

Measures of Central Tendency



Getting the Idea

Measures of central tendency help to describe and interpret a data set. They are used to interpret the “average item” of a data set. The table below shows the measures of central tendency for this data set: 5, 1, 1, 6, and 7.

Measure of Central Tendency	Example
The mean is equal to the sum of the terms in a data set divided by the number of terms in the data set.	$\text{mean} = \frac{\text{sum of terms}}{\text{number of terms}}$ $\text{mean} = \frac{5 + 1 + 1 + 6 + 7}{5} = \frac{20}{5} = 4$
The median is the middle term in a data set ordered from least to greatest. If there is an even number of terms in a data set, the median is the mean of the two middle numbers.	<p>The data ordered from least to greatest are: 1, 1, <u>5</u>, 6, 7.</p> <p>The middle term, 5, is the median.</p>
The mode is the term or terms that appear most often in a data set. A data set may have no mode, one mode, or more than one mode.	<p>5, <u>1</u>, <u>1</u>, 6, 7</p> <p>The number 1 appears twice in the data set. Every other number appears only once. So, 1 is the mode.</p>

Example 1

The scores on a science quiz are: 7, 7, 9, 7, 10, 8, 6, 9, 10, and 7.

What are the mean, median, and mode of the science quiz scores?

Strategy Calculate each measure of central tendency.

Step 1

Find the mean.

Add the values and then divide the sum by the number of values.

$$7 + 7 + 9 + 7 + 10 + 8 + 6 + 9 + 10 + 7 = 80$$

$$80 \div 10 = 8$$

Step 2

Find the median.

Order the values from least to greatest.

$$6, 7, 7, 7, \underline{7}, \underline{8}, 9, 9, 10, 10$$

There is an even number of terms.

The two middle values are 7 and 8.

Find the mean of the two middle values.

$$(7 + 8) \div 2 = 15 \div 2 = 7.5$$

Step 3

Find the mode.

The value that occurs most frequently is 7.

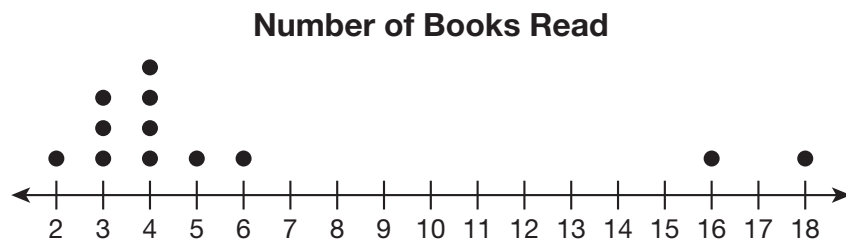
Solution **The mean is 8, the median is 7.5, and the mode is 7.**

To choose which measure of central tendency is most appropriate for a situation, look at the distribution of the ordered data from a sample. If there is a value that is much less or much greater than the other values in the set of data, the median or mode better represents the sample data than the mean. If the mode occurs at either extreme of the data, the mean or the median are better choices to represent the sample data.

Some data sets are shown on a **dot plot**, which is a display that uses a number line and dots to show data.

Example 2

Karen randomly surveyed some classmates to see how many books each of them read over the summer. The results of her survey are shown in the dot plot.



How does the mode compare to the median number of books read?

Strategy **Find the median and the mode. Compare the measures.**

Step 1

Find the median.

Use the data points shown on the dot plot.

Median: 2, 3, 3, 3, 4, **4, 4**, 4, 5, 6, 16, 18

The two middle values are 4.

The median is 4.

Step 2

Find the mode.

Mode: 2, 3, 3, 3, **4, 4, 4, 4**, 5, 6, 16, 18

The mode is 4.

Step 3

Compare the measures.

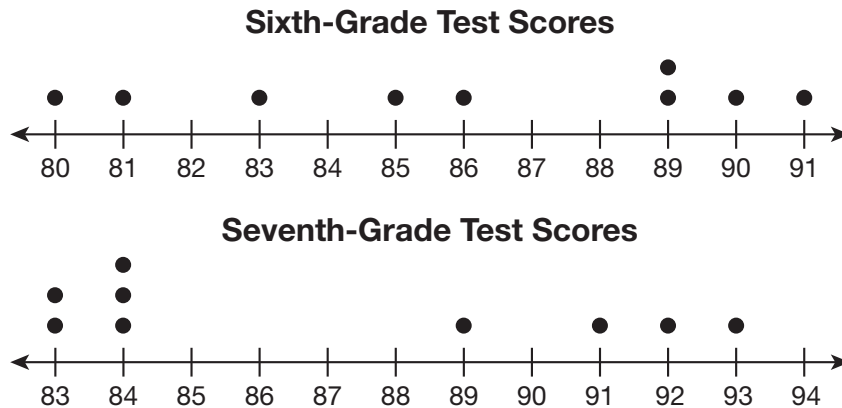
The median and the mode are the same.

