

Data and Statistics

9A Collecting and Describing Data

9-1 Samples and Surveys

LAB Explore Samples

9-2 Identifying Sampling Errors and Bias

9-3 Organizing Data

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9-6 Displaying Data

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9-8 Misleading Graphs and Statistics

9-9 Scatter Plots

LAB Create a Scatter Plot

9-10 Choosing the Best Representation of Data

LAB Use a Spreadsheet to Create Graphs

Chapter

- Use descriptive statistics to summarize data sets.
- Organize and display data to answer questions.

Why Learn This?

Scientists can use data and statistics to make predictions about populations of koi and other types of fish.



Learn It Online

Chapter Project Online go.hrw.com,

keyword MT10 Ch9

Are You Ready?

Vocabulary

Choose the best term from the list to complete each sentence.

1. A ? is a uniform measure where equal distances are marked to represent equal amounts.
2. ? is the process of approximating to a given ?.
3. Ordered pairs of numbers are graphed on a ?.

coordinate
plane
place value
rounding
scale

Complete these exercises to review skills you will need for this chapter.

Round Decimals

Round each number to the indicated place value.

4. 34.7826; nearest tenth
5. 137.5842; nearest whole number
6. 287.2872; nearest thousandth
7. 362.6238; nearest hundred

Compare and Order Decimals

Order each sequence of numbers from greatest to least.

8. 3.005, 3.05, 0.35, 3.5
9. 0.048, 0.408, 0.0408, 0.48
10. 5.01, 5.1, 5.011, 5.11
11. 1.007, 0.017, 1.7, 0.107

Place Value of Whole Numbers

Write each number in standard form.

12. 1.3 million
13. 7.59 million
14. 4.6 billion
15. 2.83 billion

Read a Table

Use the table for problems 16–18.

16. Which activity experienced the greatest change in participation from 2007 to 2008?
17. Which activity experienced the greatest positive change in participation from 2007 to 2008?
18. Which activity experienced the least change in participation from 2007 to 2008?

Student Participation		
Activity	Year	
	2007	2008
Soccer	50	65
Softball	25	30
Basketball	60	40
Hockey	30	40

Study Guide: Preview

Where You've Been

Previously, you

- used an appropriate representation for displaying relationships among collected data.
- described a set of data using mean, median, mode, and range.
- made inferences based on analysis of data.

In This Chapter

You will study

- selecting an appropriate representation for displaying relationships among collected data.
- selecting the appropriate measure of central tendency to describe data.
- making predictions and analyzing trends in scatter plots.
- recognizing misuses of graphical information.

Where You're Going

You can use the skills learned in this chapter

- to make predictions based on survey results.
- to conduct advanced research studies in science and social studies courses.

Key Vocabulary/Vocabulario

histogram	histograma
line plot	diagrama de acumulación
mean	media
median	mediana
mode	moda
population	población
sample	muestra
scatter plot	diagrama de dispersión

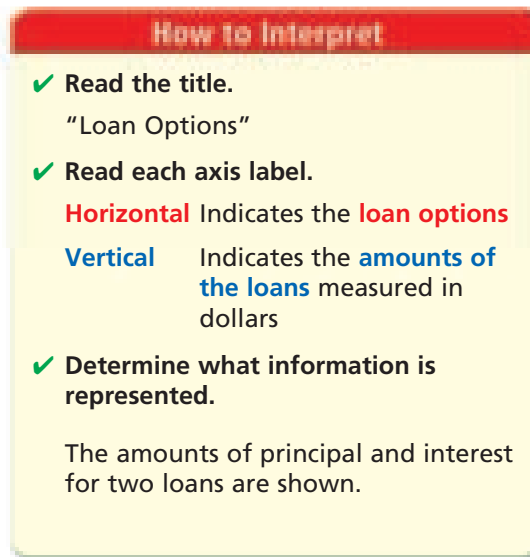
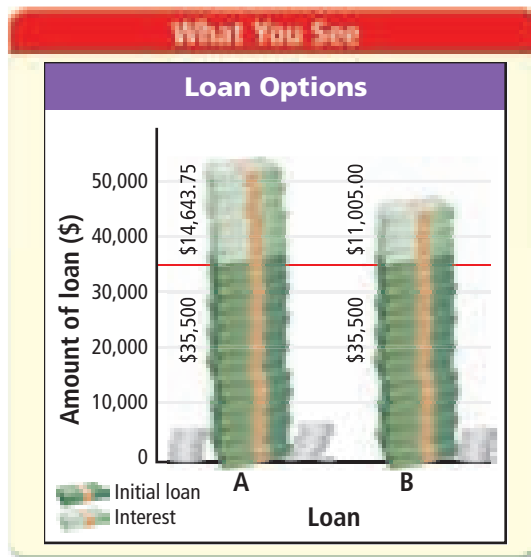
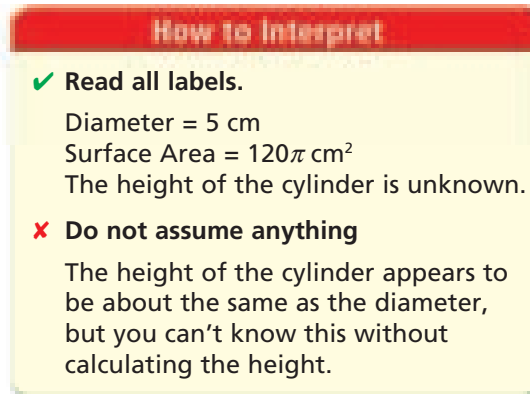
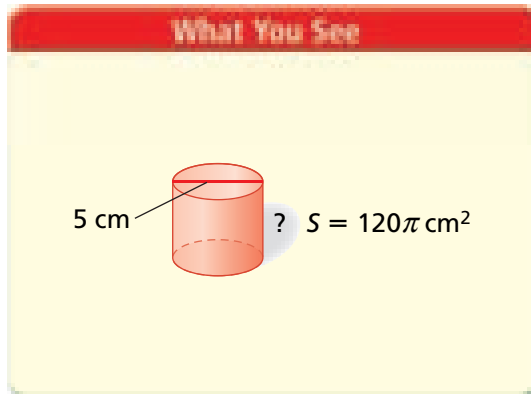
Vocabulary Connections

To become familiar with some of the vocabulary terms in the chapter, consider the following. You may refer to the chapter, the glossary, or a dictionary if you like.

1. The *population* of an area is the total number of people living in that area. What might **population** mean in the process of gathering data?
2. The word *median* is derived from the Latin word *medius*, meaning “middle.” What might the **median** value in a set of data be?
3. When you *sample* a food, you taste a small portion. What might a **sample** be in data collection?

Reading Strategy: Interpret Graphics

Knowing how to interpret figures, diagrams, charts, and graphs will help you gather the information you need to solve the problem.



Try This

Look up each exercise in the text and answer the corresponding questions.

1. Lesson 1-7 Exercise 36: What is the title of the graph? How deep is the deepest trench?
2. Lesson 2-3 Exercises 36 and 37: What does each number in the graph represent? What source provided the most energy?
3. Lesson 8-8 Exercise 2: What is the slant height of the cone? What is the radius of the base of the cone?

9-1

Samples and Surveys

Learn to identify and analyze sampling methods.

Vocabulary

population

sample

random sample

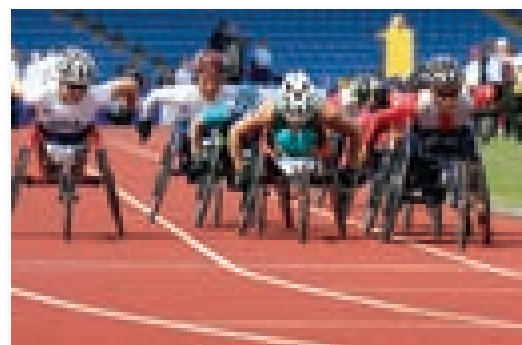
systematic sample

convenience sample

self-selected sample

If you wanted to learn about the athletes in a race, you could survey each athlete. But for a large race, this process could take a lot of time, effort, and money. Instead, you could survey a *sample* of the racers.

The **population** is the entire group being considered for a survey. A **sample** is a part of the population being studied. The table shows several ways of selecting a sample.



Sampling Methods	
Method	Description
random sample	Each member of the population has an equal chance of being selected.
systematic sample	A member of the population is selected at random, and then others are selected by using a pattern.
convenience sample	The most-available members of the population are chosen.
self-selected sample	Members of the population volunteer to respond to a survey.

EXAMPLE

1

Identifying Sampling Methods

Race organizers want to know how often participants train for a race. Identify each type of sampling method.

- A** The organizers provide written surveys at the finish line for athletes who wish to fill them out.

This is a self-selected sample because the athletes choose whether to complete the surveys.

- B** The organizers randomly choose one of the first ten names on an alphabetical list of the athletes' names. Then they select every tenth name after that.

This is a systematic sample. The first name is chosen at random, and then the other names are chosen by using a pattern.

- C** The organizers interview a group of 50 athletes as the athletes arrive at the race.

This is a convenience sample because the group of athletes is easy for the organizers to reach.

Random samples and systematic samples are more likely to be representative of a population than either convenience samples or self-selected samples.

EXAMPLE

2

Analyzing Sampling Methods

Determine which sampling method will better represent the entire population. Justify your answer.

Student Survey: New School Uniforms	
Sampling Method	Results of Survey
Kurt surveys 30 students by randomly choosing names from the school enrollment list.	57% favor new uniforms.
Sabine surveys 15 of her friends at school.	73% favor new uniforms.

Kurt's method gives results that are probably more representative of the entire student population because he uses a random sample.

Sabine's method gives results that are probably not as representative of the entire population because she uses a convenience sample.

EXAMPLE

3

Comparing Samples

About 36% of all households in the United States have a pet dog. Brad surveys a random sample of households from two towns. Compare the samples with the national percent.

Household Dog Ownership		
Sample	Number with Dogs	Number without Dogs
Town A	11	9
Town B	7	13

For each sample, find the percent of the households that have dogs.

$$\text{Town A: } \frac{\text{number of households with dogs}}{\text{total number of households}} = \frac{11}{11 + 9} = \frac{11}{20} = 0.55 = 55\%$$

$$\text{Town B: } \frac{\text{number of households with dogs}}{\text{total number of households}} = \frac{7}{7 + 13} = \frac{7}{20} = 0.35 = 35\%$$

The data suggest that dog ownership in Town B is close to the national percentage, but dog ownership in Town A is greater than the national percentage.

Think and Discuss

- Describe** a situation in which you would want to use a sample rather than survey the entire population.
- Tell** how you could randomly select five students from your class.





GUIDED PRACTICE

See Example 1 A state senator wants to know whether voters in her district support a new tax law. Identify each type of sampling method.

1. A staff member randomly chooses 500 names from a list of the district's registered voters.
2. A staff member posts a survey on the senator's Web site.

See Example 2 3. Determine which sampling method will better represent the entire population. Justify your answer.

BB Bakery: Customer Satisfaction	
Sampling Method	Results of Survey
Jane surveys every 10th customer to enter the bakery over a three-day period.	64% are satisfied with product freshness.
Sherida surveys the first 30 customers to enter the bakery one morning.	95% are satisfied with product freshness.

See Example 3 4. About 12% of adults in the United States visit a zoo each year. Malika surveys a random sample of adults from two cities in her state. Compare the samples with the national percent.

Zoo Attendance in the Past Year		
Sample	Yes	No
City A	3	22
City B	10	15

INDEPENDENT PRACTICE

See Example 1 A school librarian wants to know how often students at the school use text messaging. Identify each type of sampling method.

5. The librarian randomly selects a name from the first 20 names on a list of all students at the school and then chooses every 20th name after that.
6. The librarian surveys 40 students who are in the library during lunch period.

See Example 2 7. Determine which sampling method will better represent the entire population. Justify your answer.

New Crestview Neighborhood Park	
Sampling Method	Results of Survey
Hardit surveys 50 people randomly chosen from the neighborhood's tax records.	58% want a new park.
Rachel posts a survey on the neighborhood association's Web site.	32% want a new park.

See Example 3

8. In 2005, the average American spent 6 hours per week using the Internet. Laura surveys a random sample of 20 people in two towns. Compare the samples with the national average.

Internet Use (hours per week)	
Town A	11, 8, 7, 2, 9, 4, 2, 0, 7, 2, 8, 20, 4, 5, 8, 6, 3, 0, 2, 10
Town B	3, 12, 4, 0, 5, 7, 3, 0, 2, 4, 10, 5, 2, 2, 9, 6, 2, 2, 5, 11

PRACTICE AND PROBLEM SOLVING



Extra Practice

See page EP18.

Jasmine wants to survey a sample of the students taking art at her school. Describe how Jasmine could select each type of sample.

9. random sample 10. convenience sample 11. self-selected sample
12. **Consumer Math** On September 10, 2007, the average price of regular gasoline in the United States was \$2.82 per gallon. The table shows the price of regular gas at a sample of 10 gas stations in Miami on this date. Compare the sample to the national average.

Price per Gallon of Regular Gas in Miami
\$2.73, \$2.74, \$2.74, \$2.80, \$2.82, \$2.84, \$2.81, \$2.99, \$2.96, \$2.87

13. **Critical Thinking** There are 80 students in a soccer club. Cara chooses a random sample of 2 students and finds that one of them is also a member of the chess club. Cara concludes that 40 students in the soccer club also belong to the chess club. Do you agree? Why or why not?
-  14. **Write About It** Describe how you could choose a systematic sample of the customers visiting a music store during one week.
-  15. **Challenge** Kenneth surveys 50 students at his school and finds that 35 of them belong to an after-school club. If 102 of the school's 320 students belong to an after-school club, do you think Kenneth chose a random sample of the school's students? Explain.



Test Prep and Spiral Review

16. **Multiple Choice** Travis wants to know which candidate for mayor people in his town prefer. He surveys the first 50 people to leave a local café one day. What type of sample is this?
- (A) Random (B) Convenience (C) Self-selected (D) Systematic
17. **Short Response** Explain why a convenience sample is generally less representative of a population than a random sample.

Solve each proportion. (Lesson 5-4)

18. $\frac{2}{8} = \frac{x}{12}$

19. $\frac{5}{m} = \frac{60}{24}$

20. $\frac{6}{4} = \frac{y}{42}$

21. $\frac{t}{40} = \frac{5}{8}$



Explore Samples

9-1

Use with Lesson 9-1



REMEMBER

- Be sure that your sample reflects your population.

You can predict data about a population by collecting data from a representative sample.

Activity

Look through a magazine or a newspaper to find an article that includes the results of a survey. For example, you might find an article that shows a circle graph of people's favorite colors.

Conduct a similar survey at your school, and compare the results in the article to the results of your own survey. Follow the steps below to plan your survey.

- 1 Choose your population.
 - every student in the school
 - only your class
 - all 8th grade students
 - all girls
 - all boys
 - teachers
- 2 Choose two different sampling methods. Discuss the pros and cons of each method listed.
 - random
 - systematic
 - convenience
 - self-selected
- 3 Determine what question you will present to your sample. Decide whether your question will be multiple-choice or whether you will allow survey participants to give any answer they wish.

Think and Discuss

1. Describe how the population used for your survey differs from the population used for the survey in the article.
2. Explain how you can ensure that your sample will be representative of your population.

Try This

1. Create forms for your survey listing the different options. Then survey your sample. Make a table of your results.
2. Explain what your table tells you about your population. How do your results compare to the results from the survey in the article?

9-2

Identifying Sampling Errors and Bias

Learn to identify bias in samples and surveys and to evaluate survey claims.

Vocabulary

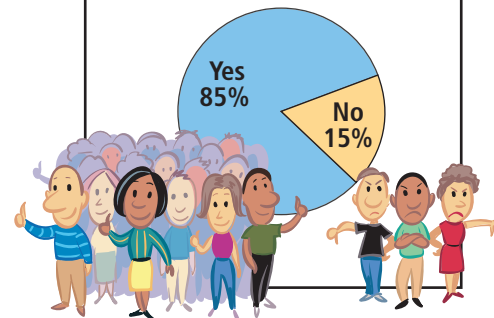
biased sample

biased question

A reporter wants to know whether city residents support the building of a new downtown subway station. The reporter surveys 80 subway riders and graphs the results.

A **biased sample** is a sample that does not fairly represent the population. The reporter's sample could be biased because subway riders may be more likely to support a new station than city residents who do not ride the subway would be.

Do We Need a New Downtown Station?



EXAMPLE 1

1

Identifying Potentially Biased Samples

Determine whether each sample may be biased. Explain.

- A** A soccer league manager randomly selects 200 players from the league to determine the average age of the league's players.
The sample is not biased. It is a random sample.
- B** The first 30 people leaving a craft store are surveyed to find out the favorite hobbies of people in the town.
The sample may be biased. People shopping at a craft store may be more likely than other people in the town to have craft-related hobbies.

The results of a survey may also be affected by *biased questions*.

A **biased question** is one that leads people to give a certain answer.

EXAMPLE 2

2

Identifying Potentially Biased Questions

Determine whether each survey question may be biased. Explain.

- A** Do you prefer the sleek and stylish cell phone or this plainer one?
The question is biased. People may be more likely to choose a cell phone that is described as sleek and stylish than one that is described as plain.
- B** In the next election, do you intend to vote for Martinez or Chen?
The question is not biased. It does not lead people to choose one candidate over the other.



To decide whether a claim based on a survey is valid, check whether the sample or the survey question is biased. In addition, make sure that the sample was taken from the correct population and that the sample size is sufficiently large.

EXAMPLE

3

Evaluating Survey Claims

Determine whether each claim is valid. Explain.

- A** Ashton conducts a survey to find out how teenagers in his town spend their free time.

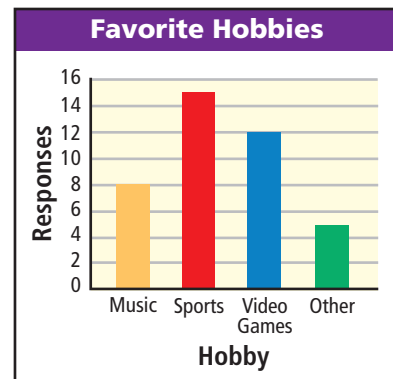
Sample: 40 teenagers at a local soccer game

Question: What is your favorite hobby?

Claim: Playing sports is the most popular hobby among teenagers in Ashton's town.

The claim may not be valid. The sample is biased because teenagers at a soccer game may be more likely to play sports than other teenagers would.

Results:



- B** The manager of a bookstore conducts a survey to find out whether customers like the store's new Web site.

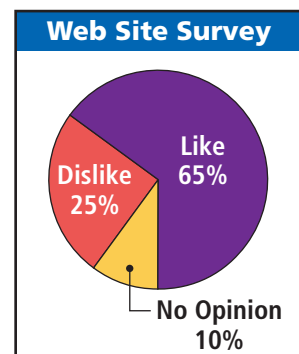
Sample: 20 book publishers selected at random from the store's database

Question: What is your opinion of our new Web site?

Claim: A majority of the bookstore's customers like the new Web site.

The claim may not be valid. The sample was taken from the wrong population. The manager should have surveyed customers of the bookstore, not book publishers.

Results:



Think and Discuss

- 1. Explain** why biased questions can lead to survey results that are not valid.
- 2. Give an example** of a biased question and of a fair question that you could ask the students in your class about their favorite books.

GUIDED PRACTICE

See Example 1 Determine whether the sample may be biased. Explain.

1. A restaurant places comment cards on its tables that customers can fill out and mail in. The manager selects the first 20 cards that are mailed in.

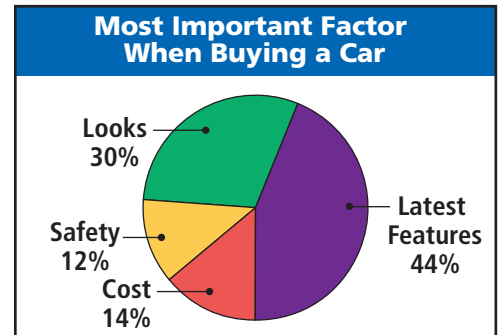
See Example 2 Determine whether each survey question may be biased. Explain.

