UNIT 6

Statistics

Essential Question

WHY is learning mathematics important?

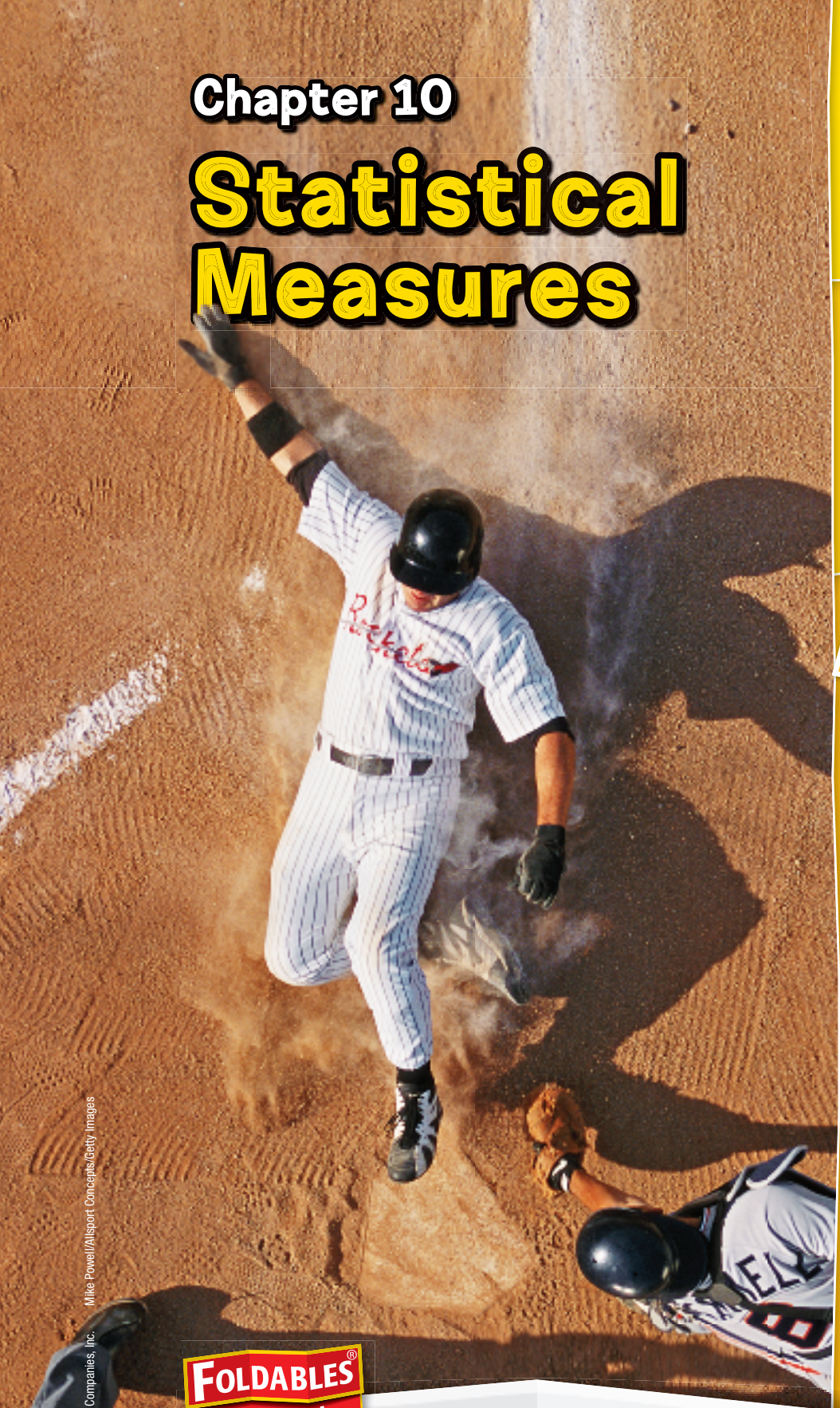
Chapter 10
Statistical Measures

Statistical data has a distribution that can be described by its center or by its spread. In this chapter, you will find and use measures of center and measures of variation to describe sets of data.

Chapter 11
Statistical Displays

Statistical data can be represented in a variety of ways. In this chapter, you will represent and analyze data using line plots, histograms, and box plots.

Chapter 10
Statistical Measures



Essential Question

HOW are the mean, median, and mode helpful in describing data?

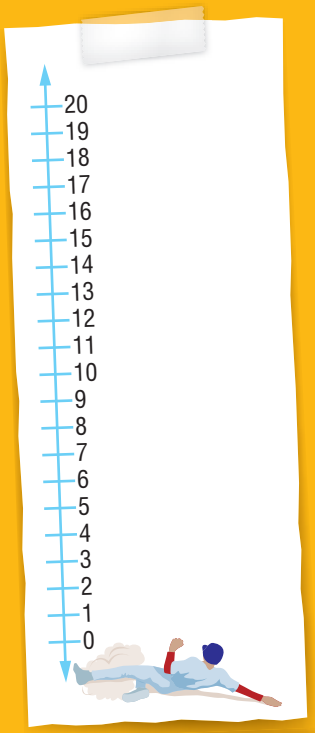
Common Core GPS

Content Standards
MCC6.SP.1, MCC6.SP.3, MCC6.SP.5, MCC6.SP.5b, MCC6.SP.5c, MCC6.SP.5d

Mathematical Practices
1, 2, 3, 4, 5, 6

Math in the Real World

Sports A baseball team scored 9, 6, 8, 16, and 5 points in 5 games. Plot the scores on the number line.



FOLDABLES® Study Organizer

1. Cut out the correct Foldable from the FL pages in the back of this book.
2. Place your Foldable on the Key Concept page toward the end of this chapter.
3. Use the Foldable throughout this chapter to help you learn about statistical measures.

What Tools Do You Need?

Vocabulary

average	median
first quartile	mode
interquartile range	outliers
mean	quartiles
mean absolute deviation	range
measure of center	statistical question
measures of variation	third quartile

Review Vocabulary

Graphic Organizer One way to remember vocabulary terms is to connect them to an opposite term or example. Use this information to complete the graphic organizer.

quotient

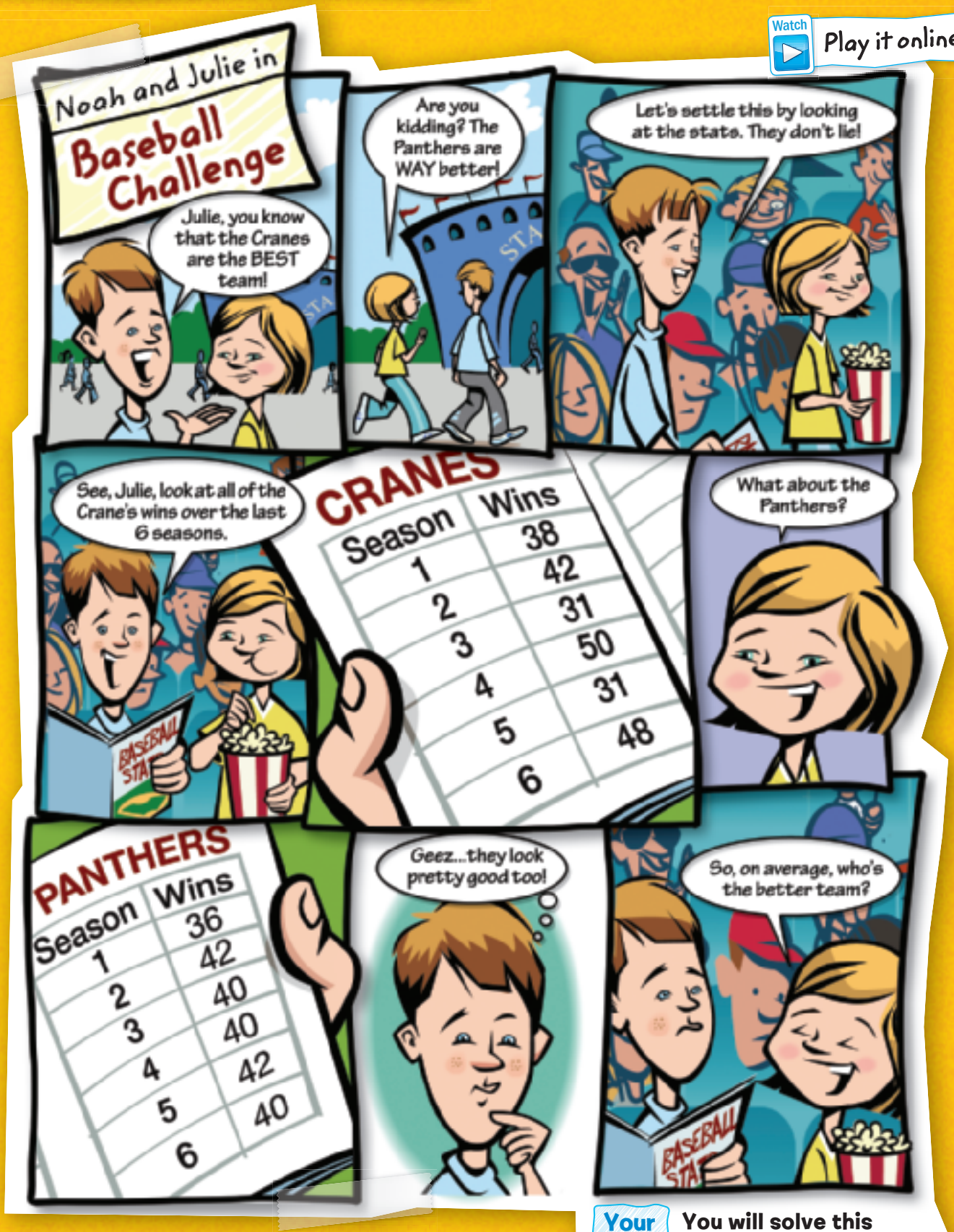
Definition

Opposite

Example

When Will You Use This?

Watch Play it online!



Your Turn! You will solve this problem in the chapter.

Are You Ready?

Try the Quick Check below.
Or, take the Online Readiness Quiz.

Quick Review

Common Core Review MCC5.NBT.7

Example 1

Find 12.53 + 9.87 + 16.24 + 22.12.

$$\begin{array}{r} {\scriptstyle 2\ 1\ 1} \\ 12.53 \\ 9.87 \\ 16.24 \\ +\,22.12 \\ \hline 60.76 \end{array}$$

Add.

Example 2

Michelle read 56.5 pages of her book on Monday and Tuesday. If she read the same amount of pages each day, how many pages did she average each day?

$56.5 \div 2 = 28.25$ Divide the total number of pages by the number of days.

Michelle averaged 28.25 pages per day.

Quick Check

Add Decimals **Find each sum.**

1. 6.20 + 31.59 + 11.11 + 19.85 =

2. 22.69 + 15.45 + 9.87 + 26.79 =

Show your work.

3. Sonya went to the baseball game. She paid $10.50 for admission. She bought a drink for $2.75, a bag of popcorn for $4.60, and a hot dog for $3.75. How much did she spend in total?

Divide Decimals **Find each quotient.**

4. 79.2 ÷ 6 =

5. 72.60 ÷ 3 =

6. 240.5 ÷ 13 =

7. The Chen family drove 345.6 miles on their vacation. They drove the same amount each of the 3 days. How many miles did they drive each day?

