Applications

1. 1 student

2. You can use the histogram with 5-minute intervals to determine the number of students that spend at least 15 minutes traveling to school. To find the number of students, identify the number of students in the 15-minute to 20-minute interval, the 20-minute to 25-minute interval, the 25-minute to 30-minute interval, the 30-minute to 35-minute interval, the 35-minute to 40-minute interval, and the 45-minute to 50-minute interval. Sum these numbers together.

   You cannot use the histogram with 10-minute intervals to determine the number of students that spend at least 15 minutes to travel to school. The interval size is 10. Within the 10-minute to 20-minute interval, it is impossible to know which of those students spend less than 15 minutes traveling to school and which spend more than 15 minutes traveling to school.

3. 26; You can add the heights of the bars in either histogram to find the total number of students.

4. The median time is 18.5 minutes; you can find the median by finding the two data values located in the middle of the dot plot. The two middle values are 18 and 19, so the median is halfway between those two values.

5. **a.** Juice F has the greatest percent of real juice. Juice G has the least percent of real juice. You can use Graph A. Possible explanation: Graph A identifies the individual drinks. If you use Graph B, you can’t identify specific drinks represented in the graph.

   b. Juice F has 34% real juice. Juice G has 9% real juice. You can use Graph A. It is the only graph in which you can identify exactly which juice has exactly what percent of real juice in it.

6. **a.** Possible answer: Graph A; you can even out the bars in the bar graph until all the bars are even. This would give you the mean. Alternatively, you can find the median by listing the data values in numerical order. Find the data value with the middle position; this is the median. Graph B is a histogram. You can only determine how many occurrences there are for intervals of data values. There is no way to determine exact data values. Because of this, you cannot find any exact measures of center, and therefore, it is difficult to find the typical percent of real juice in a juice drink.

   b. Possible answers: 19.8% (mean); 18% (median)

7. Possible answers:

   Graph A: The title could be Percentage of Real Juice in Juice Drinks. The horizontal axis could be labeled Juice Drinks and the vertical axis could be labeled Percent of Real Juice.

   Graph B: The title could be Percent of Real Juice in a Sample of Juice Drinks. The horizontal axis could be labeled Percent of Real Juice and the vertical axis could be labeled Number of Juice Drinks.

8. Yes; from Graph A, you can count how many juice drinks have a percent of juice in each interval to make Graph B.

9. No; the specific data values cannot be identified from Graph B; to make Graph A, you need detailed information.

Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

10. a. (See Figure 1.)

b. The value of Quartile 1 is 11, and the value of the minimum data value is 4. This means that 25% of the data values are greater than or equal to 4 and less than or equal to 11.

Looking at the data, the values that make up the first whisker are between 4 and 11, including both 4 and 11. The whisker is short in comparison to the other sections of the box plot because the distance between 4 and 11 is comparatively small. One fourth of the data is included in this whisker, so there is a cluster of data values within this small interval.

c. The value of Quartile 3 is 95, and the value of the maximum data value is 213. This means that 25% of the data values are greater than or equal to 95 and less than or equal to 213.

The distance between Quartile 3 and the maximum value is 118. This is a large portion of the entire box plot, so the last whisker is long. This means that the upper fourth of the data values are spread out over a wide distance.

d. The median is 50. This means that half the distances are less than or equal to 50 miles and half the distances are greater than or equal to 50 miles.

e. The mean is about 67.47 miles, which is larger than the median. This tells us the distribution is skewed to the right (it has a long tail on the right with more data clustered on the left).

11. a. (See Figure 2.)

b. 5 weekends; find the height of the bar in the interval of 20 to 40 miles. This is the number of weekends Jimena drove at least 20 but less than 40 miles.

