GRADE 7 · UNIT 13 · LESSON 1

# Effects of Outliers

**MA.7.DP.1.1**

I can find the mean, median, range and interquartile range of a data set and tell how an outlier changes each.

# Warm-Up

1. Solve: $3x + 7 = 22$
2. Solve: $n + 7 \leq 3$
3. Order from least to greatest: $2.5,\ -3,\ 0,\ -1.2,\ \frac{1}{2}$
4. Find the mean: 6, 9, 4, 13

# Warm-Up

1. Solve: $3x + 7 = 22$ $x = 5$

2. Solve: $n + 7 \leq 3$ $n \leq -4$

3. Order from least to greatest: $2.5,\ -3,\ 0,\ -1.2,\ \frac{1}{2}$

   $-3,\ -1.2,\ 0,\ \frac{1}{2},\ 2.5$

4. Find the mean: 6, 9, 4, 13 **8**

# Vocabulary

**measure of center**

one number for the middle of the data: the mean or the median

**measure of variation**

one number for how spread out the data are: the range or the interquartile range

**quartiles**

Q1 is the median of the lower half of the data; Q3 is the median of the upper half

**interquartile range (IQR)**

Q3 – Q1: how spread out the middle half of the data is

# Vocabulary

**outlier**

a value far from the rest of the data

**line plot**

a number line with a mark over each value (also called a dot plot)

**stem-and-leaf plot**

each value split into a stem (its tens) and a leaf (its ones), with a key

# Notes

## I. Two measures of center

Minutes read in 7 days: 15, 8, 20, 12, 24, 15, 18

**Mean: add the values, then divide by how many.**

$15 + 8 + 20 + 12 + 24 + 15 + 18 = 112$ and $112 \div 7 = 16$

**Median: the middle value of the list in order.**

8, 12, 15, 15, 18, 20, 24 The middle is 15.

Even count: 5, 8, 13, 21 halfway between 8 and 13: $(8 + 13) \div 2 = 10.5$

# Notes

## II. Two measures of variation

**Range = greatest – least.  IQR = Q3 – Q1, the middle half.**

Points in 8 games: 4, 6, 8, 9, 13, 15, 16, 21  Range: 21 – 4 = 17

Halves 4, 6, 8, 9 and 13, 15, 16, 21: Q1 = 7, Q3 = 15.5, IQR = 8.5

**Odd count: the median sits out.  8, 12, 14, 15, 18, 20, 24  (median 15)**

Halves 8, 12, 14 and 18, 20, 24: Q1 = 12, Q3 = 20, IQR = 8

# Notes

## III. An outlier

An outlier is a value far from the rest.

Notes I's week, and one more day of 64 minutes: 8, 12, 15, 15, 18, 20, 24, 64

| | Without 64 | With 64 |
|---|---|---|
| Mean | 16 | 22 |
| Median | 15 | 16.5 |
| Range | 16 | 56 |
| IQR | 8 | 8.5 |

**The mean and the range jump. The median and the IQR barely move.**

# Example 1

Seven quiz scores:  88, 82, 96, 40, 90, 85, 93

Find the mean and the median with the 40 and without it.

**Which changed more, the mean or the median?**

# Example 1

In order:  40, 82, 85, 88, 90, 93, 96

Mean:  $574 \div 7 = 82$

Median: the middle value, 88

**Answer:  With the 40: mean 82, median 88**

# Example 1

In order: 82, 85, 88, 90, 93, 96

Mean: 534 ÷ 6 = 89

Median: (88 + 90) ÷ 2 = 89

**Answer: The mean changed more: 82 to 89. The median: 88 to 89.**

# Your Turn

Points in seven games:  13, 8, 48, 10, 20, 12, 15

Find the mean and the median with the 48 and without it.

Which changed more?

# Your Turn

Points in seven games: 13, 8, 48, 10, 20, 12, 15

Find the mean and the median with the 48 and without it.

Which changed more?

In order: 8, 10, 12, 13, 15, 20, 48

With 48: mean $126 \div 7 = 18$, median 13

Without 48: mean $78 \div 6 = 13$, median $(12 + 13) \div 2 = 12.5$

**Answer: The mean: 18 to 13. The median: 13 to 12.5.**

# Example 2

A team's points in 9 games. Find the median and the range.

Name the outlier. What does removing it do to the range?

Points in a game

| Stem | Leaf |
|---|---|
| 4 | 2 5 7 |
| 5 | 1 3 3 6 8 |
| 6 | |
| 7 | |
| 8 | 1 |

Key: 4 \| 2 means 42

# Example 2

Values:  42, 45, 47, 51, 53, 53, 56, 58, 81

Median: the 5th of 9 values, 53.  Range:  81 – 42 = 39

Outlier: 81 — stems 6 and 7 are empty.

Without 81:  range 58 – 42 = 16

**Answer:  Median 53, range 39; the outlier 81. Without it the range is 16.**

# Your Turn

Minutes read on 9 days, a stem-and-leaf plot.

