

# Effect of Data Changes

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 24

## Q Quick Review

Changing a data set changes its summary measures in predictable ways. If you **add** the same number  $k$  to every value, the *mean* and *median* both shift up by  $k$ , but the *range*, *IQR*, and *MAD* stay the **same** (the spread does not change). If you **multiply** every value by  $k$ , the *mean*, *median*, *range*, *IQR*, and *MAD* all get multiplied by  $k$  too. Adding one **outlier** (an extreme value) pulls the *mean* strongly toward it and increases the *range*, but the *median* barely moves — which is why the median is called *resistant*.

◇ **Example:** The set 4, 6, 8, 10, 12 has mean 8 and range 8. What happens to the mean and range if (a) you add 5 to each value, and (b) you double each value?

⇒ **(a) Add 5 to each:** the data becomes 9, 11, 13, 15, 17. Adding a constant slides everything up, so the mean rises by 5 to 13. But the values keep the same gaps between them, so the range stays 8. **(b) Double each:** the data becomes 8, 12, 16, 20, 24. Multiplying scales everything, so the mean doubles to 16 *and* the range doubles to 16. Adding shifts; multiplying stretches.

**Answer:** (a) mean 13, range 8; (b) mean 16, range 16

## PRACTICE

Determine how each change affects the given measure.

- Mean is 20. Add 5 to each value. New mean? \_\_\_\_\_
- Mean is 30. Add 10 to each. New mean? \_\_\_\_\_
- Mean is 12. Multiply each by 3. New mean? \_\_\_\_\_
- Mean is 50. Multiply each by 2. New mean? \_\_\_\_\_
- Median is 15. Add 4 to each. New median? \_\_\_\_\_
- Median is 8. Multiply each by 5. New median? \_\_\_\_\_
- Range is 24. Add 7 to each. New range? \_\_\_\_\_
- Range is 9. Multiply each by 4. New range? \_\_\_\_\_
- IQR is 10. Add 6 to each. New IQR? \_\_\_\_\_
- IQR is 5. Multiply each by 3. New IQR? \_\_\_\_\_
- MAD is 4. Add 9 to each. New MAD? \_\_\_\_\_
- MAD is 6. Multiply each by 2. New MAD? \_\_\_\_\_
- Mean is 10. Subtract 3 from each. New mean? \_\_\_\_\_
- Set 2, 4, 6, 8, 10. Add an outlier 100. Mean rises or falls? \_\_\_\_\_
- Set 2, 4, 6, 8, 10. Add outlier 100. Median changes much? \_\_\_\_\_
- Mean of 4, 6, 8, 10, 12 is 8. Remove 12. New mean? \_\_\_\_\_
- Range is 0. What does that tell you? \_\_\_\_\_
- Mean is 25. Multiply each by 0. New mean? \_\_\_\_\_
- Median is 18. Subtract 18 from each. New median? \_\_\_\_\_
- IQR is 12. Multiply each by  $\frac{1}{2}$ . New IQR? \_\_\_\_\_

## ◆ Word Problems

- A teacher adds 5 bonus points to every student's test score. The original mean was 78 and the IQR was 20. What are the new mean and IQR? \_\_\_\_\_
- Prices in a store (in dollars) are doubled during a special event. If the original median price was \$15 and the range was \$40, find the new median and range. \_\_\_\_\_
- A data set of house prices has mean \$200,000. A \$5,000,000 mansion is added to the set. Will the mean or the median better describe a typical home now? \_\_\_\_\_
- Five friends' ages have a mean of 14. In 3 years, every friend will be 3 years older. What will the mean age be then? \_\_\_\_\_



