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Large Test - 8th Grade Mathematics PSSA (PA Core)

Instructions: Complete each question by choosing or typing in the best answer. To receive the highest score, be sure to leave nothing blank. When you have completed the test, click the "Grade My Test Now" button at the end of the test. If you run out of time, click the "Save for Me to Complete Later" button. Tests are automatically saved in case of internet disruption.

Language: English | [Español](#)

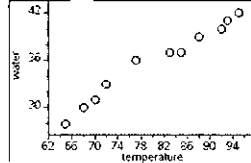
- 1) A line passes through the point (0, 5) and has a slope of $-\frac{1}{2}$. Which is the equation of the line in slope-intercept form?



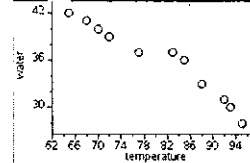
- A) $2x + y = 7$
- B) $y = 3x + 5$
- C) $y = -2x + 7$
- D) $y = -\frac{1}{2}x + 5$

2)

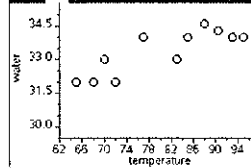
A. "Unsaved"



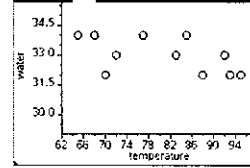
B. "Unsaved"



C. "Unsaved"



D. "Unsaved"



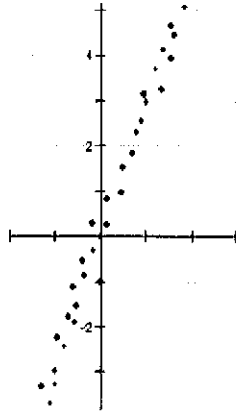
Jeremy thinks that he drinks more water when it is hotter outside. For 11 weeks he records the average temperature for the week and his average daily water intake (in ounces). He then constructs a scatterplot and finds the line of best fit. His line of fit has a small positive slope.

Which is most likely the scatterplot for this data set?



- A) A
- B) B
- C) C
- D) D

3)

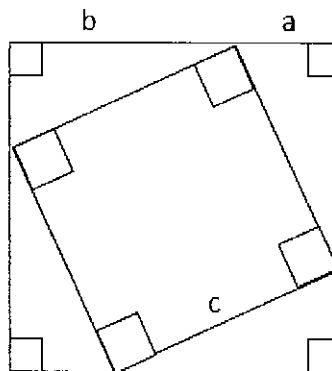


Which linear equation BEST represents the line of best fit for the scatterplot?



- A) $y = x$
- B) $y = 3x$
- C) $y = -3x$
- D) $y = 5x + 1$

4)



When proving the Pythagorean Theorem, we use the given diagram. The area of the large square is equal to the area all four triangles, plus the area of the inscribed square. Which mathematical sentence demonstrates this?



- A) $a^2 + b^2 = \frac{1}{2}ab + c^2$
- B) $a^2 + b^2 = 4\left(\frac{1}{2}ab\right) + c^2$
- C) $a^2 + 2ab + b^2 = \frac{1}{2}ab + c^2$

D) $a^2 + 2ab + b^2 = 4\left(\frac{1}{2}ab\right) + c^2$

5) Solve:

$$-\frac{3}{5}x = 15$$



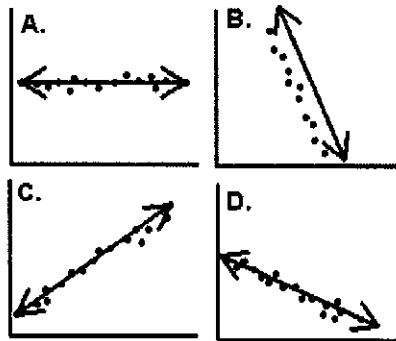
A) -25

B) -9

C) -6

D) 9

6)



Which of the choices is NOT a good example of a line of best fit?



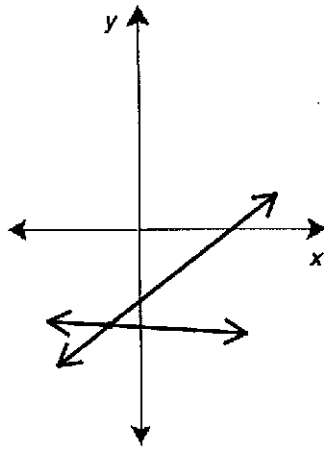
A) A

B) B

C) C

D) D

7)



A system of linear equations has been graphed in the diagram. Determine a reasonable solution for the system of equations.

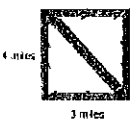
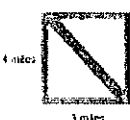

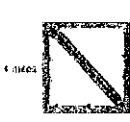


- A) (1, 4)
- B) (-1, 4)
- C) (1, -4)
- D) (-1, -4)

8) **Given: The streets form a rectangle with a diagonal.**

Michael is training for a marathon and wants to run 15 miles. Which path should he take?



- A) 
- B) 
- C) 
- D) 

* Hover over answer image to enlarge

9)



$$\begin{bmatrix} -3 & 3 & -3 & 3 \\ 3 & 3 & -3 & -3 \end{bmatrix}$$

The vertices of square QRST are represented in the vertex matrix shown. QRST is reflected over the line $y = x$ and dilated by 2 to form Q'R'S'T'. What are the coordinates of the vertex that lies in quadrant II?



- A) (0,0)
- B) (6, 6)
- C) (-6, 6)
- D) (-3, 3)

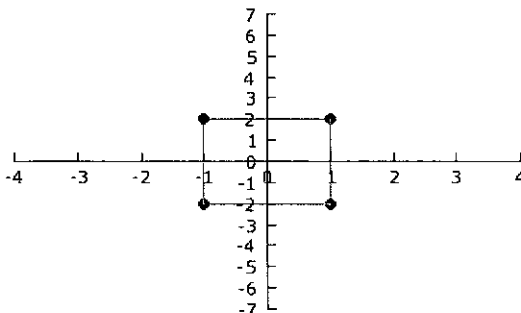
10) Put these rational numbers in order from smallest to largest.

$$\frac{3}{4}, \frac{2}{7}, \frac{2}{10}, \frac{5}{8}, \frac{2}{3}, \frac{8}{4}$$



- A) $\frac{2}{10}, \frac{2}{7}, \frac{5}{8}, \frac{2}{3}, \frac{3}{4}, \frac{8}{4}$
- B) $\frac{2}{10}, \frac{5}{8}, \frac{2}{7}, \frac{2}{3}, \frac{3}{4}, \frac{8}{4}$
- C) $\frac{2}{10}, \frac{2}{7}, \frac{5}{8}, \frac{2}{3}, \frac{8}{4}, \frac{3}{4}$
- D) $\frac{8}{4}, \frac{2}{10}, \frac{2}{7}, \frac{5}{8}, \frac{2}{3}, \frac{3}{4}$





11)



Which image is the dilation of the rectangle with the center of the dilation at the origin and a scale factor of 2?



A)

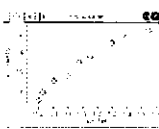
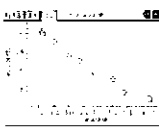
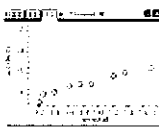
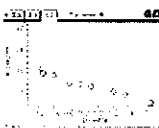
- A) 
- B) 
- C) 
- D) 

* Hover over answer image to enlarge

- 12) Jill has a data set that relates amount of snowfall (in inches) to number of traffic accidents. The line of best fit for the data has a large positive slope, meaning that the more snowfall, the more traffic accidents that occur.

Which would be the MOST LIKELY scatterplot for this data set?



- A) 
- B) 
- C) 
- D) 

* Hover over answer image to enlarge

- 13) What math symbol correctly compares the two numbers?

$$1.3 \text{ ____ } \frac{4}{3}$$



- A) <
- B) >
- C) =

D) \leq

14)

x	0	3	4	5	12
y	8	2	6	9	12

For the data in the table, find the line of best fit, rounding values to three places if necessary.



A) $y = 4.88 + 0.625x$

B) $y = 4.98 + 0.725x$

C) $y = 4.88 + 0.525x$

D) $y = 4.98 + 0.425x$

15)

Which is the BEST estimation of $\sqrt{200}$?



A) between 14.1 and 14.2

B) between 14.2 and 14.3

C) between 14.4 and 14.5

D) between 14.3 and 14.4

16)

	Male	Female
English	4	5
History	7	3
Math	10	6
Science	8	10

Owen surveyed his class on their favorite subject. The results are shown in the table. What is the relative frequency of someone who prefers math?



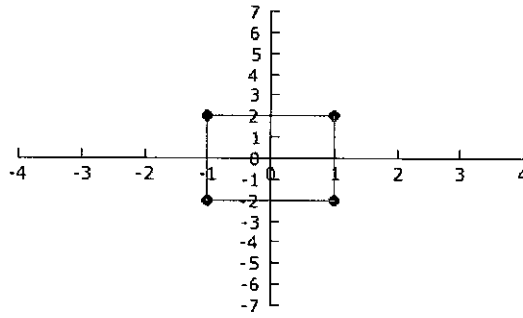
A) 0.113

B) 0.189

C) 0.302

D) 0.547

17)



Which image is the dilation of the rectangle with the center of the dilation at the origin and a scale factor of $\frac{1}{2}$?



