MATHEMATICS · GRADES 10-12

Normal distributions

Difficulty level: Advanced

Mathematics: Grades 10-12

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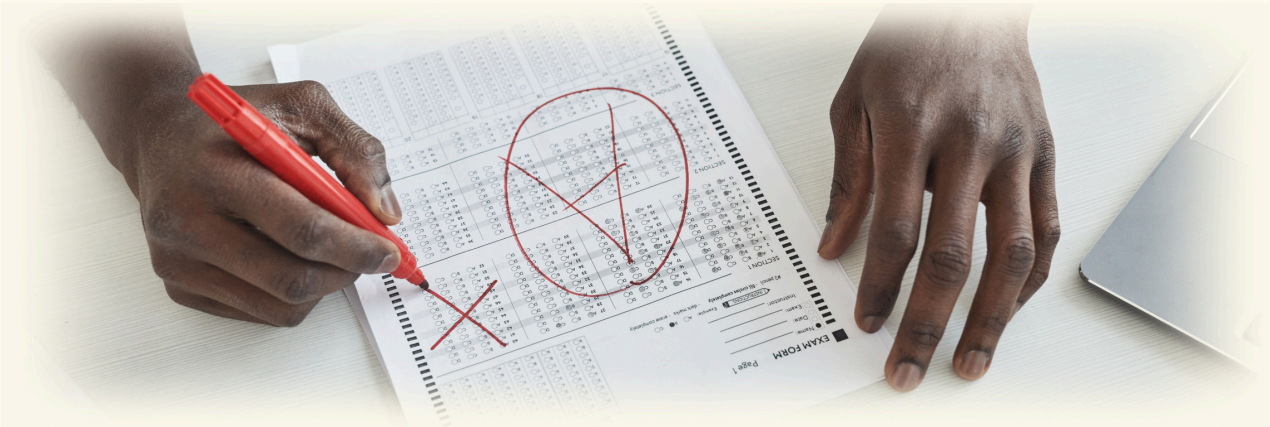
Overview of the concept

This is how you make sense of test scores, heights, or factory measurements, where most results cluster near the middle and fewer sit far above or below. A teacher uses it to see whether a test was fair, and a factory uses it to check whether its parts are coming out the right size. If a result sits far from the middle, it stands out right away as unusual and worth a second look. That is why so many real measurements, from shoe sizes to blood pressure readings, follow this same bell shape.



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Worked examples

EXAMPLE 1

Q Test scores are normally distributed with mean 100 and standard deviation 15. What percent of students score between 85 and 115?

SOLUTION

85 is one standard deviation below the mean and 115 is one above. The empirical rule says about 68% of the data falls within one standard deviation of the mean.

About 68%

EXAMPLE 2

Q With the same scores, mean 100 and standard deviation 15, what percent score above 130?

SOLUTION

130 is two standard deviations above the mean. About 95% fall within two standard deviations, so about 5% fall outside, split evenly on the two sides.

5% ÷ 2 = 2.5%

About 2.5% score above 130.

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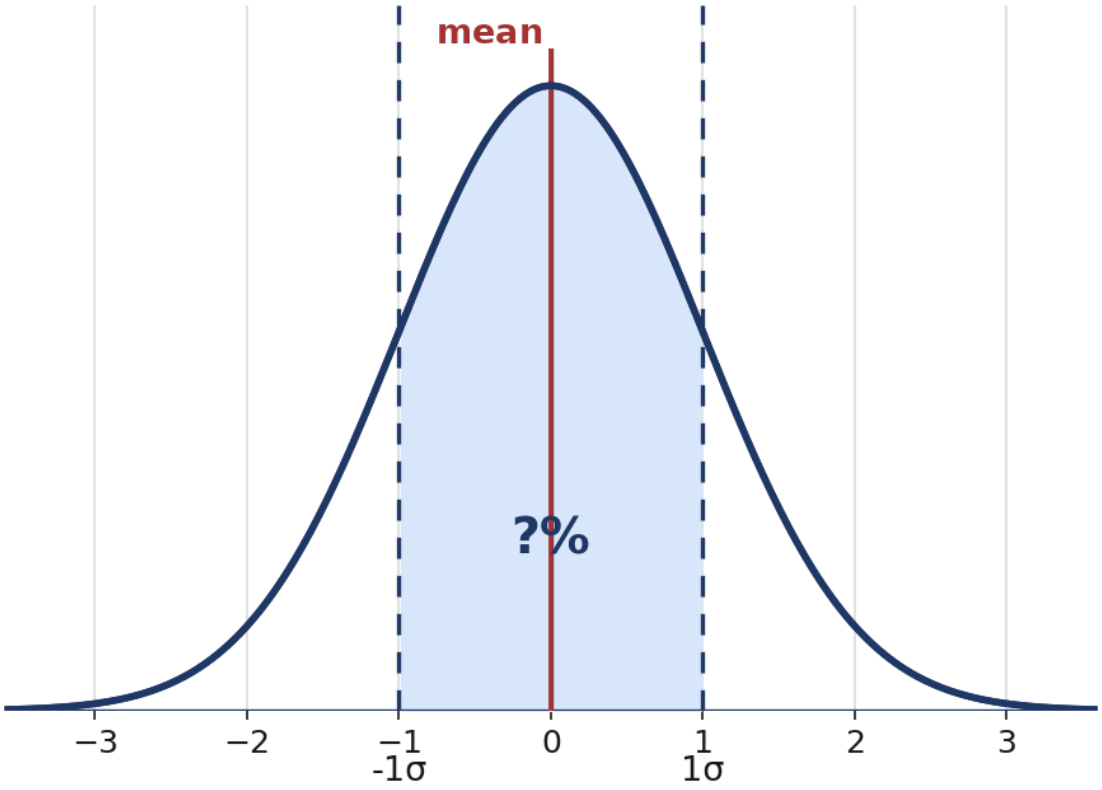
Practice questions

1 Heights are normally distributed with mean 60 inches and standard deviation 5 inches. What percent of heights fall between 55 and 65 inches?



