Box-and-Whisker Plots

GET READY for the Lesson

ELEVATION The table gives the elevation of several cities.

1. What is the least value in the data?
2. What is the lower quartile of the data?
3. What is the median of the data?
4. What is the upper quartile of the data?
5. What is the greatest value in the data?
6. Name any outliers.

Elevation of Selected United States Cities	
City	Elevation (feet)
Mobile, AL	209
Baltimore, MD	193
Richmond, VA	164
Hartford, CT	162
New York, NY	158
Anchorage, AK	130
Atlantic City, NJ	114
Wilmington, DE	92

Source: *The World Almanac*

A **box-and-whisker plot** uses a number line to show the distribution of a set of data. The *box* is drawn around the quartile values, and the *whiskers* extend from each quartile to the extreme data points that are not outliers.
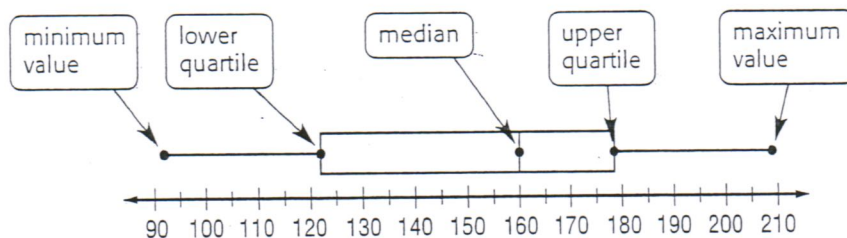
EXAMPLE Construct a Box-and-Whisker Plot

① **ELEVATION** Use the data in the table above to construct a box-and-whisker plot.

Step 1 Draw a number line that includes the least and greatest number in the data.

Step 2 Mark the extremes, the median, and the upper and lower quartile above the number line.

Step 3 Draw the box and the whiskers.

CHECK Your Progress

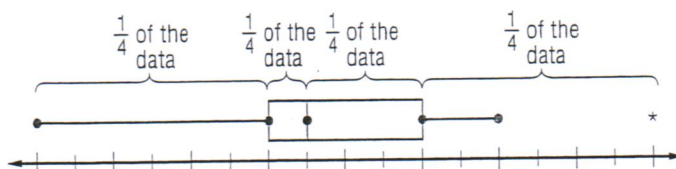**Construct a box-and-whisker plot for each set of data.**

a. Prices, in dollars, of admission to a hockey game:
   42, 38, 42, 45, 43, 65, 55, 50, 34, 36, 40, 35

b. Low temperatures for various cities:
   52, 58, 67, 63, 47, 44, 52, 28, 49, 65, 52, 59

Box-and-whisker plots separate data into four parts. Although the parts usually differ in length, each part contains one fourth of the data.

A long whisker or box indicates that the data have a greater range. A short whisker or box indicates the data have a lesser range. An asterisk (*) indicates an outlier and is not connected to be part of a whisker.

EXAMPLE   Interpret Data

② SOFTBALL What does the length of the box-and-whisker plot tell you about the data?

**Home Runs Hit in a Softball Season**

The data between the median and the upper quartile are more spread out than the data between the median and the lower quartile. The whisker at the right is longer than the whisker at the left, so the data above the upper quartile are more spread out than the data below the lower quartile.
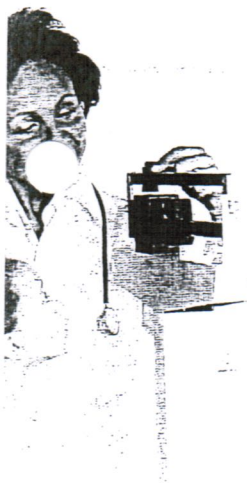
CHECK Your Progress

c. **WORK** Compare data between the median and the upper quartile and the data between the median and the lower quartile.