2. Do you approve or disapprove of the governor's tax proposal?
3. Do you agree that putting computers in every classroom is the best way to improve education?

See Example 3

4. Ellen conducts a survey to find out what is important to people in her city when they buy a car. Determine whether Ellen's claim is valid. Explain.
Sample: 50 people at a car show
Question: What is the most important factor when you buy a car?
Claim: Having the latest features is the most important factor for car buyers in Ellen's city.

Results:



INDEPENDENT PRACTICE

See Example 1 Determine whether the sample may be biased. Explain.

5. The director of a ballet studio selects every tenth name in the studio's enrollment list and then asks those dancers how they like their classes.

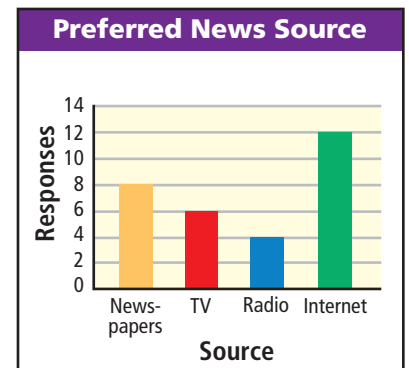
See Example 2 Determine whether each survey question may be biased. Explain.

6. Should the historic Main Street Theater be replaced by an unneeded shopping center?
7. What is your favorite brand of jeans?

See Example 3

8. Manuel conducts a survey to find out the preferred news source of students at his school. Determine whether Manuel's claim is valid. Explain.
Sample: 30 students chosen at random from the school directory
Question: What is your preferred source of news?
Claim: Most students at Manuel's school prefer to get their news from the Internet.

Results:



PRACTICE AND PROBLEM SOLVING

Extra Practice

See page EP18.

For each situation, describe a survey sample and a survey question that would be likely to lead to valid results.

9. A teacher wants to know whether his students prefer to have a class party at an ice-skating rink or at an amusement park.
10. The mayor of a city wants to know whether registered voters approve of adding a bike lane on First Street.
11. **Critical Thinking** A local news show asks viewers to call in their answers to the question “Does the city need a new airport?” Two-thirds of the 240 callers say no. The same question is asked of 240 people who are contacted by phone from a random selection of local telephone numbers. Only 28% of these people answer no. Which result is probably more valid? Explain.
12. **What’s the Error?** Lydia randomly selects one of the 30 students in her class and asks that student to name his favorite type of music. From his response, Lydia concludes that the most popular type of music in her class is country music. What is the error in Lydia’s prediction?
13. **Write About It** Explain why the question “How much time do you waste each week watching television?” is biased and describe how you could reword it to make it more fair.
14. **Challenge** A newspaper conducts a survey to find out whether residents of a town think a new playground should be built. Write a biased question that might give the results shown in the table.

Playground Survey Results	
Approve	20%
Disapprove	75%
No opinion	5%

Test Prep and Spiral Review

15. **Multiple Choice** A researcher wants to know about the driving habits of people in her state. She chooses 200 people at random from the state’s database of licensed drivers. She asks the question “In the past month, how many times have you put other people at risk by talking on your cell phone while driving?” Which of the following best explains why the survey results may not be valid?
 - (A) The sample is biased.
 - (B) The question is biased.
 - (C) The sample is from the wrong population.
 - (D) The question is not related to the topic.
16. **Short Response** Give an example of a biased sample. Explain why it is biased.

Use a number line to find each sum. (Lesson 1-5)

17. $-6 + 11$

18. $-31 + (-31)$

19. $-8 + 14$

Multiply. Write the product as one power. (Lesson 4-3)

20. $3^6 \cdot 3^7$

21. $7^2 \cdot 7^4$

22. $12^4 \cdot 12^4$

23. $x^3 \cdot x^5$

9-3

Organizing Data

Learn to organize data in line plots, stem-and-leaf plots, and Venn diagrams.

Vocabulary

line plot

stem-and-leaf plot

back-to-back

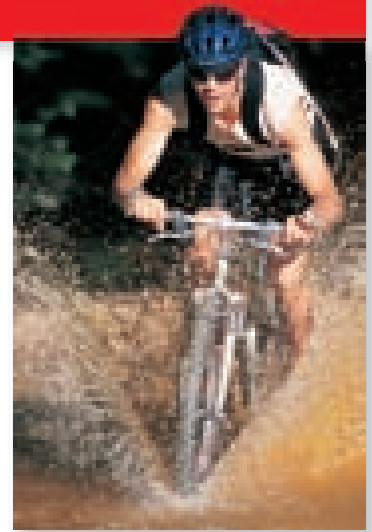
stem-and-leaf plot

Venn diagram

An eighth-grade class participated in a month-long fitness challenge. Below are the numbers of miles each student ran, walked, or biked during the first week.

7 5 6 5 5 10 9 9 9 3 3 10 1 0 8
6 8 2 3 1 5 0 4 6 4 8 9 3 4 4

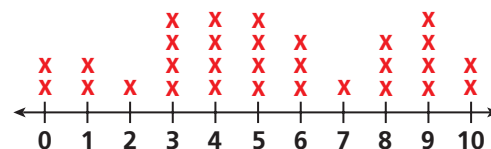
Organizing raw data can help you see patterns and trends. One way to organize data is to use a *line plot*. A **line plot** uses a number line to show how often a value occurs in a data set.



EXAMPLE 1 Organizing Data in Line Plots

Use a line plot to organize the data for the eighth-grade fitness challenge.

Find the least value, 0, and the greatest value, 10, in the data set. Then draw a number line from 0 to 10. Place an “x” above each number on the number line for each time it appears in the data set



There are 30 numbers in the data set and 30 x's above the number line.

A **stem-and-leaf plot** is a graph used to organize and display data to compare frequencies. Each leaf on the plot represents the right-hand digit in a data value. Each stem represents the remaining left-hand digits.

Stem = first digit(s)

$$2 \mid 5 = 25$$

Leaf = last digit

EXAMPLE 2 Reading Stem-and-Leaf Plots

List the data values in the stem-and-leaf plot.

0	2 5
1	3 3 7 8
2	0 2 6
3	1 7

Key: 3 | 1 means 31

The data values are 2, 5, 13, 13, 17, 18, 20, 22, 26, 31, and 37.

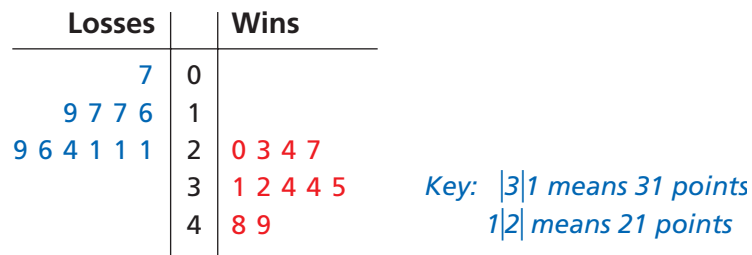
A **back-to-back stem-and-leaf plot** can be used to compare two sets of data. The stems are in the center, and the left leaves are read in reverse.

EXAMPLE 3

Organizing Data in Back-to-Back Stem-and-Leaf Plots

Use the given data to make a back-to-back stem-and-leaf plot.

Super Bowl Scores, 1995–2005											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Winning	49	27	35	31	34	23	34	20	48	32	24
Losing	26	17	21	24	19	16	7	17	21	29	21



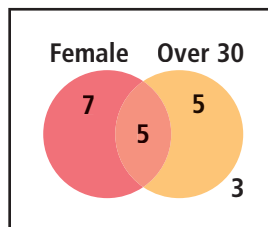
Venn diagrams are used to show relationships between sets.

EXAMPLE 4

Organizing Data in Venn Diagrams

In a survey, the genders and ages of people who completed the questions are shown at right. Make a Venn diagram to show the number of people who are female and over age 30.

Draw two circles. Label one circle “Female” and the other circle “Over 30.” The region that overlaps represents the characteristics that are shared by both sets of data.



Survey Results			
Gender	Age	Gender	Age
M	18	M	16
F	30	M	35
F	25	F	28
M	50	F	45
M	60	F	35
F	17	M	38
F	42	F	29
F	30	F	46
M	27	M	32
F	48	F	25

Think and Discuss

1. Explain what the overlapping region represents in a Venn diagram.



GUIDED PRACTICE

See Example 1 1. Use a line plot to organize the data of ages of children visiting a park. 5 7 8 2 3 3 4 5 8 2
9 10 9 10 8 8 7 6 6 5

See Example 2 2. List the data values in the stem-and-leaf plot.

2. <table style="display: inline-table; border-collapse: collapse;"> <tr><td style="border-right: 1px solid black; padding-right: 5px;">0</td><td style="padding-left: 5px;">2 3 3 7</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">1</td><td style="padding-left: 5px;">1 3 7 7 8</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">2</td><td style="padding-left: 5px;">0 0 7</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">3</td><td style="padding-left: 5px;">4 4 5 5</td></tr> </table> Key: 3 5 means 35	0	2 3 3 7	1	1 3 7 7 8	2	0 0 7	3	4 4 5 5	3. <table style="display: inline-table; border-collapse: collapse;"> <tr><td style="border-right: 1px solid black; padding-right: 5px;">6</td><td style="padding-left: 5px;">3 6 8</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">7</td><td style="padding-left: 5px;">3 3 5 7</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">8</td><td style="padding-left: 5px;">0 0 1 1</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">9</td><td style="padding-left: 5px;">0 4 5 9</td></tr> </table> Key: 9 9 means 99	6	3 6 8	7	3 3 5 7	8	0 0 1 1	9	0 4 5 9
0	2 3 3 7																
1	1 3 7 7 8																
2	0 0 7																
3	4 4 5 5																
6	3 6 8																
7	3 3 5 7																
8	0 0 1 1																
9	0 4 5 9																

See Example 3 4. Use the given data to make a back-to-back stem-and-leaf plot.

Political Divisions of the U.S. Senate										
Congress	101st	102nd	103rd	104th	105th	106th	107th	108th	109th	110th
Democrats	55	55	57	46	45	45	50	48	44	49
Republicans	45	45	43	54	55	55	50	51	55	49

See Example 4 5. Make a Venn diagram to show how many eighth-grade female students responded to a recent survey.

Survey Results										
Grade	6 th	5 th	8 th	6 th	7 th	8 th	7 th	8 th	6 th	5 th
Gender	M	F	M	F	M	F	M	F	F	M

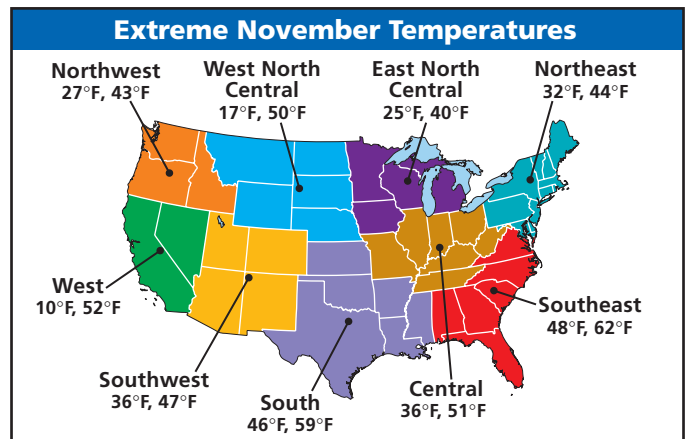
INDEPENDENT PRACTICE

See Example 1 6. Use a line plot to organize the data of the number of books read by students over the summer. 3 0 3 6 0 1 2 5 5 5 2
3 0 0 1 6 0 7 8 6 5 6

See Example 2 7. List the data values in the stem-and-leaf plot.

7. <table style="display: inline-table; border-collapse: collapse;"> <tr><td style="border-right: 1px solid black; padding-right: 5px;">5</td><td style="padding-left: 5px;">0 1 4 8</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">6</td><td style="padding-left: 5px;">2 6 7</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">7</td><td style="padding-left: 5px;">1 4 5 6 6</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">8</td><td style="padding-left: 5px;">2</td></tr> </table> Key: 6 2 means 62	5	0 1 4 8	6	2 6 7	7	1 4 5 6 6	8	2	8. <table style="display: inline-table; border-collapse: collapse;"> <tr><td style="border-right: 1px solid black; padding-right: 5px;">0</td><td style="padding-left: 5px;">1 5 7</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">1</td><td style="padding-left: 5px;">2 4 6 8</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">2</td><td style="padding-left: 5px;">0 1 7 9</td></tr> <tr><td style="border-right: 1px solid black; padding-right: 5px;">3</td><td style="padding-left: 5px;">3 3 4 6</td></tr> </table> Key: 2 1 means 21	0	1 5 7	1	2 4 6 8	2	0 1 7 9	3	3 3 4 6
5	0 1 4 8																
6	2 6 7																
7	1 4 5 6 6																
8	2																
0	1 5 7																
1	2 4 6 8																
2	0 1 7 9																
3	3 3 4 6																

See Example 3 9. Use the data given in the map to make a back-to-back stem-and-leaf plot.



- See Example 4 10. Make a Venn diagram to show how many unemployed college graduates responded to a recent survey.

Survey Results												
College Graduate	yes	no	yes	yes	yes	yes	no	yes	no	yes	yes	no
Employed	yes	yes	no	no	yes	no	yes	yes	yes	no	yes	no

PRACTICE AND PROBLEM SOLVING

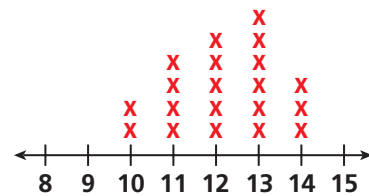
Extra Practice

See page EP18.

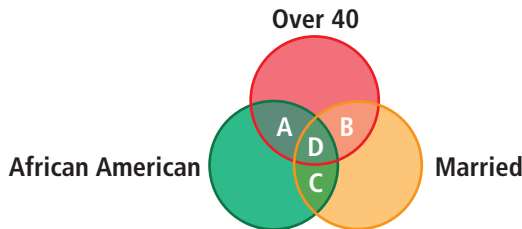
11. Use the given data to make a back-to-back stem-and-leaf plot. What is the difference in miles per gallon between the highest highway rating and the highest city rating?

Miles per Gallon Ratings of a Car Company's Models											
Model	A	B	C	D	E	F	G	H	I	J	
City Miles	11	17	28	19	18	15	18	22	14	20	
Highway Miles	15	24	36	28	26	20	23	25	17	29	

12. The ages of 20 middle school students are shown in the line plot. List the ages in order from the most frequent to the least frequent.



Use the Venn diagram to answer questions 13–16.



13. What does the portion of the Venn diagram labeled “A” represent?
 14. What does the portion of the Venn diagram labeled “B” represent?
 15. What does the portion of the Venn diagram labeled “C” represent?
 16. What does the portion of the Venn diagram labeled “D” represent?

The stem-and-leaf plot shows the scores for a recent math test.

Use it to answer questions 17–19.

17. How many students took the test?
 18. What was the highest score received? How many students received the highest score?
 19. What was the lowest score received?

Boys		Girls	
5	1	6	9
9	8 8 6	7	1 5 5 5
9	5 1 1 1	8	2 2 8
9	8 1	9	1 2 2 7 9

Key: 5 | 6 means 65

| 7 | 1 means 71



An author's writing style is as unique as a fingerprint. Punctuation, spelling, and word usage can be used to determine authorship.



A scene from the play *A Midsummer Night's Dream*

20. Act 5 of William Shakespeare's *A Midsummer Night's Dream* has the following references to numbers: 1 nine times, 2 three times, 3 six times, 10 two times, 12 one time, and 14 one time. Use the data to make a line plot.

21. The table shows the number of letters per word in the first 20 words of two books. For each book, make a line plot of the data. Do you think the books were written by the same author? Support your answer.

Book A	6	9	4	6	4	3	3	4	9	7	2	8	3	4	9	8	7	2	4	3
Book B	1	2	3	4	4	2	1	3	1	2	3	4	4	4	1	3	1	2	3	4

22. **Challenge** Select two paragraphs from a work by your favorite author and a third paragraph by a different author. Compare word choices or punctuation use in the three paragraphs. Explain the similarities and differences. Use a line plot or back-to-back stem-and-leaf plot to support your argument.



Test Prep and Spiral Review

23. **Multiple Choice** For which set of data would it NOT be appropriate to make a stem-and-leaf plot?

- (A) Scores of a baseball league's games
 (C) Prices of fruit at a local market
 (B) Average high temperatures
 (D) Instruments played in the band

24. **Short Response** Use the data to make a back-to-back stem-and-leaf plot of the ages of people who visited an art exhibit. Men: 32, 45, 61, 33, 41, 61; women: 31, 44, 55, 32, 55, 64

Solve each proportion. (Lesson 5-4)

25. $\frac{9}{10} = \frac{x}{15}$

26. $\frac{2}{w} = \frac{8}{12}$

27. $\frac{6}{1} = \frac{d}{3}$

28. $\frac{r}{4} = \frac{36}{3}$

Identify each sampling method. (Lesson 9-1)

29. Each shopper at a store grand opening places his or her name in a box. One shopper is chosen at random.
30. Every fourth customer at the grand opening receives a gift certificate.

9-4

Measures of Central Tendency

Learn to find appropriate measures of central tendency.

Measures of central tendency are used to describe the middle of a data set. Mean, median, and mode are measures of central tendency.

Vocabulary

mean

median

mode

range

outlier

weighted average

Measures of Central Tendency and Range	
Mean	To find the mean (average), add the values in the data set. Then divide by the number of values in the set.
Median	The middle value, or the mean of the two middle values, in an ordered set of data.
Mode	The value(s) that occur most frequently. A data set may have no mode, one mode, or several modes.
Range	The difference between the least and the greatest values in a data set.

An **outlier** is a value that is either far less than or far greater than the rest of the values in the data.

EXAMPLE 1

Analyzing the Effects of Outliers

[Interactivities Online](#) ▶

Identify the outlier in the data set, and determine how the outlier affects the mean, median, mode, and range of the data.

10, 6, 91, 5, 8, 6

The outlier is 91. This value is much greater than the others.

Without the outlier:

$$\text{mean: } \frac{10 + 6 + 5 + 8 + 6}{5} = 7$$

The mean is 7.

median: 5, 6, **6**, 8, 10

The median is 6.

mode: 5, **6, 6**, 8, 10

The mode is 6.

$$\text{range: } 10 - 5 = 5$$

The range is 5.

With the outlier:

$$\text{mean: } \frac{10 + 6 + 91 + 5 + 8 + 6}{6} = 21$$

The mean is 21.

median: 5, 6, **6, 8**, 10, 91

$$\frac{6 + 8}{2} = 7$$

The median is 7.

mode: 5, **6, 6**, 8, 10, 91

The mode is 6.

$$\text{range: } 91 - 5 = 86$$

The range is 86.

The outlier increases the mean by 14, the median by 1, and the range by 81. It has no effect on the mode.



As shown in Example 1, an outlier can greatly affect the mean and the range of a data set. For this reason, the mean and the range may not be the best measures to describe a set of data with an outlier.

Measure	Most Useful When
mean	The data set does not have any outliers.
median	The data set has an outlier.
mode	You need to show which value(s) occur most often, such as in election results.
range	You need to show the spread of the data.

The measure you use to describe a data set may also depend on how the information in the data set is being used.

EXAMPLE

2

Choosing the Best Measure of Central Tendency

Determine and find the most appropriate measure of central tendency for each situation. Justify your answer.

- A** For the 2004 NFL season, the top four player salaries were \$35,037,700, \$19,004,000, \$16,536,500, and \$16,000,000. What measure best describes these salaries?

The salary \$35,037,700 is an outlier. Because of the outlier, the mean is not the best measure. There is no mode. Find the median.