Solution **The median and the mode are both 4.**

You can use measures of central tendency to make inferences about two populations.

Example 3

The dot plots show the test scores of students in Mr. Coen's sixth- and seventh-grade English classes.



Are the test scores of the seventh graders generally higher than the test scores of the sixth graders?

Strategy Find the measures of central tendency for each data set. Analyze and compare them.

Step 1

Find the mean, median, and mode of the sixth-grade test scores.

Use the data points shown on the dot plot.

$$\text{Mean: } \frac{80 + 81 + 83 + 85 + 86 + 89 + 89 + 90 + 91}{9} = \frac{774}{9} = 86$$

The mean is 86.

Median: 80, 81, 83, 85, **86**, 89, 89, 90, 91

The median is 86.

Mode: 80, 81, 83, 85, 86, **89, 89**, 90, 91

The mode is 89.

Step 2

Find the mean, median, and mode of the seventh-grade test scores.

$$\text{Mean: } \frac{83 + 83 + 84 + 84 + 84 + 89 + 91 + 92 + 93}{9} = \frac{783}{9} = 87$$

The mean is 87.

Median: 83, 83, 84, 84, **84**, 89, 91, 92, 93

The median is 84.

Mode: 83, 83, **84, 84, 84**, 89, 91, 92, 93

The mode is 84.

Step 3

Compare the measures of central tendency.

The sixth-grade mean is 86, and the seventh-grade mean is 87.

The seventh-grade mean is one point higher than the sixth-grade mean.

The sixth-grade median is 86, and the seventh-grade median is 84.

The sixth-grade median is two points higher than the seventh-grade median.

The sixth-grade mode is 89, and the seventh-grade mode is 84.

The sixth-grade mode is four points higher than the seventh-grade mode.

Step 4

Analyze the data.

All the data points are close together in both grades.

The mean, median, and mode for each data set are close to most of the data points.

The question does not ask for the most common test scores, so the mode is not the best measure to use to compare the data sets.

The sixth-grade median is slightly higher than the seventh-grade median, while the seventh-grade mean is slightly higher than the sixth-grade mean. The “average” test scores are close for both classes.

Solution

The test scores of the seventh graders are not generally higher than the test scores of the sixth graders.

Example 4

Students in Mrs. Becker's class and Mr. Roland's class sold boxes of popcorn for a school fund-raiser. The tables below show the number of boxes that each student sold.

Popcorn Boxes Sold

Mrs. Becker's Class				Mr. Roland's Class			
5	8	76	15	9	10	12	20
16	84	7	12	8	34	6	27
17	11	13		14	10	3	51

How does the average number of boxes sold by each class compare?

Strategy Find the measures of central tendency for each data set. Analyze and compare them.

Step 1

Find the mean, median, and mode of Mrs. Becker's class.

$$\text{Mean: } \frac{5 + 8 + 76 + 15 + 16 + 84 + 7 + 12 + 17 + 11 + 13}{11} = \frac{264}{11} = 24$$

Median: 5, 7, 8, 11, 12, **13**, 15, 16, 17, 76, 84

The median is 13.

There is no mode since no value appears more than once.

Step 2

Find the mean, median, and mode of Mr. Roland's class.

$$\text{Mean: } \frac{9 + 10 + 12 + 20 + 8 + 34 + 6 + 27 + 14 + 10 + 3 + 51}{12} = \frac{204}{12} = 17$$

Median: 3, 6, 8, 9, 10, **10, 12**, 14, 20, 27, 34, 51

Find the mean of the two middle values, 10 and 12.

$$(10 + 12) \div 2 = 22 \div 2 = 11$$

The median is 11.

Mode: 3, 6, 8, 9, **10, 10**, 12, 14, 20, 27, 34, 51

The mode is 10.

Step 3

Compare the measures of central tendency.

The mean for Mrs. Becker's class is greater than the mean for Mr. Roland's class.

The median for Mrs. Becker's class is greater than the median for Mr. Roland's class.

