population.

13. In New Jersey, 24.79% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 2,578 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in New Jersey in 2000 was $38,362. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $40,455. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 822,000 people in New Jersey that belonged to labor unions. In 2006, the number of labor union members was 770,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 1,074,000 patients admitted to hospitals in New Jersey. Between 2000 and 2005, this number changed by 3.35%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in New Jersey in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in New Jersey was 86 in 2000. Between 2000 and 2006, this number changed by -5.81%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in New Jersey in 2006?

18. The average cost per day for a hospital stay in New Jersey in 2005 was $1,797. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in New Jersey, 36 had a college degree in 2006. If the number of adults in New Jersey with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in New Jersey, 87 had a high school diploma in 2006 compared to 87 in 2000. What was the percentage change in the number of adults with high school diplomas in New Jersey between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 8
2. 2
3. 8
4. 8
5. 5
6. 8
7. 1
8. 8586; 8
9. 5
10. 30,000 + 8,000 + 300 + 60 + 2
11. 2
12. 0
13. ones place
14. 7
15. 8
16. 2,000 + 500 + 70 + 8
17. 6
18. thousands place
19. 400,000 + 10,000 + 7,000
20. 3

Rounding Practice Answers

1. 9,018,000
2. 310,200
3. hundred thousands
4. 10
5. hundreds
6. 6,000
7. 8,700
8. 50,000
9. 54,600
10. hundreds
11. 0
12. 0
13. 0
14. 10,000
15. ten thousands
16. 600 + 30 + 9; 640
17. 300 + 10; 300
18. 980,000
19. 400,000
20. 4,000,000

Estimation Practice Answers

1. 1870 trillion BTUs
2. 22,000 square kilometers of total area
3. 3,500,000 people voted
4. 95,000 dollars
5. 1200 trillion BTUs
6. 300,000 people
7. 200,000 more births than deaths
8. 500 dollars
9. 10 percent change
10. 500,000 votes
11. 18,200 square kilometers of land
12. 2,600 square kilometers of water
13. 900,000 acres of farmland
14. 800,000 acres of farmland
15. 8,232,000 people
16. 1.04 times larger
17. 1.58 times more births than deaths
18. 1.38 times more expensive
19. 1.13 times larger
20. 1.31 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1304/8721
2. 14.95%
3. 7417/8721
4. 85.05%
5. 1,911,000
6. No. 46.2 percent voted Republican.
7. 1233/2578
8. 48%; 48 BTUs came from petroleum
9. 10,000/2,090,000
10. 0.005; 5 farms
11. 751,000
12. 9/336
13. 639 trillion BTUs
14. 5.46%
15. 6.33% decrease
16. 1,110,000
17. 81
18. 5.56%
19. 72%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of New Mexico is projected to be 1,980,225 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of New Mexico changed by 135,553 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 174,378 births in New Mexico. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in New Mexico in 2006 who were high school graduates was 82%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in New Mexico was 1,780 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of New Mexico is 121,356 square miles and the total water area is 234 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of New Mexico is 121,356 square miles and the total water area is 234 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in New Mexico was $30,202. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in New Mexico. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in New Mexico was $32,605. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in New Mexico in 2000 was $22,133. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New Mexico ranked number 47. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New Mexico ranked number 47. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in New Mexico was 2,543 acres. What is the place value furthest to the right that contains the number 3?

14. In 2006, New Mexico had 18,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in New Mexico that were sold was 30,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in New Mexico in 2003 was 663 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 663 in expanded form.

17. The number of home sales in New Mexico in 2000 was 30,000. What is the digit in the ten thousands place?

18. The number of children in New Mexico who enrolled in Prekindergarten to Grade 8 was 228,000 children in 2004. In what place value is the rightmost 8 in 228,000?

19. The number of children in New Mexico who enrolled in Grade 9 to Grade 12 in 2004 was 98,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 756,000 people in New Mexico voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

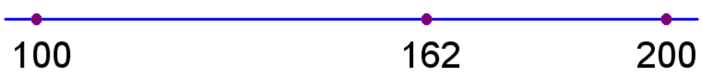
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

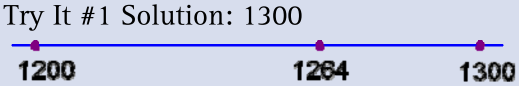


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of New Mexico is projected to be 1,980,225 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of New Mexico changed by 135,553 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 174,378 births in New Mexico. We round this number to 200,000 . To what place value did we round the number?

4. The number of hospitals in New Mexico in 2000 was 35. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in New Mexico was 1,780 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of New Mexico is 121,356 square miles and the total water area is 234 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of New Mexico is 121,356 square miles and the total water area is 234 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in New Mexico was $30,202. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in New Mexico was $32,605. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in New Mexico in 2000 was $22,133. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 22,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New Mexico ranked number 47. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New Mexico ranked number 44. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in New Mexico was 2,543 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, New Mexico had 18,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 30,000 homes. We round this number to 30,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in New Mexico in 2003 was 234 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 234 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in New Mexico in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in New Mexico who enrolled in Prekindergarten to Grade 8 was 228,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in New Mexico who enrolled in Grade 9 to Grade 12 was 98,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 756,000 people in New Mexico voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, New Mexico used 250 trillion BTUs of energy from petroleum and 234 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in New Mexico.

2. The number of square kilometers of land area in New Mexico is 314,309. The number of square kilometers of water area is 606. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 371,000 votes were cast for the Democratic candidate and 377,000 votes were cast for the Republican candidate in New Mexico. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in New Mexico who voted for the two candidates.

4. The average annual pay in New Mexico in 2004 was 31,411 dollars and in 2005 was 32,605. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in New Mexico consumed 2 trillion BTUs of energy from hydroelectric power (water) and 250 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in New Mexico in 2003.

6. In 2006, there were 1,955,000 people living in New Mexico. In 2000, there were 1,819,000 people living in New Mexico. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 174,378 births and 89,316 deaths in New Mexico. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in New Mexico was 1,388 dollars. In 2005, the average cost per day was 1,780 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 75 percent of adults living in New Mexico were high school graduates. In 2006, the number was 82 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 286,000 votes cast for the Republican candidate and 287,000 votes cast for the Democratic candidate in New Mexico in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 121,356 square miles of land in New Mexico. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 234 square miles of water in New Mexico. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 18,000 farms in New Mexico. The average number of acres of land on each farm was 2,494. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New Mexico by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 18,000 farms in New Mexico. The average number of acres of land on each farm was 2,543. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New Mexico.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of New Mexico was 16 people per square mile. There are 121,356 square miles of land in New Mexico. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,955,000 people living in New Mexico. In 2000, there were 1,819,000 people living in New Mexico. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 174,378 births and 89,316 deaths in New Mexico. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in New Mexico was 1,388 dollars. In 2005, the average cost per day was 1,780 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 75 percent of adults living in New Mexico were high school graduates. In 2006, the number was 82 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 48,000 people unemployed in New Mexico. In 2000, there were 42,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. New Mexico has 234 square miles of water area and 121,590 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of New Mexico is water.

3. New Mexico has 121,356 square miles of land area and 121,590 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of New Mexico is land.

5. Approximately 49.07% of New Mexico voters chose the Democratic candidate in the 2004 election. A total of 756,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 377,000 citizens in New Mexico who voted for the Republican candidate in the 2004 presidential election. A total of 756,000 citizens voted. Did more than 55% of the voters in New Mexico select the Republican candidate?

7. The amount of energy consumed by people in New Mexico in 2003 that came from petroleum was 250 trillion BTUs. The total amount of energy consumed from all sources was 663 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in New Mexico, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. New Mexico had 18,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in New Mexico to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in New Mexico? (Round your answer to the nearest farm.)

11. There were 44,500,000 acres of farmland in New Mexico in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in New Mexico?

12. The projected population of New Mexico in 2020 is 2,084,341 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the New Mexico population to the United States population.

13. In New Mexico, 35.29% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 663 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in New Mexico in 2000 was $22,133. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $25,903. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 53,000 people in New Mexico that belonged to labor unions. In 2006, the number of labor union members was 62,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 174,000 patients admitted to hospitals in New Mexico. Between 2000 and 2005, this number changed by -1.15%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in New Mexico in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in New Mexico was 2,494 in 2000. Between 2000 and 2006, this number changed by 1.96%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in New Mexico in 2006?

18. The average cost per day for a hospital stay in New Mexico in 2005 was $1,780. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in New Mexico, 27 had a college degree in 2006. If the number of adults in New Mexico with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in New Mexico, 82 had a high school diploma in 2006 compared to 82 in 2000. What was the percentage change in the number of adults with high school diplomas in New Mexico between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 5
3. 5
4. 8
5. 5
6. 1
7. 1
8. -7563; 7
9. 9
10. 20,000 + 2,000 + 100 + 30 + 3
11. 7
12. 4
13. ones place
14. 5
15. 1
16. 600 + 60 + 3
17. 3
18. thousands place
19. 90,000 + 8,000
20. 7

Rounding Practice Answers

1. 1,980,000
2. 135,600
3. hundred thousands
4. 50
5. hundreds
6. 121,000
7. 121,600
8. 30,000
9. 37,700
10. hundreds
11. 2500
12. 120
13. 2,400
14. 20,000
15. ten thousands
16. 200 + 30 + 4; 230
17. 0; 0
18. 230,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 480 trillion BTUs
2. 315,000 square kilometers of total area
3. 700,000 people voted
4. 63,000 dollars
5. 300 trillion BTUs
6. 200,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 0 percent change
10. 0 votes
11. 314,600 square kilometers of land
12. 0 square kilometers of water
13. 49,800,000 acres of farmland
14. 50,800,000 acres of farmland
15. 1,936,000 people
16. 1.11 times larger
17. 1.89 times more births than deaths
18. 1.29 times more expensive
19. 1.00 times larger
20. 1.25 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 234/121590
2. 0.19%
3. 121356/121590
4. 99.81%
5. 371,000
6. No. 49.9 percent voted Republican.
7. 250/663
8. 38%; 38 BTUs came from petroleum
9. 18,000/2,090,000
10. 0.009; 9 farms
11. 42,275,000
12. 2/336
13. 234 trillion BTUs
14. 17.03%
15. 16.98% increase
16. 172,000
17. 2,543
18. 5.62%
19. 54%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of New York is projected to be 19,443,672 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of New York changed by 329,362 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 1,576,125 births in New York. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in New York in 2006 who were high school graduates was 85%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in New York was 1,539 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of New York is 47,214 square miles and the total water area is 7,342 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of New York is 47,214 square miles and the total water area is 7,342 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in New York was $47,247. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in New York. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in New York was $51,937. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in New York in 2000 was $34,895. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New York ranked number 4. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New York ranked number 4. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in New York was 214 acres. What is the place value furthest to the right that contains the number 4?

14. In 2006, New York had 35,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in New York that were sold was 273,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in New York in 2003 was 4,221 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 4,221 in expanded form.

17. The number of home sales in New York in 2000 was 273,000. What is the digit in the ten thousands place?

18. The number of children in New York who enrolled in Prekindergarten to Grade 8 was 1,943,000 children in 2004. In what place value is the rightmost 3 in 1,943,000?

19. The number of children in New York who enrolled in Grade 9 to Grade 12 in 2004 was 893,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 7,448,000 people in New York voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

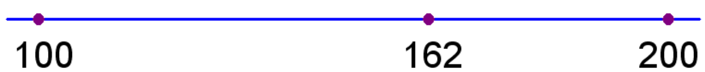
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

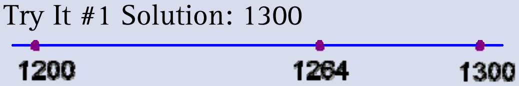


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of New York is projected to be 19,443,672 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of New York changed by 329,362 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 1,576,125 births in New York. We round this number to 1,600,000 . To what place value did we round the number?

4. The number of hospitals in New York in 2000 was 215. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in New York was 1,539 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of New York is 47,214 square miles and the total water area is 7,342 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of New York is 47,214 square miles and the total water area is 7,342 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in New York was $47,247. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in New York was $51,937. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in New York in 2000 was $34,895. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 34,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, New York ranked number 4. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, New York ranked number 5. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in New York was 214 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, New York had 35,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 273,000 homes. We round this number to 270,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in New York in 2003 was 1,179 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 1,179 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in New York in 2003 was 424 trillion BTU. (For some states, this amount will be 0.) Write 424 in expanded form. Then round the number to the nearest hundred.

18. The number of children in New York who enrolled in Prekindergarten to Grade 8 was 1,943,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in New York who enrolled in Grade 9 to Grade 12 was 893,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 7,448,000 people in New York voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, New York used 1,776 trillion BTUs of energy from petroleum and 1,179 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in New York.

2. The number of square kilometers of land area in New York is 122,283. The number of square kilometers of water area is 19,016. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 4,181,000 votes were cast for the Democratic candidate and 2,807,000 votes were cast for the Republican candidate in New York. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in New York who voted for the two candidates.

4. The average annual pay in New York in 2004 was 49,941 dollars and in 2005 was 51,937. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in New York consumed 249 trillion BTUs of energy from hydroelectric power (water) and 1,776 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in New York in 2003.

6. In 2006, there were 19,306,000 people living in New York. In 2000, there were 18,976,000 people living in New York. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 1,576,125 births and 974,346 deaths in New York. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in New York was 1,118 dollars. In 2005, the average cost per day was 1,539 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 75 percent of adults living in New York were high school graduates. In 2006, the number was 85 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 2,403,000 votes cast for the Republican candidate and 4,108,000 votes cast for the Democratic candidate in New York in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 47,214 square miles of land in New York. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 7,342 square miles of water in New York. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 38,000 farms in New York. The average number of acres of land on each farm was 205. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New York by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 35,000 farms in New York. The average number of acres of land on each farm was 214. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in New York.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of New York was 409 people per square mile. There are 47,214 square miles of land in New York. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 19,306,000 people living in New York. In 2000, there were 18,976,000 people living in New York. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 1,576,125 births and 974,346 deaths in New York. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in New York was 1,118 dollars. In 2005, the average cost per day was 1,539 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 75 percent of adults living in New York were high school graduates. In 2006, the number was 85 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 469,000 people unemployed in New York. In 2000, there were 416,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of}} \text{ area}} \times 3{,}794{,}083 \ \cancel{\text{square miles of}} \text{ area} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. New York has 7,342 square miles of water area and 54,556 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of New York is water.

3. New York has 47,214 square miles of land area and 54,556 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of New York is land.

5. Approximately 56.14% of New York voters chose the Democratic candidate in the 2004 election. A total of 7,448,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 2,807,000 citizens in New York who voted for the Republican candidate in the 2004 presidential election. A total of 7,448,000 citizens voted. Did more than 55% of the voters in New York select the Republican candidate?

7. The amount of energy consumed by people in New York in 2003 that came from petroleum was 1,776 trillion BTUs. The total amount of energy consumed from all sources was 4,221 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in New York, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. New York had 35,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in New York to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in New York? (Round your answer to the nearest farm.)

11. There were 7,500,000 acres of farmland in New York in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in New York?

12. The projected population of New York in 2020 is 19,576,920 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the New York population to the United States population.

13. In New York, 27.93% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 4,221 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in New York in 2000 was $34,895. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $37,005. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 2,156,000 people in New York that belonged to labor unions. In 2006, the number of labor union members was 1,981,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 2,416,000 patients admitted to hospitals in New York. Between 2000 and 2005, this number changed by 5.05%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in New York in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in New York was 205 in 2000. Between 2000 and 2006, this number changed by 4.39%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in New York in 2006?

18. The average cost per day for a hospital stay in New York in 2005 was $1,539. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in New York, 32 had a college degree in 2006. If the number of adults in New York with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in New York, 85 had a high school diploma in 2006 compared to 83 in 2000. What was the percentage change in the number of adults with high school diplomas in New York between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 3
2. 3
3. 5
4. 8
5. 0
6. 4
7. 8
8. 9482; 9
9. 8
10. 30,000 + 4,000 + 800 + 90 + 5
11. 4
12. 0
13. ones place
14. 2
15. 3
16. 4,000 + 200 + 20 + 1
17. 7
18. thousands place
19. 800,000 + 90,000 + 3,000
20. 7

Rounding Practice Answers

1. 19,444,000
2. 329,400
3. hundred thousands
4. 510
5. hundreds
6. 40,000
7. 54,500
8. 50,000
9. 57,000
10. hundreds
11. 0
12. 30
13. 100
14. 40,000
15. ten thousands
16. 1,000 + 100 + 70 + 9; 1180
17. 400 + 20 + 4; 400
18. 1,940,000
19. 900,000
20. 7,000,000

Estimation Practice Answers

1. 2960 trillion BTUs
2. 141,000 square kilometers of total area
3. 6,900,000 people voted
4. 99,000 dollars
5. 2000 trillion BTUs
6. 300,000 people
7. 600,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 1,700,000 votes
11. 122,200 square kilometers of land
12. 18,200 square kilometers of water
13. 8,400,000 acres of farmland
14. 8,400,000 acres of farmland
15. 19,223,000 people
16. 1.02 times larger
17. 1.63 times more births than deaths
18. 1.36 times more expensive
19. 1.13 times larger
20. 1.12 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 7342/54556
2. 13.46%
3. 47214/54556
4. 86.54%
5. 4,181,000
6. No. 37.7 percent voted Republican.
7. 1776/4221
8. 42%; 42 BTUs came from petroleum
9. 35,000/2,090,000
10. 0.017; 17 farms
11. 7,125,000
12. 20/336
13. 1179 trillion BTUs
14. 6.05%
15. 8.12% decrease
16. 2,538,000
17. 214
18. 6.50%
19. 64%
20. 2.41% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

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We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1

For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of North Carolina is projected to be 9,345,823 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of North Carolina changed by 810,014 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 749,959 births in North Carolina. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in North Carolina in 2006 who were high school graduates was 84%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in North Carolina was 1,320 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of North Carolina is 48,711 square miles and the total water area is 5,108 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of North Carolina is 48,711 square miles and the total water area is 5,108 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in North Carolina was $33,532. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in North Carolina. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in North Carolina was $35,912. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in North Carolina in 2000 was $27,067. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, North Carolina ranked number 32. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, North Carolina ranked number 32. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in North Carolina was 183 acres. What is the place value furthest to the right that contains the number 3?

14. In 2006, North Carolina had 48,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in North Carolina that were sold was 134,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in North Carolina in 2003 was 2,644 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 2,644 in expanded form.

17. The number of home sales in North Carolina in 2000 was 134,000. What is the digit in the ten thousands place?

18. The number of children in North Carolina who enrolled in Prekindergarten to Grade 8 was 986,000 children in 2004. In what place value is the rightmost 6 in 986,000?

19. The number of children in North Carolina who enrolled in Grade 9 to Grade 12 in 2004 was 400,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 3,501,000 people in North Carolina voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

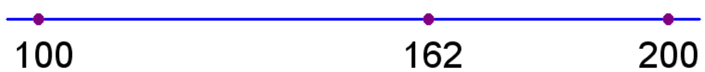
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

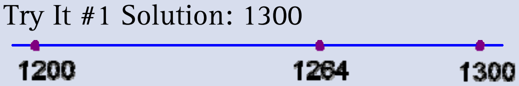


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of North Carolina is projected to be 9,345,823 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of North Carolina changed by 810,014 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 749,959 births in North Carolina. We round this number to 700,000 . To what place value did we round the number?

4. The number of hospitals in North Carolina in 2000 was 113. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in North Carolina was 1,320 dollars. We round this number to 1,300. What is the smallest place value to which you can round and get this number?

6. The total land area of North Carolina is 48,711 square miles and the total water area is 5,108 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of North Carolina is 48,711 square miles and the total water area is 5,108 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in North Carolina was $33,532. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in North Carolina was $35,912. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in North Carolina in 2000 was $27,067. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 27,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, North Carolina ranked number 32. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, North Carolina ranked number 36. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in North Carolina was 183 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, North Carolina had 48,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 134,000 homes. We round this number to 130,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in North Carolina in 2003 was 228 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 228 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in North Carolina in 2003 was 426 trillion BTU. (For some states, this amount will be 0.) Write 426 in expanded form. Then round the number to the nearest hundred.

18. The number of children in North Carolina who enrolled in Prekindergarten to Grade 8 was 986,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in North Carolina who enrolled in Grade 9 to Grade 12 was 400,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 3,501,000 people in North Carolina voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, North Carolina used 947 trillion BTUs of energy from petroleum and 228 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in North Carolina.

2. The number of square kilometers of land area in North Carolina is 126,161. The number of square kilometers of water area is 13,229. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,526,000 votes were cast for the Democratic candidate and 1,961,000 votes were cast for the Republican candidate in North Carolina. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in North Carolina who voted for the two candidates.

4. The average annual pay in North Carolina in 2004 was 34,791 dollars and in 2005 was 35,912. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in North Carolina consumed 74 trillion BTUs of energy from hydroelectric power (water) and 947 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in North Carolina in 2003.

6. In 2006, there were 8,857,000 people living in North Carolina. In 2000, there were 8,049,000 people living in North Carolina. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 749,959 births and 456,198 deaths in North Carolina. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in North Carolina was 1,061 dollars. In 2005, the average cost per day was 1,320 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 70 percent of adults living in North Carolina were high school graduates. In 2006, the number was 84 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,631,000 votes cast for the Republican candidate and 1,258,000 votes cast for the Democratic candidate in North Carolina in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 48,711 square miles of land in North Carolina. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 5,108 square miles of water in North Carolina. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 56,000 farms in North Carolina. The average number of acres of land on each farm was 166. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in North Carolina by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 48,000 farms in North Carolina. The average number of acres of land on each farm was 183. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in North Carolina.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of North Carolina was 182 people per square mile. There are 48,711 square miles of land in North Carolina. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 8,857,000 people living in North Carolina. In 2000, there were 8,049,000 people living in North Carolina. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 749,959 births and 456,198 deaths in North Carolina. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in North Carolina was 1,061 dollars. In 2005, the average cost per day was 1,320 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 70 percent of adults living in North Carolina were high school graduates. In 2006, the number was 84 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 145,000 people unemployed in North Carolina. In 2000, there were 155,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. North Carolina has 5,108 square miles of water area and 53,819 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of North Carolina is water.

3. North Carolina has 48,711 square miles of land area and 53,819 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of North Carolina is land.

5. Approximately 43.59% of North Carolina voters chose the Democratic candidate in the 2004 election. A total of 3,501,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,961,000 citizens in North Carolina who voted for the Republican candidate in the 2004 presidential election. A total of 3,501,000 citizens voted. Did more than 55% of the voters in North Carolina select the Republican candidate?