\$16,000,000; **\$16,536,500; \$19,004,000**; \$35,037,700

$$\frac{16,536,500 + 19,004,000}{2} = 17,770,250$$

The median of the top four NFL salaries is \$17,770,250. This measure best describes the center of the data.

- B** A store had sales of \$1025, \$974, \$993, \$1001, \$1027, \$1657, and \$1471 during one week. Which measure would make the store's sales for the week look the best?

Find each measure of central tendency.

mean: $\frac{1025 + 974 + 993 + 1001 + 1027 + 1657 + 1471}{7} = 1164$

The mean is \$1164.

median: 974, 993, 1001, **1025**, 1027, 1471, 1657

The median is \$1025.

mode: There is no mode.

The mean is greater than the median, and there is no mode. The mean is the best measure to describe the data because it makes the sales for the week appear the greatest.



A **weighted average** is a mean that is more strongly influenced by some data values than others. For example, your grade in a class may be a weighted average if your test scores count more than your homework scores.

To calculate a weighted average, multiply each data value by its corresponding weight. Then add the products and divide by the total number of data values.

EXAMPLE

3

Finding Weighted Averages

Find each weighted average.

- A** A number of music critics reviewed a band's new CD using a 4-star scale. What is the weighted average of the ratings?

CD Ratings					
Rating	★★★★	★★★	★★	★	no stars
Number of Critics	6	19	2	2	1

In this case, the weights are the numbers of stars.

$$\frac{6(4) + 19(3) + 2(2) + 2(1) + 1(0)}{6 + 19 + 2 + 2 + 1}$$

Multiply each number of critics by its weight. Then add.

$$\frac{87}{30} = 2.9$$

Divide by the total number of critics.

The weighted average of the critics' ratings is 2.9 stars.

- B** Slugging average is a weighted average used in baseball. To calculate slugging average, use the following weights: 4 for home runs (HR), 3 for triples (3B), 2 for doubles (2B), 1 for singles (1B), and 0 for outs. What is Evan's slugging average, to the nearest thousandth?

Evan's At-Bat Statistics				
HR	3B	2B	1B	Outs
3	2	4	9	26

$$\frac{3(4) + 2(3) + 4(2) + 9(1) + 26(0)}{3 + 2 + 4 + 9 + 26}$$

Multiply each type of at-bat by its weight. Then add.

$$\frac{35}{44} \approx 0.795$$

Divide by the total number of at-bats.

Evan's slugging average is about 0.795.

Think and Discuss

- 1. Explain** how the range is affected by outliers.
- 2. Give** a data set with the same mean, median, and mode.



GUIDED PRACTICE

See Example 1 Identify the outlier in the data set, and determine how the outlier affects the mean, median, mode, and range of the data set.

1. 35, 21, 3, 44, 36, 42, 29 2. 7, 5, 24, 6, 6, 3, 5, 2, 5

See Example 2 Determine and find the most appropriate measure of central tendency for each situation.

3. The scores on a math test were 80, 79, 90, 95, 85, 82, 96, 94, 81, 49, 92, and 87. What measure best describes these scores?
4. The weekly salaries of the employees of a hair salon are \$1025, \$975, \$823, \$750, \$1400, \$823, \$1000, and \$823. Which measure of data would make the salaries seem the highest?

See Example 3 5. At Shyam's college, grade point average (GPA) is a weighted average. Find Shyam's GPA to the nearest tenth. (*Hint:* Multiply each grade by the corresponding number of credits. Then divide the sum of the products by the total number of credits.)

Shyam's Grades					
Grade	3.0	3.0	4.0	3.0	2.0
Credits	3	4	2	2	3

INDEPENDENT PRACTICE

See Example 1 Identify the outlier in the data set, and determine how the outlier affects the mean, median, mode, and range of the data set.

6. 6, 8, 6, 22, 7, 9, 2, 4 7. 4.3, 1.3, 4.5, 8.6, 9, 3, 4.3, 18

See Example 2 Determine and find the most appropriate measure of central tendency for each situation.

8. The ages of the students in a middle school choir are 10, 11, 12, 11, 12, 11, 10, 11, 13, 12, 13, 12, 11, 13, 14, 12, 14, 12, 11, and 12. What age appears most often in the list?
9. The students in one middle school homeroom received the following scores on their achievement test: 32, 87, 89, 96, 96, 85, 79, 96, 90, 85, 78, 72, 96, 99, 91, 82, 77, 82, and 81. Which measure of data would make the scores appear the highest?

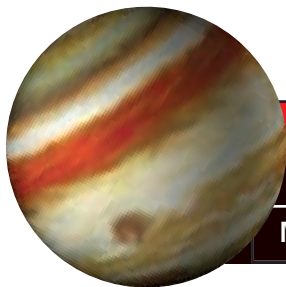
See Example 3 10. A market sold 8 pounds of lettuce at \$1.39 per pound, 5 pounds of lettuce at \$1.09 per pound, and 12 pounds of lettuce at \$0.59 per pound. Calculate the weighted average price per pound, to the nearest cent. (*Hint:* Multiply each price by the corresponding number of pounds. Then divide the sum of the products by the total number of pounds.)

PRACTICE AND PROBLEM SOLVING

Extra Practice

See page EP18.

11. **Astronomy** The table shows the approximate distance each planet is from the Sun.
- Find the range of the data.
 - Which measure of central tendency makes the planets appear to be closest to the Sun?



Distance from the Sun								
Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Miles (million)	36	67	93	141	484	887	1784	2796

12. **School** Teresa has taken three tests worth 100 points each. Her scores are 85, 93, and 88. She has one test left to take. What score must she get on her last test to have a mean test score of 90?
13. **Finance** A scientist's income over 3 years was \$72,000, \$76,000, and \$77,000. He won an award the next year, so his income was \$1,080,000. By how much does the outlier increase the scientist's mean annual income?



14. **Write a Problem** Use your test scores from one of your classes to write a problem about central tendency.



15. **Write About It** Explain how you could identify an outlier from a data set displayed in a line plot or a stem-and-leaf plot.



16. **Challenge** If $4\left(\frac{x + y + z}{3}\right) = 8$, what is the mean of x , y , and z ?

Test Prep and Spiral Review

17. **Multiple Choice** Which measure of central tendency has the smallest value for the data set: 11, 11, 4, 15, 18, 22, 24, 7?
- (A) Mean
 (B) Median
 (C) Mode
 (D) They are all equal.
18. **Gridded Response** Kelly recorded the number of sit-ups she did each day in the table below. Find the mean number of sit-ups Kelly did per day.

Mon	Tue	Wed	Thur	Fri
34	45	66	75	82

Find each number to the nearest tenth. (Lesson 6-3)

19. What number is 55% of 240? 20. What number is $66\frac{2}{3}\%$ of 847?

Determine whether each survey question may be biased. Explain. (Lesson 9-2)

21. What do you plan to do during summer vacation?
22. How many hours do you waste each month at the mall?

Use with Lesson 9-5

You can use a graphing calculator to determine the mean, median, mode, and range of a set of data.

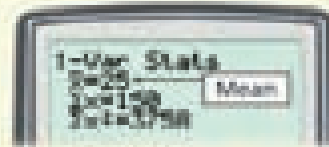
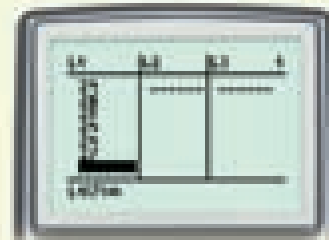
Activity

The table shows the number of CDs sold online by two bands. Use a graphing calculator to analyze the data.

Band	Jan	Feb	Mar	Apr	May	Jun
The Bulbs	24	26	25	24	24	27
Flash Pan	25	33	39	24	24	5

- Enter the data for the first band in the calculator. Press **STAT** and select **1:Edit**. Enter the data values for the first band under List 1 (**L1**). Press **ENTER** after each data value.
- Find the mean of the data. Press **STAT** and move the cursor to the Calculate (**CALC**) menu. Select **1:1-Var Stats**, and then press **2nd** **L1** to calculate the statistics for List 1. The notation \bar{x} represents the mean, so the mean is 25.
- Find the median of the data. Use the down arrow to scroll down the screen. The median is 24.5.
- Find the range of the data. The range is the difference between the greatest and least values: $27 - 24 = 3$.

Repeat these steps for the second band in the table.



Think and Discuss

- Compare the two data sets for the two bands based on their means, medians, and ranges. How are they the same? How are they different?
- The *variability* of a data set refers to how spread out the data are. Which of the two data sets is more variable? Explain how you know.
- Why is it important to use more than one measure (such as mean) to describe data?

Try This

The table shows the number of times two bands performed during a six-year period. Use a graphing calculator to analyze the data. Compare the means, medians, and ranges of the data sets.

Band	2004	2005	2006	2007	2008	2009
The Boxes	31	28	47	56	77	67
Wise Hope	58	65	84	95	107	95

9-5

Variability



The term *box-and-whisker plot* may remind you of a box of kittens. But it is a way to display data.

Learn to find measures of variability.

While central tendency describes the middle of a data set, **variability** describes how spread out the data are. A **box-and-whisker plot** uses a number line to show how data are distributed and to illustrate the variability of a data set.

Vocabulary

variability

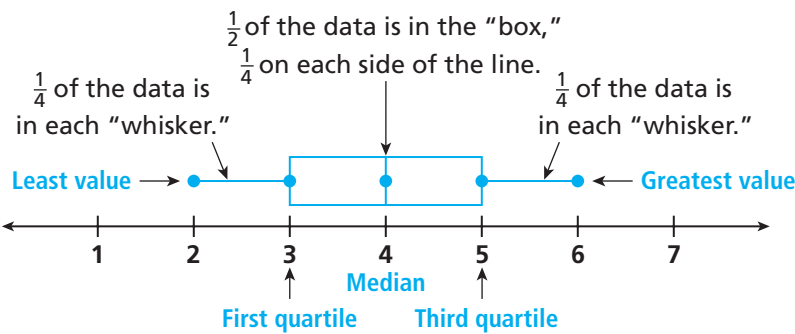
box-and-whisker plot

first quartile

third quartile

interquartile range

A box-and-whisker plot divides the data into four parts. The median, or *second quartile*, divides the data into a lower half and an upper half. The **first quartile** is the median of the lower half of the data, and the **third quartile** is the median of the upper half of the data.



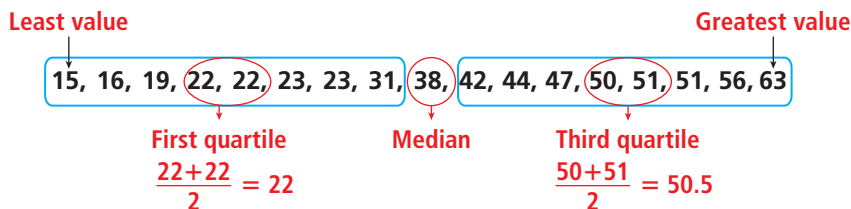
Interactivities Online ▶

EXAMPLE 1 Making a Box-and-Whisker Plot

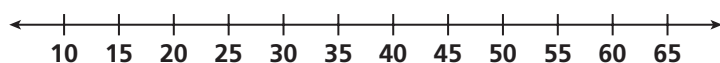
The data below represent the weights in ounces of the kittens at an animal shelter. Use the data to make a box-and-whisker plot.

23 16 51 23 56 22 63 51 22 15 19 42 44 50 38 31 47

Step 1: Order the data and find the least value, first quartile, median, third quartile, and greatest value.



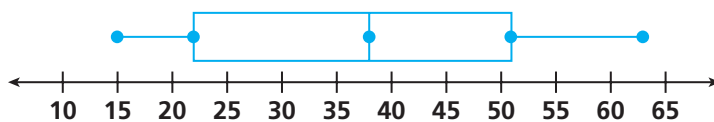
Step 2: Draw a number line and plot a point above each value from Step 1.



Reading Math

The first quartile is sometimes called the lower quartile, and the third quartile is sometimes called the upper quartile.

Step 3: Draw the box and whiskers.



The **interquartile range** of a data set is the difference between the third quartile and the first quartile. It represents the range of the middle half of the data.

You can use the interquartile range of a data set to identify outliers mathematically. Any data value that is more than 1.5 times the interquartile range beyond the first or third quartiles is an outlier.

IDENTIFYING OUTLIERS

Key: **IQR** = interquartile range, **Q1** = first quartile, and **Q3** = third quartile

A data value is an outlier if it is either

- less than $Q1 - (1.5 \cdot IQR)$, or
- greater than $Q3 + (1.5 \cdot IQR)$

EXAMPLE

2

Using Interquartile Range to Identify Outliers

Use interquartile range to identify any outliers.

85, 104, 78, 88, 90, 88, 89

Step 1: Determine the first quartile, the third quartile, and the interquartile range.

78 (85) 88 88 (89) (90) 104

Q1: 85

Q3: 90

IQR: $90 - 85 = 5$

Step 2: Determine whether there is an outlier less than the first quartile.

Q1 - $(1.5 \cdot \mathbf{IQR})$

Subtract 1.5 times the interquartile range from the first quartile.

85 - $(1.5 \cdot 5)$

85 - $7.5 = 77.5$

The least value in the data set is 78. None of the data values is less than 77.5.

Step 3: Determine whether there is an outlier greater than the third quartile.

Q3 + $(1.5 \cdot \mathbf{IQR})$

Add 1.5 times the interquartile range to the third quartile.

90 + $(1.5 \cdot 5)$

90 + $7.5 = 97.5$

The greatest value in the data set is 104. This value is greater than 97.5.

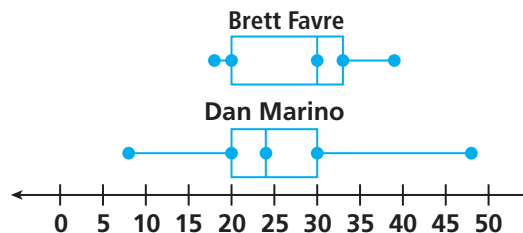
The data value 104 is an outlier.



EXAMPLE 3

Comparing Data Sets Using Box-and-Whisker Plots

The number of touchdown passes that Brett Favre and Dan Marino threw during each of their first 15 years as starting quarterbacks in the NFL is shown in the box-and-whisker plots.



A Compare the medians and ranges.

Brett Favre's median (30) is greater than Dan Marino's (24).
Dan Marino's range (40) is greater than Brett Favre's (21).

B Compare the interquartile ranges.

The interquartile range is the length of the box. So, the interquartile range is greater for Brett Favre.

Think and Discuss

- 1. Explain** why the data must first be ordered from least to greatest before making a box-and-whisker plot.
- 2. Compare** the number of data values in the box with the number of data values in the whiskers.

9-5

Exercises



Learn It Online
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keyword **MT10 9-5** [Go](#)
Exercises 1–12, 13, 15, 17, 19

GUIDED PRACTICE

See Example 1 Use the given data to make a box-and-whisker plot.

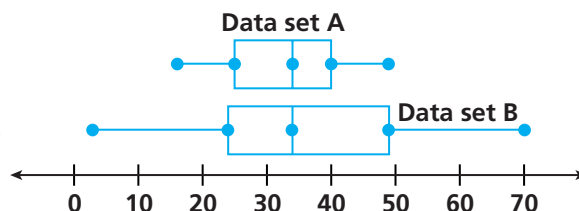
1. 32, 47, 42, 33, 23, 59, 29, 19, 34
2. 41, 11, 26, 58, 54, 32, 38, 56, 21

See Example 2 Use interquartile range to identify any outliers.

3. 12, 9, 3, 15, 28, 15, 16
4. 35, 38, 40, 49, 27, 32, 30

See Example 3 Use the box-and-whisker plots to compare the data sets.

5. Compare the medians and ranges.
6. Compare the interquartile ranges.



INDEPENDENT PRACTICE

See Example 1 Use the given data to make a box-and-whisker plot.

7. 50, 68, 85, 54, 80, 75, 68

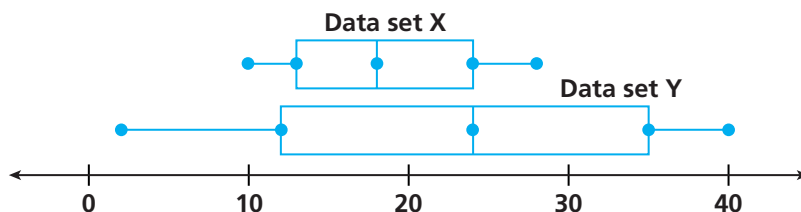
8. 7, 4, 5.7, 1.4, 6.8, 6.3, 11, 3.2

See Example 2 Use interquartile range to identify any outliers.

9. 52, 5, 50, 66, 68, 71, 115

10. 63, 18, 63, 74, 53, 77, 72

See Example 3 Use the box-and-whisker plots to compare the data sets.



11. Compare the medians and ranges.

12. Compare the interquartile ranges.

PRACTICE AND PROBLEM SOLVING

Extra Practice

See page EP18.

Find the first and third quartiles for each data set.

13. 88, 78, 85, 74, 66, 82, 68

14. 9, 2, 8, 6, 1, 7, 3, 11

15. 46, 53, 67, 29, 35, 54, 49, 61, 35

16. 3.5, 3.4, 3.7, 3.5, 3.4, 3.3, 3.4, 3.4

Use the given data to make a box-and-whisker plot.

17. 87, 79, 95, 99, 67, 71, 83, 91

18. 16, 3, 9.3, 11.3, 14, 7, 7, 4.2, 4.5

19. 0, 2, 5, 2, 1, 3, 5, 2, 4, 3, 5, 4

20. 6.4, 8.0, 6.5, 3.0, 5.4, 2.2, 5.3

21. Earth Science The table shows the average number of hurricanes and tropical storms per year in all seven ocean basins.

a. Make a box-and-whisker plot to compare the average number of tropical storms in every ocean basin per year with the average number of hurricanes in every ocean basin per year.

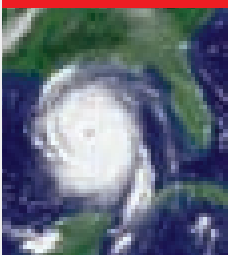
b. Compare the medians and ranges of the two data sets.

c. Suppose the average number of hurricanes in the Northwest Pacific basin increased from 16 to 20. How would this outlier affect the box-and-whisker plot you made in part a?

Average Number of Storms Per Year		
Ocean Basin	Tropical Storms	Hurricanes
NW Pacific	26	16
NE Pacific	17	9
SW Pacific	9	4
Atlantic	10	5
N Indian	5	3
SW Indian	10	4
SE Indian	7	3

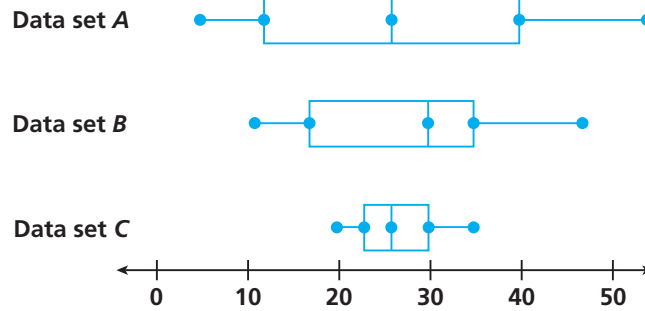


Earth Science



In 2005, a record number of tropical storms and hurricanes struck the Atlantic basin. There were 28 tropical storms in all, 15 of which became hurricanes.

22. Match each description with a box-and-whisker plot.



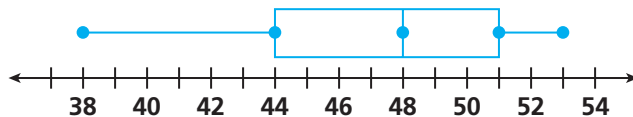
- a. The data set with the least variability
- b. The data set with the greatest interquartile range
- c. The data set with the greatest median

23. **Critical Thinking** Make a box-and-whisker plot of the following data: 18, 16, 21, 10, 15, 25, 13, 22, 25, 13, 15, 10. Add 50 to the list of data and make a new box-and-whisker plot. How did the addition of an outlier affect the box-and-whisker plot?

