



AP Statistics FRQ Practice · Unit 5

Smartphones With Mobile Data · numberbender.com

Name: _____

Date: _____

Score: / 4

What this question practices

- Mean and standard deviation of the sampling distribution of a sample proportion
- Checking the 10% and Large Counts conditions
- Normal probabilities for a sample proportion
- How sample size affects variability

*Show all your work. Answer each part in complete sentences, in the context of the problem. The data are hypothetical.
Suggested time: 13 minutes.*

In a large school district, 62% of high school students have a smartphone with mobile data. A researcher plans to select a random sample of 150 high school students from the district and find the proportion of the sample who have a smartphone with mobile data.

(a) Find the mean and standard deviation of the sampling distribution of the sample proportion. Show that any condition needed for your standard deviation formula is met.

(b) Explain why the sampling distribution of the sample proportion is approximately normal.

(c) Find the probability that 55% or fewer of the students in the sample have a smartphone with mobile data.



(d) How would the standard deviation of the sampling distribution change if the sample size were 600 instead of 150? Explain.





Each part is scored *E* (essentially correct), *P* (partially correct) or *I* (incorrect), the way AP readers score free-response questions. Compare your work with the model solution, then with the scoring note.

(a) Find the mean and standard deviation of the sampling distribution of the sample proportion. Show that any condition needed for your standard deviation formula is met.

$$\mu_{\hat{p}} = 0.62$$

$$\sigma_{\hat{p}} = \sqrt{\frac{0.62(0.38)}{150}} \approx 0.0396$$

→ The standard deviation formula requires the 10% condition: 150 students is less than 10% of all high school students in a large district.

Scoring. Essentially correct: both values and the 10% condition stated in context.

(b) Explain why the sampling distribution of the sample proportion is approximately normal.

$$np = 150(0.62) = 93 \geq 10, \quad n(1 - p) = 150(0.38) = 57 \geq 10$$

→ The Large Counts condition is met: the expected numbers of successes and failures are both at least 10, so the sampling distribution is approximately normal.

Scoring. Essentially correct: both counts calculated and compared with 10.

(c) Find the probability that 55% or fewer of the students in the sample have a smartphone with mobile data.

→ Use the normal distribution with mean 0.62 and standard deviation 0.0396, and find the area to the left of 0.55.

$$z = \frac{0.55 - 0.62}{0.0396} \approx -1.77$$

$$P(\hat{p} \leq 0.55) \approx 0.0387$$

→ There is only about a 4% chance that a random sample of 150 students would include 55% or fewer with mobile data.

Scoring. Essentially correct: correct normal distribution and boundary shown, with an answer of about 0.038 or 0.039.

(d) How would the standard deviation of the sampling distribution change if the sample size were 600 instead of 150? Explain.

→ The sample size is multiplied by 4, and the standard deviation is divided by the square root of n , so it is divided by 2.

$$\sigma_{\hat{p}} = \sqrt{\frac{0.62(0.38)}{600}} \approx 0.0198$$

→ Larger random samples give sample proportions that vary less from sample to sample.

Scoring. Essentially correct: says the standard deviation is halved (about 0.0198) and explains why.

