

Normal Curves, z-Scores and Study Design

Grade 11 – Algebra 2 math · Test Answer Key · Standards: S-ID.A.4, S-IC.A.1, S-IC.B.3, S-IC.B.4

Each answer shows the computation and a scoring guide. For histogram estimates accept an interval within one bar of the values given, and add the points for a total out of 20.

Standards: S-ID.A.4, S-IC.A.1, S-IC.B.3, S-IC.B.4 · **Level:** Grade 11 Algebra 2

Question 1 Mean and standard deviation (2 points)

Mean = $40/5 = 8$. Squared deviations: 25, 1, 0, 4, 16, sum 46, variance 9.2. $\sigma = \sqrt{9.2} \approx 3.033$.

Mean 8; $\sigma \approx 3.03$.

Scoring: 1 point for the mean, 1 point for σ .

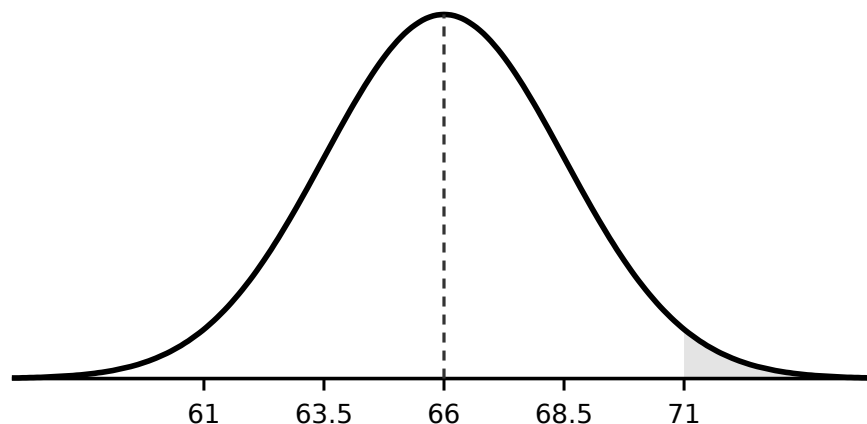
Question 2 z-scores (2 points)

$z = (61 - 52)/4.5 = 2$. For -0.8 : $52 - 0.8(4.5) = 52 - 3.6 = 48.4$. **$z = 2$ and $x = 48.4$.**

Scoring: 1 point each.

Question 3 Heights and the Empirical Rule (3 points)

- 61 and 71 are 2σ from 66: **about 95%.**
- $63.5 = 66 - 2.5$ is 1σ below: 16% are below. **About 16%.**
- 71 is 2σ above; 5% are outside 2σ , so half of that is above. **About 2.5%.**



The upper tail beyond 71 holds about 2.5%.

Scoring: 1 point per part.

Question 4 Compare swimmers (3 points)

Jo: $z = (58.2 - 60)/1.5 = -1.2$. Lee: $z = (50.5 - 52)/1 = -1.5$. Both are below average, but Lee is farther below. **Lee did better relative to the group (-1.5 versus -1.2).**

Scoring: 1 point for each z-score, 1 point for the conclusion.

Question 5 Classify the study (2 points)

(a) Treatments are randomly assigned: **experiment**. (b) Data are recorded with no treatment and no sampling from a larger plan: **observational study**.

Scoring: 1 point each.

Question 6 Margin of error from a histogram (3 points)

- a. Counting about 2 or 3 results in each tail, the middle 95% lies from about **0.33 to 0.67**.
- b. The margin of error is half the width: $(0.67 - 0.33)/2 = \mathbf{0.17}$.

Scoring: 2 points for the interval (1 for each endpoint), 1 point for the margin.

Question 7 Counting students above a score (2 points)

78 is 1σ above the mean, so about 16% scored above. $0.16 \times 400 = 64$. **About 64 students.**

Scoring: 1 point for 16%, 1 point for the count.

Question 8 Identify bias (2 points)

Club members are not representative: they may be likelier to have rides home or live nearby. **The sample is biased; use a random sample drawn from the whole student list.**

Scoring: 1 point for the bias, 1 point for the improvement.

Question 9 Cause and effect (1 point)

A randomized experiment, because random assignment balances all other factors across the groups.

Scoring: 1 point for the choice with a reason.