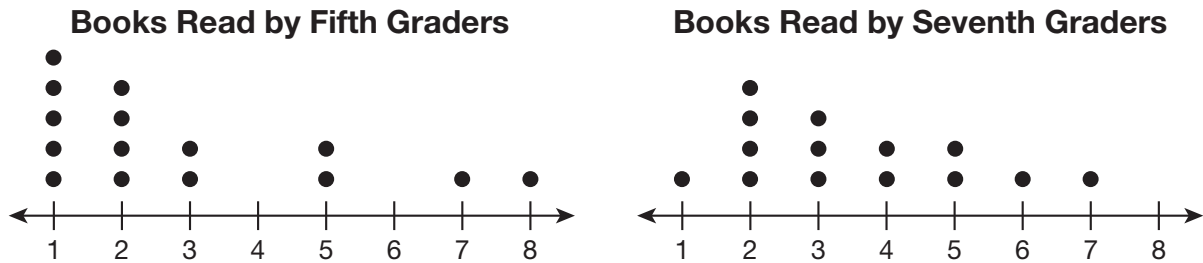
There is only one mode, so you cannot compare them.

Solution The average number of boxes sold by Mrs. Becker's students was greater than the average number sold by Mr. Roland's students.



Coached Example

The dot plots show the number of books read by fifth graders and by seventh graders during one month.



How does the average number of books read by the fifth graders compare to the average number of books read by the seventh graders?

Find the mean number of books read by fifth graders to the nearest tenth:

The mean is _____.

Find the median number of books read by fifth graders:

The median is _____.

Find the mean number of books read by seventh graders to the nearest tenth:

The mean is _____.

Find the median number of books read by seventh graders:

The median is _____.

The mean number of books read by the fifth graders is _____, while the mean number of books read by the seventh graders is _____.

The median number of books read by the fifth graders is _____, while the median number of books read by the seventh graders is _____.

The seventh graders read about an average of _____ book than the fifth graders.

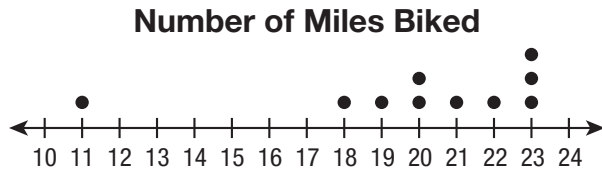


Lesson Practice

Choose the correct answer.

Use the dot plot for questions 1–3.

The dot plot shows the number of miles Jamal biked per week for ten weeks.



- What is the mean number of miles that Jamal biked per week?
 - 20 miles
 - 20.5 miles
 - 21 miles
 - 23 miles
- What is the median number of miles that Jamal biked per week?
 - 19 miles
 - 20 miles
 - 20.5 miles
 - 21 miles
- Which measure of central tendency best represents the average number of miles that Jamal biked per week?
 - mean or mode
 - mean or median
 - median or mode
 - mean, median, or mode

Use the tables for questions 4 and 5.

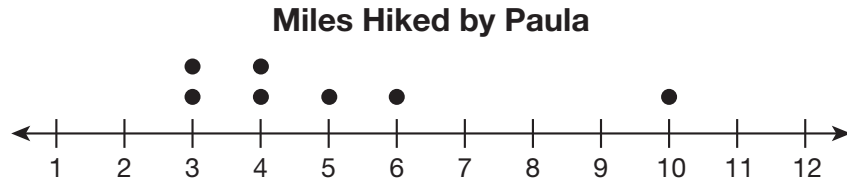
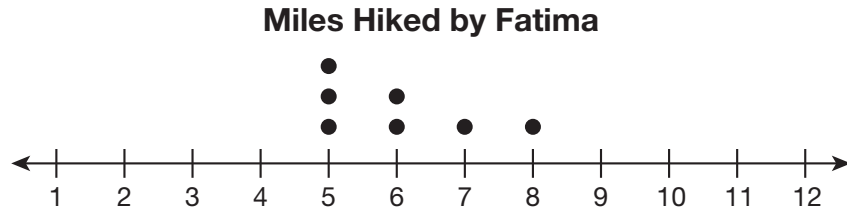
The tables show the quiz scores of students in two seventh-grade social studies classes.

Quiz Scores

Class A				Class B			
9	8	8	9	9	10	8	10
10	9	8	10	10	9	10	6
9	9	10		5	7	8	10

- Which best describes the comparison between the mode quiz scores?
 - The modes are the same.
 - The mode score for Class A is 2 points higher than for Class B.
 - The mode score for Class A is 1 point higher than for Class B.
 - The mode score for Class A is 1 point lower than for Class B.
- Which best describes the comparison between the mean quiz scores?
 - The means are the same.
 - The mean score for Class A is 0.5 point higher than for Class B.
 - The mean score for Class A is 1 point higher than for Class B.
 - The mean score for Class A is 1 point lower than for Class B.

