

# Statistics: Analyzing Data

“What do bridges have to do with math?”

Twenty-two of the longest suspension bridges in North America are 1,500 feet to 4,260 feet long. You can use a box-and-whisker plot to summarize the data about bridges. In mathematics, you will use tables, graphs, and diagrams to organize lists of numbers that describe real-life events.

You will solve problems by organizing data in box-and-whisker plots in Lesson 2-6.

# GETTING STARTED

## ► Diagnose Readiness

Take this quiz to see if you are ready to begin Chapter 2. Refer to the page number in parentheses for review.

### Vocabulary Review

Choose the correct term to complete each sentence.

- 173.02 and 37.125 have the same digit in the (hundreds, hundredths, tenths) place. (Page 555)
- The number 0.02 is (less than, equal to, greater than) 0.002. (Page 556)
- The numbers 10.88, 10.089, and 1.08 are in order from (least to greatest, greatest to least). (Page 556)

### Prerequisite Skills

Name the place value of each underlined digit. (Page 555)

- 7.95                                      5. 2,064
- 48.05                                        7. 163.3

Order from least to greatest. (Page 556)

8. 96.2, 96.02, 95.89      9. 5.61, 5.062, 5.16
10. 22.02, 22, 22.012      11. 3.98, 39.8, 0.398

Order from greatest to least. (Page 556)

12. 74.65, 74.67, 74.7      13. 1.26, 1.026, 10.26
14. 3.304, 3.04, 3.340      15. 68.9, 69.79, 68.99

Add or divide. (Pages 559 and 562)

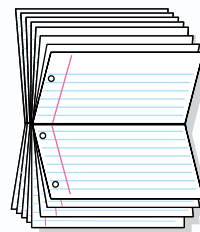
16.  $88.21 + 4.75 + 62.4 + 39.60$
17.  $215 \div 2.5$                               18.  $5.9 + 28.1 + 9.2$
19.  $333 \div 0.6$                               20.  $51 \div 1.7$



**Statistics** Make this Foldable to help you organize information about analyzing data. Begin with eight sheets of notebook paper.

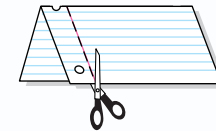
#### STEP 1 Fold

Fold 8 sheets of paper in half along the width.



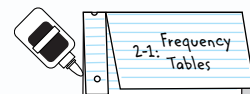
#### STEP 2 Cut

Cut a 1" tab along the left edge through one thickness.



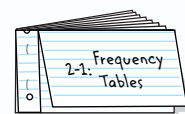
#### STEP 3 Glue and Label

Glue the 1" tab down. Write the lesson number and title on the front tab.



#### STEP 4 Repeat and Staple

Repeat Steps 2 and 3 for the remaining sheets. Staple them together on the glued tabs to form a booklet.



**Noteables™** **Chapter Notes** Each time you find this logo throughout the chapter, use your *Noteables™*: *Interactive Study Notebook with Foldables™* or your own notebook to take notes. Begin your chapter notes with this Foldable activity.



**Readiness** To prepare yourself for this chapter with another quiz, visit [msmath2.net/chapter\\_readiness](http://msmath2.net/chapter_readiness)

# 2-1

## Frequency Tables

### What You'll LEARN

Organize and interpret data in a frequency table.

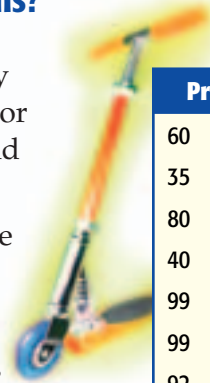
### NEW Vocabulary

statistics  
data  
frequency table  
scale  
interval

**WHEN** am I ever going to use this?

**SCOOTERS** Riding a scooter is a fun way to get exercise. The table shows prices for 35 types of nonmotorized scooters found at an online store.

1. What is the cost of the least expensive scooter? the most expensive?
2. How many scooters cost \$51 to \$75?
3. How could you reorganize the prices so that they are easier to find and read?



60	25	29	25	40
35	50	80	30	70
80	90	80	55	70
40	100	52	45	60
99	60	100	89	11
99	100	49	35	90
92	20	49	80	50

**Statistics** deals with collecting, organizing, and interpreting data. **Data** are pieces of information, which are often numerical. Large amounts of data can be organized in a frequency table. A **frequency table** shows the number of pieces of data that fall within given intervals.

Price (\$)	Tally	Frequency
1–25		4
26–50		11
51–75		7
76–100		13

The **scale** allows you to record all of the data. It includes the least value, 11, and the greatest value, 100. The scale is 1 to 100.

The **interval** separates the scale into equal parts. The interval is 25.

Tally marks are counters used to record items in a group.

From the frequency table, you can see that just over half the scooters cost between \$51 and \$100.

### EXAMPLE Make a Frequency Table

**RACING** *Cyclo-cross* is cycle racing that takes place on short off-road courses. The table shows the total points earned by the top 20 racers in the cyclo-cross World Cup events. Make a frequency table of the data.

310	179	116	91
225	173	107	76
223	150	105	55
218	149	100	52
190	123	100	50

Source: www.cyclo-cross.com

**Step 1** Choose an appropriate interval and scale for the data. The scale should include the least value, 50, and the greatest value, 310.

interval: 50  
scale: 50 to 349 } The scale includes all of the data, and the interval separates it into equal parts.

**Step 2** Draw a table with three columns and label the columns *Points*, *Tally*, and *Frequency*.

**Step 3** Complete the table.

Points	Tally	Frequency
50–99		5
100–149		7
150–199		4
200–249		3
250–299		0
300–349		1

Frequency tables can also have categories without scales and intervals.

### EXAMPLE Make and Use a Frequency Table

**1 OLYMPICS** Enrique asked his classmates to name their favorite winter Olympic event. The results are shown at the right. Make a frequency table of the data. Then determine the overall favorite event.

Favorite Winter Olympic Events					
S	F	F	S	B	F
F	S	H	J	B	S
J	F	J	F	H	F
F	B	S	F	S	H
S	B	H	F	J	J

B = bobsleigh, F = figure skating,  
H = hockey, J = ski jumping,  
S = snowboarding

Draw a table with three columns. In the first column, list the events. Then complete the rest of the table.

Event	Tally	Frequency
bobsleigh		4
figure skating		10
hockey		4
ski jumping		5
snowboarding		7

Figure skating, with 10 tallies, was the favorite event. Snowboarding was the second favorite, with 7 tallies.

### REAL-LIFE MATH

**OLYMPICS** In 2002, Vonetta Flowers became the first African-American to win a gold medal in the Winter Olympics. She and Jill Bakken won the first ever 2-woman bobsleigh event with a two-mile time of 1 minute 37.76 seconds.

Source: www.olympic-usa.org



Frequency tables are useful for interpreting data.

### EXAMPLE Interpret Data

**1 HISTORY** The frequency table shows the reigns of the last forty rulers of England. How many of them ruled England for more than 30 years?

There are three categories with more than 30 years.

31–45 years = 6 rulers

46–60 years = 4 rulers

61–75 years = 1 ruler

So,  $6 + 4 + 1$  or 11 of the last forty rulers each ruled England for more than 30 years.

Rulers of England		
Reign (years)	Tally	Frequency
1–15		18
16–30		11
31–45		6
46–60		4
61–75		1

Source: www.scotlandroyalty.org/kings.html



## Skill and Concept Check

- Writing Math** Describe an advantage and a disadvantage of using a frequency table to display data.
- OPEN ENDED** Make a frequency table that displays thirty data items and has an interval of 5.
- DATA SENSE** Explain why the frequency table in Example 1 does not have 300–310 as its last category when the greatest data value is 310.

### GUIDED PRACTICE

For Exercises 4 and 5, use the table below.

Number of Movie Rentals During the Month							
10	9	2	17	12	9	11	10
4	14	3	15	0	6	5	9
20	10	11	8	3	1	13	4

- Choose an appropriate interval and scale to make a frequency table.
- Make a frequency table of the data.

For Exercises 6 and 7, use the table below.

Favorite Breakfast Foods					
e	c	e	p	c	c
c	p	p	e	c	e
c	e	c	p	p	e

c = cereal, e = eggs, p = pancakes

- Make a frequency table of the data.
- What is the favorite breakfast food?

## Practice and Applications

Make a frequency table of each set of data.

8.

Ages of Students in Ms. Warren's Class				
12	13	13	14	14
14	14	13	13	14
13	14	13	13	12
14	13	14	12	13

9.

Years of Major Hurricanes				
1900	1975	1985	1995	1996
1938	1944	1957	1980	1992
1961	1935	1989	1972	1928
1955	1969	1979	1915	1964
1970	1960	1954	1926	1967
1999	1998			

Source: *The World Almanac*

10.

How Do You Listen to the Most Music?					
I	C	M	I	R	M
R	M	I	M	C	R
R	C	C	R	I	C
M	C	C	R	C	M
R	I	R	R	R	C

C = CDs, R = radio, I = Internet,  
M = music videos

11.

Which Chore Do Students Like Least?					
D	L	Y	L	V	R
D	L	R	D	R	D
V	D	V	R	R	Y
R	R	Y	L	D	V
D	R	V	R	R	D

D = wash dishes, V = vacuum,  
R = clean room, L = do laundry,  
Y = do yard work

- Determine** whether the categories 0–100, 100–200, and 200–300 could be used in a frequency table displaying data. Explain.

### HOMEWORK HELP

For Exercises	See Examples
8–12	1
13–18	2, 3

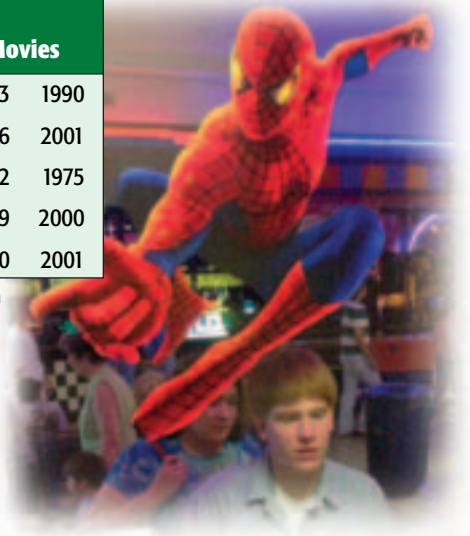
**Extra Practice**  
See pages 567, 597.

**MOVIES** For Exercises 13–15, use the table at the right. It shows when the 20 top-grossing movies of all time were released as of 2002.

- Make a frequency table of the data. Use the intervals 1970–1979, 1980–1989, 1990–1999, and 2000–2009.
- In which years were the greatest number of top-grossing movies released?
- RESEARCH** Use the Internet or another source to find the current 20 top-grossing movies. Make a frequency table of the data and compare it to the table you made in Exercise 13.

Years of Top-Grossing Movies			
1997	1993	1983	1990
1977	1994	1996	2001
1982	2001	2002	1975
1999	1994	1999	2000
2002	2001	1980	2001

Source: www.movieweb.com



**CEREAL** For Exercises 16–18, use the table at the right. It shows the number of Calories contained in one serving of students' favorite cereals.

- Make a frequency table of the data.
- How many Calories are in one serving of most of the cereals?
- If a student eats two bowls of his favorite cereal, what is the greatest and least number of Calories possible that he consumes?
- CRITICAL THINKING** Make a frequency table of the scooter data at the beginning of this lesson using a different scale and interval. Analyze the data in the new table and describe an advantage and a disadvantage of using this scale and interval.

Number of Calories per Serving of Dry Cereal				
70	120	100	100	140
70	120	100	100	100
110	110	110	120	100
110	100	100	110	150
90	110	120	110	100
140	130	100	80	100
100	110	80	90	110

## Spiral Review with Standardized Test Practice

- MULTIPLE CHOICE** The following are scores of the Duke University women's basketball team in recent conference games: 107, 76, 90, 91, 81, 73, 86, 102, 102, 86, 66, 83, 77, 81, 88, 90. Choose the best scale for making a frequency table of the scores.

(A) 66–105      (B) 68–102      (C) 66–110      (D) 70–108

- MULTIPLE CHOICE** If there are 24 students in math class, how many received a score on the exam in the interval 81–90?

(F) 7      (G) 6      (H) 5      (I) 4

Score	Frequency
71–80	8
81–90	?
91–100	9

Write each number in standard form. (Lesson 1-9)

- $1.8 \times 10^3$
- $5.33 \times 10^5$
- $2.4 \times 10^4$
- $6.0 \times 10^7$

- MEASUREMENT** How many centimeters are in 8.05 meters? (Lesson 1-8)

### GETTING READY FOR THE NEXT LESSON

#### PREREQUISITE SKILL

- At 5:00 P.M. the outside temperature was 81°F; at 6:00 P.M. it was 80°F; at 7:00 P.M. it was 79°F. If the pattern continues, predict the outside temperature at 8:00 P.M. (Lesson 1-7)



## Problem-Solving Strategy

A Preview of Lesson 2-2

### Use a Graph

#### What You'll LEARN

Solve problems by using graphs.

How many home runs do you think the Pittsburgh Pirates will get in 2004?

By just looking at the table, I can't really tell. Let's **use a graph** to get a better picture.

Pittsburgh Pirates Home Runs													
Year	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03
Home Runs	126	106	110	80	125	138	129	107	171	168	161	142	163

Source: www.baseball-almanac.com

#### Explore

We know the number of home runs from 1991 to 2002. We need to predict how many there will be in 2004.

#### Plan

If we organize the information in a graph, we may be able to see if there are any trends in the number of home runs.

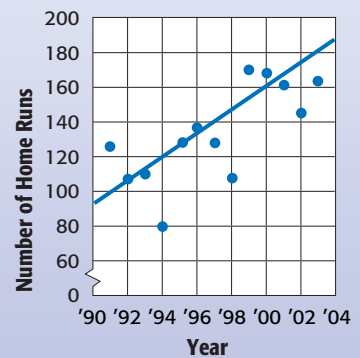
#### Solve

We can see from the graph that generally, as the years progress, the number of home runs increases. We can predict that the number of home runs in 2004 will be about 190.

#### Examine

Draw a line through the points that is close to as many of the points as possible, as shown above. The estimate is close to the line, so the prediction is reasonable.

Pittsburgh Pirates Home Runs



### Analyze the Strategy

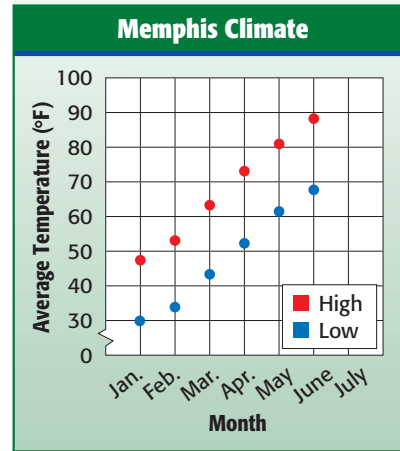
1. **Explain** why analyzing a graph is a useful way to quickly make conclusions about a set of data.
2. The last step of the four-step plan asks you to *examine* the solution. **Write** a problem in which using a graph would be a useful way to examine the solution.

## Apply the Strategy

Solve. Use a graph.

**EARTH SCIENCE** For Exercises 3 and 4, refer to the graph at the right. It shows the average high and low temperatures each month from January to June in Memphis, Tennessee. Suppose the trends continue through July.

- Predict the average high temperature for the month of July.
- Predict the average low temperature for the month of July.

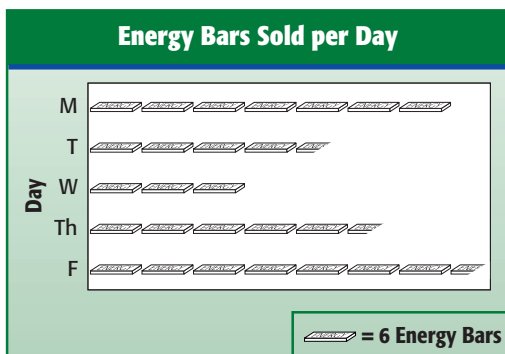


Source: www.weather.com

## Mixed Problem Solving

Solve. Use any strategy.

