11-4 Measures of Central Tendency and Range

MAIN IDEA

Find the mean, median, mode, and range of a set of data.

New Vocabulary

measures of central tendency
mean
median
mode
range

Math Online

glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

GET READY for the Lesson

OLYMPIC MEDALS Use the table to answer each question.

1. What number(s) appear the most in the bronze category?
2. What is the *average* number of medals won by the United States in the bronze category?
3. Place the numbers in the bronze category in order from least to greatest. What is the middle number?

United States' Summer Olympics Medals 1972–2004

Year	Gold	Silver	Bronze
1972	33	31	30
1976	34	35	25
1980	0	0	0
1984	83	61	30
1988	36	31	27
1992	37	34	37
1996	44	32	25
2000	40	24	33
2004	35	39	29

Source: United States Olympic Committee

Measures of central tendency are numbers that describe the center of a set of data. The most common measures are **mean**, **median**, and **mode**. The **range** is also used to describe a set of data.

Measures of Central Tendency and Range — Concept Summary

Measure	Description
mean	sum of the data divided by the number of items in the set
median	middle number of the data ordered from least to greatest, or the mean of the middle two numbers
mode	number or numbers that occur most often
range	difference between the greatest number (maximum) and least number (minimum) in a set of data

DAY 5

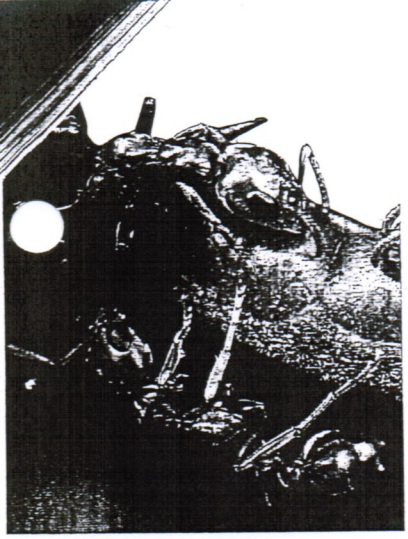
EXAMPLE 1 Find Measures of Central Tendency and Range

The ages, in years, of the people seated at a table are 22, 18, 24, 32, 24, 18. Find the mean, median, mode, and range of the set of data.

Mean $\frac{22 + 18 + 24 + 32 + 24 + 18}{6} = \frac{138}{6}$ or 23 years old

Median 18, 18, 22, 24, 24, 32 — Arrange in order from least to greatest.

$\frac{22 + 24}{2} = 23$ years old



Mode The data set has two modes, 18 and 24 years old.

Range 32 − 18 or 14 years

CHECK Your Progress

a. The prices of parking at several lots are listed below. Find the mean, median, mode, and range. Round to the nearest cent.

$3, $2.50, $6, $5.50, $3, $4.25

Sometimes one or two measures of central tendency or the range are more representative of the data than the other measure(s).

Real-World Link
There are at least one million insects for each of the world's humans.
Source: *Top Ten of Everything*

Real-World EXAMPLE

(2) INSECTS **Select the appropriate measure of central tendency or range to describe the data in the table. Justify your reasoning.**

Most Common Insects	
Species	**Number of Known Species (thousands)**
Beetles	400
Butterflies and Moths	165
Ants, Bees, and Wasps	140
True Flies	120
Bugs	90
Caddisflies	10

Source: *Top Ten of Everything*

Find the mean, median, mode, and range of the data.

Mean

$$\frac{400 + 165 + 140 + 120 + 90 + 10}{6}$$

$$= \frac{924}{6} \approx 154.2$$

The mean is about 154.2 thousand.

Study Tip
Median
Since there are two middle numbers, the median is the mean of the middle two numbers.

Median Arrange the numbers from least to greatest.

10, 90, 120, 140, 165, 400

The median is $\frac{120 + 140}{2}$ or 130 thousand.

Mode Since each number only occurs once, there is no mode.

Range 400 − 10 or 390 thousand

Since beetles, butterflies, and moths are the only insects with a greater number of known species than the mean, the mean is *not* the appropriate measure of central tendency.

Since there is no mode, the median is the appropriate measure of central tendency. The range tells us that the spread of the data is 390 thousand.

CHECK Your Progress

b. **COMPUTERS** Select the appropriate measure of central tendency or range to describe the data in the table. Justify your reasoning.

Computer Model	Hard Drive (gigabytes)
L100	40
L150	80
NX250	40
NX300	120
PC150	40
PC250	40

Different circumstances determine which measure of central tendency or range is most appropriate to describe a set of data.

Study Tip

Range
The range of a data set gives the spread, or how far the values are spread out. Use the range when you want to describe the spread.