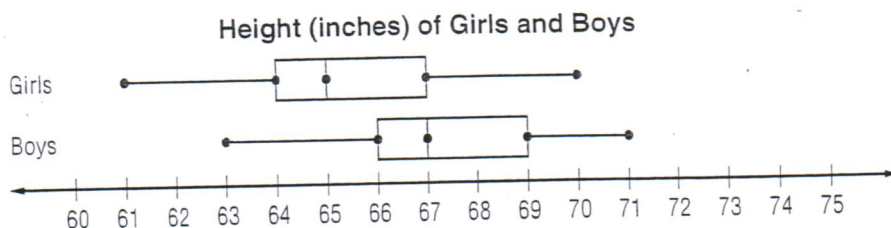**Average Daily Commute Time (minutes)
to Work for Selected U.S. States**
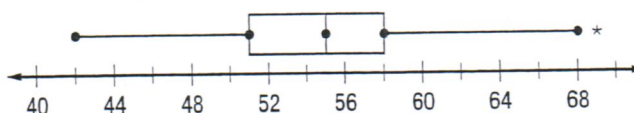
Source: U.S. Census Bureau

EXAMPLE Compare Data

3 **HEIGHT** Refer to the double box-and-whisker plot below that shows the height of girls and boys in a class. Compare the heights of the girls versus the boys.

Height (inches) of Girls and Boys

In general, the girls are shorter than the boys. The upper quartile for the girl's height is 67 inches, meaning 75% of the girls were 67 inches or shorter. The lower quartile for the boys is 66 inches, meaning 75% of the boys were at least 66 inches tall.

CHECK Your Progress

d. **HEIGHT** In the double box-and-whisker plot above, what percent of the girls and what percent of the boys are 67 inches or shorter?

CHECK Your Understanding

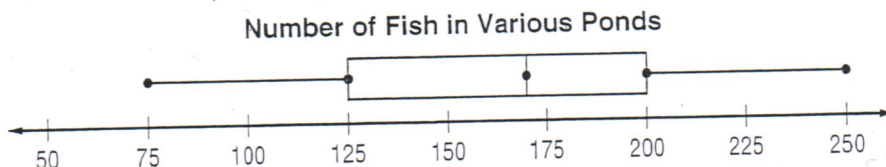**Example 1** (p. 605)   Draw a box-and-whisker plot for each set of data.

1. Hours per month volunteering at the community center: 38, 43, 36, 37, 32, 37, 29, 51

2. Points earned on a test: 100, 70, 70, 90, 50, 90, 50, 90, 100, 50, 90, 100, 90, 50, 25, 80

Example 2 (p. 606)   **FISH** For Exercises 3 and 4, use the following box-and-whisker plot.

Number of Fish in Various Ponds

3. What is the interquartile range of the data?

4. Three fourths of the ponds have at least how many fish?

Example 3 (p. 607)   5. **BASEBALL** Refer to the box-and-whisker plot. In which league did more than half of the teams win more games than the other league? Justify your reasoning.
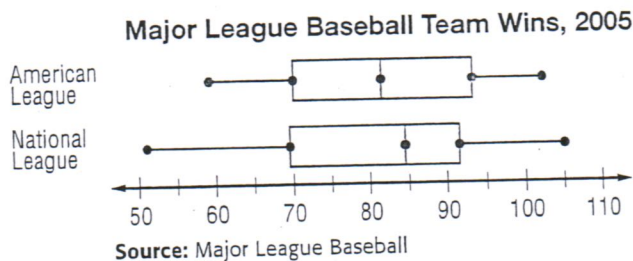
Major League Baseball Team Wins, 2005

Source: Major League Baseball

Construct a box-and-whisker plot for each set of data.