7. The amount of energy consumed by people in North Carolina in 2003 that came from petroleum was 947 trillion BTUs. The total amount of energy consumed from all sources was 2,644 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in North Carolina, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. North Carolina had 48,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in North Carolina to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in North Carolina? (Round your answer to the nearest farm.)

11. There were 8,800,000 acres of farmland in North Carolina in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in North Carolina?

12. The projected population of North Carolina in 2020 is 10,709,289 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the North Carolina population to the United States population.

13. In North Carolina, 8.62% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 2,644 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in North Carolina in 2000 was $27,067. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,138. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 179,000 people in North Carolina that belonged to labor unions. In 2006, the number of labor union members was 126,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 971,000 patients admitted to hospitals in North Carolina. Between 2000 and 2005, this number changed by 4.33%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in North Carolina in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in North Carolina was 166 in 2000. Between 2000 and 2006, this number changed by 10.24%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in North Carolina in 2006?

18. The average cost per day for a hospital stay in North Carolina in 2005 was $1,320. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in North Carolina, 26 had a college degree in 2006. If the number of adults in North Carolina with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in North Carolina, 84 had a high school diploma in 2006 compared to 79 in 2000. What was the percentage change in the number of adults with high school diplomas in North Carolina between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 5
2. 0
3. 2
4. 8
5. 6
6. 3
7. 6
8. -4233; 4
9. 2
10. 20,000 + 7,000 + 60 + 7
11. 2
12. 3
13. ones place
14. 5
15. 6
16. 2,000 + 600 + 40 + 4
17. 3
18. thousands place
19. 400,000
20. 3

Rounding Practice Answers

1. 9,346,000
2. 810,000
3. hundred thousands
4. 310
5. hundreds
6. 44,000
7. 53,800
8. 30,000
9. 41,000
10. hundreds
11. 900
12. 120
13. 100
14. 50,000
15. ten thousands
16. 200 + 20 + 8; 230
17. 400 + 20 + 6; 400
18. 990,000
19. 400,000
20. 4,000,000

Estimation Practice Answers

1. 1180 trillion BTUs
2. 139,000 square kilometers of total area
3. 3,300,000 people voted
4. 70,000 dollars
5. 1000 trillion BTUs
6. 900,000 people
7. 200,000 more births than deaths
8. 200 dollars
9. 10 percent change
10. 300,000 votes
11. 127,400 square kilometers of land
12. 13,000 square kilometers of water
13. 10,200,000 acres of farmland
14. 9,000,000 acres of farmland
15. 8,918,000 people
16. 1.11 times larger
17. 1.63 times more births than deaths
18. 1.18 times more expensive
19. 1.14 times larger
20. 0.94 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 5108/53819
2. 9.49%
3. 48711/53819
4. 90.51%
5. 1,526,000
6. Yes. 56 percent voted Republican.
7. 947/2644
8. 36%; 36 BTUs came from petroleum
9. 48,000/2,090,000
10. 0.023; 23 farms
11. 8,360,000
12. 11/336
13. 228 trillion BTUs
14. 3.96%
15. 29.61% decrease
16. 1,013,000
17. 183
18. 7.58%
19. 52%
20. 6.33% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of North Dakota is projected to be 636,623 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of North Dakota changed by -6,333 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 49,881 births in North Dakota. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in North Dakota in 2006 who were high school graduates was 89%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in North Dakota was 898 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of North Dakota is 68,976 square miles and the total water area is 1,724 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of North Dakota is 68,976 square miles and the total water area is 1,724 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in North Dakota was $27,628. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in North Dakota. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in North Dakota was $29,956. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in North Dakota in 2000 was $25,104. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, North Dakota ranked number 38. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, North Dakota ranked number 38. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in North Dakota was 1,300 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, North Dakota had 30,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in North Dakota that were sold was 11,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in North Dakota in 2003 was 395 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 395 in expanded form.

17. The number of home sales in North Dakota in 2000 was 11,000. What is the digit in the ten thousands place?

18. The number of children in North Dakota who enrolled in Prekindergarten to Grade 8 was 67,000 children in 2004. In what place value is the rightmost 7 in 67,000?

19. The number of children in North Dakota who enrolled in Grade 9 to Grade 12 in 2004 was 33,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 313,000 people in North Dakota voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

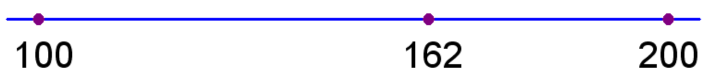
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

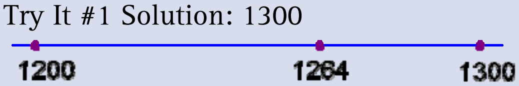


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of North Dakota is projected to be 636,623 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of North Dakota changed by -6,333 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 49,881 births in North Dakota. We round this number to 0 . To what place value did we round the number?

4. The number of hospitals in North Dakota in 2000 was 42. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in North Dakota was 898 dollars. We round this number to 900. What is the smallest place value to which you can round and get this number?

6. The total land area of North Dakota is 68,976 square miles and the total water area is 1,724 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of North Dakota is 68,976 square miles and the total water area is 1,724 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in North Dakota was $27,628. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in North Dakota was $29,956. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in North Dakota in 2000 was $25,104. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 25,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, North Dakota ranked number 38. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, North Dakota ranked number 32. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in North Dakota was 1,300 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, North Dakota had 30,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 11,000 homes. We round this number to 10,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in North Dakota in 2003 was 59 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 59 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in North Dakota in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in North Dakota who enrolled in Prekindergarten to Grade 8 was 67,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in North Dakota who enrolled in Grade 9 to Grade 12 was 33,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 313,000 people in North Dakota voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, North Dakota used 121 trillion BTUs of energy from petroleum and 59 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in North Dakota.

2. The number of square kilometers of land area in North Dakota is 178,647. The number of square kilometers of water area is 4,465. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 111,000 votes were cast for the Democratic candidate and 197,000 votes were cast for the Republican candidate in North Dakota. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in North Dakota who voted for the two candidates.

4. The average annual pay in North Dakota in 2004 was 28,987 dollars and in 2005 was 29,956. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in North Dakota consumed 18 trillion BTUs of energy from hydroelectric power (water) and 121 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in North Dakota in 2003.

6. In 2006, there were 636,000 people living in North Dakota. In 2000, there were 642,000 people living in North Dakota. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 49,881 births and 36,748 deaths in North Dakota. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in North Dakota was 747 dollars. In 2005, the average cost per day was 898 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 77 percent of adults living in North Dakota were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 175,000 votes cast for the Republican candidate and 95,000 votes cast for the Democratic candidate in North Dakota in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 68,976 square miles of land in North Dakota. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,724 square miles of water in North Dakota. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 31,000 farms in North Dakota. The average number of acres of land on each farm was 1,279. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in North Dakota by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 30,000 farms in North Dakota. The average number of acres of land on each farm was 1,300. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in North Dakota.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of North Dakota was 9 people per square mile. There are 68,976 square miles of land in North Dakota. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 636,000 people living in North Dakota. In 2000, there were 642,000 people living in North Dakota. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 49,881 births and 36,748 deaths in North Dakota. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in North Dakota was 747 dollars. In 2005, the average cost per day was 898 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 77 percent of adults living in North Dakota were high school graduates. In 2006, the number was 89 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 13,000 people unemployed in North Dakota. In 2000, there were 10,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3,794,083 \ \cancel{\text{square miles of area}} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. North Dakota has 1,724 square miles of water area and 70,700 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of North Dakota is water.

3. North Dakota has 68,976 square miles of land area and 70,700 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of North Dakota is land.

5. Approximately 35.46% of North Dakota voters chose the Democratic candidate in the 2004 election. A total of 313,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 197,000 citizens in North Dakota who voted for the Republican candidate in the 2004 presidential election. A total of 313,000 citizens voted. Did more than 55% of the voters in North Dakota select the Republican candidate?

7. The amount of energy consumed by people in North Dakota in 2003 that came from petroleum was 121 trillion BTUs. The total amount of energy consumed from all sources was 395 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in North Dakota, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. North Dakota had 30,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in North Dakota to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in North Dakota? (Round your answer to the nearest farm.)

11. There were 39,400,000 acres of farmland in North Dakota in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in North Dakota?

12. The projected population of North Dakota in 2020 is 630,112 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the North Dakota population to the United States population.

13. In North Dakota, 14.94% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 395 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in North Dakota in 2000 was $25,104. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,416. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 28,000 people in North Dakota that belonged to labor unions. In 2006, the number of labor union members was 20,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 89,000 patients admitted to hospitals in North Dakota. Between 2000 and 2005, this number changed by -2.25%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in North Dakota in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in North Dakota was 1,279 in 2000. Between 2000 and 2006, this number changed by 1.64%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in North Dakota in 2006?

18. The average cost per day for a hospital stay in North Dakota in 2005 was $898. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in North Dakota, 29 had a college degree in 2006. If the number of adults in North Dakota with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in North Dakota, 89 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in North Dakota between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 3
3. 2
4. 8
5. 7
6. 0
7. 2
8. -10137; 0
9. 6
10. 20,000 + 5,000 + 100 + 4
11. 8
12. 3
13. ones place
14. 7
15. 0
16. 300 + 90 + 5
17. 1
18. thousands place
19. 30,000 + 3,000
20. 3

Rounding Practice Answers

1. 637,000
2. (6,300)
3. hundred thousands
4. 20
5. hundreds
6. 67,000
7. 70,700
8. 30,000
9. 35,100
10. hundreds
11. 1600
12. 90
13. 1,200
14. 30,000
15. ten thousands
16. 50 + 9; 60
17. 0; 0
18. 70,000
19. 0
20. 0

Estimation Practice Answers

1. 180 trillion BTUs
2. 183,000 square kilometers of total area
3. 300,000 people voted
4. 58,000 dollars
5. 100 trillion BTUs
6. 0 people
7. 0 more births than deaths
8. 200 dollars
9. 10 percent change
10. 100,000 votes
11. 179,400 square kilometers of land
12. 5,200 square kilometers of water
13. 38,400,000 acres of farmland
14. 39,000,000 acres of farmland
15. 621,000 people
16. 1.00 times larger
17. 1.25 times more births than deaths
18. 1.29 times more expensive
19. 1.13 times larger
20. 1.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1724/70700
2. 2.44%
3. 68976/70700
4. 97.56%
5. 111,000
6. Yes. 62.9 percent voted Republican.
7. 121/395
8. 31%; 31 BTUs came from petroleum
9. 30,000/2,090,000
10. 0.014; 14 farms
11. 37,430,000
12. 1/336
13. 59 trillion BTUs
14. 13.19%
15. 28.57% decrease
16. 87,000
17. 1,300
18. 11.14%
19. 58%
20. 3.49% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Ohio is projected to be 11,576,181 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Ohio changed by 124,861 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 938,169 births in Ohio. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Ohio in 2006 who were high school graduates was 88%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Ohio was 1,673 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Ohio is 40,948 square miles and the total water area is 3,877 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Ohio is 40,948 square miles and the total water area is 3,877 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Ohio was $35,153. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Ohio. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Ohio was $37,333. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Ohio in 2000 was $28,205. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Ohio ranked number 24. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Ohio ranked number 24. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Ohio was 188 acres. What is the place value furthest to the right that contains the number 8?

14. In 2006, Ohio had 76,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Ohio that were sold was 216,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Ohio in 2003 was 3,986 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 3,986 in expanded form.

17. The number of home sales in Ohio in 2000 was 216,000. What is the digit in the ten thousands place?

18. The number of children in Ohio who enrolled in Prekindergarten to Grade 8 was 1,267,000 children in 2004. In what place value is the rightmost 7 in 1,267,000?

19. The number of children in Ohio who enrolled in Grade 9 to Grade 12 in 2004 was 573,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 5,628,000 people in Ohio voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

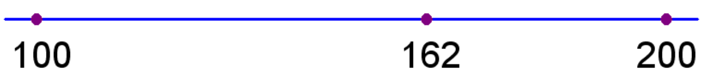
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



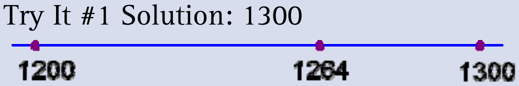
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Ohio is projected to be 11,576,181 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Ohio changed by 124,861 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 938,169 births in Ohio. We round this number to 900,000 . To what place value did we round the number?

4. The number of hospitals in Ohio in 2000 was 163. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Ohio was 1,673 dollars. We round this number to 1,700. What is the smallest place value to which you can round and get this number?

6. The total land area of Ohio is 40,948 square miles and the total water area is 3,877 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Ohio is 40,948 square miles and the total water area is 3,877 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Ohio was $35,153. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Ohio was $37,333. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Ohio in 2000 was $28,205. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,200. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Ohio ranked number 24. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Ohio ranked number 29. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Ohio was 188 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Ohio had 76,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 216,000 homes. We round this number to 220,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Ohio in 2003 was 872 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 872 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Ohio in 2003 was 88 trillion BTU. (For some states, this amount will be 0.) Write 88 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Ohio who enrolled in Prekindergarten to Grade 8 was 1,267,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Ohio who enrolled in Grade 9 to Grade 12 was 573,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 5,628,000 people in Ohio voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Ohio used 1,340 trillion BTUs of energy from petroleum and 872 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Ohio.

2. The number of square kilometers of land area in Ohio is 106,056. The number of square kilometers of water area is 10,040. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 2,741,000 votes were cast for the Democratic candidate and 2,860,000 votes were cast for the Republican candidate in Ohio. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Ohio who voted for the two candidates.

4. The average annual pay in Ohio in 2004 was 36,441 dollars and in 2005 was 37,333. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Ohio consumed 5 trillion BTUs of energy from hydroelectric power (water) and 1,340 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Ohio in 2003.

6. In 2006, there were 11,478,000 people living in Ohio. In 2000, there were 11,353,000 people living in Ohio. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 938,169 births and 675,165 deaths in Ohio. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Ohio was 1,198 dollars. In 2005, the average cost per day was 1,673 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 76 percent of adults living in Ohio were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 2,350,000 votes cast for the Republican candidate and 2,184,000 votes cast for the Democratic candidate in Ohio in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 40,948 square miles of land in Ohio. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 3,877 square miles of water in Ohio. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 79,000 farms in Ohio. The average number of acres of land on each farm was 187. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Ohio by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 76,000 farms in Ohio. The average number of acres of land on each farm was 188. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Ohio.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Ohio was 280 people per square mile. There are 40,948 square miles of land in Ohio. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 11,478,000 people living in Ohio. In 2000, there were 11,353,000 people living in Ohio. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 938,169 births and 675,165 deaths in Ohio. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Ohio was 1,198 dollars. In 2005, the average cost per day was 1,673 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 76 percent of adults living in Ohio were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 310,000 people unemployed in Ohio. In 2000, there were 234,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1

Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Ohio has 3,877 square miles of water area and 44,825 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Ohio is water.

3. Ohio has 40,948 square miles of land area and 44,825 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Ohio is land.

5. Approximately 48.70% of Ohio voters chose the Democratic candidate in the 2004 election. A total of 5,628,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 2,860,000 citizens in Ohio who voted for the Republican candidate in the 2004 presidential election. A total of 5,628,000 citizens voted. Did more than 55% of the voters in Ohio select the Republican candidate?

7. The amount of energy consumed by people in Ohio in 2003 that came from petroleum was 1,340 trillion BTUs. The total amount of energy consumed from all sources was 3,986 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Ohio, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Ohio had 76,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Ohio to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Ohio? (Round your answer to the nearest farm.)

11. There were 14,300,000 acres of farmland in Ohio in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Ohio?

12. The projected population of Ohio in 2020 is 11,644,058 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Ohio population to the United States population.

13. In Ohio, 21.88% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 3,986 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Ohio in 2000 was $28,205. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,102. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 1,011,000 people in Ohio that belonged to labor unions. In 2006, the number of labor union members was 734,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 1,404,000 patients admitted to hospitals in Ohio. Between 2000 and 2005, this number changed by 7.62%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Ohio in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Ohio was 187 in 2000. Between 2000 and 2006, this number changed by 0.53%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Ohio in 2006?

18. The average cost per day for a hospital stay in Ohio in 2005 was $1,673. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Ohio, 23 had a college degree in 2006. If the number of adults in Ohio with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Ohio, 88 had a high school diploma in 2006 compared to 87 in 2000. What was the percentage change in the number of adults with high school diplomas in Ohio between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 8
3. 1
4. 8
5. 3
6. 4
7. 0
8. -2612; 2
9. 3
10. 20,000 + 8,000 + 200 + 5
11. 4
12. 2
13. ones place
14. 3
15. 0
16. 3,000 + 900 + 80 + 6
17. 1
18. thousands place
19. 500,000 + 70,000 + 3,000
20. 5

Rounding Practice Answers

1. 11,576,000
2. 124,900
3. hundred thousands
4. 360
5. hundreds
6. 37,000
7. 44,800
8. 40,000
9. 42,400
10. hundreds
11. 400
12. 90
13. 100
14. 80,000
15. ten thousands
16. 800 + 70 + 2; 870
17. 80 + 8; 100
18. 1,270,000
19. 600,000
20. 6,000,000

Estimation Practice Answers

1. 2210 trillion BTUs
2. 116,000 square kilometers of total area
3. 5,100,000 people voted
4. 72,000 dollars
5. 1300 trillion BTUs
6. 100,000 people
7. 200,000 more births than deaths
8. 500 dollars
9. 10 percent change
10. 200,000 votes
11. 106,600 square kilometers of land
12. 10,400 square kilometers of water
13. 15,200,000 acres of farmland
14. 15,200,000 acres of farmland
15. 11,480,000 people
16. 1.01 times larger
17. 1.38 times more births than deaths
18. 1.42 times more expensive
19. 1.13 times larger
20. 1.35 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 3877/44825
2. 8.65%
3. 40948/44825
4. 91.35%
5. 2,741,000
6. No. 50.8 percent voted Republican.
7. 1340/3986
8. 34%; 34 BTUs came from petroleum
9. 76,000/2,090,000
10. 0.036; 36 farms
11. 13,585,000
12. 12/336
13. 872 trillion BTUs
14. 3.18%
15. 27.4% decrease
16. 1,511,000
17. 188
18. 5.98%
19. 46%
20. 1.15% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Oklahoma is projected to be 3,591,516 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Oklahoma changed by 128,558 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 317,771 births in Oklahoma. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Oklahoma in 2006 who were high school graduates was 88%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Oklahoma was 1,332 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Oklahoma is 68,667 square miles and the total water area is 1,231 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Oklahoma is 68,667 square miles and the total water area is 1,231 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Oklahoma was $29,699. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Oklahoma. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Oklahoma was $31,721. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Oklahoma in 2000 was $24,406. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Oklahoma ranked number 41. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Oklahoma ranked number 41. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Oklahoma was 406 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, Oklahoma had 83,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Oklahoma that were sold was 67,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Oklahoma in 2003 was 1,491 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,491 in expanded form.

17. The number of home sales in Oklahoma in 2000 was 67,000. What is the digit in the ten thousands place?

18. The number of children in Oklahoma who enrolled in Prekindergarten to Grade 8 was 453,000 children in 2004. In what place value is the rightmost 3 in 453,000?

19. The number of children in Oklahoma who enrolled in Grade 9 to Grade 12 in 2004 was 177,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,464,000 people in Oklahoma voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

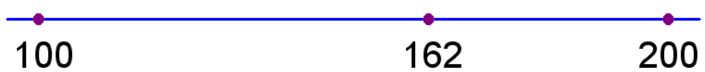
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

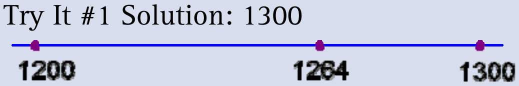


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Oklahoma is projected to be 3,591,516 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Oklahoma changed by 128,558 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 317,771 births in Oklahoma. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in Oklahoma in 2000 was 108. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Oklahoma was 1,332 dollars. We round this number to 1,300. What is the smallest place value to which you can round and get this number?

6. The total land area of Oklahoma is 68,667 square miles and the total water area is 1,231 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Oklahoma is 68,667 square miles and the total water area is 1,231 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Oklahoma was $29,699. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Oklahoma was $31,721. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Oklahoma in 2000 was $24,406. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 24,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Oklahoma ranked number 41. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Oklahoma ranked number 37. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Oklahoma was 406 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Oklahoma had 83,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 67,000 homes. We round this number to 70,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Oklahoma in 2003 was 558 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 558 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Oklahoma in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Oklahoma who enrolled in Prekindergarten to Grade 8 was 453,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Oklahoma who enrolled in Grade 9 to Grade 12 was 177,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,464,000 people in Oklahoma voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \times \cancel{10}}{4 \times \cancel{4} \times \cancel{10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \times \cancel{2} \times 5}{\cancel{2} \times \cancel{2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Oklahoma used 545 trillion BTUs of energy from petroleum and 558 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Oklahoma.

2. The number of square kilometers of land area in Oklahoma is 177,847. The number of square kilometers of water area is 3,189. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 504,000 votes were cast for the Democratic candidate and 960,000 votes were cast for the Republican candidate in Oklahoma. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Oklahoma who voted for the two candidates.

4. The average annual pay in Oklahoma in 2004 was 30,743 dollars and in 2005 was 31,721. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Oklahoma consumed 18 trillion BTUs of energy from hydroelectric power (water) and 545 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Oklahoma in 2003.

6. In 2006, there were 3,579,000 people living in Oklahoma. In 2000, there were 3,451,000 people living in Oklahoma. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 317,771 births and 220,169 deaths in Oklahoma. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Oklahoma was 1,031 dollars. In 2005, the average cost per day was 1,332 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 75 percent of adults living in Oklahoma were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 744,000 votes cast for the Republican candidate and 474,000 votes cast for the Democratic candidate in Oklahoma in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 68,667 square miles of land in Oklahoma. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,231 square miles of water in Oklahoma. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 85,000 farms in Oklahoma. The average number of acres of land on each farm was 400. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Oklahoma by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 83,000 farms in Oklahoma. The average number of acres of land on each farm was 406. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Oklahoma.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Oklahoma was 52 people per square mile. There are 68,667 square miles of land in Oklahoma. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 3,579,000 people living in Oklahoma. In 2000, there were 3,451,000 people living in Oklahoma. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 317,771 births and 220,169 deaths in Oklahoma. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Oklahoma was 1,031 dollars. In 2005, the average cost per day was 1,332 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 75 percent of adults living in Oklahoma were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 86,000 people unemployed in Oklahoma. In 2000, there were 52,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Oklahoma has 1,231 square miles of water area and 69,898 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Oklahoma is water.