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

1 2 3 4 5 6 7

Inquiry Lab
Statistical Questions

Inquiry HOW are surveys created to collect and analyze data?

Content Standards MCC6.SP.1, MCC6.SP.3

Mathematical Practices 1, 3, 4

Marketing Anderson Advertising is collecting information for a pizza shop. They want to know the number of toppings most customers prefer on their pizza. They will use this information to determine the weekly special.

Investigation 1

Statistics deals with collecting, organizing, and interpreting pieces of information, or *data*. One way to collect data is by asking statistical questions. A **statistical question** is a question that anticipates and accounts for a variety of answers.

The table below gives some examples of statistical questions and questions that are *not* statistical questions.

Statistical Questions	Not Statistical Questions
How many text messages do you send each day?	What is the height in feet of the tallest mountain in Colorado?
What is the minimum driving age for each state in the United States?	How many people attended last night's jazz concert?

Create a survey similar to the one Anderson Advertising would use to survey your classmates. Consider a cheese pizza with no additional toppings as a pizza with one topping.

Step 1 Write a statistical question. *How many toppings do you like on your pizza?*

Step 2 Survey your classmates.

Step 3 Record the results in the table to the right. Add additional numbers of toppings to the table as necessary.

How Many Toppings Do Your Like on Your Pizza?	
Number of Toppings	Number of Responses

Why is *How many toppings do you like on your pizza?* a statistical question?

Investigation 2

Sometimes a set of data can be organized into intervals to more easily organize it. This often happens when the set of data has a wide range of values.

Suppose you want to determine the number of video games each of your math classmates has at home.

Step 1 Write the statistical question. *How many different video games do you own?*

Step 2 Survey your classmates.

Step 3 Record the results in the table to the right.

How Many Different Video Games Do You Own?	
Number of Video Games	**Number of Responses**
less than 5	
5–9	
10–14	
15 or more	

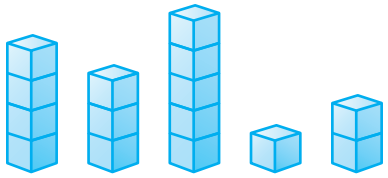
Investigation 3

Tools

You can use surveys to provide information about patterns in the responses.

Suppose you surveyed five students using the statistical question, *How many Web sites did you visit before school this morning?* The students said 4, 3, 5, 1, and 2 Web sites. If the total amount was equally distributed among all five students, how many Web sites did each student visit?

Step 1 Make a stack of centimeter cubes to represent the number of Web sites visited by each student as shown.



Step 2 Move the cubes so that each stack has the same number of cubes. Draw your models in the space below.

There are five stacks with ____ cubes in each stack. So, if the responses were equally distributed, each student visited ____ Web sites before school.

Collaborate

Work with a partner. State whether each question is a statistical question. Explain your reasoning.

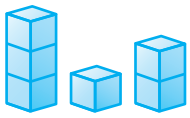
1. Who was the first president of the United States?

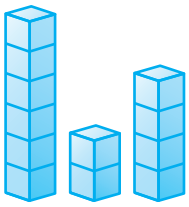
2. How much time do the students in my school spend on the Internet each night?

3. What is the height of the tallest waterslide at Wild Rides Water Park?

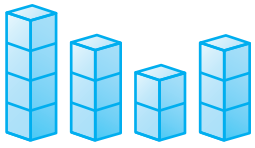
4. What are the cabin rental prices for each of the state parks in Kentucky?

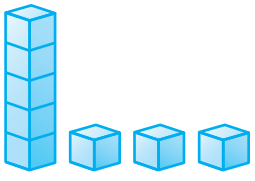
Work with a partner. Determine the equal share if the total number of centimeter cubes were equally distributed among the groups. Draw your models in the space provided.

5. 

6. 

Show your work.

7. 

8. 

Analyze

Work with a partner to determine the equal share for each exercise. Use centimeter cubes or counters if needed. The first one is done for you.

	Scenario	Responses	Response Total	Number of Responses	Equal Share
	Rainfall (inches)	7, 5, 2, 6	$7 + 5 + 2 + 6 = 20$	4	5
9.	Books Read	8, 7, 3			
10.	Eggs Hatched	5, 2, 3, 6			
11.	States Visited	1, 4, 2, 5, 3			
12.	Photos Taken	5, 3, 7, 2, 4, 3			
13.	Miles Hiked	11, 12, 8, 9			

14. **Reason Inductively** Compare the answers you provided in the table above. How does the response total and the number of responses relate to the equal share? Write a rule you can use to evenly distribute a data set without using centimeter cubes. _____

15. One week, the high temperatures in Muncie, Indiana, were 90°F, 88°F, 86°F, 89°F, 91°F, 88°F, and 91°F. What is the equal share of the data? Explain.

Reflect

16. **Model with Mathematics** Write a real-world problem that involves equal shares. Find the equal share of your data set.

17. Inquiry HOW are surveys created to collect and analyze data?

Lesson 1

Mean

What You'll Learn

Scan the lesson. Predict two things you will learn about mean.

- _____

_____

- _____

_____

Essential Question

HOW are the mean, median, and mode helpful in describing data?

Vocabulary

mean

average

Common Core GPS

Content Standards
MCC6.SP.3

Mathematical Practices
1, 2, 3, 4, 6

Real-World Link

Music Tina and her friends downloaded songs for 6 weeks, as shown in the table below.

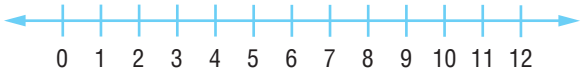
Number of Songs Downloaded Each Week					
12	6	10	9	4	1

1. How many total songs were downloaded? _____

2. On average, how many songs did they download each week?

$$\underset{\text{total}}{\square} \div \underset{\text{number of weeks}}{\square} = \underset{\text{average per week}}{\square}$$

3. On the number line below, draw an arrow that points to the average. Plot the number of songs downloaded on the number line.



4. How far below the average is 1? 4? 6? How far above the average is 9? 10? 12? _____

5. What is the sum of the distances between the average and the points below the average? above the average? _____

6. Explain why the average is the balance point of the data.

_____

_____

_____

Dave & Les Jacobs/Getty Images

Key Concept

Mean

The **mean** of a data set is the sum of the data divided by the number of pieces of data. It is the balance point for the data set.

Work Zone

On the previous page, you found a single number to describe the number of songs downloaded each week. The **average**, or mean, summarizes the data using a single number.

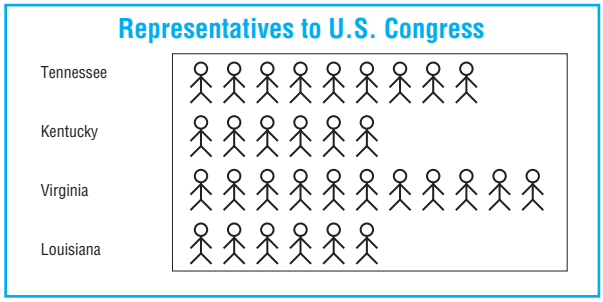
You can find the mean of a set of data shown in different displays such as pictographs and dot plots.

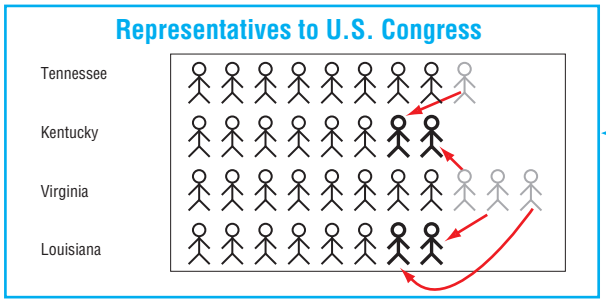
Real World

Example

Watch Tutor

1. **Find the mean number of representatives for the four states shown in the pictograph.**





Move the figures to equally distribute the total number of representatives among the four states.

Each state has a mean or average of 8 representatives.

Including Data
Even if a data value is 0, it still should be counted in the total number of pieces of data.

Show your work.

Got It? **Do this problem to find out.**

a. The table shows the number of CDs a group of friends bought. Find the mean number of CDs the group bought.

Number of CDs Purchased		
3	4	6
0	2	

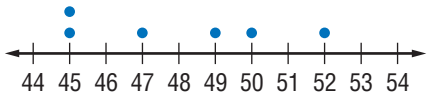
a. _____

Examples

Tutor

2. **The dot plot shows the recorded high temperatures for six days in Little Rock, Arkansas. Find the mean temperature.**

High Temperatures



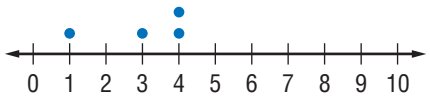
$$\text{mean} = \frac{45 + 45 + 47 + 49 + 50 + 52}{6}$$ ← sum of the data; ← number of data items

$$= \frac{288}{6} \text{ or } 48$$ Simplify.

The mean is 48 degrees. So, all of the data values can be summarized with a single number, 48.

3. **The dot plot shows the number of runs a baseball team had for each game of a 4 game series. Find the mean number of runs for the series.**

Number of Runs



$$\text{mean} = \frac{\square}{\square}$$ ← sum of the data; ← number of data items

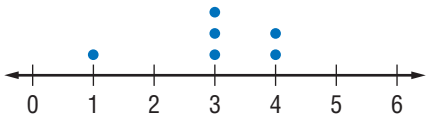
$$= \frac{\square}{\square} \text{ or } \square$$ Simplify.

The mean number of runs for the series is $\square$.

Got It? **Do this problem to find out.**

b. The dot plot shows the number of books Deanna read each week of a month-long reading challenge. Find the mean number of books she read.

Books Read



Dot Plots

In a dot plot, individual data values are represented as dots above a number line.

Show your work.

b. _____

STOP and Reflect

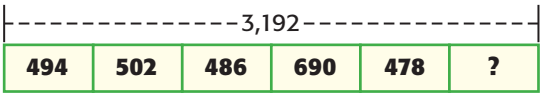
The mean is sometimes described as the balance point. Explain below what this means using the data set {2, 2, 3, 8, 10}.

Example

Tutor

4. The number of minutes Mary Anne spent talking on her cell phone each month for the past five months were 494, 502, 486, 690, and 478. Suppose the mean for six months was 532 minutes. How many minutes did she talk on her cell phone during the sixth month?

If the mean is 532, the sum of the six pieces of data must be 532 × 6 or 3,192. You can create a bar diagram.



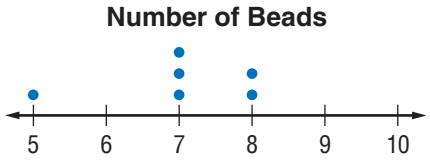
$$3{,}192 - (494 + 502 + 486 + 690 + 478) = 3{,}192 - 2{,}650$$
$$= 542$$

Mary Anne talked 542 minutes during the sixth month.

Guided Practice

Check

1. The dot plot shows the number of beads sold. Find the mean number of beads. (Examples 1–3)



2. The table shows the greatest depths of four of the five oceans in the world. If the average greatest depth is 8.094 kilometers, what is the greatest depth of the Southern Ocean? (Example 4)

Ocean	Greatest Depth (km)
Pacific	10.92
Atlantic	9.22
Indian	7.46
Arctic	5.63
Southern	■

3. Building on the Essential Question Why is it helpful to find the mean of a data set?

Rate Yourself!

