MATHEMATICS · GRADES 10-12

Z-scores

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you compare scores from different tests fairly, like seeing whether your mark was better in maths or in science, by saying how far each mark sits from its own class average. A raw mark on its own does not tell you much, because one test may have been harder than the other. A z-score measures each mark against its own class, in units of how spread out the marks were. That puts both marks on the same scale, so you can see fairly which one was the better result.



Rule

Z-scores: $z = \frac{\text{value - mean}}{\text{standard deviation}}$.

It tells you how many standard deviations a value sits above or below the mean.

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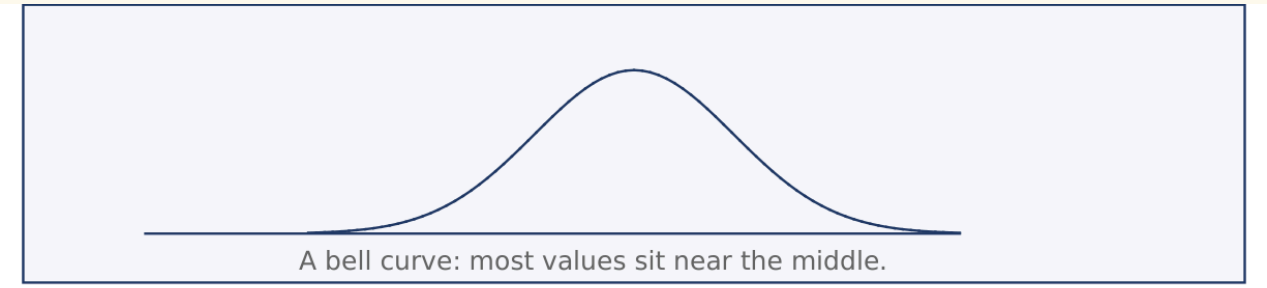
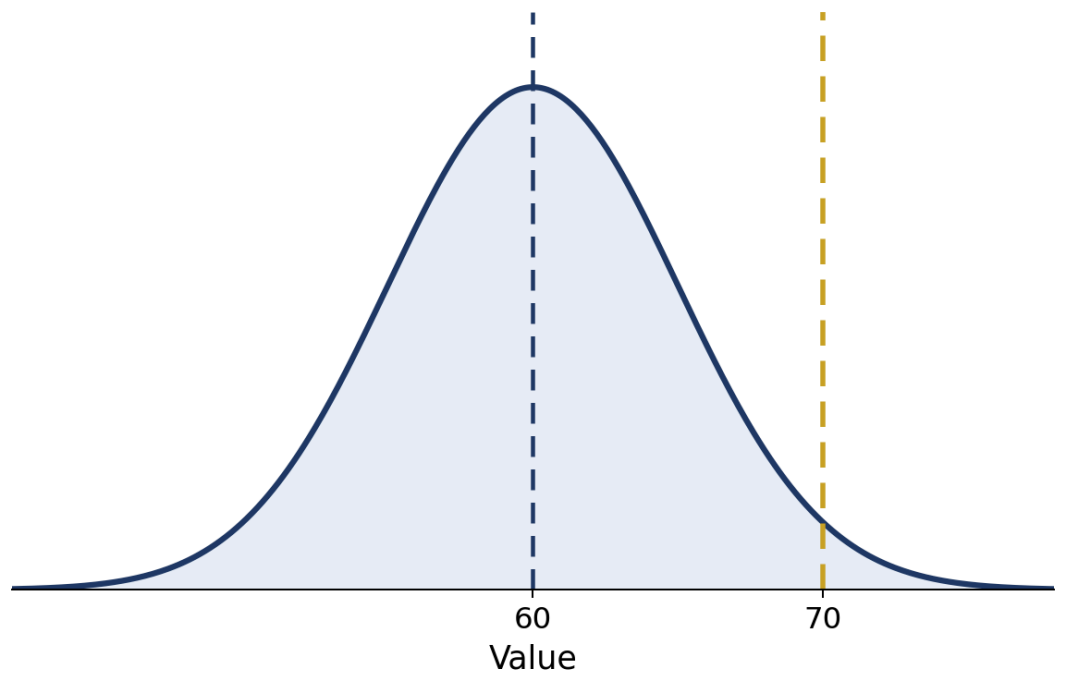
Worked examples

EXAMPLE 1

Q A value is 70, the mean is 60, the standard deviation is 5. Find the z-score.



A bell curve: most values sit near the middle.