Using Mean, Median, and Mode — Concept Summary

Measure	Most Useful When...
mean	the data have no extreme values
median	the data have extreme values there are no big gaps in the middle of the data
mode	the data have many identical numbers

TEST EXAMPLE

(3) **Spencer has the following scores on five quizzes: 90, 85, 80, 75, and 90. If his teacher drops his lowest score, which of the following statements would be true?**

A The mean would decrease.
B The mean would increase.
C The median would decrease.
D The median would not change.

Read the Item

You need to find which statement would be true if the lowest score, 75, is dropped.

Solve the Item

The mean of the five quizzes is $\frac{90 + 85 + 80 + 75 + 90}{5}$ or 84. The mean of the four quizzes is $\frac{90 + 85 + 80 + 90}{4}$ or 86.25. Since the mean increased, you can eliminate answer choice A.

Find the median to check the other answer choices. Arrange the numbers from least to greatest, with and without the lowest score.

75, 80, (85) 90, 90 — 80, 85, 90, 90 — (87.5)

Since the median increased from 85 to 87.5, you can eliminate answer choices C and D. So, the answer is B.

mean before deposit
$\frac{35+10+25+50}{4}$
$\frac{120}{4} = \$30$

median before deposit
10, 25, 35, 50
$\frac{25+35}{2} = 30$
median after 10, 25, 35, 44, 50

CHECK Your Progress

c. Darci deposited \$35, \$10, \$25, and \$50 into her savings account last month. If she deposits \$44 this week, which of the following statements about the data set would be true?

F The mean would decrease.
G The mean would not change.
H The median would increase.
J The mode would increase.

Check Your Understanding

Find the mean, median, mode, and range of each set of data. Round to the nearest tenth if necessary.

Example 1 (pp. 591–592)

1. the number of minutes spent on cell phone calls in one day
   19, 21, 18, 17, 18, 22, 46

2. the number of miles several employees commute to work
   10, 3, 17, 1, 8, 6, 12, 15

Example 2 (p. 592)

3. **TEACHERS** Select the appropriate measure of central tendency or range to describe the data in the table. Justify your reasoning.

Number of Years Teaching at South Middle School	
Ms. Malan	27
Mr. Sliger	11
Mrs. Lindley	9
Ms. Nolasco	6
Mr. Wyatt	5
Mrs. Clarke	3

Example 3 (p. 593)

4. **MULTIPLE CHOICE** Brianna studied 1 hour, 3 hours, 2 hours, and 2 hours over four days. If she would have studied 2 hours instead of 1 hour one of the days, which of the following would decrease?

   A mean C mode

   B median D range

Practice and Problem Solving

HOMEWORK HELP

For Exercises	See Examples
5–8	1
9, 10	2
22, 23	3

Find the mean, median, mode, and range of each set of data. Round to the nearest tenth if necessary.

5. the number of points scored each by five basketball players
   9, 8, 15, 8, 20

6. the ages, in years, of the Henderson family children
   23, 16, 5, 6, 14

7. the prices, in dollars, of several pairs of running shoes
   78, 80, 75, 73, 84, 81, 84, 79

8. the number of channels for various cable television plans
   36, 38, 33, 34, 32, 30, 34, 35

For Exercises 9 and 10, select the appropriate measure of central tendency or range to describe the data in each table. Justify your reasoning.

9.

Fastest Roller Coasters	
Coaster	Speed (mph)
Dodonpa	107
Kingda Ka	128
Millennium Force	93
Phantom's Revenge	82
Steel Dragon 2000	95
Superman: The Escape	100
Top Thrill Dragster	120
Tower of Terror	100

Source: Info Please

10.

Known Moons of Planets	
Planet	Number of Moons
Mercury	0
Venus	0
Earth	1
Mars	2
Jupiter	63
Saturn	34
Uranus	27
Neptune	13

Source: NASA

11. **FIELD TRIP** If Gregory earns an 85% average on five tests in Spanish, he can attend the class trip to the Hispanic Cultural Museum. His current test scores are 94%, 82%, 78%, and 80%. Find the minimum test score Gregory needs to earn on the fifth test in order to attend the class trip.

Real-World Link . . . . .
The 2004 Paralympic Summer Games were held in Greece and consisted of 19 sports, including the men's 100-meter race.

BIRDS For Exercises 12–14, use the table at the right.

12. Find the mean, median, mode, and range of the incubation periods of all the birds.

13. Select the appropriate measure of central tendency or range to describe the data. Justify your reasoning.

14. Using the measures of central tendency and the range of the parrots and of the cockatoos, determine which species, parrot or cockatoo, seems to have the greater incubation period. Justify your reasoning.