- READING** Maya read 10 pages of a 150-page book on Monday and plans to read twice as many pages each day than she did the previous day. On what day will she finish the book?
- SCHOOL** The graph shows the number of energy bars sold in a school's cafeteria during one week.



According to the graph, did the cafeteria sell more energy bars on Monday or Tuesday?

- SAFETY** An elevator sign reads *Do not exceed 2,500 pounds*. How many people, each weighing about 150 pounds, can be in the elevator at the same time?

- NUMBER THEORY** Find two numbers whose sum is 56 and whose product is 783.
- BOWLING** Tariq and three of his friends are going bowling, and they have a total of \$70 to spend. Suppose they buy a large pizza, four beverages, and each rent bowling shoes. How many games can they bowl if they all bowl the same number of games?

Bowling Costs	
Item	Price
large pizza	\$13.75
beverage	\$1.50
shoe rental	\$3.50
game	\$4.00

- STANDARDIZED TEST PRACTICE**  
The following sequence forms a pattern.  
4, 8, 12, 16, ...

If this pattern continues, which expression can be used to find the *sixth* term?

- (A)  $6 + 4$                       (B)  $6 - 4$   
(C)  $6 \div 4$                       (D)  $6 \times 4$

## Making Predictions

### HANDS-ON Mini Lab

#### What You'll LEARN

Make predictions from graphs.

#### NEW Vocabulary

line graph  
scatter plot

#### Materials

- measuring cup
- drinking glass
- metric ruler
- marbles
- grid paper

Work with a partner.

- Pour 1 cup of water into the drinking glass.
- Measure the height of the water and record it in a table like the one below.
- Place five marbles in the glass. Measure the height of the water and record it in your table.
- Continue adding marbles, five at a time, until there are twenty marbles in the glass. After each time, measure and record the height of the water.

Number of Marbles	Height of Water (cm)
0	
5	
10	
15	
20	

1. By how much did the height of the water change after each addition of five marbles?
2. Predict the height of the water when thirty marbles are in the drinking glass. Explain how you made your prediction.
3. Test your prediction by placing ten more marbles in the glass.
4. Draw a graph of the data that you recorded in the table.

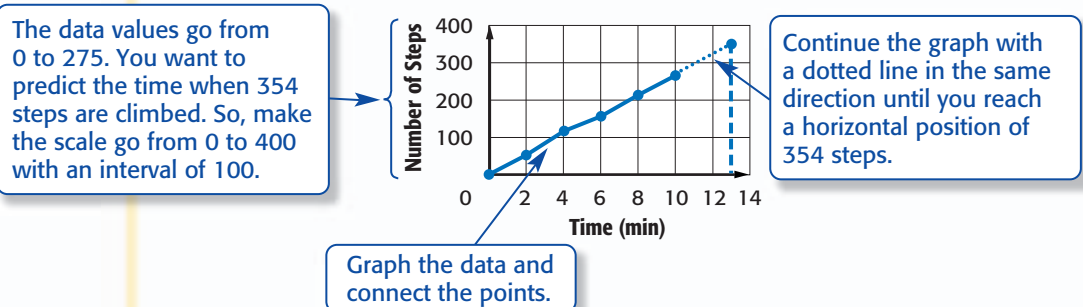
You created a line graph in the Mini Lab. **Line graphs** can be useful in predicting future events when they show trends over time.

### EXAMPLE Use a Line Graph to Predict

**STATUE OF LIBERTY** The table shows the time it takes Kyle to climb the Statue of Liberty. Make a line graph and predict the total time it will take him to climb 354 steps to the top.

Time (min)	0	2	4	6	8	10
Number of Steps	0	51	114	163	210	275

Climbing the Statue of Liberty



It will take Kyle about 13 minutes to climb 354 steps.

## READING Math

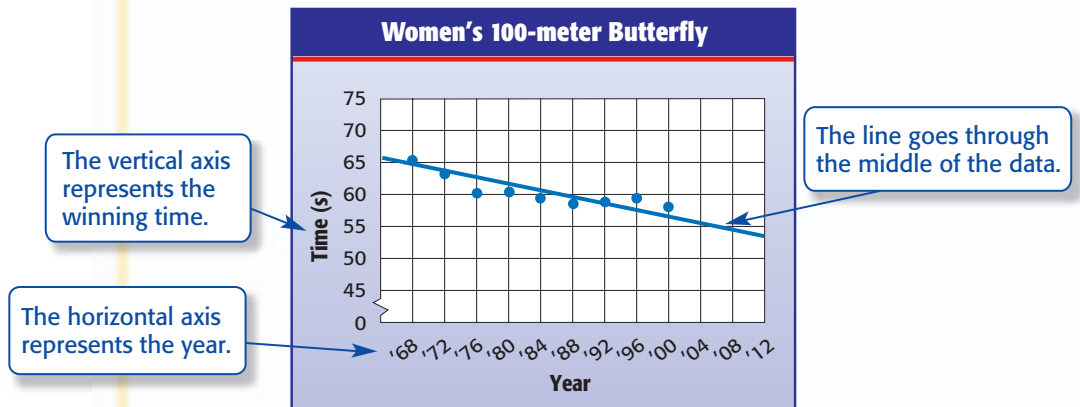
**Scatter Plots** Another name for scatter plot is *scattergram*.

A **scatter plot** displays two sets of data on the same graph. Like line graphs, scatter plots are useful for making predictions because they show trends in data. If the points on a scatter plot come close to lying on a straight line, the two sets of data are related.

### EXAMPLE

### Use a Scatter Plot to Predict

- 1 SWIMMING** The scatter plot shows the winning times for the women's 100-meter butterfly event at the Summer Olympics from 1968 to 2000. Use it to predict a winning time for this event at the 2012 Olympics.



Source: *The World Almanac*

By looking at the pattern in the graph, we can predict that the winning time at the 2012 Olympics will be about 54 seconds.

## Skill and Concept Check

- Writing Math** Explain how a graph can be used to make predictions.
- OPEN ENDED** Name two sets of data that can be graphed on a scatter plot.
- Which One Doesn't Belong?** Identify the term that does not have the same characteristic as the other three. Explain your reasoning.

line graph

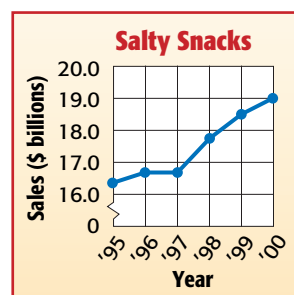
tally mark

frequency  
table

scatter plot

## GUIDED PRACTICE

- SNACKS** The graph shows the sales, in billions of dollars, of salty snacks like potato chips and pretzels for several years. If the trend continues, about what will the sales be in 2006?

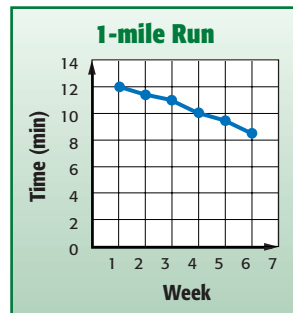


Source: *American Demographics*



## Practice and Applications

5. **RUNNING** Mahkah has been training for several weeks for cross-country tryouts. His progress is shown in the graph at the right. To make the team, he must be able to run 1 mile in less than 8 minutes. If the trend continues, will Mahkah make the team? Explain.



### HOMWORK HELP

For Exercises	See Examples
5–9	1
10–12	2

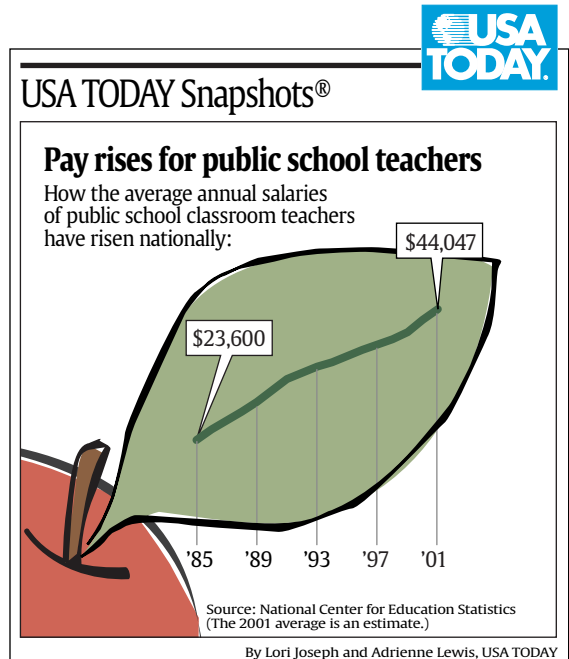
**Extra Practice**  
See pages 567, 597.

6. **SCHOOLS** The line graph shows public school teachers' salaries for the past few years. If the trend continues, about what will the average annual salary be in 2005?
7. **RESEARCH** Use the Internet or another source to find a real-life example of a line graph. Write a description of what the graph displays and extend the graph to show where the data will be in the future.

**OLYMPICS** For Exercises 8 and 9, use the table below. It shows the number of nations that participated in the Summer Olympics from 1948 to 2000.

Year	Number of Nations	Year	Number of Nations
1948	59	1976	92
1952	69	1980	80
1956	72	1984	140
1960	83	1988	159
1964	93	1992	169
1968	112	1996	197
1972	121	2000	199

Source: www.factmonster.com



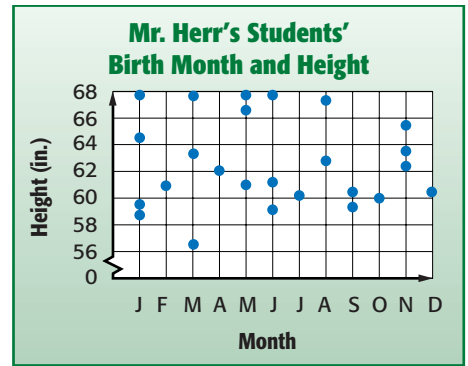
8. Make a line graph of the data.
9. Predict the number of nations that will participate in the 2008 Summer Olympics.

For Exercises 10–12, use the table at the right. It shows the relationship between the speed of a vehicle and the distance required to stop in certain weather conditions.

Speed (mph)	Stopping Distance (ft)
55	273
65	355
75	447

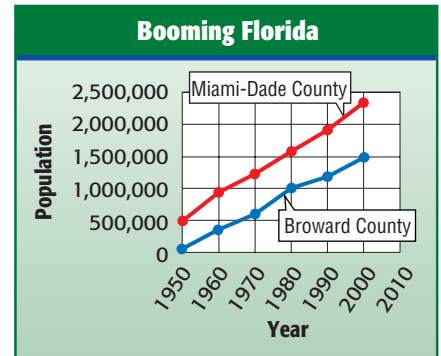
10. Make a scatter plot of the data. Use the speed on the horizontal axis and the stopping distance on the vertical axis.
11. Describe the relationship, if any, between the two sets of data.
12. Predict the stopping distance for a car traveling 45 miles per hour.

13. **CRITICAL THINKING** What can you conclude about the relationship between students' birth month and height shown in the scatter plot at the right?



14. **EXTENDING THE LESSON** The graph at the right is called a *multiple-line graph* because it contains more than one line graph.

The multiple-line graph shows the population of Miami-Dade and Broward Counties in Florida from 1950 to 2000. Do you think that the population of Broward County will catch up to the population of Miami-Dade County in the next census of 2010? Explain.

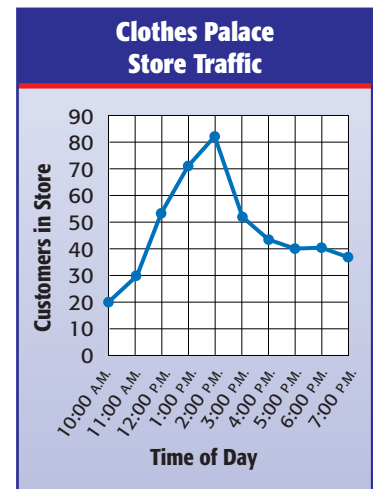


Source: U.S. Census Bureau

## Spiral Review with Standardized Test Practice

For Exercises 15 and 16, refer to the graph at the right that shows the number of customers at Clothes Palace at different times during the day.

15. **MULTIPLE CHOICE** Extra workers are needed when the number of customers in the store exceeds 50. Between which hours is extra help needed?
- Ⓐ 12:00 P.M.–3:00 P.M.      Ⓑ 11:00 A.M.–4:00 P.M.  
 Ⓒ 1:00 P.M.–4:00 P.M.      Ⓓ 1:00 P.M.–3:00 P.M.
16. **SHORT RESPONSE** Predict about how many customers are in the store at 8:00 P.M.
17. **STATISTICS** Choose an appropriate interval and scale for the following set of data: 35, 42, 18, 25, 32, 47, 34. (Lesson 2-1)
18. Write 72,000 in scientific notation. (Lesson 1-9)



Write each product in exponential form. (Lesson 1-2)

19.  $9 \cdot 9$                       20.  $14 \cdot 14 \cdot 14 \cdot 14$       21.  $7 \cdot 7 \cdot 7$                       22.  $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** The following data are the heights of the players, in feet, on the Miami Heat basketball team: 6.8, 7.0, 6.2, 6.7, 6.8, 6.4, 6.7, 6.1, 6.5, 6.2, 6.5, 6.8, 6.8, 7.0, 6.2. (Page 556)

23. Order the heights from least to greatest.



# Line Plots

## What You'll LEARN

Construct and interpret line plots.

## NEW Vocabulary

line plot  
cluster  
outlier  
range

## Link to READING

**Everyday Meaning of Range:** in music, all the notes between the high and low notes, as in a singer with a wide range

**WHEN** am I ever going to use this?

**BUILDINGS** The table shows the number of stories in the 32 tallest buildings in Los Angeles.

1. Do any of the values seem much greater or much less than the other data values?
2. Do some of the buildings have the same number of stories? Is this easy to see? Explain.
3. What better ways can you suggest for organizing these data?

Number of Stories

28	52	44	39
17	44	36	73
32	44	42	53
40	33	33	37
42	62	36	52
34	55	34	28
31	48	41	52
52	54	52	34

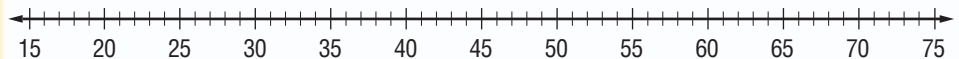
Source: *The World Almanac*

One way to show how data are spread out is to use a line plot. A **line plot** is a diagram that shows the frequency of data on a number line. An "×" is placed above a number on a number line each time that data value occurs.

## EXAMPLE Make a Line Plot

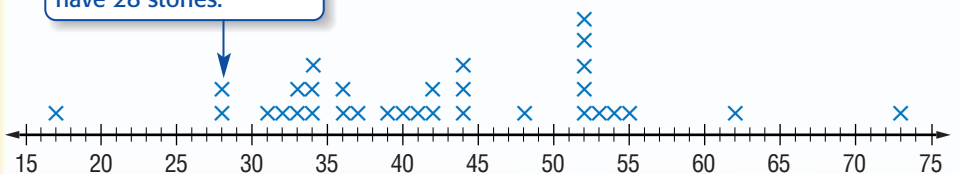
**BUILDINGS** Make a line plot of the data shown above.

**Step 1** Draw a number line. Because the shortest building in the table has 17 stories, and the tallest has 73, you can use a scale of 15 to 75 and an interval of 5. **Other scales and intervals could also be used.**



**Step 2** Put an × above the number that represents the number of stories in each building.

These two ×'s represent the two buildings that have 28 stories.