SOLUTION

Formula: $z = \frac{\text{value - mean}}{\text{standard deviation}}$

So $z = \frac{(70 - 60)}{5} = \frac{10}{5}$

Z-score = 2

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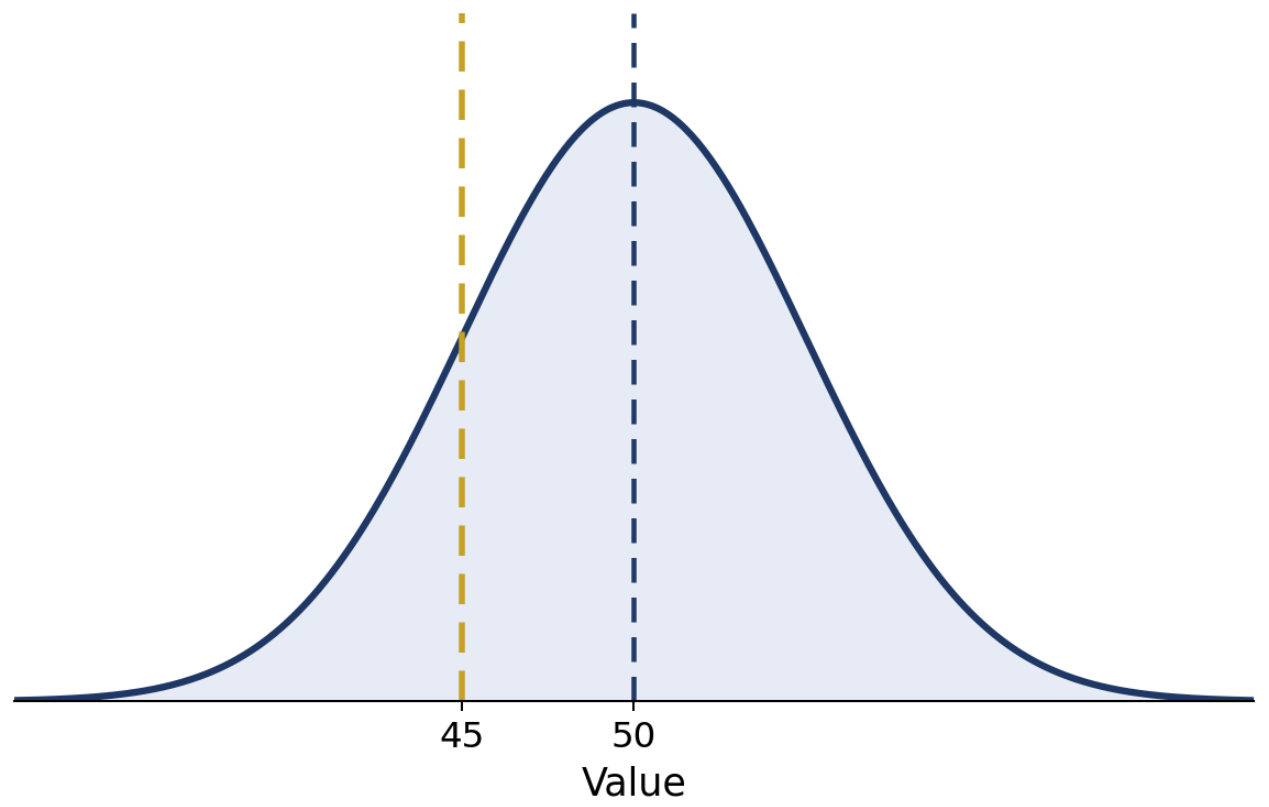
EXAMPLE 2

Q **A value is 45, the mean is 50, the standard deviation is 5. Find the z-score.**



SOLUTION

$$Z = \frac{(45 - 50)}{5} = -\frac{5}{5}$$

So z = -1

The value sits one standard deviation below the mean.

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Practice questions

1. A test score is 80, the mean is 70, the standard deviation is 10. What is the z-score?

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2. A runner's time is 30, the mean is 40, the standard deviation is 5. What is the z-score?

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3. A plant measures 35 cm. The mean height is 50 cm and the standard deviation is 5 cm. Work out its z-score.

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4 A battery lasts 70 hours. The average life is 80 hours and the standard deviation is 5 hours. What is its z-score?

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5 A student scores 65. The class mean is 50 and the standard deviation is 5. How far above the mean is the score, in standard deviations?

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6 A car travels at 90 km per hour. The mean speed is 80 km per hour and the standard deviation is 20 km per hour. What is the z-score?

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7 A seedling is 12 cm tall. The mean height is 10 cm and the standard deviation is 2 cm. What is its z-score?

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8 A test score of 40 is below the mean of 55. The standard deviation is 5. What is the z-score?

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9 A plant is 15 cm tall when the mean is 20 cm and the standard deviation is 10 cm. What is its z-score?

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10 A score of 100 equals the mean of 100. The standard deviation is 15. What is the z-score?

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ANSWER KEY

1. 1

2. -2

3. -3

4. -2

5. 3

6. 0.5

7. 1

8. -3

9. -0.5

10. 0

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