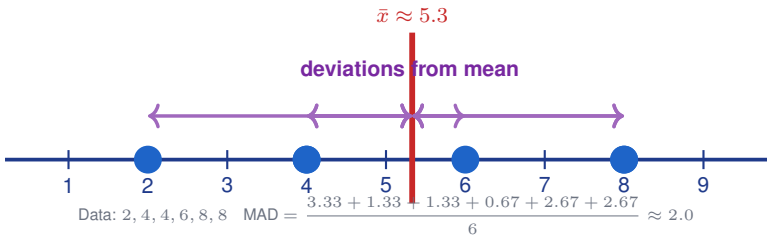
Mean Absolute Deviation (MAD)

Name: _____	Date: _____	Score: _____ / 18

The mean tells you *where* the center of a data set is, but it does not tell you how tightly the data clusters around that center—and that is exactly what the **Mean Absolute Deviation (MAD)** measures! MAD is the average distance between each data value and the mean. A small MAD means the data stays close to the center; a larger MAD means the values are more spread out. This makes MAD a fantastic tool for comparing consistency between two different data sets.



Key Concepts & Quick Review

Steps: ① Find $\bar{x}$. ② Compute $|x_i - \bar{x}|$ for each value. ③ Average the absolute deviations: MAD $= \dfrac{\sum |x_i - \bar{x}|}{n}$.

Interpretation: MAD $= 0$ means all values are identical. Small MAD $\rightarrow$ consistent data. Large MAD $\rightarrow$ variable data.

Examples

① Find the MAD of: $3, 7, 7, 9, 4$.

Think It Through: Start with the mean: $(3 + 7 + 7 + 9 + 4) \div 5 = 30 \div 5 = 6$. Then measure how far each value is from the mean using absolute value: $3, 1, 1, 3, 2$. Add those deviations to get 10, and divide by the number of data values, 5. That gives a mean absolute deviation of 2. MAD tells us that, on average, the data points are 2 units away from the mean.

Answer: *MAD* $= 2$

② Two teams' scores: Team A: $50, 52, 48, 50, 50$; Team B: $30, 70, 50, 40, 60$. Which team is more consistent? Use MAD.

Think It Through: Both teams have the same mean of 50, so the comparison comes from the spread. Team A's scores stay very close to 50, with deviations $0, 2, 2, 0, 0$, giving MAD $= \frac{4}{5} = 0.8$. Team B's scores are much farther from the mean, with deviations $20, 20, 0, 10, 10$, so MAD $= \frac{60}{5} = 12$. A smaller MAD means the data are more tightly clustered, so Team A is much more consistent.

Answer: *Team A (MAD* $= 0.8$*) is more consistent than B (MAD* $= 12$*)*

Scan Me

Practice Problems

Find the MAD for each data set. Show the mean and each absolute deviation.

1. 2, 4, 6, 8, 10 _____

2. 5, 5, 5, 5, 5 _____

3. 1, 3, 5, 7, 9 _____

4. 10, 12, 14, 16 _____

5. 4, 8, 6, 2, 10 _____

6. 20, 25, 30, 35 _____

7. 3, 3, 9, 9 _____

8. 6, 8, 10, 12, 14 _____

9. 100, 110, 90, 120, 80 _____

10. 7, 7, 7, 13, 11 _____

11. 15, 18, 12, 21, 9 _____

12. 0, 4, 8, 12, 16 _____

13. 50, 55, 60, 65, 70 _____

14. 1, 1, 5, 5, 3 _____

15. 40, 44, 48, 52, 56 _____

Study Tips

- Always use **absolute value** for deviations — negative deviations would cancel out positive ones and give MAD $= 0$ for every data set, which is useless.
- Build a **table**: one column for data, one for $(x - \bar{x})$, one for $|x - \bar{x}|$. Then sum the last column and divide by n.
- If all data values equal the mean, MAD $= 0$. The larger the MAD, the more **spread out** the data is from its centre.