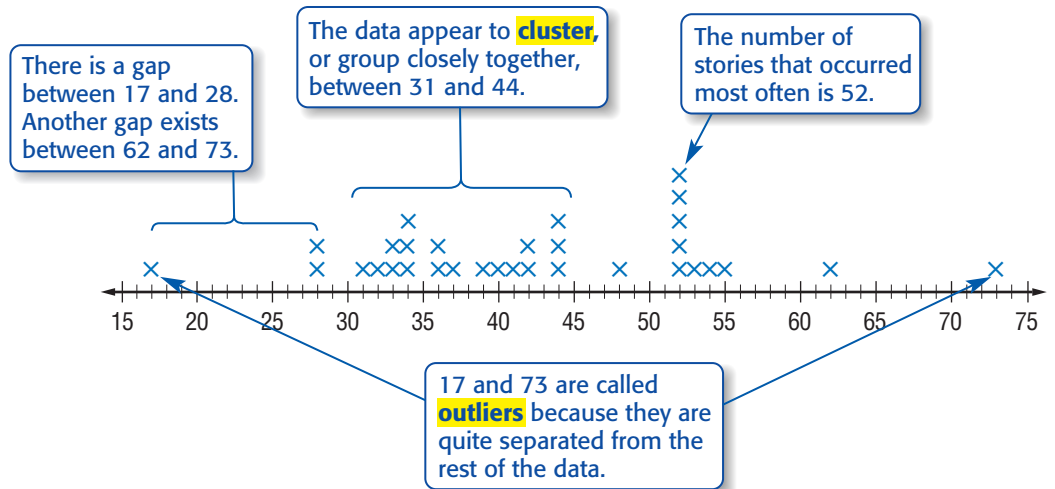


## READING in the Content Area

For strategies in reading this lesson, visit [msmath2.net/reading](http://msmath2.net/reading).

You can see on the line plot how many buildings have the same number of stories. This information is not easily found using the table above.

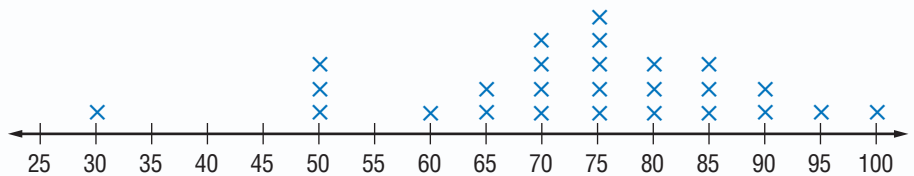
You can make some observations about the *distribution* of data, or how data are grouped together or spread out, using the line plot in Example 1.



In a line plot, you can also easily find the **range** of the data, or the difference between the greatest and least numbers in the data set. This value is helpful in seeing how spread out the data are.

### EXAMPLES Use a Line Plot to Analyze Data

**1 SHOES** The line plot below shows prices for different basketball shoes. What is the range of the data?



The greatest price is \$100, and the lowest price is \$30.

range:  $100 - 30$  or  $70$

The range of the prices is \$70.

#### STUDY TIP

**Clusters** You can describe a cluster by stating a range of values or by giving a single value around which the data appear to be grouped.

**1** Identify any clusters, gaps, and outliers in the data in Example 2 and explain what they mean.

Many of the data cluster around \$75. You could say that most of the shoes cost from \$70 to \$85.

There is a gap from \$30 to \$50, so there were no shoes in this price range.

The number 30 appears removed from the rest of the data, so it could be considered an outlier. This means that \$30 is an extremely low price and not representative of the whole data set.

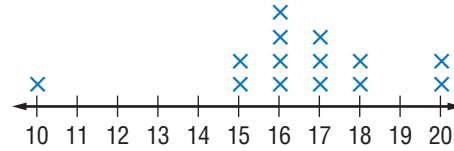
#### Your Turn

a. Identify the range of the data in Example 1.



## Skill and Concept Check

- List the information you can identify from a line plot that is not obvious in an unorganized list of data.
- OPEN ENDED** Draw a line plot that displays fifteen pieces of data. Arrange the data so that there is a cluster and one outlier.
- FIND THE ERROR** Ryan and Darnell are analyzing the data shown in the line plot at the right. Who is correct? Explain.



Ryan  
greatest data value: 16  
least data value: 10

Darnell  
greatest data value: 20  
least data value: 10

- DATA SENSE** Refer to the line plot in Exercise 3. Find the range and identify any clusters, gaps, or outliers.

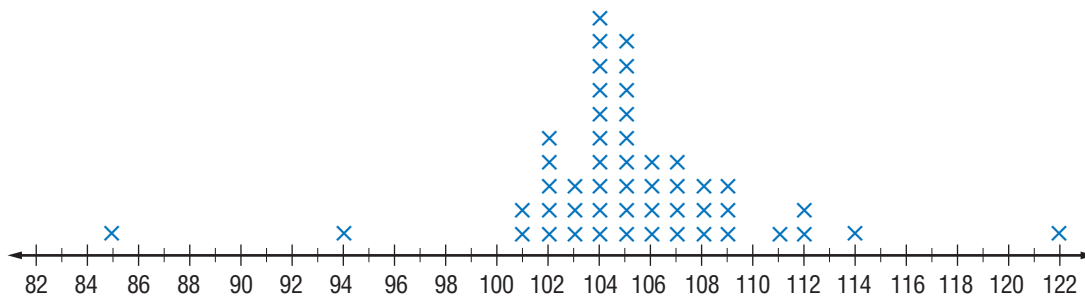
## GUIDED PRACTICE

For Exercises 5–7, use the table at the right. It shows the number of music CDs owned by students in a classroom.

- Make a line plot of the data.
- Identify any clusters, gaps, or outliers.
- Summarize the data in a sentence or two.

Number of Music CDs				
12	9	11	8	12
0	7	10	20	11
6	4	10	10	8
10	9	8	11	6

**WEATHER** For Exercises 8–11, use the line plot below. It shows the record high temperatures recorded by weather stations in each of the fifty states.



Source: *The World Almanac*

- What is the range of the data?
- What temperature occurred most often?
- Identify any clusters, gaps, or outliers and analyze the data by describing what these values represent.
- Describe how the range of the data would change if 122 were not part of the data set.



**Data Update** What are the record high temperatures for some of the cities in your state? Visit [msmath2.net/data\\_update](http://msmath2.net/data_update) to learn more.

## Practice and Applications

### HOMWORK HELP

For Exercises 12–13, 19–22	See Examples 1–3
14–18	2, 3

**Extra Practice**  
See pages 567, 597.

Make a line plot for each set of data. Identify any clusters, gaps, or outliers.

12. **Heights of Desert Cacti (ft)**

30	10	1	15	10
10	10	10	2	10
20	3	2	15	5

Source: ag.arizona.edu/pubs/garden/mg/cacti

13. **Test Scores**

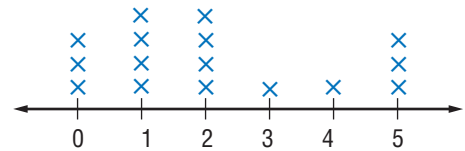
98	90	97	85	86	92
92	93	95	79	91	92
91	94	88	90	93	92

Determine whether each statement is *sometimes*, *always*, or *never* true. Explain.

- You can determine the number of items in a data set from a line plot.
- If there is a cluster, it will appear in the center of the line plot.

**SURVEY** For Exercises 16–18, use the line plot at the right and the information below.

Jamie asked her classmates how many cans of soda they drink on a typical day. The results are shown on the line plot.



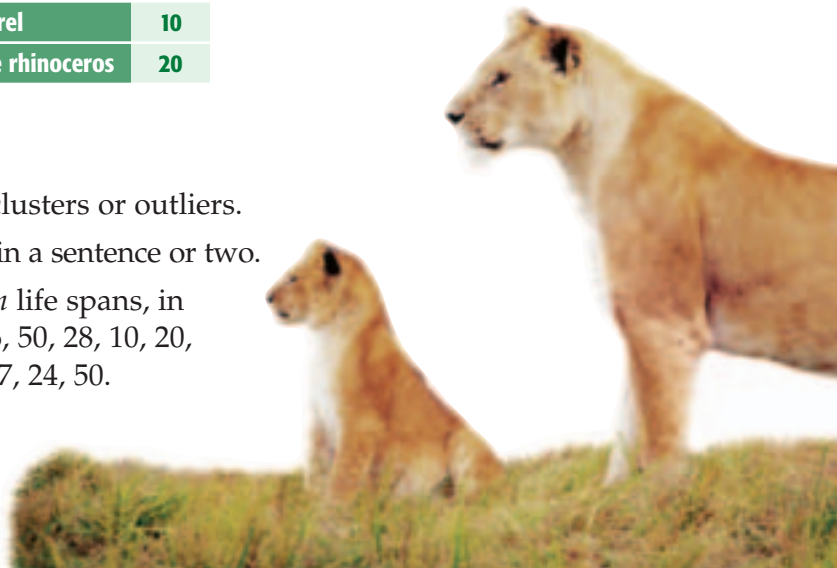
- What was the most frequent response?
- What is the range?
- Summarize the data in a sentence or two.

**ANIMALS** For Exercises 19–22, use the table below.

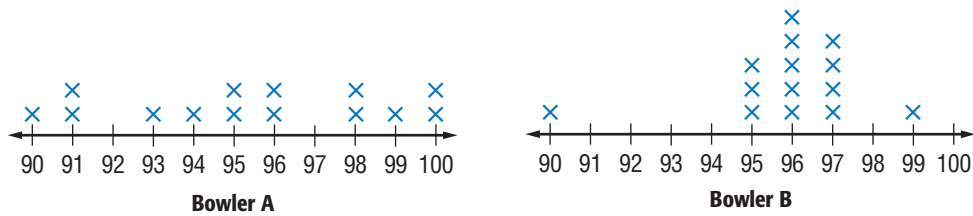
Average Life Spans					
Animal	Span (yr)	Animal	Span (yr)	Animal	Span (yr)
black bear	18	giraffe	10	lion	15
camel	12	gorilla	20	pig	10
cat	12	grizzly bear	25	polar bear	20
chipmunk	6	horse	20	rhesus monkey	15
dog	12	kangaroo	7	squirrel	10
elephant	40	leopard	12	white rhinoceros	20

Source: *The World Almanac for Kids*

- Make a line plot of the data.
- Find the range and determine any clusters or outliers.
- Summarize the data on the line plot in a sentence or two.
- The following data are the *maximum* life spans, in order, of the animals in the table: 36, 50, 28, 10, 20, 77, 36, 54, 50, 50, 24, 23, 30, 27, 45, 37, 24, 50. Make a line plot of the data and compare it to the line plot you made in Exercise 19. Include a discussion about clusters, outliers, range, and gaps in data.



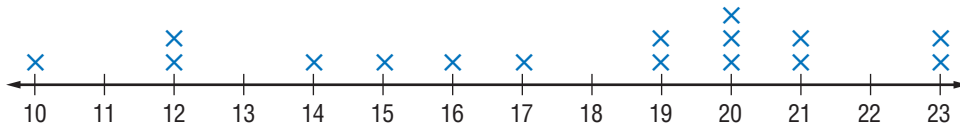
23. **DATA SENSE** The last fourteen bowling scores of two people are shown on the line plots below. Describe which person is more consistent and explain how you know.



24. **CRITICAL THINKING** Compare and contrast line plots and frequency tables. Include a discussion about what they show and when it is better to use each one.

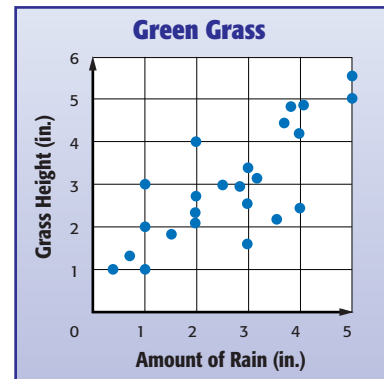
## Spiral Review with Standardized Test Practice

For Exercises 25 and 26, refer to the line plot shown below.



25. **MULTIPLE CHOICE** Which of the following describes a cluster of data?
- (A) 20–23      (B) 14–17      (C) 12–14      (D) 19–21
26. **MULTIPLE CHOICE** Determine which sentence is *not* true.
- (F) The number that occurs most often is 20.  
 (G) There are 23 numbers in the data set.  
 (H) The majority of the data is greater than 18.  
 (I) The range is 13.

27. **RAIN** The scatter plot shows the height of grass on several lawns and the amount of rain that has fallen on each lawn. Write a conclusion based on the graph. (Lesson 2-2)



28. *True or False?* A frequency table is a good way to organize large amounts of data. (Lesson 2-1)

Solve each equation mentally. (Lesson 1-5)

29.  $\frac{t}{5} = 15$       30.  $m + 18 = 33$   
 31.  $25 = a - 4$       32.  $12x = 120$

### GETTING READY FOR THE NEXT LESSON

**BASIC SKILL** Add or divide. Round to the nearest tenth if necessary.

33.  $16 + 14 + 17$       34.  $32 + 34 + 36$       35.  $4.6 + 2.5 + 9$       36.  $77 + 71 + 74$   
 37.  $\frac{202}{16}$       38.  $\frac{56}{3}$       39.  $\frac{255}{7}$       40.  $\frac{155.3}{30}$

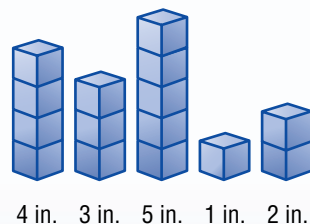
# 2-4

# Mean, Median, and Mode

## HANDS-ON Mini Lab

**Materials**

- centimeter cubes



### What You'll LEARN

Find the mean, median, and mode of a set of data.

### NEW Vocabulary

measures of central tendency  
mean  
median  
mode

### Link to READING

**Everyday Meaning of Median:** the middle paved or planted section of a highway, as in median strip

*Work with a partner.*

In five days, it snowed 4 inches, 3 inches, 5 inches, 1 inch, and 2 inches.

- Make a stack of cubes to represent the snowfall for each day, as shown at the right.
- Move the cubes from stack to stack until each stack has the same number of cubes.

- How many cubes are in each stack?
- In the past five days, it snowed an average of    ? inches per day.
- Suppose on the sixth day it snowed 9 inches. If you moved the cubes again, how many cubes would be in each stack?

If you had to choose one number to represent the data set 1, 2, 3, 4, 5, a good choice would be the middle number, 3. When analyzing data, it is often helpful to use a single number to describe the whole set.

Numbers called **measures of central tendency** can be used to describe the *center* of data. The most common of these measures are mean, median, and mode.

## Noteables

### Key Concept: Mean

**Words** The **mean** of a set of data is the sum of the data divided by the number of items in the data set.

**Example** data set: 1, 1, 5, 2, 2, 4, 2, 5  
mean:  $\frac{1 + 1 + 5 + 2 + 2 + 4 + 2 + 5}{8}$  or 2.75

### EXAMPLE Find the Mean

**1 NUTRITION** The table shows the grams of sugar in twenty different breakfast bars. Find the mean.

$$\begin{aligned} \text{mean} &= \frac{14 + 11 + \dots + 12}{20} \quad \leftarrow \text{sum of data} \\ &\quad \leftarrow \text{number of data items} \\ &= \frac{253}{20} \text{ or } 12.65 \end{aligned}$$

Grams of Sugar in Breakfast Bars				
14	11	7	14	15
22	18	18	21	10
10	10	11	9	11
11	9	12	8	12

Source: www.cspinet.org

The mean amount of sugar for the breakfast bars is 12.65 grams.



**Words** The **median** of a set of data is the middle number of the ordered data, or the mean of the middle two numbers.

**Example** data set: 7, 11, 15, 17, 20, 20  
 median:  $\frac{15 + 17}{2}$  or 16 The median divides the data in half.

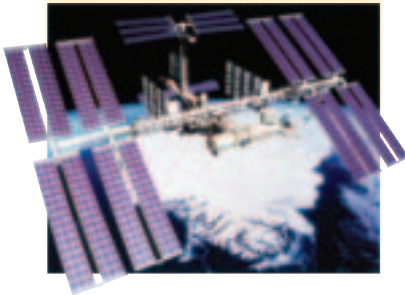
**Words** The **mode** or modes of a set of data is the number or numbers that occur most often.