- 24. **What's the Error?** A student wrote that the data set 33, 28, 29, 56, 27, 43, 33, 25, 40, 65 has a range of 32. What's the error?
- 25. **Write About It** What do box-and-whisker plots tell you about data that measures of central tendency do not?
- 26. **Challenge** What would an exceptionally short box with extremely long whiskers tell you about a data set?

Test Prep and Spiral Review

27. **Multiple Choice** Find the first quartile for the data set shown in the box-and-whisker plot.



- (A) 38 (B) 44 (C) 46 (D) 48

28. **Extended Response** Ken recorded his golf scores during a three week period. His scores were: 85, 76, 83, 99, 83, 74, 75, 81, and 87. Find the range, median, and first and third quartiles. Make a box-and-whisker plot of the data.

Find the two square roots of each number. (Lesson 4-5)

29. 16 30. 81 31. 100 32. 1

Find the mean, median, and mode of each data set to the nearest tenth. (Lesson 9-4)

33. 3, 5, 5, 6, 9, 3, 5, 2, 5 34. 17, 15, 14, 16, 18, 13 35. 100, 75, 48, 75, 48, 63, 45

Create Box-and-Whisker Plots

Use with Lesson 9-5



The data below are the heights in inches of the 15 girls in Mrs. Lopez's 8th-grade class.

57, 62, 68, 52, 53, 56, 58, 56, 57, 50, 56, 59, 50, 63, 52

Activity

Graph the heights of the 15 girls in Mrs. Lopez's class on a box-and-whisker plot.

Press **STAT** and select **1:Edit** to enter the values into List 1 (**L1**). If necessary, press the up arrow and then **CLEAR** **ENTER** to clear old data. Enter the data from the class into **L1**. Press **ENTER** after each value.

Use the **STAT PLOT** editor to obtain the plot setup menu.

Press **2nd** **STAT PLOT** **Y=** **ENTER**. Use the arrow keys and **ENTER** to select **On** and then the fifth type. **Xlist** should be **L1** and **Freq** should be 1, as shown. Press **ZOOM** and select **9:ZoomStat**.

Use the **TRACE** key and the **←** and **→** keys to see all five summary statistical values (minimum: **MinX**, first quartile: **Q1**, median: **MED**, third quartile: **Q3**, and maximum: **MaxX**). The minimum value in the data set is 50 in., the first quartile is 52 in., the median is 56 in., the third quartile is 59 in., and the maximum is 68 in.

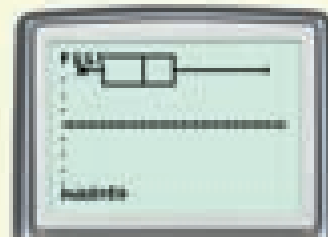
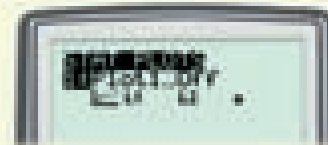
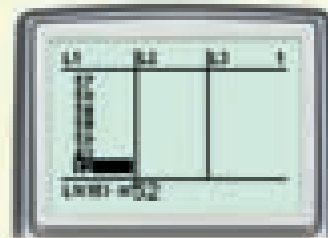
Think and Discuss

1. Explain how the box-and-whisker plot gives information that is hard to see by just looking at the numbers.

Try This

Collect data from the students in your class about the number of hours they slept last night.

1. Use a graphing calculator to make a box-and-whisker plot of the data.
2. What are the minimum, first quartile, median, third quartile, and maximum values of the data set?



Quiz for Lessons 9-1 Through 9-5

 **9-1 Samples and Surveys**

A park ranger would like to know how often visitors to the park go camping each year. Identify each type of sampling method.

1. The ranger places survey forms in the park's gift shop.
2. The ranger surveys the first 50 visitors who pass through the park's information booth.

 **9-2 Identifying Sampling Errors and Bias**

Determine whether each sample may be biased. Explain.

3. The owner of a hair salon surveys 30 people randomly selected from the salon's customer database to find out how satisfied customers are.
4. A DVD rental manager asks people who rent dramas what their favorite movie is.

 **9-3 Organizing Data**

5. Use a line plot to organize the data of the ages of people playing bridge.

72 78 76 75 79 70 74 80 72 78
71 69 70 72 68 70 69 75 75 74

6. Use the given data to make a back-to-back stem-and-leaf plot.

Greatest Number of Home Runs by a Player, 2000–2004					
	2000	2001	2002	2003	2004
American League	47	52	57	47	43
National League	50	73	49	47	48

 **9-4 Measures of Central Tendency**

Determine and find the most appropriate measure of central tendency for each situation.

7. The finishing times in minutes for a 5-kilometer run by a group of friends were 21.1, 20.6, 19.7, 20.3, 17.7, and 20.6. Which measure would make the finishing times seem the best?
8. The week's average high temperatures in degrees Fahrenheit were 70, 72, 72, 74, 76, 74, and 52. What measure best describes the temperatures?

 **9-5 Variability**

Use the given data to make a box-and-whisker plot.

9. 43, 36, 25, 22, 34, 40, 18, 32, 43
10. 21, 51, 36, 38, 45, 52, 28, 16, 41

Focus on Problem Solving



Make a Plan

- Identify too much/too little information

When you read a problem, you must decide if the problem has too much or too little information. If the problem has too much information, you must decide what information to use to solve the problem. If the problem has too little information, then you should determine what additional information you need to solve the problem.

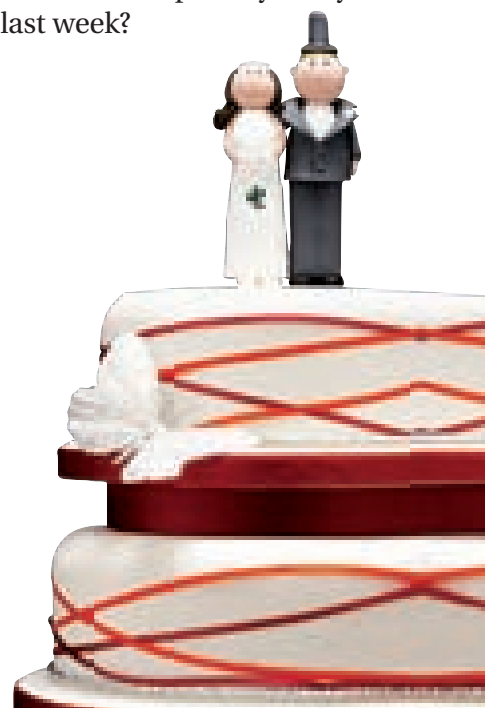


Read the problems below and decide if there is too much or too little information in each problem. If there is too much information, tell what information you would use to solve the problem. If there is too little information, tell what additional information you would need to solve the problem.

- 1 On Monday, 20 students took an exam. There were 10 students who scored above 85 and 10 students who scored below 85. What was the average score?
- 2 The average elevation in California is about 2900 ft above sea level. The highest point, Mt. Whitney, has an elevation of 14,494 ft above sea level. The lowest point, Death Valley, has an elevation of 282 ft below sea level. What is the range of elevations in California?
- 3 Use the table to find the median number of marriages per year in the United States for the years between 1940 and 2000.
- 4 Aishya is cross-training for a marathon. She ran for 50 minutes on Monday, 70 minutes on Wednesday, and 45 minutes on Friday. On Tuesday and Thursday, she lifted weights at the gym for 45 minutes each day. She swam for 45 minutes over the weekend. What was the average amount of time per day Aishya spent running last week?

Number of Marriages in the United States							
Year	1940	1950	1960	1970	1980	1990	2000
Number (thousands)	1596	1667	1523	2159	2390	2443	2329

Source: National Center for Health Statistics





Make a Circle Graph

9-6

Use with Lesson 9-6



WHAT YOU NEED:

- Compass
- Protractor
- Ruler
- Paper

REMEMBER

- A circle measures 360° .
- Percent compares a number to 100.

Activity

Skunks are legal pets in some states but not in most. Use the information from the table to make a circle graph showing the percents for each category.

- Use a compass to draw a large circle. Use a ruler to draw a vertical radius.
- Extend the table to show the percent of states with each category of legality.
- A *sector* is a section of a circle graph. Use the percents to determine the angle measure of each sector of the graph.
- Use a protractor to draw each angle clockwise from the radius.
- Label the graph and each sector. Color the sectors.

Skunks as Pets by State	
Legality	Number of States
Legal (no restrictions)	6
Legal with permit	12
Legal in some areas	2
Illegal	27
Other conditions	3

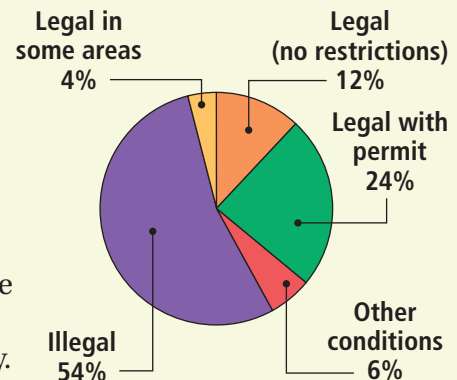
Legality	Number of States	Percent of States	Angle of Section
Legal (no restrictions)	6	$\frac{6}{50} = 12\%$	$\frac{12}{100} \cdot 360 = 43.2^\circ$
Legal with permit	12	$\frac{12}{50} = 24\%$	$\frac{24}{100} \cdot 360 = 86.4^\circ$
Legal in some areas	2	$\frac{2}{50} = 4\%$	$\frac{4}{100} \cdot 360 = 14.4^\circ$
Illegal	27	$\frac{27}{50} = 54\%$	$\frac{54}{100} \cdot 360 = 194.4^\circ$
Other conditions	3	$\frac{3}{50} = 6\%$	$\frac{6}{100} \cdot 360 = 21.6^\circ$

Think and Discuss

- How many states would need to legalize skunks as pets for the largest sector to be 180° ?

Try This

- Collect data from the students in your class about their favorite type of music or another topic of your choice. Then make a circle graph of the data showing the percents for each category.



9-6

Displaying Data

Learn to display data in bar graphs, histograms, and line graphs.

Vocabulary

double-bar graph

frequency table

histogram

double-line graph

In 1990, the United States qualified for the soccer World Cup for the first time in 40 years. Since then, popularity in youth soccer in the United States has grown tremendously.

A **double-bar graph** is used to display and compare two sets of data. You can organize data using a **frequency table** by listing items according to the number of times that the items occur.



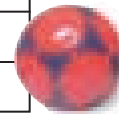
EXAMPLE 1

Displaying Data in a Double-Bar Graph

Make a double-bar graph.

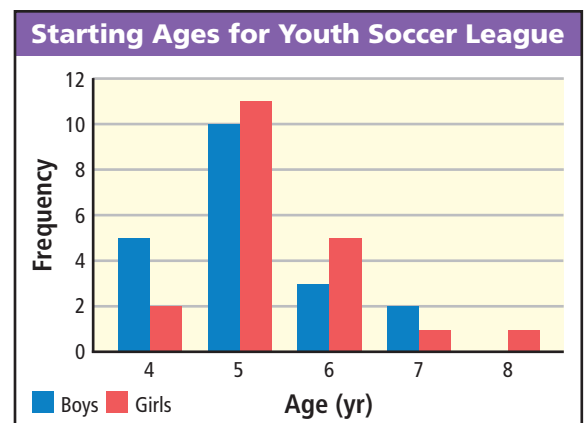
The following are the ages when a randomly chosen soccer group of 20 boys and 20 girls began playing in a local youth soccer league.

Age	4	5	6	7	8
Boys	5	10	3	2	0
Girls	2	11	5	1	1



Use the ages as categories on the horizontal axis. The vertical axis represents the number of players.

The heights of the bars show the frequencies. Use a different color to represent each gender.



A **histogram** is a bar graph that shows the frequency of data within equal intervals.

EXAMPLE 2 Displaying Data in a Histogram

Edwina asked 10 classmates how many minutes of sleep they had the previous night. Use the data to make a histogram.

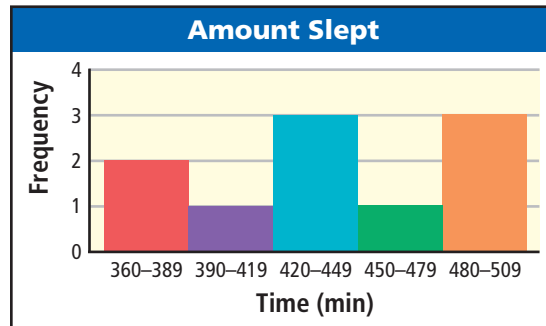
460 400 425 440 490 365 435 500 380 505

Make a frequency table with 30-minute intervals. Then make a histogram.

Helpful Hint

Histograms do not have spaces between the bars.

Minutes	Frequency
360–389	2
390–419	1
420–449	3
450–479	1
480–509	3

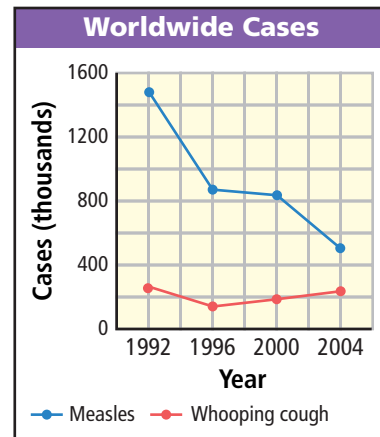


A **double-line graph** is used to show how two related sets of data change over time.

EXAMPLE 3 Displaying Data in a Line Graph

Make a double-line graph of the given data. Use the graph to estimate the number of measles cases and whooping cough cases in 2002.

Number of Worldwide Cases		
Year	Measles	Whooping Cough
1992	1,481,971	255,475
1996	870,989	141,445
2000	836,407	186,198
2004	504,742	235,740



The graph shows about 200,000 whooping cough cases and about 650,000 measles cases in 2002.

Think and Discuss

1. **Describe** the difference between a bar graph and a histogram.

GUIDED PRACTICE

- See Example 1 1. Make a double-bar graph.
 Data Set 1: 11 10 13 11 12 13 13 9 10 11 12 10
 Data Set 2: 13 11 12 12 11 9 10 11 12 10 9 11

- See Example 2 2. The numbers of Freshman National Merit Scholars attending certain schools are listed for 2004. Use the data to make a histogram with intervals of 50.
 Vanderbilt, 144; Princeton, 192; Duke, 90; Stanford, 217; Yale, 224; Northwestern, 152; Rice University, 173; Cal Tech, 51; University of Chicago, 198; M.I.T., 134; University of Texas-Austin, 242; Washington University, 197

- See Example 3 3. Make a double-line graph of the given data. Use the graph to estimate the life expectancies of a male and a female born in 1997.

Life Expectancy by Birth Year (U.S.)					
Year	1980	1985	1990	1995	2000
Age Male	70.0	71.1	71.8	72.5	74.3
Age Female	77.4	78.2	78.8	78.9	79.7

Source: National Center for Health Statistics

INDEPENDENT PRACTICE

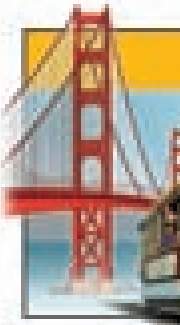



- See Example 1 4. Make a double-bar graph.

Temperature °F	10	15	20	25	30	35	40
Data Set 1	2	6	9	7	4	2	1
Data Set 2	5	7	8	5	4	2	0

- See Example 2 5. The list shows the prices of entrées at a restaurant. Use the data to make a histogram with intervals of \$10.

\$9 \$11 \$22 \$22 \$30 \$24 \$13 \$16 \$17 \$21 \$18 \$25 \$17 \$25
 \$17 \$21 \$19 \$21 \$14 \$19 \$15 \$15 \$10 \$16 \$12 \$21 \$19 \$17

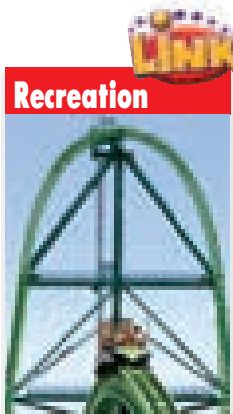
- See Example 3 6. Make a double-line graph of the given data. Use the graph to estimate the populations of Philadelphia and San Francisco in 1995.

City Population			
	San Francisco	Year	Philadelphia
	715,674	1970	1,948,609
	678,974	1980	1,688,210
	723,959	1990	1,585,577
	776,733	2000	1,517,550

PRACTICE AND PROBLEM SOLVING

Extra Practice

See page EP19.



The fastest roller coasters can reach speeds of up to 128 miles per hour in as little as 3.5 seconds.

7. Organize the data into a frequency table and make a double-bar graph.

Data set 1: 1 6 3 1 4 6 4 5 6 1 2 5 5 4 2 3 1 6 2 2

Data set 2: 3 1 3 4 2 1 5 6 1 2 6 5 1 6 4 3 3 2 1 5

8. **Sports** Make a double-line graph of the data in the table. In which year was the difference between the mean salary and the median salary the greatest?

National Football League Salaries						
Year	2000	2001	2002	2003	2004	2005
Mean (\$1000)	787	986	1180	1259	1331	1400
Median (\$1000)	441	501	525	534	537	569

9. **Recreation** The list of data shows the ages of the passengers on a roller coaster. Make a histogram of the data with intervals of 10. Explain how you can identify the outlier in the data just by looking at the histogram.

28 14 18 20 33 42 17 18 27 25 69 12 20 16

32 23 40 18 22 22 15 16 29 30 34 24 39 18

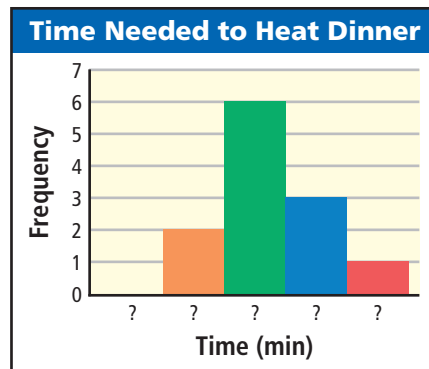
10. **Write About It** Which kind of graph would you use to compare the average salaries of professional basketball players and professional hockey players from 2000 to 2010?

11. **Challenge** Determine the size of the interval used in the histogram using the data below.

Time needed to heat a frozen dinner in the microwave (min)

4:30 5:30 7:00 4:45 5:20 8:00

3:45 2:30 6:40 6:00 4:30 5:25



Test Prep and Spiral Review

12. **Multiple Choice** Which data display is most appropriate to show the change in the temperature of a greenhouse over a 24-hour period?

(A) Bar graph (B) Frequency table (C) Line graph (D) Stem-and-leaf plot

13. **Short Response** A middle school principal asked 12 students the number of football games each attended during the school year. The results were 1, 3, 5, 2, 4, 4, 4, 3, 5, 2, 4, 2. Organize the data into a frequency table.

Find the sum of the angle measures in each polygon. (Lesson 7-4)

14. 18-gon

15. 24-gon

16. heptagon

Find the range of each set of data. (Lesson 9-4)

17. 16, 32, 1, 54, 30, 28

18. 105, 969, 350, 87, 410

19. 0.2, 0.8, 0.65, 0.7, 1.6, 1.1

Use with Lesson 9-6

You can use a graphing calculator to make a histogram.

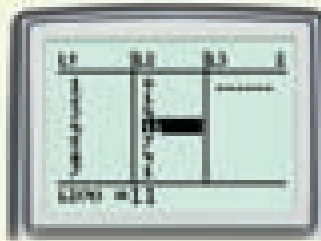
Activity

The frequency table shows the length of the feet of students in Mrs. Alvarez's math class. Use a graphing calculator to make a histogram of the data.

To enter the data, press **STAT**.

Then press **ENTER** to select **1:Edit**.