- A)
- B)
- C)
- D)

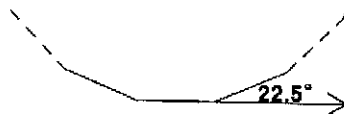
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18) Simplify the expression $\sqrt{18} + \sqrt{50}$.



- A) $3\sqrt{2}$
- B) $5\sqrt{2}$
- C) $8\sqrt{2}$
- D) $34\sqrt{2}$

19)



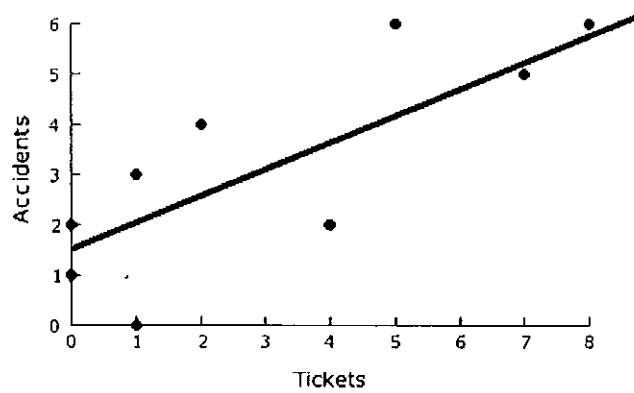
The diagram shows part of a regular polygon. Determine the number of sides for the polygon.



- A) 16
- B) 17
- C) 18
- D) 19

20)

Number of Tickets and Accidents

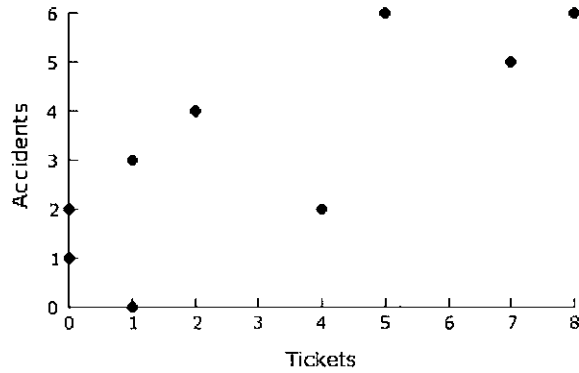


The graph shows number of tickets a person has received versus the number of accidents they have been in. If the trend continues, how many accidents would a person who has received 10 tickets be in?



- A) 5
- B) 7
- C) 10
- D) 12

21)

Number of Tickets and Accidents

Nina recorded collected data on the number of tickets that people had received and how many accidents they had been in. She made a scatterplot of her data. What is the best line of fit for this data?



- A) $y = x - .75$
- B) $y = -x - .75$
- C) $y = \frac{5}{7}x + 1$
- D) $y = -(\frac{5}{7}x + 1)$

22) What is $\frac{100}{56}$ in its simplest form?



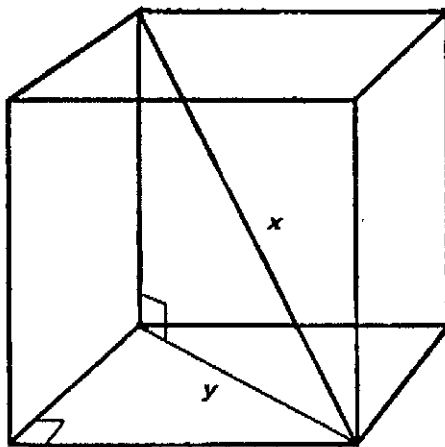
- A) $\frac{5}{7}$
- B) $\frac{14}{25}$
- C) $\frac{7}{5}$
- D) $\frac{25}{14}$

23) Which number is IRRATIONAL?



- A) $\sqrt{16}$
- B) $\sqrt{25}$
- C) $\sqrt{48}$
- D) $\sqrt{100}$

24)

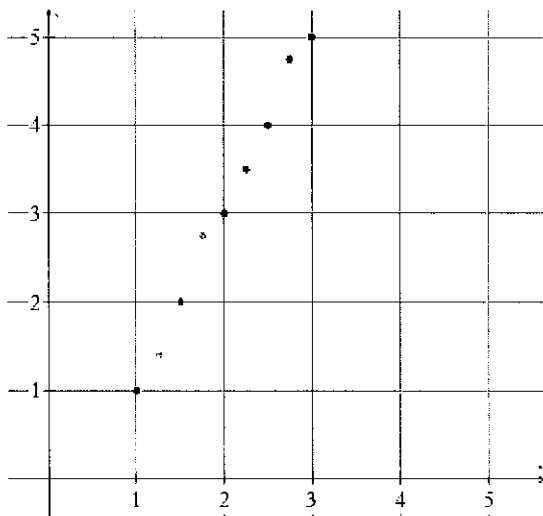


If the cube shown is 4 inches on all sides, what is the length of the diagonal, x , of the cube?



- A) $3\sqrt{2}$ inches
- B) $3\sqrt{3}$ inches
- C) $3\sqrt{4}$ inches
- D) $4\sqrt{3}$ inches

25)



Which line best fits the data in the scatterplot?

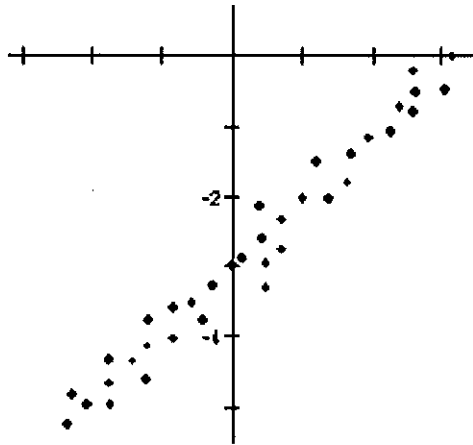


- A) $y = 2x - 1$
- B) $y = 2x + 1$

C) $y = 2x + 2$

D) $y = 2x + 3$

26)



Which equation BEST represents the line of best fit for the scatterplot?



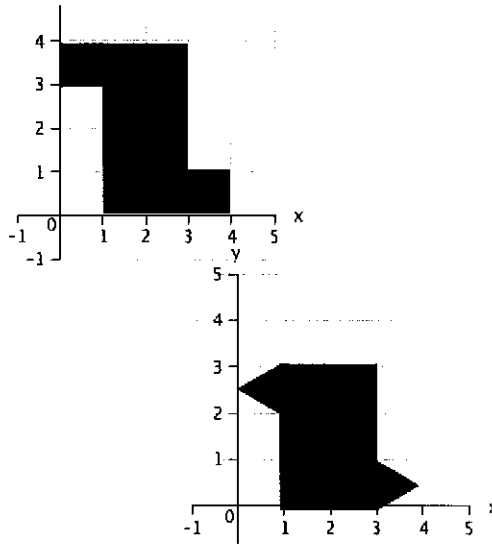
A) $y = 3x$

B) $y = x - 2$

C) $y = x - 3$

D) $y = x + 3$

27)



Farmer Lucas needs to build a new chicken coop. He has outlined on grid paper what both the base house and roof will look like, with the coop being in green and the roof being in red. If each tick mark represents 6 feet, what is the total area of material he needs to buy?



- A) 108 ft²
- B) 120 ft²
- C) 540 ft²
- D) 612 ft²

28) Solve for x.

$$\frac{4 - 3x}{2} = 5$$



- A) -2
- B) $-\frac{1}{2}$
- C) $\frac{1}{2}$
- D) 2

29) A recipe calls for 2 tablespoons of sugar for every 7 tablespoons of flour. If you plan on tripling the recipe what is the ratio of sugar to flour?



- A) 2 to 7
- B) 2 to 21
- C) 5 to 10
- D) 5 to 7

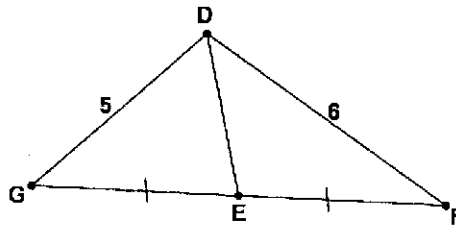
30) Explain how to form a linear combination to eliminate the variable y for this system.

$$\begin{aligned} 2x - 3y &= 3 \\ 5x + 2y &= 17 \end{aligned}$$



- A) Multiply the first equation by 2 and the second equation by 3.
- B) Multiply the first equation by -5 and the second equation by -2 .
- C) Multiply the first equation by -2 and the second equation by 3.
- D) Multiply the first equation by 2 and the second equation by -3 .

31)



Based on the diagram, which statement is accurate?