How confident are you about finding the mean of a data set? Check the box that applies.

For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

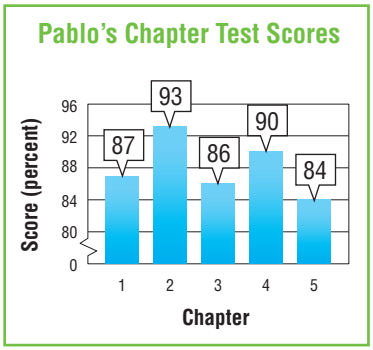
Independent Practice

Go online for Step-by-Step Solutions eHelp

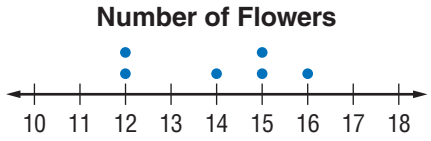
Find the mean for each data set. (Examples 1–3)

1. _____

Show your work.



2. _____



3 **Financial Literacy** Jamila babysat nine times. She earned $15, $20, $10, $12, $20, $16, $80, and $18 for eight babysitting jobs. How much did she earn the ninth time if the mean of the data set is $24?

(Example 4) _____

4. COPS **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.

a. What is the mean number of wins for the Cranes? for the Panthers?

_____

_____

b. Based on your answer for part **a**, is the mean a good measure for determining which team has the better record? Explain.

_____

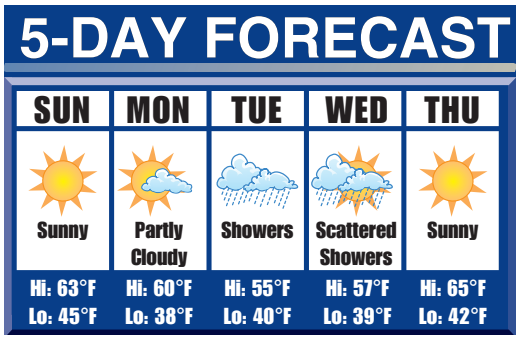
_____

5. A stem-and-leaf plot is a display that organizes data from least to greatest. The digits of the least place value form the leaves, and the next place-value digits form the stems. The stem and leaf plot shows Marcia's scores on several tests. Find the mean test score.

Stem	Leaf
7	8
8	5 8 9
9	2 6

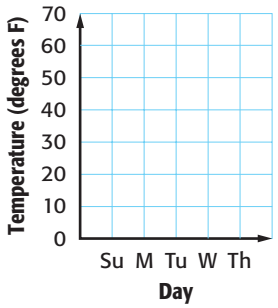
7|8 = 78

6. CCGPS **Multiple Representations** The graphic shows the 5-day forecast.



a. Numbers What is the difference between the mean high and mean low temperature for this 5-day period? Justify your answer.

b. Graph Make a double-line graph of the high and low temperatures for the 5-day period.



H.O.T. Problems Higher Order Thinking

7. CCGPS **Reason Abstractly** Create a data set that has five values. The mean of the data set should be 34.

8. CCGPS **Persevere with Problems** The mean of a set of data is 45 years. Find the missing numbers in the data set {40, 45, 48, ?, 54, ?, 45}. Explain the method or strategy you used.

Georgia Test Practice

9. Which of the following data sets does *not* have a mean of 12?

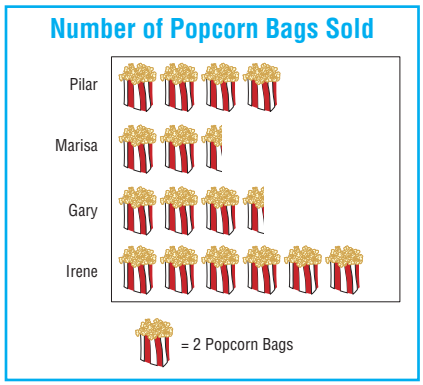
Ⓐ 12, 11, 13
Ⓑ 8, 16, 10, 14
Ⓒ 12, 12, 12, 8
Ⓓ 7, 12, 17

Name _____ My Homework _____

Extra Practice

Find the mean for each data set.

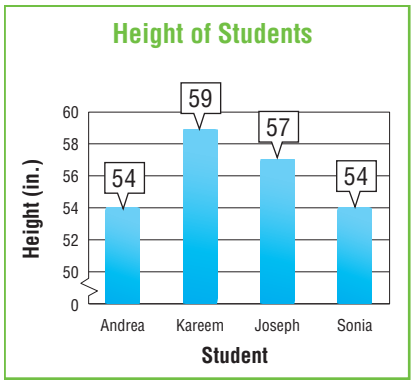
10. 8 bags



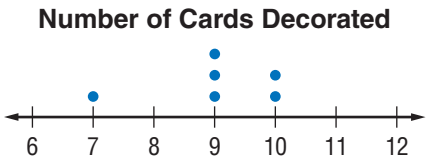
Homework Help

$\frac{8 + 5 + 7 + 12}{4} = 8$

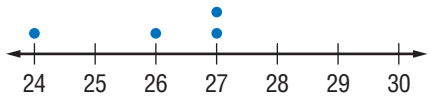
11. _____



12. _____



13. _____



14. CCSPS **Be Precise** The table shows the approximate heights of some of the tallest U.S. trees.

Tallest Trees in U.S.	
Tree	**Height (ft)**
Western Red Cedar	160
Coast Redwood	320
Monterey Cypress	100
California Laurel	110
Sitka Spruce	200
Port-Orford-Cedar	220

a. Find the mean of the data. _____

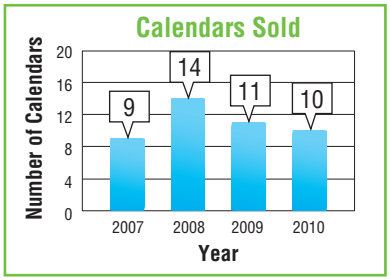
b. Find the mean if the Coast Redwood is not included in the data set. _____

c. How does the height of the Coast Redwood affect the mean of the data? _____

d. Suppose Blue Spruce was included in the list and the mean decreased to 165 feet. What is the height of the Blue Spruce?

Georgia Test Practice

15. The Student Council sells school calendars each year as a fundraiser. Eric was on the Student Council from 2007 to 2010. The bar graph shows the number of calendars he sold over the 4 years.



What is the mean number of calendars Eric sold each year?

Ⓐ 9 Ⓒ 11

Ⓑ 10 Ⓓ 14

16. Short Response The table shows the money raised by each booth at a craft sale.

Northside Craft Sale	
Booth	**Money Raised ($)**
Artwork	58
Candles	47
Holiday decorations	54
Jewelry	70
Picture frames	45
T-shirts	?

How much money, in dollars, was raised by the T-shirt booth if the mean amount raised was $59? _____

17. Find the mean number of points scored in three games.

Ⓕ 9 Ⓗ 30

Ⓖ 25 Ⓘ 75

Game	Points Scored
1	24
2	30
3	21

Common Core Review

Compare the numbers using < or >. MCC4.NBT.2

18. 18 ◯ 16

19. 65 ◯ 63

20. 22 ◯ 28

21. 34 ◯ 31

22. 75 ◯ 79

23. 67 ◯ 57

24. The table shows the distances from Louisville to several cities.

a. How much farther is it from Louisville to Charlotte than from Louisville to Lexington? MCC4.NBT.4 _____

b. Which city is the greatest distance from Louisville? MCC4.NBT.2 _____

City	Distance (miles)
Charlotte	474
Cincinnati	100
Indianapolis	114
Lexington	75
St. Louis	265

Lesson 2

Median and Mode

What You'll Learn

Scan the lesson. List two headings you would use to make an outline of the lesson.

- _____
- _____

Essential Question

HOW are the mean, median, and mode helpful in describing data?

Vocabulary

measures of center
median
mode

Common Core GPS

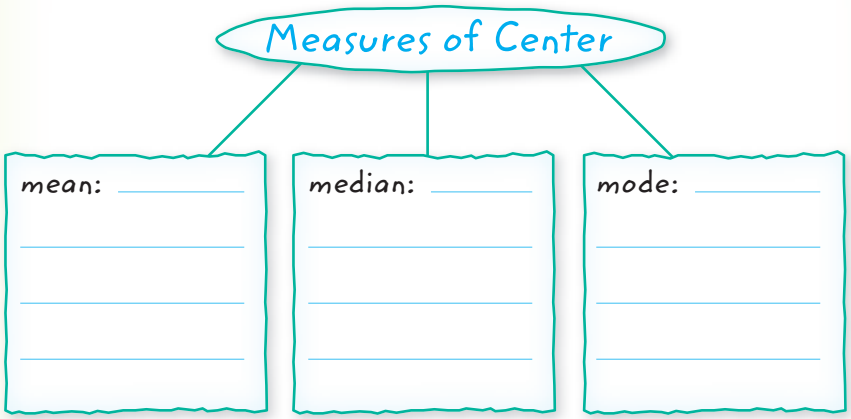
Content Standards
MCC6.SP.3, MCC6.SP.5, MCC6.SP.5b, MCC6.SP.5c

Mathematical Practices
1, 3, 4, 5, 6

Vocabulary Start-Up

A data set can also be described by its median or its mode. The mean, median, and mode are called **measures of center** because they describe the center of a set of data.

Find the definition of each term in the glossary. Then complete the graphic organizer.



Real-World Link

Hurricanes The table shows the number of Atlantic hurricanes in different years.

Atlantic Hurricanes						
5	15	9	7	4	9	8

1. Order the data from least to greatest. Circle the number in the middle of your list. _____

2. Find the mean. Compare the middle number to the mean of the data. Round to the nearest hundredth if necessary.

_____

Matthias Clamer/Getty Images

Key Concept

Median and Mode

The **median** of a list of values is the value appearing at the center of a sorted version of the list, or the mean of the two central values, if the list contains an even number of values.

The **mode** is the number or numbers that occur most often.

Work Zone

Just as mean is one value used to summarize a data set, the median and mode also summarize a data set with a single number. If there is more than one number that occurs with the same frequency, a data set may have more than one mode.

Examples

Watch Tutor

1. **The table shows the number of monkeys at eleven different zoos. Find the median and mode of the data.**

Number of Monkeys					
28	36	18	25	12	44
18	42	34	16	30	

Order the data from least to greatest.

Median 12, 16, 18, 18, 25, (28), 30, 34, 36, 42, 44 — 28 is in the center.

Mode 12, 16, (18, 18), 25, 28, 30, 34, 36, 42, 44 — 18 occurs most often.

The median is 28 monkeys. The mode is 18 monkeys.

2. **Dina recorded her scores on 7 tests in the table. Find the median and mode of the data.**

Test Scores					
93	88	94	93		
85	97	90			

Order the data from least to greatest.

Circle the number in the center. This is the median.

Circle the most frequently occurring numbers. This value is the mode.

The median is a score of ____. The mode is a score of ____.

Got It? Do this problem to find out.

Show your work.

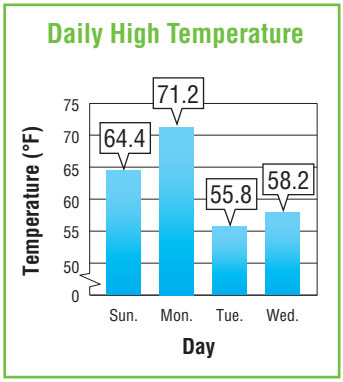
a. The list shows the number of stories in the 11 tallest buildings in Springfield. Find the median and mode of the data.

