

Constructing a confidence interval for a population proportion

Step 1: Have you met the conditions for using a confidence interval?

Randomly selected sample – Look for the term SRS. Without random selection, we lose the ability to make inferences about the population.

Normal Distribution – We will be using Normal Curves to find probabilities, so we need the distribution to be Normal. For Proportions: $np \geq 10$ and $n(1-p) \geq 10$.

Independent Observations – In order to use our standard deviation formula, we need the sample size to be less than 10% of the population size, so $10n < N$. This is especially true when sampling without replacement.

Step 2: Find the sample proportion, \hat{p} , used to estimate the population mean, p , using an SRS. $\mu_{\hat{p}} = p$

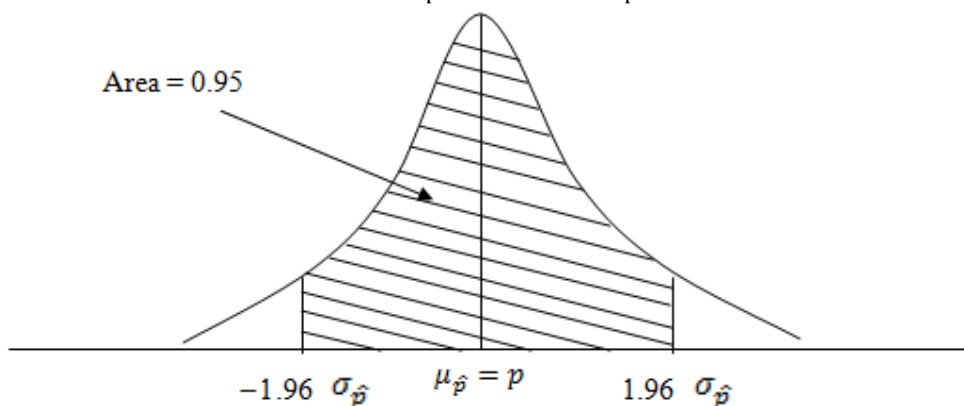
Step 3: Calculate the Standard Deviation of the sample mean:
$$\sigma_{\hat{p}} = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

This is sometimes called the Standard Error of the Estimate (SEE)

Step 4: Decide what confidence level you want. Usually the confidence level is 90%, 95% or 99%. Use the calculator to find the critical z-value based.

Step 5: Find the Margin of Error (MOE) by multiplying $z \cdot \sigma_{\hat{p}}$

In the example below, the distribution of these sample means is approximately normal with 95% of all \hat{p} values between $\hat{p} - z \cdot \sigma_{\hat{p}}$ and $\hat{p} + z \cdot \sigma_{\hat{p}}$



Step 6: State the Confidence Interval: $\hat{p} \pm z \cdot \sigma_{\hat{p}}$ Lower = $\hat{p} - z \cdot \sigma_{\hat{p}}$
Upper = $\hat{p} + z \cdot \sigma_{\hat{p}}$

Step 7: State the AP Language:

We are _____ confident that the interval _____ to _____ captures the true population
Conf. level *lower* *upper*
 proportion of _____.
Parameter of interest

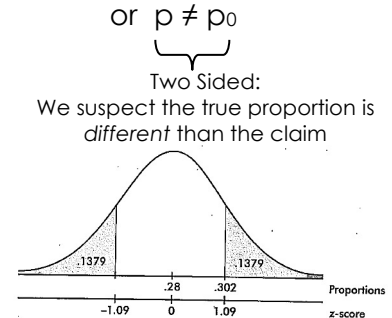
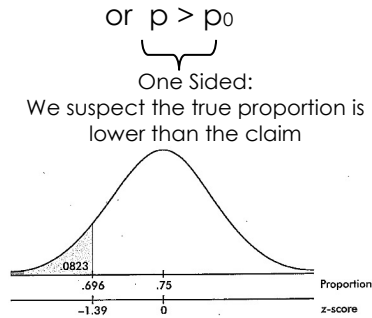
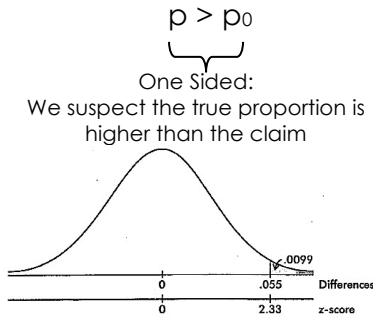
Now write a sentence giving the meaning of the conclusion tied to the purpose of the study.

Conduction a significance test for a population proportion

Step 1: Set up your hypothesis based on what you think about the population and identify the parameter of interest. Example: p = approval rate of president Claim: approval rate is 50%

$H_0 : p = 0.5$	The Null Hypothesis states a claim about the value of a parameter. The previous example made a claim that the proportion was 0.5. There must be evidence to reject this claim.
$H_a : p \leq 0.5$	The Alternate Hypothesis states our suspicion about the population. Our suspicion is that the true proportion is less than 50%

NOTE: The null hypothesis is center of the graph. The alternative will be stated in one of three ways:



Step 2: Have you met the conditions for using a significance test?

Randomly selected sample – Look for the term SRS. Without random selection, we lose the ability to make inferences about the population.

Normal Distribution – We will be using Normal Curves to find probabilities, so we need the distribution to be Normal. For Proportions: $np \geq 10$ and $n(1-p) \geq 10$.

Independent Observations – In order to use our standard deviation formula, we need the sample size to be less than 10% of the population size, so $10n < N$. This is especially true when sampling without replacement.

Step 3: Find the sample proportion, \hat{p} used to estimate the population proportion, p , using an SRS.

Step 4: Calculate the Standard Deviation of the sample proportion: $\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$ p is the null

Step 5: Find the Z-Value $Z = \frac{\hat{p} - null}{\sigma_{\hat{p}}}$ Example: $Z = \frac{.35 - .05}{\sqrt{\frac{.5(1-.5)}{100}}} = 2.108$

Step 6: Calculate the **p-value**: The probability of getting a result at least as far out as our result if the null is true. Example: $P(Z \geq 2.108) = 0.0175$

Step 7: Compare the p-value to the significance level (called an α – level)

If the p-value is **below** the significance level:

- Then we reject the null hypothesis H_0 in favor of the alternate hypothesis H_a
- We say the results are statistically significant

If the p-value is **above** the significance level:

- Then we fail to reject the null hypothesis H_0 and reject the alternate hypothesis H_a
- We say the results are NOT statistically significant

Step 8: State your conclusion using AP Language.

If the true proportion is really _____ for _____, there is a _____ chance of finding a _____

(null) (param of interest) (state the p-value)

sample of _____ people with an \hat{p} value of _____. We conclude that at the _____

(sample size, n) (test statistic) (state the α -level)

significance level the claim [is rejected] or [fails to be rejected].

Now write a sentence giving the meaning of the conclusion tied to the purpose of the study.