

Normal Curves, z-Scores and Study Design

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

Name: _____ Date: _____ Class: _____

These problems train mean, standard deviation, the 68-95-99.7 rule, z-scores, study design and margin of error from simulation, matching standards S-ID.A.4, S-IC.A.1, S-IC.B.3 and S-IC.B.4.

Early problems compute and apply the rule on normal curves. Later ones evaluate studies, read a simulation histogram and estimate a margin of error.

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

Problem 1 Mean of a data set (easy)

A bakery counted 23, 31, 28, 19 and 34 loaves sold on five afternoons. Find the mean number of loaves.

Problem 2 Standard deviation of a small set (easy)

Find the standard deviation of 3, 5, 9, 13, 15, treating the numbers as a whole population. Round to the nearest hundredth.

Problem 3 Compute a z-score (easy)

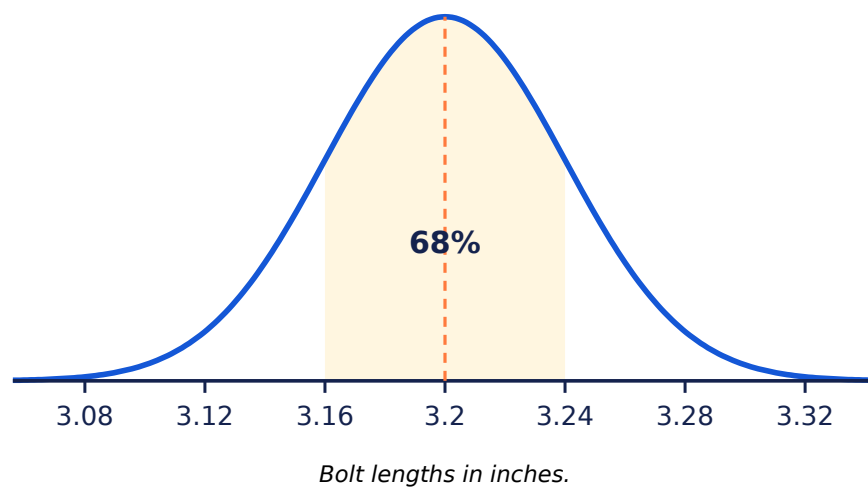
A student scores 84 on a test with mean 72 and standard deviation 6. Find the z-score.

Problem 4 Value from a z-score (easy)

A distribution has mean 500 and standard deviation 80. Find the value with z-score -1.5 .

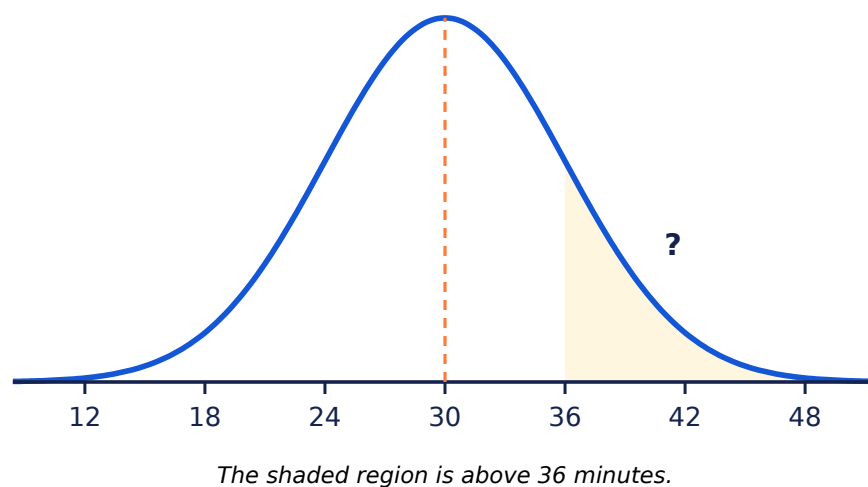
Problem 5 Applying the 68-95 rule (medium)

Bolt lengths are normally distributed with mean 3.2 in and standard deviation 0.04 in. Between which lengths do about 68% of bolts fall? About 95%?



Problem 6 Percent beyond one standard deviation (medium)

Daily commute times are normal with mean 30 minutes and standard deviation 6 minutes. What percent of commutes are longer than 36 minutes?

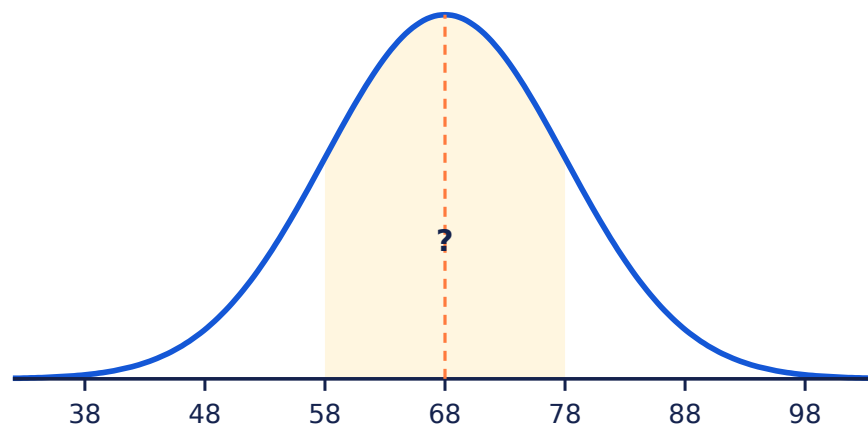


Problem 7 Between two values (medium)

Exam scores are normal with mean 76 and standard deviation 8. About what percent of scores fall between 60 and 92?

