LESSON MAKER PRO

Chance in a Sample

Estimate sample proportions with a normal model.

HIGH SCHOOL · MM.D3D.C.19.b

MM.D3D.C.19.b "Use the normal approximation of a proportion from a random event or sample when conditions are met."

NAME _____ DATE _____

WHEN THE MODEL FITS

For independent trials with success chance p, use a normal model for the sample proportion p_hat when np and n(1 - p) are both at least 10. The model has mean p and standard deviation SD = sqrt(p(1 - p)/n). Use the table to estimate areas near the mean.

WORKED EXAMPLE

In 400 independent trials, the success chance is 0.20. Estimate P(p_hat ≥ 0.24).

NORMAL MODEL AREAS

Interval centered at the mean	Area
Within 1 SD	68%
Within 2 SD	95%

1. np = 80 and n(1 - p) = 320, so the model fits.
2. SD = sqrt(0.20(0.80)/400) = 0.02.
3. 0.24 is 2 SD above the mean, 0.20.
4. The upper tail is (100% - 95%)/2 = 2.5%.

Answer: About 2.5%.

PRACTICE 4 problems

1 For 100 independent trials with p = 0.50, estimate P(p_hat ≥ 0.55).

ANSWER _____

2 For 300 independent trials with p = 0.75, estimate P(p_hat ≤ 0.70).

ANSWER _____

3 For 100 independent trials with p = 0.80, estimate P(0.76 ≤ p_hat ≤ 0.84).

ANSWER _____

4 For 100 independent trials with p = 0.05, can you use a normal model for p_hat? Give a reason.

ANSWER _____

APPLY IT Show your work

1 Each music-app play is independent. Use the table to estimate the chance that at least 45% of plays are skips.

SKIP MODEL

Number of plays	Chance of a skip
96	0.40

ANSWER _____

2 A player makes each free throw independently with chance 0.50. In 25 shots, estimate the chance that the proportion made is between 0.30 and 0.70.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A game awards a bonus on each of 84 independent spins with chance 0.30. Estimate the chance that the proportion of bonus spins is between 0.35 and 0.40. Explain how you found the area.

WORK SPACE AND ANSWER

Chance in a Sample

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	For 100 independent trials with p = 0.50, estimate P(p_hat ≥ 0.55).	**About 16%.**
2	For 300 independent trials with p = 0.75, estimate P(p_hat ≤ 0.70).	**About 2.5%.**
3	For 100 independent trials with p = 0.80, estimate P(0.76 ≤ p_hat ≤ 0.84).	**About 68%.**
4	For 100 independent trials with p = 0.05, can you use a normal model for p_hat? Give a reason.	**No. np = 5, which is less than 10.**

PART 2 · APPLY IT

1. **About 16%.** The counts are 38.4 and 57.6, so the model fits. SD = sqrt(0.40(0.60)/96) = 0.05, and 0.45 is 1 SD above the mean.
2. **About 95%.** Both expected counts are 12.5, and SD = sqrt(0.50(0.50)/25) = 0.10. The bounds are 2 SD below and above the mean.

CHALLENGE

About 13.5%. Both expected counts exceed 10, and SD = sqrt(0.30(0.70)/84) = 0.05. The bounds are 1 and 2 SD above the mean, so the area is (95% - 68%)/2 = 13.5%.

Accept equivalent decimals or fractions for percentages. Answers are estimates based on the 68% and 95% normal-model areas.