Mean Absolute Deviation

Investigate mistakes, reverse problems, and transformations

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

The mean absolute deviation (MAD) describes the average distance from the mean. First find $\bar{x} = \frac{\text{sum}}{n}$. Find each nonnegative distance $|x - \bar{x}|$. Then divide the sum of those distances by n, not $n - 1$. A larger MAD means more spread. Give exact answers.

Worked example

Find the MAD of $2, 4, 6, 8$.

1. Mean: $\bar{x} = \frac{20}{4} = 5$.
2. Compute $|x - 5|$ for each value: $3, 1, 1, 3$. Their sum is 8.
3. MAD $= \frac{8}{4} = 2$.
Answer: 2

Practice Problems

Show your thinking.

1. Lee says the MAD of $2, 4, 6, 8$ is 0 because the signed deviations add to 0. Correct Lee.

2. Mia divides a distance sum of 12 by 3 for a data set with four values. Correct the MAD.

3. Find both MADs. What happens when 5 is added to every value? A: $2, 4, 4, 6$. B: $7, 9, 9, 11$.

4. Find both MADs. How does doubling every value affect MAD? A: $2, 4, 4, 6$. B: $4, 8, 8, 12$.

5. The values $2, 4, 6, x$ have mean 5. Find x, then find the MAD.

6. Give four values with mean 5 and MAD 2. Check your example.

7. A data set has five values. Their absolute distances sum to 15. One student reports MAD 15. Fix the last step.

8. The values $4, 4, 10, 10$ have MAD 3. What is the MAD after adding 20 to every value? Verify.

9. Can a data set have a negative MAD? Use the distance formula to justify your answer.

10. Rae rounds the mean of $0, 0, 2$ to 1 before finding the MAD. Find the exact MAD instead.

Answer Key

1. MAD $= 2$.
2. 3
3. A: 1; B: 1. Equal spread. Adding 5 leaves MAD unchanged.
4. A: 1; B: 2. A is more consistent. Doubling values doubles MAD.
5. $x = 8$; MAD $= 2$.
6. One answer: $3, 3, 7, 7$.
7. MAD $= 3$.
8. 3
9. No; MAD ≥ 0.
10. $\frac{8}{9}$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The mean is $20 \div 4 = 5$. The signed deviations are $-3, -1, 1, 3$.
2. Use absolute distances: $3, 1, 1, 3$. Their sum is 8, not 0.
3. Divide by four: MAD $= 8 \div 4 = 2$.

Problem 2

1. MAD averages all four absolute deviations, so the divisor is 4, not $4 - 1$.
2. The corrected calculation is $12 \div 4 = 3$.

Problem 3

1. A: mean $= 4$; distances $2, 0, 0, 2$; MAD $= 4 \div 4 = 1$.
2. B: mean $= 9$; distances $2, 0, 0, 2$; MAD $= 4 \div 4 = 1$.
3. The two MADs are equal, so their average distances from their own means are equal.
4. Adding 5 shifts the mean from 4 to 9 but preserves every distance, so the MAD stays 1.

Problem 4

1. A: mean $= 4$; distances $2, 0, 0, 2$; MAD $= 4 \div 4 = 1$.
2. B: mean $= 8$; distances $4, 0, 0, 4$; MAD $= 8 \div 4 = 2$.
3. The smaller MAD shows greater consistency: A.
4. Doubling every value doubles each distance from its new mean; the MAD doubles from 1 to 2.

Problem 5

1. The required total is $4 \times 5 = 20$, so $x = 20 - (2 + 4 + 6) = 8$.
2. Distances from 5 are $3, 1, 1, 3$, which total 8.
3. MAD $= 8 \div 4 = 2$.

Problem 6

1. Place two values 2 below 5 and two values 2 above it: $3, 3, 7, 7$.
2. Mean $= (3 + 3 + 7 + 7) \div 4 = 5$. Distances are $2, 2, 2, 2$, so MAD $= 8 \div 4 = 2$.

Problem 7

1. The sum 15 is a total distance, not the average distance.
2. Divide by the five values: MAD $= 15 \div 5 = 3$.

Problem 8

1. The new data are $24, 24, 30, 30$ with mean $108 \div 4 = 27$.
2. Absolute distances are still $3, 3, 3, 3$, so MAD $= 12 \div 4 = 3$.

Problem 9

1. Every absolute distance $|x - \bar{x}|$ is at least 0, so their sum cannot be negative.
2. Dividing a nonnegative sum by the positive number of values keeps the MAD nonnegative.

Problem 10

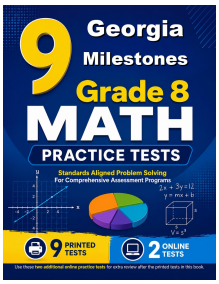
1. The exact mean is $2 \div 3 = \frac{2}{3}$, not 1.
2. Distances are $\frac{2}{3}, \frac{2}{3}, \frac{4}{3}$, which sum to $\frac{8}{3}$.
3. MAD $= \frac{8}{3} \div 3 = \frac{8}{9}$. Keep the mean exact until the final result.

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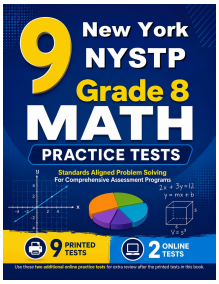
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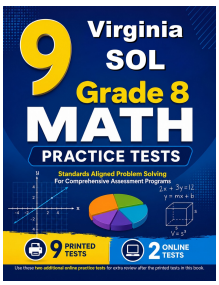
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