9-6 Box-and-Whisker Plots

Main IDEA

Display and interpret data in a box-and-whisker plot.

Targeted TEKS 8.12 The student uses statistical procedures to describe data. **(C) Select and use an appropriate representation for presenting and displaying relationships among collected data, including** line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, **box and whisker plots,** histograms, and Venn diagrams, with and **without the use of technology.**

GET READY for the Lesson

WILDFIRES The table gives the number of acres burned in wildfires for various years.

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.

Significant Wildfires in the United States

Year	Number of Acres Burned
1871	3,780,000
1825	3,000,000
1910	3,000,000
1988	1,585,000
1881	1,000,000
1987	640,000
1903	637,000
1997	610,000

Source: National Interagency Fire Center

NEW Vocabulary

box-and-whisker plot

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.

Concepts in MOtion
Animation tx.msmath3.com

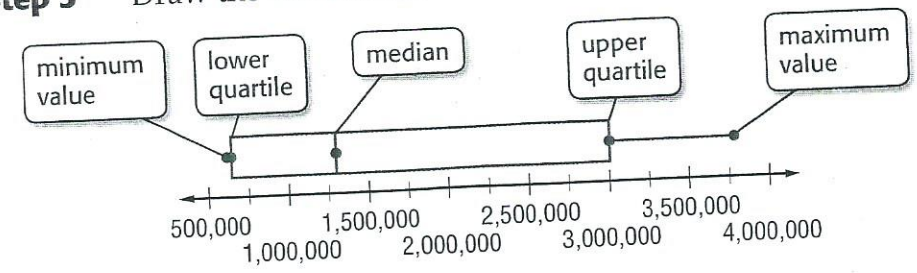
EXAMPLE 1 Construct a Box-and-Whisker Plot

WILDFIRES 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.

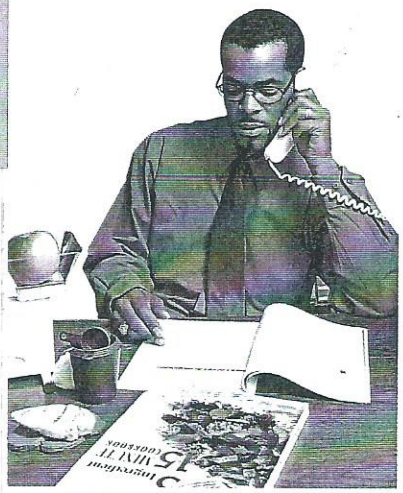


CHECK Your Progress

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

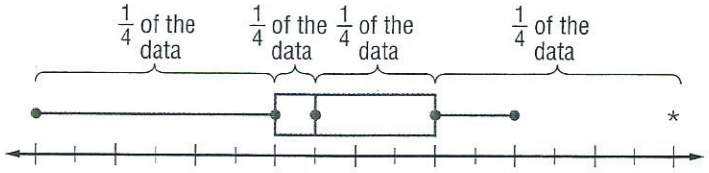
b. Low temperatures for various cities:
52, 58, 67, 63, 47, 44, 52, 28, 49, 65, 52, 59



Real-World Career . . . .
How Does a Dietitian Use Math?
Dietitians keep track of Calories, fat, salt, and nutrients in food. They use this information to help people maintain an appropriate diet.

Math Online
For more information, go to tx.msmath3.com.

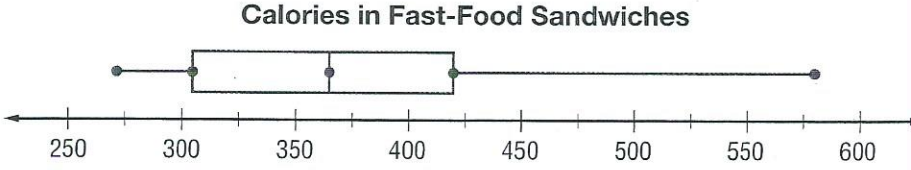
Box-and-whisker plots separate data into four parts. Although the pa usually differ in length, each part contains one-fourth of the data.



A long whisker or box indicates that the data in that quartile or quart have a greater range. A short whisker or box indicates the data in tha quartile or quartiles have a lesser range. An asterisk (*) indicates an outlier and is not connected to a whisker.

EXAMPLE Interpret Data

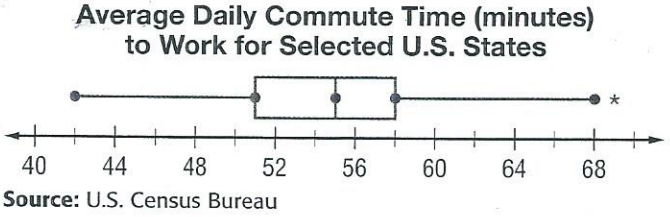
2 **DIET** **What does the length of the box-and-whisker plot tell you about the data?**



The median line seems to divide the box into two approximately equal parts, so data in the second and third quartiles are similarly spread out. The whisker at the right is longer than the other parts o the plot, so the data in the fourth quartile are more spread out.