Number of Days of Incubation Periods for Pet Birds	
Australian King Parrot	20
Glossy Cockatoo	30
Major Mitchell's Cockatoo	26
Princess Parrot	21
Red-Tailed Cockatoo	30
Red-Winged Parrot	21
Regent Parrot	21
Superb Parrot	20
White-Tailed Cockatoo	29
Yellow-Tailed Cockatoo	29

15. **BASEBALL** The table gives the seating capacity of several baseball parks. Describe how the mean, median, mode, and range are each affected if the data for Yankee Stadium are not included.

Seating Capacity of Baseball Parks	
Comerica Park	40,120
Tropicana Field	43,772
Jacobs Field	43,405
Yankee Stadium	56,937
Kauffman Stadium	40,793
U.S. Cellular Field	40,615

Source: *Major League Baseball Teams*

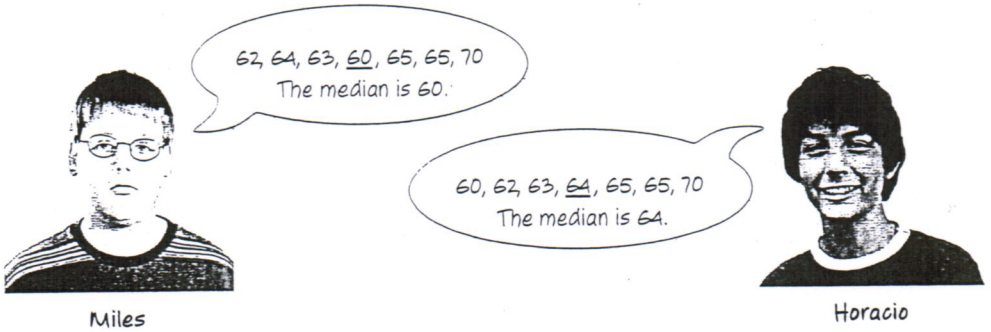
16. **RUNNING** Natalie runs 4 miles on Mondays, 3.5 miles on Wednesdays, and 4.5 miles on Fridays. Describe how the mean, median, mode, and range would each be affected if Natalie chooses to add a 3.5-mile jog on Sundays.

EXTRA PRACTICE
See pages 697, 710.

H.O.T. Problems

17. **OPEN ENDED** Construct a set of data that has a mode of 10 and a median of 7.

18. **FIND THE ERROR** Miles and Horacio are finding the median of 62, 64, 63, 60, 65, 65, and 70. Who is correct? Explain.



19. **REASONING** Determine whether the following statement is *sometimes*, *always*, or *never* true. Explain your reasoning.

All measures of central tendency must be members of the set of data.

20. **CHALLENGE** Give a counterexample to show that the following statement is false.

The median is always representative of the data.

21. **WRITING IN MATH** Write a problem that asks for the measures of central tendency. Use data from a newspaper or magazine. Tell which measure is most representative of the data.

TEST PRACTICE

22. The speeds, in miles per hour, of several cars on a busy street were clocked as 42, 38, 44, 35, 50, and 38. Which measure of data would make the speeds appear the fastest?

A mode

B median

C mean

D range

23. Isaac earned the following by mowing lawns: \$25, \$20, \$30, and \$25. If he earns another \$30, which of the following statements would be true?

F The mode would not be affected.

G The mean would decrease.

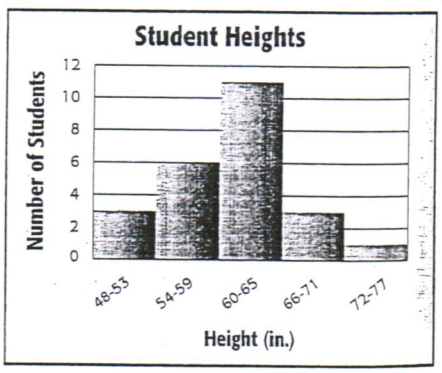
H The median would decrease.

J The mean would increase.

Spiral Review

24. **FOOD** Makayla surveyed the students in her class regarding their favorite school lunch. Fifty-two percent voted for pizza, 25% voted for nachos, 15% voted for cheeseburgers, and 8% voted for salad. Make a circle graph of the data. (Lesson 11-3)

HEIGHTS For Exercises 25 and 26, use the histogram at the right. (Lesson 11-2)



25. How many students are at least 60 inches tall?

26. How many students are between 54 and 71 inches tall?

27. **SPEED** If a car travels an average of 58 miles per hour, how far will it travel in 3.5 hours? (Lesson 4-3)

GET READY for the Next Lesson

PREREQUISITE SKILL Order each set of rational numbers from least to greatest. (Lesson 2-2)

28. 3.1, 3.25, 3.2, 2.9, 2.89

29. 91.3, 93.1, 94.7, 93.11, 93

30. 17.4, 16.8, 16.79, 15.01, 15.1