3. Oklahoma has 68,667 square miles of land area and 69,898 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Oklahoma is land.

5. Approximately 34.43% of Oklahoma voters chose the Democratic candidate in the 2004 election. A total of 1,464,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 960,000 citizens in Oklahoma who voted for the Republican candidate in the 2004 presidential election. A total of 1,464,000 citizens voted. Did more than 55% of the voters in Oklahoma select the Republican candidate?

7. The amount of energy consumed by people in Oklahoma in 2003 that came from petroleum was 545 trillion BTUs. The total amount of energy consumed from all sources was 1,491 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Oklahoma, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Oklahoma had 83,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Oklahoma to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Oklahoma? (Round your answer to the nearest farm.)

11. There were 33,700,000 acres of farmland in Oklahoma in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Oklahoma?

12. The projected population of Oklahoma in 2020 is 3,735,690 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Oklahoma population to the United States population.

13. In Oklahoma, 37.42% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,491 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Oklahoma in 2000 was $24,406. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,117. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 132,000 people in Oklahoma that belonged to labor unions. In 2006, the number of labor union members was 93,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 429,000 patients admitted to hospitals in Oklahoma. Between 2000 and 2005, this number changed by 6.53%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Oklahoma in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Oklahoma was 400 in 2000. Between 2000 and 2006, this number changed by 1.50%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Oklahoma in 2006?

18. The average cost per day for a hospital stay in Oklahoma in 2005 was $1,332. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Oklahoma, 23 had a college degree in 2006. If the number of adults in Oklahoma with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Oklahoma, 88 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Oklahoma between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 1
2. 5
3. 9
4. 8
5. 6
6. 9
7. 4
8. -8066; 8
9. 8
10. 20,000 + 4,000 + 400 + 6
11. 1
12. 3
13. ones place
14. 0
15. 3
16. 1,000 + 400 + 90 + 1
17. 6
18. thousands place
19. 100,000 + 70,000 + 7,000
20. 1

Rounding Practice Answers

1. 3,592,000
2. 128,600
3. hundred thousands
4. 800
5. hundreds
6. 68,000
7. 69,900
8. 30,000
9. 36,800
10. hundreds
11. 1600
12. 120
13. 300
14. 80,000
15. ten thousands
16. 500 + 50 + 8; 560
17. 0; 0
18. 450,000
19. 200,000
20. 1,000,000

Estimation Practice Answers

1. 1110 trillion BTUs
2. 181,000 square kilometers of total area
3. 1,500,000 people voted
4. 62,000 dollars
5. 500 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 200,000 votes
11. 179,400 square kilometers of land
12. 2,600 square kilometers of water
13. 36,000,000 acres of farmland
14. 32,800,000 acres of farmland
15. 3,588,000 people
16. 1.03 times larger
17. 1.45 times more births than deaths
18. 1.30 times more expensive
19. 1.13 times larger
20. 1.80 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1231/69898
2. 1.76%
3. 68667/69898
4. 98.24%
5. 504,000
6. Yes. 65.6 percent voted Republican.
7. 545/1491
8. 37%; 37 BTUs came from petroleum
9. 83,000/2,090,000
10. 0.04; 40 farms
11. 32,015,000
12. 4/336
13. 558 trillion BTUs
14. 15.21%
15. 29.55% decrease
16. 457,000
17. 406
18. 7.51%
19. 46%
20. 2.33% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Oregon is projected to be 3,790,996 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Oregon changed by 279,322 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 284,655 births in Oregon. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Oregon in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Oregon was 2,062 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Oregon is 95,997 square miles and the total water area is 2,384 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Oregon is 95,997 square miles and the total water area is 2,384 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Oregon was $34,450. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Oregon. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Oregon was $36,588. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Oregon in 2000 was $28,093. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Oregon ranked number 25. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Oregon ranked number 25. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Oregon was 435 acres. What is the place value furthest to the right that contains the number 5?

14. In 2006, Oregon had 39,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Oregon that were sold was 63,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Oregon in 2003 was 1,049 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,049 in expanded form.

17. The number of home sales in Oregon in 2000 was 63,000. What is the digit in the ten thousands place?

18. The number of children in Oregon who enrolled in Prekindergarten to Grade 8 was 377,000 children in 2004. In what place value is the rightmost 7 in 377,000?

19. The number of children in Oregon who enrolled in Grade 9 to Grade 12 in 2004 was 176,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,837,000 people in Oregon voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

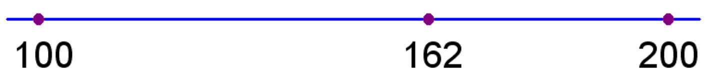
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

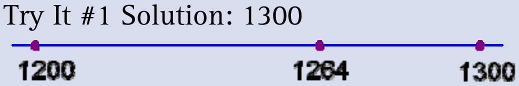


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Oregon is projected to be 3,790,996 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Oregon changed by 279,322 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 284,655 births in Oregon. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in Oregon in 2000 was 59. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Oregon was 2,062 dollars. We round this number to 2,100. What is the smallest place value to which you can round and get this number?

6. The total land area of Oregon is 95,997 square miles and the total water area is 2,384 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Oregon is 95,997 square miles and the total water area is 2,384 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Oregon was $34,450. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Oregon was $36,588. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Oregon in 2000 was $28,093. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Oregon ranked number 25. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Oregon ranked number 28. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Oregon was 435 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Oregon had 39,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 63,000 homes. We round this number to 60,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Oregon in 2003 was 220 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 220 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Oregon in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Oregon who enrolled in Prekindergarten to Grade 8 was 377,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Oregon who enrolled in Grade 9 to Grade 12 was 176,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,837,000 people in Oregon voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}
\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\
&= \frac{10 \times 10}{4} \\
&= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\
&= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\
&= 5 \times 5 \\
&= 25
\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Oregon used 370 trillion BTUs of energy from petroleum and 220 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Oregon.

2. The number of square kilometers of land area in Oregon is 248,631. The number of square kilometers of water area is 6,174. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 943,000 votes were cast for the Democratic candidate and 867,000 votes were cast for the Republican candidate in Oregon. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Oregon who voted for the two candidates.

4. The average annual pay in Oregon in 2004 was 35,630 dollars and in 2005 was 36,588. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Oregon consumed 341 trillion BTUs of energy from hydroelectric power (water) and 370 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Oregon in 2003.

6. In 2006, there were 3,701,000 people living in Oregon. In 2000, there were 3,421,000 people living in Oregon. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 284,655 births and 191,461 deaths in Oregon. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Oregon was 1,461 dollars. In 2005, the average cost per day was 2,062 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 82 percent of adults living in Oregon were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 714,000 votes cast for the Republican candidate and 720,000 votes cast for the Democratic candidate in Oregon in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 95,997 square miles of land in Oregon. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 2,384 square miles of water in Oregon. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 40,000 farms in Oregon. The average number of acres of land on each farm was 433. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Oregon by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 39,000 farms in Oregon. The average number of acres of land on each farm was 435. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Oregon.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Oregon was 39 people per square mile. There are 95,997 square miles of land in Oregon. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 3,701,000 people living in Oregon. In 2000, there were 3,421,000 people living in Oregon. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 284,655 births and 191,461 deaths in Oregon. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Oregon was 1,461 dollars. In 2005, the average cost per day was 2,062 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 82 percent of adults living in Oregon were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 81,000 people unemployed in Oregon. In 2000, there were 93,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1

Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Oregon has 2,384 square miles of water area and 98,381 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Oregon is water.

3. Oregon has 95,997 square miles of land area and 98,381 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Oregon is land.

5. Approximately 51.33% of Oregon voters chose the Democratic candidate in the 2004 election. A total of 1,837,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 867,000 citizens in Oregon who voted for the Republican candidate in the 2004 presidential election. A total of 1,837,000 citizens voted. Did more than 55% of the voters in Oregon select the Republican candidate?

7. The amount of energy consumed by people in Oregon in 2003 that came from petroleum was 370 trillion BTUs. The total amount of energy consumed from all sources was 1,049 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Oregon, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Oregon had 39,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Oregon to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Oregon? (Round your answer to the nearest farm.)

11. There were 17,100,000 acres of farmland in Oregon in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Oregon?

12. The projected population of Oregon in 2020 is 4,260,393 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Oregon population to the United States population.

13. In Oregon, 20.97% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,049 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Oregon in 2000 was $28,093. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,388. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 223,000 people in Oregon that belonged to labor unions. In 2006, the number of labor union members was 211,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 330,000 patients admitted to hospitals in Oregon. Between 2000 and 2005, this number changed by 1.82%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Oregon in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Oregon was 433 in 2000. Between 2000 and 2006, this number changed by 0.46%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Oregon in 2006?

18. The average cost per day for a hospital stay in Oregon in 2005 was $2,062. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Oregon, 28 had a college degree in 2006. If the number of adults in Oregon with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Oregon, 90 had a high school diploma in 2006 compared to 88 in 2000. What was the percentage change in the number of adults with high school diplomas in Oregon between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 3
3. 6
4. 9
5. 1
6. 8
7. 6
8. -3315; 3
9. 3
10. 20,000 + 8,000 + 90 + 3
11. 5
12. 2
13. ones place
14. 6
15. 3
16. 1,000 + 40 + 9
17. 6
18. thousands place
19. 100,000 + 70,000 + 6,000
20. 1

Rounding Practice Answers

1. 3,791,000
2. 279,300
3. hundred thousands
4. 100
5. hundreds
6. 94,000
7. 98,400
8. 30,000
9. 41,700
10. hundreds
11. 900
12. 90
13. 300
14. 40,000
15. ten thousands
16. 200 + 20; 220
17. 0; 0
18. 380,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 590 trillion BTUs
2. 255,000 square kilometers of total area
3. 1,600,000 people voted
4. 71,000 dollars
5. 700 trillion BTUs
6. 300,000 people
7. 100,000 more births than deaths
8. 600 dollars
9. 10 percent change
10. 0 votes
11. 249,600 square kilometers of land
12. 5,200 square kilometers of water
13. 17,200,000 acres of farmland
14. 17,600,000 acres of farmland
15. 3,744,000 people
16. 1.09 times larger
17. 1.47 times more births than deaths
18. 1.40 times more expensive
19. 1.13 times larger
20. 0.89 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 2384/98381
2. 2.42%
3. 95997/98381
4. 97.58%
5. 943,000
6. No. 47.2 percent voted Republican.
7. 370/1049
8. 35%; 35 BTUs came from petroleum
9. 39,000/2,090,000
10. 0.019; 19 farms
11. 16,245,000
12. 4/336
13. 220 trillion BTUs
14. 4.61%
15. 5.38% decrease
16. 336,000
17. 435
18. 4.85%
19. 56%
20. 2.27% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Pennsylvania is projected to be 12,584,487 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Pennsylvania changed by 159,567 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 902,068 births in Pennsylvania. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Pennsylvania in 2006 who were high school graduates was 88%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Pennsylvania was 1,500 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Pennsylvania is 44,817 square miles and the total water area is 1,239 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Pennsylvania is 44,817 square miles and the total water area is 1,239 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Pennsylvania was $36,995. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Pennsylvania. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Pennsylvania was $39,661. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Pennsylvania in 2000 was $29,693. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Pennsylvania ranked number 16. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Pennsylvania ranked number 16. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Pennsylvania was 131 acres. What is the place value furthest to the right that contains the number 1?

14. In 2006, Pennsylvania had 58,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Pennsylvania that were sold was 196,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Pennsylvania in 2003 was 3,973 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 3,973 in expanded form.

17. The number of home sales in Pennsylvania in 2000 was 196,000. What is the digit in the ten thousands place?

18. The number of children in Pennsylvania who enrolled in Prekindergarten to Grade 8 was 1,235,000 children in 2004. In what place value is the rightmost 5 in 1,235,000?

19. The number of children in Pennsylvania who enrolled in Grade 9 to Grade 12 in 2004 was 593,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 5,770,000 people in Pennsylvania voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

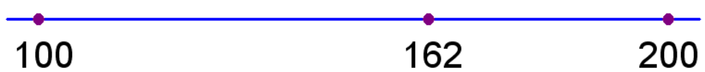
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

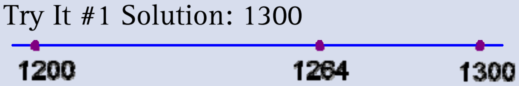


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Pennsylvania is projected to be 12,584,487 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Pennsylvania changed by 159,567 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 902,068 births in Pennsylvania. We round this number to 900,000 . To what place value did we round the number?

4. The number of hospitals in Pennsylvania in 2000 was 207. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Pennsylvania was 1,500 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of Pennsylvania is 44,817 square miles and the total water area is 1,239 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Pennsylvania is 44,817 square miles and the total water area is 1,239 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Pennsylvania was $36,995. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Pennsylvania was $39,661. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Pennsylvania in 2000 was $29,693. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 29,700. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Pennsylvania ranked number 16. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Pennsylvania ranked number 18. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Pennsylvania was 131 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Pennsylvania had 58,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 196,000 homes. We round this number to 200,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Pennsylvania in 2003 was 730 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 730 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Pennsylvania in 2003 was 775 trillion BTU. (For some states, this amount will be 0.) Write 775 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Pennsylvania who enrolled in Prekindergarten to Grade 8 was 1,235,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Pennsylvania who enrolled in Grade 9 to Grade 12 was 593,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 5,770,000 people in Pennsylvania voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Pennsylvania used 1,466 trillion BTUs of energy from petroleum and 730 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Pennsylvania.

2. The number of square kilometers of land area in Pennsylvania is 116,075. The number of square kilometers of water area is 3,208. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 2,938,000 votes were cast for the Democratic candidate and 2,794,000 votes were cast for the Republican candidate in Pennsylvania. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Pennsylvania who voted for the two candidates.

4. The average annual pay in Pennsylvania in 2004 was 38,555 dollars and in 2005 was 39,661. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Pennsylvania consumed 34 trillion BTUs of energy from hydroelectric power (water) and 1,466 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Pennsylvania in 2003.

6. In 2006, there were 12,441,000 people living in Pennsylvania. In 2000, there were 12,281,000 people living in Pennsylvania. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 902,068 births and 806,419 deaths in Pennsylvania. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Pennsylvania was 1,080 dollars. In 2005, the average cost per day was 1,500 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 75 percent of adults living in Pennsylvania were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 2,281,000 votes cast for the Republican candidate and 2,486,000 votes cast for the Democratic candidate in Pennsylvania in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 44,817 square miles of land in Pennsylvania. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,239 square miles of water in Pennsylvania. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 59,000 farms in Pennsylvania. The average number of acres of land on each farm was 130. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Pennsylvania by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 58,000 farms in Pennsylvania. The average number of acres of land on each farm was 131. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Pennsylvania.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Pennsylvania was 278 people per square mile. There are 44,817 square miles of land in Pennsylvania. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 12,441,000 people living in Pennsylvania. In 2000, there were 12,281,000 people living in Pennsylvania. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 902,068 births and 806,419 deaths in Pennsylvania. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Pennsylvania was 1,080 dollars. In 2005, the average cost per day was 1,500 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 75 percent of adults living in Pennsylvania were high school graduates. In 2006, the number was 88 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 317,000 people unemployed in Pennsylvania. In 2000, there were 255,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Pennsylvania has 1,239 square miles of water area and 46,055 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Pennsylvania is water.

3. Pennsylvania has 44,817 square miles of land area and 46,055 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Pennsylvania is land.

5. Approximately 50.92% of Pennsylvania voters chose the Democratic candidate in the 2004 election. A total of 5,770,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 2,794,000 citizens in Pennsylvania who voted for the Republican candidate in the 2004 presidential election. A total of 5,770,000 citizens voted. Did more than 55% of the voters in Pennsylvania select the Republican candidate?

7. The amount of energy consumed by people in Pennsylvania in 2003 that came from petroleum was 1,466 trillion BTUs. The total amount of energy consumed from all sources was 3,973 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Pennsylvania, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Pennsylvania had 58,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Pennsylvania to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Pennsylvania? (Round your answer to the nearest farm.)

11. There were 7,650,000 acres of farmland in Pennsylvania in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Pennsylvania?

12. The projected population of Pennsylvania in 2020 is 12,787,354 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Pennsylvania population to the United States population.

13. In Pennsylvania, 18.37% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 3,973 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Pennsylvania in 2000 was $29,693. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $32,019. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 1,196,000 people in Pennsylvania that belonged to labor unions. In 2006, the number of labor union members was 745,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 1,796,000 patients admitted to hospitals in Pennsylvania. Between 2000 and 2005, this number changed by 3.73%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Pennsylvania in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Pennsylvania was 130 in 2000. Between 2000 and 2006, this number changed by 0.77%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Pennsylvania in 2006?

18. The average cost per day for a hospital stay in Pennsylvania in 2005 was $1,500. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Pennsylvania, 27 had a college degree in 2006. If the number of adults in Pennsylvania with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Pennsylvania, 88 had a high school diploma in 2006 compared to 86 in 2000. What was the percentage change in the number of adults with high school diplomas in Pennsylvania between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 4
2. 5
3. 8
4. 8
5. 0
6. 6
7. 5
8. -770; 0
9. 6
10. 20,000 + 9,000 + 600 + 90 + 3
11. 6
12. 1
13. ones place
14. 5
15. 9
16. 3,000 + 900 + 70 + 3
17. 9
18. thousands place
19. 500,000 + 90,000 + 3,000
20. 5

Rounding Practice Answers

1. 12,584,000
2. 159,600
3. hundred thousands
4. 700
5. hundreds
6. 44,000
7. 46,000
8. 40,000
9. 44,800
10. hundreds
11. 400
12. 60
13. 0
14. 60,000
15. ten thousands
16. 700 + 30; 730
17. 700 + 70 + 5; 800
18. 1,240,000
19. 600,000
20. 6,000,000

Estimation Practice Answers

1. 2200 trillion BTUs
2. 119,000 square kilometers of total area
3. 5,300,000 people voted
4. 77,000 dollars
5. 1500 trillion BTUs
6. 100,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 200,000 votes
11. 117,000 square kilometers of land
12. 2,600 square kilometers of water
13. 7,800,000 acres of farmland
14. 7,800,000 acres of farmland
15. 12,510,000 people
16. 1.01 times larger
17. 1.11 times more births than deaths
18. 1.36 times more expensive
19. 1.13 times larger
20. 1.23 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1239/46055
2. 2.69%
3. 44817/46055
4. 97.31%
5. 2,938,000
6. No. 48.4 percent voted Republican.
7. 1466/3973
8. 37%; 37 BTUs came from petroleum
9. 58,000/2,090,000
10. 0.028; 28 farms
11. 7,268,000
12. 13/336
13. 730 trillion BTUs
14. 7.83%
15. 37.71% decrease
16. 1,863,000
17. 131
18. 6.67%
19. 54%
20. 2.33% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000+40,000+5000+600+70+1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Rhode Island is projected to be 1,116,652 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Rhode Island changed by 19,291 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 79,147 births in Rhode Island. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Rhode Island in 2006 who were high school graduates was 84%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Rhode Island was 1,719 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Rhode Island is 1,045 square miles and the total water area is 500 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Rhode Island is 1,045 square miles and the total water area is 500 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Rhode Island was $36,415. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Rhode Island. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Rhode Island was $38,751. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Rhode Island in 2000 was $29,212. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Rhode Island ranked number 18. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Rhode Island ranked number 18. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Rhode Island was 71 acres. What is the place value furthest to the right that contains the number 1?

14. In 2006, Rhode Island had 1,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Rhode Island that were sold was 17,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Rhode Island in 2003 was 228 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 228 in expanded form.

17. The number of home sales in Rhode Island in 2000 was 17,000. What is the digit in the ten thousands place?

18. The number of children in Rhode Island who enrolled in Prekindergarten to Grade 8 was 107,000 children in 2004. In what place value is the rightmost 7 in 107,000?

19. The number of children in Rhode Island who enrolled in Grade 9 to Grade 12 in 2004 was 49,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 437,000 people in Rhode Island voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

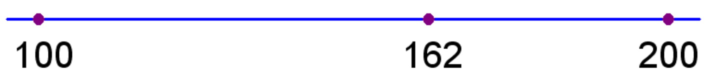
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

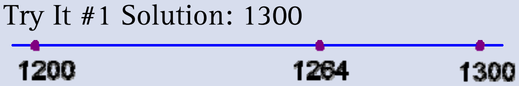


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Rhode Island is projected to be 1,116,652 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Rhode Island changed by 19,291 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 79,147 births in Rhode Island. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in Rhode Island in 2000 was 11. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Rhode Island was 1,719 dollars. We round this number to 1,700. What is the smallest place value to which you can round and get this number?

6. The total land area of Rhode Island is 1,045 square miles and the total water area is 500 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Rhode Island is 1,045 square miles and the total water area is 500 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Rhode Island was $36,415. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Rhode Island was $38,751. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Rhode Island in 2000 was $29,212. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 29,200. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Rhode Island ranked number 18. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Rhode Island ranked number 15. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Rhode Island was 71 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Rhode Island had 1,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 17,000 homes. We round this number to 20,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Rhode Island in 2003 was 81 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 81 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Rhode Island in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Rhode Island who enrolled in Prekindergarten to Grade 8 was 107,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Rhode Island who enrolled in Grade 9 to Grade 12 was 49,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 437,000 people in Rhode Island voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Rhode Island used 102 trillion BTUs of energy from petroleum and 81 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Rhode Island.

2. The number of square kilometers of land area in Rhode Island is 2,706. The number of square kilometers of water area is 1,295. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 260,000 votes were cast for the Democratic candidate and 169,000 votes were cast for the Republican candidate in Rhode Island. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Rhode Island who voted for the two candidates.

4. The average annual pay in Rhode Island in 2004 was 37,651 dollars and in 2005 was 38,751. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Rhode Island consumed 0 trillion BTUs of energy from hydroelectric power (water) and 102 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Rhode Island in 2003.