40, 38, 40, 37, 33, 30, 20, 24, 21, 17, 19

a. _____

Examples

3. **Find the median and mode of the temperatures displayed in the graph.**



Median 55.8, 58.2, 64.4, 71.2

$$\frac{58.2 + 64.4}{2} = \frac{122.6}{2}$$
$$= 61.3°$$

There are an even number of data values. So, to find the median, find the mean of the two central values.

Mode There is no mode.

4. **Miguel researched the average precipitation in several states. Find and compare the median and mode of the average precipitation.**

State	Precipitation (in.)	State	Precipitation (in.)
Alabama	58.3	Louisiana	60.1
Florida	54.5	Maine	42.2
Georgia	50.7	Michigan	32.8
Kentucky	48.9	Missouri	42.2

Median 32.8, 42.2, 42.2, 48.9, 50.7, 54.5, 58.3, 60.1

$$\frac{48.9 + 50.7}{2} = \frac{99.6}{2}$$
$$= 49.8$$

Mode 32.8, 42.2, 42.2, 48.9, 50.7, 54.5, 58.3, 60.1

The median is 49.8 inches and the mode is 42.2 inches. The median is 7.6 inches greater than the mode.

Got It? Do these problems to find out.

Show your work.

b. Find the median and mode of the costs in the table.

Cost of Backpacks ($)			
16.78	48.75	31.42	18.38
22.89	51.25	28.54	26.79

b. _____

c. Find and compare the median and mode of the costs in the table.

Cost of Juice ($)			
1.65	1.97	2.45	2.87
2.35	3.75	2.49	2.87

c. _____

d. _____

Show your work.

Example

Tutor

5. **Describe the daily high temperatures using the measures of center.**

Daily High Temperature (°F)						
72	73	67	65	71	64	71

Mean $\frac{72 + 73 + 67 + 65 + 71 + 64 + 71}{7} = \frac{483}{7}$ or 69°

Median 64, 65, 67, 71, 71, 72, 73

Mode 64, 65, 67, 71, 71, 72, 73

The median and mode are equal, 71 degrees. They are both 2 degrees greater than the mean. The data follows the measures of center in that the temperatures are close to the measures of center.

Got It? **Do this problem to find out.**

d. Describe the cost of CDs using the measures of center.

Cost of CDs ($)		
11.95	12.89	19.99
19.99	12.59	18.49

Guided Practice

Check

1. Find and compare the median and mode for the following set of data.
monthly spending: $46, $62, $62, $57, $50, $42, $56, $40 (Examples 1–4)

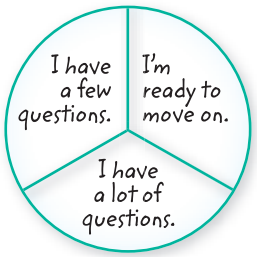
2. Describe the daily high temperatures using the measures of center. (Example 5)

Daily High Temperature (°F)						
34	35	31	36	31	24	33

3. **Building on the Essential Question** How are mean and median similar? _____

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

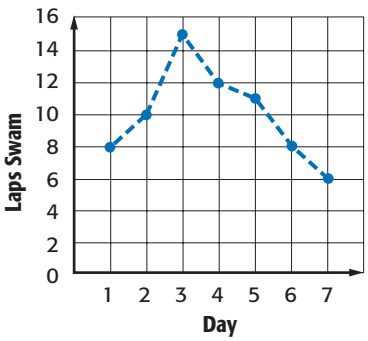
Independent Practice

Go online for Step-by-Step Solutions eHelp

Find and compare median and mode for each set of data. (Examples 1–4)

1 math test scores: 97, 85, 92, 86 _____

2.



_____

_____

3. Describe the average speeds using the measures of center. (Example 5)

_____

_____

_____

Average Speeds (mph)			
40	52	44	46
52	40	44	50
41	44	44	50

4. CCSPS **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.

a. Find the median and mode for each team's wins.

_____

_____

b. Which team had the better record? Justify your response.

_____

_____

5 A Louisville newspaper claims that during seven days, the high temperature in Lexington was typically 6° warmer than the high temperature in Louisville. What measure was used to make this claim?

Justify your answer. _____

Daily High Temperatures (°F)	
Louisville	Lexington
75, 50, 80, 72, 70, 84, 70	80, 73, 75, 74, 71, 76, 76

6. **Use Math Tools** Use the Internet to find the high temperatures for each of the last seven days in a city near you. Then find the median high temperature.

H.O.T. Problems Higher Order Thinking

7. **Persevere with Problems** The ticket prices for a concert series were $12, $37, $45, $18, $8, $25, and $18. What was the ticket price of the eighth and final concert in this series if the set of 8 prices had a mean of $23, a mode of $18, a median of $19.50? _____

8. **Construct an Argument** One evening at a local pizzeria, the following number of toppings were ordered on each large pizza.

3, 0, 1, 1, 2, 5, 4, 3, 1, 0, 0, 1, 1, 2, 2, 3, 6, 4, 3, 2, 0, 2, 1, 3

Determine whether each statement is *true* or *false*. Explain your reasoning.

a. The greatest number of people ordered a pizza with 1 topping.

b. Half the customers ordered pizzas with 3 or more toppings, and half the customers ordered pizzas with less than 3 toppings.

9. **Justify Conclusions** In the data set {3, 7, 4, 2, 31, 5, 4}, which measure best describes the set of data: mean, median, or mode? Explain your reasoning. _____

Georgia Test Practice

10. The lengths of the 5 long jumps at track practice were 14.5 feet, 13.7 feet, 14.1 feet, 14.9 feet, and 13.8 feet. What would the sixth length have to be to have a mean length of 14.1 feet?

Ⓐ 14.8 feet Ⓒ 13.6 feet

Ⓑ 14.1 feet Ⓓ 12.9 feet

Name _____ My Homework _____

Extra Practice

Find and compare median and mode for each set of data.

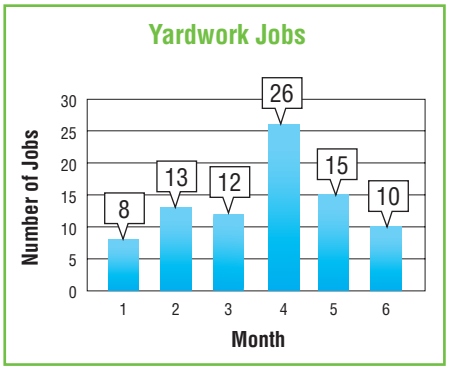
11. age of employees: 23, 22, 15, 44, 44 median: 23; mode: 44; The mode is 21 years more than the median.

Homework Help

Median: 15, 22, (23), 44, 44
Each number occurs only once so there is no mode.

12. minutes spent on homework: 18, 20, 22, 11, 19, 18, 18

13.



14. Describe the test grades using the measures of center.

Test Grades			
100	77	80	65
87	85	85	82
100	97	95	75

15. CCSPS **Be Precise** Fill in the graphic organizer with the description. The first one is done for you.

measures of center	numbers used to describe the center of data
mean	
median	
mode	

Georgia Test Practice

16. The table shows the number of concerts performed by The Quest. What is the difference between the median number of concerts and the mode number of concerts for 2003–2010?

The Quest			
Year	Number of Concerts	Year	Number of Concerts
2003	142	2007	124
2004	142	2008	138
2005	136	2009	136
2006	136	2010	150

Ⓐ 0 Ⓒ 4

Ⓑ 1 Ⓓ 5

17. Short Response The prices of some dinners at the Town Diner are shown in the table.

Dinner	Price($)
Turkey	9.90
Cheeseburger	6.75
Chicken Salad	5.29
Spaghetti	8.15

What is the median of the prices in dollars for the meals? _____

18. The table shows the number of schools in 12 different counties. What is the median of the data?

Ⓕ 4 Ⓗ 7

Ⓖ 6 Ⓘ 8

Number of Schools					
4	3	6	10	3	14
8	5	7	11	7	8

Common Core Review

Find the greatest number in the data set. MCC4.NBT.2

19. {23, 35, 31, 28, 26, 34} _____

20. {56, 58, 49, 50, 56, 57} _____

21. {78, 81, 79, 84, 82, 83} _____

Find the least number in the data set. MCC4.NBT.2

22. {62, 58, 56, 61, 59, 57} _____

23. {24, 29, 22, 26, 23, 24} _____

24. {56, 58, 52, 54, 53, 57} _____

25. The table shows the distances Mari biked each day. What is the greatest distance she biked during the week? MCC5.NBT.3b

_____

Day	Distance (miles)
Monday	5.2
Tuesday	3.5
Wednesday	4.9
Thursday	3.8
Friday	3.2

26. It is 143 miles from Columbus to Cleveland and 107 miles from Columbus to Cincinnati. How much further is it from Columbus to Cleveland than Columbus to Cincinnati? MCC4.NBT.4

_____

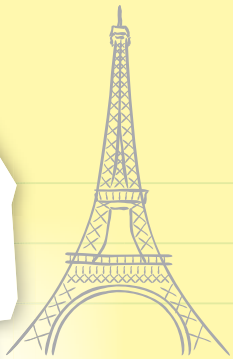
Use Logical Reasoning

Content Standards
MCC6.SP.1
Mathematical Practices
1, 3, 4

Case #1 Speak to Me

Amy surveyed 15 students with the statistical question, "Do you speak Spanish, French, both languages, or neither language?" Four students speak French, seven students speak Spanish, and two students speak both languages.

Use a Venn diagram to find how many students speak neither Spanish nor French.



1 Understand *What are the facts?*

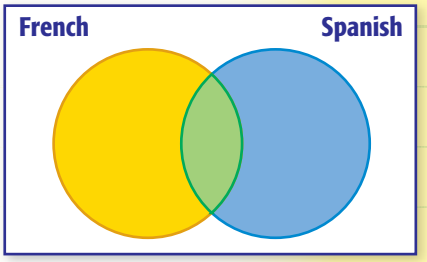
- You know ☐ classmates speak Spanish and ☐ classmates speak French.
- You know that ☐ students speak both languages.

2 Plan *What is your strategy to solve this problem?*

Make a Venn diagram to organize the information. Use logical reasoning to find the answer.

3 Solve *How can you apply the strategy?*

Draw and label two overlapping circles to represent the two languages. Since 2 students speak both languages, place a 2 in the section that is part of both circles. Use subtraction to determine the number for each of the other sections.



only French: 4 − ☐ = ☐

only Spanish: 7 − ☐ = ☐

neither: 15 − ☐ − ☐ − ☐ = ☐

So, ☐ students speak neither French nor Spanish.

4 Check *Does the answer make sense?*

Check each circle to see if the appropriate number of students is represented.

Analyze the Strategy

Tutor

Reason Inductively Explain why Amy's question, "Do you speak Spanish, French, both languages, or neither language?" is a statistical question.

Case #2 Battle of the Mascots

Nick conducted a survey of 85 students about a new school mascot. The results showed that 40 students liked Tigers, and 31 students liked Bears. Of those students, 12 liked both Tigers and Bears.

How many students liked neither Tigers nor Bears?

1 Understand

Read the problem. What are you being asked to find?

I need to find _____

Underline key words and values in the problem. What information do you know?