- A) $m\angle GDE = m\angle FDE$
- B) $m\angle GDE < m\angle FDE$
- C) $m\angle DEG < m\angle DEF$
- D) $m\angle DFE > m\angle DGE$

32)

What is the length of the hypotenuse for a right triangle with legs of length 12 and 35?



- A) 36
- B) 37
- C) 39
- D) 41

33)

Which square root is a whole number?



- A) $\sqrt{167}$
- B) $\sqrt{168}$
- C) $\sqrt{169}$
- D) $\sqrt{170}$

34)

Multiply (4.7×10^4) by (6.4×10^{15}) . Express your answer in scientific notation.



- A) 3.008×10^{20}

- B) 3.008×10^{60}
- C) 3.008×10^{61}
- D) 30.08×10^{19}

35) Evaluate: $(\frac{2}{3})^{-3}$



- A) $-\frac{27}{8}$
- B) $-\frac{8}{27}$
- C) $\frac{8}{27}$
- D) $\frac{27}{8}$

36) The square root of 70 is between what two numbers?



- A) 7 and 8
- B) 8 and 9
- C) 9 and 10
- D) 64 and 81

37) Place the numbers in ascending order.

{7.88, 7.885, 7.8809, and 7.89}



- A) 7.88, 7.885, 7.8809, 7.89
- B) 7.88, 7.8809, 7.89, 7.885
- C) 7.88, 7.8809, 7.885, 7.89
- D) 7.88, 7.89, 7.885, 7.8809

38) Simplify.

$$\sqrt{256}$$



- A) 16
- B) 20
- C) 24
- D) 28

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Assessment - RADUSUNAYA

Instructions: Complete each question by choosing or typing in the best answer. To receive the highest score, be sure to leave nothing blank. When you have completed the test, click the "Grade My Test Now" button at the end of the test. If you run out of time, click the "Save for Me to Complete Later" button. Tests are automatically saved in case of internet disruption.

- 1) Which data set suggests a perfect negative linear association between the two variables?



A)

1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10
10	10
11	10
12	10
13	10
14	10
15	10
16	10
17	10
18	10
19	10
20	10

B)

1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10
10	10
11	10
12	10
13	10
14	10
15	10
16	10
17	10
18	10
19	10
20	10

C)

1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10
10	10
11	10
12	10
13	10
14	10
15	10
16	10
17	10
18	10
19	10
20	10

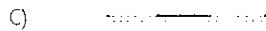
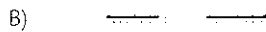
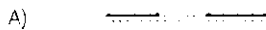
D)

1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10
10	10
11	10
12	10
13	10
14	10
15	10
16	10
17	10
18	10
19	10
20	10

* Hover over answer image to enlarge

- 2) Which graph satisfies the compound inequality?

$$x < -4 \text{ or } x > 3$$



* Hover over answer image to enlarge

- 3) When you solve this equation, which extraneous root do you get?

$$\sqrt{(13 - 2x)} - x = 1$$



- A) $x = 6$
- B) $x = -6$
- C) $x = -2$
- D) $x = 2$

Bonus Question

4)

Data from Previous Truck Head Gaskets

Temperature (°C) Damage Index

12	11
13	8
14	8
16	2
18	2
19	2
19	2
19	1
19	1
20	0
21	4
21	0
21	0

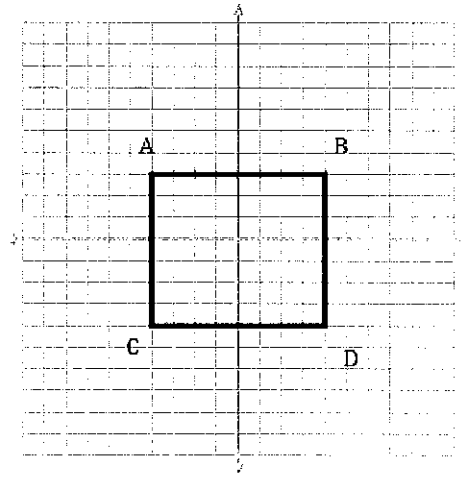
Scientists believe there is a link between ambient temperature and damage to a head gasket on a car. Using the provided information draw a scatterplot of the data.

If the forecast was for temperatures at 5° Celsius, what recommendation would you give to a truck driver who wanted to leave on a trip? Justify your recommendation.



- A) I would recommend that he goes as there were many more temperatures with no damage than with damage.
- B) I would recommend that he goes as lower temperatures have a strong positive correlation, therefore the lower the temperature the less damage is caused.
- C) I would recommend that he does not go as lower temperatures have a strong negative correlation, therefore the lower the temperature the more damage is caused.
- D) I would recommend that he does not go as higher temperatures have a strong positive correlation therefore the higher the temperature the more damage is caused.

5)



Suppose that rectangle ABCD is dilated to $A'B'C'D'$ using $(0, 0)$ as the center and a magnitude of 2.

What are the coordinates of A' ?



- A) $(8, 6)$
- B) $(-8, 6)$
- C) $(8, -6)$
- D) $(-8, -6)$

6)

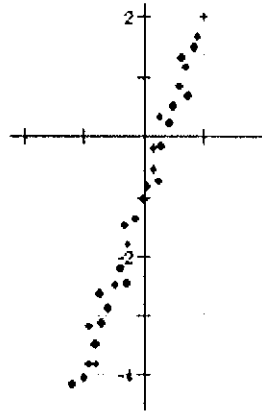
	Have a Sibling	Only Child
Have Chores	7	9
Do Not Have Chores	8	6

Fiona interviewed her 30 classmates on whether or not they have a sibling and if they have assigned chores at home. She displayed her results in the table shown. Which statement is true?



- A) More than half of her classmates are only children.
- B) Half of her classmates have a sibling, and half do not.
- C) More only children do not have chores than those with a sibling.
- D) Fewer classmates have chores than don't have chores.

7)

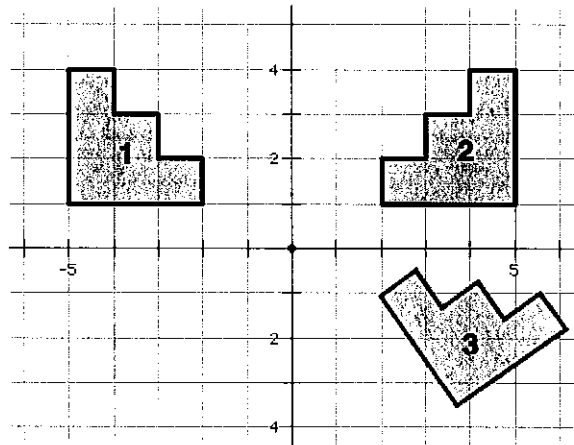


Which linear equation BEST represents the line of best fit for the scatterplot?



- A) $y = \frac{1}{5}x - 1$
- B) $y = -\frac{1}{5}x + 1$
- C) $y = 3x + 1$
- D) $y = 3x - 1$

8)



The figure is transformed as shown in the diagram. Describe the transformation.



- A) reflection, then rotation
- B) translation, then dilation
- C) translation, then reflection
- D) reflection, then translation

9) Which table shows a decreasing linear relationship?



A)

x	y
4	10
7	14
10	18
13	22

B)

x	y
10	-16
15	-18
20	-20
25	-22

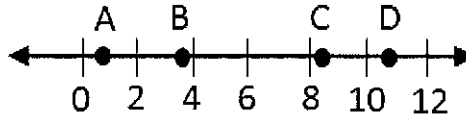
C)

x	y
14	16
17	18
20	20
23	22

D)

x	y
4	16
7	16
10	16
13	16

10)

Which point approximates $\sqrt{15}$?

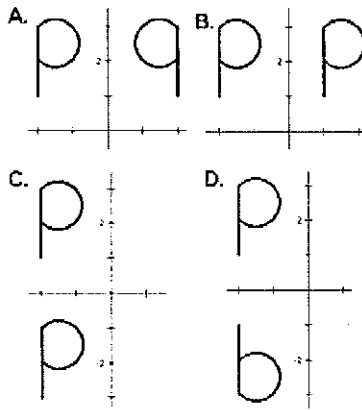
A) A

B) B

C) C

D) D

11)



Which choice shows a reflection across the x-axis?



- A) A
- B) B
- C) C
- D) D

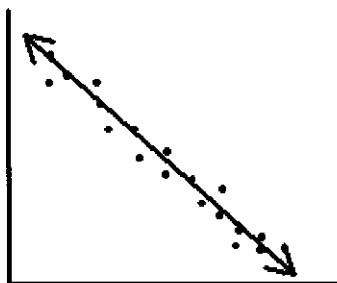
12) What is the line of best fit for these points?

(0, 6)(2, 10)(-2, 2)(-1, 4)



- A) $y = x + 4$
- B) $y = 2x + 6$
- C) $y = 4x + 4$
- D) $y = -2x + 6$

13)



Describe the correlation of the scatterplot.



- A) no correlation
- B) prime correlation
- C) positive correlation
- D) negative correlation

14) If a is a rational number and b is an irrational number, then the sum $a + b$ is



- A) rational.
- B) imaginary.
- C) irrational.
- D) an integer.