6. Ages of persons in line for a jazz concert:
   49, 45, 55, 32, 28, 53, 26, 38, 35, 35, 51

7. Number of miles between rest stops on a highway:
   77, 85, 72, 76, 95, 90, 73, 82, 82, 80, 73

8. Speed, in miles per hour, of commercial airliners:
   540, 460, 520, 350, 500, 480, 475, 525, 450, 515

9. Prices, in dollars, of plane tickets from Detroit to Atlanta:
   225, 245, 220, 270, 350, 280, 230, 240, 225, 270

**HISTORY** For Exercises 10 and 11, use the box-and-whisker plot at the right.

10. Approximately what percent of the states had populations greater than 100,000?

Population of Thirteen Original States, 1790 (thousands)

Source: U.S. Census Bureau

11. How does the length of the whisker after the upper quartile represent the data?

**ZOOS** For Exercises 12 and 13, use the following box-and-whisker plot.

Areas (acres) of the Ten Largest Zoos in the United States

Source: *The Sacramento Bee*
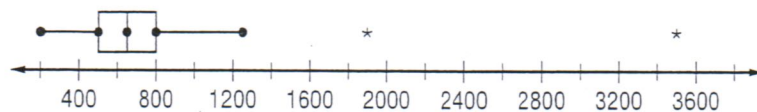
12. How many outliers are in the data?

13. Describe the distribution of the data. What can you say about the areas of the major zoos in the U.S.?

ROLLER COASTERS For Exercises 14–18, use the box-and-whisker plot below.

Speed (miles per hour) of Roller Coasters
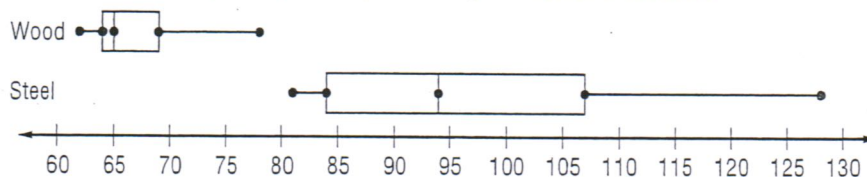
14. Which set of data has a greater range?

15. How many outliers are in the data?

16. What percent of wood roller coasters travel at least 69 miles per hour?

17. What percent of steel roller coasters travel at least 84 miles per hour?

18. In general, do metal roller coasters travel faster or slower than wood roller coasters? Justify your reasoning.

PARKS For Exercises 19 and 20, use the table at the right.

19. Construct a box-and-whisker plot for the set of data. Then determine in which interval the data are the most spread out.

20. Describe how the box-and-whisker plot would change if the data for California and Florida were not included.

State and National Parkland of Selected States	
State	Total Acres per 10 Square Miles of Land
California	616.6
Florida	611.2
Arizona	412.8
Michigan	176.6
North Carolina	172.8
Minnesota	79.5
Texas	72.7
Ohio	58.3
Georgia	25.1

Source: Indiana Chamber

WEATHER For Exercises 21–23, use the box-and-whisker plot below.

Average Number of Sunny Days Per Year for Selected U.S. Cities

Southeastern and South Central Cities

Northeastern and Midwestern Cities

100   150   200   250   300   350
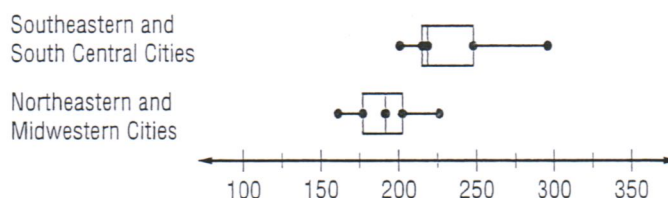
**Source:** U.S. Census Bureau

21. What percent of the data for the Southeastern and South Central cities is above the lower quartile for the Northeastern and Midwestern cities?

22. Boston, Massachusetts, has an average number of 98 sunny days a year. If this city is added to the data for the Northeastern and Midwestern cities, describe how the box-and-whisker plots would change.

23. Write one or two sentences comparing the average number of sunny days of Southeastern and South Central U.S. cities versus Northeastern and Midwestern U.S. cities.
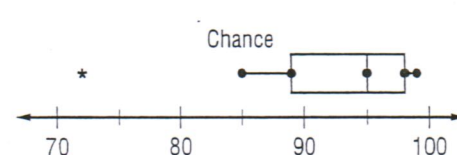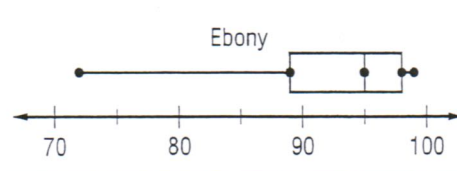
H.O.T. Problems

24. **OPEN ENDED** Write a set of data that could be represented by the box-and-whisker plot at the right.