[ ] students were surveyed. In the survey, [ ] students said they liked Tigers, [ ] said they liked Bears, and [ ] said they liked both.

2 Plan

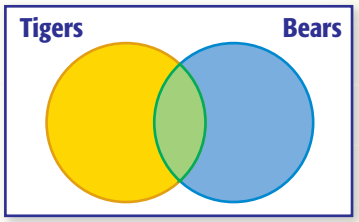
Choose a problem-solving strategy.

I will use the _____ strategy.

3 Solve

Use your problem-solving strategy and a Venn diagram to solve the problem.

Draw and label two overlapping circles to represent the two mascots. Since [ ] students said they liked both mascots, place a [ ] in the section that is part of both circles. Subtract to find the numbers for the other sections.



only tigers: _____ only bears: _____

neither tigers nor bears: _____

So, [ ] students liked neither tigers nor bears as the school mascot.

4 Check

Use information from the problem to check your answer.

_____

_____

_____

Collaborate Work with a small group to solve the following cases. Show your work on a separate piece of paper.

Case #3 Marketing

A survey showed that 70 customers bought white bread, 63 bought wheat bread, and 35 bought rye bread. Of those who bought exactly two types of bread, 12 bought wheat and white, 5 bought white and rye, and 7 bought wheat and rye. Two customers bought all three.

How many customers bought only wheat bread?

Case #4 Pets

Dr. Poston is a veterinarian. One week she treated 20 dogs, 16 cats, and 11 birds. Some owners had more than one pet, as shown in the table.

How many owners had only a dog as a pet?

Pet	Number of Owners
dog and cat	7
dog and bird	5
cat and bird	3
dog, cat, and bird	2

Case #5 Sports

The Student Council surveyed a group of 24 students by asking the statistical question, "Do you like softball, basketball, both, or neither?" The results showed that 14 students liked softball, and 18 liked basketball. Of these, 8 liked both.

How many students liked just softball and how many liked just basketball?

Circle a strategy below to solve the problem.

- Act it out.
- Guess, check, and revise.
- Solve a simpler problem.
- Look for a pattern.

Case #6 Money

Jorge has $125 in his savings account. He deposits $20 every week and withdraws $25 every four weeks.

What will his balance be in 8 weeks?

Mid-Chapter Check

Vocabulary Check

1. Define *mean*. Then determine the mean of the following data set {22, 18, 38, 6, 24, 18}. (Lesson 1)

2. Fill in the blank in the sentence below with the correct term. (Lesson 2)

The _____ is the number or numbers that occur most often in a set.

Skills Check and Problem Solving

Find the mean of each data set. (Lesson 1)

3. number of home runs by baseball players in a season: 43, 21, 35, 15, 35

4. number of different birds spotted: 7, 10, 13, 9, 12, 3

Find the median and mode for each set of data. (Lesson 2)

5. hours spent studying: 4, 2, 5, 7, 1

6. heights of buildings in feet: 35, 42, 40, 25, 42, 54, 50

7. **Use Math Tools** Use the table that shows the lengths of different lizards. Find and compare the median and mode of the data. (Lesson 2)

Lizard Length (cm)			
14	12	14	14
19	18	11	16
30	12	19	15

8. **Georgia Test Practice** The table shows the number of minutes spent doing different exercises. Which is the median? (Lesson 2)

Ⓐ 12.5 Ⓒ 18.2

Ⓑ 15 Ⓓ 38

Daily Exercises	
Exercise	**Time (min)**
Pull-ups	8
Push-ups	10
Running	38
Sit-ups	15
Weight lifting	20

Lesson 3

Measures of Variation

What You'll Learn

Scan the lesson. Predict two things you will learn about measures of variation.

- _____

_____

- _____

_____

Essential Question

HOW are the mean, median, and mode helpful in describing data?

Vocabulary

measures of variation
quartiles
first quartile
third quartile
interquartile range
range
outliers

Common Core GPS

Content Standards
MCC6.SP.3, MCC6.SP.5, MCC6.SP.5c

Mathematical Practices
1, 2, 3, 4, 5

Vocabulary Start-Up

Measures of variation are used to describe the distribution, or spread, of the data. They describe how the values of a data set vary with a single number. A *quartile* is one measure of variation.

Look in a dictionary and find words that begin with *quar-*. Write two of the words and their definitions.

Word beginning with quar-	Definition

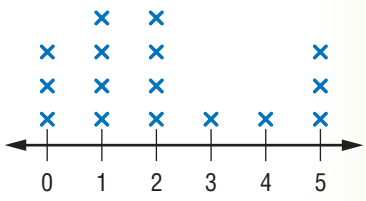
Based on the definitions you found, fill in the blank below.

Quartiles are values that divide a set of data into _____ equal parts.

Real-World Link

Surveys James asked his classmates how many hours of TV they watch on a typical day.

Hours of TV Watched



1. Divide the data into 4 equal parts. Draw a circle around each part.

2. How many data values are in each group? _____

Key Concept

Measures of Variation

Quartiles are values that divide the data set into four equal parts.

First and Third Quartiles

The first and third quartiles are the medians of the data values less than the median and the data values greater than the median, respectively.

Interquartile Range (IQR)

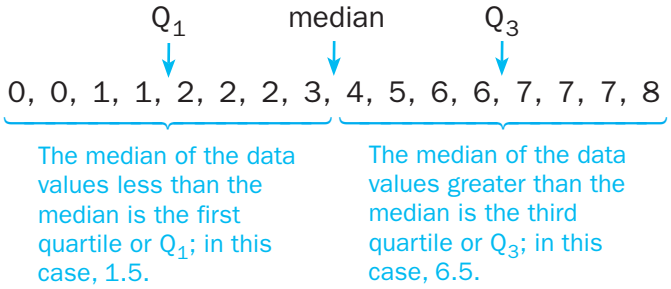
The distance between the first and third quartiles of the data set.

Range

The difference between the greatest and least data values.

Work Zone

Measures of variation of a data set are shown below.



One fourth of the data lie below the first quartile and one fourth of the data lie above the third quartile. So, one half of the data lie between the first quartile and third quartile.

Example

Tutor

1. **Find the measures of variation for the data.**

Animal	Speed (mph)
cheetah	70
lion	50
cat	30
elephant	25
mouse	8
spider	1

Range 70 − 1 or 69 mph

Quartiles Order the numbers.

Q_1 median = 27.5 Q_3

1 8 25 30 50 70

Interquartile Range 50 − 8 or 42 $Q_3 - Q_1$

The range is 69, the median is 27.5, the first quartile is 8, the third quartile is 50, and the IQR is 42.

Interquartile Range
If the interquartile range is low, the middle data are grouped closely together.

Show your work.

Got It? **Do this problem to find out.**

a. Determine the measures of variation for the data 64, 61, 67, 59, 60, 58, 57, 71, 56, and 62.

a. _____

Find Outliers and Analyze Data

An **outlier** is a data value that is either much *greater* or much *less* than the median. If a data value is more than 1.5 times the value of the interquartile range beyond the quartiles, it is an outlier.

STOP and Reflect

Which measure of center would most likely be affected by an outlier? Explain below.

Example

Tutor

2. **The ages of candidates in an election are 23, 48, 49, 55, 57, 63, and 72. Name any outliers in the data.**

Find the interquartile range: $63 - 48 = 15$

Multiply the interquartile range by 1.5: $15 \times 1.5 = 22.5$

Subtract 22.5 from the first quartile and add 22.5 to the third quartile to find the limits for the outliers.

$48 - 22.5 = 25.5$ $\qquad$ $63 + 22.5 = 85.5$

The only age beyond the limits is 23. So, it is the only outlier.

Got It? **Do this problem to find out.**

Show your work.

b. The lengths, in feet, of various bridges are 88, 251, 275, 354, and 1,121. Name any outliers in the data set.

b. _____

Real World Example

Tutor

3. **The table shows a set of scores on a science test in two different classrooms. Compare and contrast their measures of variation.**

Room A	Room B
72	63
100	93
67	79
84	83
65	98
78	87
92	73
87	81
80	65

Find the measures of variation for both rooms.

	Room A	Room B
Range	$100 - 65 = 35$	$98 - 63 = 35$
Median	80	81
$\mathbf{Q_3}$	$\frac{87 + 92}{2} = 89.5$	$\frac{87 + 93}{2} = 90$
$\mathbf{Q_1}$	$\frac{67 + 72}{2} = 69.5$	$\frac{65 + 73}{2} = 69$
IQR	$89.5 - 69.5 = 20$	$90 - 69 = 21$

Both classrooms have a range of 35 points, but Room B has an interquartile range of 21 points while Room A's interquartile range is 20 points. There are slight differences in the medians as well as the third and first quartiles.

Show your work.

c. _____

Got It? Do this problem to find out.

c. Temperatures for the first half of the year are given for Antelope, Montana, and Augusta, Maine. Compare and contrast the measures of variation of the two cities.

Month	Antelope, MT	Augusta, ME
January	21	28
February	30	32
March	42	41
April	58	53
May	70	66
June	79	75

Guided Practice

Check

1. The average wind speeds for several cities in Pennsylvania are given in the table. (Examples 1 and 2)

Wind Speed	
Pennsylvania City	**Speed (mph)**
Allentown	8.9
Erie	11.0
Harrisburg	7.5
Middletown	7.7
Philadelphia	9.5
Pittsburgh	9.0
Williamsport	7.6

a. Find the range of the data. _____

b. Find the median and the first and third quartiles.

_____

c. Find the interquartile range. _____

d. Identify any outliers in the data. _____

2. The heights of several types of palm trees, in feet, are 40, 25, 15, 22, 50, and 30. The heights of several types of pine trees, in feet, are 60, 75, 45, 80, 75, and 70. Compare and contrast the measures of variation of both kinds of trees. (Example 3)

_____

_____

_____

_____

3. **Building on the Essential Question** Describe the difference between measure of center and measure of variation. _____

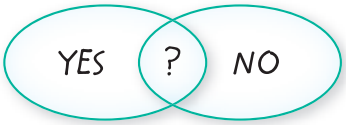
_____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.



For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

1 The table shows the number of golf courses in various states. (Examples 1 and 2)

Number of Golf Courses			
California	1,117	New York	954
Florida	1,465	North Carolina	650
Georgia	513	Ohio	893
Iowa	437	South Carolina	456
Michigan	1,038	Texas	1,018

a. Find the range of the data. _____

b. Find the median and the first and third quartiles.

_____

c. Find the interquartile range. _____

d. Name any outliers in the data. _____

For each data set, find the median, the first and third quartiles, and the interquartile range. (Example 1)

2. texts per day: 24, 53, 38, 12, 31, 19, 26

_____

_____

3 daily attendance at the water park: 346, 250, 433, 369, 422, 298

_____

_____

4. The table shows the number of minutes of exercise for each person. Compare and contrast the measures of variation for both weeks. (Example 3) _____

Minutes of Exercise		
	Week 1	Week 2
Tanika	45	30
Tasha	40	55
Tyrone	45	35
Uniqua	55	60
Videl	60	45
Wesley	90	75

_____

_____

_____

_____

5. STEM The table shows the number of known moons for each planet in our solar system. Use the measures of variation to describe the data. _____

Known Moons of Planets			
Mercury	0	Jupiter	63
Venus	0	Saturn	34
Earth	1	Uranus	27
Mars	2	Neptune	13

_____

_____

_____

6. **Use Math Tools** The double stem-and-leaf plot, where the stem is in the middle and the leaves are on either side, shows the high temperatures for two cities in the same week. Use the measures of variation to describe the data in the stem-and-leaf plot.