15) Bill has grown an average of 1.2 cm per month from January to December. His height measured at the end of January was 152 cm. Find Bill's height at the end of October (Rounded to the nearest cm).



- A) 161
- B) 163
- C) 164
- D) 165

16)



Which point best represents $\sqrt{68}$?



- A) point A
- B) point B
- C) point C

D) point D

17)

Class Survey

	Animal	Color	Vacation Spot	Language
1	Cat	Red	Beach	French
2	Cat	Blue	Beach	French
3	Dog	Blue	Beach	French
4	Dog	Blue	Beach	French
5	Dog	Blue	Beach	Spanish
6	Dog	Red	Mountain	Spanish
7	Cat	Red	Beach	Spanish
8	Cat	Red	Beach	French
9	Cat	Blue	Beach	French
10	Cat	Red	Mountain	Spanish

Jimmy surveyed his classmates recording if they preferred cats or dogs, red or blue, beach or mountains and French or Spanish.

Which two-way table displays which animal they prefer and which language they prefer?



- A)

	French	Spanish
Cat	2	4
Dog	2	2
- B)

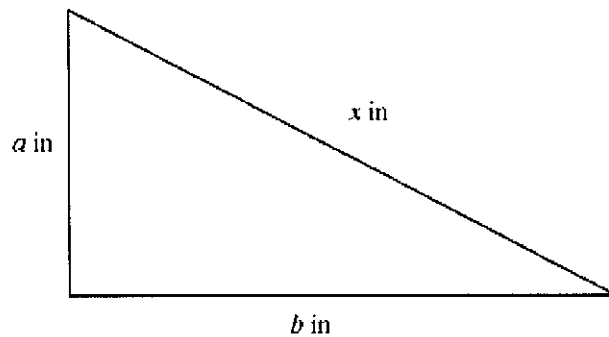
	French	Spanish
Cat	4	2
Dog	2	2
- C)

	French	Spanish
Cat	2	2
Dog	4	2
- D)

	French	Spanish
Cat	2	2
Dog	2	4

* Hover over answer image to enlarge

18)



If you are told that this is a RIGHT triangle, which statement must be true?



- A) $x = a + b$
- B) $x = a^2 + b^2$
- C) $x = \sqrt{a + b}$
- D) $x = \sqrt{a^2 + b^2}$

19)

x	y
0	-3
2	5
3	9
4	13

Which equation matches the table?



- A) $y = x - 3$
- B) $y = x + 3$
- C) $y = 4x - 3$
- D) $y = 4x + 3$

20)

Solve.

$$x - 5 = 17$$



- A) $x = 22$
- B) $x = 12$
- C) $x = 3.4$
- D) $x = -12$

21)

Which is the BEST estimation of $\sqrt{72}$?

- A) between 8.1 and 8.2
- B) between 8.2 and 8.3
- C) between 8.4 and 8.5

D) between 8.0 and 8.1

- 22) Allen is given three lengths of rope: 4 feet, 8 feet, and 15 feet. Can Allen form a triangle with side lengths of 4 feet, 8 feet, and 15 feet using these three pieces of rope, why or why not?



- A) Cannot be determined because there is not enough information.
- B) No, set of side lengths does not satisfy Triangle Inequality Theorem.
- C) Yes, set of side lengths satisfy the Triangle Inequality Theorem.
- D) Yes, set of side lengths satisfy the Pythagorean Theorem.

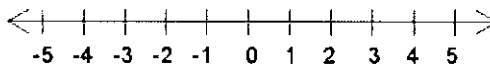
- 23) Simplify.

$$\sqrt{216}$$



- A) $6\sqrt{6}$
- B) 10
- C) $10\sqrt{2}$
- D) $36\sqrt{6}$

- 24)



$\sqrt{10}$ is between which two numbers on the number line?



- A) 0 and 1
- B) 1 and 2
- C) 2 and 3
- D) 3 and 4

Grade My Test Now

CHAPTER
5

Statistics and Probability

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Understanding Sampling

1 GETTING THE IDEA

When you hear the term *population*, you may think about the number of people living in a city or country. In statistics, **population** has a different meaning. A population is a group of individuals or objects that you want to study.

You may want to gather information about characteristics or attributes of a population. For example, you may want to find out how many of all the students in your school walk to school. Since it may be difficult or impossible to survey every student in your school, you may choose to survey only a **sample**, or part, of the population.

The best kind of sample to pick is a **random sample**. In a random sample, every member of the population has an equal chance of being chosen. As a result, random samples are usually representative of the larger population being studied. The members of a **representative sample** possess the characteristics of the members of the population. A representative sample of the students in your school, for example, would include students from all grades.

In statistics, an **inference** is an estimate or prediction about the population that is based on a sample. If the people in a sample are representative of the larger population, then the inferences you make based on your sample are likely to be true of that population.

In contrast, a **biased sample** is not representative of the population. A sample is biased if some members of the population are more likely to be chosen than others. For example, if you survey only students gathered by the bike rack at your school about whether or not they walk to school, that is a biased sample. Statistical inferences from a biased sample are not likely to represent the population accurately.

Example 1

Mark wants to estimate the average age of vehicles driven in his town. He reviews a list of registered vehicles and notices that there are many more cars than trucks. Then he creates a sample by randomly choosing 100 cars and 100 trucks from the list.

Did Mark select a representative sample? Why or why not?

Strategy Compare the characteristics of the sample with the population.

Step 1 Identify the population.

The population is all the vehicles driven in the town, including cars, trucks, buses, motorcycles, and so on.

Step 2

Describe the sample.

The sample is 100 cars and 100 trucks randomly selected from a list of registered vehicles.

Step 3

Compare the characteristics of the sample with the population.

The characteristics are not the same. The sample has the same number of cars and trucks. The population does not. In addition, the sample does not include vehicles other than cars and trucks.

The sample is not representative of the population of all vehicles.

Solution

Mark's sample is not representative of the population he is studying because the sample does not represent the population as a whole.

Example 2

Ruth is studying characteristics of American popular songs from 1900 to 1945. She obtains a list of 500 songs published during this period. She wants to select 30 songs to include in her sample. Which of these methods will result in a random sample?

- A. Choose the first 15 songs and the last 15 songs.
- B. Number the songs from 001 to 500. Use a computer to generate 30 random three-digit whole numbers between 1 and 500. Select those songs.
- C. Choose a number from 1 to 5 by drawing a slip of paper from a hat. Beginning with that number, choose every 10th song in the list.

Strategy

For each sample, decide if each song in the population has an equal chance of being selected.

Step 1

Test Method A.

This does not yield a random sample. Songs with numbers from 016 to 485 have no chance of being chosen.

Step 2

Test Method B.

This creates a random sample. Each song has an equal chance of being selected.

Step 3

Test Method C.

This does not yield a random sample. Since only 30 songs will be selected, only songs numbered from 1 to 295 have a chance of being selected. Songs with numbers greater than 295 have no chance of being selected.

Solution

Method B will result in a random sample.

There are many reasons why a sample might be biased. Perhaps part of the population is not represented adequately or at all. In surveys, the people who are not included may have opinions that are not reflected in the sample.

Example 3

A park ranger estimates that there are 4,000 birch trees in a forest preserve. She wants to check a sample for possible insect damage. She selects 100 trees that are planted along the access roads.

Is this sample representative or biased? Explain.

Strategy Determine if the characteristics of the sample match the population.

Step 1 Compare the sample with the population.

The trees in the sample are limited to those along the access roads. The environment of these trees is different from that of the rest of the trees in the forest. The amount of rainfall and sunlight they receive, the space in which their roots can or cannot grow, and/or the number of times they are sprayed or treated by park staff may differ. As a result, they may be more or less likely to have insect damage than trees deeper in the forest.

Step 2 Do the sample and the population have the same characteristics?

No, they most likely do not.

Step 3 Decide if the sample is biased.

The sample is biased because the sample and population are likely to have different characteristics. Also some members of the population are more likely to be chosen than others.

Solution The sample is biased because trees near the roads may not be representative of all the trees in the forest preserve.

Selecting a random and representative sample makes it more likely that inferences made about the larger population are accurate. Inferences often involve proportional thinking. For example, if one-third of the people in a representative sample have ages under 20, then you can estimate that one-third of the people in the larger population are probably younger than 20.

Example 4

A large high school has 3,000 students. During a one-week period, 75 students were selected at random at various times of the day. Each student was asked if he or she had one or more social media accounts. The survey found that 3 out of 75 students did not have any social media accounts. Estimate the number of students in the entire school who do not have social media accounts.

Strategy Write and solve a proportion.

Step 1 Write the ratio comparing the students who do not have social media accounts to all the students in the sample.

$$\frac{3}{75}$$

Step 2

Write and solve a proportion.

Use x for the number of students in the school who do not have social media accounts.

$$\frac{3}{75} = \frac{x}{3,000}$$

$$3 \cdot 3,000 = 75 \cdot x$$

$$9,000 = 75x$$

$$\frac{9,000}{75} = \frac{75x}{75}$$

$$120 = x$$

Solution

It is likely that about 120 of the 3,000 students in the school do not have any type of social media account.