6. In 2006, there were 1,068,000 people living in Rhode Island. In 2000, there were 1,048,000 people living in Rhode Island. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 79,147 births and 60,604 deaths in Rhode Island. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Rhode Island was 1,313 dollars. In 2005, the average cost per day was 1,719 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 72 percent of adults living in Rhode Island were high school graduates. In 2006, the number was 84 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 131,000 votes cast for the Republican candidate and 250,000 votes cast for the Democratic candidate in Rhode Island in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 1,045 square miles of land in Rhode Island. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 500 square miles of water in Rhode Island. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 1,000 farms in Rhode Island. The average number of acres of land on each farm was 75. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Rhode Island by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 1,000 farms in Rhode Island. The average number of acres of land on each farm was 71. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Rhode Island.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Rhode Island was 1,022 people per square mile. There are 1,045 square miles of land in Rhode Island. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,068,000 people living in Rhode Island. In 2000, there were 1,048,000 people living in Rhode Island. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 79,147 births and 60,604 deaths in Rhode Island. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Rhode Island was 1,313 dollars. In 2005, the average cost per day was 1,719 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 72 percent of adults living in Rhode Island were high school graduates. In 2006, the number was 84 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 32,000 people unemployed in Rhode Island. In 2000, there were 23,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of}} \text{ area}} \times 3,794,083 \ \cancel{\text{square miles of}} \text{ area} = 256,480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Rhode Island has 500 square miles of water area and 1,545 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Rhode Island is water.

3. Rhode Island has 1,045 square miles of land area and 1,545 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Rhode Island is land.

5. Approximately 59.50% of Rhode Island voters chose the Democratic candidate in the 2004 election. A total of 437,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 169,000 citizens in Rhode Island who voted for the Republican candidate in the 2004 presidential election. A total of 437,000 citizens voted. Did more than 55% of the voters in Rhode Island select the Republican candidate?

7. The amount of energy consumed by people in Rhode Island in 2003 that came from petroleum was 102 trillion BTUs. The total amount of energy consumed from all sources was 228 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Rhode Island, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Rhode Island had 1,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Rhode Island to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Rhode Island? (Round your answer to the nearest farm.)

11. There were 60,000 acres of farmland in Rhode Island in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Rhode Island?

12. The projected population of Rhode Island in 2020 is 1,154,230 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Rhode Island population to the United States population.

13. In Rhode Island, 35.53% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 228 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Rhode Island in 2000 was $29,212. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $32,637. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 86,000 people in Rhode Island that belonged to labor unions. In 2006, the number of labor union members was 76,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 119,000 patients admitted to hospitals in Rhode Island. Between 2000 and 2005, this number changed by 6.72%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Rhode Island in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Rhode Island was 75 in 2000. Between 2000 and 2006, this number changed by -5.33%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Rhode Island in 2006?

18. The average cost per day for a hospital stay in Rhode Island in 2005 was $1,719. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Rhode Island, 31 had a college degree in 2006. If the number of adults in Rhode Island with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Rhode Island, 84 had a high school diploma in 2006 compared to 81 in 2000. What was the percentage change in the number of adults with high school diplomas in Rhode Island between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 2
3. 5
4. 8
5. 4
6. 1
7. 5
8. -1350; 1
9. 5
10. 20,000 + 9,000 + 200 + 10 + 2
11. 8
12. 1
13. ones place
14. 0
15. 0
16. 200 + 20 + 8
17. 1
18. thousands place
19. 40,000 + 9,000
20. 4

Rounding Practice Answers

1. 1,117,000
2. 19,300
3. hundred thousands
4. 10
5. hundreds
6. 0
7. 1,500
8. 40,000
9. 43,900
10. hundreds
11. 400
12. 60
13. 0
14. 0
15. ten thousands
16. 80 + 1; 80
17. 0; 0
18. 110,000
19. 0
20. 0

Estimation Practice Answers

1. 180 trillion BTUs
2. 4,000 square kilometers of total area
3. 500,000 people voted
4. 75,000 dollars
5. 100 trillion BTUs
6. 100,000 people
7. 0 more births than deaths
8. 400 dollars
9. 10 percent change
10. 200,000 votes
11. 2,600 square kilometers of land
12. 2,600 square kilometers of water
13. 0 acres of farmland
14. 0 acres of farmland
15. 1,022,000 people
16. 1.10 times larger
17. 1.33 times more births than deaths
18. 1.31 times more expensive
19. 1.14 times larger
20. 1.50 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 500/1545
2. 32.36%
3. 1045/1545
4. 67.64%
5. 260,000
6. No. 38.7 percent voted Republican.
7. 102/228
8. 45%; 45 BTUs came from petroleum
9. 1,000/2,090,000
10. 0; 0 farms
11. 57,000
12. 1/336
13. 81 trillion BTUs
14. 11.72%
15. 11.63% decrease
16. 127,000
17. 71
18. 5.82%
19. 62%
20. 3.7% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of South Carolina is projected to be 4,446,704 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of South Carolina changed by 309,433 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 349,748 births in South Carolina. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in South Carolina in 2006 who were high school graduates was 83%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in South Carolina was 1,465 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of South Carolina is 30,110 square miles and the total water area is 1,911 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of South Carolina is 30,110 square miles and the total water area is 1,911 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in South Carolina was $30,750. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in South Carolina. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in South Carolina was $32,927. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in South Carolina in 2000 was $24,424. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, South Carolina ranked number 39. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, South Carolina ranked number 39. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in South Carolina was 197 acres. What is the place value furthest to the right that contains the number 7?

14. In 2006, South Carolina had 25,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in South Carolina that were sold was 64,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in South Carolina in 2003 was 1,614 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,614 in expanded form.

17. The number of home sales in South Carolina in 2000 was 64,000. What is the digit in the ten thousands place?

18. The number of children in South Carolina who enrolled in Prekindergarten to Grade 8 was 504,000 children in 2004. In what place value is the rightmost 4 in 504,000?

19. The number of children in South Carolina who enrolled in Grade 9 to Grade 12 in 2004 was 199,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 1,618,000 people in South Carolina voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

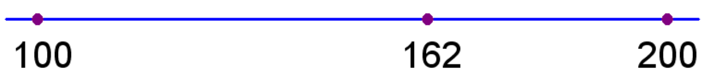
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

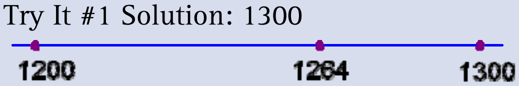


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of South Carolina is projected to be 4,446,704 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of South Carolina changed by 309,433 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 349,748 births in South Carolina. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in South Carolina in 2000 was 63. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in South Carolina was 1,465 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of South Carolina is 30,110 square miles and the total water area is 1,911 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of South Carolina is 30,110 square miles and the total water area is 1,911 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in South Carolina was $30,750. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in South Carolina was $32,927. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in South Carolina in 2000 was $24,424. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 24,400. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, South Carolina ranked number 39. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, South Carolina ranked number 45. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in South Carolina was 197 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, South Carolina had 25,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 64,000 homes. We round this number to 60,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in South Carolina in 2003 was 147 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 147 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in South Carolina in 2003 was 525 trillion BTU. (For some states, this amount will be 0.) Write 525 in expanded form. Then round the number to the nearest hundred.

18. The number of children in South Carolina who enrolled in Prekindergarten to Grade 8 was 504,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in South Carolina who enrolled in Grade 9 to Grade 12 was 199,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 1,618,000 people in South Carolina voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, South Carolina used 517 trillion BTUs of energy from petroleum and 147 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in South Carolina.

2. The number of square kilometers of land area in South Carolina is 77,983. The number of square kilometers of water area is 4,949. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 662,000 votes were cast for the Democratic candidate and 938,000 votes were cast for the Republican candidate in South Carolina. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in South Carolina who voted for the two candidates.

4. The average annual pay in South Carolina in 2004 was 31,839 dollars and in 2005 was 32,927. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in South Carolina consumed 38 trillion BTUs of energy from hydroelectric power (water) and 517 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in South Carolina in 2003.

6. In 2006, there were 4,321,000 people living in South Carolina. In 2000, there were 4,012,000 people living in South Carolina. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 349,748 births and 234,424 deaths in South Carolina. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in South Carolina was 1,101 dollars. In 2005, the average cost per day was 1,465 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 68 percent of adults living in South Carolina were high school graduates. In 2006, the number was 83 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 787,000 votes cast for the Republican candidate and 566,000 votes cast for the Democratic candidate in South Carolina in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 30,110 square miles of land in South Carolina. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,911 square miles of water in South Carolina. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 24,000 farms in South Carolina. The average number of acres of land on each farm was 203. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in South Carolina by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 25,000 farms in South Carolina. The average number of acres of land on each farm was 197. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in South Carolina.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of South Carolina was 144 people per square mile. There are 30,110 square miles of land in South Carolina. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 4,321,000 people living in South Carolina. In 2000, there were 4,012,000 people living in South Carolina. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 349,748 births and 234,424 deaths in South Carolina. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in South Carolina was 1,101 dollars. In 2005, the average cost per day was 1,465 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 68 percent of adults living in South Carolina were high school graduates. In 2006, the number was 83 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 84,000 people unemployed in South Carolina. In 2000, there were 71,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98{,}605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1

Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. South Carolina has 1,911 square miles of water area and 32,020 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of South Carolina is water.

3. South Carolina has 30,110 square miles of land area and 32,020 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of South Carolina is land.

5. Approximately 40.91% of South Carolina voters chose the Democratic candidate in the 2004 election. A total of 1,618,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 938,000 citizens in South Carolina who voted for the Republican candidate in the 2004 presidential election. A total of 1,618,000 citizens voted. Did more than 55% of the voters in South Carolina select the Republican candidate?

7. The amount of energy consumed by people in South Carolina in 2003 that came from petroleum was 517 trillion BTUs. The total amount of energy consumed from all sources was 1,614 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in South Carolina, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. South Carolina had 25,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in South Carolina to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in South Carolina? (Round your answer to the nearest farm.)

11. There were 4,850,000 acres of farmland in South Carolina in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in South Carolina?

12. The projected population of South Carolina in 2020 is 4,822,577 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the South Carolina population to the United States population.

13. In South Carolina, 9.11% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,614 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in South Carolina in 2000 was $24,424. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $25,765. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 70,000 people in South Carolina that belonged to labor unions. In 2006, the number of labor union members was 59,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 495,000 patients admitted to hospitals in South Carolina. Between 2000 and 2005, this number changed by 6.67%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in South Carolina in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in South Carolina was 203 in 2000. Between 2000 and 2006, this number changed by -2.96%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in South Carolina in 2006?

18. The average cost per day for a hospital stay in South Carolina in 2005 was $1,465. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in South Carolina, 23 had a college degree in 2006. If the number of adults in South Carolina with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in South Carolina, 83 had a high school diploma in 2006 compared to 83 in 2000. What was the percentage change in the number of adults with high school diplomas in South Carolina between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 4
3. 2
4. 8
5. 9
6. 2
7. 1
8. -7015; 7
9. 9
10. 20,000 + 4,000 + 400 + 20 + 4
11. 9
12. 4
13. ones place
14. 2
15. 3
16. 1,000 + 600 + 10 + 4
17. 6
18. thousands place
19. 100,000 + 90,000 + 9,000
20. 1

Rounding Practice Answers

1. 4,447,000
2. 309,400
3. hundred thousands
4. 40
5. hundreds
6. 28,000
7. 32,000
8. 30,000
9. 38,000
10. hundreds
11. 1600
12. 150
13. 100
14. 30,000
15. ten thousands
16. 100 + 40 + 7; 150
17. 500 + 20 + 5; 500
18. 500,000
19. 200,000
20. 2,000,000

Estimation Practice Answers

1. 670 trillion BTUs
2. 83,000 square kilometers of total area
3. 1,500,000 people voted
4. 64,000 dollars
5. 500 trillion BTUs
6. 300,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 200,000 votes
11. 78,000 square kilometers of land
12. 5,200 square kilometers of water
13. 4,000,000 acres of farmland
14. 6,000,000 acres of farmland
15. 4,320,000 people
16. 1.08 times larger
17. 1.52 times more births than deaths
18. 1.36 times more expensive
19. 1.14 times larger
20. 1.14 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1911/32020
2. 5.97%
3. 30110/32020
4. 94.03%
5. 662,000
6. Yes. 58 percent voted Republican.
7. 517/1614
8. 32%; 32 BTUs came from petroleum
9. 25,000/2,090,000
10. 0.012; 12 farms
11. 4,608,000
12. 5/336
13. 147 trillion BTUs
14. 5.49%
15. 15.71% decrease
16. 528,000
17. 197
18. 6.83%
19. 46%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of South Dakota is projected to be 786,399 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of South Dakota changed by 27,075 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 68,615 births in South Dakota. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in South Dakota in 2006 who were high school graduates was 90%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in South Dakota was 733 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of South Dakota is 75,885 square miles and the total water area is 1,232 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of South Dakota is 75,885 square miles and the total water area is 1,232 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in South Dakota was $27,210. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in South Dakota. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in South Dakota was $29,149. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in South Dakota in 2000 was $25,718. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, South Dakota ranked number 36. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, South Dakota ranked number 36. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in South Dakota was 1,396 acres. What is the place value furthest to the right that contains the number 6?

14. In 2006, South Dakota had 31,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in South Dakota that were sold was 13,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in South Dakota in 2003 was 264 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 264 in expanded form.

17. The number of home sales in South Dakota in 2000 was 13,000. What is the digit in the ten thousands place?

18. The number of children in South Dakota who enrolled in Prekindergarten to Grade 8 was 84,000 children in 2004. In what place value is the rightmost 4 in 84,000?

19. The number of children in South Dakota who enrolled in Grade 9 to Grade 12 in 2004 was 39,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 388,000 people in South Dakota voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

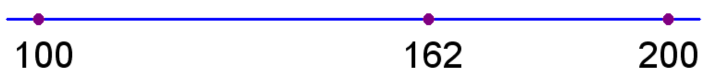
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

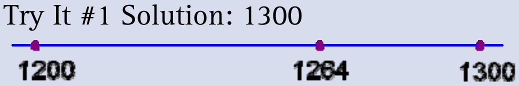


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of South Dakota is projected to be 786,399 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of South Dakota changed by 27,075 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 68,615 births in South Dakota. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in South Dakota in 2000 was 48. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in South Dakota was 733 dollars. We round this number to 700. What is the smallest place value to which you can round and get this number?

6. The total land area of South Dakota is 75,885 square miles and the total water area is 1,232 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of South Dakota is 75,885 square miles and the total water area is 1,232 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in South Dakota was $27,210. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in South Dakota was $29,149. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in South Dakota in 2000 was $25,718. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 25,700. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, South Dakota ranked number 36. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, South Dakota ranked number 26. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in South Dakota was 1,396 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, South Dakota had 31,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 13,000 homes. We round this number to 10,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in South Dakota in 2003 was 45 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 45 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in South Dakota in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in South Dakota who enrolled in Prekindergarten to Grade 8 was 84,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in South Dakota who enrolled in Grade 9 to Grade 12 was 39,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 388,000 people in South Dakota voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, South Dakota used 113 trillion BTUs of energy from petroleum and 45 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in South Dakota.

2. The number of square kilometers of land area in South Dakota is 196,540. The number of square kilometers of water area is 3,191. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 149,000 votes were cast for the Democratic candidate and 233,000 votes were cast for the Republican candidate in South Dakota. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in South Dakota who voted for the two candidates.

4. The average annual pay in South Dakota in 2004 was 28,281 dollars and in 2005 was 29,149. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in South Dakota consumed 44 trillion BTUs of energy from hydroelectric power (water) and 113 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in South Dakota in 2003.

6. In 2006, there were 782,000 people living in South Dakota. In 2000, there were 755,000 people living in South Dakota. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 68,615 births and 43,865 deaths in South Dakota. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in South Dakota was 476 dollars. In 2005, the average cost per day was 733 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 77 percent of adults living in South Dakota were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 191,000 votes cast for the Republican candidate and 119,000 votes cast for the Democratic candidate in South Dakota in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 75,885 square miles of land in South Dakota. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 1,232 square miles of water in South Dakota. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 32,000 farms in South Dakota. The average number of acres of land on each farm was 1,358. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in South Dakota by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 31,000 farms in South Dakota. The average number of acres of land on each farm was 1,396. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in South Dakota.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of South Dakota was 10 people per square mile. There are 75,885 square miles of land in South Dakota. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 782,000 people living in South Dakota. In 2000, there were 755,000 people living in South Dakota. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 68,615 births and 43,865 deaths in South Dakota. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in South Dakota was 476 dollars. In 2005, the average cost per day was 733 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 77 percent of adults living in South Dakota were high school graduates. In 2006, the number was 90 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 13,000 people unemployed in South Dakota. In 2000, there were 11,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1

Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. South Dakota has 1,232 square miles of water area and 77,117 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of South Dakota is water.

3. South Dakota has 75,885 square miles of land area and 77,117 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of South Dakota is land.

5. Approximately 38.40% of South Dakota voters chose the Democratic candidate in the 2004 election. A total of 388,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 233,000 citizens in South Dakota who voted for the Republican candidate in the 2004 presidential election. A total of 388,000 citizens voted. Did more than 55% of the voters in South Dakota select the Republican candidate?

7. The amount of energy consumed by people in South Dakota in 2003 that came from petroleum was 113 trillion BTUs. The total amount of energy consumed from all sources was 264 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in South Dakota, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. South Dakota had 31,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in South Dakota to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in South Dakota? (Round your answer to the nearest farm.)

11. There were 43,700,000 acres of farmland in South Dakota in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in South Dakota?

12. The projected population of South Dakota in 2020 is 801,939 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the South Dakota population to the United States population.

13. In South Dakota, 17.05% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 264 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in South Dakota in 2000 was $25,718. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,618. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 27,000 people in South Dakota that belonged to labor unions. In 2006, the number of labor union members was 21,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 99,000 patients admitted to hospitals in South Dakota. Between 2000 and 2005, this number changed by 3.03%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in South Dakota in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in South Dakota was 1,358 in 2000. Between 2000 and 2006, this number changed by 2.80%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in South Dakota in 2006?

18. The average cost per day for a hospital stay in South Dakota in 2005 was $733. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in South Dakota, 25 had a college degree in 2006. If the number of adults in South Dakota with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in South Dakota, 90 had a high school diploma in 2006 compared to 92 in 2000. What was the percentage change in the number of adults with high school diplomas in South Dakota between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 6
2. 0
3. 4
4. 9
5. 4
6. 7
7. 6
8. -10555; 0
9. 5
10. 20,000 + 5,000 + 700 + 10 + 8
11. 6
12. 2
13. ones place
14. 8
15. 0
16. 200 + 60 + 4
17. 1
18. thousands place
19. 30,000 + 9,000
20. 3

Rounding Practice Answers

1. 786,000
2. 27,100
3. hundred thousands
4. 80
5. hundreds
6. 75,000
7. 77,100
8. 30,000
9. 34,200
10. hundreds
11. 1600
12. 90
13. 1,300
14. 30,000
15. ten thousands
16. 40 + 5; 50
17. 0; 0
18. 80,000
19. 0
20. 0

Estimation Practice Answers

1. 160 trillion BTUs
2. 200,000 square kilometers of total area
3. 300,000 people voted
4. 56,000 dollars
5. 100 trillion BTUs
6. 0 people
7. 100,000 more births than deaths
8. 200 dollars
9. 10 percent change
10. 100,000 votes
11. 197,600 square kilometers of land
12. 2,600 square kilometers of water
13. 40,800,000 acres of farmland
14. 42,000,000 acres of farmland
15. 760,000 people
16. 1.00 times larger
17. 1.75 times more births than deaths
18. 1.40 times more expensive
19. 1.13 times larger
20. 1.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 1232/77117
2. 1.60%
3. 75885/77117
4. 98.40%
5. 149,000
6. Yes. 60.1 percent voted Republican.
7. 113/264
8. 43%; 43 BTUs came from petroleum
9. 31,000/2,090,000
10. 0.015; 15 farms
11. 41,515,000
12. 1/336
13. 45 trillion BTUs
14. 15.16%
15. 22.22% decrease
16. 102,000
17. 1,396
18. 13.64%
19. 50%
20. 2.17% decrease

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Tennessee is projected to be 6,230,852 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Tennessee changed by 349,541 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 493,881 births in Tennessee. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Tennessee in 2006 who were high school graduates was 81%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Tennessee was 1,234 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Tennessee is 41,217 square miles and the total water area is 926 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Tennessee is 41,217 square miles and the total water area is 926 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Tennessee was $33,581. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Tennessee. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Tennessee was $35,879. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Tennessee in 2000 was $26,096. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Tennessee ranked number 34. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Tennessee ranked number 34. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Tennessee was 139 acres. What is the place value furthest to the right that contains the number 9?

14. In 2006, Tennessee had 82,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Tennessee that were sold was 100,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Tennessee in 2003 was 2,269 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 2,269 in expanded form.

17. The number of home sales in Tennessee in 2000 was 100,000. What is the digit in the ten thousands place?

18. The number of children in Tennessee who enrolled in Prekindergarten to Grade 8 was 671,000 children in 2004. In what place value is the rightmost 1 in 671,000?

19. The number of children in Tennessee who enrolled in Grade 9 to Grade 12 in 2004 was 270,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,437,000 people in Tennessee voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

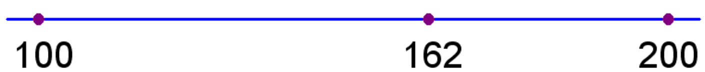
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



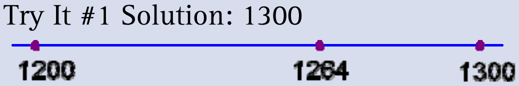
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Tennessee is projected to be 6,230,852 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Tennessee changed by 349,541 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 493,881 births in Tennessee. We round this number to 500,000 . To what place value did we round the number?

4. The number of hospitals in Tennessee in 2000 was 121. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Tennessee was 1,234 dollars. We round this number to 1,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Tennessee is 41,217 square miles and the total water area is 926 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Tennessee is 41,217 square miles and the total water area is 926 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Tennessee was $33,581. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Tennessee was $35,879. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Tennessee in 2000 was $26,096. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 26,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Tennessee ranked number 34. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Tennessee ranked number 35. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Tennessee was 139 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Tennessee had 82,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 100,000 homes. We round this number to 100,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Tennessee in 2003 was 268 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 268 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Tennessee in 2003 was 252 trillion BTU. (For some states, this amount will be 0.) Write 252 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Tennessee who enrolled in Prekindergarten to Grade 8 was 671,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Tennessee who enrolled in Grade 9 to Grade 12 was 270,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,437,000 people in Tennessee voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4 \times} 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2 \times} 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Tennessee used 782 trillion BTUs of energy from petroleum and 268 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Tennessee.

2. The number of square kilometers of land area in Tennessee is 106,752. The number of square kilometers of water area is 2,399. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,036,000 votes were cast for the Democratic candidate and 1,384,000 votes were cast for the Republican candidate in Tennessee. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Tennessee who voted for the two candidates.

4. The average annual pay in Tennessee in 2004 was 34,925 dollars and in 2005 was 35,879. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Tennessee consumed 123 trillion BTUs of energy from hydroelectric power (water) and 782 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Tennessee in 2003.

