Effect of Data Changes

Name: _____	Date: _____	Score: _____ / 24

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.

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

♦ 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

1. 25
2. 40
3. 36
4. 100
5. 19
6. 40
7. 24
8. 36
9. 10
10. 15
11. 4
12. 12
13. 7
14. rises
15. barely
16. 7
17. all values equal
18. 0
19. 0
20. 6
21. new mean $= 83$, new IQR $= 20$
22. new median $= \$30$, new range $= \$80$
23. the median — it resists the outlier
24. 17 years

Step-by-Step Explanations

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

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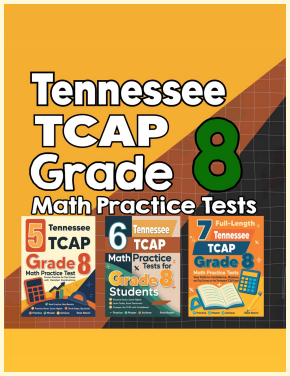

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