**Example** data set: 50, 45, 45, 52, 49, 56, 56  
 modes: 45 and 56

REAL-LIFE MATH

**SPACE** The International Space Station measures 356 feet by 290 feet, and contains almost an acre of solar panels.

Source: *The World Almanac*



EXAMPLE Find the Mean, Median, and Mode

**1** **SPACE** Twenty-seven countries have sent people into space. The table shows the number of individuals from each country. Find the mean, median, and mode of the data.

People in Space								
267	1	9	8	1	1	1	1	1
97	1	1	1	3	1	1	2	1
11	2	1	1	5	1	1	1	1

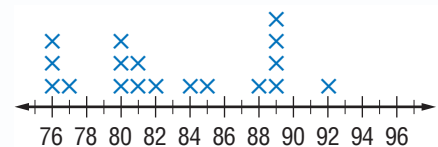
Source: *The World Almanac*

mean: sum of data divided by 27, or 15.6  
 median: 14th number of the ordered data, or 1  
 mode: number appearing most often, or 1

The mean of the data in Example 2 does not accurately describe the data set because it is greater than most of the data items. This happens when one or more of the data is an outlier.

EXAMPLE Analyze Data

**1** **TESTS** The line plot shows the test scores of the students in Mrs. Hiroshi's math class. Would the mean, median, or mode best represent the test scores?



mean:  $\frac{76 + 76 + 76 + \dots + 92}{18}$  or 83  
 median:  $\frac{9\text{th term} + 10\text{th term}}{2} = \frac{81 + 82}{2}$  or 81.5  
 mode: 89

The mode of 89 misrepresents the scores as being higher than they really were. Either the mean of 83 or the median of 81.5 could be used to represent the scores.

STUDY TIP

**Median** When there is an odd number of data, the median is the middle number of the ordered set. When there is an even number of data, the median is the mean of the two middle numbers.

You can find measures of central tendency from charts, tables, graphs, and line plots. Below are some general guidelines for using these measures.

Concept Summary		Mean, Median, and Mode
Measure	Most Useful When . . .	
Mean	• data set has no outliers	
Median	• data set has outliers • there are no big gaps in the middle of the data	
Mode	• data set has many identical numbers	

### Skill and Concept Check

- Writing Math** Determine whether the median is *sometimes*, *always*, or *never* part of the data set. Explain.
- OPEN ENDED** Write a problem in which the mean is not the best representation of the data set. Explain why not.
- FIND THE ERROR** Jared and Marissa are analyzing the data in the frequency table at the right. Who is correct? Explain.

Time (min)	Tally	Frequency
1		5
2	I	6
3	IIII	9
4		1

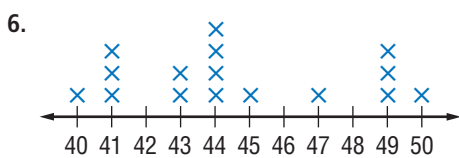
Jared  
median: 2 min  
mode: 3 min

Marissa  
median: 2.5 min  
mode: 9 min

### GUIDED PRACTICE

Find the mean, median, and mode for each set of data. Round to the nearest tenth if necessary.

- 14, 5, 16, 7, 4, 15, 9, 7, 2, 14, 6
- 29, 14, 80, 59, 78, 30, 59, 69, 55, 50



7.

Number of Wins	Tally	Frequency
7	II	12
8	IIII	4
9	II	2
10	II	7

**SCHOOL** For Exercises 8 and 9, use the line plot. It shows the number of times per day that students drink from the water fountain at school.

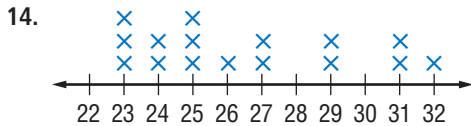
- Find the mean, median, and mode.
- Which measure best describes the data? Explain.



## Practice and Applications

Find the mean, median, and mode for each set of data. Round to the nearest tenth if necessary.

- 65, 56, 57, 75, 76, 66, 64
- 9.3, 8.4, 8.0, 9.1, 9.4, 9.0, 7.8, 9.3, 8.0
- 95, 90, 92, 94, 91, 90, 98, 88, 89, 100
- \$10, \$18, \$11, \$6, \$6, \$5, \$10, \$11, \$46, \$7, \$6, \$8



15.

Price	Tally	Frequency
\$7.50	III	8
\$8.00		3
\$8.50	I	6

### HOMEWORK HELP

For Exercises	See Examples
10–16	1, 2
17, 18	3

**Extra Practice**  
See pages 568, 597.

**MUSIC** For Exercises 16 and 17, use the data at the right. It shows the number of weeks that songs have been on the *Top 20 Hot Country Singles & Tracks* chart.

- Find the mean, median, and mode of the data.
- Determine which measure best represents the data. Explain.

Number of Weeks in Top 20				
8	15	14	24	21
28	12	20	19	18
12	7	11	30	25
15	21	22	18	31

Source: www.billboard.com



**Data Update** What is the mean, median, and mode of the number of weeks of the current songs that are on the *Top 20 Hot Country Singles & Tracks* chart? Visit [msmath2.net/data\\_update](http://msmath2.net/data_update) to learn more.

- DATA SENSE** According to the U.S. Census Bureau, the average number of family members per household in Texas is 3.28. State whether this average is a mean or mode. Explain how you know.
- CRITICAL THINKING** Without calculating, would the mean, median, or mode be most affected by eliminating 1,000 from the list below? Which would be the least affected? Explain.  
50, 100, 75, 60, 75, 1,000, 90, 100

## Spiral Review with Standardized Test Practice

- MULTIPLE CHOICE** Which measure describes the center of a set of data?  
 A mean     B median     C mode     D all of the above
- GRID IN** The Cardinals baseball team played 8 games and scored a total of 96 runs. What was the mean number of runs scored per game?
- NUTRITION** The grams of fiber in one serving of fifteen different cereals are 5, 5, 4, 3, 3, 3, 1, 1, 1, 2, 1, 1, 1, 1, and 0. Make a line plot of the data. (Lesson 2-3)
- What type of graph often shows trends over time? (Lesson 2-2)

### GETTING READY FOR THE NEXT LESSON

**BASIC SKILL** Name the place value of the highlighted digit.

- 581
- 6,295
- 4,369
- 284



**What You'll LEARN**

Use mean, median, mode, and range to describe a set of data.

**Materials**

- markers
- ruler

**Are You Average?**

**INVESTIGATE** Work in groups of four.

What do you think of when you hear the word “average”? How would you describe an “average” student in your school? In this lab, you will investigate what an average student in your math class is like.



**STEP 1** Your group will create a survey of ten appropriate questions to ask your classmates that will help you describe the “average” student in your class. For example:

- What is your height in inches?
- How many hours per week do you spend doing homework?
- What is your favorite subject in school?
- What is your favorite extracurricular activity?

**STEP 2** After your teacher approves your list of questions, have your classmates complete your survey.

**STEP 3** Compile the data in a frequency table. Find the mean, median, mode, and range of the data for each question if appropriate. Which measure best describes each set of data? Justify your answer.

**STEP 4** Create appropriate graphs to display your data from all ten questions. Each group will present their graphs with a description of what the “average” student in your classroom is like.

**Writing Math**

1. **Explain** why results may vary if you survey another class in your school.
2. **Explain** why your group selected the graph that you did to display your data. Could you have used another type of graph? Explain.
3. The word *bias* means to influence. **Describe** any factors that could have unfairly influenced the responses given by your classmates. Is there a way to limit bias in a survey?

# Mid-Chapter Practice Test

## Vocabulary and Concepts

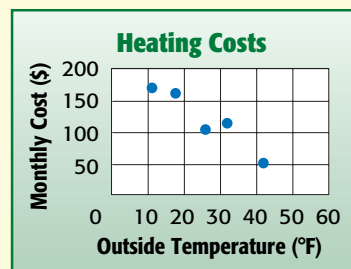
1. **Explain** what a frequency table shows. (Lesson 2-1)
2. **Describe** a situation in which a line graph would be useful. (Lesson 2-2)
3. **List** the information that you can identify from a line plot that is not obvious in an unorganized list of data. (Lesson 2-3)
4. **Define** *mean*. (Lesson 2-4)

## Skills and Applications

For Exercises 5–10, use the data below that shows the ages of twenty people when they got their driver's licenses. (Lessons 2-1, 2-3, and 2-4)

16 17 16 16 18 21 16 16 18 18 17 25 16 17 17 17 17 16 20 16

5. Make a frequency table of the data.
6. Make a line plot of the data.
7. Identify any clusters or gaps.
8. Identify any outliers.
9. Find the mean, median, and mode.
10. What is the range of the data?
11. **HEATING** Use the scatter plot to make a conclusion about the average monthly outside temperature and heating costs of a home. (Lesson 2-2)



Find the mean, median, and mode for each set of data. (Lesson 2-4)

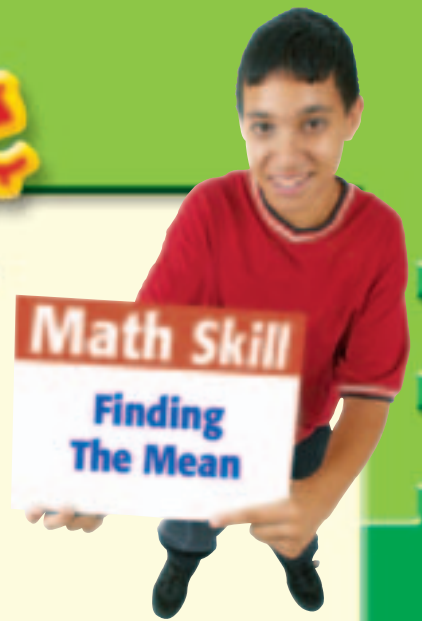
12. 27, 32, 18, 24, 32, 39, 41
13. 7.6, 6.8, 6.5, 7, 7.9, 6.8, 7, 7, 6.8, 8.1

## Standardized Test Practice

14. **GRID IN** Below are the quiz scores of a science class.  
89 92 67 75 95 89 82 92 89  
89 92 96 85 94 90 79 94 87  
What is the median quiz score?  
(Lesson 2-4)
15. **MULTIPLE CHOICE** Which may *not* show individual pieces of data?  
(Lessons 2-1, 2-2, and 2-3)
  - (A) scatter plot
  - (B) frequency table
  - (C) line plot
  - (D) an ordered list

# The Game Zone

A Place To Practice Your Math Skills



## Can You Guess?

### ● GET READY!

**Players:** the entire class divided into three-person teams

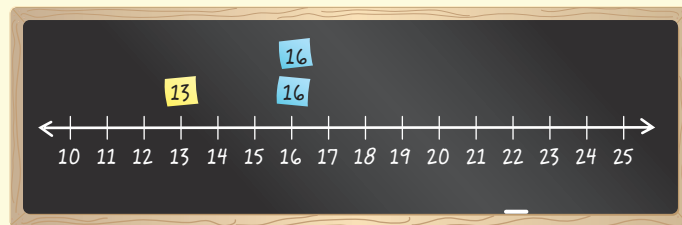
**Materials:** cup, coins, water dropper, self-adhesive notes

### ● GET SET!

- Draw a number line on the chalkboard with a scale from 10 to 25.
- Each team should fill a cup with water.

### ● GO!

- Use the water dropper and find how many drops of water your team can get to stay on the head of a dime. Write the results on a sticky note. Post it on the chalkboard above the corresponding number on the number line. Find the mean of the numbers.



- Next, use the mean to predict how many drops of water will fit on the head of a penny. Record your team's prediction on a piece of paper.
- Find how many drops of water will stay on the head of a penny. Record the result on a sticky note and post it on the chalkboard. Find the mean of all of the results for the pennies. If your prediction is within three drops of the mean, your team gets to stay in the game.
- Continue predicting and testing using a nickel and a quarter.
- **Who Wins?** The teams left at the end of the game are the winners.

## Stem-and-Leaf Plots

**WHEN** am I ever going to use this?

### What You'll LEARN

Construct and interpret stem-and-leaf plots.

### NEW Vocabulary

stem-and-leaf plot  
leaf  
stem

**HISTORY** Benjamin Franklin was the oldest signer of the Declaration of Independence. The table shows the ages in years of all the people who signed the Declaration of Independence.

1. What was the age of the youngest signer?
2. What methods do you already have for showing the distribution of ages?

Ages of Signers of Declaration of Independence						
40	70	69	34	46	53	31
38	50	30	45	46	39	38
35	50	37	48	41	41	52
39	50	65	46	29	34	45
33	41	44	63	60	26	42
42	52	37	35	45	35	42
47	26	55	57	45	33	60
62	35	33	53	49	50	46

Source: *The World Almanac*

A useful way to organize data as you collect it is a stem-and-leaf plot. In a **stem-and-leaf plot**, the data are organized from least to greatest. The digits of the least place value usually form the **leaves**, and the next place value digits form the **stems**.

### EXAMPLE Construct a Stem-and-Leaf Plot

**HISTORY** Make a stem-and-leaf plot of the data above.

**Step 1** The digits in the least place value will form the leaves and the remaining digits will form the stems. In this data, 26 is the least value, and 70 is the greatest. So, the ones digits will form the leaves and the tens digits will form the stems.

**Step 2** List the stems 2 to 7 in order from least to greatest in the *Stem* column. Write the leaves, the ones digits of the ages, to the right of the corresponding stems. The ages in the first column of the chart are shown at the right.

Stem	Leaf
2	
3	8 5 9 3
4	0 2 7
5	
6	2
7	

**Step 3** Order the leaves and write a *key* that explains how to read the stems and leaves.

Stem	Leaf
2	6 6 9
3	0 1 3 3 3 4 4 5 5 5 5 7 7 8 8 9 9
4	0 1 1 1 2 2 2 4 5 5 5 5 6 6 6 6 7 8 9
5	0 0 0 0 2 2 3 3 5 7
6	0 0 2 3 5 9
7	0

The tens digits of the data form the stems.

A key shows how the digits are related.

$$3 | 1 = 31 \text{ yr}$$

The ones digits of the data form the leaves.

Stem-and-leaf plots are useful in analyzing data because you can see all the data values, including the greatest, least, mode, and median value.

### EXAMPLE Analyze Data

**PETS** The stem-and-leaf plot shows the average chick weight in grams of sixteen different species of pet birds. Find the range, median, and mode of the data.

Stem	Leaf
0	5 6 7
1	0 0 1 1 2 2 2 3 8 9
2	0 1 1 5    1   2 = 12 g

Source: www.upatsix.com

range: greatest weight – least weight = 25 – 5 or 20 grams

median: middle value, or 12 grams

mode: most frequent value, or 12 grams

Stem-and-leaf plots are also useful for making conclusions about data. Most of the data in the plot above are clustered in the 10–19 interval. So, you could say that most of those birds weigh 10 to 19 grams as chicks.

### EXAMPLE Make Conclusions About Data

**NUTRITION** The table shows the average amounts of pasta that people in different countries consume each year. Make a stem-and-leaf plot of the data. Then use it to describe how the data are spread out.

Country	Pasta per Person (lb)	Country	Pasta per Person (lb)
Argentina	15	Netherlands	9
Australia	5	Portugal	15
Canada	14	Russia	15
Egypt	15	Spain	9
France	15	Sweden	8
Germany	10	Switzerland	20
Greece	19	Turkey	11
Italy	59	United Kingdom	4
Japan	3	United States	20
Mexico	8	Venezuela	28

Source: National Pasta & National Restaurant Associations

The least value is 3, and the greatest value is 59. So, the tens digits form the stems, and the ones digits form the leaves.

The data that do not have a digit in the tens place have 0 for a stem.

Stem	Leaf
0	3 4 5 8 8 9 9
1	0 1 4 5 5 5 5 9
2	0 0 8
3	
4	
5	9      2   8 = 28 lb

It is easy to see in the stem-and-leaf plot that people in most of the countries consume less than 20 pounds of pasta per year. You can also see that the mode is 15 and that 59 is an outlier, with a significant gap between that value and the next smaller value.

### REAL-LIFE CAREERS

#### How Does a Nutritionist Use Math?

Nutritionists use statistical graphs to summarize and compare the nutritional values of various foods.