Problem 8 Counting students (medium)

Scores on a placement test are approximately normal with mean 68 and standard deviation 10. Among 400 students, about how many scored between 58 and 78?



Scores between 58 and 78.

Problem 9 Compare with z-scores (medium)

Mia scored 88 on a test with mean 80 and standard deviation 4. Noah scored 91 on a different test with mean 82 and standard deviation 6. Who performed better relative to their class?

Problem 10 Identify the study type (medium)

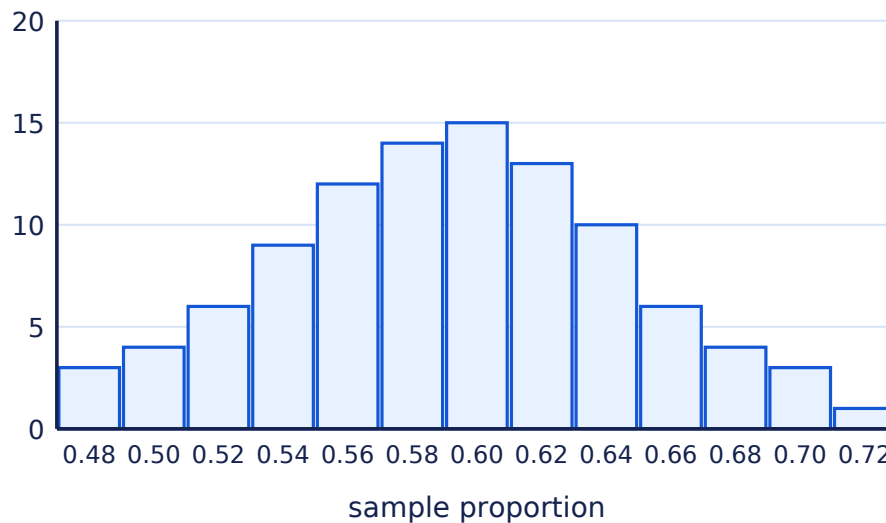
Classify each as a survey, an observational study or an experiment: (a) 300 voters are called and asked about a ballot measure; (b) a researcher records the sleep hours of students who already drink coffee and those who do not; (c) 60 plants are randomly split between two fertilizers and their growth measured.

Problem 11 Spot the bias (medium)

To learn whether students like the new cafeteria menu, a reporter asks only the first 30 students who enter the gym. Explain why the results may be biased and suggest a better method.

Problem 12 Margin of error from a simulation (hard)

A pollster simulates 100 random samples of 50 people from a population where 60% agree with a statement. The histogram shows the sample proportions. Estimate the interval holding the middle 95% of the results, and then the margin of error.



Results of 100 simulated samples of 50 people when the true proportion is 0.60.

Problem 13 Mean and deviation from a frequency table (medium)

A data set has the value 2 three times, 5 four times and 8 three times. Find the mean and the population standard deviation, to the nearest hundredth.

Problem 14 Find the mean from a z-score (medium)

On a quiz with standard deviation 8, a score of 93 has a z-score of 1.75. Find the mean of the quiz.

Problem 15 Percentiles from the rule (hard)

The heights of 10-year-old girls are approximately normal with mean 55 inches and standard deviation 2.4 inches. Find the height that about 2.5% of girls exceed, and the height below which about 2.5% fall.

Problem 16 Effect of an outlier (hard)

The data 14, 15, 15, 16, 17 have a mean and standard deviation. A new value 40 is added. Find the mean and population standard deviation before and after, to the nearest hundredth, and describe the change.

Problem 17 Design an experiment (hard)

A teacher wants to know whether a new study app improves quiz scores. Describe an experiment with 60 students that supports a cause-and-effect conclusion.

Problem 18 Margin of error by formula (hard)

In a poll of 40 voters, 55% support a proposal. Use margin of error $\approx 2\sqrt{p(1 - p)/n}$ to estimate the margin of error and the interval likely to contain the true proportion.

Problem 19 Unusual temperatures (hard)

Daily high temperatures in July are approximately normal with mean 86°F and standard deviation 5°F . Find the z-scores of 97°F and 78°F and decide whether each is unusual ($|z| > 2$).

Problem 20 Compare two classes (hard)

Class A and Class B both have mean score 70. Class A has standard deviation 5 and Class B has standard deviation 12. Find the z-score of a score of 85 in each class and explain which class is likelier to have students above 85.