

Sampling Distributions of Proportions and Means

Grade 12 – AP Statistics math · Worksheet · Standards: AP Statistics Unit 2 (2026-27)

Name: _____ Date: _____ Class: _____

These twenty problems train the ideas of AP Statistics sampling distributions: parameters and statistics, bias and variability, the sampling distributions of $\hat{p}$ and $\bar{x}$, the Central Limit Theorem, and the sampling distributions of differences. Later problems ask for checked conditions and interpretations.

Standards: AP Statistics Unit 2 (2026-27) · **Level:** Grade 12 AP Statistics

Problem 1 Parameter or Statistic (easy)

Classify each number as a parameter or a statistic and give its symbol.

- The mean salary of all 12,000 employees of a company is \$58,400.
- In a random sample of 80 customers, 62 say they are satisfied, a proportion of 0.775.
- A tester checks 25 batteries and finds a mean life of 9.4 hours.

Problem 2 Center and Spread of $\hat{p}$ (easy)

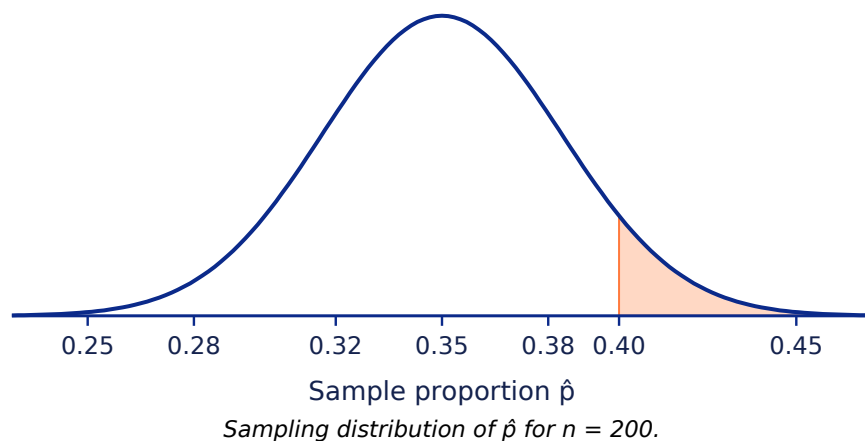
In a large school district, 40% of students ride the bus. Random samples of 100 students are selected. Find the mean and standard deviation of the sampling distribution of the sample proportion $\hat{p}$.

Problem 3 Checking Conditions for $\hat{p}$ (medium)

About 8% of the items made by a machine are defective. A random sample of 120 items is taken from a day's output of 5,000 items. Is the sampling distribution of $\hat{p}$ approximately normal? What happens with a sample of 250?

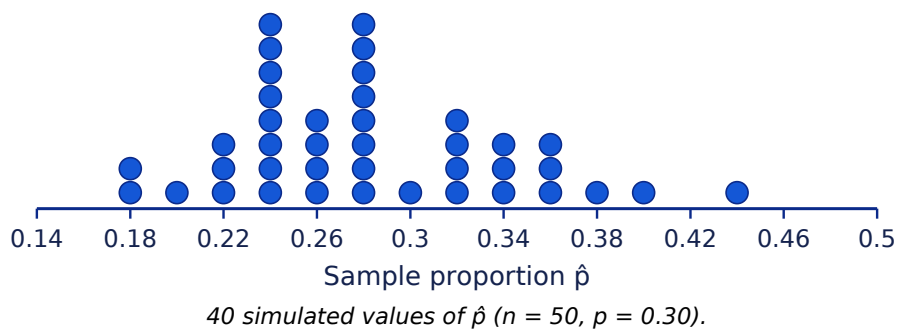
Problem 4 Probability for a Sample Proportion (medium)

In a city, 35% of adults have a library card. A random sample of 200 adults is taken. The curve shows the sampling distribution of the sample proportion. Find the probability that the sample proportion is at least 0.40.



Problem 5 Reading a Simulated Sampling Distribution (medium)

The dotplot shows the sample proportions from 40 simulated random samples of size 50 from a population with $p = 0.30$.



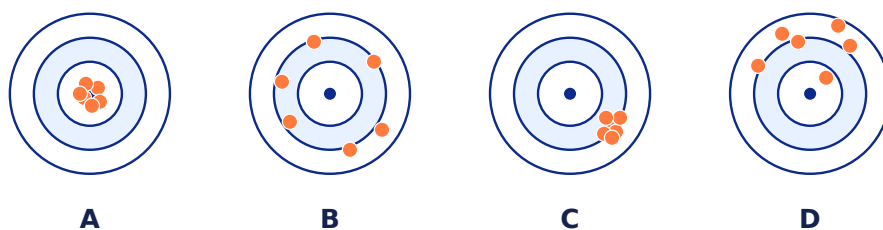
Describe the shape, center and spread of the distribution, and compare the spread to the theoretical standard deviation.

Problem 6 Sample Size and Spread (easy)

For a population with $p = 0.5$, compare the standard deviation of $\hat{p}$ for samples of size 100 and size 400. How does quadrupling the sample size affect the standard deviation?