#### Research

For information about a career as a nutritionist, visit: [msmath2.net/careers](http://msmath2.net/careers)



## Skill and Concept Check

- Writing Math** Compare and contrast a stem-and-leaf plot and a frequency table.
- OPEN ENDED** Make a stem-and-leaf plot in which the median of the data is 25.
- Write** the stems that would be used in a stem-and-leaf plot for the following set of data: 21, 8, 12, 7, 18, 9, 22, 31, 1, 14, 19, 11, 2.
- FIND THE ERROR** Selena and Lauren are analyzing the stem-and-leaf plot at the right. Who is correct? Explain.

Selena  
None of the data have  
3 in the tens place.

Lauren  
Thirty is one of the  
data values.

Stem	Leaf
2	6 6 9
3	
4	6
5	3 6 2   6 = 26 in.

## GUIDED PRACTICE

Make a stem-and-leaf plot for each set of data.

- 42, 47, 19, 16, 21, 23, 25, 25, 29, 31, 33, 34, 35, 39, 48
- 225, 227, 230, 229, 246, 243, 269, 269, 267, 278, 278, 278

**CHES** For Exercises 7–10, use the stem-and-leaf plot at the right. It shows the number of matches won by each member of the Avery Middle School Chess Team.

- How many members are on the chess team?
- What is the range of the number of matches won?
- Find the mean, median, and mode for these data.
- Describe how the data are spread out.

Stem	Leaf
0	8 8 9
1	9
2	0 0 2 4 4 8 9
3	1 1 2 4 5 5 6 6 7 7 8
4	0 0 0 3 8 9
5	2 4
6	1 3   2 = 32 wins

## Practice and Applications

Make a stem-and-leaf plot for each set of data.

- 15, 13, 28, 32, 38, 30, 31, 13, 36, 35, 38, 32, 38, 24
- 56, 70, 96, 62, 80, 80, 69, 93, 66, 55, 95, 63, 90, 93, 60, 91, 67, 60
- 451, 458, 439, 403, 411, 434, 433, 454, 457, 442, 449, 459, 454
- 8.2, 9.3, 10, 9.9, 8, 9.2, 8.7, 8, 8.2, 9, 9.9, 8.7, 8.5, 8.1, 8.8, 9.3

**SHOPPING** For Exercises 15–18, use the stem-and-leaf plot at the right. It shows the prices of portable CD players found on an Internet shopping site.

- How many CD players are represented on the stem-and-leaf plot?
- What is the range of the prices?
- Find the median and mode for these data.
- Write a sentence or two to describe how the prices of the portable CD players are spread out.

Stem	Leaf
7	0
8	2 5 5
9	9 9
10	0 0 2 5 6 8
11	0 0 5 5 5 9 9
12	5 7 7
13	
14	
15	0 0 0 5 11   5 = \$115

### HOMEWORK HELP

For Exercises	See Examples
11–14, 19	1
15–17, 20	2
18, 21	3

**Extra Practice**  
See pages 568, 597.

**BASKETBALL** For Exercises 19–21, use the table at the right. It shows the points scored in each post-season tournament game by the Indiana Hoosiers men’s basketball teams from 1990 to 2003.

Points Scored in Post-Season Games					
63	79	82	65	94	52
106	78	97	73	82	67
67	68	60	51	62	52
85	84	68	61	89	
108	77	94	57	73	
75	76	74	81	73	

Source: www.iuhoosiers.com



- Make a stem-and leaf-plot of the data.
  - Find the mean, median, mode, and range of the data.
  - Write a sentence or two to describe how the points shown in the stem-and-leaf plot are spread out.
22. **RESEARCH** Use the Internet or another source to find an interesting set of data that can be displayed using a stem-and-leaf plot. Then make a stem-and-leaf plot of the data.
23. **CRITICAL THINKING** Make a frequency table, a line plot, and a stem-and-leaf plot of the data at the right. Describe the similarities and differences among the representations and state which of the three you prefer to make and use. Explain your reasoning.

Price of Jeans (\$)			
40	45	38	30
35	32	33	24
26	36	56	36
26	38	49	34
28	40	40	35

## Spiral Review with Standardized Test Practice

24. **MULTIPLE CHOICE** The table shows how many minutes the students in Mr. Davis’ class spent doing their homework one evening. Choose the correct stems for a stem-and-leaf plot of the data.

Homework Time (min)				
42	5	75	30	55
45	47	0	24	75
45	51	56	23	45
39	30	49	58	35

- Ⓐ 1, 2, 3, 4, 5, 6, 7                      Ⓑ 0, 1, 2, 3, 4, 5, 6, 7  
 Ⓒ 0, 2, 3, 4, 5, 7                        Ⓓ 2, 3, 4, 5, 6, 7

25. **GRID IN** Determine the mode of the data shown in the stem-and-leaf plot at the right.

Stem	Leaf
7	2 3 5 5
8	0 0 0 1 2
9	6 7 7 7 7 7   2 = 72

Find the mean, median, and mode for each set of data. (Lesson 2-4)

- 80, 23, 55, 58, 45, 32, 40, 55, 50
- 3.6, 2.4, 3.0, 7.9, 7.8, 2.4, 3.6, 3.9
- Make a line plot of the following test scores. (Lesson 2-3)  
 83, 94, 78, 78, 85, 86, 88, 83, 82, 92, 90, 77, 83,  
 81, 89, 90, 88, 87, 88, 85, 84, 81, 83, 85, 91

Evaluate each expression. (Lesson 1-3)

29.  $18 + 9 \div 3$                       30.  $24 \div (6 + 2)$                       31.  $3(7 - 3) + 1$                       32.  $(3 + 5) \div 4 - 2$

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** Order each set of decimals from least to greatest. (Page 556)

- 6, 8.4, 8, 7.9
- 4.0, 2.3, 4.5, 3.0, 3.8
- 0.14, 0.33, 0.7, 0.09
- 5.01, 5.8, 4.99, 5.64, 4.25



# Box-and-Whisker Plots



**WHEN** am I ever going to use this?

## What You'll LEARN

Construct and interpret box-and-whisker plots.

## NEW Vocabulary

lower quartile  
upper quartile  
box-and-whisker plot  
lower extreme  
upper extreme  
interquartile range

## REVIEW Vocabulary

**outlier:** a number separated from the rest of the data (Lesson 2-3)

**NUTRITION** The Calories per serving of items from the meat, poultry, and fish food group are shown in the table.

1. What is the median of the data?
2. Into how many parts does the median divide the data?

Nutrition Facts			
Item	Calories	Item	Calories
bacon	110	ham	205
beef steak	240	pork chop	275
bologna	180	roast beef	135
crabmeat	135	salmon	120
fish sticks	70	sardines	175
fried shrimp	200	trout	175
ground beef	245	tuna	165

Source: *The World Almanac*

A median divides a data set into two parts. To divide the data into four parts, find the median of the lower half, called the **lower quartile (LQ)**, and the median of the upper half, called the **upper quartile (UQ)**. A **box-and-whisker plot** is a diagram that summarizes data by dividing it into four parts.

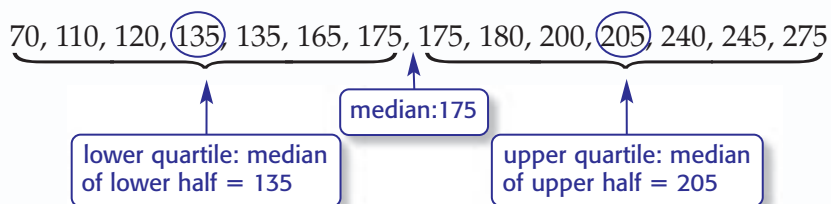
## EXAMPLE

### Construct a Box-and-Whisker Plot

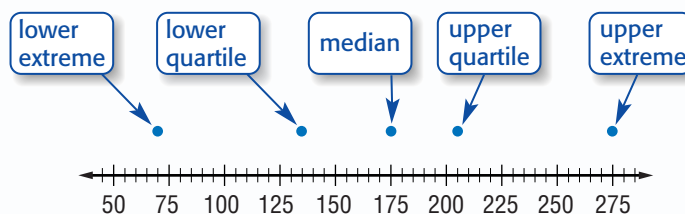
**NUTRITION** Make a box-and-whisker plot of the data in the table above.

**Step 1** Order the data from least to greatest.

**Step 2** Find the median and the quartiles.



**Step 3** Draw a number line. The scale should include the median, the quartiles, and the least and greatest values, which are called the **lower extreme** and the **upper extreme**, respectively. Graph the values as points above the line.

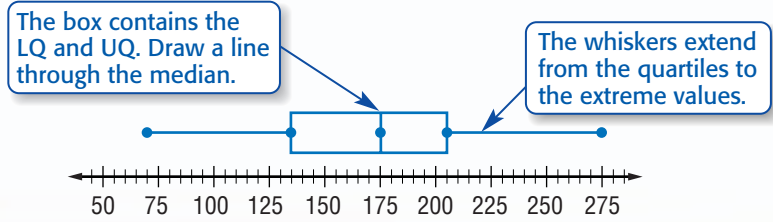


## STUDY TIP

**Length of Parts** The parts of a box-and-whisker plot are different lengths because of how the data are clustered or spread out.

- short part: data are clustered together
- long part: data are spread out

**Step 4** Draw the box and whiskers.



Each of the four parts of a box-and-whisker plot contain one fourth of the data.

## EXAMPLE Analyze Data

**1 ARCHITECTURE** The table shows the heights of the ten tallest buildings in St. Louis, Missouri. Make a box-and-whisker plot of the data. Then use it to describe how the data are spread out.

Find the median, the quartiles, and the extremes. Then construct the plot.

$$\text{median} = \frac{485 + 420}{2} \text{ or } 452.5$$

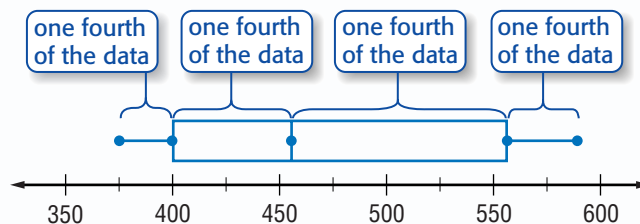
$$\text{LQ} = 398 \quad \text{UQ} = 557$$

$$\text{lower extreme} = 375$$

$$\text{upper extreme} = 593$$

Building	Height (ft)
Metropolitan Square Tower	593
One Bell Center	588
Thomas F. Eagleton Federal Courthouse	557
Mercantile Center Tower	540
Firststar Center	485
Boatmen's Plaza	420
Laclede Gas Building	400
SW Bell Telephone Building	398
Civil Courts Building	390
One City Center	375

Source: *The World Almanac*



The graph shows that half of the tallest buildings are between 398 and 557 feet high. The largest range of the four quartiles is from 452.5 to 557 feet. One-fourth of the tallest buildings are within these heights.

## READING Math

**Quartiles** A *quartile* can also refer to any of the four parts of a box-and-whisker plot. So, each quartile contains one-fourth, or 25%, of the data.

Another way to describe how data are spread out is to use the **interquartile range**, or the difference between the upper quartile and the lower quartile.

In Lesson 2-3, you learned that outliers are values separated from the rest of the data. In a box-and-whisker plot, outliers are data that are more than 1.5 times the interquartile range from the quartiles. They are not included in the whiskers of a box-and-whisker plot.



## REAL-LIFE MATH

**PRESIDENTS** The state where the greatest number of presidents was born is Virginia, with 8 presidents.

Source: www.learningnetwork.com



George Washington



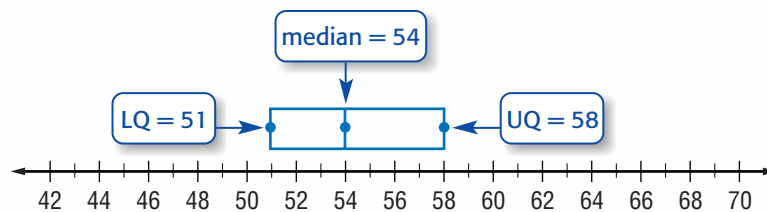
Woodrow Wilson

## EXAMPLE Identify and Plot Outliers

**PRESIDENTS** The table shows the ages of the last 21 presidents when they first took office. Make a box-and-whisker plot of the data.

Ages of Presidents						
47	55	54	42	51	56	55
51	54	51	60	62	43	55
56	61	52	69	64	46	54

Find the median and the quartiles. Plot the points and draw a box.



Next, determine whether there are any outliers.

interquartile range:  $UQ - LQ = 58 - 51$  or 7

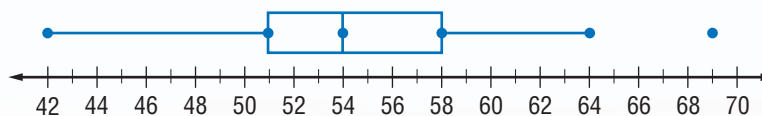
So, outliers are data more than  $1.5(7)$  or 10.5 from the quartile.

lower limit:  $LQ - 10.5 = 51 - 10.5$  or 40.5

upper limit:  $UQ + 10.5 = 58 + 10.5$  or 68.5

40.5 and 68.5 are limits for the outliers.

Any data point that is less than 40.5 or greater than 68.5 is an outlier. So, 69 is an outlier. Plot the outlier using a dot. Then draw the lower whisker to the lower extreme, 42, and the upper whisker to the greatest value that is not an outlier, 64.



## Skill and Concept Check

- Writing Math** Describe advantages of using a stem-and-leaf plot and advantages of using a box-and-whisker plot to display data.
- OPEN ENDED** Draw a box-and-whisker plot in which the data between the lower quartile and the median are clustered and the data between the median and the upper quartile are spread out.

## GUIDED PRACTICE

For Exercises 3–6, refer to the data at the right. It gives the number of Calories in common snacks you can buy at the movies.

- Find the lower extreme, LQ, median, UQ, and upper extreme.
- Are there any outliers? If so, identify them.
- Draw a box-and-whisker plot of the data.
- What is the largest range of the four quartiles? Explain what this means.

Movie Snack Calories		
380	286	588
350	1,221	901
492	360	500
363	270	

## Practice and Applications

**SPORTS** For Exercises 7–9, refer to the table at the right. It shows the regular season games won by each men’s professional basketball team in a recent season.

Number of Wins					
25	36	46	15	30	53
40	32	17	45	41	31
56	50	52	47	26	48
43	56	51	50	55	58
44	47	53	23	19	

- Find the lower extreme, LQ, median, UQ, and upper extreme.
- Draw a box-and-whisker plot of the data.
- What fraction of the data are between 45 and 51.5?

### HOMWORK HELP

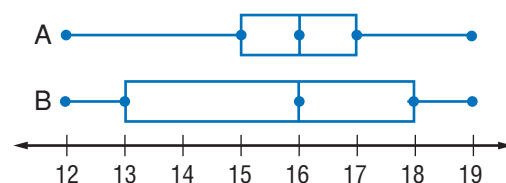
For Exercises	See Examples
7, 8, 12	1
9, 13	2
10, 11	3

**Extra Practice**  
See pages 568, 597.

**BRIDGES** For Exercises 10–13, refer to table at the right. It shows the lengths of 22 of the longest suspension bridges in North America.

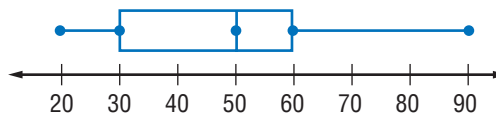
Length of Bridges (ft)			
4,260	2,310	1,800	1,595
4,200	2,300	1,750	1,550
3,800	2,190	1,632	1,500
3,500	2,150	1,600	1,500
2,800	2,000	1,600	
2,800	1,850	1,600	

- Determine the interquartile range.
- What are the limits on outliers? Are there any outliers?
- Draw a box-and-whisker plot of the data.
- What fraction of the bridges are between 1,600 and 2,800 feet long?
- Compare and contrast the data represented in the box-and-whisker plots at the right.
- CRITICAL THINKING** Describe a set of data in which there is only one whisker in its box-and-whisker plot.