6. In 2006, there were 6,039,000 people living in Tennessee. In 2000, there were 5,689,000 people living in Tennessee. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 493,881 births and 351,615 deaths in Tennessee. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Tennessee was 1,078 dollars. In 2005, the average cost per day was 1,234 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 67 percent of adults living in Tennessee were high school graduates. In 2006, the number was 81 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,062,000 votes cast for the Republican candidate and 982,000 votes cast for the Democratic candidate in Tennessee in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 41,217 square miles of land in Tennessee. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 926 square miles of water in Tennessee. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 88,000 farms in Tennessee. The average number of acres of land on each farm was 134. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Tennessee by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 82,000 farms in Tennessee. The average number of acres of land on each farm was 139. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Tennessee.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Tennessee was 147 people per square mile. There are 41,217 square miles of land in Tennessee. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 6,039,000 people living in Tennessee. In 2000, there were 5,689,000 people living in Tennessee. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 493,881 births and 351,615 deaths in Tennessee. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Tennessee was 1,078 dollars. In 2005, the average cost per day was 1,234 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 67 percent of adults living in Tennessee were high school graduates. In 2006, the number was 81 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 132,000 people unemployed in Tennessee. In 2000, there were 115,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \cancel{\text{ square miles of area}}} \times 3{,}794{,}083 \cancel{\text{ square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Tennessee has 926 square miles of water area and 42,143 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Tennessee is water.

3. Tennessee has 41,217 square miles of land area and 42,143 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Tennessee is land.

5. Approximately 42.51% of Tennessee voters chose the Democratic candidate in the 2004 election. A total of 2,437,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,384,000 citizens in Tennessee who voted for the Republican candidate in the 2004 presidential election. A total of 2,437,000 citizens voted. Did more than 55% of the voters in Tennessee select the Republican candidate?

7. The amount of energy consumed by people in Tennessee in 2003 that came from petroleum was 782 trillion BTUs. The total amount of energy consumed from all sources was 2,269 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Tennessee, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Tennessee had 82,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Tennessee to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Tennessee? (Round your answer to the nearest farm.)

11. There were 11,400,000 acres of farmland in Tennessee in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Tennessee?

12. The projected population of Tennessee in 2020 is 6,780,670 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Tennessee population to the United States population.

13. In Tennessee, 11.81% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 2,269 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Tennessee in 2000 was $26,096. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $28,199. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 252,000 people in Tennessee that belonged to labor unions. In 2006, the number of labor union members was 153,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 737,000 patients admitted to hospitals in Tennessee. Between 2000 and 2005, this number changed by 12.48%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Tennessee in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Tennessee was 134 in 2000. Between 2000 and 2006, this number changed by 3.73%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Tennessee in 2006?

18. The average cost per day for a hospital stay in Tennessee in 2005 was $1,234. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Tennessee, 22 had a college degree in 2006. If the number of adults in Tennessee with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Tennessee, 81 had a high school diploma in 2006 compared to 80 in 2000. What was the percentage change in the number of adults with high school diplomas in Tennessee between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 5
3. 7
4. 8
5. 4
6. 2
7. 2
8. -4184; 4
9. 2
10. 20,000 + 6,000 + 90 + 6
11. 4
12. 3
13. ones place
14. 9
15. 5
16. 2,000 + 200 + 60 + 9
17. 0
18. thousands place
19. 200,000 + 70,000
20. 2

Rounding Practice Answers

1. 6,231,000
2. 349,500
3. hundred thousands
4. 120
5. hundreds
6. 40,000
7. 42,100
8. 30,000
9. 41,000
10. hundreds
11. 900
12. 120
13. 0
14. 80,000
15. ten thousands
16. 200 + 60 + 8; 270
17. 200 + 50 + 2; 300
18. 670,000
19. 300,000
20. 2,000,000

Estimation Practice Answers

1. 1050 trillion BTUs
2. 109,000 square kilometers of total area
3. 2,400,000 people voted
4. 70,000 dollars
5. 900 trillion BTUs
6. 300,000 people
7. 100,000 more births than deaths
8. 100 dollars
9. 10 percent change
10. 100,000 votes
11. 106,600 square kilometers of land
12. 2,600 square kilometers of water
13. 11,700,000 acres of farmland
14. 11,200,000 acres of farmland
15. 6,027,000 people
16. 1.05 times larger
17. 1.40 times more births than deaths
18. 1.09 times more expensive
19. 1.14 times larger
20. 1.08 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 926/42143
2. 2.20%
3. 41217/42143
4. 97.80%
5. 1,036,000
6. Yes. 56.8 percent voted Republican.
7. 782/2269
8. 34%; 34 BTUs came from petroleum
9. 82,000/2,090,000
10. 0.039; 39 farms
11. 10,830,000
12. 7/336
13. 268 trillion BTUs
14. 8.06%
15. 39.29% decrease
16. 829,000
17. 139
18. 8.10%
19. 44%
20. 1.25% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Texas is projected to be 24,648,888 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Texas changed by 2,655,993 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 2,351,909 births in Texas. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Texas in 2006 who were high school graduates was 79%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Texas was 1,636 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Texas is 261,797 square miles and the total water area is 6,784 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Texas is 261,797 square miles and the total water area is 6,784 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Texas was $36,968. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Texas. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Texas was $40,150. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Texas in 2000 was $28,310. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Texas ranked number 23. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Texas ranked number 23. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Texas was 564 acres. What is the place value furthest to the right that contains the number 4?

14. In 2006, Texas had 230,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Texas that were sold was 382,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Texas in 2003 was 12,370 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 12,370 in expanded form.

17. The number of home sales in Texas in 2000 was 382,000. What is the digit in the ten thousands place?

18. The number of children in Texas who enrolled in Prekindergarten to Grade 8 was 3,184,000 children in 2004. In what place value is the rightmost 4 in 3,184,000?

19. The number of children in Texas who enrolled in Grade 9 to Grade 12 in 2004 was 1,221,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 7,411,000 people in Texas voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

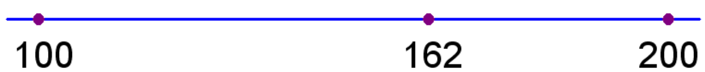
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



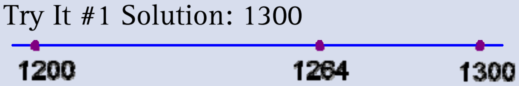
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Texas is projected to be 24,648,888 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Texas changed by 2,655,993 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 2,351,909 births in Texas. We round this number to 2,400,000 . To what place value did we round the number?

4. The number of hospitals in Texas in 2000 was 403. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Texas was 1,636 dollars. We round this number to 1,600. What is the smallest place value to which you can round and get this number?

6. The total land area of Texas is 261,797 square miles and the total water area is 6,784 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Texas is 261,797 square miles and the total water area is 6,784 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Texas was $36,968. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Texas was $40,150. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Texas in 2000 was $28,310. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,300. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Texas ranked number 23. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Texas ranked number 25. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Texas was 564 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Texas had 230,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 382,000 homes. We round this number to 380,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Texas in 2003 was 4,553 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 4,553 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Texas in 2003 was 349 trillion BTU. (For some states, this amount will be 0.) Write 349 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Texas who enrolled in Prekindergarten to Grade 8 was 3,184,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Texas who enrolled in Grade 9 to Grade 12 was 1,221,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 7,411,000 people in Texas voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Texas used 5,628 trillion BTUs of energy from petroleum and 4,553 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Texas.

2. The number of square kilometers of land area in Texas is 678,051. The number of square kilometers of water area is 17,570. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 2,833,000 votes were cast for the Democratic candidate and 4,527,000 votes were cast for the Republican candidate in Texas. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Texas who voted for the two candidates.

4. The average annual pay in Texas in 2004 was 38,511 dollars and in 2005 was 40,150. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Texas consumed 9 trillion BTUs of energy from hydroelectric power (water) and 5,628 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Texas in 2003.

6. In 2006, there were 23,508,000 people living in Texas. In 2000, there were 20,852,000 people living in Texas. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 2,351,909 births and 962,634 deaths in Texas. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Texas was 1,274 dollars. In 2005, the average cost per day was 1,636 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 72 percent of adults living in Texas were high school graduates. In 2006, the number was 79 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 3,800,000 votes cast for the Republican candidate and 2,434,000 votes cast for the Democratic candidate in Texas in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 261,797 square miles of land in Texas. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 6,784 square miles of water in Texas. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 228,000 farms in Texas. The average number of acres of land on each farm was 573. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Texas by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 230,000 farms in Texas. The average number of acres of land on each farm was 564. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Texas.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Texas was 90 people per square mile. There are 261,797 square miles of land in Texas. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 23,508,000 people living in Texas. In 2000, there were 20,852,000 people living in Texas. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 2,351,909 births and 962,634 deaths in Texas. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Texas was 1,274 dollars. In 2005, the average cost per day was 1,636 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 72 percent of adults living in Texas were high school graduates. In 2006, the number was 79 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 552,000 people unemployed in Texas. In 2000, there were 452,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Texas has 6,784 square miles of water area and 268,581 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Texas is water.

3. Texas has 261,797 square miles of land area and 268,581 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Texas is land.

5. Approximately 38.23% of Texas voters chose the Democratic candidate in the 2004 election. A total of 7,411,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 4,527,000 citizens in Texas who voted for the Republican candidate in the 2004 presidential election. A total of 7,411,000 citizens voted. Did more than 55% of the voters in Texas select the Republican candidate?

7. The amount of energy consumed by people in Texas in 2003 that came from petroleum was 5,628 trillion BTUs. The total amount of energy consumed from all sources was 12,370 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Texas, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Texas had 230,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Texas to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Texas? (Round your answer to the nearest farm.)

11. There were 129,700,000 acres of farmland in Texas in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Texas?

12. The projected population of Texas in 2020 is 28,634,896 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Texas population to the United States population.

13. In Texas, 36.81% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 12,370 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Texas in 2000 was $28,310. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,904. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 584,000 people in Texas that belonged to labor unions. In 2006, the number of labor union members was 476,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 2,367,000 patients admitted to hospitals in Texas. Between 2000 and 2005, this number changed by 6.00%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Texas in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Texas was 573 in 2000. Between 2000 and 2006, this number changed by -1.57%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Texas in 2006?

18. The average cost per day for a hospital stay in Texas in 2005 was $1,636. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Texas, 26 had a college degree in 2006. If the number of adults in Texas with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Texas, 79 had a high school diploma in 2006 compared to 79 in 2000. What was the percentage change in the number of adults with high school diplomas in Texas between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 8
2. 9
3. 3
4. 7
5. 2
6. 8
7. 0
8. -797; 0
9. 6
10. 20,000 + 8,000 + 300 + 10 + 0
11. 3
12. 2
13. ones place
14. 7
15. 9
16. 10,000 + 2,000 + 300 + 70
17. 8
18. thousands place
19. 1,000,000 + 200,000 + 20,000 + 1,000
20. 7

Rounding Practice Answers

1. 24,649,000
2. 2,656,000
3. hundred thousands
4. 300
5. hundreds
6. 255,000
7. 268,600
8. 40,000
9. 45,300
10. hundreds
11. 400
12. 90
13. 500
14. 230,000
15. ten thousands
16. 4,000 + 500 + 50 + 3; 4550
17. 300 + 40 + 9; 300
18. 3,180,000
19. 1,200,000
20. 7,000,000

Estimation Practice Answers

1. 10180 trillion BTUs
2. 696,000 square kilometers of total area
3. 6,900,000 people voted
4. 77,000 dollars
5. 5600 trillion BTUs
6. 2,600,000 people
7. 1,400,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 1,400,000 votes
11. 681,200 square kilometers of land
12. 18,200 square kilometers of water
13. 131,100,000 acres of farmland
14. 128,800,000 acres of farmland
15. 23,580,000 people
16. 1.12 times larger
17. 2.45 times more births than deaths
18. 1.23 times more expensive
19. 1.14 times larger
20. 1.22 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 6784/268581
2. 2.53%
3. 261797/268581
4. 97.47%
5. 2,833,000
6. Yes. 61.1 percent voted Republican.
7. 5628/12370
8. 45%; 45 BTUs came from petroleum
9. 230,000/2,090,000
10. 0.11; 110 farms
11. 123,215,000
12. 29/336
13. 4553 trillion BTUs
14. 5.63%
15. 18.49% decrease
16. 2,509,000
17. 564
18. 6.11%
19. 52%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Utah is projected to be 2,595,013 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Utah changed by 316,865 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 308,460 births in Utah. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Utah in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Utah was 1,823 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Utah is 82,144 square miles and the total water area is 2,755 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Utah is 82,144 square miles and the total water area is 2,755 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Utah was $31,106. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Utah. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Utah was $33,328. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Utah in 2000 was $23,874. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Utah ranked number 43. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Utah ranked number 43. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Utah was 768 acres. What is the place value furthest to the right that contains the number 8?

14. In 2006, Utah had 15,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Utah that were sold was 36,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Utah in 2003 was 705 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 705 in expanded form.

17. The number of home sales in Utah in 2000 was 36,000. What is the digit in the ten thousands place?

18. The number of children in Utah who enrolled in Prekindergarten to Grade 8 was 355,000 children in 2004. In what place value is the rightmost 5 in 355,000?

19. The number of children in Utah who enrolled in Grade 9 to Grade 12 in 2004 was 148,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 928,000 people in Utah voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

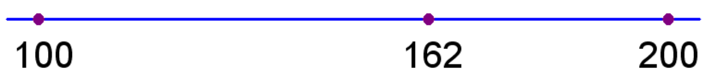
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

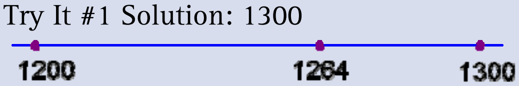


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Utah is projected to be 2,595,013 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Utah changed by 316,865 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 308,460 births in Utah. We round this number to 300,000 . To what place value did we round the number?

4. The number of hospitals in Utah in 2000 was 42. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Utah was 1,823 dollars. We round this number to 1,800. What is the smallest place value to which you can round and get this number?

6. The total land area of Utah is 82,144 square miles and the total water area is 2,755 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Utah is 82,144 square miles and the total water area is 2,755 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Utah was $31,106. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Utah was $33,328. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Utah in 2000 was $23,874. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 23,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Utah ranked number 43. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Utah ranked number 47. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Utah was 768 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Utah had 15,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 36,000 homes. We round this number to 40,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Utah in 2003 was 163 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 163 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Utah in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Utah who enrolled in Prekindergarten to Grade 8 was 355,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Utah who enrolled in Grade 9 to Grade 12 was 148,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 928,000 people in Utah voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Utah used 276 trillion BTUs of energy from petroleum and 163 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Utah.

2. The number of square kilometers of land area in Utah is 212,751. The number of square kilometers of water area is 7,136. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 241,000 votes were cast for the Democratic candidate and 664,000 votes were cast for the Republican candidate in Utah. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Utah who voted for the two candidates.

4. The average annual pay in Utah in 2004 was 32,171 dollars and in 2005 was 33,328. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Utah consumed 4 trillion BTUs of energy from hydroelectric power (water) and 276 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Utah in 2003.

6. In 2006, there were 2,550,000 people living in Utah. In 2000, there were 2,233,000 people living in Utah. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 308,460 births and 82,192 deaths in Utah. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Utah was 1,375 dollars. In 2005, the average cost per day was 1,823 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 85 percent of adults living in Utah were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 515,000 votes cast for the Republican candidate and 203,000 votes cast for the Democratic candidate in Utah in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 82,144 square miles of land in Utah. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 2,755 square miles of water in Utah. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 16,000 farms in Utah. The average number of acres of land on each farm was 748. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Utah by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 15,000 farms in Utah. The average number of acres of land on each farm was 768. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Utah.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Utah was 31 people per square mile. There are 82,144 square miles of land in Utah. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 2,550,000 people living in Utah. In 2000, there were 2,233,000 people living in Utah. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 308,460 births and 82,192 deaths in Utah. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Utah was 1,375 dollars. In 2005, the average cost per day was 1,823 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 85 percent of adults living in Utah were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 36,000 people unemployed in Utah. In 2000, there were 38,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of}} \text{ area}} \times 3{,}794{,}083 \ \cancel{\text{square miles of}} \text{ area} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3,537,438}{3,794,083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Utah has 2,755 square miles of water area and 84,899 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Utah is water.

3. Utah has 82,144 square miles of land area and 84,899 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Utah is land.

5. Approximately 25.97% of Utah voters chose the Democratic candidate in the 2004 election. A total of 928,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 664,000 citizens in Utah who voted for the Republican candidate in the 2004 presidential election. A total of 928,000 citizens voted. Did more than 55% of the voters in Utah select the Republican candidate?

7. The amount of energy consumed by people in Utah in 2003 that came from petroleum was 276 trillion BTUs. The total amount of energy consumed from all sources was 705 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Utah, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Utah had 15,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Utah to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Utah? (Round your answer to the nearest farm.)

11. There were 11,600,000 acres of farmland in Utah in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Utah?

12. The projected population of Utah in 2020 is 2,990,094 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Utah population to the United States population.

13. In Utah, 23.12% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 705 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Utah in 2000 was $23,874. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $25,409. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 82,000 people in Utah that belonged to labor unions. In 2006, the number of labor union members was 61,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 194,000 patients admitted to hospitals in Utah. Between 2000 and 2005, this number changed by 14.95%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Utah in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Utah was 748 in 2000. Between 2000 and 2006, this number changed by 2.67%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Utah in 2006?

18. The average cost per day for a hospital stay in Utah in 2005 was $1,823. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Utah, 27 had a college degree in 2006. If the number of adults in Utah with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Utah, 91 had a high school diploma in 2006 compared to 91 in 2000. What was the percentage change in the number of adults with high school diplomas in Utah between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 5
2. 8
3. 8
4. 9
5. 6
6. 4
7. 3
8. -6659; 6
9. 9
10. 20,000 + 3,000 + 800 + 70 + 4
11. 3
12. 4
13. ones place
14. 2
15. 1
16. 700 + 5
17. 3
18. thousands place
19. 100,000 + 40,000 + 8,000
20. 9

Rounding Practice Answers

1. 2,595,000
2. 316,900
3. hundred thousands
4. 20
5. hundreds
6. 79,000
7. 84,900
8. 30,000
9. 38,400
10. hundreds
11. 1600
12. 150
13. 700
14. 20,000
15. ten thousands
16. 100 + 60 + 3; 160
17. 0; 0
18. 360,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 440 trillion BTUs
2. 220,000 square kilometers of total area
3. 900,000 people voted
4. 64,000 dollars
5. 300 trillion BTUs
6. 400,000 people
7. 200,000 more births than deaths
8. 400 dollars
9. 0 percent change
10. 300,000 votes
11. 213,200 square kilometers of land
12. 7,800 square kilometers of water
13. 15,000,000 acres of farmland
14. 15,400,000 acres of farmland
15. 2,542,000 people
16. 1.18 times larger
17. 3.88 times more births than deaths
18. 1.29 times more expensive
19. 1.00 times larger
20. 1.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 2755/84899
2. 3.25%
3. 82144/84899
4. 96.75%
5. 241,000
6. Yes. 71.6 percent voted Republican.
7. 276/705
8. 39%; 39 BTUs came from petroleum
9. 15,000/2,090,000
10. 0.007; 7 farms
11. 11,020,000
12. 3/336
13. 163 trillion BTUs
14. 6.43%
15. 25.61% decrease
16. 223,000
17. 768
18. 5.49%
19. 54%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Vermont is projected to be 652,512 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Vermont changed by 15,081 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 40,670 births in Vermont. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Vermont in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Vermont was 1,166 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Vermont is 9,250 square miles and the total water area is 365 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Vermont is 9,250 square miles and the total water area is 365 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Vermont was $32,086. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Vermont. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Vermont was $34,197. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Vermont in 2000 was $27,678. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Vermont ranked number 28. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Vermont ranked number 28. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Vermont was 197 acres. What is the place value furthest to the right that contains the number 7?

14. In 2006, Vermont had 6,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Vermont that were sold was 12,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Vermont in 2003 was 156 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 156 in expanded form.

17. The number of home sales in Vermont in 2000 was 12,000. What is the digit in the ten thousands place?

18. The number of children in Vermont who enrolled in Prekindergarten to Grade 8 was 66,000 children in 2004. In what place value is the rightmost 6 in 66,000?

19. The number of children in Vermont who enrolled in Grade 9 to Grade 12 in 2004 was 32,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 312,000 people in Vermont voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

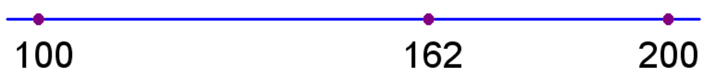
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.



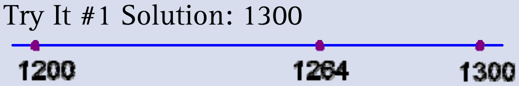
Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1

According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Vermont is projected to be 652,512 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Vermont changed by 15,081 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 40,670 births in Vermont. We round this number to 0 . To what place value did we round the number?

4. The number of hospitals in Vermont in 2000 was 14. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Vermont was 1,166 dollars. We round this number to 1,200. What is the smallest place value to which you can round and get this number?

6. The total land area of Vermont is 9,250 square miles and the total water area is 365 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Vermont is 9,250 square miles and the total water area is 365 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Vermont was $32,086. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Vermont was $34,197. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Vermont in 2000 was $27,678. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 27,700. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Vermont ranked number 28. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Vermont ranked number 24. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Vermont was 197 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Vermont had 6,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 12,000 homes. We round this number to 10,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Vermont in 2003 was 9 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 9 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Vermont in 2003 was 46 trillion BTU. (For some states, this amount will be 0.) Write 46 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Vermont who enrolled in Prekindergarten to Grade 8 was 66,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Vermont who enrolled in Grade 9 to Grade 12 was 32,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 312,000 people in Vermont voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Vermont used 86 trillion BTUs of energy from petroleum and 9 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Vermont.

2. The number of square kilometers of land area in Vermont is 23,956. The number of square kilometers of water area is 945. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 184,000 votes were cast for the Democratic candidate and 121,000 votes were cast for the Republican candidate in Vermont. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Vermont who voted for the two candidates.

4. The average annual pay in Vermont in 2004 was 33,274 dollars and in 2005 was 34,197. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Vermont consumed 12 trillion BTUs of energy from hydroelectric power (water) and 86 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Vermont in 2003.