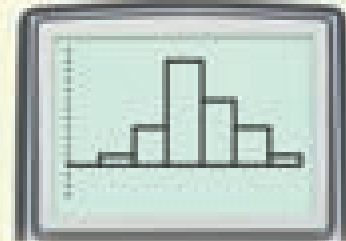
Under L1, enter 1, 2, 3, 4, 5, 6, and 7 to represent the seven intervals. Interval 1 corresponds to "Less than 5," while interval 7 corresponds to "10 or greater." In L2, enter the number of students for each interval.



Foot Length (in.)	Number of Students
Less than 5	0
5 to less than 6	1
6 to less than 7	4
7 to less than 8	11
8 to less than 9	7
9 to less than 10	4
10 or greater	1

To see a histogram of the data,

press **2nd** **STAT PLOT** **Y=** **ENTER** to select "STAT PLOTS 1:" Scroll and press **ENTER** to select "On" and the histogram icon.



Then scroll to "Freq:" and press **2nd** **2** to paste the data from L2.

Press **ZOOM** **9** to view the histogram. Press **TRACE** and the arrow keys to read the histogram.

Think and Discuss

1. How would the histogram change if the first interval is left out? Draw the histogram.
2. Explain how you can use the histogram to find the total number of students who have feet that are at least 7 inches long.

Try This

1. Measure the lengths of the right arms of everyone in your classroom. Divide the data into 5 equal intervals. Use a graphing calculator to make a histogram of the data.

Learn to analyze and make predictions from data displays.

It is important that you can read and understand various types of graphs. When analyzing data displays, be sure to read any titles or labels and pay attention to the scales used on the axes.

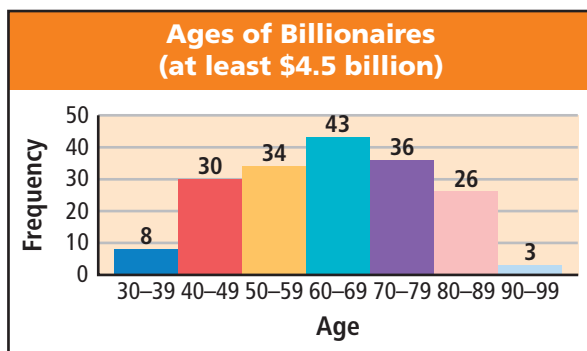
EXAMPLE 1

Analyzing Histograms

Remember!

Recall from Lesson 9-5 that a histogram is a bar graph that shows the frequency of data within equal intervals.

The histogram shows the ages of people with a net worth of at least \$4.5 billion as of March 2007. Use the histogram to answer each question.



Source: Forbes.com

- A** How many people under the age of 50 had a net worth of at least \$4.5 billion?

$$8 + 30 = 38$$

There are 38 people under the age of 50 who had a net worth of at least \$4.5 billion.

Add the number of people in the 30–39 and 40–49 intervals.

- B** What is the approximate median age of the billionaires shown in the histogram?

$$8 + 30 + 34 + 43 + 36 + 26 + 3 = 180$$

Add to find the total number of billionaires.

Interval	Frequency	Rank (by age)
30–39	8	1–8
40–49	30	9–38
50–59	34	39–72
60–69	43	73–115

Since there are 180 ages, the median is the mean of the 90th and 91st ages.

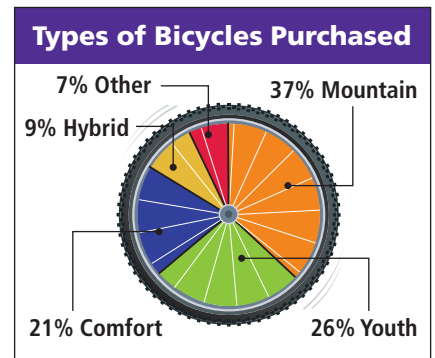
Determine the interval of the 90th and 91st ages.

The 90th and 91st ages are in the middle of the 60–69 interval. So, a good estimate of the median age of the billionaires is 65.

A *circle graph* shows how a set of data is divided into parts. The entire circle represents 100% of the data. Each *sector* represents one part of the data set.

EXAMPLE 2 Analyzing Circle Graphs

In one year, people in the U.S. purchased approximately 16.6 million bicycles. The circle graph shows the types of bicycles purchased. Use the circle graph to answer each question.



A How many of the bicycles purchased were youth bikes?

$$26\% \text{ of } 16,600,000 = 0.26 \cdot 16,600,000 = 4,316,000$$

26% of the bicycles were youth bikes.

Of the bicycles purchased, about 4.3 million were youth bikes.

B For the year shown, the average price for a mountain bike was \$188. A reporter claims that consumers spent over \$1.5 billion on mountain bikes that year. Is the claim valid? Explain.

$$0.37 \cdot 16,600,000 = 6,142,000$$

Find the number purchased.

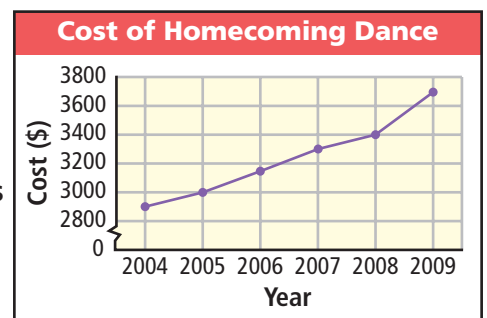
$$6,142,000 \cdot \$188 = \$1,154,696,000$$

Multiply the number of mountain bikes by the average price.

No; consumers spent just under \$1.2 billion on mountain bikes.

EXAMPLE 3 Analyzing Line Graphs

The line graph shows how the cost of a dance at a middle school has changed over time. If the cost of the dance continues to increase at the same rate as it did between 2008 and 2009, what will the cost be in 2010?



$$\$3700 - \$3400 = \$300$$

Find the difference between the costs in 2009 and 2008.

$$\$3700 + \$300 = \$4000$$

Add the difference to the cost in 2009.

The cost of the dance in 2010 will be \$4000.

Think and Discuss

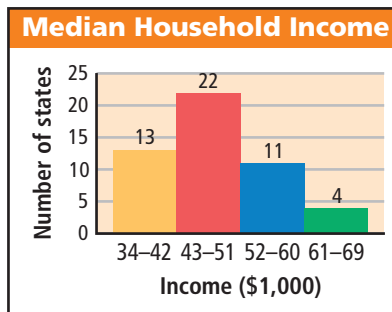
1. Explain how to use the circle graph in Example 2 to find the combined number of comfort and hybrid bicycles purchased.



GUIDED PRACTICE

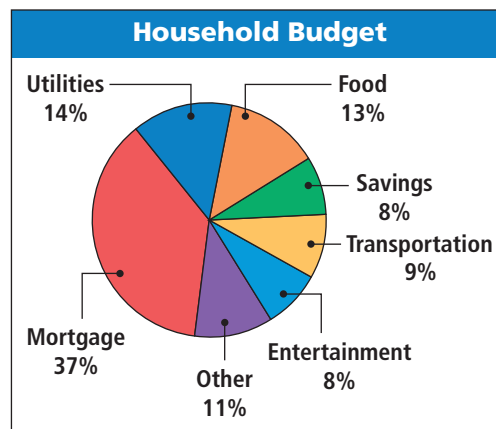
See Example 1 Use the histogram for Exercises 1 and 2.

- How many states have a median household income greater than \$51,000?
- Estimate the median household income in the United States.



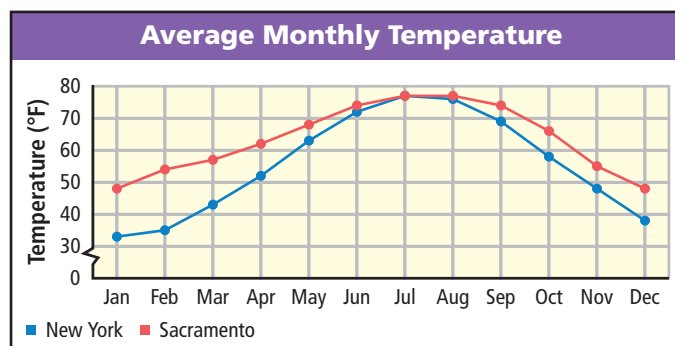
See Example 2 The circle graph shows a budget based on a monthly income of \$4,000. Use the circle graph for Exercises 3 and 4.

- How much money does the family spend per month on transportation?
- A student claims that the family saves more than \$3,500 per year. Is the claim valid? Explain.



See Example 3 Use the line graph for Exercises 5 and 6.

- In which month is the difference between the average temperatures of the two cities the greatest?
- Last year, the average monthly temperatures of the two cities were the same in one month. During which month would you predict this happened? Explain.



INDEPENDENT PRACTICE

See Example 1 7. Use the histogram above. What percent of the states have a median household income between \$43,000 and \$60,000?

See Example 2 8. Use the circle graph above. The family's monthly income increases from \$4,000 to \$5,500. How much more money will the family spend on entertainment per month?

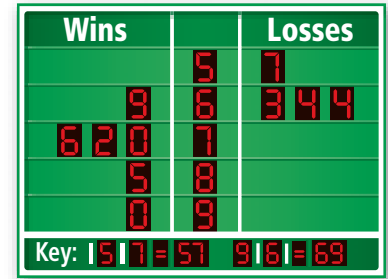
See Example 3 9. Use the line graph above. Approximately how many degrees warmer is the average October temperature in Sacramento than in New York?

PRACTICE AND PROBLEM SOLVING

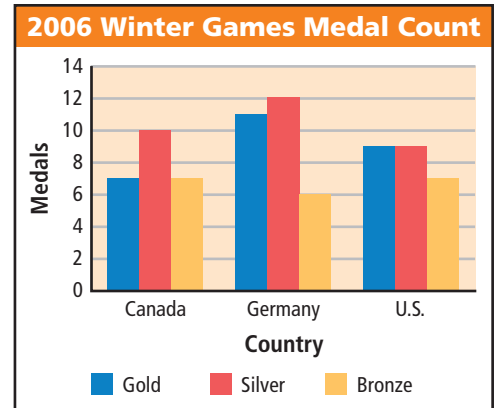
Extra Practice

See page EP19.

10. The stem-and-leaf plot shows a college basketball team's scores during the first ten games of a season.
- What is the mean of the winning scores? the losing scores?
 - What is the median of the scores?
 - Based on the data, will the team likely win or lose if it scores 88 points in its next game? Explain.



11. **Olympics** The bar graph shows the numbers of medals won by three countries in the 2006 Winter Olympics.
- How many medals did the U.S. team win?
 - How many more silver medals did Canada win than the U.S.?
 - A reporter claimed that Canada won more medals than the U.S. Is this claim valid? Explain.



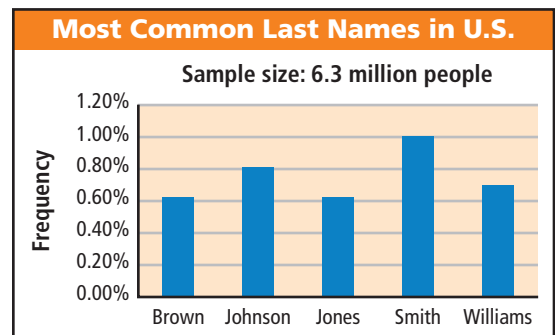
- Write a Problem** Find a graph in a newspaper or magazine. Write a problem that involves the data in the graph.
- Write About It** Explain how a key is helpful when analyzing a multi-bar graph or a multi-line graph.
- Challenge** Work with a partner to survey a random sample of students at your school about how they usually get to school each day. Make a circle graph of your results. Then use the graph to predict how many students at your school usually ride the bus. Justify your prediction.

Test Prep and Spiral Review

15. **Multiple Choice** Approximately how many people in the sample had the third most common last name?

(A) 38,000 (C) 4,100,000
 (B) 44,000 (D) 4,400,000

16. **Short Response** In 2007, the U.S. population was about 300,000,000. Based on the graph, about how many people in the U.S. had a last name of Smith in 2007?



Tell which property is represented. (Lesson 1-3)

17. $(2 + 1) + 5 = 2 + (1 + 5)$ 18. $192 \cdot 1 = 192$ 19. $891 + 32 = 32 + 891$

9-8

Misleading Graphs and Statistics

Learn to recognize misleading graphs and statistics.

Graphs and statistics are often used to make advertisements visually appealing. Some advertisements, however, use art to mislead consumers.



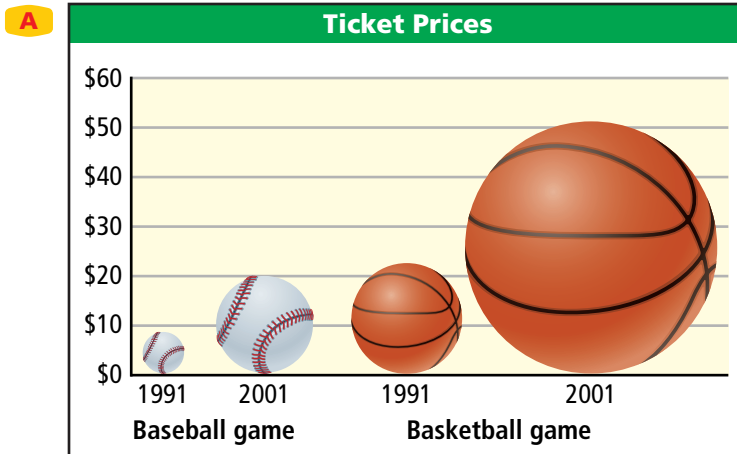
EXAMPLE

1

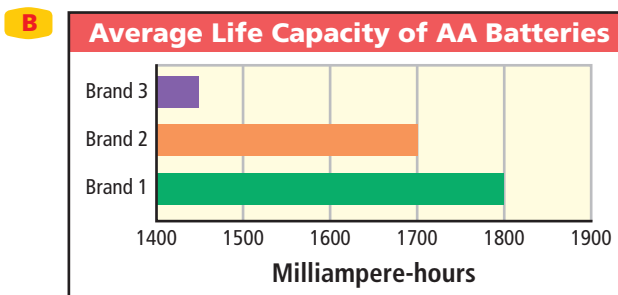
Identifying Misleading Graphs

[Interactivities Online](#) ▶

Explain why each graph is misleading.

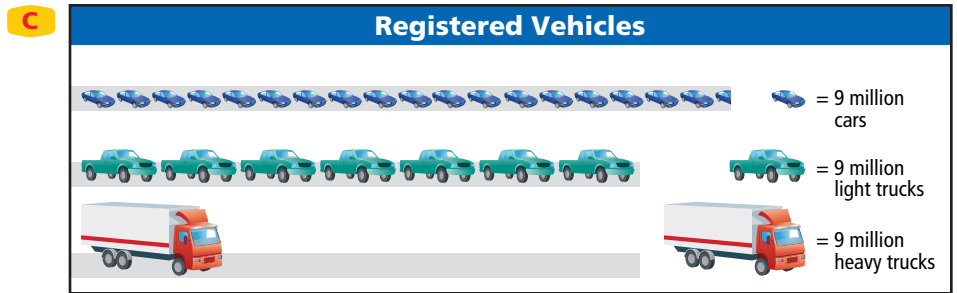


The heights of the balls are used to represent the ticket prices. However, the areas of the circles and volumes of the balls distort the comparison. The basketball prices are only about $2\frac{1}{2}$ times greater than the baseball prices, but they look like much more.



Since the horizontal scale does not start at 0, the bar for Brand 1 appears to be eight times as long as the bar for Brand 3. In fact, the capacity of Brand 1 is only 24% more than Brand 3.

Explain why the graph is misleading.



Different-sized icons represent the same number of vehicles. The number of light trucks looks like it is close to the number of cars, but it is really less than half. The number of heavy trucks is less than 5% of the total, but it appears much greater.

EXAMPLE 2 Identifying Misleading Statistics

Explain why each statistic is misleading.

- A** A housing development features 5 home models with the starting prices of \$475,000, \$500,000, \$225,000, \$480,000, and \$510,000. An ad reads: “New homes—average price \$438,000.” Although \$438,000 is the average price, only one model sells below that price. It is likely that a new home owner will pay more than the advertised price of \$438,000.
- B** A movie previews for 6 selected viewers. Four viewers rate the movie highly. The producer tells the production studio: “The movie will be a hit because test audiences rate the movie favorably at a rate of 2 to 1.” The sample size is too small. Twice as many people liked the movie, but the difference between 4 and 2 people is not meaningful.
- C** The revenue for Ski Resort A for November was \$6,600,000. The revenue for Ski Resort B for February was \$8,300,000. A reporter claims that Ski Resort B is more popular than Ski Resort A. The revenues are measured at different times of the year. Weather conditions can change dramatically from month to month, affecting revenue.

Think and Discuss

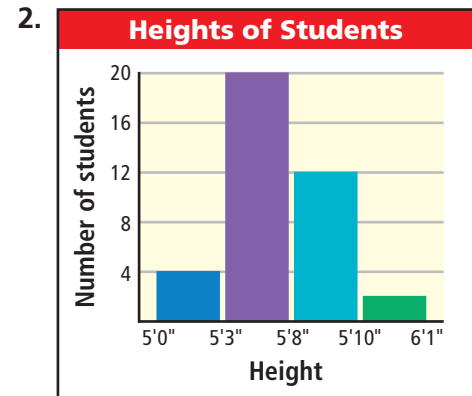
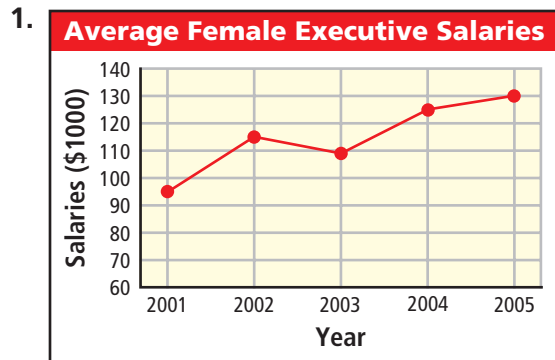
1. **Give an example** of a graph that starts at zero but is still misleading.
2. **Explain** how a statistic can be accurate but still misleading.





GUIDED PRACTICE

See Example 1 Explain why each graph is misleading.

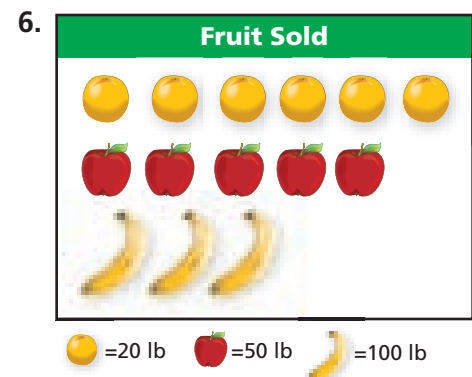
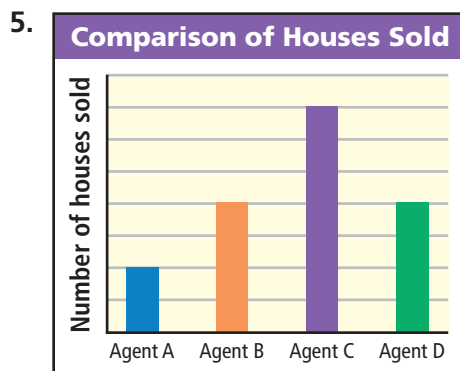


See Example 2 Explain why each statistic is misleading.

- A stalk of broccoli has 477 mg of potassium. A large carrot has 230 mg of potassium. An article claims that broccoli is richer in potassium than carrots are.
- Water Sports World sold 619 life jackets from April 1 to September 1. Boats and More sold 153 life jackets from July 1 to September 1. An ad states that Water Sports World sells more life jackets than Boats and More.

INDEPENDENT PRACTICE

See Example 1 Explain why each graph is misleading.



See Example 2 Explain why each statistic is misleading.