CHECK Your Progress

c. **WORK** Compare the lower quartile and the upper quartile of the data.



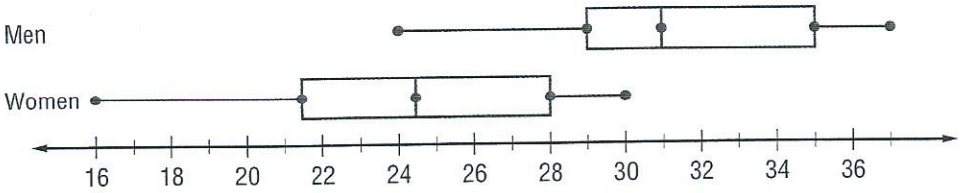
Source: U.S. Census Bureau

Online Personal Tutor at tx.msmath3.com

EXAMPLE Compare Data

3 **OLYMPICS** Refer to the double box-and-whisker plot below. Were about half the men and women in the same age group? Justify your reasoning.

Ages of the U.S.A. 2002 Olympic Hockey Players



Source: *USA Today*

The youngest age of the men was 24 years, and the median was 31 years. So half of the men were 24 to 31 years old.

The median age of the women was 24.5 years, and the oldest age was 30. So half the women were 24.5 to 30 years old.

So, about half the men and women were in the same age group.

CHECK Your Progress

d. **OLYMPICS** Describe the ages of the women compared to the ages of the men in the double box-and-whisker plot above.

CHECK Your Understanding

Example 1 (p. 497)

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

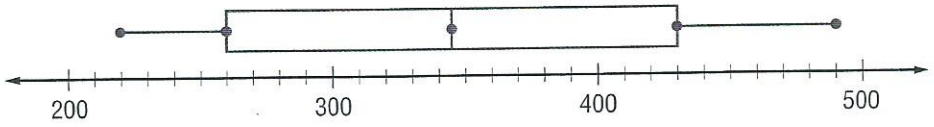
1. Hours per month volunteering at the community center: 38, 43, 36, 37, 32, 37, 29, 51

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. 498)

FOOD For Exercises 3–4, use the following box-and-whisker plot.

Calories in Muffins



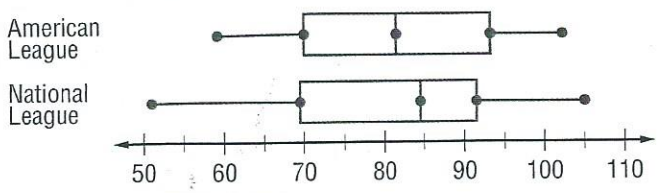
3. What is the interquartile range of the data?

4. Three fourths of the muffins have at least how many Calories?

Example 3 (p. 499)

5. **BASEBALL** Refer to the box-and-whisker plot below. 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, 2004



Source: mlb.com

Exercises

HOMEWORK HELP

For Exercises	See Examples
6–9	1
10–13, 15	2
14, 16–18	3

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

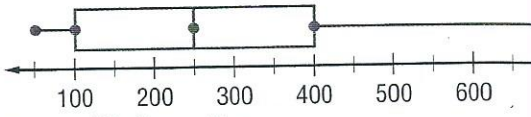
7. Number of miles between rest stops on a highway:
77, 85, 72, 76, 95, 90, 73, 82, 82, 80, 73

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, 23, 240, 225, 270

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

Population of Thirteen Original States, 1790 (thousands)



Source: U.S. Census Bureau

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

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

Real-World Link . . . .
The first official count of the U.S. population was conducted in 1790 by federal marshals on horseback. It took 18 months to question and record the answers of the 3.9 million U.S. inhabitants in notebooks or on bits of paper.
Source: Population Resource Center

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

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

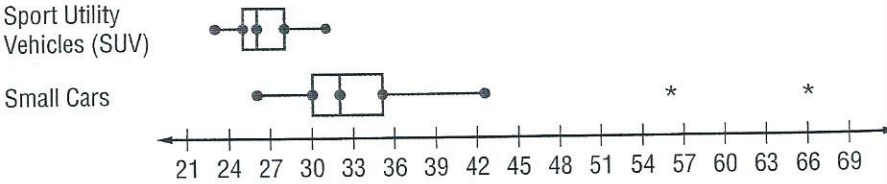
Source: *The Sacramento Bee*

12. How many outliers are in the data?

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

GAS MILEAGE For Exercises 14–18, use the box-and-whisker plot below.