6. In 2006, there were 624,000 people living in Vermont. In 2000, there were 609,000 people living in Vermont. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 40,670 births and 31,805 deaths in Vermont. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Vermont was 888 dollars. In 2005, the average cost per day was 1,166 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 81 percent of adults living in Vermont were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 120,000 votes cast for the Republican candidate and 149,000 votes cast for the Democratic candidate in Vermont in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 9,250 square miles of land in Vermont. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 365 square miles of water in Vermont. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 7,000 farms in Vermont. The average number of acres of land on each farm was 192. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Vermont by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 6,000 farms in Vermont. The average number of acres of land on each farm was 197. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Vermont.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Vermont was 68 people per square mile. There are 9,250 square miles of land in Vermont. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 624,000 people living in Vermont. In 2000, there were 609,000 people living in Vermont. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 40,670 births and 31,805 deaths in Vermont. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Vermont was 888 dollars. In 2005, the average cost per day was 1,166 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 81 percent of adults living in Vermont were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 15,000 people unemployed in Vermont. In 2000, there were 9,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2
The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Vermont has 365 square miles of water area and 9,614 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Vermont is water.

3. Vermont has 9,250 square miles of land area and 9,614 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Vermont is land.

5. Approximately 58.97% of Vermont voters chose the Democratic candidate in the 2004 election. A total of 312,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 121,000 citizens in Vermont who voted for the Republican candidate in the 2004 presidential election. A total of 312,000 citizens voted. Did more than 55% of the voters in Vermont select the Republican candidate?

7. The amount of energy consumed by people in Vermont in 2003 that came from petroleum was 86 trillion BTUs. The total amount of energy consumed from all sources was 156 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Vermont, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Vermont had 6,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Vermont to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Vermont? (Round your answer to the nearest farm.)

11. There were 1,240,000 acres of farmland in Vermont in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Vermont?

12. The projected population of Vermont in 2020 is 690,686 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Vermont population to the United States population.

13. In Vermont, 5.77% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 156 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Vermont in 2000 was $27,678. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $29,910. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 26,000 people in Vermont that belonged to labor unions. In 2006, the number of labor union members was 34,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 52,000 patients admitted to hospitals in Vermont. Between 2000 and 2005, this number changed by -1.92%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Vermont in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Vermont was 192 in 2000. Between 2000 and 2006, this number changed by 2.60%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Vermont in 2006?

18. The average cost per day for a hospital stay in Vermont in 2005 was $1,166. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Vermont, 34 had a college degree in 2006. If the number of adults in Vermont with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Vermont, 91 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Vermont between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 2
2. 0
3. 2
4. 9
5. 3
6. 9
7. 8
8. -5679; 5
9. 0
10. 20,000 + 7,000 + 600 + 70 + 8
11. 8
12. 2
13. ones place
14. 3
15. 0
16. 100 + 50 + 6
17. 1
18. thousands place
19. 30,000 + 2,000
20. 3

Rounding Practice Answers

1. 653,000
2. 15,100
3. hundred thousands
4. 40
5. hundreds
6. 9,000
7. 9,700
8. 30,000
9. 39,300
10. hundreds
11. 900
12. 60
13. 100
14. 10,000
15. ten thousands
16. 9; 10
17. 40 + 6; 0
18. 70,000
19. 0
20. 0

Estimation Practice Answers

1. 100 trillion BTUs
2. 25,000 square kilometers of total area
3. 200,000 people voted
4. 66,000 dollars
5. 100 trillion BTUs
6. 0 people
7. 0 more births than deaths
8. 300 dollars
9. 10 percent change
10. 0 votes
11. 23,400 square kilometers of land
12. 0 square kilometers of water
13. 1,900,000 acres of farmland
14. 2,000,000 acres of farmland
15. 612,000 people
16. 1.00 times larger
17. 1.33 times more births than deaths
18. 1.33 times more expensive
19. 1.13 times larger
20. 2.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 365/9614
2. 3.80%
3. 9250/9614
4. 96.21%
5. 184,000
6. No. 38.8 percent voted Republican.
7. 86/156
8. 55%; 55 BTUs came from petroleum
9. 6,000/2,090,000
10. 0.003; 3 farms
11. 1,178,000
12. 1/336
13. 9 trillion BTUs
14. 8.06%
15. 30.77% increase
16. 51,000
17. 197
18. 8.58%
19. 68%
20. 1.11% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000	100,000	10,000	1000	100	10	1
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Virginia is projected to be 8,010,245 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Virginia changed by 563,854 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 633,794 births in Virginia. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Virginia in 2006 who were high school graduates was 87%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Virginia was 1,394 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Virginia is 39,594 square miles and the total water area is 3,180 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Virginia is 39,594 square miles and the total water area is 3,180 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Virginia was $38,585. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Virginia. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Virginia was $42,287. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Virginia in 2000 was $31,085. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Virginia ranked number 12. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Virginia ranked number 12. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Virginia was 182 acres. What is the place value furthest to the right that contains the number 2?

14. In 2006, Virginia had 47,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Virginia that were sold was 130,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Virginia in 2003 was 2,429 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 2,429 in expanded form.

17. The number of home sales in Virginia in 2000 was 130,000. What is the digit in the ten thousands place?

18. The number of children in Virginia who enrolled in Prekindergarten to Grade 8 was 840,000 children in 2004. In what place value is the rightmost 0 in 840,000?

19. The number of children in Virginia who enrolled in Grade 9 to Grade 12 in 2004 was 365,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 3,195,000 people in Virginia voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

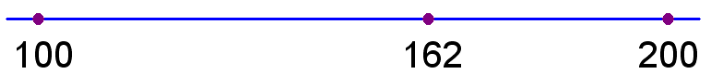
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

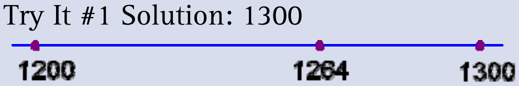


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Virginia is projected to be 8,010,245 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Virginia changed by 563,854 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 633,794 births in Virginia. We round this number to 600,000 . To what place value did we round the number?

4. The number of hospitals in Virginia in 2000 was 88. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Virginia was 1,394 dollars. We round this number to 1,400. What is the smallest place value to which you can round and get this number?

6. The total land area of Virginia is 39,594 square miles and the total water area is 3,180 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Virginia is 39,594 square miles and the total water area is 3,180 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Virginia was $38,585. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Virginia was $42,287. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Virginia in 2000 was $31,085. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 31,100. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Virginia ranked number 12. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Virginia ranked number 9. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Virginia was 182 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Virginia had 47,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 130,000 homes. We round this number to 130,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Virginia in 2003 was 272 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 272 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Virginia in 2003 was 259 trillion BTU. (For some states, this amount will be 0.) Write 259 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Virginia who enrolled in Prekindergarten to Grade 8 was 840,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Virginia who enrolled in Grade 9 to Grade 12 was 365,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 3,195,000 people in Virginia voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Virginia used 965 trillion BTUs of energy from petroleum and 272 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Virginia.

2. The number of square kilometers of land area in Virginia is 102,548. The number of square kilometers of water area is 8,237. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,455,000 votes were cast for the Democratic candidate and 1,717,000 votes were cast for the Republican candidate in Virginia. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Virginia who voted for the two candidates.

4. The average annual pay in Virginia in 2004 was 40,534 dollars and in 2005 was 42,287. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Virginia consumed 18 trillion BTUs of energy from hydroelectric power (water) and 965 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Virginia in 2003.

6. In 2006, there were 7,643,000 people living in Virginia. In 2000, there were 7,079,000 people living in Virginia. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 633,794 births and 357,755 deaths in Virginia. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Virginia was 1,057 dollars. In 2005, the average cost per day was 1,394 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 75 percent of adults living in Virginia were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,437,000 votes cast for the Republican candidate and 1,217,000 votes cast for the Democratic candidate in Virginia in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 39,594 square miles of land in Virginia. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 3,180 square miles of water in Virginia. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 49,000 farms in Virginia. The average number of acres of land on each farm was 180. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Virginia by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 47,000 farms in Virginia. The average number of acres of land on each farm was 182. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Virginia.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Virginia was 193 people per square mile. There are 39,594 square miles of land in Virginia. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 7,643,000 people living in Virginia. In 2000, there were 7,079,000 people living in Virginia. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 633,794 births and 357,755 deaths in Virginia. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Virginia was 1,057 dollars. In 2005, the average cost per day was 1,394 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 75 percent of adults living in Virginia were high school graduates. In 2006, the number was 87 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 143,000 people unemployed in Virginia. In 2000, there were 82,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Virginia has 3,180 square miles of water area and 42,774 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Virginia is water.

3. Virginia has 39,594 square miles of land area and 42,774 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Virginia is land.

5. Approximately 45.54% of Virginia voters chose the Democratic candidate in the 2004 election. A total of 3,195,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,717,000 citizens in Virginia who voted for the Republican candidate in the 2004 presidential election. A total of 3,195,000 citizens voted. Did more than 55% of the voters in Virginia select the Republican candidate?

7. The amount of energy consumed by people in Virginia in 2003 that came from petroleum was 965 trillion BTUs. The total amount of energy consumed from all sources was 2,429 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Virginia, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Virginia had 47,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Virginia to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Virginia? (Round your answer to the nearest farm.)

11. There were 8,500,000 acres of farmland in Virginia in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Virginia?

12. The projected population of Virginia in 2020 is 8,917,395 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Virginia population to the United States population.

13. In Virginia, 11.20% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 2,429 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Virginia in 2000 was $31,085. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $34,196. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 268,000 people in Virginia that belonged to labor unions. In 2006, the number of labor union members was 140,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 727,000 patients admitted to hospitals in Virginia. Between 2000 and 2005, this number changed by 7.29%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Virginia in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Virginia was 180 in 2000. Between 2000 and 2006, this number changed by 1.11%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Virginia in 2006?

18. The average cost per day for a hospital stay in Virginia in 2005 was $1,394. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Virginia, 32 had a college degree in 2006. If the number of adults in Virginia with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Virginia, 87 had a high school diploma in 2006 compared to 87 in 2000. What was the percentage change in the number of adults with high school diplomas in Virginia between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 0
2. 8
3. 1
4. 8
5. 7
6. 2
7. 4
8. 820; 0
9. 8
10. 30,000 + 1,000 + 80 + 5
11. 2
12. 0
13. ones place
14. 4
15. 6
16. 2,000 + 400 + 20 + 9
17. 3
18. thousands place
19. 300,000 + 60,000 + 5,000
20. 3

Rounding Practice Answers

1. 8,010,000
2. 563,900
3. hundred thousands
4. 90
5. hundreds
6. 37,000
7. 42,800
8. 40,000
9. 47,400
10. hundreds
11. 100
12. 30
13. 100
14. 50,000
15. ten thousands
16. 200 + 70 + 2; 270
17. 200 + 50 + 9; 300
18. 840,000
19. 400,000
20. 3,000,000

Estimation Practice Answers

1. 1240 trillion BTUs
2. 111,000 square kilometers of total area
3. 2,900,000 people voted
4. 81,000 dollars
5. 1000 trillion BTUs
6. 500,000 people
7. 200,000 more births than deaths
8. 300 dollars
9. 10 percent change
10. 200,000 votes
11. 104,000 square kilometers of land
12. 7,800 square kilometers of water
13. 9,000,000 acres of farmland
14. 9,000,000 acres of farmland
15. 7,720,000 people
16. 1.07 times larger
17. 1.75 times more births than deaths
18. 1.27 times more expensive
19. 1.13 times larger
20. 1.75 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 3180/42774
2. 7.43%
3. 39594/42774
4. 92.57%
5. 1,455,000
6. No. 53.7 percent voted Republican.
7. 965/2429
8. 40%; 40 BTUs came from petroleum
9. 47,000/2,090,000
10. 0.022; 22 farms
11. 8,075,000
12. 9/336
13. 272 trillion BTUs
14. 10.01%
15. 47.76% decrease
16. 780,000
17. 182
18. 7.17%
19. 64%
20. 0% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200{,}000 + 40{,}000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Washington is projected to be 6,541,963 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Washington changed by 501,658 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 503,819 births in Washington. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Washington in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Washington was 2,143 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Washington is 66,544 square miles and the total water area is 4,756 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Washington is 66,544 square miles and the total water area is 4,756 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Washington was $39,021. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Washington. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Washington was $40,721. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Washington in 2000 was $31,775. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Washington ranked number 11. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Washington ranked number 11. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Washington was 444 acres. What is the place value furthest to the right that contains the number 4?

14. In 2006, Washington had 34,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Washington that were sold was 112,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Washington in 2003 was 1,935 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,935 in expanded form.

17. The number of home sales in Washington in 2000 was 112,000. What is the digit in the ten thousands place?

18. The number of children in Washington who enrolled in Prekindergarten to Grade 8 was 695,000 children in 2004. In what place value is the rightmost 5 in 695,000?

19. The number of children in Washington who enrolled in Grade 9 to Grade 12 in 2004 was 325,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,859,000 people in Washington voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

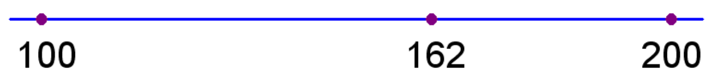
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

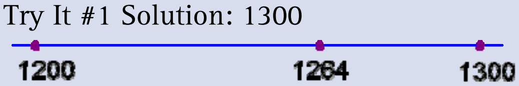


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Washington is projected to be 6,541,963 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Washington changed by 501,658 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 503,819 births in Washington. We round this number to 500,000 . To what place value did we round the number?

4. The number of hospitals in Washington in 2000 was 84. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Washington was 2,143 dollars. We round this number to 2,100. What is the smallest place value to which you can round and get this number?

6. The total land area of Washington is 66,544 square miles and the total water area is 4,756 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Washington is 66,544 square miles and the total water area is 4,756 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Washington was $39,021. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Washington was $40,721. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Washington in 2000 was $31,775. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 31,800. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Washington ranked number 11. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Washington ranked number 14. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Washington was 444 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Washington had 34,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 112,000 homes. We round this number to 110,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Washington in 2003 was 255 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 255 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Washington in 2003 was 79 trillion BTU. (For some states, this amount will be 0.) Write 79 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Washington who enrolled in Prekindergarten to Grade 8 was 695,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Washington who enrolled in Grade 9 to Grade 12 was 325,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,859,000 people in Washington voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \times \cancel{10}}{4 \times \cancel{4} \times \cancel{10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \times \cancel{2} \times 5}{\cancel{2} \times \cancel{2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Washington used 793 trillion BTUs of energy from petroleum and 255 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Washington.

2. The number of square kilometers of land area in Washington is 172,348. The number of square kilometers of water area is 12,317. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,510,000 votes were cast for the Democratic candidate and 1,305,000 votes were cast for the Republican candidate in Washington. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Washington who voted for the two candidates.

4. The average annual pay in Washington in 2004 was 39,361 dollars and in 2005 was 40,721. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Washington consumed 735 trillion BTUs of energy from hydroelectric power (water) and 793 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Washington in 2003.

6. In 2006, there were 6,396,000 people living in Washington. In 2000, there were 5,894,000 people living in Washington. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 503,819 births and 281,861 deaths in Washington. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Washington was 1,511 dollars. In 2005, the average cost per day was 2,143 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 84 percent of adults living in Washington were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,109,000 votes cast for the Republican candidate and 1,248,000 votes cast for the Democratic candidate in Washington in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 66,544 square miles of land in Washington. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 4,756 square miles of water in Washington. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 37,000 farms in Washington. The average number of acres of land on each farm was 420. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Washington by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 34,000 farms in Washington. The average number of acres of land on each farm was 444. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Washington.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Washington was 96 people per square mile. There are 66,544 square miles of land in Washington. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 6,396,000 people living in Washington. In 2000, there were 5,894,000 people living in Washington. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 503,819 births and 281,861 deaths in Washington. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Washington was 1,511 dollars. In 2005, the average cost per day was 2,143 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 84 percent of adults living in Washington were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 131,000 people unemployed in Washington. In 2000, there were 151,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1

Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Washington has 4,756 square miles of water area and 71,300 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Washington is water.

3. Washington has 66,544 square miles of land area and 71,300 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Washington is land.

5. Approximately 52.82% of Washington voters chose the Democratic candidate in the 2004 election. A total of 2,859,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,305,000 citizens in Washington who voted for the Republican candidate in the 2004 presidential election. A total of 2,859,000 citizens voted. Did more than 55% of the voters in Washington select the Republican candidate?

7. The amount of energy consumed by people in Washington in 2003 that came from petroleum was 793 trillion BTUs. The total amount of energy consumed from all sources was 1,935 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Washington, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Washington had 34,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Washington to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Washington? (Round your answer to the nearest farm.)

11. There were 15,100,000 acres of farmland in Washington in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Washington?

12. The projected population of Washington in 2020 is 7,432,136 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Washington population to the United States population.

13. In Washington, 13.18% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,935 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Washington in 2000 was $31,775. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $32,668. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 420,000 people in Washington that belonged to labor unions. In 2006, the number of labor union members was 549,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 505,000 patients admitted to hospitals in Washington. Between 2000 and 2005, this number changed by 7.52%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Washington in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Washington was 420 in 2000. Between 2000 and 2006, this number changed by 5.71%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Washington in 2006?

18. The average cost per day for a hospital stay in Washington in 2005 was $2,143. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Washington, 31 had a college degree in 2006. If the number of adults in Washington with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Washington, 91 had a high school diploma in 2006 compared to 92 in 2000. What was the percentage change in the number of adults with high school diplomas in Washington between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 1
2. 6
3. 8
4. 9
5. 2
6. 1
7. 7
8. 1256; 1
9. 7
10. 30,000 + 1,000 + 700 + 70 + 5
11. 1
12. 1
13. ones place
14. 1
15. 5
16. 1,000 + 900 + 30 + 5
17. 1
18. thousands place
19. 300,000 + 20,000 + 5,000
20. 2

Rounding Practice Answers

1. 6,542,000
2. 501,700
3. hundred thousands
4. 50
5. hundreds
6. 62,000
7. 71,300
8. 40,000
9. 45,800
10. hundreds
11. 100
12. 30
13. 300
14. 30,000
15. ten thousands
16. 200 + 50 + 5; 260
17. 70 + 9; 100
18. 700,000
19. 300,000
20. 3,000,000

Estimation Practice Answers

1. 1050 trillion BTUs
2. 184,000 square kilometers of total area
3. 2,500,000 people voted
4. 80,000 dollars
5. 1500 trillion BTUs
6. 500,000 people
7. 200,000 more births than deaths
8. 600 dollars
9. 10 percent change
10. 100,000 votes
11. 174,200 square kilometers of land
12. 13,000 square kilometers of water
13. 16,800,000 acres of farmland
14. 13,200,000 acres of farmland
15. 6,432,000 people
16. 1.08 times larger
17. 1.79 times more births than deaths
18. 1.40 times more expensive
19. 1.13 times larger
20. 0.87 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 4756/71300
2. 6.67%
3. 66544/71300
4. 93.33%
5. 1,510,000
6. No. 45.6 percent voted Republican.
7. 793/1935
8. 41%; 41 BTUs came from petroleum
9. 34,000/2,090,000
10. 0.016; 16 farms
11. 14,345,000
12. 7/336
13. 255 trillion BTUs
14. 2.81%
15. 30.71% increase
16. 543,000
17. 444
18. 4.67%
19. 62%
20. 1.09% decrease

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of West Virginia is projected to be 1,829,141 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of West Virginia changed by 10,120 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 130,202 births in West Virginia. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in West Virginia in 2006 who were high school graduates was 82%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in West Virginia was 1,113 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of West Virginia is 24,078 square miles and the total water area is 152 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of West Virginia is 24,078 square miles and the total water area is 152 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in West Virginia was $29,284. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in West Virginia. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in West Virginia was $31,347. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in West Virginia in 2000 was $21,898. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, West Virginia ranked number 49. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, West Virginia ranked number 49. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in West Virginia was 170 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, West Virginia had 21,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in West Virginia that were sold was 23,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in West Virginia in 2003 was 784 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 784 in expanded form.

17. The number of home sales in West Virginia in 2000 was 23,000. What is the digit in the ten thousands place?

18. The number of children in West Virginia who enrolled in Prekindergarten to Grade 8 was 198,000 children in 2004. In what place value is the rightmost 8 in 198,000?

19. The number of children in West Virginia who enrolled in Grade 9 to Grade 12 in 2004 was 83,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 756,000 people in West Virginia voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

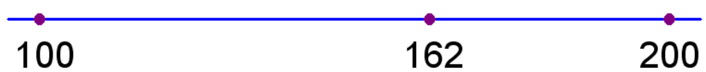
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

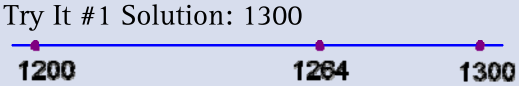


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of West Virginia is projected to be 1,829,141 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of West Virginia changed by 10,120 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 130,202 births in West Virginia. We round this number to 100,000 . To what place value did we round the number?

4. The number of hospitals in West Virginia in 2000 was 57. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in West Virginia was 1,113 dollars. We round this number to 1,100. What is the smallest place value to which you can round and get this number?

6. The total land area of West Virginia is 24,078 square miles and the total water area is 152 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of West Virginia is 24,078 square miles and the total water area is 152 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in West Virginia was $29,284. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in West Virginia was $31,347. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in West Virginia in 2000 was $21,898. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 21,900. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, West Virginia ranked number 49. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, West Virginia ranked number 49. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in West Virginia was 170 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, West Virginia had 21,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 23,000 homes. We round this number to 20,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in West Virginia in 2003 was 134 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 134 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in West Virginia in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in West Virginia who enrolled in Prekindergarten to Grade 8 was 198,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in West Virginia who enrolled in Grade 9 to Grade 12 was 83,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 756,000 people in West Virginia voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food \$2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, West Virginia used 255 trillion BTUs of energy from petroleum and 134 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in West Virginia.

2. The number of square kilometers of land area in West Virginia is 62,361. The number of square kilometers of water area is 394. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 327,000 votes were cast for the Democratic candidate and 424,000 votes were cast for the Republican candidate in West Virginia. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in West Virginia who voted for the two candidates.

4. The average annual pay in West Virginia in 2004 was 30,382 dollars and in 2005 was 31,347. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in West Virginia consumed 14 trillion BTUs of energy from hydroelectric power (water) and 255 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in West Virginia in 2003.