## Spiral Review with Standardized Test Practice

- MULTIPLE CHOICE** What is the lower quartile of the data in the box-and-whisker plot at the right?



- Ⓐ 60      Ⓑ 50      Ⓒ 30      Ⓓ 20

- GRID IN** Find the interquartile range of the following set of data.  
25, 36, 46, 15, 30, 53, 40, 32, 17, 45, 41, 31, 56, 50, 52, 47, 26

**RAINFALL** For Exercises 18 and 19, refer to the table at the right.

- Make a stem-and-leaf plot of these data. (Lesson 2-5)
- Find the mean, median, and mode. Round to the nearest tenth if necessary. (Lesson 2-4)

Days of Rain per Year		
17	26	29
30	32	37
42	36	35

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** Choose an appropriate interval and scale to make a frequency table for each set of data. (Lesson 2-1)

- 9, 0, 18, 19, 2, 9, 8, 13, 4
- 30, 20, 60, 80, 90, 110, 40



# Graphing Calculator Investigation

## A Follow-Up of Lesson 2-6

### What You'll LEARN

Use a graphing calculator to make box-and-whisker plots.

### Box-and-Whisker Plots

You can create a box-and-whisker plot using a TI-83/84 Plus graphing calculator.

#### ACTIVITY

Make a box-and-whisker plot of the data at the right. It shows the grades on Miss Romero's last Math 7 test.

Miss Romero's Math 7 Test							
78	94	85	92	72	56	89	92
90	84	98	82	75	100	94	87
92	85	94	70	78	95	70	80

#### STEP 1 Enter the data.

Begin by clearing any existing data in the first list, L1.

Press **STAT** **ENTER** **▲** **CLEAR** **ENTER**.

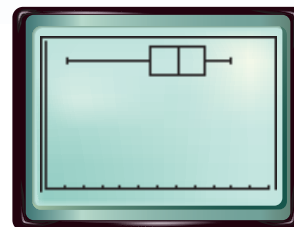
Then enter the data into L1. Input each number and press **ENTER**.

#### STEP 2 Choose the type of graph.

Press **2nd** **[STAT PLOT]** **ENTER** to choose the first plot. Highlight On, the modified box-and-whisker plot for the type, L1 for the Xlist, and 1 as the frequency.

#### STEP 3 Choose the display window.

Press **WINDOW** and choose appropriate range settings for the  $x$  values. The window 50 to 110 with a scale of 5 includes all of this data.



#### STEP 4 Display the graph.

Press **GRAPH**. Press **TRACE** and the arrow keys to determine the five key data points of your graph.

#### EXERCISES

1. What are the values of the five key data points of the graph? What do they represent?
2. What percent of the test scores are below 78?
3. What percent of the test scores are above the median? What percent of the test scores are below the median?
4. What percent of the scores are between 56 and 86?
5. Suppose you earned a grade of 80. Describe what percent of students scored higher and what percent scored lower than you.

# Bar Graphs and Histograms

**WHEN** am I ever going to use this?

**ANIMALS** The cheetah is the fastest known land animal. The table shows its fastest speed and the top speeds of four other land animals.

Animal	Speed (mph)
cheetah	70
wildebeest	50
lion	50
elk	45
zebra	40

Source: *The World Almanac*

1. What are the fastest and slowest speeds recorded in the table?
2. How can you create a visual representation to summarize the data?
3. Do any of these representations show both the animal name and its speed?

## What You'll LEARN

Construct and interpret bar graphs and histograms.

## NEW Vocabulary

bar graph  
histogram

## REVIEW Vocabulary

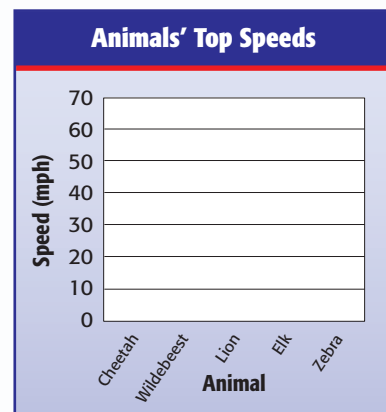
**frequency table:** a table that shows how often an item occurs (Lesson 2-1)

A **bar graph** is one method of comparing data by using solid bars to represent quantities.

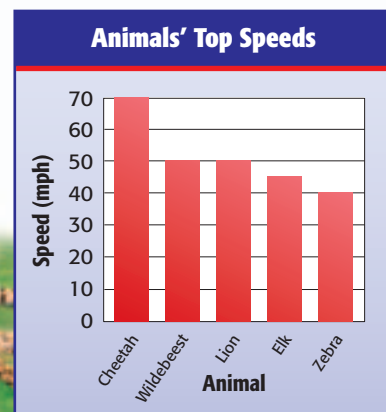
## EXAMPLE Construct a Bar Graph

**1** Make a bar graph to display the data in the table above.

**Step 1** Draw a horizontal axis and a vertical axis. Label the axes as shown. In this case, the scale on the vertical axis is chosen so that it includes all the speeds. Add a title.



**Step 2** Draw a bar to represent each category. In this case, a bar is used to represent the speed of each animal.



A special kind of bar graph, called a **histogram**, uses bars to represent the frequency of numerical data that have been organized in intervals.

## EXAMPLE Construct a Histogram

- 1 ANIMALS** The top speeds of thirty different land animals have been organized into a frequency table. Make a histogram of the data.

Maximum Speed (mph)	Frequency
11–20	5
21–30	5
31–40	10
41–50	8
51–60	0
61–70	2

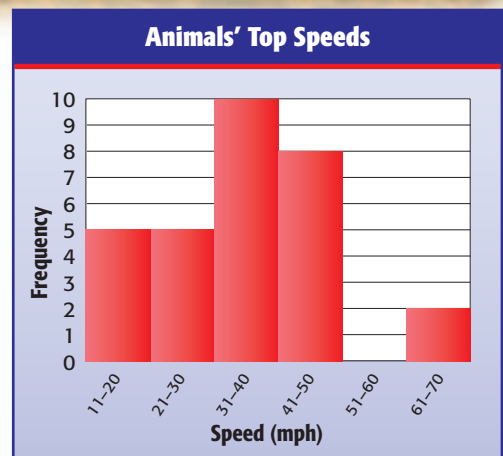
Source: *The World Almanac*



### STUDY TIP

**Histograms** Because the intervals are equal, all of the bars have the same width, with no space between them. The space at 51–60 indicates that there are no data values on that interval.

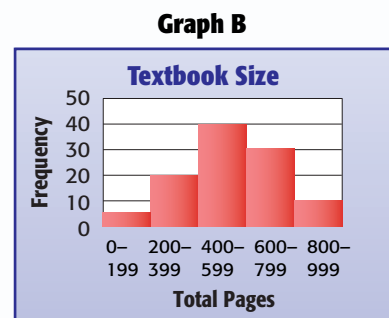
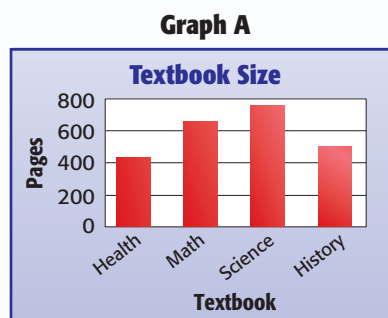
- Step 1** Draw and label horizontal and vertical axes. Add a title.
- Step 2** Draw a bar to represent the frequency of each interval.



The two highest bars represent a majority of the data. From the graph, you can easily see that most of the animals have a top speed of 31–50 miles per hour.

## EXAMPLE Compare Bar Graphs and Histograms

- 1 TEXTBOOKS** Refer to the graphs below.



Which graph would you use to determine how many textbooks have less than 600 pages?

Graph B

Which graph would you use to compare the size of a science book and a history book?

Graph A



### Test-Taking Tip

#### Read a Graph

When analyzing data in a histogram, ask yourself questions such as, "What does each bar represent?"

## EXAMPLE Use Graphs to Solve a Problem

**MULTIPLE-CHOICE TEST ITEM** Which conclusion *cannot* be made about the data in Graph B in Example 3?

- (A) There are 105 books in the data set.
- (B) Twenty books have between 200 and 399 pages.
- (C) Health books have the fewest pages.
- (D) The interval with the fewest books is 0–199.

#### Read the Test Item

Determine which of the four statements is *not* correct.

#### Solve the Test Item

A is correct; 5 books have 0–199 pages, 20 books have 200–399 pages, and so on, for a total of 105 books.

B is correct; the bar representing 200–399 has a value of 20.

C is incorrect; the graph does not describe individual books.

D is correct; only 5 books have 0 to 199 pages, which is less than the other intervals. The answer is C.

## Skill and Concept Check

1. **Describe** how to determine the number of values in a data set using a histogram.
2. **Writing Math** Can any data set be displayed using a histogram? If yes, explain why. If no, give a counterexample and explain why not.

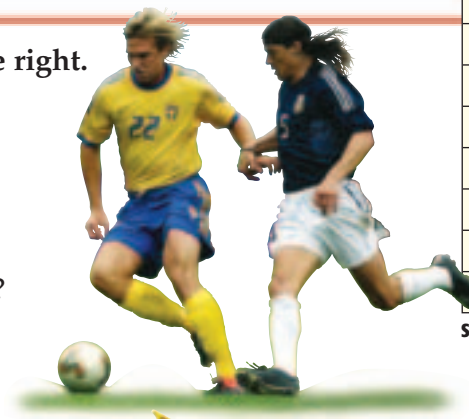
### GUIDED PRACTICE

For Exercises 3–6, use the table at the right.

3. Describe the data in the table.
4. Make a bar graph of the data.
5. What do the horizontal and vertical axes represent?
6. Which country won the most titles? the least titles?

Men's World Cup Soccer Titles, 1930–2002	
Country	Titles Won
Uruguay	2
Italy	3
Germany	3
Brazil	5
England	1
Argentina	2
France	1

Source: fifaworldcup.yahoo.com/en



## Practice and Applications

For Exercises 7–10, use the table below.

- Describe the data in the table.
- What does each interval represent?
- Make a histogram of the data.
- Describe general patterns in the histogram.

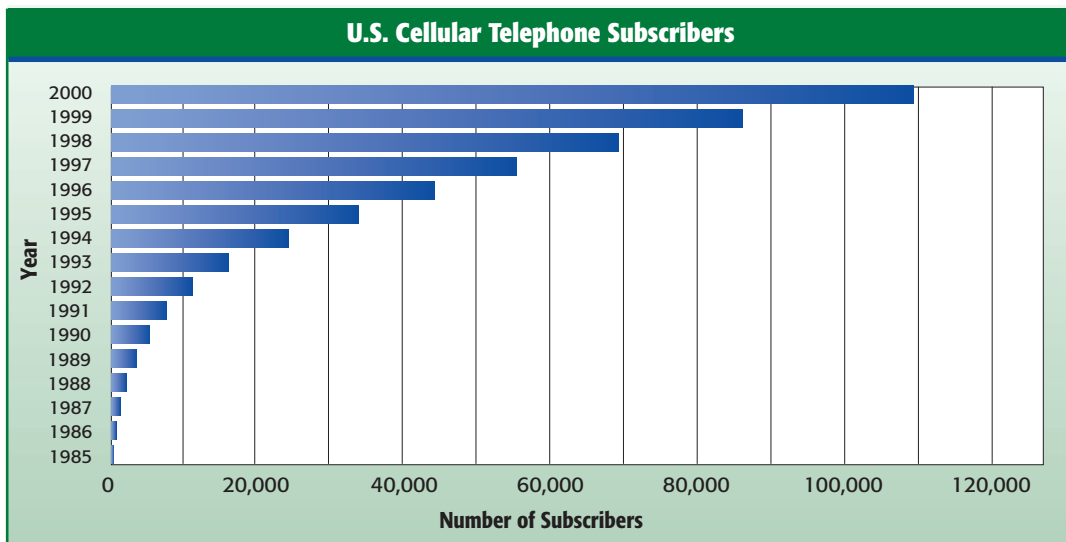
Candies in Snack-Size Packages	
Number of Candies	Frequency
9–11	8
12–14	15
15–17	24
18–20	3

### HOMWORK HELP

For Exercises	See Examples
7–9	1, 2
10–16	3

**Extra Practice**  
See pages 569, 597.

**TECHNOLOGY** For Exercises 11–13, use the bar graph below.



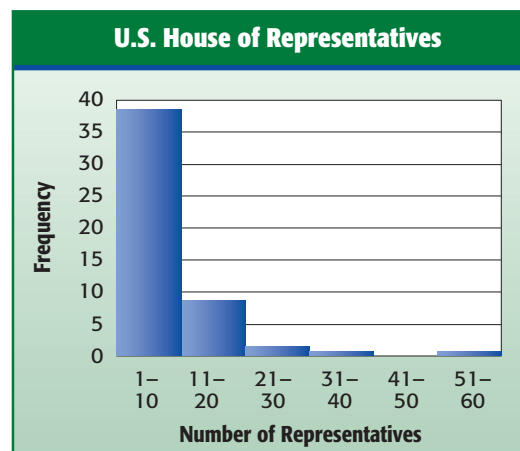
Source: *The World Almanac*

- How is this bar graph different from the other bar graphs in the lesson?
- Describe how the number of cell phone subscribers grew over the 15-year period.
- Use the graph to predict the number of cell phone subscribers in 2006.

**CIVICS** For Exercises 14–16, use the histogram at the right and the information below.

Congress is made up of senators and representatives. Each state has 2 senators, and the number of representatives per state is determined by the state's population.

- What does each interval represent?
- Describe general patterns in the histogram.
- There are 435 members in the House of Representatives. Determine the mean number of representatives per state. Compare this value to the value of the median number, according to the histogram. Discuss the significance of 38 states having 10 or fewer representatives.



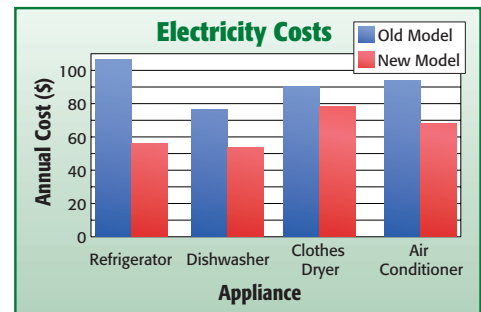
17. **CRITICAL THINKING** The histograms show players' salaries to the nearest million dollars for two major league baseball teams. Compare the salary distributions of the two teams.



### EXTENDING THE LESSON

A *multiple-bar graph* shows two or more sets of data on the same graph. The multiple-bar graph compares the annual costs of using old model appliances and using equivalent new model appliances.

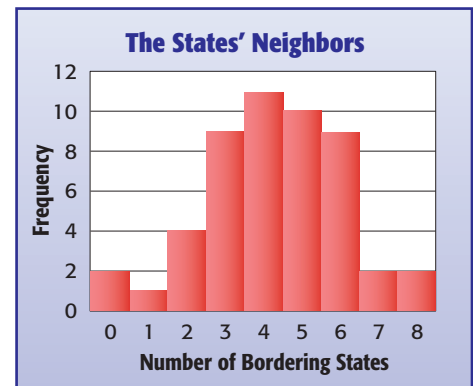
18. For which appliance is the difference in electricity costs between the old and new model the greatest? Explain.
19. Describe an advantage of using a multiple-bar graph rather than two separate graphs to compare data.



Source: Association of Home Appliance Manufacturers

## Spiral Review with Standardized Test Practice

20. **MULTIPLE CHOICE** The histogram at the right shows the number of bordering states for each of the fifty states. Which is *not* a true statement?
- (A) The mode of the data is 4.
- (B) The greatest number of bordering states is 8.
- (C) Ten states have five bordering states.
- (D) No states have only 1 bordering state.
21. **SHORT RESPONSE** Which type of graph can be drawn using the data in a frequency table?



For Exercises 22 and 23, use the data 12, 17, 23, 5, 9, 25, 13, 16, 2, 25, 31, and 10.