Example 5

Each month a manufacturing plant makes 14,500 light bulbs. Last month, a random sample of 200 bulbs found that 2.5% were defective. Estimate the number of defective bulbs that were produced last month.

Strategy

Write and solve a proportion.

Step 1

Use proportional reasoning.

2.5% = 0.025, so to find 2.5% of 14,500, multiply by that decimal!

$$0.025 \times 14,500 = 362.5$$

Step 2

Is it likely that exactly 362.5 bulbs were defective last month?

Since the number of defective light bulbs will be a whole number, not a fraction, 362.5 is not the exact number. A good estimate is 363.

The plant manager should expect that about 363 bulbs were defective. The actual number may be slightly more or slightly less than that, but if the sample was representative, it should be close to that estimate.

Solution

It is likely that about 363 bulbs produced last month were defective. That is an estimate, not the exact number of bulbs that were defective.

A large university has 24,000 students. A randomly selected sample of 750 students were surveyed and asked how far away they live from the university. Of those surveyed, 120 students live more than 500 miles away from the university. Based on the survey results, what is an estimate of the number of students who live within 500 miles of the university?

There are _____ students in the sample.

Since 120 students live more than 500 miles away, the number of students surveyed who live within 500 miles of the university is: _____ - 120 = _____

Use the ratio $\frac{\square}{750}$ to write a proportion. Let w represent the number of students living within 500 miles of the university. Then solve for w .

$$\frac{\square}{750} = \frac{w}{\square}$$

$$\underline{\hspace{2cm}} \cdot \underline{\hspace{2cm}} = 750w$$

$$\underline{\hspace{2cm}} = 750w$$

$$\frac{\underline{\hspace{2cm}}}{750} = \frac{750w}{750}$$

$$\underline{\hspace{2cm}} = w$$

An estimate based on the survey results would be that about _____ students live within 500 miles of the university.

3 LESSON PRACTICE

1 Sheri wants to know how the 1,090 students at her school feel about after-school art programs. She needs to select a sample that is representative of the school to conduct a survey. Which of these samples is most likely to represent the population?

- A. 50 students in the spring musical
- B. 50 students from the school mailing list
- C. 50 students who are studying art
- D. 50 students at a school football game

2 An English teacher wants to know the mean number of words students included in recent essays. He randomly chooses 20 essays submitted by 180 students. He records the word count of each one. His data are shown below.

250	320	330	340
500	330	360	210
280	295	315	270
350	320	275	410
380	305	255	300

Which is a reasonable prediction of the number of words in a typical essay turned in by one of the teacher's students?

- A. 270
- B. 290
- C. 300
- D. 320

3 Some students are conducting surveys to find out if adults in their town will vote to fund a new city park. Which of the following samples will be most representative of the voting population?

- A. Lavonne asks 20 parents of her friends.
- B. Quentin asks every other person leaving the library until he has asked 20 people.
- C. Ruth calls 20 randomly selected adults in town.
- D. Vince sends surveys to 40 local business owners and receives 20 responses.

4 In a random sample of DVDs that were mailed out as rentals, 13 out of 200 DVDs were scratched. Which of the following proportions can be used to predict how many out of 50,000 rental DVDs will **not** be scratched?

- A. $\frac{x}{200} = \frac{13}{50,000}$
- B. $\frac{x}{13} = \frac{200}{50,000}$
- C. $\frac{x}{50,000} = \frac{13}{200}$
- D. $\frac{x}{50,000} = \frac{187}{200}$

- 5** A travel club has 3,000 members. A random sample of 50 of the club members found that 12 people like mountain vacations best. Which statement is **not** supported by the sample data?
- A.** Twenty-four percent of those sampled say they like mountain vacations best.
 - B.** An estimated 720 club members would likely say they enjoy mountain vacations best.
 - C.** Almost one-quarter of club members would likely say they enjoy mountain vacations best.
 - D.** More than 2,500 club members would likely say they prefer other vacations over mountain vacations.

- 6** A quality control inspector at a clothing manufacturer is checking to make sure collars on shirts are sewn correctly. Twenty shirts are randomly chosen and 3 have defective collars. Shirts that are defective are discarded. Based on this sample, how many shirts do you predict are likely to be discarded in a week when 500 shirts are produced?
- A.** 17
 - B.** 20
 - C.** 75
 - D.** 425

Paolo wants to know how many of the 500 students at his school have at least one pet. He wants to survey a sample of 20 students. Use this information for questions 7 and 8.

- 7** Which of the following methods will result in a random sample?
- A.** Paolo assigns a number to each student at school. He writes the numbers on slips of paper, randomly chooses 20 numbers, and surveys those students.
 - B.** Paolo puts up a sign that asks students to voluntarily record the number of pets they have. He takes the first 20 students.
 - C.** Paolo randomly surveys one boy and one girl at each lunch table during school lunch until he has surveyed 20 people.
 - D.** Paolo asks 20 out of 40 teachers at the school to randomly choose one student for the survey.
- 8** Twelve out of 20 students in Paolo's survey have at least one pet. If the sample is representative, which of the following inferences can be made?
- A.** Some students have more than one pet.
 - B.** More than half the students at the school are likely to have at least one pet.
 - C.** About 175 students are likely to have at least one pet.
 - D.** About 200 students are likely to have at least one pet.

- 9** Parents at a middle school were randomly selected to participate in a survey. Forty-two out of 60 parents who were surveyed support a proposal to buy new computers. There are 456 parents with students at the middle school. How many of these parents are likely to support the proposal?

A. 42 parents
B. 70 parents
C. 137 parents
D. 319 parents

- 10** A garden contains 60 plants. The plant varieties are daisies, zinnias, dahlias, and marigolds. There is an equal number of each kind of plant. Beth randomly chooses a sample of 5 plants. Her sample has 4 marigolds. Which statement is true?

A. Beth's sample is representative of the population because she chose the flowers randomly.
B. Beth's sample is not representative of the population because not all the plants are represented.
C. Beth's sample is representative of the population because some of the plants are represented.
D. Beth's sample is not representative of the population because she chose the plants randomly.

Parker and China work quality control at a sofa factory. Parker inspects a sofa from the assembly line every 10 minutes. China inspects every 10th sofa from the assembly line. One day, Parker inspected 52 sofas and found 1 defective sofa. China inspected 60 sofas and found 2 defective sofas. Use this information for questions 11 and 12.

- 11** What percent of Parker's sofas were defective and what percent of China's sofas were defective?

A. Parker: 0.02%; China: 0.03%
B. Parker: 0.2%; China: 0.3%
C. Parker: 1%; China: 2%
D. Parker: 2%; China: 3%

- 12** The factory produces around 620 sofas in one day. China found twice as many defective sofas than Parker. What is the most likely reason their results are so different?

A. Parker's sampling method is more representative of the population than China's.
B. China's sampling method is more representative of the population than Parker's.
C. Their results only differ by one sofa. A larger sample is needed for a more accurate representation of the population.
D. They were inspecting on different days.

13 A random sample is taken of people who have bought tickets for a concert. In the sample, 21 out of 150 people say they will contribute \$5.00 each toward a music scholarship for local high school students. If 3,500 people bought concert tickets, predict how much will be raised for the scholarship.

- A. \$105
- B. \$490
- C. \$2,450
- D. \$3,500

14 A musician produced 2,000 compact discs of his music. He sold 125 of the discs. Four were returned because they were defective. Based on the sample of discs sold, what is the predicted total number of defective discs?

- A. 40
- B. 64
- C. 80
- D. 128

15 Kris and Aubrey want to know how students in their school feel about a new after-school program being developed.

Part A

Kris picks every fifth name from a list of the 500 students enrolled at the school and e-mails them a survey. She waits for responses and records data from the 53 surveys that are returned to her. Is her sample biased? Explain your answer.

Part B

Aubrey picks every 20th name from the same list of students. He calls each one and asks for his or her opinion. How many fewer responses did Aubrey collect than Kris? Is Aubrey's sample more or less representative of the population of the school than Kris's? Explain your answer.

Comparing Data Distributions Using Measures of Center and Variability

1 GETTING THE IDEA

Two groups of numeric data can be compared by analyzing their line plots or box plots, which allow you to compare their **measures of center**, **measures of variability**, and overall shape.

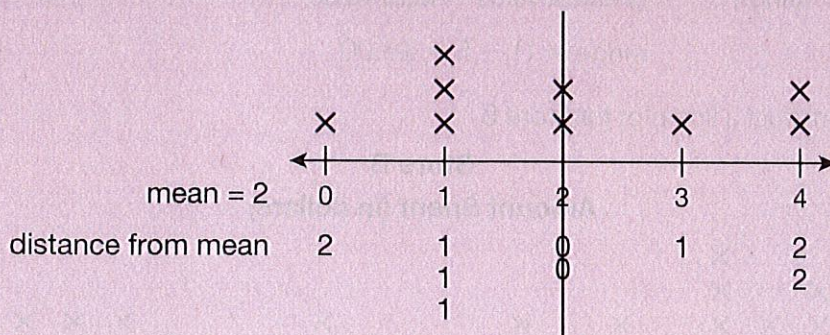
Measures of center include the **mean** and the **median**. These describe the “center” of a group of data. The mean is the sum of the values in the data group divided by the number of values in the group. The median is the middle number in a group of numeric data ordered from least to greatest.