6. In 2006, there were 1,818,000 people living in West Virginia. In 2000, there were 1,808,000 people living in West Virginia. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 130,202 births and 131,811 deaths in West Virginia. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in West Virginia was 844 dollars. In 2005, the average cost per day was 1,113 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 66 percent of adults living in West Virginia were high school graduates. In 2006, the number was 82 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 336,000 votes cast for the Republican candidate and 295,000 votes cast for the Democratic candidate in West Virginia in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 24,078 square miles of land in West Virginia. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 152 square miles of water in West Virginia. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 21,000 farms in West Virginia. The average number of acres of land on each farm was 173. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in West Virginia by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 21,000 farms in West Virginia. The average number of acres of land on each farm was 170. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in West Virginia.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of West Virginia was 76 people per square mile. There are 24,078 square miles of land in West Virginia. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 1,818,000 people living in West Virginia. In 2000, there were 1,808,000 people living in West Virginia. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 130,202 births and 131,811 deaths in West Virginia. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in West Virginia was 844 dollars. In 2005, the average cost per day was 1,113 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 66 percent of adults living in West Virginia were high school graduates. In 2006, the number was 82 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 65,000 people unemployed in West Virginia. In 2000, there were 44,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "%" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. West Virginia has 152 square miles of water area and 24,230 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of West Virginia is water.

3. West Virginia has 24,078 square miles of land area and 24,230 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of West Virginia is land.

5. Approximately 43.25% of West Virginia voters chose the Democratic candidate in the 2004 election. A total of 756,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 424,000 citizens in West Virginia who voted for the Republican candidate in the 2004 presidential election. A total of 756,000 citizens voted. Did more than 55% of the voters in West Virginia select the Republican candidate?

7. The amount of energy consumed by people in West Virginia in 2003 that came from petroleum was 255 trillion BTUs. The total amount of energy consumed from all sources was 784 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in West Virginia, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. West Virginia had 21,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in West Virginia to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in West Virginia? (Round your answer to the nearest farm.)

11. There were 3,600,000 acres of farmland in West Virginia in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in West Virginia?

12. The projected population of West Virginia in 2020 is 1,801,112 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the West Virginia population to the United States population.

13. In West Virginia, 17.09% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 784 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in West Virginia in 2000 was $21,898. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $24,352. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 143,000 people in West Virginia that belonged to labor unions. In 2006, the number of labor union members was 101,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 288,000 patients admitted to hospitals in West Virginia. Between 2000 and 2005, this number changed by 1.39%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in West Virginia in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in West Virginia was 173 in 2000. Between 2000 and 2006, this number changed by -1.73%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in West Virginia in 2006?

18. The average cost per day for a hospital stay in West Virginia in 2005 was $1,113. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in West Virginia, 16 had a college degree in 2006. If the number of adults in West Virginia with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in West Virginia, 82 had a high school diploma in 2006 compared to 77 in 2000. What was the percentage change in the number of adults with high school diplomas in West Virginia between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 9
2. 1
3. 1
4. 8
5. 2
6. 4
7. 9
8. -8481; 8
9. 7
10. 20,000 + 1,000 + 800 + 90 + 8
11. 9
12. 4
13. ones place
14. 8
15. 1
16. 700 + 80 + 4
17. 2
18. thousands place
19. 80,000 + 3,000
20. 7

Rounding Practice Answers

1. 1,829,000
2. 10,100
3. hundred thousands
4. 80
5. hundreds
6. 24,000
7. 24,300
8. 30,000
9. 36,400
10. hundreds
11. 2500
12. 150
13. 100
14. 20,000
15. ten thousands
16. 100 + 30 + 4; 130
17. 0; 0
18. 200,000
19. 100,000
20. 1,000,000

Estimation Practice Answers

1. 390 trillion BTUs
2. 62,000 square kilometers of total area
3. 700,000 people voted
4. 60,000 dollars
5. 300 trillion BTUs
6. 0 people
7. 0 more births than deaths
8. 300 dollars
9. 10 percent change
10. 0 votes
11. 62,400 square kilometers of land
12. 0 square kilometers of water
13. 3,400,000 acres of farmland
14. 3,400,000 acres of farmland
15. 1,824,000 people
16. 1.00 times larger
17. 1.00 times more births than deaths
18. 1.38 times more expensive
19. 1.14 times larger
20. 1.75 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 152/24230
2. 0.63%
3. 24078/24230
4. 99.37%
5. 327,000
6. Yes. 56.1 percent voted Republican.
7. 255/784
8. 33%; 33 BTUs came from petroleum
9. 21,000/2,090,000
10. 0.01; 10 farms
11. 3,420,000
12. 2/336
13. 134 trillion BTUs
14. 11.21%
15. 29.37% decrease
16. 292,000
17. 170
18. 8.98%
19. 32%
20. 6.49% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Wisconsin

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Introduction

"When am I ever going to use this?" It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau's 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the "What's the big idea?" pages give learners the opportunity to reflect on the things they've learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Wisconsin is projected to be 5,727,426 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Wisconsin changed by 192,791 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 434,966 births in Wisconsin. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Wisconsin in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Wisconsin was 1,458 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Wisconsin is 54,310 square miles and the total water area is 11,188 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Wisconsin is 54,310 square miles and the total water area is 11,188 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Wisconsin was $33,425. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Wisconsin. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Wisconsin was $35,471. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Wisconsin in 2000 was $28,568. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Wisconsin ranked number 19. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Wisconsin ranked number 19. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Wisconsin was 201 acres. What is the place value furthest to the right that contains the number 1?

14. In 2006, Wisconsin had 76,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Wisconsin that were sold was 92,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Wisconsin in 2003 was 1,833 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 1,833 in expanded form.

17. The number of home sales in Wisconsin in 2000 was 92,000. What is the digit in the ten thousands place?

18. The number of children in Wisconsin who enrolled in Prekindergarten to Grade 8 was 578,000 children in 2004. In what place value is the rightmost 8 in 578,000?

19. The number of children in Wisconsin who enrolled in Grade 9 to Grade 12 in 2004 was 287,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 2,997,000 people in Wisconsin voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

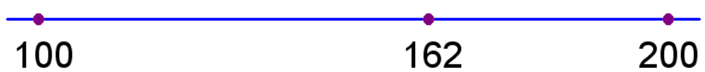
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

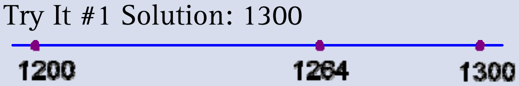


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Wisconsin is projected to be 5,727,426 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Wisconsin changed by 192,791 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 434,966 births in Wisconsin. We round this number to 400,000 . To what place value did we round the number?

4. The number of hospitals in Wisconsin in 2000 was 118. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Wisconsin was 1,458 dollars. We round this number to 1,500. What is the smallest place value to which you can round and get this number?

6. The total land area of Wisconsin is 54,310 square miles and the total water area is 11,188 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Wisconsin is 54,310 square miles and the total water area is 11,188 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Wisconsin was $33,425. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Wisconsin was $35,471. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Wisconsin in 2000 was $28,568. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,600. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Wisconsin ranked number 19. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Wisconsin ranked number 22. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Wisconsin was 201 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Wisconsin had 76,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 92,000 homes. We round this number to 90,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Wisconsin in 2003 was 398 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 398 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Wisconsin in 2003 was 127 trillion BTU. (For some states, this amount will be 0.) Write 127 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Wisconsin who enrolled in Prekindergarten to Grade 8 was 578,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Wisconsin who enrolled in Grade 9 to Grade 12 was 287,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 2,997,000 people in Wisconsin voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1

In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2

Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned}\frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \times \cancel{10}}{4 \times \cancel{4} \times \cancel{10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \times \cancel{2} \times 5}{\cancel{2} \times \cancel{2}} \\ &= 5 \times 5 \\ &= 25\end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Wisconsin used 597 trillion BTUs of energy from petroleum and 398 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Wisconsin.

2. The number of square kilometers of land area in Wisconsin is 140,663. The number of square kilometers of water area is 28,976. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 1,490,000 votes were cast for the Democratic candidate and 1,478,000 votes were cast for the Republican candidate in Wisconsin. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Wisconsin who voted for the two candidates.

4. The average annual pay in Wisconsin in 2004 was 34,743 dollars and in 2005 was 35,471. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Wisconsin consumed 19 trillion BTUs of energy from hydroelectric power (water) and 597 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Wisconsin in 2003.

6. In 2006, there were 5,557,000 people living in Wisconsin. In 2000, there were 5,364,000 people living in Wisconsin. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 434,966 births and 290,915 deaths in Wisconsin. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Wisconsin was 1,055 dollars. In 2005, the average cost per day was 1,458 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 79 percent of adults living in Wisconsin were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 1,237,000 votes cast for the Republican candidate and 1,243,000 votes cast for the Democratic candidate in Wisconsin in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 54,310 square miles of land in Wisconsin. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 11,188 square miles of water in Wisconsin. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 78,000 farms in Wisconsin. The average number of acres of land on each farm was 206. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Wisconsin by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 76,000 farms in Wisconsin. The average number of acres of land on each farm was 201. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Wisconsin.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Wisconsin was 102 people per square mile. There are 54,310 square miles of land in Wisconsin. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 5,557,000 people living in Wisconsin. In 2000, there were 5,364,000 people living in Wisconsin. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 434,966 births and 290,915 deaths in Wisconsin. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Wisconsin was 1,055 dollars. In 2005, the average cost per day was 1,458 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 79 percent of adults living in Wisconsin were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 113,000 people unemployed in Wisconsin. In 2000, there were 101,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Wisconsin has 11,188 square miles of water area and 65,498 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Wisconsin is water.

3. Wisconsin has 54,310 square miles of land area and 65,498 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Wisconsin is land.

5. Approximately 49.72% of Wisconsin voters chose the Democratic candidate in the 2004 election. A total of 2,997,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 1,478,000 citizens in Wisconsin who voted for the Republican candidate in the 2004 presidential election. A total of 2,997,000 citizens voted. Did more than 55% of the voters in Wisconsin select the Republican candidate?

7. The amount of energy consumed by people in Wisconsin in 2003 that came from petroleum was 597 trillion BTUs. The total amount of energy consumed from all sources was 1,833 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Wisconsin, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Wisconsin had 76,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Wisconsin to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Wisconsin? (Round your answer to the nearest farm.)

11. There were 15,300,000 acres of farmland in Wisconsin in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Wisconsin?

12. The projected population of Wisconsin in 2020 is 6,004,954 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Wisconsin population to the United States population.

13. In Wisconsin, 21.71% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 1,833 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Wisconsin in 2000 was $28,568. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $30,292. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 466,000 people in Wisconsin that belonged to labor unions. In 2006, the number of labor union members was 386,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 558,000 patients admitted to hospitals in Wisconsin. Between 2000 and 2005, this number changed by 9.68%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Wisconsin in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Wisconsin was 206 in 2000. Between 2000 and 2006, this number changed by -2.43%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Wisconsin in 2006?

18. The average cost per day for a hospital stay in Wisconsin in 2005 was $1,458. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Wisconsin, 25 had a college degree in 2006. If the number of adults in Wisconsin with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Wisconsin, 91 had a high school diploma in 2006 compared to 87 in 2000. What was the percentage change in the number of adults with high school diplomas in Wisconsin between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 7
2. 7
3. 1
4. 9
5. 9
6. 5
7. 1
8. -4340; 4
9. 1
10. 20,000 + 8,000 + 500 + 60 + 8
11. 9
12. 2
13. ones place
14. 3
15. 4
16. 1,000 + 800 + 30 + 3
17. 9
18. thousands place
19. 200,000 + 80,000 + 7,000
20. 2

Rounding Practice Answers

1. 5,727,000
2. 192,800
3. hundred thousands
4. 810
5. hundreds
6. 43,000
7. 65,500
8. 30,000
9. 40,600
10. hundreds
11. 400
12. 60
13. 100
14. 80,000
15. ten thousands
16. 300 + 90 + 8; 400
17. 100 + 20 + 7; 100
18. 580,000
19. 300,000
20. 3,000,000

Estimation Practice Answers

1. 1000 trillion BTUs
2. 170,000 square kilometers of total area
3. 2,700,000 people voted
4. 68,000 dollars
5. 600 trillion BTUs
6. 200,000 people
7. 100,000 more births than deaths
8. 400 dollars
9. 10 percent change
10. 0 votes
11. 140,400 square kilometers of land
12. 28,600 square kilometers of water
13. 16,800,000 acres of farmland
14. 16,000,000 acres of farmland
15. 5,508,000 people
16. 1.04 times larger
17. 1.48 times more births than deaths
18. 1.36 times more expensive
19. 1.13 times larger
20. 1.10 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 11188/65498
2. 17.08%
3. 54310/65498
4. 82.92%
5. 1,490,000
6. No. 49.3 percent voted Republican.
7. 597/1833
8. 33%; 33 BTUs came from petroleum
9. 76,000/2,090,000
10. 0.036; 36 farms
11. 14,535,000
12. 6/336
13. 398 trillion BTUs
14. 6.03%
15. 17.17% decrease
16. 612,000
17. 201
18. 6.86%
19. 50%
20. 4.6% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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Introduction

“When am I ever going to use this?” It is a question that has plagued teachers and learners for decades. Now, with the help of Make It Real Learning Company, you can answer the question.

States by the Numbers is a real-data math adventure across the United States. Learn about your favorite state or states by delving into place values, rounding, estimation, fractions and percentages.

There are 50 workbooks in the series – one for each state. The data in each workbook is taken directly from the Census Bureau’s 2008 Statistical Abstract of the United States.

Each workbook includes basic instruction and 80 practice problems. Additionally, the “What’s the big idea?” pages give learners the opportunity to reflect on the things they’ve learned. Throughout the workbook series, we have consistently sought to address the content and process standards of the National Council of Teachers of Mathematics.

There are multiple ways to use the activities in a teaching environment. Since the activities teach both mathematics and social studies, many teachers and families enjoy using the workbooks to reinforce mathematics across the curriculum. Although the activities may be effectively used in a formal teaching setting, they are designed specifically for the independent learner.

We hope you enjoy the activities! We continue to increase the number of workbooks in the Make It Real Learning workbook series. Please visit www.MakeItRealLearning.com for the most current list of activities. Thanks!

Frank C. Wilson
Author

Blaine C. Wilson
Graphic Designer

Mathematical Objectives by Section

Place Value

- Identify the digit in the *ones* place of a number. Problems 4, 11, 20
- Identify the digit in the *tens* place of a number. Problem 12, 17
- Identify the digit in the *hundreds* place of a number. Problems 2, 5, 7
- Identify the digit in the *thousands* place of a number. Problems 1, 6, 8, 9, 13, 14,18
- Identify the digit in the *ten thousands* place of a number. Problems 3,15
- Write a number in expanded form. Problem 10, 16, 19

Rounding

- Round a whole number to the nearest *ten.* Problems 4, 11, 12, 16
- Round a whole number to the nearest *hundred.* Problems 2, 7, 9, 13, 17
- Round a whole number to the nearest *thousand.* Problem 1
- Round a whole number to the nearest *ten thousand.* Problems 6, 8, 14, 18
- Round a whole number to the nearest *hundred thousand.* Problem 19
- Round a whole number to the nearest *million.* Problem 20
- Given a number and a rounded value of the number, determine to what place value the number was rounded. Problems 3, 5, 10, 15,
- Write a number in expanded form. Problems 16, 17

Estimation

- Estimate the *sum* of two numbers. Problems 1 – 5
- Estimate the *difference* of two numbers. Problems 6 – 10
- Estimate the *product* of two numbers. Problems 11 – 15
- Estimate the *quotient* of two numbers. Problems 16 – 20
- Round to the nearest ten, hundred, thousand, or ten thousand. Problems 1 - 20

Understanding Fractions and Percents

- Create a fraction to compare two quantities. Problems 1, 3, 6 7, 9, 12
- Convert a fraction to a percent. Problems 2, 4, 6, 8
- Interpret the practical meaning of a decimal in a real world context. Problem 10
- Find the stated percentage of a given quantity. Problems 5, 13
- Determine the percentage change in a quantity over time. Problems 14, 15, 20
- Given an initial value and a percentage change, determine the number that results from changing the initial value by the given percent. Problems 11, 16, 17
- Given two values, determine the percentage change needed to make the first value equal the second value. Problem 18
- Determine a percent from a verbal description of real world context. Problem 19

Place Value

There are many different numbering systems. The most common numbering system is the base-10 system. The ten digits used in this system are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. All numbers may be created using these digits.

Although the numbers 368 and 836 both have the digits 3, 6, and 8, the numbers have different values because of the placement of the digits.

368 means 300 + 60 + 8 but 836 means 800 + 30 + 6. For the number 368, there are 3 hundreds, 6 tens, and 8 ones. We say that 3 is in the hundreds place, 6 is in the tens place, and 8 is in the ones place.

100 hundreds	10 tens	1 ones
3	6	8

Try It #1
For 836, which digit is in the hundreds place? Which digit is in the tens place? Which digit is in the ones place?

See solution at bottom of page.

The same idea may be used for larger numbers. For example, the number 134,657 may be written in expanded form as 100,000 + 30,000 + 4000 + 600 + 50 + 7.

100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones
1	3	4	6	5	7

1 is in the hundred thousands place, 3 is in the ten thousands place, 4 is in the thousands place, 6 is in the hundreds place, 5 is in the tens place, and 7 is in the ones place.

- Try It #1 Solution: *8 is in the hundreds place, 3 is in the tens place and 6 is in the ones place.*

Try It #2
Write the number 245,671 in expanded form.

See solution at the bottom of the page.

We can add columns to a place value table, like the one shown earlier, by adding a zero to the number in the previous column.

1,000,000 millions	100,000 hundred thousands	10,000 ten thousands	1000 thousands	100 hundreds	10 tens	1 ones

Try It #3
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). Write out this number in words. Then identify the digit in the hundred millions place and the digit in the one millions place.

See solution at the bottom of the page.

Try It #4
The Census Bureau predicts that the population of the United States will be 363,584,435 on July 1, 2030. (Source: www.census.gov). In what place values is the digit 3?

See solution at the bottom of the page.

The skill of finding place values will be helpful to you when rounding large numbers. We will teach that in the next section.

- Try It #2 Solution: $200,000 + 40,000 + 5000 + 600 + 70 + 1$
- Try It #3 Solution: *Three hundred six million, three hundred fifty eight thousand, eight hundred fourteen. The number in the hundred millions place is 3 and the number in the one millions place is 6.*
- Try It #4 Solution: *Hundred millions, millions, and tens*

Place Value Practice

1. The population of Wyoming is projected to be 519,886 in 2010. What is the digit in the thousands place?

2. Between April 1, 2000, and July 1, 2006, the population of Wyoming changed by 21,222 people. (A negative change means the population went down.) What is the digit in the hundreds place?

3. Between April 1, 2000, and July 1, 2006, there were 41,063 births in Wyoming. If there had been twenty thousand fewer births, what number would be in the ten thousands place?

4. The percentage of adults in Wyoming in 2006 who were high school graduates was 91%. If you switch the order of the digits in this number, what number is in the ones place?

5. In 2005, there average cost per day for a hospital stay in Wyoming was 805 dollars. If you double this number, what digit is in the hundreds place?

6. The total land area of Wyoming is 97,100 square miles and the total water area is 713 square miles. Find the number in the thousands place for the combined total of the land and water areas.

7. The total land area of Wyoming is 97,100 square miles and the total water area is 713 square miles. Find the number in the hundreds place for the difference of the land and water areas.

8. In 2003, the average annual pay for an adult working in Wyoming was $29,924. The average annual pay nationally was $37,765. Find the difference between the average pay nationally and the average pay in Wyoming. Then determine the digit in the thousands place. (Note: If the difference ends up being negative, that means that the average annual pay in the state is below the national average.)

9. In 2005, the average annual pay for an adult working in Wyoming was $33,251. If the 2010 pay is $6500 more than the 2005 pay, what number will be in the thousands place?

10. The term *per capita* means *per person*. The personal income per capita in Wyoming in 2000 was $28,458. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. Write this number in expanded form.

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Wyoming ranked number 21. What is the digit in the ones place?

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Wyoming ranked number 21. What is the digit in the tens place?

13. In 2006, the average number of acres on a farm in Wyoming was 3,780 acres. What is the place value furthest to the right that contains the number 0?

14. In 2006, Wyoming had 9,000 farms. If the number of farms today is 3,000 farms less than this, what digit is in the thousands place?

15. In 2000, the number of existing homes in Wyoming that were sold was 10,000 homes. Suppose that the number of homes sold in 2010 will be half has many as the homes sold in 2000. What is the digit in the ten thousands place for the projected number of homes sold in 2010?

16. The amount of energy consumed in Wyoming in 2003 was 461 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write 461 in expanded form.

17. The number of home sales in Wyoming in 2000 was 10,000. What is the digit in the ten thousands place?

18. The number of children in Wyoming who enrolled in Prekindergarten to Grade 8 was 57,000 children in 2004. In what place value is the rightmost 7 in 57,000?

19. The number of children in Wyoming who enrolled in Grade 9 to Grade 12 in 2004 was 27,000. Write this number in expanded form.

20. In the 2004 Presidential Election, 244,000 people in Wyoming voted. If the order of the digits in this number is reversed, what is the number in the one's place?

Place Value - What's the big idea?

(Use this page to explain what you've learned.)

Rounding

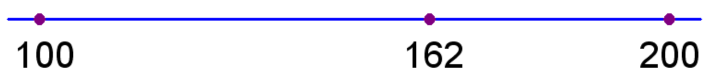
The estimated population of the United States on May 5, 2009, was 306,358,814 (Source: www.census.gov). This number is read *three hundred six million, three hundred fifty-eight thousand, eight hundred fourteen*. Just saying this number requires us to use eleven words! Oftentimes, we prefer to work a number that is close to the number we have but is easier to use. For example, 300,000,000 (three hundred million) is close to 306,358,814 but can be said in three words instead of eleven.

Rounding is a common process we use to make large numbers simpler and easier to work with. With a good understanding of place values, the rounding process is easy to learn.

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). The actual amount of money your family spends may be more or less than this. For our first example, we will round 162 to the nearest ten. In our answer, every digit after the tens place will need to be a zero. We create a number line with 160, 162, and 170.

Notice that 160 and 170 are the numbers ending in 0 that are closest to 162. Since 162 is closer to 160 than 170, 162 rounded to the nearest ten is 160.

Suppose that we wanted to round 162 to the nearest hundred. In our answer, every digit after the hundreds place will need to be a zero. We create a number line with 100, 162, and 200.

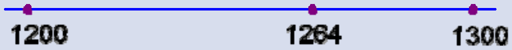


Notice that 100 and 200 are the numbers ending in 00 that are closest to 162. Since 162 is closer to 200 than 100, 162 rounded to the nearest hundred is 200.