Minneapolis		Columbus
5 3 1 0	2	5 7 9 9
6 4	3	7
3	4	8
	5	
	6	2
613 = 36°		215 = 25°

H.O.T. Problems Higher Order Thinking

7. **Find the Error** Hiroshi was finding the measures of variation of the following set of data: 89, 93, 99, 110, 128, 135, 144, 152, and 159. Find his mistake and correct it.

8. **Reason Abstractly** Create a list of data with at least six numbers that has an interquartile range of 15 and two outliers.

9. **Persevere with Problems** How is finding the first and third quartiles similar to finding the median?

10. **Reason Inductively** Explain why the median is not affected by very high or very low values in the data.

Georgia Test Practice

11. Which of the following sets of data has an interquartile range of 10?

Ⓐ 3, 4, 9, 16, 17, 24, 31
Ⓑ 41, 43, 49, 49, 50, 53, 55
Ⓒ 12, 14, 17, 19, 19, 20, 21
Ⓓ 55, 56, 56, 57, 58, 59, 62

Name _____ My Homework _____

Extra Practice

12. The table shows the countries with the most Internet users.

Millions of Internet Users	
China	99.8
Germany	41.88
India	36.97
Japan	78.05
South Korea	31.67
United Kingdom	33.11
United States	185.55

a. Find the range of the data.

Homework Help

153,880,000 185,550,000 − 31,670,000 = 153,880,000

b. Find the median and the first and third quartiles.

41,880,000; 33,110,000; 99,800,000

31.67 33.11 36.97 41.88 78.05 99.8 185.55

Q_1 Median Q_3

c. Find the interquartile range.

66,690,000 99,800,000 − 33,110,000 = 66,690,000

d. Name any outliers in the data. none

13. CCSS **Use Math Tools** The table shows the top teams in the National Football Conference (NFC) and the American Football Conference (AFC).

Penalties By NFL Teams			
NFC		AFC	
Dallas Cowboys	104	New England Patriots	78
Arizona Cardinals	137	Indianapolis Colts	67
Green Bay Packers	113	Jacksonville Jaguars	76
New Orleans Saints	68	San Diego Chargers	94
New York Giants	77	Cleveland Browns	114
Seattle Seahawks	59	Pittsburgh Steelers	80
Minnesota Vikings	86	Houston Texans	82

a. Which conference had a greater range of penalties? _____

b. Find the measures of variation for each conference. _____

c. Compare and contrast the measures of variation for each conference.

14. Find the median, the first and third quartiles, and the interquartile range for the cost of admission: $13.95, $24.59, $19.99, $29.98, $23.95, $28.99.

Georgia Test Practice

15. The number of games won by 10 chess players is given.

13, 15, 2, 7, 5, 9, 11, 10, 12, 11

Which of the following statements is *not* supported by these data?

Ⓐ Half of the players won more than 10.5 games and half won less than 10.5 games.

Ⓑ The range of the data is 13 games.

Ⓒ There are no outliers.

Ⓓ Only one fourth of the players won more than 7 games.

16. The normal monthly rainfall in inches for a city are given in the table.

Jan	Feb	Mar	Apr	May	June
0.65	1.39	0.63	2.16	2.82	4.21
July	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
3.22	1.20	9.31	11.25	0.70	0.80

What values, if any, are outliers?

Ⓕ 9.31 only

Ⓖ 11.25 only

Ⓗ both 9.31 and 11.25

Ⓘ There are no outliers.

17. Short Response The ages in months of dogs enrolled in obedience class are: 8, 12, 20, 10, 6, 15, 12, 9, and 10. Find the range, median, first and third quartiles, and interquartile range of the dogs' ages.

Common Core Review

Divide. MCC5.NBT.6, MCC5.NBT.7

18. 160 ÷ 5 = _____

Show your work.

19. 188 ÷ 8 = _____

20. 133 ÷ 7 = _____

21. 87.5 ÷ 5 = _____

22. 136.5 ÷ 7 = _____

23. 74.4 ÷ 6 = _____

24. Refer to the table. How much farther did the Sing family drive on Friday than on Saturday? MCC4.NBT.4

Day	Distance (miles)
Thursday	68
Friday	193
Saturday	26
Sunday	95

25. Refer to the table. How many more hours did Koli work in week 2 than in week 3? MCC4.NBT.4

Week	Hours Worked
1	12
2	16
3	9

Lesson 4

Mean Absolute Deviation

What You'll Learn

Scan the lesson. List two headings you would use to make an outline of the lesson.

- _____
- _____

Essential Question

HOW are the mean, median, and mode helpful in describing data?

Vocabulary

mean absolute deviation

Common Core GPS

Content Standards
MCC6.SP.5, MCC6.SP.5b, MCC6.SP.5c

Mathematical Practices
1, 2, 3, 4, 5, 6

Real-World Link

Basketball The tables show the number of points two teams scored.

Ally's Team			
52	48	60	50
56	54	58	62

Lena's Team			
51	48	60	49
59	50	62	61

1. Plot each set of data on a number line.

Ally's Team

Lena's Team

2. Find the mean of each set of data. Plot the means on the number lines with a star.

3. Find the range of each set of data. _____

_____

4. Refer to the number lines. Compare and contrast each set of data.

_____

_____

_____

Work Zone

Find Mean Absolute Deviation

You have used the interquartile range to describe the spread of a set of data. You can also use the mean absolute deviation. The **mean absolute deviation** of a set of data is the average distance between each data value and the mean.

Example

Tutor

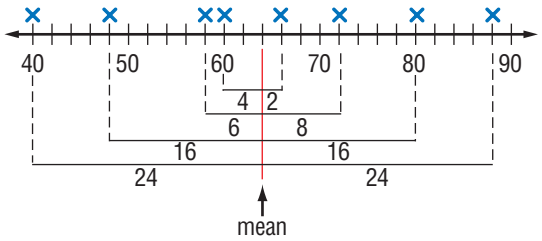
1. **The table shows the maximum speeds of eight roller coasters. Find the mean absolute deviation of the set of data. Describe what the mean absolute deviation represents.**

Maximum Speeds of Roller Coasters (mph)			
58	88	40	60
72	66	80	48

Step 1 Find the mean.

$$\frac{58 + 88 + 40 + 60 + 72 + 66 + 80 + 48}{8} = 64$$

Step 2 Find the absolute value of the differences between each value in the data set and the mean. Each data value is represented by an "x".



Step 3 Find the average of the absolute values of the differences between each value in the data set and the mean.

$$\frac{24 + 16 + 6 + 4 + 2 + 8 + 16 + 24}{8} = 12.5$$

The mean absolute deviation is 12.5. This means that the average distance each data value is from the mean is 12.5 miles per hour.

Got It? **Do this problem to find out.**

Show your work.

a. The table shows speeds of ten birds. Find the mean absolute deviation of the data. Round to the nearest hundredth. Describe what the mean absolute deviation represents.

Speeds of Top Ten Fastest Birds (mph)				
88	77	65	70	65
72	95	80	106	68

a. _____

Compare Variation

You can compare the mean absolute deviations for two data sets. A data set with a smaller mean absolute deviation has data values that are closer to the mean than a data set with a greater mean absolute deviation.

Example

2. **The top five salaries and the bottom five salaries for the 2010 New York Yankees are shown in the table below. Salaries are in millions of dollars and are rounded to the nearest hundredth.**

2010 New York Yankees Salaries (millions of $)										
Top Five Salaries					Bottom Five Salaries					
33.00	24.29	22.60	20.63	16.50	0.45	0.44	0.43	0.41	0.41	

a. Find the mean absolute deviation for each set of data. Round to the nearest hundredth.

Find the mean of the top five salaries.

$$\frac{33.00 + 24.29 + 22.60 + 20.63 + 16.50}{5} \approx 23.40$$

The mean is about \$23.40 million.

Find the mean absolute deviation of the top five salaries.

$$\frac{9.60 + 0.89 + 0.80 + 2.77 + 6.90}{5} \approx 4.19$$

The mean absolute deviation is about \$4.19 million.

Find the mean of the bottom five salaries.

$$\frac{0.45 + 0.44 + 0.43 + 0.41 + 0.41}{5} \approx 0.43$$

The mean is about \$0.43 million.

Find the mean absolute deviation of the bottom five salaries.

$$\frac{0.02 + 0.01 + 0 + 0.02 + 0.02}{5} \approx 0.01$$

The mean absolute deviation is about \$0.01 million.

b. Write a few sentences comparing their variation.

The mean absolute deviation for the bottom five salaries is much less than that for the top five salaries. The data for the bottom five salaries are closer together than the data for the top five salaries.

Mean Absolute Deviation

The absolute values of the differences between each data value and the mean for the top five salaries are calculated below.

$|33.00 - 23.40| = 9.60$

$|24.29 - 23.40| = 0.89$

$|22.60 - 23.40| = 0.80$

$|20.63 - 23.40| = 2.77$

$|16.50 - 23.40| = 6.90$

Show your work.

b. _____

Got It? Do this problem to find out.

b. The table shows the running time in minutes for two kinds of movies. Find the mean absolute deviation for each set of data. Round to the nearest hundredth. Then write a few sentences comparing their variation.

Running Time for Movies (min)										
Comedy					Drama					
90	95	88	100	98	115	120	150	135	144	

Guided Practice

Check

1. Find the mean absolute deviation for the set of data. Round to the nearest hundredth if necessary. Then describe what the mean absolute deviation represents. (Example 1)

Number of Daily Visitors to a Web Site				
112	145	108	160	122

2. The table shows the height of waterslides at two different water parks. Find the mean absolute deviation for each set of data. Round to the nearest hundredth. Then write a few sentences comparing their variation. (Example 2)

Height of Waterslides (ft)										
Splash Lagoon					Wild Water Bay					
75	95	80	110	88	120	108	94	135	126	

3. **Building on the Essential Question** What does the mean absolute deviation tell you about a set of data?

Rate Yourself!

☐ I understand how to find the mean absolute deviation.

Great! You're ready to move on!

☐ I still have questions about finding the mean absolute deviation.

No Problem! Go online to access a Personal Tutor. Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Find the mean absolute deviation for each set of data. Round to the nearest hundredth if necessary. Then describe what the mean absolute deviation represents. (Example 1)

1

Known Moons of Planets			
0	0	1	2
63	34	27	13

2.

Hard Drive (gigabytes)			
640	250	500	640
720	640	250	720

3. The table shows the lengths of the longest bridges in the United States and in Europe. Find the mean absolute deviation for each set of data. Round to the nearest hundredth if necessary. Then write a few sentences comparing their variation.

Longest Bridges (kilometers)										
United States					Europe					
38.4	36.7	29.3	24.1	17.7	17.2	11.7	7.8	6.8	6.6
12.9	11.3	10.9	8.9	8.9	6.1	5.1	5.0	4.3	3.9

For Exercises 4–7, refer to the table that shows the recent population, in millions, of the ten largest U.S. cities.

Population of Largest U.S. Cities (millions)				
1.5	3.8	1.3	1.6	2.9
1.4	0.9	2.3	8.4	1.3

4. Find the mean absolute deviation. Round to the nearest hundredth.

5 How many data values are closer than one mean absolute deviation away from the mean?

6. Which population is farthest from the mean? How far away from the mean is that population? Round to the nearest hundredth.