Figure 1

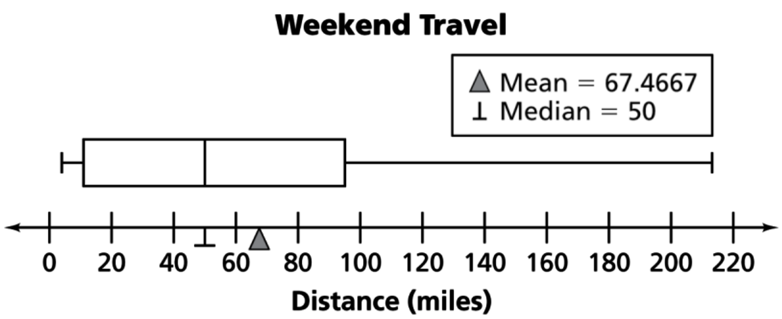
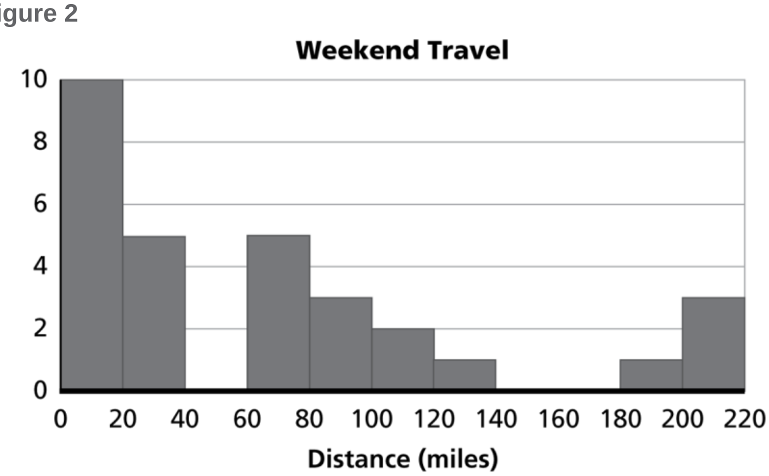


Figure 2



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

c. 7 weekends; find the heights of all the bars from 100 miles to 220 miles. Add these heights together to find the total number of weekends Jimena drove more than 100 miles.

d. The median falls in the interval 40 miles to 60 miles. The median marks the midpoint of the distribution of data values. Of 30 data values, 15 are less than 40 miles; the remaining data values are greater than 60 miles. So, the median marks the halfway point between 40 and 60 miles, or 50 miles, even though no data points are near 50.

12. a. The histogram highlights 3 clusters in the data: 0 to 40 miles; 60 to 140 miles, and 180 to 220 miles. The box plot does not show these clusters. Instead, the quartiles suggest spreads of data values. Both distributions do, however, show a skew to the right.

b. The first bar in the histogram is tall. It suggests that many values cluster there. The length of the first whisker in the box plot is short, which suggests that there is little variation within that first whisker. These indicate the same pattern in the data.

c. The histogram shows the four highest data values, which relates to the last whisker in the box plot. The right-hand whisker includes these four data values as well as some of the values within the center cluster of the histogram. Additionally, the histogram shows more spread on the right side of the graph. This also relates to the last whisker in the box plot.

13. Both sets of box plots are shown below.

Possible answer: The girls in Mrs. R's class appeared to have performed better than the girls in Mr. K's class. The median for Mrs. R's class is 80 jumps. The upper 50% of the data is contained within 80 to almost 100 jumps. The median for Mr. K's class indicates that half the data values at or above the median (57) are more spread out than those below or at the median. (See Figure 3.)

Possible answer: The boys in Mr. K's class appear to have performed better than the boys in Mrs. R's class. The median for Mr. K's class is 27 jumps. The median for Mrs. R's class is only 16 jumps. (See Figure 4.)