Measures of variability describe the spread of a data set. For example, **range** is the difference between the greatest value and the least value in a group of numeric data.

Interquartile range (IQR) is another measure of variability. **Quartiles** divide the data set into four equal parts. The **first quartile (Q1)** is the median of the lower half of the data. The **third quartile (Q3)** is the median of the upper half of the data. The interquartile range is the difference between the first and third quartiles ($Q3 - Q1$).

Another measure of variability is the **mean absolute deviation (MAD)**. It is the average distance between each data value and the mean. To find the MAD, first find the mean of the data, and then find the deviation of each value from the mean. For example, if the mean is 8, the deviation of 12 from the mean is $|8 - 12| = |-4| = 4$. Then add all the deviations and divide by the number of data values.

The diagram below shows how to determine the MAD of data shown on a line plot.



Since there are 9 data values, the MAD is the sum of all the deviations (distances from the mean) divided by 9.

$$2 + 1 + 1 + 1 + 0 + 0 + 1 + 2 + 2 = 10$$

$$\frac{10}{9} \approx 1.11$$

Example 1

Twelve customers leaving two different bookstores were chosen at random. They were asked how much they spent on that visit to the store. These are the data from the survey:

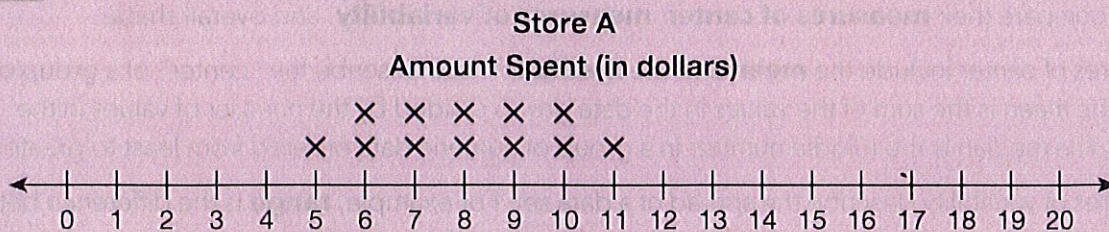
Store A (Amounts Spent in dollars): 8, 9, 6, 10, 7, 11, 5, 9, 6, 7, 10, 8

Store B (Amounts Spent in dollars): 4, 2, 16, 4, 12, 6, 8, 17, 2, 3, 4, 18

Display the data with line plots. Compare the amounts spent at the two bookstores using the line plots by comparing their centers, variabilities, and shapes. At which store do customers tend to spend more money?

Strategy Compare the two groups of data by comparing the means, medians, ranges, and shapes of the line plots.

Step 1 Construct a line plot for Store A.



Step 2 Find the mean, median, and range for Store A.

Mean: $\text{sum spent} = 5 + 6 + 6 + 7 + 7 + 8 + 8 + 9 + 9 + 10 + 10 + 11$
 $= \$96$

$\text{mean} = \frac{96}{12} = \8.00

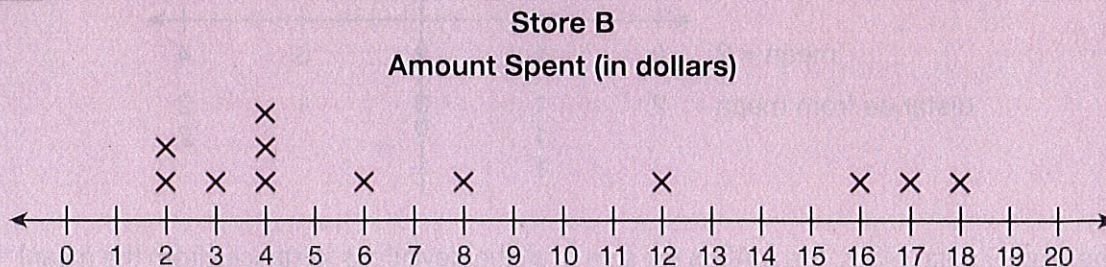
Median: There is an even number of data values, so the median is the mean of the two middle numbers, which are both 8.

$\text{median} = 8$

Range: $\text{greatest value} - \text{least value}$

$\text{range} = 11 - 5 = \6.00

Step 3 Construct a line plot for Store B.



Step 4 Find the mean, median, and range for Store B.

Mean: $\text{sum spent} = 2 + 2 + 3 + 4 + 4 + 4 + 6 + 8 + 12 + 16 + 17 + 18$
 $= \$96$

$\text{mean} = \frac{96}{12} = \8.00

Median: There is an even number of data values, so the median is the mean of the two middle numbers, which are 4 and 6.

$\text{median} = \frac{4+6}{2} = \5.00

Range: greatest value – least value

$\text{range} = 18 - 2 = \16.00

Step 5 Compare the two sets of data.

The mean amount customers spent at both stores was \$8.

The median amount spent at Store A is \$8.00, while the median amount spent at Store B is \$5.00.

The range of amounts spent at Store A is \$6.00. At Store B, the range is \$16.00.

The line plots show that the amounts spent at Store B are more widely distributed.

The shape of the line plot for Store A shows the data clustered between \$5 and \$11. The shape of the line plot for Store B shows the data much more spread out, with gaps between some values.

From these small samples, it is impossible to tell at which store customers tend to spend more.

Solution The stores have the same mean, but there is much more variability in the amounts spent at Store B. It is impossible to tell at which store customers tend to spend more.

Example 2

Two chess clubs chose 10-person teams to compete in a chess tournament. The table below shows the ages of the people on the two teams.

Team A (age in years)	11	9	12	14	8	7	13	15	12	9
Team B (age in years)	18	12	26	14	9	19	21	24	15	12

Compare the ages of the people on the two teams using the mean and mean absolute deviation.

Strategy Calculate the means and mean absolute deviations.

Step 1 Calculate the mean for Team A.

$11 + 9 + 12 + 14 + 8 + 7 + 13 + 15 + 12 + 9 = 110$

$\frac{110}{10} = 11$

Step 2 Find the deviations for Team A.

Age	11	9	12	14	8	7	13	15	12	9
Mean	11	11	11	11	11	11	11	11	11	11
Absolute Deviation from Mean	0	2	1	3	3	4	2	4	1	2

Step 3 Calculate the mean absolute deviation for Team A.

$$0 + 2 + 1 + 3 + 3 + 4 + 2 + 4 + 1 + 2 = 22$$

$$\frac{22}{10} = 2.2$$

Step 4 Calculate the mean for Team B.

$$18 + 12 + 26 + 14 + 9 + 19 + 21 + 24 + 15 + 12 = 170$$

$$\frac{170}{10} = 17$$

Step 5 Find the deviations for Team B.

Age	18	12	26	14	9	19	21	24	15	12
Mean	17	17	17	17	17	17	17	17	17	17
Absolute Deviation from Mean	1	5	9	3	8	2	4	7	2	5

Step 6 Calculate the mean absolute deviation for Team B.

$$1 + 5 + 9 + 3 + 8 + 2 + 4 + 7 + 2 + 5 = 46$$

$$\frac{46}{10} = 4.6$$

Step 7 Compare the means.

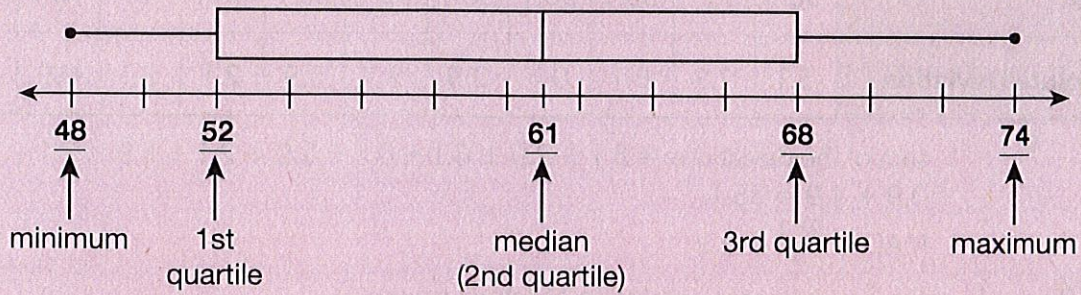
The mean age of the members of Team A is 11. The mean age for Team B is 17. On average, the people on Team B are older.

Step 8 Compare the mean absolute deviations.

For Team A, the mean absolute deviation is 2.2 years. For Team B, this is 4.6 years. There is more variability in the ages of the members of Team B.

Solution Members of Team B are generally older than the members of Team A, and their ages are more variable.