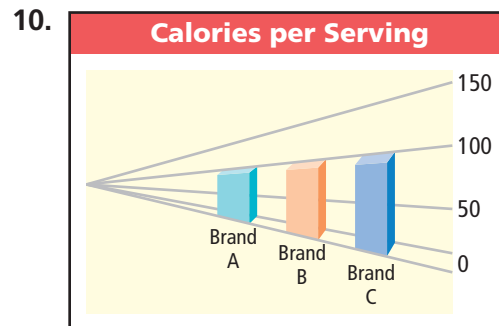
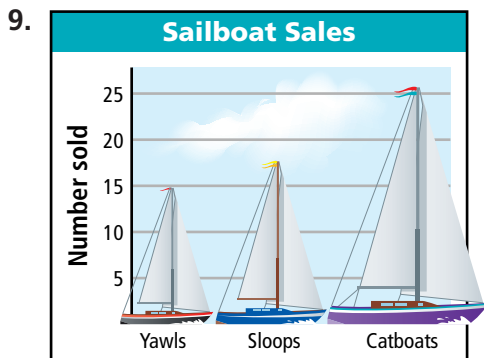
- A survey of 1000 college students found that 110 majored in engineering and 112 majored in the social sciences. A magazine article reports that students prefer the social sciences over engineering.
- A reporter asked 90 students if they participate in organized athletics. Of the 50 who responded "yes," 26 played on school teams. The reporter said, "Half of all students play on school teams."

PRACTICE AND PROBLEM SOLVING

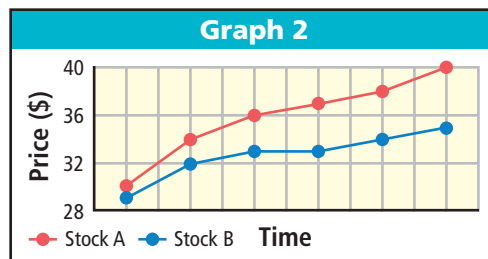
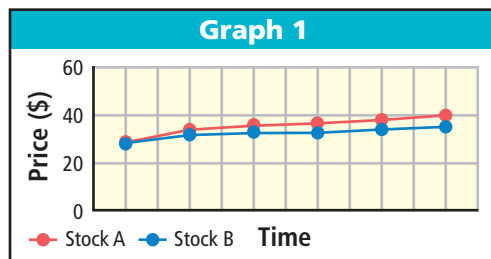
Extra Practice

See page EP19.

Explain why each graph is misleading.



11. **Write About It** When might you want to use a scale on a graph that does not start at 0?
12. **Challenge** The two graphs show the recent performance of two companies' stocks, A and B. Which graph should be shown to the stockholders of company A?



Test Prep and Spiral Review

13. **Multiple Choice** Six dentists are surveyed regarding toothpaste. Four dentists recommended Brand X. An ad for Brand X states: "Recommended by 2 out of 3 dentists." Explain why the statement is misleading.
- (A) The sample was too large.
 (B) The sample was too small.
 (C) The sample should have included construction workers.
 (D) The statement should say "Recommended by 1 out of 2 dentists."
14. **Short Response** A salesman earns the following commissions: December \$965; January \$125; February \$170; March \$100; April \$110; May \$120. He tells his friends that he averages \$265 per month in commission. Explain why the statistic is misleading.

Find the area of each figure with the given dimensions. (Lesson 8-2)

15. trapezoid: $b_1 = 3$, $b_2 = 5$, $h = 8$

16. triangle: $b = 16$, $h = 9$

17. People responding to a survey had the following ages: 30, 21, 20, 26, 23, 30, 23, 23, 21, 20, 27, 20, 24, 23, and 30. Use the data to make a line plot. (Lesson 9-3)

9-9

Scatter Plots

Learn to create and interpret scatter plots.

In many Olympic sports, athletes keep improving and setting new records. One way to show how the winning times have changed over time is by using a *scatter plot*.

Vocabulary

scatter plot

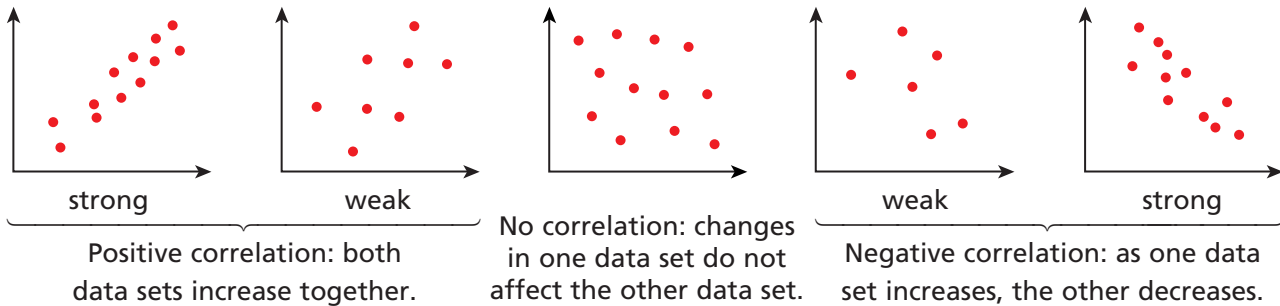
correlation

line of best fit

A **scatter plot** is a graph with points plotted to show a relationship between two sets of data. You can use a scatter plot to investigate the relationship between the year in which an Olympic event is held and the winning time.



Correlation describes the relationship between two sets of data.



EXAMPLE 1

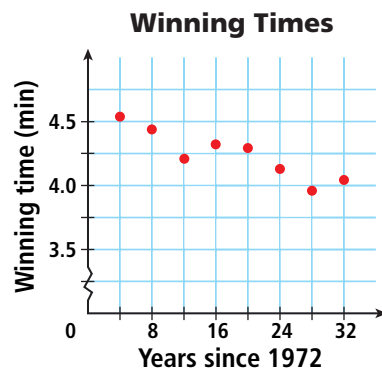
Describing Correlation from Scatter Plots

The table shows the winning times for the Olympic women's 3000-meter speed skating race. Use the given data to make a scatter plot, and describe the correlation.

Years since 1972	4	8	12	16	20	24	28	32
Winning time (min)	4.54	4.41	4.20	4.33	4.29	4.12	3.96	4.04

Helpful Hint

A strong correlation does not mean there is a cause-and-effect relationship. For example, your age and the price of a regular movie ticket are both increasing, so they are positively correlated.



Use the table to make ordered pairs for the scatter plot.

The *x*-value represents the number of years since 1972, and the *y*-value represents the winning time.

Plot the ordered pairs.

As the number of years increases, the winning times tend to decrease. There is a negative correlation between the two data sets.



A **line of best fit** is a straight line that comes closest to the points on a scatter plot. You can use a line of best fit to help you make predictions.

EXAMPLE 2 Using a Scatter Plot to Make Predictions

Make a scatter plot of the data, and draw a line of best fit. Then use the data to predict the exam grade of a student who studies 4 hours per week.

Hours studied	5	9	3	12	1	2	6	7
Exam grade	80	95	75	98	70	95	82	88

Step 1: Make a scatter plot.

Let hours studied represent the independent variable x and exam grade represent the dependent variable y .

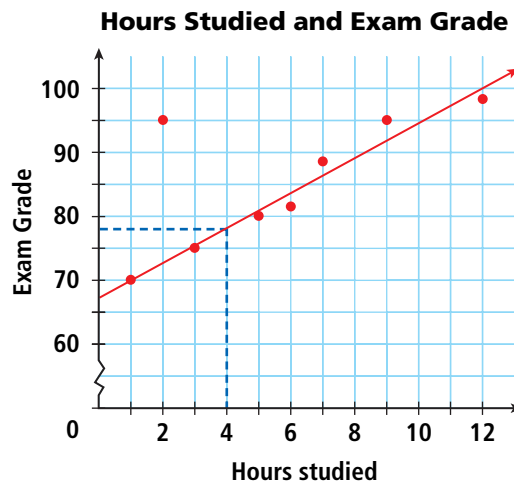
A student's exam grade may be dependent on the number of hours studied.

Step 2: Draw a line of best fit.

Draw a line that has about the same number of points above and below it. Ignore any outliers when drawing a line of best fit.

Reading Math

A *trend line* is a line on a scatter plot that helps show the correlation between data sets more clearly. A line of best fit is a trend line.



The data point (2, 95) is an outlier because it lies far away from the other data points.

Step 3: Make a prediction.

According to the graph, a student who studies 4 hours per week should earn a score of about 78.

Find the point on the line whose x -value is 4. The corresponding y -value is about 78.

Think and Discuss

- 1. Compare** a scatter plot to a line graph.
- 2. Tell** how you can tell which variable to use as the independent variable and which variable to use as the dependent variable when making a scatter plot.





GUIDED PRACTICE

- See Example 1 1. Use the given data to make a scatter plot, and describe the correlation.

Country	Area (mi ²)	Population
Guatemala	42,467	12,728,111
Honduras	43,715	7,483,763
El Salvador	8,206	6,948,073
Nicaragua	50,503	5,675,356
Costa Rica	19,929	4,133,884
Panama	30,498	3,242,173



- See Example 2 2. Make a scatter plot of the data, and draw a line of best fit. Then use the data to predict the wind chill at 35 mi/h.

Apparent Temperature Due to Wind at 15 °F						
Wind speed (mi/h)	10	20	30	40	50	60
Wind chill (°F)	2.7	-2.3	-5.5	-7.9	-9.8	-11.4

INDEPENDENT PRACTICE

- See Example 1 3. Use the given data to make a scatter plot, and describe the correlation.

Temperature Due to Humidity at a Room Temperature of 72 °F						
Humidity (%)	0	20	40	60	80	100
Apparent temperature (°F)	64	67	70	72	74	76

- See Example 2 4. Draw a line of best fit for the scatter plot you drew in Exercise 3. Then use the data to predict the apparent temperature at 70% humidity.

PRACTICE AND PROBLEM SOLVING

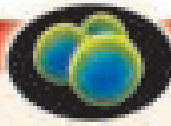
Extra Practice

See page EP19.

5. **Recreation** Use the data in the table.

High Temperatures and Swimming Pool Visitors							
High temperature (°F)	95	92	85	90	98	88	94
Pool visitors	312	305	256	124	352	270	320

- Make a scatter plot of the data. Tell which variable you used for the independent variable, and explain your choice.
- Which data point represents an outlier? Explain.
- Predict the number of visitors to the swimming pool on a day when the high temperature is 100 °F. Explain how you determined your answer.



About 50 million Americans suffer from allergies. Airborne pollen generated by trees, grasses, plants, and weeds is a major cause of illness and disability. Because pollen grains are small and light, they can travel through the air for hundreds of miles. Pollen levels are measured in grains per cubic meter.

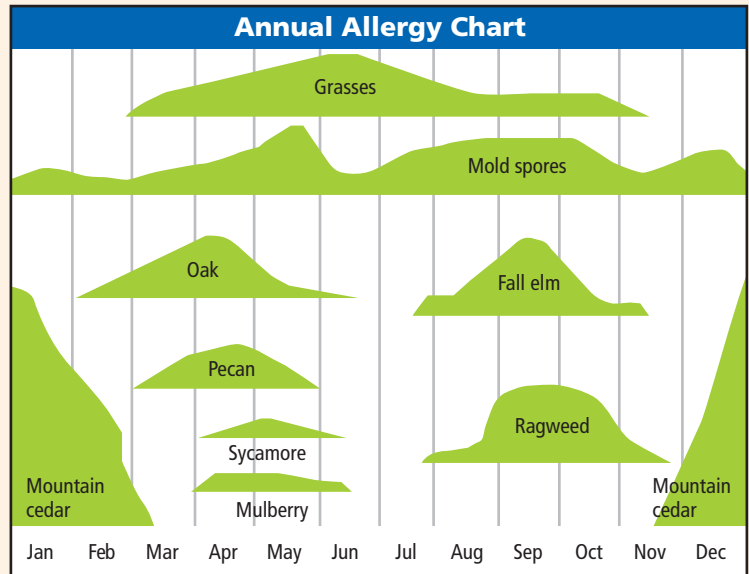
Some common substances that cause allergies include pollens, dust mites, and mold spores.

6. Use the given data to make a scatter plot. Describe the correlation.

Pollen Levels		
Day	Weed Pollen	Grass Pollen
1	350	16
2	51	1
3	49	9
4	309	3
5	488	29
6	30	3
7	65	12

7. Explain how the pollens are compared in the chart at right.

Use the chart at right to determine if the pollens have a positive, a negative, or no correlation.



Source: Central Texas Allergy and Asthma Center

8. mountain cedar, grass
9. fall elm, ragweed
10. **Challenge** Use the allergy chart to explain the difference between correlation and a cause-and-effect relationship.

Test Prep and Spiral Review

11. **Multiple Choice** Does the size of a box of cereal and the price of the cereal have a positive, negative, or no correlation?
- (A) Positive (B) Negative (C) Scatter plot (D) No correlation

12. **Short Response** What type of correlation exists between a person's birthday and his or her height? Explain.

Determine the number of lines of symmetry for each polygon. (Lesson 7-8)

13. square 14. equilateral triangle 15. regular pentagon

16. A bookstore sells 2 copies of *Sail Away* and 4 copies of *Race Car Mania*. The bookstore owner concludes that his customers are twice as likely to buy racing books than sailing books. Identify why this statistic is misleading. (Lesson 9-8)

Create a Scatter Plot

Use with Lesson 9-9



You can use a graphing calculator to make a scatter plot.

Activity 1

The table shows heights and weights of students in Mr. Devany's class. Use a graphing calculator to create a scatter plot of the data.

Height (in.)	Weight (lb)
41	92
43	111
46	105
50	120
51	110
55	107
60	125
62	125
62	125
66	152
69	175
70	210

To enter the data, press **STAT** and select **1:Edit**.

In L1, enter the heights. In L2, enter the weights.

To see a scatter plot of the data, press **2nd** **STAT PLOT** **Y=** **ENTER** to select "STAT PLOTS 1:"

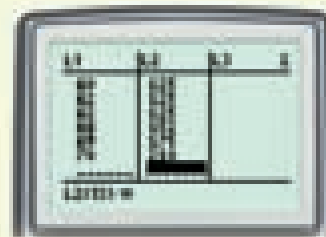
Scroll and press **ENTER** to select "On" and the scatter plot icon. Scroll to "Xlist=" and

press **2nd** **L1** to select List 1.

Scroll to "Ylist=" and press **2nd** **L2** to select List 2. Finally, scroll to "Mark:" and choose the box.

To view the scatter plot, press **ZOOM** and select **9: Zoom Stat**.

Press **TRACE** and the arrow keys to read the coordinates of the data points.



Think and Discuss

- Describe the correlation shown in the scatter plot.
- Suppose you added a third category: boy or girl. How could the height, weight, and gender data be displayed?

Try This

Use a graphing calculator to create a scatter plot of the data.

- | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|
| x | 52 | 36 | 13 | 41 | 39 | 52 | 18 | 50 | 44 | 30 | 51 |
| y | 10 | 15 | 27 | 15 | 12 | 9 | 27 | 10 | 11 | 21 | 4 |

Activity 2

You can use a graphing calculator to find a line of best fit on a scatter plot.

Create a scatter plot of the data shown. Use a line of best fit to predict the value of y when $x = 11$.

Follow the steps in Activity 1 to make a scatter plot of the data.

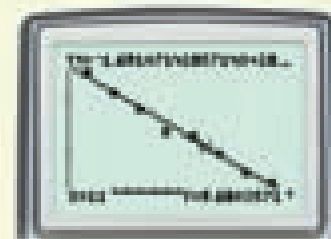
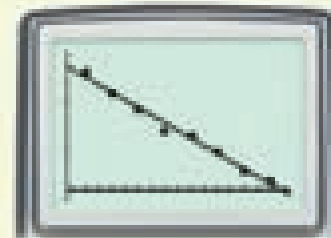
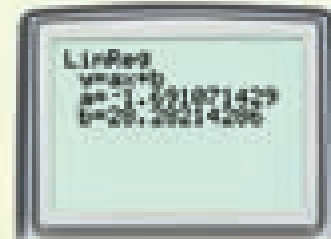
To find a line of best fit, press **STAT** and move the cursor to the Calculate (**CALC**) menu. Select **4:LinReg(ax+b)** and press **ENTER**.

The calculator displays the equation of a line of best fit.

To graph the line of best fit, press **Y=**. Then press **VARS** and select **5:Statistics**. Move the cursor to the **EQ** menu and select **1:RegEQ** to choose the equation of the line of best fit. To see the scatter plot and the graph of the line, press **ZOOM** and select **9:ZoomStat**.

Use the Calculate menu to find the value of y when $x = 11$. Press **2nd** **CALC** **TRACE**. Select **1: value**. Enter the value 11 for x , and press **ENTER**. The screen shows that $y \approx 9.68$ when $x = 11$.

x	y
2	26.1
4	21.5
6	17.4
8	13.2
10	11.7
12	8.5
14	4.2
16	1.9



Think and Discuss

1. What uses might a line of best fit have in the real world?
2. What type of correlation does the data have in Activity 2? How do you know?

Try This

1. Use a graphing calculator to create a scatter plot of the data shown. Use a line of best fit to predict the value of y when $x = 8$.

x	0	5	10	15	20	25
y	0.8	15.2	32.4	46.3	60.1	74.4

2. Complete a table relating shoe size and shoe length in centimeters. Since female and male shoes are sized differently, collect data from female students only or from male students only. Create a scatter plot of your data. Then use a line of best fit to predict the length of a typical size 8 shoe.

9-10

Choosing the Best Representation of Data

Learn to select the best representation for a set of data.

In a survey, students were asked, “About how many hours a year do you volunteer?” The responses are shown in the table.



Hours Spent Volunteering	
Fewer than 20	15%
20–39	35%
40–59	13%
60–80	7%
More than 80	30%

Data can be represented in several different ways, depending both on the type of data and the message to be conveyed.

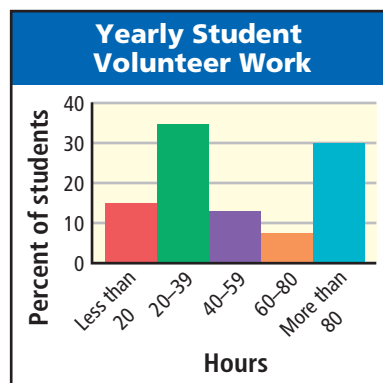
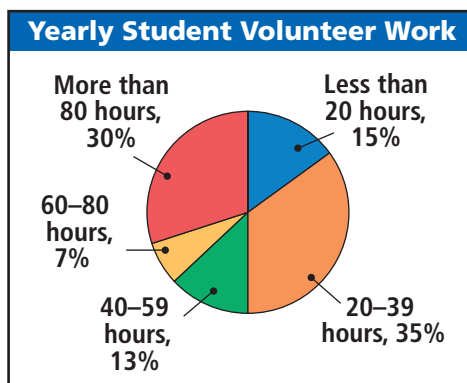
Type of Graph	Common Use
Line graph	Shows change in data over time.
Bar graph	Shows relationships or comparisons between groups.
Circle graph	Compares parts to a whole.
Histogram	Shows the frequency of data divided into equal groups.
Box-and-whisker plot	Shows the distribution and spread of data.
Line plot	Shows the distribution of data.
Scatter plot	Shows the relationship of two data sets.

EXAMPLE

1

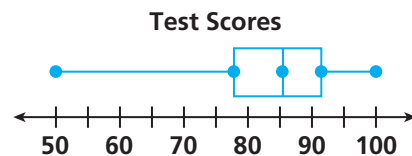
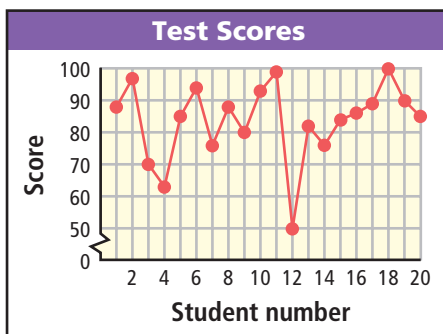
Selecting a Data Display

A Which graph is a better display of the data on student volunteering?



