

Chapter 9 ANSWER KEY

1. A statistical question is one for which you don't expect to get a single answer. Instead, you expect a variety of answers, and you are interested in the distribution and tendency of those answers. *Sample question:* How old are the teachers in middle school?

2. You need to collect, organize, analyze, and interpret data related to the question.

3. yes; There are many different answers.

4. 12 in.; yes

5. *Sample answer:* 2 pets; no

6. *Sample answer:* 9th; no

7. 100 senators; yes

8. statistical; There are many different answers.

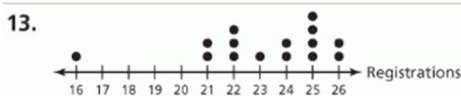
9. not statistical; There is only one answer

10. statistical; There are many different answers.

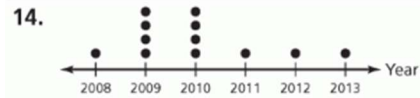
11. statistical; There are many different answers.



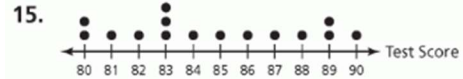
Most of the data are clustered around 1. There are peaks at 1 and 2. There is a gap between 2 and 6.



Most of the registrations are in a cluster from 21 to 26. The peak is 25. There is a gap between 16 and 21.



Most of the years cluster around 2009 and 2010. The peaks are 2009 and 2010. There is no gap.



The test scores are spread out pretty evenly with no clusters or gaps. The peak is 83.

16. a. yes; It is a statistical question because you would anticipate variability in the hours spent on homework each night by students.



Most of the hours cluster around 2. The peak is 2. There is no gap.

c. Most students spend about 2 hours on homework during a school night.

17. a. 21 earthworms

b. *Sample answer:* Use a centimeter ruler. The units are centimeters.

c. *Sample answer:* "What is the length of an earthworm?"; The lengths are spread out pretty evenly from 15 centimeters to 20 centimeters.

18. a. 18 players

b. *Sample answer:* Use a tape measure. The units are inches.

c. *Sample answer:* "What are the heights of players on an NBA championship team?"; The heights are spread out, but most of the heights (in inches) are in the mid-to-low 80s.

19. *Sample answer:* Anemometer; miles per hour

20. *Sample answer:* Rain gauge; inches

21. *Sample answer:* Richter scale; magnitude

22. *Sample answer:* 45 mi/h; Most of the data cluster around 45 and 45 miles per hour is a common speed limit.

Chapter 9 section 1 continued

23. *Sample answer:* 65 mi/h; Most of the data cluster around 65 and 65 miles per hour is a common speed limit.

24. "How many letters are in an alphabet?"; The original question only has one answer. The new question has many answers because there are many alphabets in the world.

25. See *Taking Math Deeper*.

26. yes

27. no

28. yes

Chapter 9 Section 2

1. Add the data values then divide by the number of data values.

2. No; Dividing the sum of the data by the number of data values to find the mean does not necessarily result in one of the data values.

3. yes; Because of the variability of the answers to a statistical question, the mean gives an average of the answers. That way, you can use only one value, the mean, to answer the statistical question.

4. 12 years old; Find the sum of the ages and divide by the number of students in the class.

5. 1 movie seen this week; Find the total number of movies and divide by the number of people.

6. 2 pets

7. 3 brothers and sisters

8. 103 sit-ups

9. 16 visits

16 visits

10. a. about 7th

b. 26 and 37 are outliers because they are much greater than the other values.

11. a. yes; There will be variability in the lengths of the commercial breaks.

b. 3.45 minutes

12. 3.245 inches

13. *Sample answer:*
20, 21, 21, 21, 21, 22
20, 20.5, 20.5, 21.5, 21.5, 22

14. a. The 288 minutes used in September is much less than the other values, so it is an outlier.

b. With outlier: 488.4
Without outlier: 538.5
The outlier caused the mean to be about 50 minutes less.

c. *Sample answer:* School could have caused you to spend less time talking on your cell phone.

15. 3.9 inches; No, neither team has a height that is much shorter or taller than the other heights. So, you can say that the Tigers are taller than the Dolphins on average.

Chapter 9, Section 2 continued

16.



$$\begin{aligned} \text{Mean} &= \frac{11 + 13 + 17 + 15 + 12 + 18 + 12}{7} \\ &= \frac{98}{7} \\ &= 14 \end{aligned}$$

Sample answer: The mean is the point where the data set is balanced because the sum of the distances from the mean to points above the mean ($1 + 3 + 4 = 8$) is equal to the sum of the distances from the mean to points below the mean ($1 + 2 + 2 + 3 = 8$).

17. See *Taking Math Deeper*.

18. 11 pounds; Use the mean of each collection to work backwards to find the total weight of the collection. Divide the sum of the weights of the two collections by the total number of backpacks (20) to find the mean.

19. 9

20. 30

21. 18.5

22. 15.5

23. B

Your s

Chapter 9 Section 3

1. *Sample answer:*
1, 2, 3, 4, 5, 6

2. It depends on the data. The mean is often affected more by an outlier when the middle values of the ordered data are relatively close, but if they are not close, the median may be affected more.