Figure 3

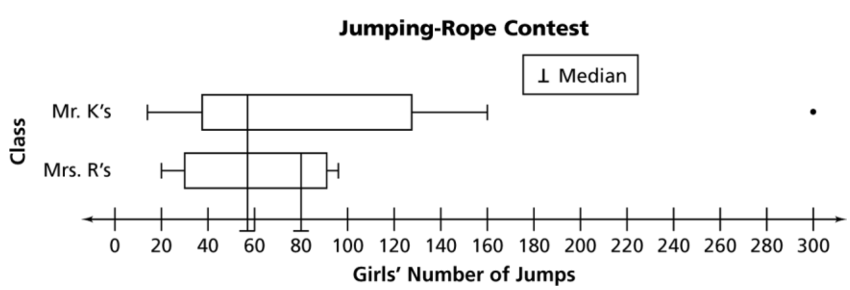
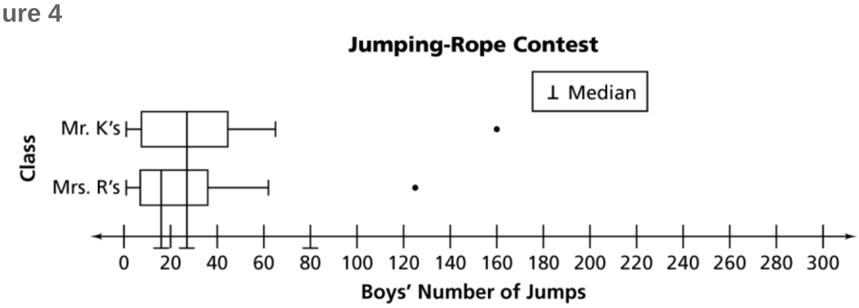


Figure 4



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

14. The box plots below compare the performance of the girls in both classes to the performance of the boys in both classes. The girls performed better than the boys. Both groups have outliers: the boys have outliers at 160 and 125 jumps; the girls have an outlier at 300 jumps. The boys' maximum value (not including the outlier) is equal to the median of the girls' data values. The median for the girls is 65 jumps, and the median for the boys is 18.5 jumps. Also, the minimum number of jumps for the girls appears to be almost identical to the median number of jumps to the boys. (See Figure 5.)

15. D; The mean is not used to construct a box plot.

16. Students can reasonably agree with either Tim or Kadisha. Their explanations determine whether or not they understand the box plots. Possible explanation: From the box plot of the number of raisins per box, you can see that about 75, of the boxes of Brand X raisins contain more raisins than any of the boxes of Brand Y raisins. From the box plot of the mass in grams per box, you can see that the brands are quite similar; the medians only differ by about $\frac{1}{2}$ gram. In terms of which is a better deal, if a consumer wants more raisins, Brand X is a better deal. It may be that Brand X raisins are less plump than Brand Y raisins, however, so in terms of mass, they would be about equal.

17. a. Grade 1 range is 7 pounds, Grade 3 range is 7 pounds, Grade 5 range is 19 pounds, and Grade 7 range is 36 pounds; you find the range by subtracting the minimum value from the maximum value.

b. Grade 1 median is 4 pounds, Grade 3 median is 7 pounds, Grade 5 median is 11 pounds, and Grade 7 median is 19 pounds; you find the median by identifying the value in the middle position in a set of ordered data.

c. Possible answer: Grade 7 appears to have the greatest variation in backpack weights. The data's range (36) is the greatest of the four grades. The data are quite spread out.

d. The data for Grade 1 data are clustered at the lower end of the distribution, but the data for Grade 3 are clustered near the median. The medians are different for the two grade levels.

18. a. C; Possible explanation: There are no values greater than 10. So the only box plot that could match is C.

b. A; Possible explanation: The greatest value shown on the dot plot is 11. The matching box plot must be A.

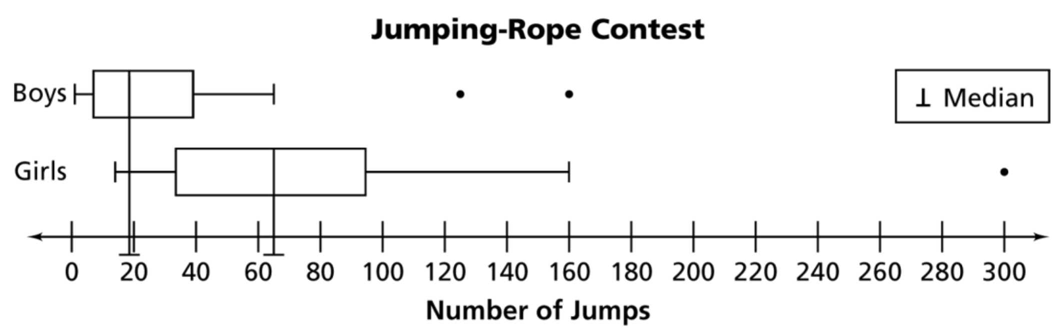
c. B; Possible explanation: The only box plot that shows a maximum of 23 (Grade 5's maximum) is B.

