

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.

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| 1. Mean is 20. Add 5 to each value. New mean? _____ | 13. Mean is 10. Subtract 3 from each. New mean? _____ |
| 2. Mean is 30. Add 10 to each. New mean? _____ | 14. Set 2, 4, 6, 8, 10. Add an outlier 100. Mean rises or falls? _____ |
| 3. Mean is 12. Multiply each by 3. New mean? _____ | 15. Set 2, 4, 6, 8, 10. Add outlier 100. Median changes much? _____ |
| 4. Mean is 50. Multiply each by 2. New mean? _____ | 16. Mean of 4, 6, 8, 10, 12 is 8. Remove 12. New mean? _____ |
| 5. Median is 15. Add 4 to each. New median? _____ | 17. Range is 0. What does that tell you? _____ |
| 6. Median is 8. Multiply each by 5. New median? _____ | 18. Mean is 25. Multiply each by 0. New mean? _____ |
| 7. Range is 24. Add 7 to each. New range? _____ | 19. Median is 18. Subtract 18 from each. New median? _____ |
| 8. Range is 9. Multiply each by 4. New range? _____ | 20. IQR is 12. Multiply each by $\frac{1}{2}$. New IQR? _____ |
| 9. IQR is 10. Add 6 to each. New IQR? _____ | |
| 10. IQR is 5. Multiply each by 3. New IQR? _____ | |
| 11. MAD is 4. Add 9 to each. New MAD? _____ | |
| 12. MAD is 6. Multiply each by 2. New MAD? _____ | |

◆ Word Problems

21. 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? _____
22. 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. _____
23. 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? _____
24. 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

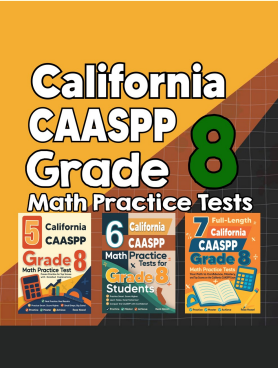
- | | |
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| <p>1. <input type="text" value="25"/></p> <p>2. <input type="text" value="40"/></p> <p>3. <input type="text" value="36"/></p> <p>4. <input type="text" value="100"/></p> <p>5. <input type="text" value="19"/></p> <p>6. <input type="text" value="40"/></p> <p>7. <input type="text" value="24"/></p> <p>8. <input type="text" value="36"/></p> <p>9. <input type="text" value="10"/></p> <p>10. <input type="text" value="15"/></p> <p>11. <input type="text" value="4"/></p> <p>12. <input type="text" value="12"/></p> | <p>13. <input type="text" value="7"/></p> <p>14. <input type="text" value="rises"/></p> <p>15. <input type="text" value="barely"/></p> <p>16. <input type="text" value="7"/></p> <p>17. <input type="text" value="all values equal"/></p> <p>18. <input type="text" value="0"/></p> <p>19. <input type="text" value="0"/></p> <p>20. <input type="text" value="6"/></p> <p>21. <input type="text" value="new mean = 83, new IQR = 20"/></p> <p>22. <input type="text" value="new median = \$30, new range = \$80"/></p> <p>23. <input type="text" value="the median — it resists the outlier"/></p> <p>24. <input type="text" value="17 years"/></p> |
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Step-by-Step Explanations

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| <p>1. Adding 5 to every value raises the mean by 5: $20 + 5 = 25$.</p> <p>2. Adding a constant shifts the mean by that constant: $30 + 10 = 40$.</p> <p>3. Multiplying every value by 3 multiplies the mean by 3: $12 \times 3 = 36$.</p> <p>4. Doubling each value doubles the mean: $50 \times 2 = 100$.</p> <p>5. Adding 4 to every value shifts the median up by 4: $15 + 4 = 19$.</p> <p>6. Multiplying every value by 5 multiplies the median by 5: $8 \times 5 = 40$.</p> <p>7. Adding a constant moves all values equally, so the range is unchanged: still 24.</p> <p>8. Multiplying every value by 4 multiplies the range by 4: $9 \times 4 = 36$.</p> <p>9. Adding a constant does not change spread, so the IQR stays 10.</p> <p>10. Multiplying every value by 3 multiplies the IQR by 3: $5 \times 3 = 15$.</p> <p>11. Adding a constant does not change how spread out the data is, so MAD stays 4.</p> <p>12. Multiplying every value by 2 multiplies the MAD by 2: $6 \times 2 = 12$.</p> <p>13. Subtracting 3 from each value lowers the mean by 3: $10 - 3 = 7$.</p> <p>14. The large value 100 pulls the mean strongly upward, so the mean rises a</p> | <p>lot.</p> <p>15. The median is resistant — one extreme value barely moves the middle of the data.</p> <p>16. The remaining values 4, 6, 8, 10 have sum 28, so the new mean is $\frac{28}{4} = 7$.</p> <p>17. A range of 0 means the max and min are the same, so every value in the set is identical.</p> <p>18. Multiplying every value by 0 makes all values 0, so the mean is 0.</p> <p>19. Subtracting 18 from every value shifts the median down by 18: $18 - 18 = 0$.</p> <p>20. Multiplying every value by $\frac{1}{2}$ halves the IQR: $12 \times \frac{1}{2} = 6$.</p> <p>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.</p> <p>22. Multiplying every price by 2 doubles all measures: the median becomes $15 \times 2 = 30$ and the range becomes $40 \times 2 = 80$.</p> <p>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.</p> <p>24. Adding 3 to every age raises the mean by 3: $14 + 3 = 17$ years. Shifting all values shifts the mean by the same amount.</p> |
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