Try It #1
According to the U.S. National Weather Service, there were 1264 tornados in the United States in 2005. Use a number line to round 1264 to the nearest hundred.

See solution at bottom of page.

- Try It #1 Solution: 1300



Can we round 1264 to the nearest thousand without using a number line? Sure. First, we make every digit after the thousands place a 0. That gives us 1000. We then find the first number greater than 1264 with three zeros at the end: 2000. Is 1264 closer to 1000 or closer to 2000? Since 1500 is the number that is exactly halfway between 1000 and 2000 and 1264 is less than 1500, 1264 is closer to 1000.

Try It #2

Round the US population of 306,358,814 to the nearest million.

See solution at bottom of page.

When asked to round a number that lies exactly halfway between the two choices for the rounded number, we round up. For example, if asked to round 1500 to the nearest thousand, we round up to 2000. The number that is exactly halfway between the two choices for a rounded number will always end with a 5 followed by an appropriate number zeros. For example, the number exactly halfway between 3000 and 4000 is 3500. The number exactly halfway between 40 and 50 is 45.

Try It #3

There were 650 people injured by tornados in the United States in 1995. Round 650 to the nearest hundred.

See solution at bottom of page.

Try It #4

The United States contains 3,537,438 square miles of land. Round this number to the nearest million square miles.

See solution at bottom of page.

- Try It #2 Solution: *306,000,000*
- Try It #3 Solution: *700 tornados*
- Try It #4 Solution: *4,000,000 square miles*

Rounding Practice

1. The population of Wyoming is projected to be 519,886 in 2010. Round this number to the nearest thousand.

2. Between April 1, 2000, and July 1, 2006, the population of Wyoming changed by 21,222 people. (A negative change means the population went down.) Round this number to the nearest hundred.

3. Between April 1, 2000, and July 1, 2006, there were 41,063 births in Wyoming. We round this number to 0 . To what place value did we round the number?

4. The number of hospitals in Wyoming in 2000 was 24. Switch the order of the digits and round this number to the nearest ten.

5. In 2005, the average cost per day for a hospital stay in Wyoming was 805 dollars. We round this number to 800. What is the smallest place value to which you can round and get this number?

6. The total land area of Wyoming is 97,100 square miles and the total water area is 713 square miles. Round each number to the nearest thousand. Then use your answers to predict the difference in the land and water areas.

7. The total land area of Wyoming is 97,100 square miles and the total water area is 713 square miles. Round each number to the nearest hundred. Then use your answers to predict the combined total of land and water areas.

8. In 2003, the average annual pay for an adult working in Wyoming was $29,924. Round this number to the ten thousands place.

9. In 2005, the average annual pay for an adult working in Wyoming was $33,251. Round this number to the nearest hundred. Then add 5,100 to predict the 2011 average annual pay.

10. The term *per capita* means *per person*. The personal income per capita in Wyoming in 2000 was $28,458. This number is calculated by adding up all of the money earned by people working in the state and dividing it by the total number of the people living in the states. We round this number to 28,500. To what place value did we round this number? (If rounding to two different place values results in the same number, choose the smaller place value as your answer.)

11. The personal income per capita is different in each state. When the personal incomes per capita were ranked from highest to lowest in 2000, Wyoming ranked number 21. Round this number to the nearest ten. Then multiply the rounded number by itself.

12. When the personal incomes per capita were ranked from highest to lowest in 2006, Wyoming ranked number 6. Round this number to the nearest ten. Then triple the rounded number.

13. In 2006, the average number of acres on a farm in Wyoming was 3,780 acres. Round this number to the nearest hundred. Then subtract 100 to predict the average farm size if each farm was reduced by 100 acres.

14. In 2006, Wyoming had 9,000 farms. Round this number to the nearest ten thousand.

15. In 2000, the number of existing homes that were sold was 10,000 homes. We round this number to 10,000. To what place value did we round this number?

16. The amount of energy from natural gas consumed in Wyoming in 2003 was 121 trillion BTU. (The acronym BTU means British Thermal Unit. A BTU is defined as the amount of heat required to raise the temperature of one pound of water from 60 degrees Fahrenheit to 61 degrees Fahrenheit.) Write the number 121 in expanded form. Then round the number to the nearest ten.

17. The amount of energy from nuclear electric power consumed in Wyoming in 2003 was 0 trillion BTU. (For some states, this amount will be 0.) Write 0 in expanded form. Then round the number to the nearest hundred.

18. The number of children in Wyoming who enrolled in Prekindergarten to Grade 8 was 57,000 children in 2004. Round this number to the nearest ten thousand.

19. The number of children in Wyoming who enrolled in Grade 9 to Grade 12 was 27,000 youth in 2004. Round this number to the nearest hundred thousand.

20. In the 2004 Presidential Election, 244,000 people in Wyoming voted. Round this number to the nearest million.

Rounding - What's the big idea?

(Use this page to explain what you've learned.)

Estimation

People who learn how to do mental math quickly can often figure out answers to their questions more rapidly than those who cannot. One technique that will help you do mental math quickly is estimation. It can be used with addition, subtraction, multiplication and division.

For example, there were 1819 tornados in the United States in 2004 and 1032 tornados in 2006, according to the U.S. National Weather Service. Approximately how many more tornados were there in 2004 than in 2006? To come up with a quick estimate, we round both numbers to the nearest hundred and subtract them mentally. The number 1819 rounds to 1800 and the number 1032 rounds to 1000.

$$1800 - 1000 = 800$$

There were approximately 800 more tornados in 2004 than in 2006. (The exact answer is 787.)

Try It #1
In 2003, tornados in the United States caused 1263 million dollars of damage to homes, cars, and other property. In 2006, tornados caused 752 million dollars of property damage. Approximately how much more property damage was there in 2003 than in 2006?

See solution at bottom of page.

When asked to find the product of two numbers, we can also estimate. For example, if we are asked to multiply together 23 and 47, we first round each number to the nearest 10. The number 23 rounds to 20 and the number 47 rounds to 50. We need to find 20×50. Since $2 \times 5 = 10$, the product of 20 and 50 is 1000. Our estimate for the product of 23 and 47 is 1000. (The exact value of 23×47 is 1081.)

Try It #2
Minimum wage is the least amount of money a business can pay a worker for each hour of work. In July 2008, minimum wage was 6.55 dollars per hour. Round the wage to the nearest dollar. Then estimate the amount of money a person would earn by working 12 hours at minimum wage.

See solution at bottom of page.

- Try It #1 Solution: $1300 - 800 = 500$ million dollars
- Try It #2 Solutions: *Rounded wage is 7 dollars. Estimated earnings are 84 dollars.*

The amount of money it takes to feed a family of four each week in the United States is approximately 162 dollars (Source: www.census.gov). If we have 4000 dollars available to spend on food, approximately how many weeks of food will that money buy? We need to divide the 4000 dollars by 162 dollars per week to figure out how many weeks of food we can buy. That is, we need to find $4000 \div 162$. To create our estimate, we round 162 to 160 and calculate the result.

$$\frac{4000}{160} = \frac{4 \times 10 \times 10 \times 10}{4 \times 4 \times 10}$$

Notice that by factoring the numerator and denominator of the fraction we are able to see how to cancel out some of the factors.

$$\begin{aligned} \frac{4000}{160} &= \frac{\cancel{4} \times 10 \times 10 \cancel{\times 10}}{4 \cancel{\times 4} \cancel{\times 10}} \\ &= \frac{10 \times 10}{4} \\ &= \frac{(2 \times 5) \times (2 \times 5)}{2 \times 2} \\ &= \frac{\cancel{2} \times 5 \cancel{\times 2} \times 5}{\cancel{2} \cancel{\times 2}} \\ &= 5 \times 5 \\ &= 25 \end{aligned}$$

We estimate that 4000 dollars will buy 25 weeks of food. (The calculated value for $4000 \div 162$ is approximately 24.69 weeks.)

Try It #3

Given that it takes 162 to feed a family of four for a week in the United States, estimate how many weeks of food $2400 will buy?

See solution at bottom of page.

- Try It #3 Solution: $\frac{2400}{160} = \frac{80 \times 30}{80 \times 2} = 15$ weeks

Estimation Practice

1. In 2003, Wyoming used 162 trillion BTUs of energy from petroleum and 121 trillion BTUs from natural gas. Round each of these values to the nearest 10 trillion BTUs. Then estimate the total amount of energy used from petroleum and natural gas in 2003 in Wyoming.

2. The number of square kilometers of land area in Wyoming is 251,489. The number of square kilometers of water area is 1,847. Round each of these values to the nearest thousand square kilometers. Then estimate the total area of land and water in the state.

3. In the 2004 presidential election, 71,000 votes were cast for the Democratic candidate and 168,000 votes were cast for the Republican candidate in Wyoming. Round each of these values to the nearest hundred thousand. Then estimate the total number of people in Wyoming who voted for the two candidates.

4. The average annual pay in Wyoming in 2004 was 31,210 dollars and in 2005 was 33,251. Round each of the values to the nearest thousand dollars. Then estimate the amount of money earned in 2004 and 2005 combined.

5. In 2003, people living in Wyoming consumed 6 trillion BTUs of energy from hydroelectric power (water) and 162 trillion BTUs of energy from petroleum (oil). Round each of the values to the nearest hundred trillion BTUs. Then estimate the total amount of energy from hydroelectric power and from petroleum consumed in Wyoming in 2003.

6. In 2006, there were 515,000 people living in Wyoming. In 2000, there were 494,000 people living in Wyoming. Round each of the populations to the nearest hundred thousand and use mental math to estimate the change in the population between 2000 and 2006.

7. Between April 1, 2000, and July 1, 2006, there were 41,063 births and 25,329 deaths in Wyoming. Round each of the values to nearest hundred thousand and use mental math to estimate the difference in births and deaths.

8. In 2000, the average cost per day for a stay in a hospital in Wyoming was 677 dollars. In 2005, the average cost per day was 805 dollars. Round each of the values to the nearest hundred and use mental math to determine the change in the average cost per day.

9. In 1990, 83 percent of adults living in Wyoming were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use mental math to estimate the change in the percent of adults who were high school graduates.

10. In 2000, there were 148,000 votes cast for the Republican candidate and 60,000 votes cast for the Democratic candidate in Wyoming in the presidential election. Round each value to the nearest hundred thousand and estimate the difference in the number of votes for each candidate.

11. There are 97,100 square miles of land in Wyoming. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of land to the nearest thousand square miles then estimate the number of square kilometers of land.

12. There are 713 square miles of water in Wyoming. There are approximately 2.6 square kilometers in a square mile. Round the number of square miles of water to the nearest thousand square miles then estimate the number of square kilometers of water.

13. In 2000, there were 9,000 farms in Wyoming. The average number of acres of land on each farm was 3,750. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Wyoming by multiplying the number of farms by the number of acres per farm.

14. In 2006, there were 9,000 farms in Wyoming. The average number of acres of land on each farm was 3,780. Round the number of farms to the nearest ten thousand and the number of acres per farm to the nearest ten. Then estimate the number of acres of farm land in Wyoming.

15. The population density of a state is the total number of people in the state divided by the total square miles of land in the state. A state with a high population density is more crowded than a state with a lower population density. In 2006, the population density of Wyoming was 5 people per square mile. There are 97,100 square miles of land in Wyoming. Round the land area to the nearest thousand square miles. Then estimate the 2006 population of the state by multiplying the population density by the land area.

16. In 2006, there were 515,000 people living in Wyoming. In 2000, there were 494,000 people living in Wyoming. Round each of the populations to the nearest hundred thousand and use division to estimate how many times larger the 2006 population was than the 2000 population. (If the number is less than 1, the 2006 population is less than the 2000 population.)

17. Between April 1, 2000, and July 1, 2006, there were 41,063 births and 25,329 deaths in Wyoming. Round each of the values to nearest ten thousand and use division to estimate how many times more births there were than deaths. (If the number is less than 1, there were more deaths than births.)

18. In 2000, the average cost per day for a stay in a hospital in Wyoming was 677 dollars. In 2005, the average cost per day was 805 dollars. Round each of the values to the nearest hundred and use division to estimate how many times greater the 2005 cost was than the 2000 cost.

19. In 1990, 83 percent of adults living in Wyoming were high school graduates. In 2006, the number was 91 percent. Round each value to the nearest ten percent and use division to estimate how many times larger the percent of high school graduates was in 2006 than in 1990.

20. In 1990, there were 13,000 people unemployed in Wyoming. In 2000, there were 10,000 people unemployed in the state. Round each value to the nearest ten thousand and use division to estimate how many times more people were unemployed in 1990 than in 2000. (If the number of times is less than 1, that means that the number of people unemployed in 1990 was greater than the number of people unemployed in 2000.)

Estimation - What's the big idea?

(Use this page to explain what you've learned.)

Understanding Fractions and Percents

Fractions are often created by dividing one value by another. For example, when we divide 4 by 5 we get the fraction $\frac{4}{5}$. When we divide 9 by 12, we get the fraction $\frac{9}{12}$. One of the difficulties many people have with fractions is that it is hard to tell if one fraction is bigger than another. For example, which is bigger $\frac{5}{8}$ or $\frac{3}{5}$? It is hard to tell from the fraction itself. When we divide the numbers using a calculator, we see that $\frac{5}{8} = 0.625$ and $\frac{3}{5} = 0.6$. Since 0.625 is bigger than 0.6, $\frac{5}{8}$ is bigger than $\frac{3}{5}$.

In 2003, the amount of energy consumed in the United States was 98,605 trillion BTUs. (BTU stands for British Thermal Unit.) Of this energy, 7959 trillion BTUs came from nuclear power sources. The fraction $\frac{7959}{98,605}$ compares the amount of energy from nuclear power sources to the total amount of energy from all sources. We can find the decimal form of this fraction by using a calculator to divide 7959 by 98,605. This gives us approximately 0.0807.

The decimal 0.0807 is the same as $\frac{8.07}{100}$ or 8.07%. The symbol "$\%$" is called the *percent* sign and means *per hundred.* It means that for every 100 BTUs of energy consumed in the United States, approximately 8 of them came from nuclear power.

It is easy to convert a decimal into a percent. We know that $1 = \frac{100}{100} = 100\%$. This means that 1 is the same as 100%. Since multiplying a number by 1 doesn't change the value of the number, multiplying a number by 100% won't change the value of a number either. We use this fact to convert decimals into percents.

Try It #1
Write 0.549 as a percent.

See solution at bottom of page.

- Try It #1 Solution: $0.549 = \frac{54.9}{100} = 54.9\%$

Many data are reported as percents. For example, 28% of the adults in the United States had a college degree in 2006. We can write 28% as $\frac{28}{100}$. This means that 28 out of every 100 adults had a college degree.

Approximately 6.76% of the area of the United States is water. We know that 6.76% means that for every 100 square miles of area, 6.76 square miles are water. The total land and water area of the United States is 3,794,083 square miles. Approximately how many square miles of water are there in the United States? We multiply 6.76% by 3,794,083 to find the answer to the question.

$$\frac{6.76 \text{ square miles of water}}{100 \ \cancel{\text{square miles of area}}} \times 3{,}794{,}083 \ \cancel{\text{square miles of area}} = 256{,}480 \text{ square miles of water}$$

There are approximately 256,480 square miles of water area in the United States.

Try It #2

The United States has 3,537,438 square miles of land area and 3,794,083 square miles of total area (water and land). For every 100 square feet of total area, how many square feet are land?

See solution at bottom of page.

Oftentimes we are interested in the percentage change in data over time. For example, there were 5174 thousand homes sold in the United States in 2000. The number of homes sold in 2006 was 6480 thousand. To determine the percentage change in home sales, we first find the difference in the two levels of home sales.

$$6480 - 5174 = 1306$$

The change in home sales between 2000 and 2006 was 1306 thousand homes. To determine the percentage change in home sales over the six-year period, we divide the change by the home sales level for 2000.

$$\frac{1306}{5174} = 0.2524 = 25.24\%$$

Between 2000 and 2006, home sales increased by 25.24% from the level of home sales in 2000.

- Try It #2 Solution: $\frac{3{,}537{,}438}{3{,}794{,}083} = 0.9324 = 93.24\%$. *For every 100 square feet of total area in the United States, 92.24 square feet are land.*

Understanding Fractions and Percents Practice

1. Wyoming has 713 square miles of water area and 97,814 square miles of total area (water and land). Write a fraction that compares the water area to the total area.

2. Using the fraction from problem 1, determine what percentage of the total area of Wyoming is water.

3. Wyoming has 97,100 square miles of land area and 97,814 square miles of total area (water and land). Write a fraction that compares the land area to the total area.

4. Using the fraction from problem 3, determine what percentage of the total area of Wyoming is land.

5. Approximately 29.10% of Wyoming voters chose the Democratic candidate in the 2004 election. A total of 244,000 citizens voted. Rounded to the nearest thousand, how many people voted for the Democratic candidate?

6. There were 168,000 citizens in Wyoming who voted for the Republican candidate in the 2004 presidential election. A total of 244,000 citizens voted. Did more than 55% of the voters in Wyoming select the Republican candidate?

7. The amount of energy consumed by people in Wyoming in 2003 that came from petroleum was 162 trillion BTUs. The total amount of energy consumed from all sources was 461 trillion BTUs. Write a fraction that compares the energy consumed that came from petroleum to the total energy consumed.

8. Convert the fraction in problem 7 to a percentage. For every 100 BTUs of energy consumed in Wyoming, how many BTUs came from petroleum? (Round to the nearest BTU.)

9. Wyoming had 9,000 farms in 2006. In that year, there were a total of 2,090,000 farms in the United States. Write a fraction that compares the number of farms in Wyoming to the number of farms in the United States.

10. Convert the fraction in problem 9 to a decimal. For every 1000 farms in the United States, how many are in Wyoming? (Round your answer to the nearest farm.)

11. There were 34,400,000 acres of farmland in Wyoming in 2006. If the amount of farmland decreases by 5%, how many acres of farmland will there be in Wyoming?

12. The projected population of Wyoming in 2020 is 530,948 people. The projected population of the United States in 2020 is 335,804,546. Round each value to the nearest million. Then use the rounded values to create a fraction that compares the Wyoming population to the United States population.

13. In Wyoming, 26.25% of the energy consumed in the state in 2003 came from natural gas. The total amount of energy consumed in the state was 461 trillion BTUs. How many trillion BTUs came from natural gas?

14. The term *per capita* means *per person*. The personal income per capita in Wyoming in 2000 was $28,458. This number is calculated by adding up all of the money earned by people working in the state in 2000 and dividing it by the total number of the people living in the state. In 2006, the personal income per capita was $35,508. By what percent did the personal income per capita change between 2000 and 2006?

15. Labor unions are formed to help protect the rights of workers. In 1983, there were 27,000 people in Wyoming that belonged to labor unions. In 2006, the number of labor union members was 19,000. By what percent did the number of workers in labor unions change between 1983 and 2006?

16. In 2000, there were 48,000 patients admitted to hospitals in Wyoming. Between 2000 and 2005, this number changed by 6.25%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) How many patients were admitted to hospitals in Wyoming in 2005? (Round your answer to the nearest thousand patients.)

17. The average number of acres of land on a farm in Wyoming was 3,750 in 2000. Between 2000 and 2006, this number changed by 0.80%. (A positive percent means the number of patients increased. A negative percent means the number of patients decreased.) What was the average number of acres of land on a farm in Wyoming in 2006?

18. The average cost per day for a hospital stay in Wyoming in 2005 was $805. If this amount goes up by $100, what is the percentage increase in the cost per day?

19. For every 100 adults living in Wyoming, 21 had a college degree in 2006. If the number of adults in Wyoming with college degrees doubles, what percent of adults will have college degrees?

20. For every 100 adults living in Wyoming, 91 had a high school diploma in 2006 compared to 90 in 2000. What was the percentage change in the number of adults with high school diplomas in Wyoming between 2000 and 2006?

Understanding Fractions and Percents - What's the big idea?

(Use this page to explain what you've learned.)

Answers to Practice Problems

Place Value Practice Answers

1. 9
2. 2
3. 2
4. 9
5. 6
6. 7
7. 3
8. -7841; 7
9. 9
10. 20,000 + 8,000 + 400 + 50 + 8
11. 1
12. 0
13. ones place
14. 6
15. 0
16. 1,000 + 800 + 30 + 3
17. 1
18. thousands place
19. 200,000 + 80,000 + 8,000
20. 2

Rounding Practice Answers

1. 520,000
2. 21,200
3. hundred thousands
4. 40
5. hundreds
6. 96,000
7. 97,800
8. 30,000
9. 38,400
10. hundreds
11. 400
12. 30
13. 3,700
14. 10,000
15. ten thousands
16. 100 + 20 + 1; 120
17. 0; 0
18. 60,000
19. 0
20. 0

Estimation Practice Answers

1. 280 trillion BTUs
2. 253,000 square kilometers of total area
3. 300,000 people voted
4. 63,000 dollars
5. 200 trillion BTUs
6. 0 people
7. 0 more births than deaths
8. 100 dollars
9. 10 percent change
10. 0 votes
11. 252,200 square kilometers of land
12. 2,600 square kilometers of water
13. 37,500,000 acres of farmland
14. 37,800,000 acres of farmland
15. 485,000 people
16. 1.00 times larger
17. 1.33 times more births than deaths
18. 1.14 times more expensive
19. 1.13 times larger
20. 1.00 times more people unemployed

Understanding Fractions and Percents Practice Answers

1. 713/97814
2. 0.73%
3. 97100/97814
4. 99.27%
5. 71,000
6. Yes. 68.9 percent voted Republican.
7. 162/461
8. 35%; 35 BTUs came from petroleum
9. 9,000/2,090,000
10. 0.004; 4 farms
11. 32,680,000
12. 1/336
13. 121 trillion BTUs
14. 24.77%
15. 29.63% decrease
16. 51,000
17. 3,780
18. 12.42%
19. 42%
20. 1.11% increase

About the Author

Frank Wilson earned his B.S. and M.S. degrees in mathematics from Brigham Young University. He spent six years serving as an officer in the United States Air Force before returning to civilian life. He has taught students math at the United States Air Force Academy, Park College, Green River Community College, and Chandler-Gilbert Community College. In addition to teaching, Frank is a popular author and workshop presenter. His college mathematics textbooks (*Finite Mathematics, Finite Mathematics and Applied Calculus, Brief Applied Calculus*, and *Applied Calculus*) are used at colleges and universities across the United States. *Finite Mathematics and Applied Calculus* was selected by the Textbook and Academic Author's Association as the winner of the 2007 TEXTY Textbook Excellence award for mathematics.

Frank lives with his wife and five children in San Tan Valley, Arizona.

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