22. Make a box-and-whisker plot of the data. (Lesson 2-6)
23. Make a stem-and-leaf plot of the data. (Lesson 2-5)

### GETTING READY FOR THE NEXT LESSON

**PREREQUISITE SKILL** Determine whether each statement is *true* or *false*.

(Lesson 2-2)

24. The vertical scale on a line graph must have equal intervals.
25. You do not need to label the axes of a line graph.



### What You'll LEARN

Use a spreadsheet to make a multiple-line graph and a multiple-bar graph.

## Multiple-Line and Multiple-Bar Graphs

In Lessons 2-2 and 2-7, you interpreted data in a multiple-line graph and in a multiple-bar graph, respectively. You can use a Microsoft® Excel® spreadsheet to make these two types of graphs.

### ACTIVITY 1

The stopping distances on dry pavement and on wet pavement are shown in the table at the right.

Speed (mph)	Stopping Distance (ft)	
	Dry Pavement	Wet Pavement
50	200	250
60	271	333
70	342	430
80	422	532

Source: Continental Teves

Set up a spreadsheet like the one shown below.

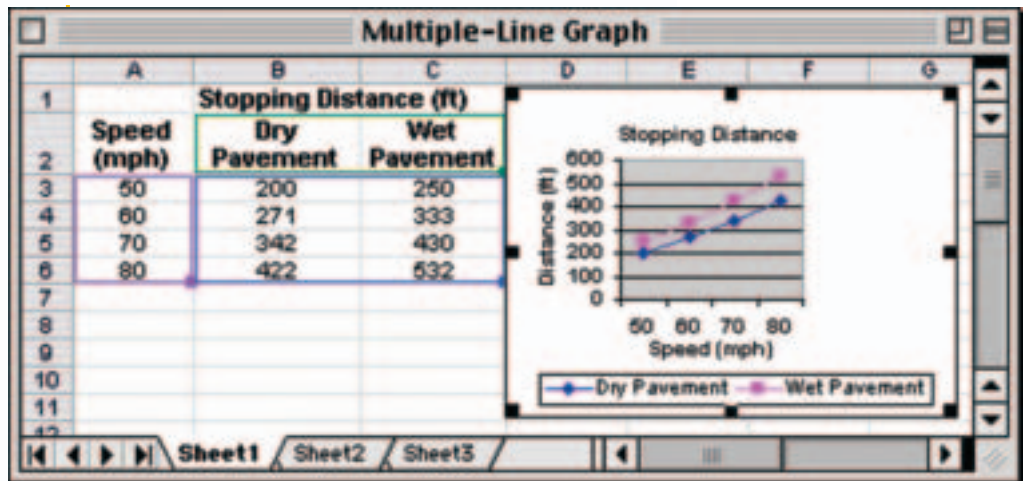
In column A, enter the driving speeds.

In columns B and C enter the stopping distances on dry and wet pavement, respectively.

The next step is to “tell” the spreadsheet to make a double-line graph for the data.

1. Highlight the data in columns B and C, from B2 through C6.
2. Click on the Chart Wizard icon.
3. Choose the line graph and click Next.
4. To set the  $x$ -axis, choose the Series tab and press the icon next to the Category (X) axis labels.
5. On the spreadsheet, highlight the data in column A, from A3 through A6.
6. Press the icon on the bottom of the Chart Wizard box to automatically paste the information.
7. Click Next and enter the chart title and labels for the  $x$ - and  $y$ -axes.
8. Click Next and then Finish.

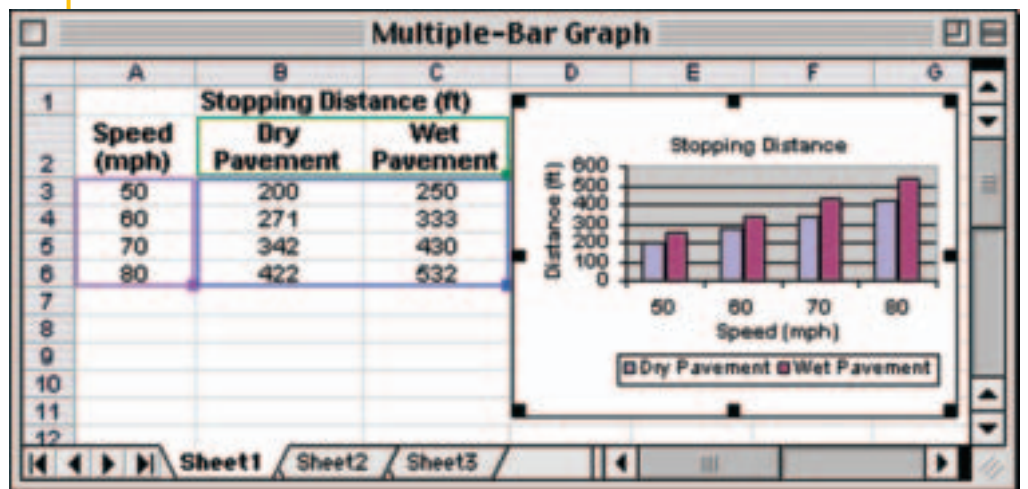
This tells the spreadsheet to read the data in columns B and C.



## ACTIVITY 2

Use the same data to make a multiple-bar graph. Set up the spreadsheet shown in Activity 1. The next step is to “tell” the spreadsheet to make a bar graph for the data.

- Highlight the data in columns B and C, from B2 through C6.
- Click on the Chart Wizard icon.
- Click on Column and Next to choose the vertical bar graph.
- Complete steps 4–8 from Activity 1.



## EXERCISES

1. Explain the steps you would take to make a multiple-line graph of the stopping distances that include the speeds 55, 65, and 75.
2. **OPEN ENDED** Collect some data that can be displayed in a multiple-line graph or a multiple-bar graph. Record the data in a spreadsheet. Then make a graph to display the data.
3. **Discuss** the advantages and disadvantages of using a spreadsheet to make a multiple-bar graph.

# Misleading Statistics

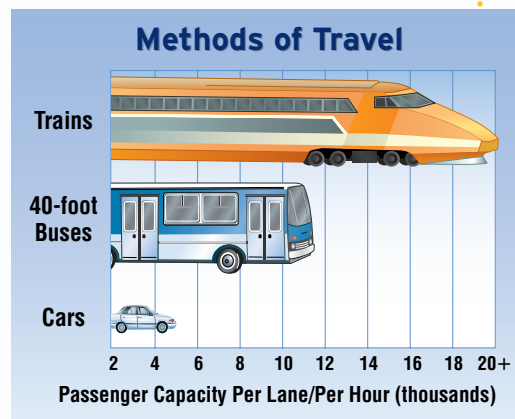
## What You'll LEARN

Recognize when statistics and graphs are misleading.

**WHEN** am I ever going to use this?

**TRANSPORTATION** A graph like the one at the right appeared in a brochure describing various modes of transportation.

1. Approximately how many more passengers per lane can a 40-foot bus transport in an hour than a car can transport?
2. Is the bus on the graph about twice as large as the car? Explain.
3. Do you think the graph appeared in a brochure for a train/bus transit company or for a car company? What makes you think so?

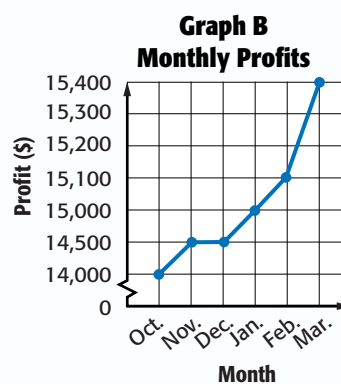
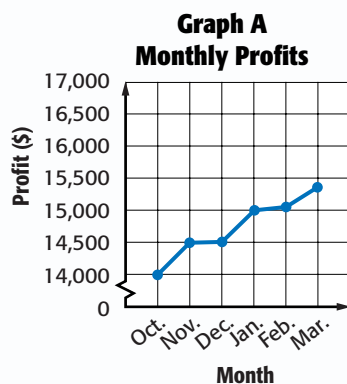


The graph above shows that a car can transport about 5,000 people per lane, per hour. A train can transport about 4 times that many. However, the train on the graph is much more than 4 times larger than the car. For this reason, the graph could be considered misleading.

Other ways that graphs could be misleading are if there is no title, there are no labels on the axes or scales, or the intervals on a scale are not equal.

## EXAMPLE Misleading Graphs

- BUSINESS** The line graphs below show monthly profits of a company from October to March. Which graph is misleading? Explain.



Graph B is misleading because the vertical scale has intervals of both \$500 and \$100. The increase in profits are exaggerated.

Statistical averages used to describe data may also be misleading. For example, whenever there are outliers, the mean may not be a good way to describe a data set because it is affected the most by outliers.

### EXAMPLE Misleading Statistics

**1 SALARY** ABC Corporation claims the average salary for its employees is more than \$60,000, while the average salary at XYZ Incorporated is only \$25,000. Use the table to explain their reasoning and determine where you would prefer to work.

Position	Salary (\$)	
	ABC Corp.	XYZ Inc.
President	500,000	120,000
1st Vice President	400,000	85,000
2nd Vice President	240,000	75,000
Sales Staff (5)	20,000	40,000
Supporting Staff (8)	15,000	25,000
Catalog Staff (7)	9,000	22,500

	<u>ABC Corp.</u>	<u>XYZ Inc.</u>
mean salary	\$61,870	\$36,413
median salary	\$15,000	\$25,000

ABC Corporation used the mean to represent its average salary. They used the median to represent the average salary at XYZ Inc.

Unless you could be a president or vice president, it would be better to work for XYZ Inc. because its 20 lowest-paid employees are all better paid than any of the 20 lowest-paid employees at ABC Corporation.

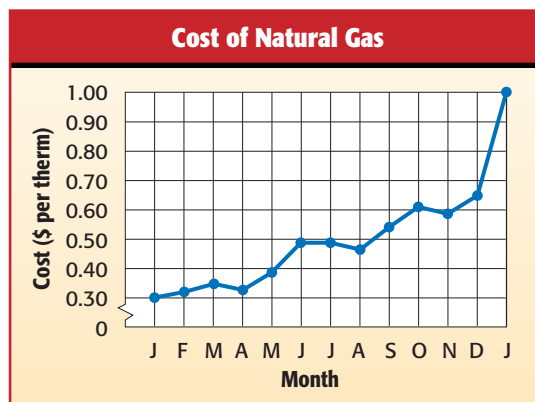
### Skill and Concept Check

- Writing Math** Describe two ways in which the presentation of data can be misleading.
- OPEN ENDED** Find an example of a graph in a newspaper or magazine that could be considered misleading.

### GUIDED PRACTICE

For Exercises 3–6, use the graph at the right. It shows the prices for natural gas charged by an Illinois natural gas supplier.

- What trend seems to be revealed in the line graph?
- What problems might there be in using this graph to predict future prices of natural gas?
- Which measure of central tendency might the gas supplier use to advertise its prices? Explain.
- Which measure of central tendency could competitors use to discourage customers from choosing that natural gas supplier? Explain.



# Practice and Applications

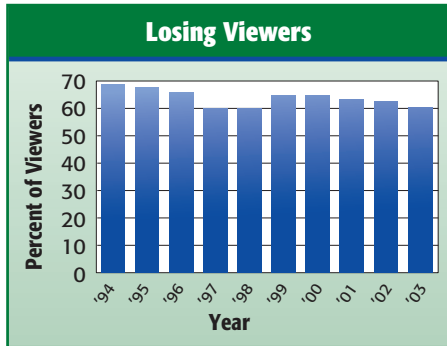
## HOMWORK HELP

For Exercises	See Examples
7–8	1
9–13	2

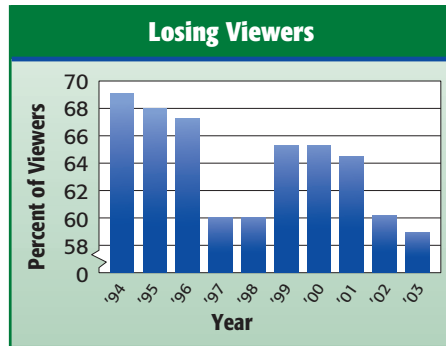
Extra Practice  
See pages 569, 597.

7. **ENTERTAINMENT** Both bar graphs show the percent of viewers that watch network television. Which graph makes it appear that the number of viewers is decreasing rapidly? Explain.

**Graph A**

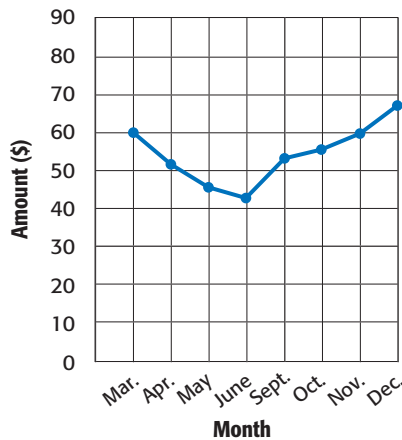


**Graph B**



8. **UTILITIES** The line graph shows the monthly electric bill for the condominium that Toshiko is interested in renting. Why is the graph misleading?

**Electric Bill**



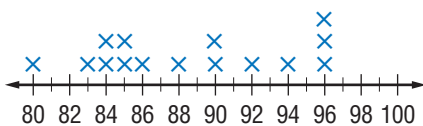
**GEOGRAPHY** For Exercises 9–11, use the table at the right.

- Find the mean, mode, and median of the data.
- Which measure of central tendency would be misleading in describing the size of the islands? Explain.
- Which measure would most accurately describe the data?

Caribbean Islands			
Island	Area (sq mi)	Island	Area (sq mi)
Antigua	108	Martinique	425
Aruba	75	Puerto Rico	3,339
Barbados	166	Tobago	116
Curacao	171	Virgin Islands, UL	59
Dominica	290	Virgin Islands U.S.	134

Source: U.S. Census Bureau

**TESTS** For Exercises 12 and 13, use Miguel's test scores shown in the line plot.



- Which measure of central tendency might he use to emphasize the high scores?
- Would this number be misleading? Explain.

14. **CRITICAL THINKING** Do values that are much greater or much less than the other values affect the median of a set of data? Give an example to support your answer.

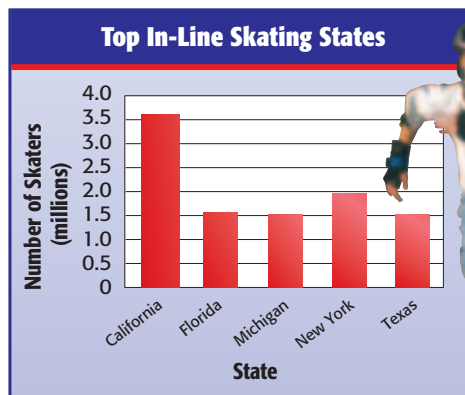
## Spiral Review with Standardized Test Practice

15. **MULTIPLE CHOICE** The table below shows the population of ten counties in Arizona from the 2000 Census. Which measure of central tendency, if any, is misleading in representing the data?

County	Population	County	Population
Apache	69,423	La Paz	19,715
Cochise	117,755	Maricopa	3,072,149
Coconino	116,320	Mohave	155,032
Gila	51,335	Navajo	97,470
Graham	33,489	Santa Cruz	38,381

Source: U.S. Census Bureau

- (A) mode      (B) mean      (C) median      (D) none of them
16. **SHORT RESPONSE** Describe one way that a graph could be misleading.
17. **SKATING** Describe what the height of the fourth bar in the graph represents.  
(Lesson 2-7)
18. Make a box-and-whisker plot of the following data. 12, 15, 20, 12, 13, 14, 15, 14, 17, 16, 16, 18, 15 (Lesson 2-6)



Source: National Sporting Goods Association

**MOVIES** For Exercises 19 and 20, use the movie ticket prices below.

\$7.50, \$6.50, \$7.50, \$8.00, \$8.50, \$8.00, \$7.00

19. Find the mean, median, and mode. Round to the nearest tenth if necessary. (Lesson 2-4)
20. Find the range of the data. (Lesson 2-3)

**Complete.** (Lesson 1-8)

21.  $8.5 \text{ g} = \underline{\quad?} \text{ mg}$
22.  $19 \text{ cm} = \underline{\quad?} \text{ mm}$
23.  $643 \text{ mg} = \underline{\quad?} \text{ g}$
24.  $5,375 \text{ mL} = \underline{\quad?} \text{ L}$

## INTERDISCIPLINARY PROJECT

### Lions, Tigers, and Bears

**Math and Science** It's time to complete your project. Use the information and data you have gathered about the animals you selected to prepare a video or poster. Be sure to include a spreadsheet and all the necessary graphs with your project.