7. Are there any populations that are more than twice the mean absolute deviation from the mean? Explain.

Be Precise **For Exercises 8 and 9, look up the word *deviate* in a dictionary or online.**

8. What does the word *deviate* mean? How can it help you remember what the mean absolute deviation refers to? _____

_____

9. How does the word *absolute* help you to remember how to calculate the mean absolute deviation? _____

_____

H.O.T. Problems Higher Order Thinking

10. **Reason Abstractly** Create two sets of data, each with five values, that satisfy the following conditions.

The mean absolute deviation of Set A is less than the mean absolute deviation of Set B.

The mean of Set A is greater than the mean of Set B.

_____

Persevere with Problems **For Exercises 11 and 12, refer to the table that shows the recorded speeds of several cars on a busy street.**

Recorded Speeds (mph)					
35	38	41	35	36	55

11. Calculate the mean absolute deviation both with and without the data value of 55. Round to the nearest hundredth if necessary.

_____

_____

12. Explain how including the value of 55 affects the mean absolute deviation.

_____

_____

_____

13. **Construct an Argument** Explain why the mean absolute deviation is calculated using absolute value. _____

_____

Georgia Test Practice

14. The table shows the high temperature for 6 days. Which of the following is the mean absolute deviation for the set of data?

High Temperature (°F)					
75	58	72	68	69	66

Ⓐ 4°F Ⓑ 4.8°F Ⓒ 10°F Ⓓ 68°F

Name _____ My Homework _____

Extra Practice

Use Math Tools **Find the mean absolute deviation for each set of data. Round to the nearest hundredth if necessary. Then describe what the mean absolute deviation represents.**

15.

Digital Camera Prices ($)				
140	125	190	148	156
212	178	188	196	224

$26.76; The average distance each data value is from the mean is $26.76.

Homework Help

mean: $\frac{140 + 125 + 190 + 148 + 156 + 212 + 178 + 188 + 196 + 224}{10} = \$175.70$

mean absolute deviation: $\frac{35.7 + 50.7 + 14.3 + 27.7 + 19.7 + 36.3 + 2.3 + 12.3 + 20.3 + 48.3}{10} = 26.76$

16.

Grand Slam Singles Titles Won				
14	8	7	6	5
10	11	8	8	6

Copy and Solve **Find the mean absolute deviation for each set of data. Round to the nearest hundredth. Then write a few sentences comparing their variation.**

17. The table shows the amount of money raised by the homerooms for two grade levels at a middle school.

Money Raised ($)											
Sixth Grade						Seventh Grade					
88	116	94	108	112	124	144	91	97	122	128	132

18. The table shows the number of points scored each game for two different basketball teams.

Number of Points Scored											
Lakeside Panthers						Jefferson Eagles					
44	38	54	48	26	36	58	42	64	62	70	40

Georgia Test Practice

19. The table shows the prices for parking at various beaches along the same coastline.

Beach Parking ($)				
2.50	3.75	1.25	2.25	3.00

Which of the following is the mean absolute deviation for the set of data?

Ⓐ $0.25 Ⓒ $2.50

Ⓑ $0.66 Ⓓ $2.55

20. Which of the following is true concerning the mean absolute deviation of a set of data?

Ⓕ It describes the variation of the data values around the median.

Ⓖ It describes the absolute value of the mean.

Ⓗ It describes the average distance between each data value and the mean.

Ⓘ It describes the variation of the data values around the mode.

21. **Short Response** The table shows the number of Calories in several sandwiches at a restaurant. Find the mean absolute deviation for the set of data. Round to the nearest hundredth.

Number of Calories per Sandwich					
477	660	572	561	527	605

_____

Common Core Review

Divide. MCC5.NBT.6, MCC5.NBT.7

22. 86 ÷ 5 = _____

23. 95 ÷ 4 = _____

24. 105 ÷ 6 = _____

25. 94.5 ÷ 15 = _____

26. 72 ÷ 5 = _____

27. 40.6 ÷ 7 = _____

28. 59.5 ÷ 7 = _____

29. 126 ÷ 8 = _____

30. 146 ÷ 5 = _____

31. The table shows the number of different cones Delightful Dips ice cream shop sold in one afternoon. What is the total number of cones sold? MCC4.NBT.4 _____

Flavor	Number of Cones
Chocolate	57
Cookie Crunch	49
Fudge Swirl	41
Strawberry	37
Vanilla	51

32. The hiking club wanted to cover a different trail each day for a week. On Monday they hiked 2.3 miles, on Tuesday they hiked 1.8 miles, on Wednesday they hiked 3.2 miles, on Thursday they hiked 1.4 miles and on Friday they hiked 2.8 miles. What is the total distance they hiked? MCC5.NBT.7

_____

Lesson 5

Appropriate Measures

What You'll Learn

Scan the lesson. Predict two things you will learn about appropriate measures.

- _____

_____

- _____

_____

Essential Question

HOW are the mean, median, and mode helpful in describing data?

Common Core GPS

Content Standards
MCC6.SP.5, MCC6.SP.5c, MCC6.SP.5d

Mathematical Practices
1, 3, 4

Real-World Link

Watch

Recycling The green committee had a recycling drive where they collected aluminum cans, plastic bottles, newspapers, and batteries. The weights collected on the first day are shown.

12.2 lb | 11 lb | 19.5 lb | 13 lb

1. Find the mean weight collected. _____

2. If the newspapers are not included, find the mean weight of the remaining items. _____

3. How does the weight of the newspapers affect the mean?

_____

_____

4. What is the median for the data set? How does the median differ if the newspapers are not included?

_____

_____

Key Concept

Using Mean, Median, and Mode

Measure	Most appropriate when...
mean	• the data have no extreme values.
median	• the data have extreme values. • there are no big gaps in the middle of the data.
mode	• data have many repeated numbers.

Work Zone

Sometimes, one measure is more appropriate than others to use to summarize a data set.

Examples

Tutor

1. **The table shows the number of medals won by the U.S. Which measure of center best represents the data? Then find the measure of center.**

Year	1992	1996	2000	2004	2008
Number of Medals	112	101	97	103	110

Since the set of data has no extreme values or numbers that are repeated, the mean would best represent the data.

Mean $\frac{112 + 101 + 97 + 103 + 110}{5} = \frac{523}{5}$ or $104\frac{3}{5}$

The mean number of medals won is $104\frac{3}{5}$ medals.

2. **The table shows the water temperature over several days. Which measure of center best represents the data? Then find the measure of center.**

Water Temperature (°F)
82 85 82 81 82 82 78

In the set of data, there are no extreme values. There is a temperature repeated four times, so the mode 82° is the measure of center that best represents the data.

Show your work.

Got It? Do this problem to find out.

a. The prices of several DVDs are \$22.50, \$21.95, \$25.00, \$21.95, \$19.95, \$21.95, and \$21.50. Which measure of center best represents the data? Justify your selection. Then find the measure of center.

a. _____

Outliers and Appropriate Measure

Sometimes data sets contain outliers. Outliers are deviations from the majority of the data set. The outlier may affect the measures of center.

Examples

Tutor

The table shows average life spans of some animals.

Average Life Span	
Animal	**Life Span (years)**
African elephant	35
Bottlenose dolphin	30
Chimpanzee	50
Galapagos tortoise	200
Gorilla	30
Gray whale	70
Horse	20

3. Identify the outlier in the data set.

Compared to the other values, 200 years is extremely high. So, it is an outlier.

4. Determine how the outlier affects the mean, median, and mode of the data.

Find the mean, median, and mode with and without the outlier.

With the outlier

Mean $\frac{35 + 30 + 50 + 200 + 30 + 70 + 20}{7} \approx 62$

Median 35

Mode 30

Without the outlier

Mean $\frac{35 + 30 + 50 + 30 + 70 + 20}{6} \approx 39$

Median 32.5

Mode 30

The mean life span decreased by 62 − 39 or 23 years. The median life span decreased by 35 − 32.5 or 2.5 years. The mode did not change.

5. Which measure of center best describes the data with and without the outlier? Justify your selection.

The mean was affected the most with the outlier. The median life span changed very little with and without the outlier, so it best describes the data in both cases. The mode does not describe the data very well since there were only two repeated numbers.

Outliers

In Example 3, 200 is an outlier.

IQR = 40

40 • 1.5 = 60

200 − 70 = 130

130 > 60

So, 200 is an outlier.

STOP and Reflect

If a data set has an outlier, why might you use the median instead of the mean?

Show your work.

b. _____

Got It? Do these problems to find out.

The prices of some new athletic shoes are shown in the table.

Price of Athletic Shoes			
$51.95	$47.50	$46.50	$48.50
$52.95	$78.95	$39.95	

b. Identify the outlier in the data set.

c. Determine how the outlier affects the mean, median, and mode of the data. _____

d. Tell which measure of center best describes the data with and without the outlier. _____

Guided Practice

Check

1. The table shows the required temperatures for different recipes. (Examples 1–5)

Cooking Temperature (°F)			
175	325	325	350
350	350	400	450

a. Identify the outlier in the data set. _____

b. Determine how the outlier affects the mean, median, and mode of the data. _____

c. Tell which measure of center best describes the data with and without the outlier. Justify your selection.

2. **Building on the Essential Question** How does an outlier affect the mean, median, and mode of a data set?

Rate Yourself!

How well do you understand choosing the appropriate measure of center for a data set? Circle the image that applies.

For more help, go online to access a Personal Tutor.

Tutor

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

1 The number of minutes spent studying are: 60, 70, 45, 60, 80, 35, and 45. Find the measure of center that best represents the data. Justify your selection and then find the measure of center. (Examples 1 and 2)

2. The table shows monthly rainfall in inches for five months. Identify the outlier in the data set. Determine how the outlier affects the mean, median, and mode of the data. Then tell which measure of center best describes the data with and without the outlier. Round to the nearest hundredth. Justify your selection. (Examples 3–5)

Month	June	July	Aug	Sept	Oct	Nov
Rainfall (in.)	6.14	7.19	8.63	8.38	6.47	2.43

3 The table shows the average depth of several lakes.

Lake	Depth (ft)
Crater Lake	1,148
East Okoboji	10
Lake Gilead	43
Lake Erie	62
Great Salt Lake	14
Medicine Lake	24

a. Identify the outlier in the data set. _____

b. Determine how the outlier affects the mean, median, mode, and range of the data. _____

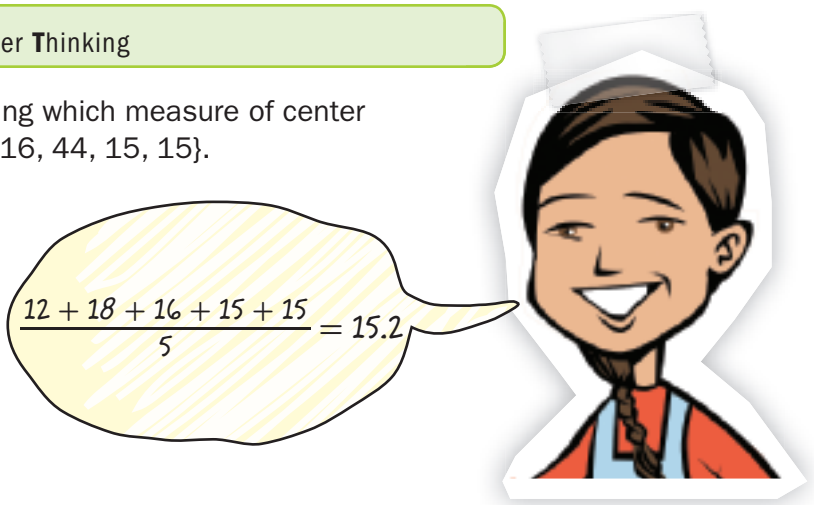
c. Tell which measure of center best describes the data with and without the outlier. _____

4. CCSPS **Construct an Argument** Fill in the graphic organizer below.

Measure of Center	How can an outlier affect it?
mean	
median	
mode	

H.O.T. Problems Higher Order Thinking

5. **Find the Error** Pilar is determining which measure of center best describes the data set {12, 18, 16, 44, 15, 15}. Find her mistake and correct it.