Find the median, the range, the outlier, and the range without it.

Minutes read

| Stem | Leaf |
|---|---|
| 0 | 3 |
| 1 | |
| 2 | 1 4 5 7 |
| 3 | 0 2 4 6 |

Key: 2 | 1 means 21

# Your Turn

Minutes read on 9 days, a stem-and-leaf plot.

Find the median, the range, the outlier, and the range without it.

Minutes read

| Stem | Leaf |
|---|---|
| 0 | 3 |
| 1 | |
| 2 | 1 4 5 7 |
| 3 | 0 2 4 6 |

Key: 2 | 1 means 21

Median: the 5th of 9 values, 27

Range: 36 – 3 = 33

Outlier: 3. Without it: 36 – 21 = 15

**Answer: Median 27, range 33; outlier 3; then range 15**

# Whiteboards · Question 1 of 9

Pages read: 5, 9, 12, 7, 10, 11

**Find the mean.**

**Answer it.**

# Whiteboards · Question 1 of 9

Pages read: 5, 9, 12, 7, 10, 11

**Find the mean.**

$$5 + 9 + 12 + 7 + 10 + 11 = 54$$

$$54 \div 6 = 9$$

**Answer: 9 pages**

# Whiteboards · Question 2 of 9

Minutes of practice: 14, 9, 21, 6, 17, 11, 19

**Find the median.**

**Answer it.**

# Whiteboards · Question 2 of 9

Minutes of practice: 14, 9, 21, 6, 17, 11, 19

**Find the median.**

In order: 6, 9, 11, 14, 17, 19, 21

The middle of 7 values is the 4th: 14

**Answer: 14 minutes**

# Whiteboards · Question 3 of 9

Quiz scores: 23, 31, 18, 27, 35, 20, 29, 25

**Find the median.**

**Answer it.**

# Whiteboards · Question 3 of 9

Quiz scores: 23, 31, 18, 27, 35, 20, 29, 25

**Find the median.**

In order: 18, 20, 23, 25, 27, 29, 31, 35

Two middles: $(25 + 27) \div 2 = 26$

**Answer: 26**

# Whiteboards · Question 4 of 9

**Find the range of the points.**

Points in a game

| Stem | Leaf |
|---|---|
| 3 | 4 8 |
| 4 | 1 5 5 7 |
| 5 | 2 6 |
| 6 | 3 |

Key: 3 | 4 means 34

**Answer it.**

# Whiteboards · Question 4 of 9

**Find the range of the points.**

Points in a game

| Stem | Leaf |
|---|---|
| 3 | 4 8 |
| 4 | 1 5 5 7 |
| 5 | 2 6 |
| 6 | 3 |

Key: 3 | 4 means 34

Least: 3 | 4 is 34. Greatest: 6 | 3 is 63

63 – 34 = 29

**Answer: 29 points**

# Whiteboards · Question 5 of 9

Points: 17, 4, 25, 10, 6, 21, 12, 15

**Find the interquartile range.**

**Answer it.**

# Whiteboards · Question 5 of 9

Points: 17, 4, 25, 10, 6, 21, 12, 15

**Find the interquartile range.**

In order: 4, 6, 10, 12, 15, 17, 21, 25

Lower half 4, 6, 10, 12. Q1: $(6 + 10) \div 2 = 8$

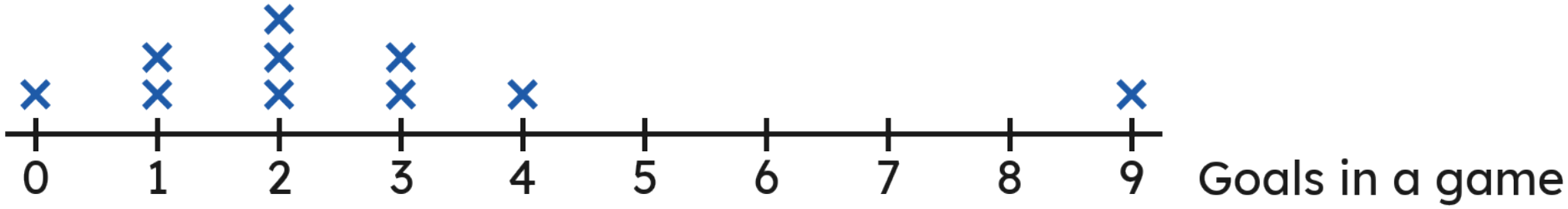
Upper half 15, 17, 21, 25. Q3: $(17 + 21) \div 2 = 19$