6. The dot plots show the number of miles hiked by Fatima and by Paula over one week.



- A. How does the median number of miles hiked by Fatima compare to the median number of miles hiked by Paula? Show your work.

- B. How does the mean number of miles hiked by Fatima compare to the mean number of miles hiked by Paula? Show your work.

7. Find the measures of central tendency for the set of numbers below. Draw a line from each measure of central tendency to its value.

26, 28, 28, 28, 29, 30, 31, 32

- | | | |
|-----------|---|--------|
| A. mean | ● | ● 28 |
| B. median | ● | ● 28.5 |
| C. mode | ● | ● 29 |

8. Merida completed math problems from her homework packet each night. Below is a list of the numbers of problems she completed each night. Find the measures of central tendency. Circle each measure of central tendency.

2, 7, 5, 9, 7, 4, 8

mean =

6
7
8
9

median =

6
7
8
9

mode =

6
7
8
9

9. Daniel kept track of the miles he ran each day for 2 weeks. The distances are displayed in the table below.

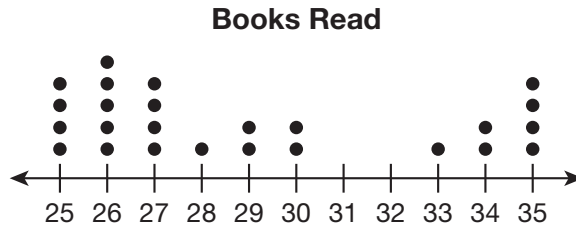
4	3	4	3	2	4	6
2	4	1	4	4	5	3

Determine whether each number below is a measure of central tendency for the set of data. Write each number in the correct box.

2	2.5	3	3.5	4	4.5	5
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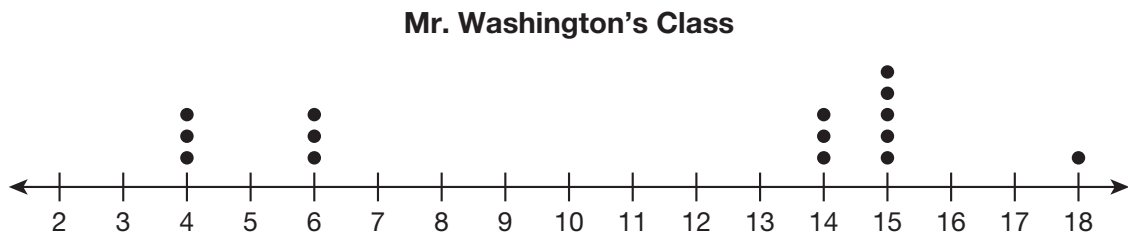
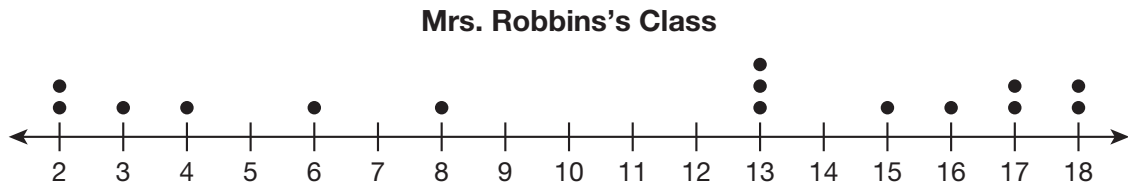
Measure of Central Tendency	Not a Measure of Central Tendency

10. Which is a measure of central tendency for the dot plot? Circle all that apply.



- A. 26
- B. 27
- C. 28
- D. 29
- E. 30
- F. 31

11. Seventh-grade students are selling popcorn tins for a fund-raiser. The dot plots below show the number of popcorn tins each student sold in two classes. Compare the two dot plots of data. Select True or False for each statement.



- A. The mean of Mrs. Robbins's class data and the mean of Mr. Washington's class data are the same. True False
- B. The median of Mrs. Robbins's class data is greater than the median of Mr. Washington's class data. True False
- C. The mode of Mr. Washington's class data is the greatest measure of central tendency for his class's data. True False
- D. The mean of Mrs. Robbins's class data is 11. True False