Line plots such as the ones in Example 1 are one way to visualize data. Another way is to use box plots. To draw a box plot, you need 5 values: the minimum, the maximum, the median, and the 1st and 3rd quartiles. The quartiles divide the data into four equal parts.



Example 3

Two samples of seeds were planted at the same time. Two different plant foods were used to nourish the plants as they grew. Here are the plant heights, in centimeters, from each sample, at the end of the experiment.

Plant Food A (heights in cm): 20, 19, 21, 18, 22, 24, 25, 17, 28, 26, 24

Plant Food B (heights in cm): 25, 33, 24, 30, 33, 28, 36, 28, 28, 31, 35

Calculate the mean and the MAD. Display the data with box plots. Compare the plant heights for the two plant foods using their centers, variabilities, and shapes. Which plant food seems to be more effective?

Strategy Use a double box plot to verify your comparisons.

Step 1 Calculate the mean for Plant Food A and Plant Food B.

Plant Food A: sum of heights = 244 cm

$$\text{mean} = \frac{244}{11} \approx 22.2 \text{ cm}$$

Plant Food B: sum of heights = 331 cm

$$\text{mean} = \frac{331}{11} \approx 30.1 \text{ cm}$$

Step 2 Calculate the mean absolute deviation for the data. Organize your work in a table.

Data for Plant Food A	20	19	21	18	22	24	25	17	28	26	24
Mean	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2
Absolute Deviation	2.2	3.2	1.2	4.2	0.2	1.8	2.8	5.2	5.8	3.8	1.8

$$\text{sum of the deviations} = 2.2 + 3.2 + 1.2 + 4.2 + 0.2 + 1.8 + 2.8 + 5.2 + 5.8 + 3.8 + 1.8 = 32.2$$

$$\text{MAD} = \frac{32.2}{11} \approx 2.9$$

Data for Plant Food B	25	33	24	30	33	28	36	28	28	31	35
Mean	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1
Absolute Deviation	5.1	2.9	6.1	0.1	2.9	2.1	5.9	2.1	2.1	0.9	4.9

sum of the deviations = $5.1 + 2.9 + 6.1 + 0.1 + 2.9 + 2.1 + 5.9 + 2.1 + 2.1 + 0.9 + 4.9 = 35.1$

$$\text{MAD} = \frac{35.1}{11} \approx 3.2$$

Step 3 Find the five measures needed to construct box plots.

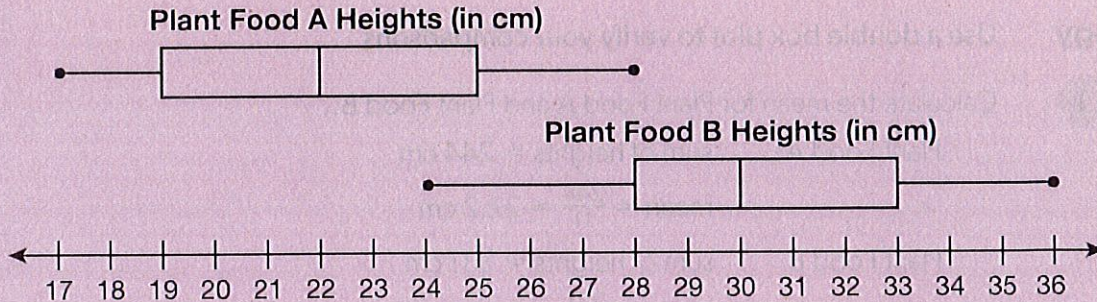
Order the values from least to greatest.

Plant Food A (heights in cm): 17, 18, 19, 20, 21, 22, 24, 24, 25, 26, 28

Plant Food B (heights in cm): 24, 25, 28, 28, 28, 30, 31, 33, 33, 35, 36

Plant Food	Minimum	1st Quartile	Median	3rd Quartile	Maximum
A	17	19	22	25	28
B	24	28	30	33	36

Step 4 Construct a double box plot.



Step 5 Find the range for Plant Food A and Plant Food B.

$$\text{Plant Food A: range} = 28 - 17 = 11 \text{ cm}$$

$$\text{Plant Food B: range} = 36 - 24 = 12 \text{ cm}$$

Step 6 Compare the height data for the two samples.

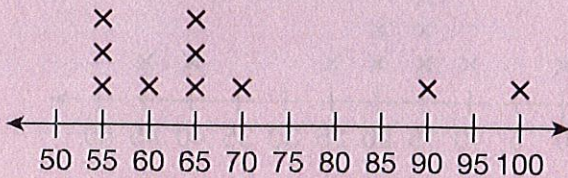
The MADs for both data sets are about 3, so the variability is about the same. The means and the medians are very different, while the ranges are about the same. The box plots verify this. The data in the two groups overlap to some extent.

Solution The mean absolute deviations for both data sets are about the same, so the two groups of data have about the same variability, but the mean and median heights are much greater for Plant Food B. This comparison is verified by the shapes of the box plots. So, Plant Food B seems to be quite a bit more effective.

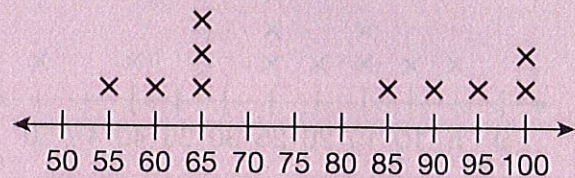
2 COACHED EXAMPLE

The students in Ms. Linden's math class took their midterm test last week. Ms. Linden asked students how many hours they studied and divided the test scores into two groups based on their responses. Below are line plots based on the groups' data.

Group A Test Scores
(Hours Studied: < 10)



Group B Test Scores
(Hours Studied: ≥ 10)



Use the line plots to compare the two sets of scores.

Calculate the mean for each group.

Group A: sum of scores = _____

Group B: sum of scores = _____

$$\text{mean} = \frac{\boxed{}}{\boxed{}} = \underline{\hspace{2cm}}$$

$$\text{mean} = \frac{\boxed{}}{\boxed{}} = \underline{\hspace{2cm}}$$

Calculate the median for each group.

$$\text{Group A: median} = \frac{\boxed{} + \boxed{}}{\boxed{}} = \underline{\hspace{2cm}}$$

$$\text{Group B: median} = \frac{\boxed{} + \boxed{}}{\boxed{}} = \underline{\hspace{2cm}}$$

Calculate the range for each group.

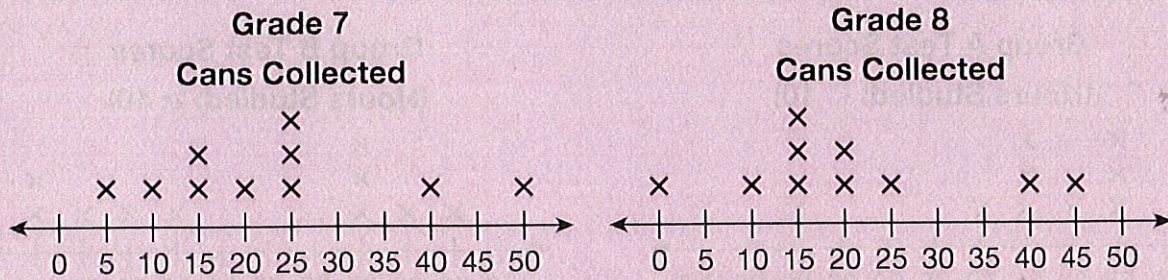
$$\text{Group A: range} = \underline{\hspace{1cm}} - \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

$$\text{Group B: range} = \underline{\hspace{1cm}} - \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

The two sets of scores have about the same _____, but the _____ are much greater for Group _____. This comparison is verified by the shapes of the _____.

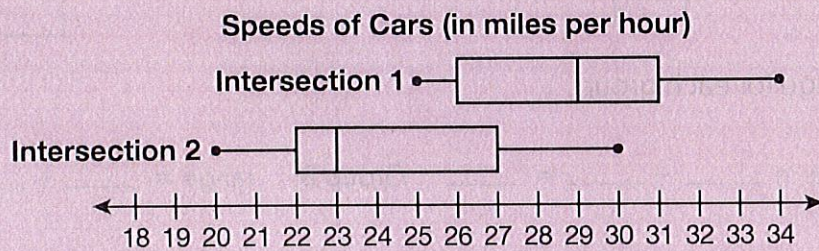
3 LESSON PRACTICE

- 1 Some students in Grade 7 and Grade 8 collected cans for recycling one week. Below are line plots for each group.



Which statement comparing the two groups of data is true?

- A. The mean number of cans collected by Grade 7 is less than the mean number of cans collected by Grade 8, and the ranges for both grades are the same.
 - B. The mean number of cans collected by Grade 7 is greater than the mean number of cans collected by Grade 8, and the ranges for both grades are the same.
 - C. The mean number of cans collected by Grade 7 is less than the mean number of cans collected by Grade 8, and the range for Grade 7 is greater than the range for Grade 8.
 - D. The mean number of cans collected by Grade 7 is greater than the mean number of cans collected by Grade 8, and the range for Grade 7 is less than the range for Grade 8.
- 2 Harry and Sharlene are doing a traffic survey. They record the speeds of cars passing through two different intersections. Below is a double box plot comparing the data.