[msmath2.net/webquest](http://msmath2.net/webquest)



[msmath2.net/self\\_check\\_quiz](http://msmath2.net/self_check_quiz)



## Vocabulary and Concept Check

bar graph (p. 85)

box-and-whisker plot (p. 80)

cluster (p. 65)

data (p. 54)

frequency table (p. 54)

histogram (p. 86)

interquartile range (p. 81)

interval (p. 54)

leaf (p. 76)

line graph (p. 60)

line plot (p. 64)

lower extreme (p. 80)

lower quartile (p. 80)

mean (p. 69)

measures of central

tendency (p. 69)

median (p. 70)

mode (p. 70)

outlier (p. 65)

range (p. 65)

scale (p. 54)

scatter plot (p. 61)

statistics (p. 54)

stem (p. 76)

stem-and-leaf plot (p. 76)

upper extreme (p. 80)

upper quartile (p. 80)

State whether each sentence is *true* or *false*. If *false*, replace the underlined word to make a true sentence.

- The range is the difference between the greatest and the least values in a set of data.
- The mode divides a set of data in half.
- A graph that uses bars to make comparisons is a bar graph.
- A scatter plot shows two sets of related data on the same graph.
- The median is a data value that is quite separated from the rest of the data.
- The mean is the arithmetic average of a set of data.
- The number or item that appears most often in a set of data is the mode.
- The lower quartile is the middle number in a set of data when the data are arranged in numerical order.

## Lesson-by-Lesson Exercises and Examples

## 2-1

## Frequency Tables (pp. 54–57)

Make a frequency table of each set of data.

9.

Hours of Sleep Per Night							
9	6	7	8	9	5	8	7
6	7	6	7	7	8	9	8

10.

Favorite Sport									
B	F	H	S	K	F	S	B	B	F
B	F	K	S	F	F	B	K	F	S

B = baseball, F = football, H = hockey,  
S = soccer, K = basketball

**Example 1** Make a frequency table of the data at the right.

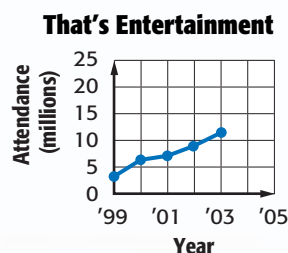
Age of Pet (yr)					
4	2	2	3	8	9
5	9	8	7	10	4

interval: 4  
scale: 0–11

Age (yr)	Tally	Frequency
0–3		3
4–7		4
8–11		5

## 2-2 Making Predictions (pp. 60–63)

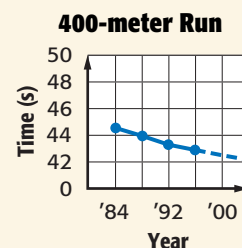
11. **ENTERTAINMENT** The graph shows the attendance at a theme park. If the trend continues, predict the attendance in 2005.



### Example 2

**SPORTS** The graph shows the 400-meter winning times in the Summer Olympics. Predict the winning time in 2004.

By extending the graph, it appears that the winning time in 2004 will be about 42.1 seconds.

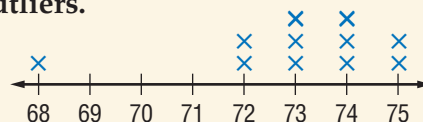


## 2-3 Line Plots (pp. 64–68)

Make a line plot for each set of data. Identify any clusters, gaps, or outliers.

12. 10, 12, 10, 8, 13, 10, 8, 12
13. 7, 8, 8, 9, 14, 9, 8, 7
14. 43, 41, 42, 45, 43, 42, 43, 46, 44, 44
15. 21, 23, 19, 21, 22, 28, 20, 22, 23, 19

**Example 3** Make a line plot for the data set 72, 75, 73, 72, 74, 68, 73, 74, 74, 75, and 73. Identify any clusters, gaps, or outliers.



cluster: 72–75, gap: 68–72, outlier: 68

## 2-4 Mean, Median, and Mode (pp. 69–72)

Find the mean, median, and mode for each set of data.

16. 2, 3, 4, 3, 4, 3, 8, 7, 2
17. 31, 24, 26, 18, 23, 31, 18
18. 89, 76, 93, 100, 72, 86, 74
19. 125, 108, 172, 136, 121, 112, 148, 136

**Example 4** Find the mean, median, and mode for the data set 23, 22, 19, 19, and 20.

mean:  $\frac{23 + 22 + 19 + 19 + 20}{5}$  or 20.6

median: 20 middle value of the ordered set

mode: 19 value that occurs most often

## 2-5 Stem-and-Leaf Plots (pp. 76–79)

Make a stem-and-leaf plot for each set of data.

20. 29, 54, 31, 26, 38, 46, 23, 21, 32, 37
21. 75, 83, 78, 85, 87, 92, 78, 53, 87, 89, 91
22. 9, 5, 12, 21, 18, 7, 16, 24, 11, 10, 3, 14
23. 234, 218, 229, 204, 221, 219, 201, 225

**Example 5** Make a stem-and-leaf plot for the data set 12, 15, 17, 20, 22, 22, 23, 25, 27, and 45.

The tens digits form the stems, and the ones digits form the leaves.

Stem	Leaf
1	2 5 7
2	0 2 2 3 5 7
3	
4	5 2   3 = 23

**Mixed Problem Solving**

For mixed problem-solving practice, see page 597.

**2-6 Box-and-Whisker Plots** (pp. 80–83)

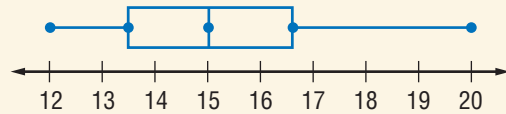
**GRADES** For Exercises 24–27, use the following math test scores.

83, 92, 75, 59, 94, 82, 88, 79, 92, 90, 85, 96

24. Find the lower extreme, LQ, median, UQ, and upper extreme.
25. Determine the interquartile range.
26. Identify any outliers.
27. Draw a box-and-whisker plot of the data.

**Example 6** Make a box-and-whisker plot of the data set 12, 12, 13, 14, 14, 15, 15, 15, 16, 16, 17, 18, and 20.

lower extreme = 12    upper extreme = 20  
median = 15    LQ = 13.5    UQ = 16.5



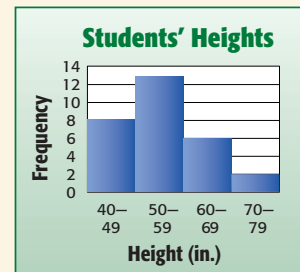
**2-7 Bar Graphs and Histograms** (pp. 85–89)

For Exercises 28 and 29, refer to the graph at the right.

28. How many students are 50 to 59 inches tall?
29. How many students are at least 60 inches tall?

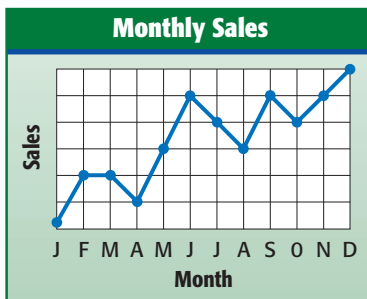
**Example 7** The graph shows the heights to the nearest inch of students in a classroom. Is this a bar graph or a histogram? Explain.

This is a histogram because it shows the number of students having the heights described by each interval.

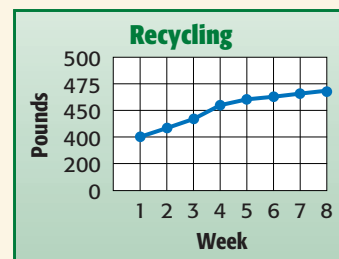


**2-8 Misleading Statistics** (pp. 92–95)

30. **SALES** The graph below shows the monthly CD sales at the Music Barn. Why is the graph misleading?



- Example 8** The graph shows the pounds of aluminum cans that students recycled. Why is this graph misleading?



The vertical scale does not have equal intervals. It has intervals of 200 and 50.

## Practice Test

## Vocabulary and Concepts

1. Explain how the range is different from the mean, median, and mode.
2. Describe how quartiles separate a set of data.

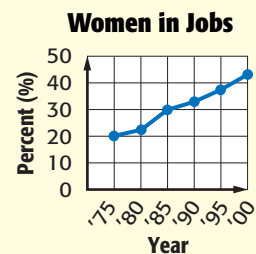
## Skills and Applications

**TESTS** For Exercises 3–5, use the French test grades shown below.

95, 76, 82, 90, 83, 76, 79, 82, 95, 85, 93, 81, 63

3. Make a frequency table of the data.
4. Make a line plot of the data.
5. Identify any clusters, gaps, or outliers.

6. **EMPLOYMENT** The line graph shows the percent of women who had jobs outside the home from 1975 to 2000. Use the graph to predict the percent of women who will have jobs outside the home in 2005.



Find the mean, median, and mode for each set of data.

Round to the nearest tenth if necessary.

7. 4, 6, 11, 7, 4, 11, 4
8. 12.4, 17.9, 16.5, 10.2

Make a stem-and-leaf plot for each set of data.

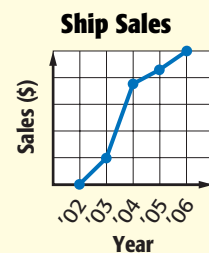
9. 37, 59, 26, 42, 57, 53, 31, 58
10. 461, 422, 430, 425, 425, 467, 429

**ALLOWANCES** For Exercises 11 and 12, use the monthly allowances below.

\$25, \$32, \$40, \$10, \$18, \$15, \$30, \$40, \$25, \$36, \$20

11. Find the lower extreme, LQ, median, UQ, and upper extreme.
12. Make a box-and-whisker plot of the data.

13. **SALES** The line graph shows ship sales at Marvin's Marina in thousands of dollars. Why is the graph misleading?



14. Make a histogram for the French test grades given for Exercises 3–5.

## Standardized Test Practice

15. **MULTIPLE CHOICE** Choose the statement that is *not* correct.

- A The bars on a histogram represent the frequency of data in intervals.
- B The bars on a bar graph represent the number of data items in each interval.
- C The bars on a bar graph have space between them.
- D There is no space between the bars on a histogram.



**PART 1** Multiple Choice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

1. Which is greater than 6.8? (Prerequisite Skill, p. 556)

- (A) 6.08
- (B) 6.79
- (C) 6.80
- (D) 6.9

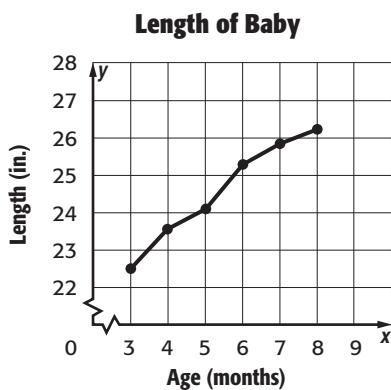
2. What is the value of the expression  $5 + 2 \times 4^2 - 9$ ? (Lesson 1-3)

- (F) 4
- (G) 19
- (H) 28
- (I) 103

3. Which is 430,000 written in scientific notation? (Lesson 1-9)

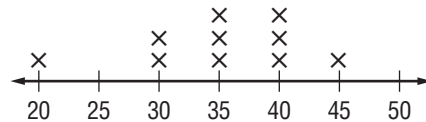
- (A)  $4.3 \times 10^5$
- (B)  $4.3 \times 10^6$
- (C)  $43 \times 10^5$
- (D)  $43 \times 10^6$

4. The line graph shows a baby's length during the first 8 months. If the pattern of growth continues, predict the baby's length at 9 months old. (Lesson 2-2)



- (F) 26 in.
- (G) 27 in.
- (H) 28 in.
- (I) 29 in.

5. The line plot shows the number of minutes ten different students spent on homework last night. What is the range of the data? (Lesson 2-3)



- (A) 20
- (B) 25
- (C) 30
- (D) 50

6. The table shows the length of the phone calls made in one household on a given day. What is the median? (Lesson 2-4)

- (F) 2 min
- (G) 6 min
- (H) 7 min
- (I) 8 min

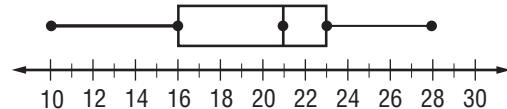
Length of Phone Calls (min)					
2	3	10	2	8	12
6	7	25	7	6	7

7. The stem-and-leaf plot shows the average monthly temperature in one city for a year. What is the mode? (Lesson 2-5)

Stem	Leaf
4	2 2 2 5
5	5 6
6	4
7	0 8 8
8	2 5 5   6 = 56°F

- (A) 42
- (B) 55
- (C) 65
- (D) 78

8. The box-and-whisker plot below summarizes the ages of Leila's cousins. Which statement is *not* true? (Lesson 2-6)



- (F) One fourth of Leila's cousins are between 10 and 16 years old.
- (G) Half of Leila's cousins are between 16 and 21 years old.
- (H) The range of ages is 18 years.
- (I) Half of Leila's cousins are older than 21.

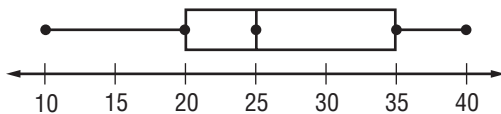
**PART 2** Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

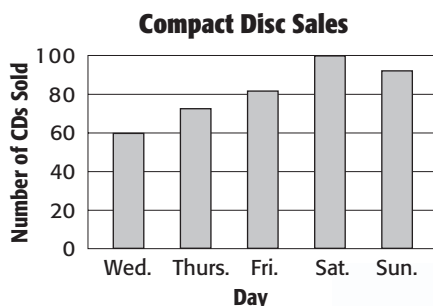
- What is the value of  $14 + x^2$  if  $x = 3$ ?  
(Lesson 1-4)
- Find the missing number in the sequence below. (Lesson 1-7)  
24.7, 25.0,    ?, 25.6, 25.9, ...
- The frequency table summarizes the number of miles Dino ran daily to train for a race. What interval shows the number of miles that he ran most frequently? (Lesson 2-1)

Number of Miles	Tally	Frequency
0–4		9
5–9		13
10–14		4
15–19		1

- If the number 18 was taken out of the number data set 7, 18, 46, 24, 2, 44, 31, 11, would the median or the mean change the most? (Lesson 2-4)
- What is the upper extreme of the box-and-whisker plot below? (Lesson 2-6)



- The graph below shows the sales of compact discs during a five-day sale. How many more compact discs were sold on Saturday than on Wednesday? (Lesson 2-7)



**TEST-TAKING TIP**

**Question 15** Make sure you have answered every part of an open-ended question. If you find that you cannot answer the question entirely, do as much as you can, because you may earn partial credit.

**PART 3** Extended Response

Record your answers on a sheet of paper. Show your work.

- The table shows how the value of a painting increased over ten years. (Lesson 2-2)

Year	Value	Year	Value
1997	\$350	2002	\$1,851
1998	\$650	2003	\$2,151
1999	\$950	2004	\$2,451
2000	\$1,250	2005	\$2,752
2001	\$1,551	2006	\$3,052

- Make a line graph of the data.
- Use the graph to predict what the value of the painting will be in 2010.

- Dominique had swimming practice before school one week and after school the following week. Her timed results are in the table below. (Lesson 2-7)

Day	Time Before School (s)	Time After School (s)
Monday	45.2	41.5
Tuesday	41.3	38.7
Wednesday	40.6	37.4
Thursday	42.9	35.2
Friday	40.7	38.9

- Make a double-line graph of the data. Let the  $x$ -axis represent the days and let the  $y$ -axis represent the times. Title the graph and label each part.
- Write a sentence comparing the data.