d. D; Possible answer: The only graph that shows the value of 39 (Grade 7's maximum) is D. This must display Grade 7 data.

e. Possible answers:

Grade 1 is skewed to right; there is no left whisker because the minimum value and Quartile 1 are the same.

Figure 5



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

Grade 3 is skewed to the left; the median and Quartile 3 are the same. Also, there is an outlier.

Grade 5 is symmetric; the median is in the middle of the box and the whiskers are about the same size.

Grade 7 is skewed to the left; the median is shifted to the right side of the box. There is also an outlier and the distribution is very spread out.

19. **a.** C; Possible explanation: This is the only graph that has more than half its data values in the interval 0 pounds to 5 pounds.

b. A; Possible explanation: All but 4 dots on the dot plot belong in the interval 5 pounds to 10 pounds. This is the only graph where the histogram has that much height from 5 pounds to 10 pounds.

c. B; Possible explanation: The only histogram that has an even amount of data values in the 5 to 10 and 10 to 15 intervals is Histogram B. Additionally, this graph has no outliers.

d. D; Possible answer: This is the only histogram that shows a data value within the interval 35 pounds to 40 pounds.

e. Possible answers:

Grade 1 is skewed to right; the histogram has a high bar at the left, and the bars keep decreasing in height.

Grade 3 is symmetric, with a high bar in the interval 5 pounds to 10 pounds, and very short bars in the intervals to either side.

Grade 5 is slightly skewed to the right. It has values in intervals 15 pounds to 20 pounds and 20 pounds to 25 pounds that outweigh the 0 pounds to 5 pounds interval on the left.

Grade 7 is fairly symmetric. It has similar bar heights to the left and to the right of the most frequent interval, 15 pounds to 20 pounds.

20. Possible answer: You can compare medians. Both box plots are fairly symmetric, even though the 7th-grade data is more spread out. So while the shortest 8th-grade student is much taller than the shortest 7th-grade student, the Grade 8 median (65.5 inches) is 2.5 inches greater than the Grade 7 median (63 inches).

21. By using the medians of the Grade 5 and Grade 8 data, students should expect to grow about 6 inches (or $\frac{1}{2}$ foot) in height from Grade 5 to Grade 8.

22. The Grade 6 distribution is slightly skewed. The median is not in the center of the box. Also, the right-side whisker is longer than the left-side whisker. The distribution is slightly skewed to the right.

23. The Grade 8 distribution appears to be symmetric; the median is in the center of the box, and the two tails are about the same length.

24. Answers will vary; Possible answer: about 37 cm; looking at the measures of center, the typical height for a student in Grades 6–8 is about 162 cm. The typical height for a student in Grades K–2 is about 125 cm. Thus, the students in Grades 6–8 are about 35 cm taller than the students in Grades K–2.

25. Answers will vary; Possible answer: about 18 cm; looking at the measures of center, the typical height for a student in Grades 6–8 is about 162 cm. The typical height for a student in Grades 3–5 is about 144 cm.

Thus, the students in Grades 6–8 are about 18 cm taller than the students in Grades 3–5.

Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

26. The K–2 heights seem symmetrical with a few heights at the lower end. The 6–8 heights seem symmetrical with a few heights at the upper end. The 3–5 heights seem to have clumps. One clump is found at 130–145 cm and then another clump occurs from 155 cm to 160 cm. The differences in their heights are due to different rates of growth at the different ages, some of which may be affected by factors such as gender.