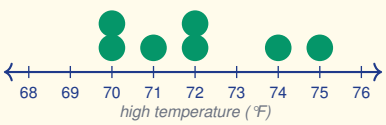
Word Problems

16. A factory makes bolts that should be exactly $12\,mm$ long. A quality inspector measures 8 bolts: $11.8,\ 12.2,\ 12.0,\ 11.6,\ 12.4,\ 12.1,\ 11.9,\ 12.0\,mm$. Find the mean and MAD. The specification allows deviation of at most $0.3\,mm$ on average. Does this batch pass quality control? _____

17. Two archers each shoot 6 arrows. Their distances from the bullseye (cm) are: Archer A: $5, 3, 4, 6, 5, 7$. Archer B: $1, 10, 2, 9, 3, 11$. Find the mean and MAD for each archer. Both have similar means. Which archer is more consistent? If you had to bet on the next shot landing close to the bullseye, who would you choose?

_____

18. This dot plot records the daily high temperatures (°F) for one week. Use the plot to find the mean, then compute each absolute deviation from the mean and find the MAD.



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Answer Keys

1) $\frac{12}{5}$
2) 0
3) $\frac{12}{5}$
4) 2
5) $\frac{12}{5}$
6) 5
7) 3
8) $\frac{12}{5}$
9) 12
10) $\frac{12}{5}$
11) $\frac{18}{5}$
12) $\frac{24}{5}$
13) 6
14) $\frac{8}{5}$
15) $\frac{24}{5}$
16) Mean $12.0\ mm$; MAD $0.175\ mm$; passes
17) A: mean 5, MAD 1.0; B: mean 6, MAD 4.0; choose Archer A
18) Data $70, 70, 71, 72, 72, 74, 75$; mean 72; MAD about 1.43

Step-by-Step Explanations

Strategy: For Volume of Pyramids, find the matching prism volume and divide by 3 because a pyramid with the same base and height takes one third of that space. The pyramid relationship is the key: same base and height as a prism, but one third as much volume.

Practice 1: A square pyramid has base side length 6 units and vertical height 4 units. Find its volume. **Answer:** 48

In the opening example, find the base area, multiply by height, then divide by 3.

Practice 15: A square pyramid has base side length 10 units and vertical height 3 units. Find its volume. **Answer:** 100

For the end-of-set item, find the base area, multiply by height, then divide by 3.

Word-problem notes:

16. Answer: $V = \frac{1}{3}(200^2)(120) = \frac{1}{3}(4{,}800{,}000) = 1{,}600{,}000\ m^3$; mass $= 1.6 \times 10^6 \times 2500 = 4 \times 10^9\ kg$.

The square base area is $200^2 = 40{,}000\ m^2$. Multiply by the vertical height and one third: $V = \frac{1}{3}(40{,}000)(120) = 1{,}600{,}000\ m^3$. For mass, use mass = density $\times$ volume. So $2{,}500 \times 1.6 \times 10^6 = 4.0 \times 10^9\ kg$. Writing the answer in scientific notation makes a very large value easier to read.

17. Answer: After $4\ min$ (h=2 m): $V = \frac{1}{3}(9)(2) = 6\ m^3$; $10\ min$ (h=5 m): $V = 15\ m^3$; $18 = \frac{1}{3}(9)h \Rightarrow h = 6\ m$.

The base area stays constant at $3 \times 3 = 9\ m^2$, so the volume formula becomes $V = \frac{1}{3}(9)h = 3h$. After $4\ min$, the height is $0.5 \times 4 = 2\ m$, so the volume is $3(2) = 6\ m^3$. After $10\ min$, the height is $5\ m$, so the volume is $3(5) = 15\ m^3$. To find when the volume reaches $18\ m^3$, solve $18 = 3h$, giving $h = 6\ m$.

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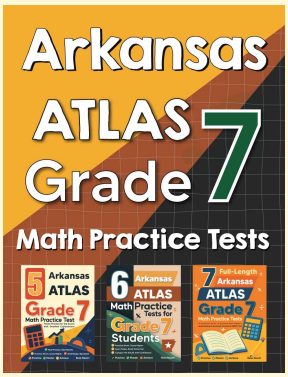

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