## Answer Keys

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|---|---|
| <ol style="list-style-type: none"> <li>1. <input type="text" value="25"/></li> <li>2. <input type="text" value="40"/></li> <li>3. <input type="text" value="36"/></li> <li>4. <input type="text" value="100"/></li> <li>5. <input type="text" value="19"/></li> <li>6. <input type="text" value="40"/></li> <li>7. <input type="text" value="24"/></li> <li>8. <input type="text" value="36"/></li> <li>9. <input type="text" value="10"/></li> <li>10. <input type="text" value="15"/></li> <li>11. <input type="text" value="4"/></li> <li>12. <input type="text" value="12"/></li> </ol> | <ol style="list-style-type: none"> <li>13. <input type="text" value="7"/></li> <li>14. <input type="text" value="rises"/></li> <li>15. <input type="text" value="barely"/></li> <li>16. <input type="text" value="7"/></li> <li>17. <input type="text" value="all values equal"/></li> <li>18. <input type="text" value="0"/></li> <li>19. <input type="text" value="0"/></li> <li>20. <input type="text" value="6"/></li> <li>21. <input type="text" value="new mean = 83, new IQR = 20"/></li> <li>22. <input type="text" value="new median = \$30, new range = \$80"/></li> <li>23. <input type="text" value="the median — it resists the outlier"/></li> <li>24. <input type="text" value="17 years"/></li> </ol> |
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### Step-by-Step Explanations

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|---|---|
| <ol style="list-style-type: none"> <li>1. Adding 5 to every value raises the mean by 5: <math>20 + 5 = 25</math>.</li> <li>2. Adding a constant shifts the mean by that constant: <math>30 + 10 = 40</math>.</li> <li>3. Multiplying every value by 3 multiplies the mean by 3: <math>12 \times 3 = 36</math>.</li> <li>4. Doubling each value doubles the mean: <math>50 \times 2 = 100</math>.</li> <li>5. Adding 4 to every value shifts the median up by 4: <math>15 + 4 = 19</math>.</li> <li>6. Multiplying every value by 5 multiplies the median by 5: <math>8 \times 5 = 40</math>.</li> <li>7. Adding a constant moves all values equally, so the range is unchanged: still 24.</li> <li>8. Multiplying every value by 4 multiplies the range by 4: <math>9 \times 4 = 36</math>.</li> <li>9. Adding a constant does not change spread, so the IQR stays 10.</li> <li>10. Multiplying every value by 3 multiplies the IQR by 3: <math>5 \times 3 = 15</math>.</li> <li>11. Adding a constant does not change how spread out the data is, so MAD stays 4.</li> <li>12. Multiplying every value by 2 multiplies the MAD by 2: <math>6 \times 2 = 12</math>.</li> <li>13. Subtracting 3 from each value lowers the mean by 3: <math>10 - 3 = 7</math>.</li> <li>14. The large value 100 pulls the mean strongly upward, so the mean rises a</li> </ol> | <ol style="list-style-type: none"> <li>lot.</li> <li>15. The median is resistant — one extreme value barely moves the middle of the data.</li> <li>16. The remaining values 4, 6, 8, 10 have sum 28, so the new mean is <math>\frac{28}{4} = 7</math>.</li> <li>17. A range of 0 means the max and min are the same, so every value in the set is identical.</li> <li>18. Multiplying every value by 0 makes all values 0, so the mean is 0.</li> <li>19. Subtracting 18 from every value shifts the median down by 18: <math>18 - 18 = 0</math>.</li> <li>20. Multiplying every value by <math>\frac{1}{2}</math> halves the IQR: <math>12 \times \frac{1}{2} = 6</math>.</li> <li>21. Adding 5 to every score raises the mean by 5 to 83, but the gaps between scores do not change, so the IQR stays 20.</li> <li>22. Multiplying every price by 2 doubles all measures: the median becomes <math>15 \times 2 = 30</math> and the range becomes <math>40 \times 2 = 80</math>.</li> <li>23. The mansion is a huge outlier that pulls the mean far upward, away from a typical home. The median barely moves, so it better describes a typical price.</li> <li>24. Adding 3 to every age raises the mean by 3: <math>14 + 3 = 17</math> years. Shifting all values shifts the mean by the same amount.</li> </ol> |
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