Highway Gas Mileage (miles per gallon) for 2006 Models



Source: fueleconomy.gov

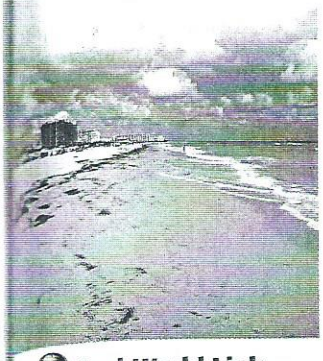
14. Which set of data has a greater range?

15. How many outliers are in the data?

16. What percent of the SUVs get at least 28 miles per gallon?

17. What percent of the small cars get at least 30 miles per gallon?

18. In general, do SUVs get more or less gas mileage than small cars? Ju your reasoning.



Real-World Link . . . . .
Florida, the "Sunshine State," actually ranks sixth in the average number of sunny days per year. In fact, Florida has more partly cloudy days than anywhere else in the United States.
Source: washingtontimes.com

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.

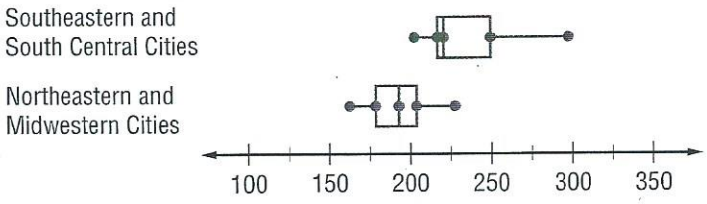
State and National Parkland of Selected States

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



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?

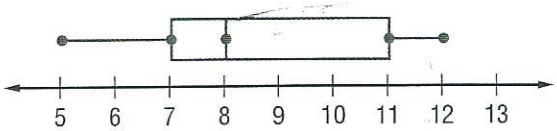
22. Boston, Massachusetts, has an average number of 98 sunny days a year. If this city is added to the data, describe how the box-and-whisker plots would change.

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.

EXTRA PRACTICE
See pages 719, 736.
Math Online
Self-Check Quiz at tx.msmath3.com

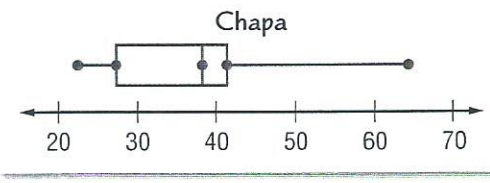
H.O.T. Problems . . . .

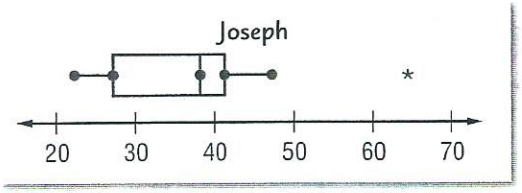
24. **OPEN ENDED** Write a set of data that could be represented by the box-and-whisker plot at the right.



25. **FIND THE ERROR** Chapa and Joseph are making a box-and-whisker plot for the following set of data. Who is correct? Explain.

22, 23, 27, 30, 34, 38, 39, 40, 41, 47, 64





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.

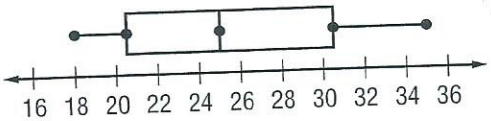
   b. The box between the median and the upper quartile is twice as long as the box between the median and the lower quartile.

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

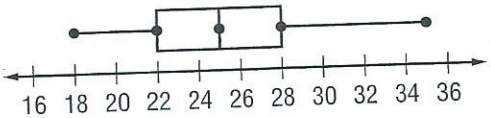
TEST PRACTICE

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

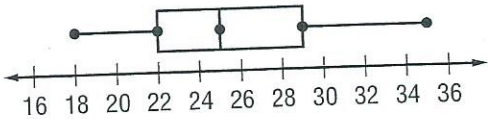
A



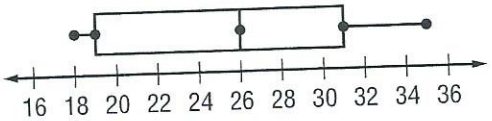
B



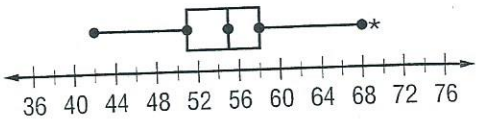
C



D



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



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 th interval 55–58.

Spiral Review

Find the range, median, upper and lower quartiles, interquartile range, and any outliers for each set of data. (Lesson 9-5)

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. **LIFE SCIENCE** Find the mean, median, mode, and range of the plant heights 22, 4, 1, 12, 5, 22, 5, 25, 25, 19, 23, 24, 11, 16, 3, and 22 inches. Round to the nearest tenth if necessary. (Lesson 9-4)

GET READY for the Next Lesson

PREREQUISITE SKILL **Make a line plot for each set of data.** (Page 676)

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

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