The data shows how groups of people who responded to the survey compare to the whole. The circle graph is the better representation.

B Which graph shows the distribution of test scores better?



Since the question asks about the distribution of the data, the box-and-whisker plot is the better representation.

EXAMPLE

2

PROBLEM SOLVING APPLICATION



José spent a week camping and hiking. The data of each hike is recorded in the table. Choose an appropriate data display. Draw the graph. About how long would it have taken José to hike 12 km?

Time (h)	1	1.5	2	3	4.5	6	7
Distance (km)	3.2	4.8	8	10.5	11.2	13.7	15.6

1 Understand the Problem

You are looking for the best data display and the estimated time for a 12 km hike.

2 Make a Plan

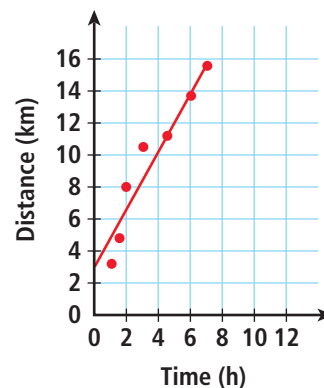
You need to find the relationship between time and distance. Since the data can be written as ordered pairs, plot them in a scatter plot.

3 Solve

Plot the data points on the scatter plot. To estimate the time needed for a 12 km hike, draw the line of best fit. Then find t when $d = 12$. The line of best fit indicates that a 12 km hike would take about 5 hours.

4 Look Back

Look at the table. An 11.2 km hike took 4.5 h and a 13.7 km hike took 6 h, so 5 h for a 12 km hike is reasonable.

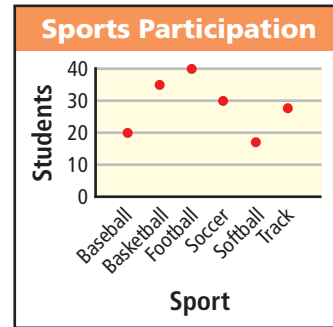
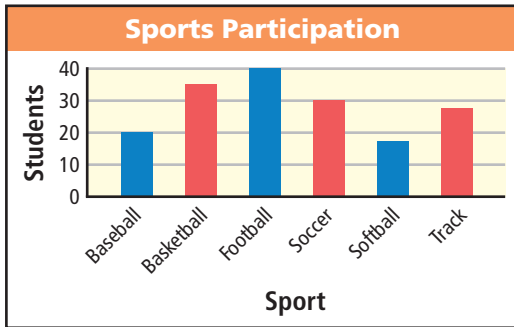


Think and Discuss

- 1. Describe** the kind of data that is best represented by a bar graph.
- 2. Give** a situation in which you would use a line graph to display data.

GUIDED PRACTICE

- See Example 1 1. Which graph is a better display of the numbers of students participating in high school sports?

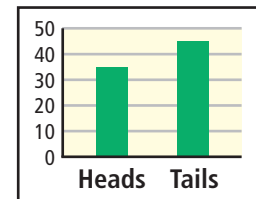
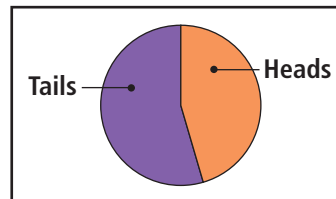


- See Example 2 2. The highest elevations for several states are listed in the table. Choose an appropriate data display and draw the graph. Which of the states shown in the graph has the third highest elevation?

State	Highest Elevation
Alaska	6194 m
California	4421 m
Colorado	4399 m
Washington	4392 m

INDEPENDENT PRACTICE

- See Example 1 3. Which graph is a better display of the percent of times a coin comes up heads and tails in 80 tosses?



- See Example 2 4. Ann spent the day shopping and running errands. The table shows her distance from home at various times during the day. Choose an appropriate data display and draw the graph. How much farther was Ann from home at 10:00 AM than at 4:00 PM?

Time	Distance (mi)
8:00 AM	0
10:00 AM	5
12:00 noon	12
2:00 PM	8
4:00 PM	3

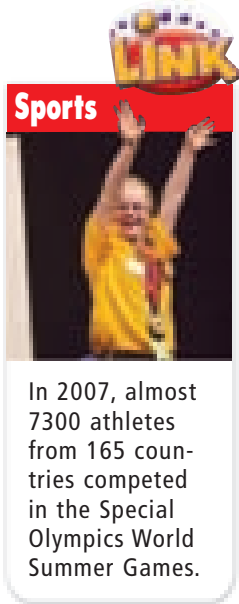
PRACTICE AND PROBLEM SOLVING

Extra Practice

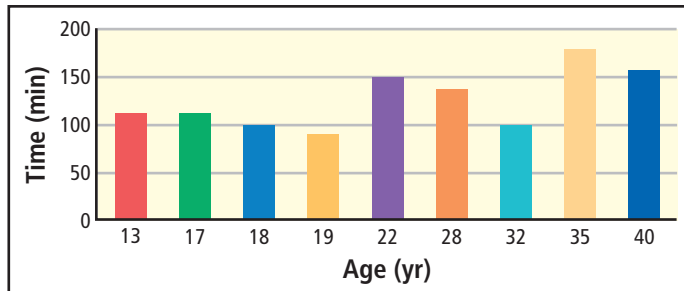
See page EP19.

Choose the best data display for each situation. Explain.

- height of a child over time
- class sizes at a middle school
- amount of time spent on different tasks during a day
- comparison of people's shoe sizes to their ages



9. **Fitness** A survey of exercise habits was conducted. The ages of respondents and the number of minutes they reported exercising weekly are shown. Choose and construct a better display for the data.



Age	Time (min)
13	120
17	120
18	100
19	90
22	150
28	135
32	100
35	180
40	160

10. **Sports** What kind of graph would best show the increase in the number of participants in the Special Olympics World Summer Games since it was founded in 1968?
11. **Write a Problem** Write a survey question for which a circle graph would best represent the data. Then collect the data and make the circle graph.
12. **Write About It** Explain how you would decide if a line graph or a scatter plot were a better representation of data.
13. **Challenge** An appliance store sells four brands of televisions. The table shows how many of each brand were sold last month. Which two kinds of graphs could be used to display this data? What message would each kind of graph give about the data?

Brand	Number Sold
A	120
B	130
C	100
D	95



Test Prep and Spiral Review

14. **Multiple Choice** What type of display would you least likely construct from data of test scores for a class?

(A) circle graph (B) line graph (C) histogram (D) bar graph

15. **Short Answer** Find the mean, median, mode, and range of the data in the stem-and-leaf plot. If any of the measures cannot be found, give the reason.

0	1 4 9
1	3 3 4 7
2	1 2 2 2 3 3

Find the area of each circle. Round to the nearest tenth, if necessary.

Use 3.14 for π . (Lesson 8-3)

16. circle with diameter 10 cm 17. circle with radius 5.2 yd
18. A 27 cm^3 cube is built from 1 cm^3 cubes. Compare the ratio of the length of an edge of the large cube to the length of an edge of a small cube. (Lesson 8-10)

Use a Spreadsheet to Create Graphs

Use with Lesson 9-10



You can use a spreadsheet to make circle graphs, line graphs, and bar graphs. A spreadsheet allows you to model different situations easily.

Activity

- Suppose a farmer has 22 pigs, 2 milk cows, 4 goats, 3 sheep, and 6 chickens. You can use a spreadsheet to make a circle graph of the data.

	A	B	C	D	E	F	G
1							
2		pig	cow	goat	sheep	chicken	
3		22	2	4	3	6	
4							

In row 2, enter the type of animal.

In row 3, enter the number of each type of animal.

Select the data by clicking in cell B2 and dragging over to cell F3.

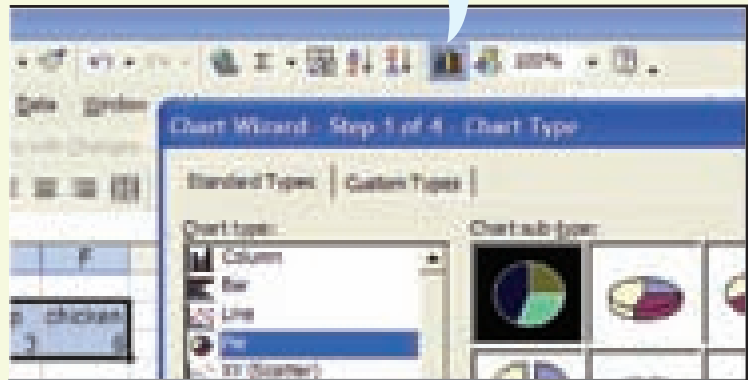
Chart Wizard icon

Click the Chart Wizard icon in the top toolbar.

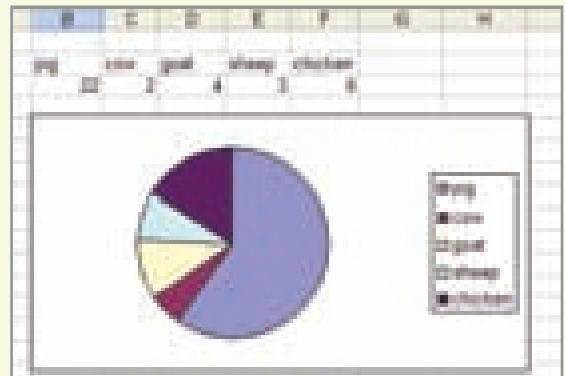
Click “Pie” under Chart Type in the Chart Wizard window. (*Pie chart* is another name for a circle graph.)

Click the top left circle graph under the Chart Sub-Type.

Click “Next” until the Finish button appears. Click “Finish.”



Now change the number of pigs to 12 and the number of goats to 11. Notice how the circle graph changes to reflect the new data.



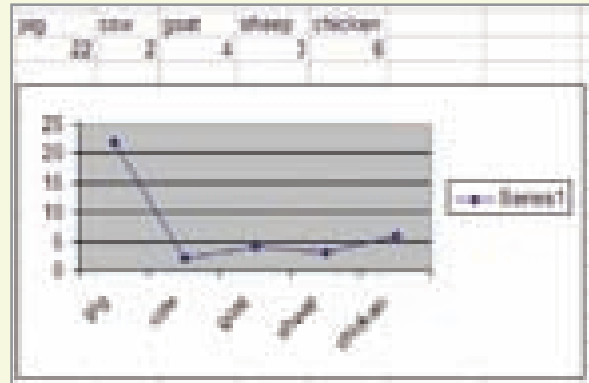
- 2 Use the spreadsheet to draw a line graph of the data.

Right click on the graph and select “Chart Type . . .”

Click “Line” and make sure that the top left graph is selected.

Click “OK.”

Now change the number of animals. Notice how the line graph changes to reflect the new data.



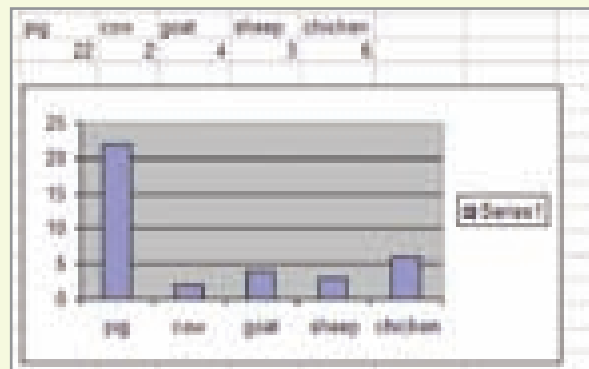
- 3 Use the spreadsheet to make a bar graph of the data.

Right click on the graph and select “Chart Type . . .”

Click “Column” and make sure that the top left graph is selected.

Click “OK.”

Now change the number of animals. Notice how the bar graph changes to reflect the new data.



Think and Discuss

1. Compare the three types of graphs. When might you prefer using one type over the others? Which is the best representation of the animal data? Explain.
2. Explain the value of spreadsheets for modeling different situations.
3. Describe a situation when you would want to use a spreadsheet to make a circle graph.

Try This

1. Take a walk in your neighborhood and record the color of the first 30 cars you see. Use a spreadsheet to make a circle graph, a line graph, and a bar graph of your data. Which represents the data best? Explain.
2. Now record the color of the next 30 cars you see. Modify your data from Try This 1. How did each graph change?

Quiz for Lessons 9-6 Through 9-10

9-6 Displaying Data

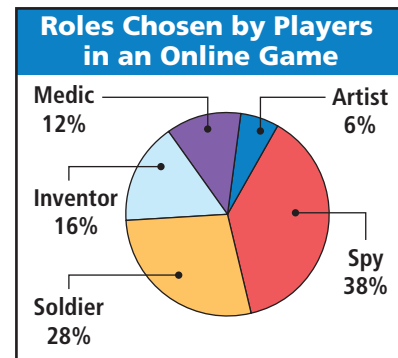
1. A fitness group calculated the average number of minutes they exercised each day. Use the data to make a histogram with intervals of 10.

29 31 42 42 50 44 33 36 37 41 38 45 37 45
37 41 39 41 34 39 35 35 30 36 32 41 39 37

9-7 Analyzing Data Displays

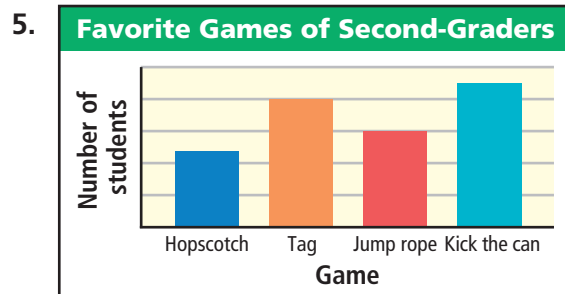
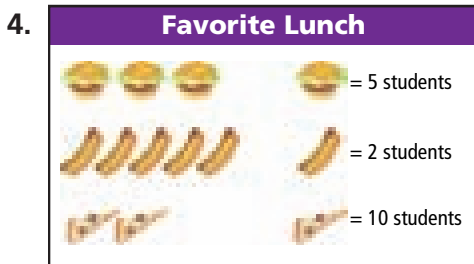
Use the circle graph for Exercises 2 and 3.

2. There are about 12,000 people who play this online game. Approximately how many of them choose to play inventors?
3. Micah claims that about $\frac{2}{3}$ of the players choose the roles of soldiers or spies. Is his claim valid? Explain.



9-8 Misleading Graphs and Statistics

Explain why each graph is misleading.



9-9 Scatter Plots

6. Use the given data of the estimated U.S. population to make a scatter plot, and describe the correlation.

Year	1998	1999	2000	2001	2002	2003	2004
Population (in millions)	270.2	272.7	282.2	285.1	287.9	290.8	293.7

9-10 Choosing the Best Representation of Data

7. The eighth-grade chorus had 10 altos, 16 sopranos, 4 bass vocalists, and 10 tenors. Choose an appropriate data display and draw the graph. What percent of the chorus were the altos and tenors?

The New York Mets The New York Mets played their first season of Major League Baseball in 1962. They finished the year with a dismal record of 40 wins and 120 losses. Since then, they have been much more successful, including two World Series wins and four National League pennants.



Mets 2007 Season Statistics

Player	Runs Scored	Home Runs
Marlon Anderson	14	3
Endy Chavez	20	1
Julio Franco	7	1
Carlos Gomez	14	2
Ruben Gotay	25	4
Shawn Green	62	10
Lastings Milledge	27	7
David Newhan	9	1
Jose Valentin	18	3

- The table shows statistics for several players on the 2007 team.
 - Find the mean and median of the number of runs scored by these players.
 - Which of these measures best describes the typical number of runs scored by these players? Justify your choice.
- Choose a way to display the number of home runs hit by the players listed in the table. Make the display, and explain why you chose this method to show the data.
- Make a scatter plot of the data in the table. Let the number of runs scored represent the independent variable, and let the number of home runs represent the dependent variable.
- Describe any correlation in the scatter plot.
- Suppose a player on the 2007 team scored 50 runs. Use your scatter plot to predict the number of home runs that this player hit.



Game Time

Distribution of Primes

Remember that a prime number is only divisible by 1 and itself. There are infinitely many prime numbers, but there is no algebraic formula to find them. The largest known prime number, discovered on September 4, 2006, is $2^{32,582,657} - 1$. In standard form, this number would have 9,808,358 digits.

Sieve of Eratosthenes

One way to find prime numbers is called the sieve of Eratosthenes. Use a list of whole numbers in order. Cross off 1. The next number, 2, is prime. Circle it. Then cross off all multiples of 2, because they are not prime. Circle the next number on the list. Cross off all of its multiples. Repeat this step until all of the numbers are circled or crossed off. The circled numbers will all be primes.

1	②	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

- Use the sieve of Eratosthenes to find all prime numbers less than 50.
- Create a scatter plot of the first 15 prime numbers. Use the prime numbers as the x -coordinates and their positions in the sequence as the y -coordinates; 2 is the 1st prime, 3 is the 2nd prime, and so on.

Prime Number	2	3	5	7	■	■	■	■	■	■	■	■	■	■	■
Position in Sequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

- Estimate the line of best fit and use it to estimate the number of primes under 100. Use the sieve of Eratosthenes to check your estimate.

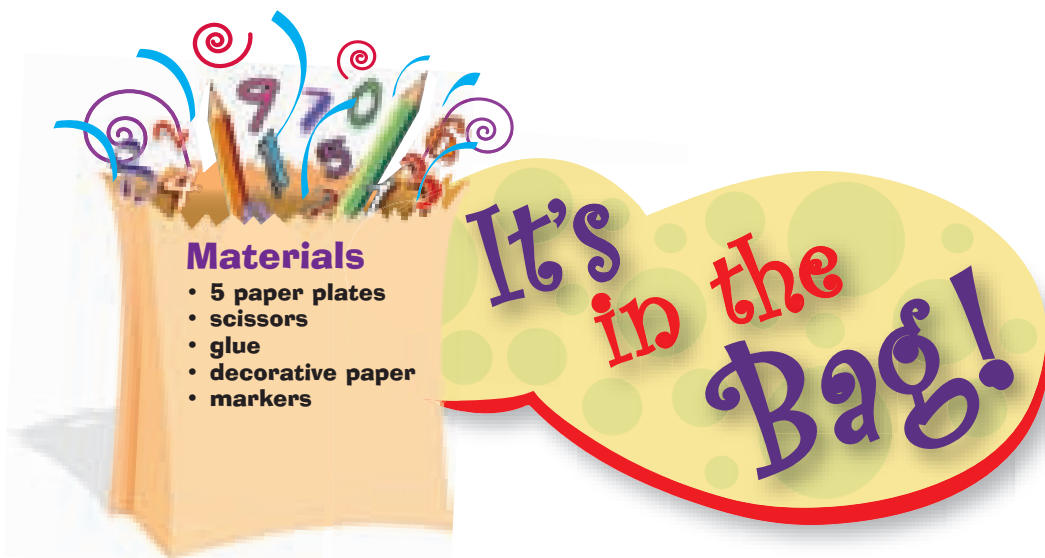
Math in the Middle

This game can be played by two or more players. On your turn, roll 5 number cubes. The number of spaces you move is your choice of the mean, rounded to the nearest whole number; the median; or the mode, if it exists. The winner is the first player to land on the *Finish* square by exact count.

A complete set of rules and a game board are available online.

Learn It Online
 Game Time Extra go.hrw.com,
 keyword MT10 Games 

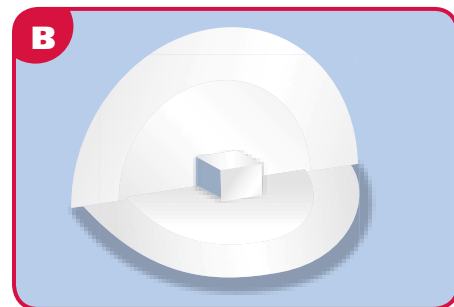
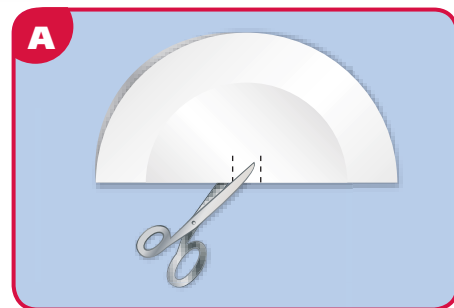




PROJECT Data Pop-Ups

Here is a way to take notes on collecting, displaying, and analyzing data that is guaranteed to pop out!