5   6   7   8   9   10   11   12   13
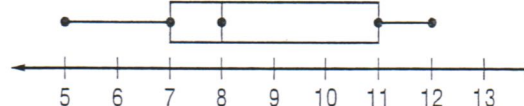
25. **FIND THE ERROR** Ebony and Chance are making a box-and-whisker plot for the following set of data. Who is correct? Explain.

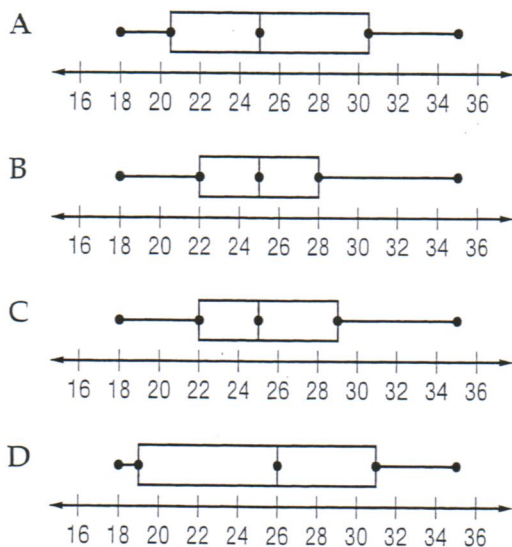72, 85, 89, 90, 90, 95, 97, 97, 98, 99, 99

Ebony

70   80   90   100

Chance

70   80   90   100

26. **REASONING** The lower quartile, median, and upper quartile of a data set are x, y, and 70, respectively. If a box-and-whisker plot were to be made from this data, give possible values for x and y according to each of the following conditions.

    a. The median separates the box into two equal parts.

    b. The box between the median and the upper quartile is twice as long as the box between the median and the lower quartile.

27. **WRITING IN MATH** Explain the advantage of using a box-and-whisker plot to display data.

TEST PRACTICE

28. Which box-and-whisker plot represents the data set 18, 22, 31, 25, 30, 19, 26, 24, and 35?

    A

       16 18 20 22 24 26 28 30 32 34 36

    B

       16 18 20 22 24 26 28 30 32 34 36

    C

       16 18 20 22 24 26 28 30 32 34 36

    D

       16 18 20 22 24 26 28 30 32 34 36

29. Which of the following statements is *not* true concerning the box-and-whisker plot below?

    36 40 44 48 52 56 60 64 68 72 76
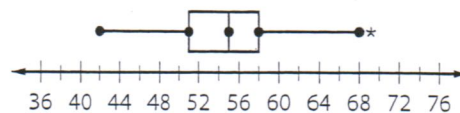
    F The value 69 is an outlier.

    G Half of the data is above 55.

    H $\frac{1}{4}$ of the data is in the interval 58–69.

    J There are more data values in the interval 42–51 than there are in the interval 55–58.

Spiral Review

Find the range, median, upper and lower quartiles, interquartile range, and any outliers for each set of data. (Lesson 11-5)

30. 73, 52, 31, 54, 46, 28, 47, 49, 58

31. 87, 63, 84, 94, 89, 74, 50, 85, 91, 78, 99, 81, 77, 86, 65, 81, 74

32. **TEMPERATURES** Find the mean, median, mode, and range of the temperatures 76, 65, 91, 34, 23, 45, 74, 65, 82, 31, 65 and 24 degrees. Round to the nearest tenth if necessary. (Lesson 11-4)

▷ GET READY for the Next Lesson

PREREQUISITE SKILL Make a line plot for each set of data. (Page 749)

33. 2, 5, 9, 8, 2, 6, 2, 5, 8, 10

34. 14, 12, 9, 7, 12, 10, 14, 7, 8, 12