Connections

27. a. The number of data values in the set must be 250 ÷ 25 (or 10). One possible set of values is 15, 10, 18, 7, 34, 26, 21, 19, 57, and 43.

b. Any set of 10 values with a sum of 250 will work, so other students probably gave different data sets. **Note:** This helps students understand that some problems have more than one answer. It also points out that the mean may be a measure of center for many different sets of values.

c. The median and the mean don't have to be close in value. If there are some very high or very low values, the mean might be quite different from the median. In the data set in part (a), the median is 20. The mean is affected by the relatively high values of 43 and 57.

28. a. (See Figure 6.)

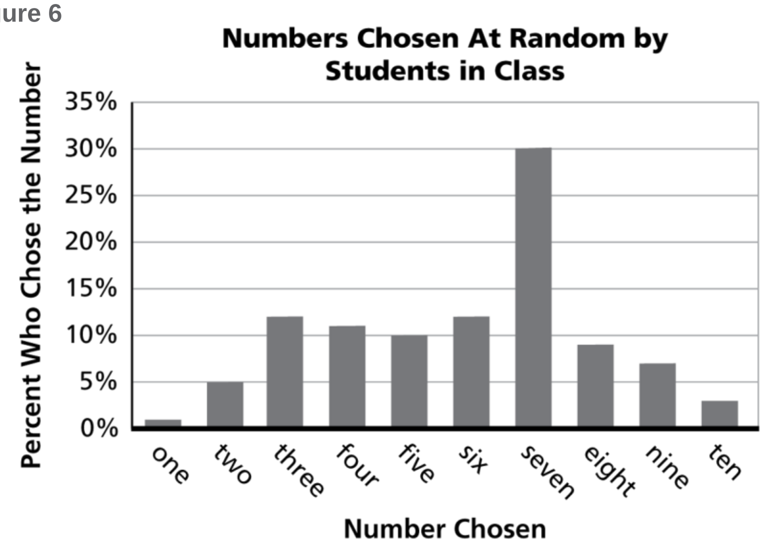
b. The numbers are not equally likely to be chosen. According to this data set, when people choose a number between 1 and 10 "randomly," they choose the number 7 over other numbers. The number 1 and the number 10 are not chosen frequently.

c. 7 is the mode.

d. If nine students chose 5 as their number, that means nine students are 10% (or one tenth) of the population surveyed. To figure out how many students were surveyed, multiply 9 by 10 to get 90. There are 90 students in Grade 7.

29. 72; The sum of her six scores with x, the score of the missing quiz, is $82 + 71 + 83 + 91 + 78 + x = 405 + x$. To get an average of 79.5 for the six quizzes, divide $405 + x$ by 6. So the question becomes "405 plus what number gives 79.5 when divided by 6?" or equivalently "79.5 times 6 equals 405 plus what number?". The answer is 72 since $(79.5 \times 6) = 405 + 72$.

Figure 6



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

30. a. Springfield Yellows: mean: $23.\overline{6}$ years, median: 23 years

Charlestown Spartans: mean: about 27.85 years, median: 27 years

Below are both dot plots and box plots for these data about ages. (See Figures 7, 8, 9 and 10.)

The Springfield Yellows appear to be a young team. The majority of players' ages vary from 20 to 26 years, with one outlier at 30 years old. The mean and median are both about 23 or 24 years.

The Charlestown Spartans appear to be older than the Springfield Yellows. The median and mean are about 27 or 28 years. These data are more spread out.

Looking at the box plots, the Springfield Yellows seem to have a more symmetrical distribution (the median is in the middle of the box); the Charlestown Spartans' ages are more variable; the median is located closer to Q1 than to the middle of the box, which suggests an asymmetrical distribution.