A About 50 percent

B About 68 percent

C About 95 percent

D About 99.7 percent

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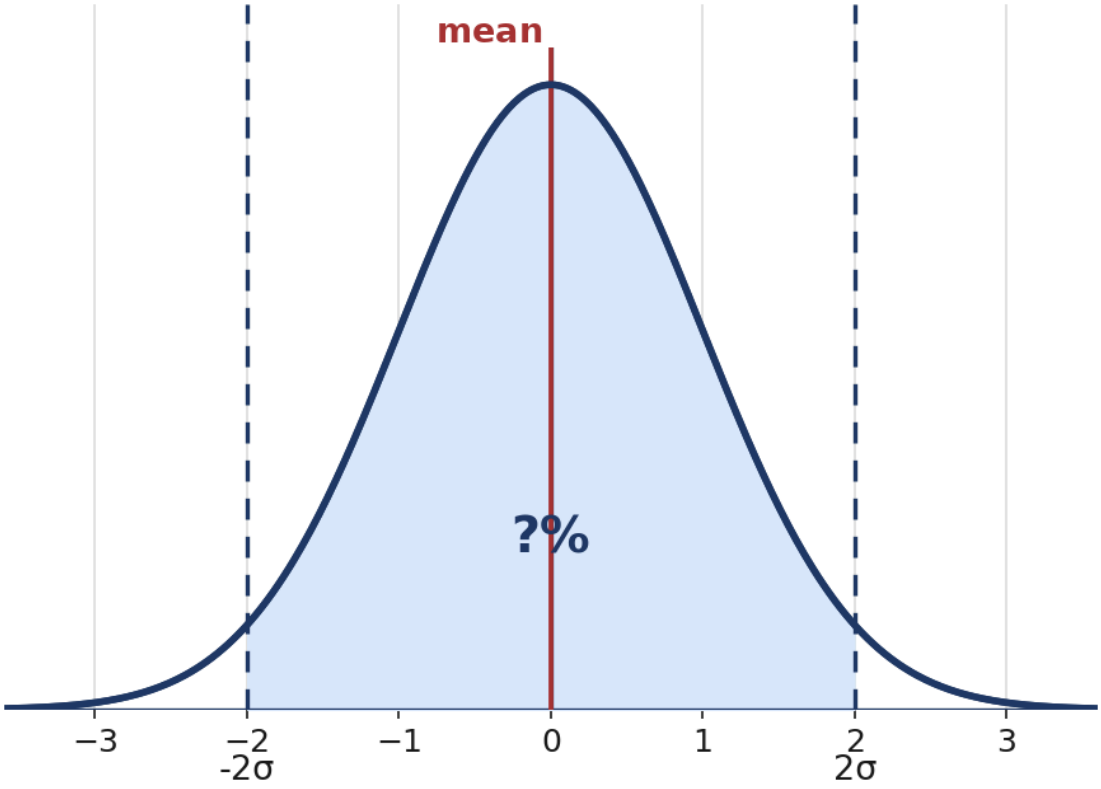
2 **With the same heights, mean 60 and standard deviation 5, what percent fall between 50 and 70 inches?**



A About 68 percent

B About 95 percent

C About 99.7 percent

D About 50 percent

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3 **With the same heights, mean 60 and standard deviation 5, what percent are above 70 inches?**

- **A** About 16 percent
- **B** About 5 percent
- **C** About 2.5 percent
- **D** About 0.15 percent

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4 **With the same heights, mean 60 and standard deviation 5, what percent are greater than 55 inches?**

- **A** About 84 percent
- **B** About 68 percent
- **C** About 50 percent
- **D** About 95 percent

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5 IQ scores are normally distributed with mean 100 and standard deviation 15. What percent of people have an IQ above 115?

- **A** About 2.5 percent
- **B** About 34 percent
- **C** About 50 percent
- **D** About 16 percent

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6 A score of 70 comes from a distribution with mean 60 and standard deviation 5. What is its z-score (how many standard deviations it is from the mean)?

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7 Anna scores 85 on a test with mean 70 and standard deviation 5. Ben scores 90 on a test with mean 80 and standard deviation 5. Who did better compared to their own class?

- **A** Anna
- **B** Ben
- **C** They did equally well
- **D** Cannot tell from the given information

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8 A score sits exactly at the mean of a normal distribution. Which percentile (the percent of scores below it) is it at?

- **A** 25th percentile
- **B** 50th percentile
- **C** 75th percentile
- **D** 99th percentile

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9 On a normal curve with mean 50 and standard deviation 10, what value is two standard deviations above the mean?

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10 In a normal distribution, how do the mean, median, and mode compare?

A. The mean is the largest

B. The median is the largest

C. All equal

D. The mode is the largest

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ANSWER KEY

1. About 68 percent

2. About 95 percent

3. About 2.5 percent

4. About 84 percent

5. About 16 percent

6. 2

7. Anna

8. 50th percentile

9. 70

10. All equal

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