3. outlier; The other three are measures of center.

4. The number 8 must be in the data set at least twice, because the mode is the data value that occurs most often.

5. 5.5

6. 24

7. median: 7; mode: 3

8. median: 15; modes: 14, 16

9. median: 92.5; mode: 94

10. median: 33; no mode

11. median: 17; mode: 12

12. median: 51.5; modes: 44, 55

13. The data were not ordered from least to greatest;
The median is 55.
49, 50, 51, 55, 58, 59, 63

14. black, blue

15. singing

16. No, only the mode can describe a set of data that is not made up of numbers.

17. mean: 35.875; median: 44
mode: 48
Sample answer: The median is probably best, because it is close to most of the data. The mean is less than most of the data and the mode is the greatest value.

18. mean: 50; median: 40
mode: 95
Sample answer: The mean is probably best, because the mode is the greatest value and the median is too far from the greater values.

19. mean: 12; median: 8
mode: 2
Sample answer: The median is the best measure, because the mean is greater than most of the data and the mode is the least value.

20. mean: 110; median: 114.5
mode: 144
Sample answer: Either the mean or median is best, because they are both at the middle of the data, while the mode is the greatest value.

<i>With Outlier</i>	<i>Without Outlier</i>
mean: 48.5	mean: 53
median: 53	median: 54
mode: none	mode: none

The outlier reduces the median slightly, but reduces the mean more. There is no mode with or without the outlier.

<i>With Outlier</i>	<i>Without Outlier</i>
mean: 103	mean: 85
median: 85	median: 85
mode: 85	mode: 85

The outlier makes the mean greater than all of the other values, but does not affect the median or mode.

23. mean: 7.61; median: 7.42; no mode

24. mean: $6\frac{3}{8}$; median: $6\frac{3}{16}$; mode: $6\frac{5}{8}$

25. a. mean: 94°F; median: 91°F; mode: 91°F
Sample answer: Both the median and mode are the best measures for the data, because both are very close to most of the values.

b. mean: 77°F; median: 77°F;
modes: 77°F and 78°F
Sample answer: Both the mean and median are the best measures for the data, because there are two modes.

26. *Answer should include, but is not limited to:* prices of 10 cereals with 1 outlier; unit prices calculated

- a. calculation of mean, median, and mode and explanation of which is best
- b. outlier identified; mean, median, and mode calculated; measure most affected described

27. 10 hours; Using the mean as the average, you would need to work 12 hours. Using the median as the average, you would need to work 10 or more hours. Using the mode as the average, you would need to work 10 hours. So, the minimum number of hours is 10 and you can use the median or mode to justify your answer.

28. *Sample answer:* A mode can be an unreliable measure of a data set because there can be no mode or more than one mode. When there is one mode, it may not be representative of the entire data set.

30. a. no; The price is the mode, but it is the lowest price. Most cameras cost more.

b. By advertising the lowest price, they are likely to draw more customers to the store.

c. *Sample answer:* Knowing all the measures can help you know whether the store has many models in your price range.

31. a. mean: \$1794; median: \$1790; mode: \$1940

b. mean: \$1883.70; median: \$1879.50; mode: \$2037; The mean, median, and mode all increased by 5%.

c. annual salaries: \$23,280, \$19,920, \$22,320, \$25,200, \$20,640, \$18,480, \$21,120, \$23,280, \$21,840, \$19,200; mean: \$21,528; median: \$21,480; mode: \$23,280; They are 12 times the mean, median, and mode of the monthly salary.

32. a. mean: $8x$; median: $5x$; mode: $3x$

b. yes; $23x$

33. 13

34. 65

35. 119

36. 2875

37. D

Chapter 9 section 4

1. A measure of center represents the center of a data set, but a measure of variation describes the distribution of a data set.

2. 3 quartiles

3. What is the range of the data?; 20; 12

4. median = 7, median of lower half = 5.5, median of upper half = 9; The data are close together.

5. median = 81.5; median of lower half = 67; median of upper half = 92; The data are spread out.

6. 12

7. 23

8. 57

9. 7.3

10. The data were not ordered from least to greatest; 35, 38, 41, 44, 48, 49, 51; The range is 16.

11. median = 37; $Q_1 = 33.5$;
 $Q_3 = 40.5$; IQR = 7

12. median = 88; $Q_1 = 84$;
 $Q_3 = 92$; IQR = 8

13. median = 133.5; $Q_1 = 128$; $Q_3 = 139$;
IQR = 11

14. median = 58.5; $Q_1 = 55$;
 $Q_3 = 65$; IQR = 10

15. range = $21\frac{3}{4}$ ft; The distances traveled by the paper airplane vary by no more than $21\frac{3}{4}$ feet; IQR = 11 ft; The middle half of the distances traveled by the paper airplane vary by no more than 11 feet.

16. range; The range is the difference between the greatest value and the least value. The interquartile range is the range of the middle half of the data. So, the range is greater than the interquartile range.

17. Exercise 11: 54
Exercise 12: none
Exercise 13: 106 and 158
Exercise 14: 38

18. *Sample answer:* An outlier increases the range of a data set because there is a wider spread between the greatest and least values.