b. Springfield Yellows:
mean: 198.25 centimeters,
median: 200.5 centimeters

Figure 7

Ages of Charlestown Spartans Players

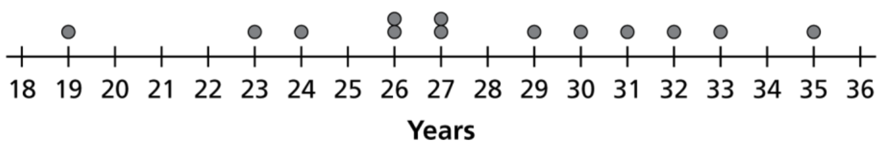


Figure 8

Ages of Springfield Yellows Players

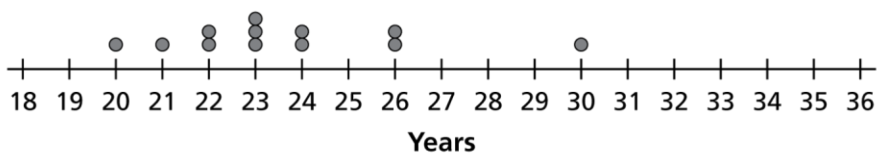


Figure 9

Ages of Charlestown Spartans Players

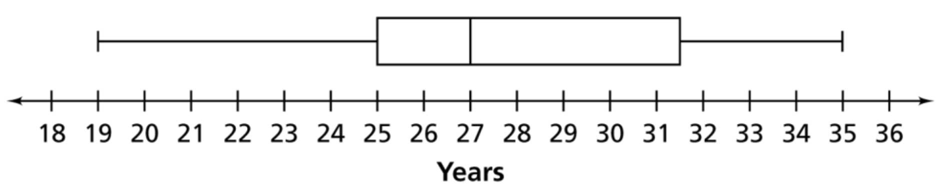
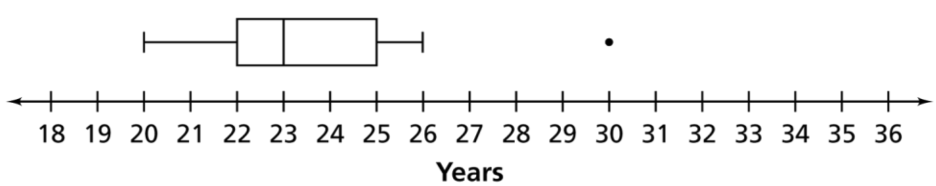


Figure 10

Ages of Springfield Yellows Players



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

Charlestown Spartans:
mean: about 196.46 centimeters,
median: 198 centimeters

Below are both dot plots and box plots for these data about heights. (See Figures 11, 12, 13, and 14.)

The heights of the teams display similar distributions. Both distributions are a bit skewed to the left. The Springfield Yellows, however, are slightly taller than the Charlestown Spartans. This can be seen by comparing their means, medians, and upper and lower quartiles.

c. The ages and the heights do not appear to be drastically different based on the statistics reported. A typical age might be about 25 years. A typical height may about 200 centimeters. Only two teams were compared, however, and it is not wise to generalize these statistics to the entire professional basketball league. The ages and heights for the Springfield Yellows and Charlestown Spartans may not be typical for the rest of the professional basketball league. You need more data from other teams to make an informed generalization.