- 1 Cut one paper plate in half. You will use the two halves later to make covers for your pop-up book.
- 2 Fold each of the remaining paper plates in half. Cut two 1-inch slits in the middle of the folded edge of each plate. The slits should be about 1 inch apart. **Figure A**
- 3 Bend the paper between the slits back and forth, and then push it inward as you unfold the plate. This will create a pop-up tab. **Figure B**
- 4 Fold the paper plates shut. Glue the bottom of one paper plate to the top of the next paper plate to form a book. Make covers by gluing one of the paper-plate halves onto the front of the book and the other onto the back of the book.
- 5 Cut out four small rectangles of decorative paper. After taking notes on these rectangles, you will glue them onto the pop-up tabs in your book. **Figure C**



Taking Note of the Math

Use the rectangles of decorative paper to take notes on collecting, displaying, and analyzing data. Then glue the rectangles to the pop-up tabs inside the book. You can also take notes by writing directly on the paper plates.



Study Guide: Review

Vocabulary

back-to-back stem-and-leaf plot472	histogram491	sample462
biased question467	interquartile range483	scatter plot504
biased sample467	line of best fit504	self-selected sample462
box-and-whisker plot ..482	line plot471	stem-and-leaf plot471
convenience sample ...462	mean476	systematic sample462
correlation504	median476	third quartile482
double-bar graph491	mode476	variability482
double-line graph492	outlier476	Venn diagram472
first quartile482	population462	weighted average478
frequency table491	random sample462	
	range476	

Complete the sentences below with vocabulary words from the list above.

- The ___?___ is the line that comes closest to all the points on a(n) ___?___.
___?___ describes the type of relationship between two data sets.

EXAMPLES**9-1** Samples and Surveys (pp. 462–465)

- A bookstore owner places printed surveys at the checkout counter. Identify the type of sampling method.

This is a self-selected sample because customers choose whether to fill out the surveys.

EXERCISES

Lou wants to know how many students at his school ride the bus to school. Identify each type of sampling method.

- Lou surveys every tenth student listed in the school directory.
- Lou surveys 30 students in the gym.

9-2 Identifying Sampling Errors and Bias (pp. 467–470)

- Members of a hiking club are surveyed to determine what type of shoes people prefer. Determine whether the sample may be biased. Explain.

The sample may be biased. People in a hiking club may be more likely than others to choose hiking boots.

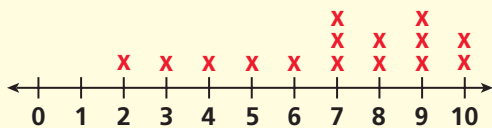
- A park employee surveys 20 joggers in a park to determine whether more bike trails should be added to the park. Determine whether the sample may be biased.

EXAMPLES

9-3 Organizing Data (pp. 471–475)

- Use a line plot to organize the data.

7 10 6 9 7 4 8 9
3 8 2 10 5 9 7



EXERCISES

Use a line plot to organize the data.

5.

Ages of People at a Skate Park					
12	13	13	14	12	11
14	15	13	13	12	13

9-4 Measures of Central Tendency (pp. 476–480)

- Determine and find the most appropriate measure of central tendency for the data set 50, 65, 72, 3, 85, 105, and 120.

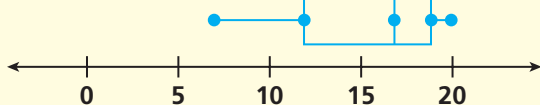
Because there is an outlier, the median of 72 is the best measure of central tendency.
3, 50, 65, 72, 85, 105, 120

6. The prices of the cars sold in one month were \$17,500; \$15,300; \$16,800; \$65,900; \$12,800; \$16,300. What measure of central tendency would make the cars appear the least expensive?

9-5 Variability (pp. 482–486)

- Use the given data to make a box-and-whisker plot.

7, 10, 14, 16, 17, 17, 18, 20, 20



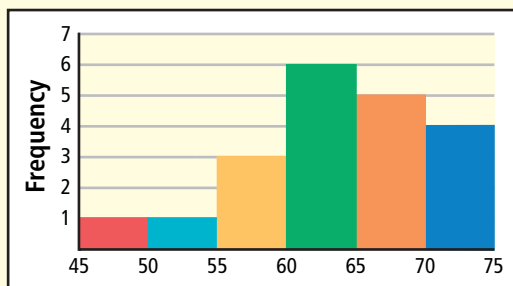
Use the given data to make a box-and-whisker plot.

7. 51, 56, 56, 59, 63, 68, 68, 73, 73, 79
8. 87, 87, 80, 72, 85, 82, 53, 65, 65
9. 75, 80, 80, 82, 85, 87, 87, 90, 90, 94

9-6 Displaying Data (pp. 491–494)

- Make a histogram of the data set.

72, 64, 56, 60, 66, 72, 48, 66, 58, 60,
60, 50, 68, 72, 68, 62, 72, 58, 60, 68



Make a histogram of each data set.

10.

Weight (lb)	Frequency
91–100	5
101–110	7
111–120	10
121–130	4
131–140	2
141–150	3

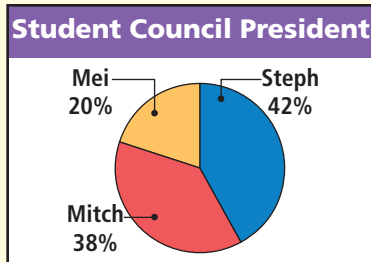
11. Computer usage (h/week): 8, 3, 5, 10, 11, 12, 10, 7, 8, 7, 7, 22, 13, 15, 18, 6, 3



EXAMPLES

9-7 Analyzing Data Displays (pp. 496–499)

- If 312 students voted in the election, how many voted for Steph?



$312 \cdot 0.42 \approx 131$ Find 42% of 312.
131 students voted for Steph.

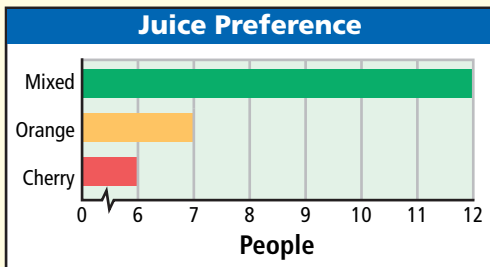
EXERCISES

Use the circle graph to answer each question.

- How many more students voted for Mitch than voted for Mei?
- Beth claims that Steph and Mitch together received about $\frac{2}{3}$ of the votes. Is Beth's claim valid? Explain.

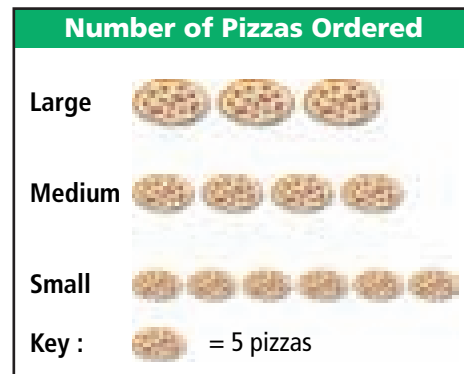
9-8 Misleading Graphs and Statistics (pp. 500–503)

- Explain why the graph is misleading.



The bar for mixed juice is 7 times longer than the bar for cherry juice, but it is only preferred by 2 times as many people.

- Explain why the graph is misleading.



9-9 Scatter Plots (pp. 504–507)

- Does the age of a battery in a flashlight and the intensity of the flashlight beam have a positive, a negative, or no correlation? Explain.

Negative: The older the battery is, the less intense the flashlight beam will be.

- Use the given data to make a scatter plot, and describe the correlation.

Day	0	2	4	6	8	10
Height (cm)	9	12	19	20	26	28

9-10 Choosing the Best Representation of Data (pp. 510–513)

- Choose the best display to compare children's shoe sizes to their heights.

A scatter plot would be the best display because you are comparing two sets of data.

Choose the best data display for the situation below. Explain your answer.

- the amount of money spent in each category of a budget

Chapter Test

CHAPTER 9

The manager of a skating rink wants to know what type of music skaters prefer. Identify each type of sampling method.

1. The manager surveys 30 people seated at the snack bar.
2. The manager surveys every 20th person who rents skates during one week.
3. To learn about people's favorite musical instruments, a reporter surveys the first 50 people leaving a rock concert. Determine whether the sample may be biased. Explain.
4. The scores on a history test were 79, 82, 85, 100, 82, 83, 78, 84, 80, 82, and 77. What measure makes the students' performance seem the best?

Use the given data to make a box-and-whisker plot.

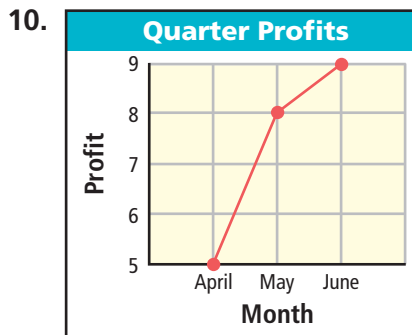
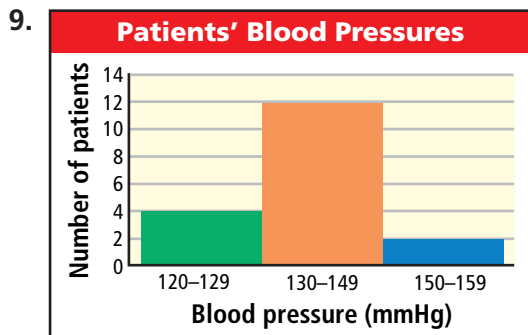
5. 62, 60, 77, 66, 92, 87, 62, 60, 64
6. 2.2, 6.8, 6.4, 8, 6.5, 4.2, 6.5, 5, 8

A middle school class calculated the average number of minutes they spent on the phone each day. Use the data for problems 7 and 8.

18 31 32 42 50 34 33 36 27 41 5 35 27 15
37 12 9 31 24 29 10 25 20 66 22 31 9 3

7. Make a histogram of the data with intervals of 10.
8. Which interval includes the greatest number of students?

Explain why each graph is misleading.



11. Use the given data to make a scatter plot, and describe the correlation.

Food	Pizza	Hamburger	Taco	Hot Dog	Caesar Salad	Taco Salad
Fat (g)	11	13	14	12	4	21
Calories	374	310	220	270	90	410

12. In a randomly chosen group of 100 people, 38 have type O positive blood, 7 have O negative, 34 have A positive, 6 have A negative, 9 have B positive, 2 have B negative, 3 have AB positive, and 1 has AB negative. Choose an appropriate data display and draw the graph. About what fraction of the population has type O blood?

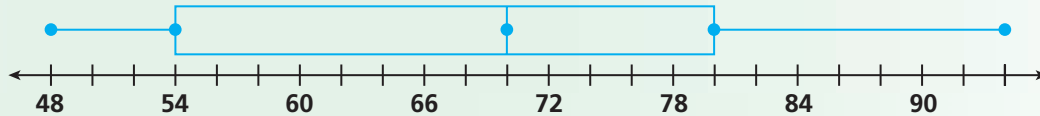


All Types: Using a Graphic

Sometimes a graph or a picture is given with a test item. Look carefully at any drawings on a test. Keep in mind that figures are not always drawn to scale and can be misleading.

EXAMPLE 1

Multiple Choice The box-and-whisker plot shows the number of sales for the year. What is the range?



(A) 46

(B) 54

(C) 68

(D) 80

- Look at the box-and-whisker plot. The whiskers extend to the least and greatest values. The range is the difference between these values.

$$94 - 48 = 46 \quad \textit{Find the difference.}$$

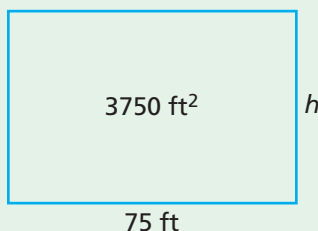
- The range is 46, so the correct answer is choice A.

Sometimes you will need to draw a diagram based on the information given in a test item. Always read the question carefully to make sure that your diagram is properly labeled.

EXAMPLE 2

Short Answer An ice rink has an area of 3750 ft^2 and length of 75 ft. What is the perimeter of the ice rink? Explain your reasoning and show your work.

Draw a diagram to help you visualize the problem.



$$A = bh$$

$$3750 = 75h$$

$$50 = h$$

$$P = 2(b + h)$$

$$P = 2(75 + 50)$$

You know the area and base. You need to find the height.

Use the formula for perimeter. Substitute the known values.

The perimeter of the ice rink is 250 ft.

$$P = 2(125)$$

$$P = 250$$



Draw a diagram if one is not provided to help you visualize the problem.

Read each test problem and answer the questions that follow.

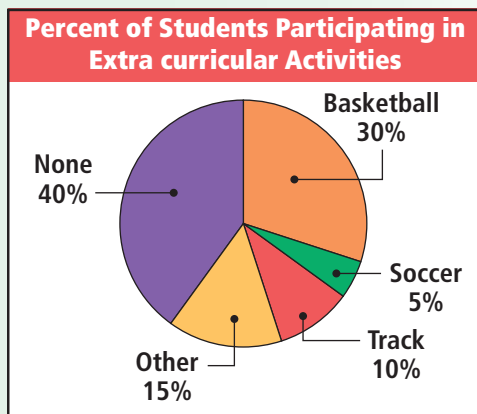
Item A

A pizza restaurant sells a 12-inch small pizza, a 14-inch medium pizza, and a 16-inch large pizza. How much more pizza do you get for a large pizza than a small pizza? Explain your reasoning and show your work.

1. Draw a diagram to help you visualize the problem.
2. Use information from your diagram to solve the problem.

Item B

A middle school has 1000 students. According to the circle graph, how many students are in track?



- (F) 400 (H) 100
(G) 300 (J) 30

3. What percent of the students are in track? How do you know?
4. How do you find the number of students who are in track?

Item C

When a rectangle is divided into thirds, three squares are formed, each with a perimeter of 9.6 cm. What is the perimeter of the original rectangle?

5. Draw a diagram to visualize the problem.
6. What information from your diagram do you need to solve the problem?
7. If your answer is a decimal, what do you need to remember to do on the grid?
8. Show how you would grid your response below.

/	/	/	/	/
•	•	•	•	•
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Item D

A 10 cm section of plastic pipe has an inner diameter 12 cm and an outer diameter 16 cm. What is the volume of the solid plastic pipe? Use 3.14 for π .

- (A) 879.2 cm³ (C) 2009.6 cm³
(B) 1130.4 cm³ (D) 3140 cm³

9. Draw a diagram to help you visualize the problem.
10. Use information from your diagram to solve the problem.

Cumulative Assessment, Chapters 1–9

Multiple Choice

1. Which is NOT true for this data set?

10, 10, 10.5, 9, 9.5

- (A) mean < mode
(B) median > mean
(C) median = mean
(D) median = mode

2. In order to participate in after-school activities, a student needs to have a grade point average, g , of 2.0 or better. Which inequality represents this requirement?

- (F) $g \geq 2.0$ (H) $g > 2.0$
(G) $g \leq 2.0$ (J) $g < 2.0$

3. Which ordered pair is a solution to the equation $2x + 4y = -18$?

- (A) (0, -9) (C) (-11, 1)
(B) (6, 0) (D) (-3, -4)

4. Which expression is **NOT** equivalent to $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$?

- (F) $\frac{1}{4^{-5}}$ (H) $4^2 \cdot 4^3$
(G) 20 (J) 1024

5. A 6-inch model is made to represent a 30-foot plane. What is the scale?

- (A) 1 in. = 5 ft (C) 6 in. = 5 ft
(B) 5 in. = 1 ft (D) 30 in. = 5 ft

6. The stem-and-leaf plot shows test scores for a teacher's first and second periods. What can you conclude?

1st period		2nd period
7	6	5 8
6 4 2	7	5 6 9
9 8 6 4 2 0	8	1 3 5 7 7 8 8
9 7 7 2 1	9	0 6 7 8 9

Key: |9|0 means 90
7|6| means 67

- (F) More first period students scored in the 90's.
(G) Fewer first period students scored 80 or below.
(H) More second period students scored in the 70's.
(J) More second period students scored in the 80's.

7. A soup company is producing a cylindrical can to package its new soup. The radius of the cylinder is 1.5 in. and the volume of the cylinder has to be 14 in^3 . What must the height of the can be, rounded to the nearest whole inch?

- (A) 1 inch (C) 3 inches
(B) 2 inches (D) 4 inches

8. Emma buys a refrigerator on sale for \$665. This is 30% off the original price. What is the original price of the refrigerator?

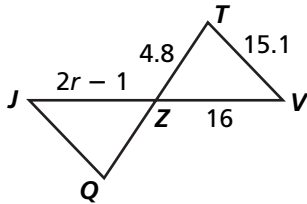
- (F) \$200 (H) \$1995
(G) \$950 (J) \$2217

9. Which is a solution to the equation

$$-10 + 5x = -25?$$

- Ⓐ $x = -15$ Ⓒ $x = -3$
 Ⓑ $x = -7$ Ⓓ $x = -1$

10. If triangle $JQZ \cong$ triangle VTZ , what is the value of r ?



- Ⓕ 7.5 Ⓗ 9
 Ⓖ 8.5 Ⓙ 33

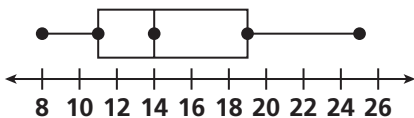


Read a graph or diagram as closely as you do the actual question. These visual aids contain important information.

Gridded Response

11. An object is dropped from the top of a building 180 ft tall. The function $f(t) = -16t^2 + 180$ models the height in feet of the object after t seconds. What is the height in feet of the object after 2 seconds?

Use the box-and-whisker plot to answer questions 12 and 13.

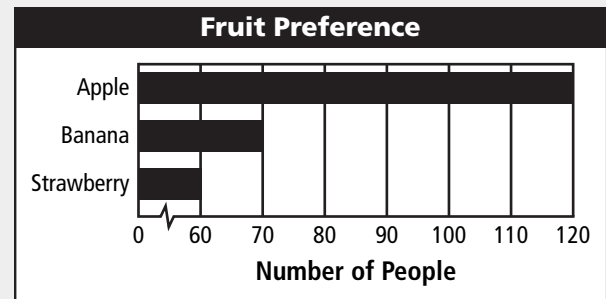


12. What is the range of the data?
 13. What is the first quartile of the data?
 14. Monica scored 85, 83, 81, 80, and 81 on her last five assignments. What would Monica need to earn on her next assignment to bring her average to an 85?

Short Response

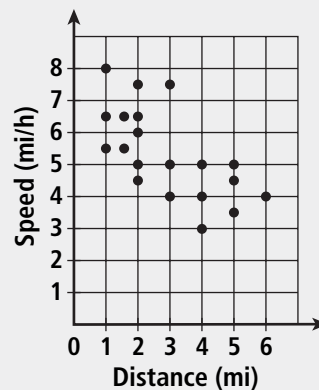
S1. Name two ordered pairs (x, y) that satisfy these conditions: The mean of 0, x , and y is twice the median; $0 < x < y$; and $y = nx$ (y is a multiple of x). What is the value of n ? Show your work or explain in words how you determined your answer.

S2. Explain why the graph is misleading and then redraw it so that it better represents the data.



Extended Response

E1. Twenty students in a gym class kept a record of their jogging. The results are shown in the scatter plot.



- a. Describe the correlation of the data in the scatter plot.
 b. Find the average speeds of joggers who run 1, 2, 3, 4, and 5 miles.
 c. Explain the relationship between your answer from part a and your answers from part b.