Problem 7 Matching Bias and Variability (medium)

Four sampling methods were each used to take six samples. The bullseye is the true population parameter.



Each dot is the result of one sample; the bullseye is the true parameter.

- (a) Which method has low bias and low variability? (b) Which has high bias but low variability?
 (c) Which is biased and highly variable? (d) Which change could reduce the variability of method B?

Problem 8 Mean and SD of a Sample Mean (easy)

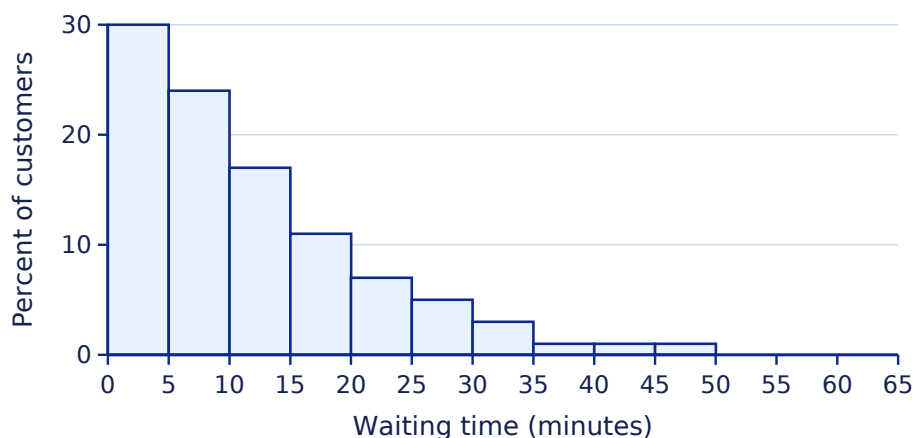
Test scores in a large course have mean 72 and standard deviation 9. Find the mean and standard deviation of the sampling distribution of $\bar{x}$ for random samples of 36 students.

Problem 9 Normal Population, Sample Mean (medium)

The weights of apples from an orchard are approximately normal with mean 160 g and standard deviation 14 g. A random sample of 25 apples is taken. Find the probability that the mean weight of the sample exceeds 164 g.

Problem 10 Central Limit Theorem Application (hard)

Waiting times at a service counter are skewed right with mean 15.2 minutes and standard deviation 11 minutes, as shown.



A skewed right population of waiting times.

A random sample of 45 customers is selected. Explain why a normal model can be used for $\bar{x}$,

then find $P(\bar{x} > 18)$.

Problem 11 Individual Versus Mean (medium)

Apple weights are approximately normal with mean 160 g and standard deviation 14 g. (a) Find the probability that one randomly chosen apple weighs less than 150 g. (b) Find the probability that the mean of a random sample of 16 apples is less than 150 g. (c) Explain the difference.

Problem 12 Sample Size for a Target Standard Deviation (medium)

A population has standard deviation $\sigma = 14$. What is the smallest sample size for which the standard deviation of $\bar{x}$ is at most 2?

Problem 13 Difference of Two Proportions (medium)

In city A, 55% of residents support a recycling program; in city B, 48% do. Independent random samples of 120 residents from A and 150 from B are taken. Find the mean and standard deviation of $\hat{p}_A - \hat{p}_B$.

Problem 14 Probability for a Difference of Proportions (hard)

Continue with the two cities. Check the conditions for normality, then find the probability that the sample proportion from city B is higher than the sample proportion from city A, that is $\hat{p}_A - \hat{p}_B < 0$.

Problem 15 Difference of Two Sample Means (medium)

Students in course A have scores with mean 82 and standard deviation 12; in course B, mean 76 and standard deviation 10. Independent random samples of 40 students from A and 35 from B are taken. Find the mean and standard deviation of $\bar{x}_A - \bar{x}_B$.

Problem 16 Probability for a Difference of Means (hard)

Use the two courses above. Assuming the sampling distribution is approximately normal, find the probability that the sample mean of A exceeds the sample mean of B by more than 10 points.

Problem 17 A Complete Sampling Distribution (hard)

A tiny population has four values: 3, 5, 9 and 11. All 16 possible samples of size 2 are drawn

with replacement (ordered pairs). List the sampling distribution of $\bar{x}$ and show that the mean of the sampling distribution equals the population mean.

Problem 18 Quality Control Proportion (hard)

A plant produces bolts, 4% of which are defective. An inspector checks a random sample of 500 bolts from a very large shipment. Verify the conditions and find the probability that more than 6% of the sample is defective.

Problem 19 Is the Sample Mean Unusual? (hard)

A cereal company states that its boxes average 340 g with a standard deviation of 6 g. An inspector weighs a random sample of 36 boxes and finds a mean of 338 g. Find the probability of a sample mean this low or lower if the company's claim is true. Does the sample give convincing evidence against the claim?

Problem 20 Comparing Two Clinics (hard)

Recovery rates are 70% at clinic A and 62% at clinic B. A random sample of 140 patients from A and 120 patients from B is studied. Find the probability that the sample recovery rate at A exceeds that at B by at least 0.15. Interpret the result.