Figure 11

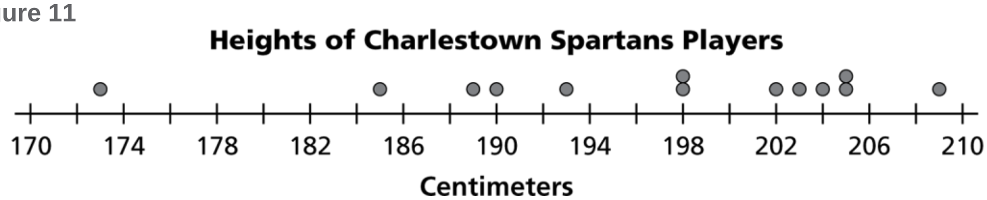


Figure 12

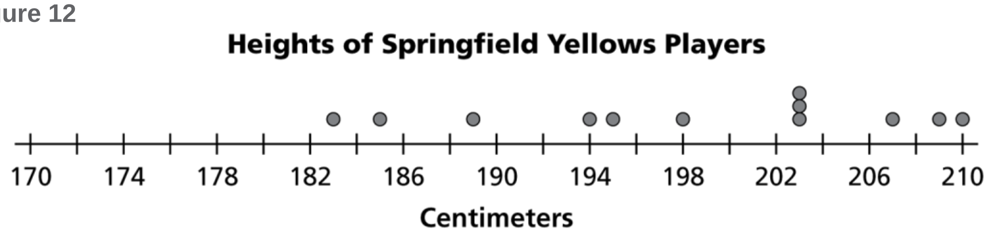


Figure 13

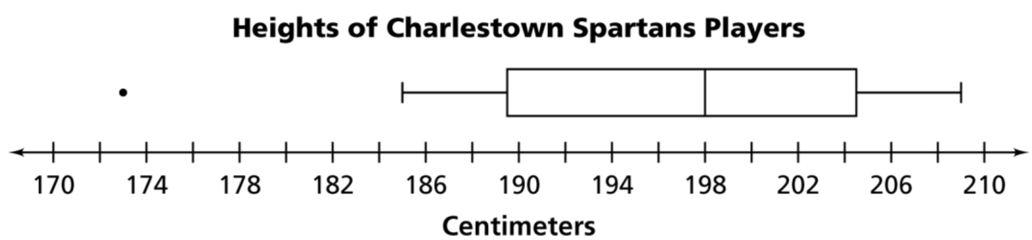
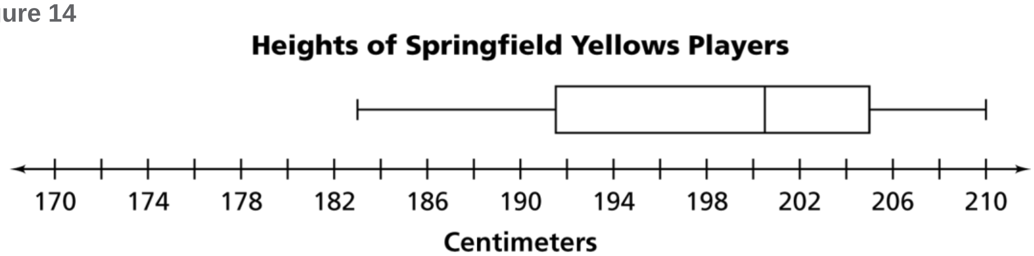


Figure 14



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

Extensions

31. a. The graph could be titled "Lengths of Baseball Games," with a horizontal axis label of "Game Length (minutes)" and a vertical axis label of "Number of Games" or "Frequency."

b. The distribution is skewed to the right. There is a tail of large data values on the right side of the graph. This means that the mean will be higher than the median. There are no gaps in the data, however, and no discrete clusters. Most games are between 140 and 190 minutes long.

c. About 147 games are represented.

d. Estimates will vary. Sample estimate: The lower quartile is between 140 and 150, the median is between 160 and 170, and the upper quartile is between 170 and 180. These numbers indicate that approximately 25% of games last less than 150 minutes, 25% last between 150 and 165 minutes, 25, last between 165 and 180 minutes, and 25% last more than 180 minutes.

32. Possible answer: The middle box plot is symmetrical. So if the median is 4, then Q1 could be 3, which would mean Q3 should be 5. The minimum data value could be 1, which would mean the maximum data value would be about 8 (since the right-hand whisker is slightly longer than the left-hand whisker). You could use these five values as your data set, or you could provide an infinite number of other data sets.

For the top box plot, Q3 and the maximum data value are close to the same summary statistics for the middle box plot. So Q3 would be 5 and the maximum data value could be 7. Q1 is between the minimum data value and Q1 of the middle box plot, so the top box plot's Q1 could be 1.5. The minimum value might be –1. You could use these five values as your data set, or you could provide an infinite number of other data sets.

For the bottom box plot, the entire left-hand whisker is within the left-hand whisker of the middle box plot. So the minimum value for the bottom box plot could be 1.5 and Q1 could be 2.5. Q3 could be 7, and the maximum value could be 11. You could use these five values as your data set, or you could provide an infinite number of other data sets.

Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.