IQR: $19 - 8 = 11$

**Answer: 11**

# Whiteboards · Question 6 of 9

**A soccer team's goals in 10 games. Which value is the outlier?**




**A.** 0

**B.** 2

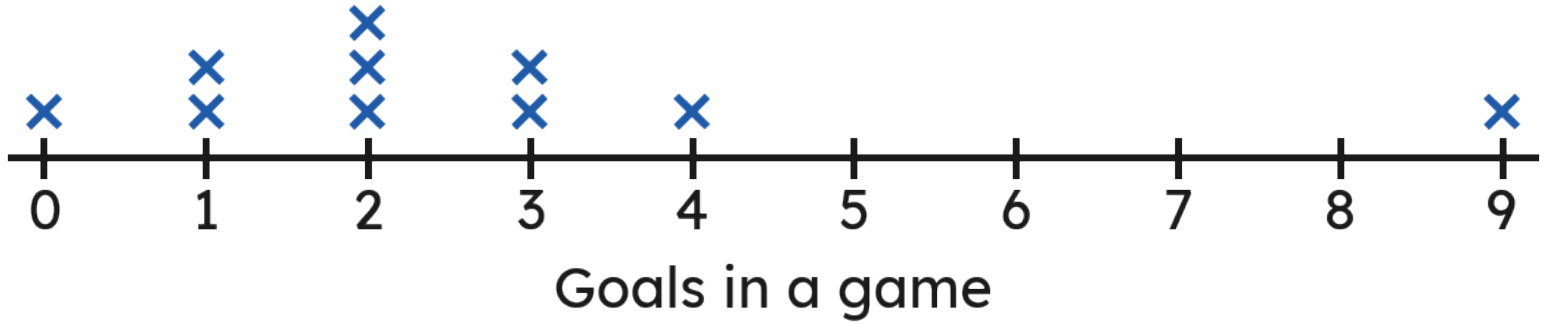
**C.** 4

**D.** 9

**Answer it.**

# Whiteboards · Question 6 of 9

**A soccer team's goals in 10 games. Which value is the outlier?**




Nine games: 0 to 4 goals. One game: 9, with nothing at 5, 6, 7 or 8.

**Answer: D — 9**

# Whiteboards · Question 7 of 9

Points in 8 games: 10, 12, 13, 14, 15, 16, 18, 46

**The 46 is removed. Which measure changes the most?**

**A.** the interquartile range

**B.** the mean

**C.** the range

**D.** the median

**Answer it.**

# Whiteboards · Question 7 of 9

Points in 8 games: 10, 12, 13, 14, 15, 16, 18, 46

**The 46 is removed. Which measure changes the most?**

Mean: 18 to 14

Median: 14.5 to 14 IQR: 4.5 to 4

Range: $46 - 10 = 36$ to $18 - 10 = 8$

**Answer: C — the range**

# Whiteboards · Question 8 of 9

Sam scored 14, 9, 17, 12 and 13 points in the first 5 games of a 20-game season.

**What was his mean score in those 5 games?**

**Answer it.**

# Whiteboards · Question 8 of 9

Sam scored 14, 9, 17, 12 and 13 points in the first 5 games of a 20-game season.

**What was his mean score in those 5 games?**

$$14 + 9 + 17 + 12 + 13 = 65$$

$$65 \div 5 = 13$$

**Answer: 13 points**

# Whiteboards · Question 9 of 9

Tia read 3, 15, 16, 18, 20 and 21 minutes on six days.

She says taking out the 3 changes the median less than the mean.

**Is she right? Explain.**

**Write your answer in sentences.**

# Whiteboards · Question 9 of 9

Tia read 3, 15, 16, 18, 20 and 21 minutes on six days.

She says taking out the 3 changes the median less than the mean.

**Is she right? Explain.**

With 3: median $(16 + 18) \div 2 = 17$, mean $93 \div 6 = 15.5$

Without 3: median 18, mean $90 \div 5 = 18$

The median moves 1; the mean moves 2.5

**Answer: Yes — the median moves 1, the mean 2.5**

# Independent Practice

1. Find the mean: 8, 12, 7, 15, 13
2. Find the median: 16, 11, 25, 19, 14, 22
3. Find the range: 27, 13, 45, 31, 18
4. Find the interquartile range: 13, 2, 16, 6, 12, 4, 9, 15, 5
5. Name the outlier in the stem-and-leaf plot.
6. Find the mean of 5, 6, 6, 7, 26, then the mean without the 26.

**5.**

| Stem | Leaf |
|---|---|
| 3 | 1 4 6 |
| 4 | 0 2 2 7 |
| 5 | |
| 6 | |
| 7 | 8 |

Key: 3 | 1 means 31

# Before You Go

Mean and median: the center. Range and IQR: the spread.

An outlier pulls the mean and the range; the median and the IQR barely move.

Tomorrow: which measure to use, and why.

# IXL

1. Open IXL and start today's skills.
2. Work on paper where the question needs work. The answer box does not show it.
3. Every skill listed is required, to a SmartScore of 60. Due by the Unit 13 test.

**Today's skills — all required**

Interpret stem-and-leaf plots (BCT)
Identify an outlier and describe the effect of removing it (QZU)
Calculate mean, median, mode, and range (U2A)
Calculate quartiles and interquartile range (NZN)
Interpret charts and graphs to find mean, median, mode, and range (CYK)