6. **Justify Conclusions** Determine whether the following statement is *true* or *false*. If true, explain your reasoning. If false, give a counterexample.

Of mean, median, and mode, the median will always be most affected by outliers.

7. **Persevere with Problems** Add three data values to the following data set so the mean increases by 10 and the median does not change.

42, 37, 32, 29, 20

Georgia Test Practice

8. The table shows the greatest recorded weights of fish.

Record Fish Weights	
Fish	**Weight (lb)**
King Mackerel	90
Red Snapper	46.5
Snook	44
Swordfish	612.75
Tarpon	243
Yellowfin Grouper	34.38

Which measure is most affected by the outlier?

Ⓐ mean Ⓒ mode

Ⓑ median Ⓓ range

Extra Practice

9. The number of songs downloaded per month by a group of friends were 8, 12, 6, 4, 2, 0, and 10. Find the measure of center that best represents the data. Justify your selection then find the measure of center. Since the set of data has no extreme values or numbers that are identical, the mean or median, 6 songs, would best represent the data.

Homework Help

There are no extreme values and no repeated numbers.

mean: $\frac{0+2+4+6+8+10+12}{7} = 6$

median: 0, 2, 4, (6), 8, 10, 12

10. The ages of participants in a relay race are 12, 15, 14, 13, 15, 12, 22, 16, and 11. Identify the outlier in the data set. Determine how the outlier affects the mean, median, and mode of the data. Then tell which measure of center best describes the data with and without the outlier. _____

11. CCGPS **Justify Conclusions** The table shows the high temperatures during one week. Round to the nearest hundredth if necessary.

High Temperatures				
29°	27°	29°	25°	
28°	29°	62°		

a. Identify the outlier in the data set. _____

b. Determine how the outlier affects the mean, median, mode, and range of the data. _____

c. Tell which measure of center best describes the data with and without the outlier. Explain your reasoning to a classmate. _____

Georgia Test Practice

12. Find the measures of center for the set of data.

17, 36, 45, 98, 25, 34, 19, 45, 36

Ⓐ mean: 41, median: 36, modes: 45 and 36, outlier: none

Ⓑ mean: 41, median: 36, modes: 45 and 36, outliers: 98 and 19

Ⓒ mean: 39.4, median: 36, modes: 45 and 36, outlier: 98

Ⓓ mean: 39.4, median: 36, mode: 45, outlier: 98

13. **Short Response** Refer to Exercise 12. Which measure best describes the set of data? Explain.

14. The table shows the points a basketball team scored in different games.

Points Scored		
79	83	79
85	41	77

Which measure is most affected by the outlier?

Ⓕ mean

Ⓖ median

Ⓗ mode

Ⓘ range

15. **Short Response** The times from a 100 meter race in seconds were: 12.5, 13.1, 11.9, 12.4, 12.7, 13.1, 12.6, and 12.2. What measure of center best represents the data? Explain.

Common Core Review

Find the total of each set of numbers. MCC4.NBT.4

16. {19, 16, 24, 22, 18} _____

17. {54, 48, 52, 57, 49} _____

18. {9, 5, 6, 7, 4, 11, 7} _____

19. {31, 36, 28, 34, 25} _____

20. The table shows the number of tickets sold to the school musical on three days. How many total tickets were sold? MCC4.NBT.4

Day	Number of Tickets Sold
Wednesday	56
Thursday	79
Friday	68

21ST CENTURY CAREER in Marine Biology

Marine Biologist

Do all the unusual and amazing creatures in the ocean fascinate you? Do you think you would be good at coming up with your own experiments to test theories about them? If so, a career in marine biology might be something to think about! A marine biologist studies plants and animals that live in the ocean. These include everything from microscopic plankton to multi-ton whales. Marine biologists study organisms that live in the tiny layers of the surface and those that live thousands of meters below the surface.

College & Career READINESS

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Is This the Career for You?

If you would like to be a marine biologist, you may want to take some of the following courses in high school.

- Biology
- Calculus
- Chemistry
- Marine Science
- Statistics

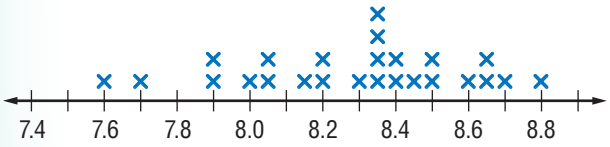
Turn the page to find out how math relates to a career in Marine Biology.

Ready to Make Waves?

Use the information in the line plot and the table to solve each problem. Round to the nearest tenth if necessary.

1. Find the mean of the pipefish data. _____
2. Find the median and mode of the pipefish data. _____
3. What is the range of the pipefish data? Would you describe the data as spread out or close in value? Explain. _____
4. Identify the outlier in the artificial reef data. Find the mean with and without the outlier. _____
5. Describe how the outlier affects the mean in Exercise 4. _____
6. Find the median and mode of the artificial reef data. Which better represents the data? Explain. _____

Pipefish Specimens (cm)



Number of Artificial Reefs in Florida Counties

198	62	108	34	29	73	173
96	97	9	46	21	22	69
8	83	31	79	67	61	15
105	63	34	351	13	126	36
25	12	82	35	4		

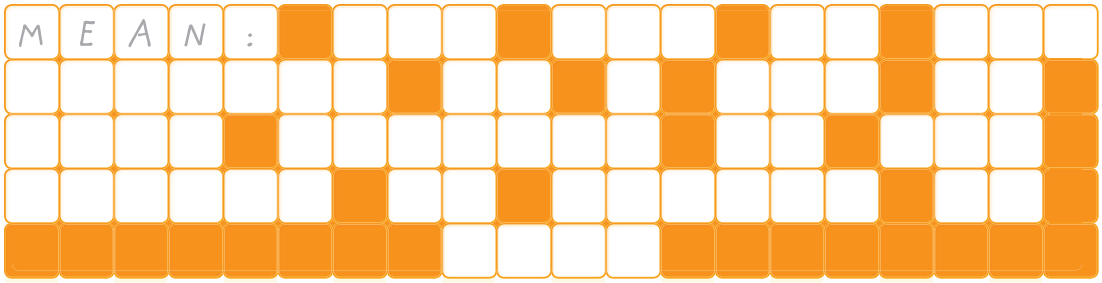
Career Project

It's time to update your career portfolio! Use the Internet or another source to research several careers in marine biology. Write a brief summary comparing and contrasting the careers.

What subject in school is the most important to you? How would you use that subject in this career?

Vocabulary Check

Reconstruct the vocabulary word and definition from the letters under the grid. The letters for each column are scrambled directly under that column.



								F			I								
M	A	T	B					I		E	U			E			O	F	
N	E	M	B		R	S	V	D	D	P	A		B	E	T		O	F	
N	U	M	A	E	R	I	H	I	A	S	A	M	C	Y	F		T	E	
D	U	A	N	E	D	T	O	E	N	T	D	E	S	O	S	T	H	H	E

Complete each sentence using the vocabulary list at the beginning of the chapter.

1. The _____ is the number(s) or item(s) that appear most often in a set of data.
2. Numbers that are used to describe the center of a set of data are _____.
3. The difference between the greatest number and the least number in a set of data is the _____.
4. The _____ of a list of values is the value appearing at the center of a sorted version of the list, or the mean of the two central values, if the list contains an even number of values.
5. The _____ is the distance between the first and third quartiles of a data set.
6. A value that is much higher or much lower than the other values of a data set is a(n) _____.

Key Concept Check

Use Your FOLDABLES

Use your Foldable to help review the chapter.

Tape here

Tape here

Measures of Center

Definition

Definition

Definition

Definition

Definition

Definition

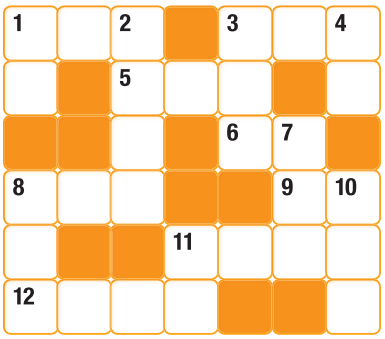
Measures of Variation

Tab 1

Tab 2

Got it?

Complete the cross number puzzle by finding the mean of each data set.



Across

1. {563, 462, 490}

3. {260, 231, 248, 257}

5. {140, 163, 133, 116}

6. {21, 9, 18}

8. {145, 158, 182, 171}

9. {113, 82, 98, 91}

11. {7960, 8624, 8298, 8366}

12. {4625, 3989, 5465}

Down

1. {62, 58, 51, 41}

2. {5326, 5048, 4968}

3. {269, 293, 281}

4. {103, 89, 98, 98}

7. {720, 597, 756}

8. {142, 169, 150, 155}

10. {588, 615, 652, 653}

11. {70, 89, 90}

Problem Solving

1. The speeds of six cheetahs are shown in the table.

What is the mean speed? (Lesson 1) _____

Cheetah Speeds (mph)					
68	72	74	72	71	75

2. **Be Precise** The minutes spent doing homework for one week were 30, 60, 77, 90, 88, 76, and 90. Find the median and mode of these times. (Lesson 2) _____

3. The table shows the high temperatures for one week in July. Find the median and mode for these temperatures. (Lesson 2) _____

July Temperatures (°F)						
78	82	85	84	82	79	83

4. The table shows the number of books read in a reading challenge. Use the measures of variation to describe the data and identify any outliers. (Lesson 3) _____

Books Read						
12	15	12	2	18	20	14
15	13	15	16	10	15	17

5. The table shows the museum admission price for several museums. Find the mean absolute deviation. Round to the nearest hundredth if necessary. Then describe what the mean absolute deviation represents.

(Lesson 4) _____

Museum Admission ($)		
14.25	11.00	15.00
12.25	12.50	13.50

6. The number of points scored in volleyball games are 15, 11, 14, 15, 9, 12, 10, 15, 3, and 15. Find the measure of center that best represents the data. Justify you selection and then find the measure of center. (Lesson 5)

7. The table shows scores on an English test. Which measure of center best describes the data with and without the outlier. (Lesson 5)

Test Scores (%)			
87	89	94	95
98	88	92	94
89	52	94	96

Reflect

Answering the Essential Question

Use what you learned about mean, median, and mode to complete the graphic organizer.

Essential Question

HOW are the mean, median, and mode helpful in describing data?

	mean	median	mode
definition			
When is it appropriate to use?			
How does an outlier affect it?			

Answer the Essential Question. HOW are the mean, median, and mode helpful in describing data?