19. a. range = 172 points;
IQR = 42 points
b. The outlier is 193 points; range = 101; IQR = 34; range

20. no; Two data sets can have the same range and different interquartile ranges due to outliers and/or the distribution of the data.
Example: Data set 1: 1, 5, 6, 6, 6, 7, 11;
range = 10, IQR = 2
Data set 2: 1, 2, 2, 6, 10, 10, 11;
range = 10, IQR = 8

Chapter 9, Section 4 continued

21. a. Show A: mean = 20, median = 19.5,
range = 13, IQR = 5

Show B: mean = 21, median = 20.5,
range = 23, IQR = 6

The mean ages for the shows, 20 and 21, and the median ages for the shows, 19.5 and 20.5, are about the same. The interquartile ranges of ages for the shows, 5 and 6, are about the same. The range of the ages for Show A is 13 years and the range for Show B is 23 years. So, the ages for show B are more spread out.

b. Show A: The mean of the ages decreases a small amount, from 20 to $19\frac{8}{9}$. The median of the ages decreases from 19.5 to 18. The range of the ages stays at 13. The interquartile ranges of the ages increases from 5 to 6.5. Some of these values do not change by a large amount because 21 is towards the middle of the data set.

Show B: The mean of the ages decreases from 21 to $19\frac{1}{3}$. The median of the ages decreases a small amount, from 20.5 to 20. The range of the ages decreases a large amount, from 23 to 12. The interquartile ranges of the ages increases a small amount, from 6 to 6.5. Some of these values change by a large amount because 36 is an outlier of the data set.

22. See *Taking Math Deeper*.

23. 11

24. 56

25. D

Chapter 9 Section 5

1. All the values in the data set are the same.

2. mean; It is a measure of center. All the other measures are measures of variation.

3. 2.8 years

4. \$7.20

5. 4.4; The prices differ from the mean price by an average of \$4.40.

6. 0; The heights are the same, so the mean absolute deviation is 0.

7. 4.9; The capacities differ from the mean capacity by an average of 4.9 thousand, or 4900 people.

8. 25.4; The numbers of visitors differ from the mean by an average of 25.4, or about 25 visitors.

9. When calculating the mean absolute deviation, you need to divide by 6, not 5. Even though the distance from the mean of one of the values (38) is 0, it is still included in the calculation.

$$\text{mean absolute deviation} = \frac{3 + 2 + 0 + 6 + 4 + 3}{6} = 3$$

So, the values differ from the mean by an average 3.0.

10. range: 14; The prices vary by no more than \$14.

IQR: 8; The middle half of the prices vary by no more than \$8.

mean absolute deviation: 4; The admission prices differ from the mean price by an average of \$4.

11. The MAD of the five most-expensive dishes is 3.6. The MAD of the five least-expensive dishes is 1.76. The MAD of the five least-expensive dishes is much less than the MAD of the five most-expensive dishes. So, the data for the five least-expensive dishes is closer together compared to the five most-expensive dishes.

12. Derek's collection: mean: 1929; median: 1930; no mode; range: 54; IQR: 48; MAD: 23.75

Paul's collection: mean: 1929; median: 1929.5; no mode; range: 15; IQR: 6; MAD: 3.5

Sample answer: The measures of center for the data sets are almost identical. But the measures of variation for Paul's coin collection are much less than the measures for Derek's coin collection. This means that the years of the coins in Paul's collection are closer together than the years of the coins in Derek's collection.

13. a. mean: 8.25; median: 8.5; mode: 5
range: 13; IQR: 5.5; MAD: 3

b. no; Using the interquartile range, 21 is inside the outlier boundaries.

mean: 9; median: 9; mode: 5
range: 19; IQR: 6.5; MAD: 3.5

The range is most affected by including this value. The mode stays the same. The mean, median, IQR, and MAD all increased slightly.

<p>14. guesses for number of gumballs in a jar; Less baseballs will fit in a jar, making them easier to count with more success. Many gumballs will fit in a jar, making guessing more difficult and more varied, which leads to a greater mean absolute deviation.</p>	<p>20. C</p>
<p>15. monthly amounts of water used in a home; <i>Sample answer:</i> The amount of rainfall that falls in a city during a month usually ranges from 0 to 5–6 inches. The monthly amounts of water used in a home are much greater numbers that will have more variation from month to month.</p>	
<p>16. <i>Sample answer:</i> The range only uses two data values from a set and is greatly affected by outliers. The interquartile range ignores outliers but only uses a few data values from a set. When calculating the mean absolute deviation of a data set, you use all of the values in its calculation.</p>	
<p>17. a. 50%; 87.5%; 2 and 15</p> <p>b. <i>Sample answer:</i> A good portion of a data set is within one MAD of the mean and most of the data set is within 2 MADs of the mean. As you get more and more MADs away from the mean, the percent increases because more and more data are included in the interval.</p>	
<p>18. mean: 6.5; median: 6; mode: 6</p>	
<p>19. mean: 1.6; median: 1.7; modes: 1.2, 1.7</p>	