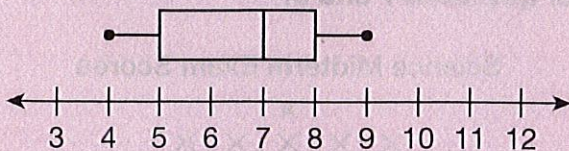


Which statement correctly compares the two groups of data?

- A. The median speed is higher for Intersection 1, but Intersection 2 has a much higher variability in speeds.
- B. The median speed is higher for Intersection 2, but Intersection 1 has a much higher variability in speeds.
- C. The median speed is higher for Intersection 1, but the variability in speeds is about the same for both intersections.
- D. The median speed is higher for Intersection 2, but the variability in speeds is about the same for both intersections.

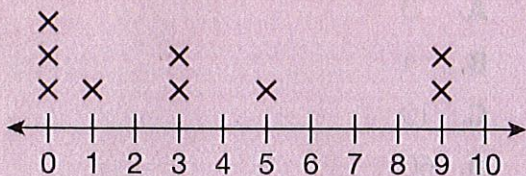
- 3 The box plot below represents the weights at birth of 7 puppies in a litter.

Weights of Puppies (in ounces)



A second litter of 7 puppies has the same median weight but a greater range. Which could be the weights, in ounces, of the puppies in the second litter?

- A. 10, 5, 7, 5, 7, 7, 7
 B. 11, 5, 7, 5, 6, 7, 7
 C. 11, 5, 7, 5, 6, 7, 6
 D. 10, 5, 7, 5, 6, 7, 6
- 4 The line plot below shows the number of runs Team A scored in each of the last 9 games.



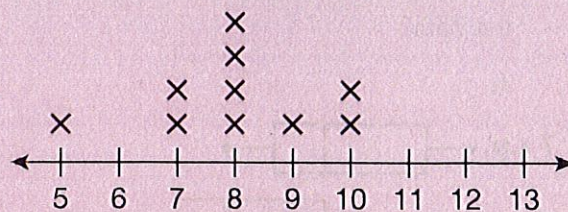
The median number of runs scored by Team B in each of the last 9 games is the same as the median number of runs scored by Team A, but the mean number of runs scored by Team B is greater. Which could be the number of runs scored by Team B in each of the last 9 games?

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

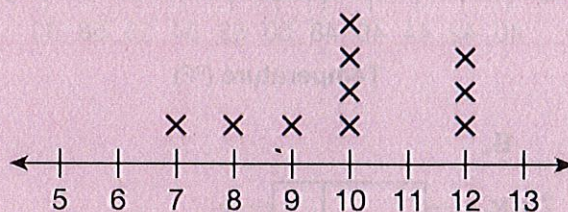
- 5 The line plots below show the individual scores for the members of the two teams left competing in a Science Olympiad.

Individual Scores in Science Olympiad

Team A



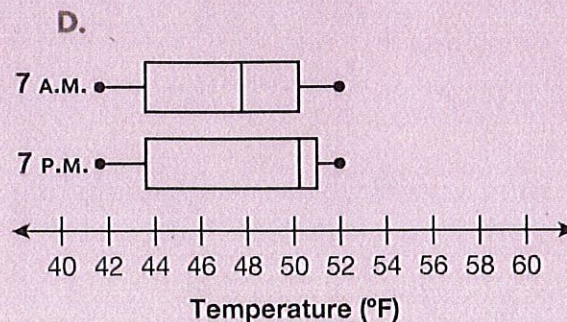
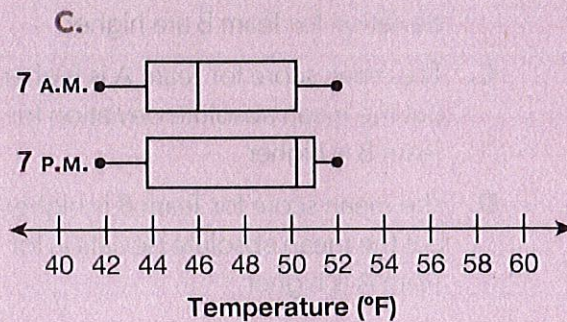
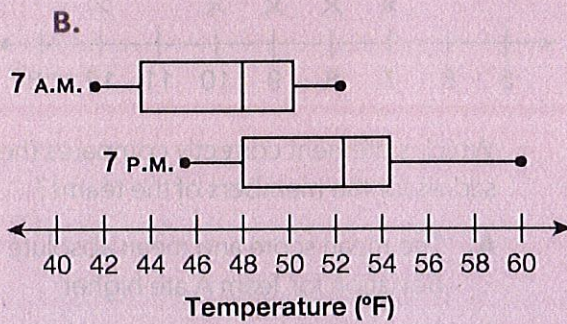
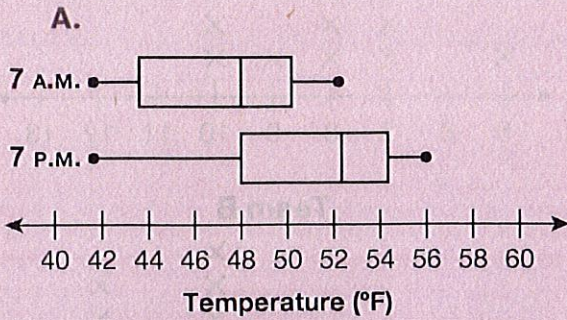
Team B



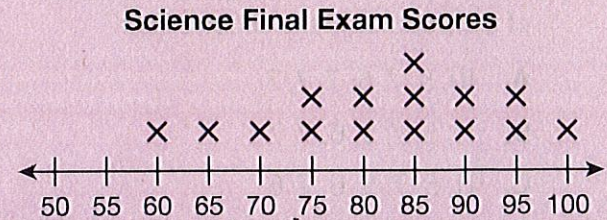
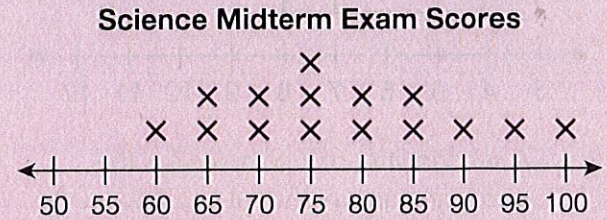
Which statement correctly compares the scores for the members of the teams?

- A. The mean score and mean absolute deviation for Team A are higher.
 B. The mean score and mean absolute deviation for Team B are higher.
 C. The mean score for Team A is higher, but the mean absolute deviation for Team B is higher.
 D. The mean score for Team B is higher, but the mean absolute deviation for Team A is higher.

- 6 Sue recorded the temperature at 7 A.M. and 7 P.M. each day for two weeks. The range of temperatures for both times was the same, but the median temperature at 7 P.M. was 4°F greater than at 7 A.M. Which double box plot could represent the data?

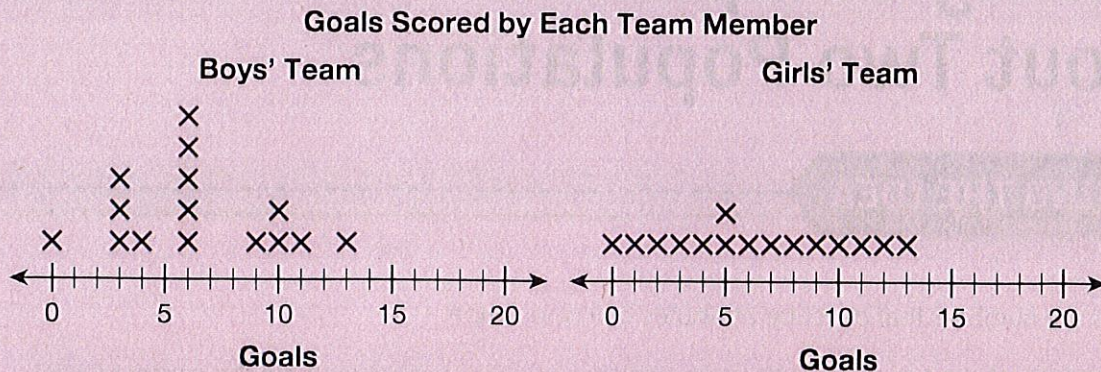


The line plots below show students' scores on the science midterm exam and the science final exam. Use the line plots for questions 7 and 8.



- 7 How many points greater was the mean score on the final exam than the mean score on the midterm exam?
- A. 0
B. 4
C. 10
D. 60
- 8 How many points greater was the mean absolute deviation for the final exam scores than the mean absolute deviation for the midterm exam scores?
- A. 0
B. 4
C. 10
D. 60

- 9 Below are line plots representing the number of goals scored by each member of the girls' soccer team and each member of the boys' soccer team over their seasons.



Part A

Calculate the mean number of goals for each team. Compare the average number of goals scored by the teams.

Part B

What is the mean absolute deviation for the number of goals scored by each team? Show your calculations. What can you say about the variability?