Hypothesis Testing for Proportions

Essential Statistics

Hypothesis Test for Proportions

- In this section, you will learn how to test a population proportion, p. If np ≥ 10 and n(1-p) ≥ 10 for a binomial distribution, then the sampling distribution for $\hat{p}$ is normal with $\mu_{\hat{p}} = p$ and $\sigma_{\hat{p}} = \sqrt{p(1-p)/n}$

Steps for doing a hypothesis test

"Since the p-value < (>) α, I **reject** (**fail to reject**) the H_0. There **is** (**is not**) sufficient evidence to suggest that **H_a (in context)**."

1) A

2) W

H_0: p = 12 vs H_a: p (<, >, or ≠) 12

3) Calculate the test statistic & p-value

4) Write a statement in the context of the problem.

What is the p-value

- The **<u>P-Value</u>** is the probability of obtaining a test statistic that is at least as extreme as the one that was actually observed, assuming the null is true.

- p-value $<$ ($>$) α, I **reject** (**fail to reject**) the **H_o**.

How to calculate the P-value

- Under Stat – Tests
- Select 1 Prop Z-test
- Input p, x, and n
  - P is claim proportion
  - X is number of sampling matching claim
  - N is number sampled
- Select correct Alternate Hypothesis
- Calculate

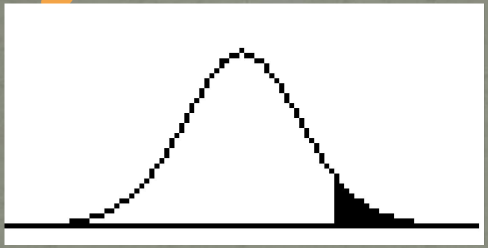
Reading the Information

- Provides you with the z score
- P-Value
- Sample proportion

- Interpret the p-value based off of your Confidence interval

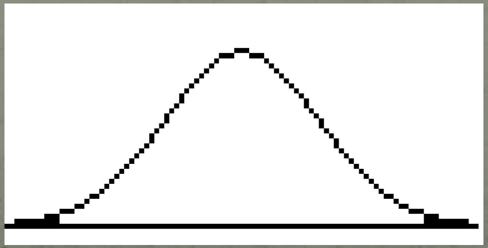
Draw & shade a curve & calculate the p-value:

1) right-tail test z = 1.6



P-value = .0548

2) two-tail test z = 2.3



P-value = (.0107)2 = .0214

What is α

α Represents the remaining percentage of our confidence interval. 95% confidence interval has a 5% alpha.

Ex. 1: Hypothesis Test for a Proportion

- A medical researcher claims that less than 20% of American adults are allergic to a medication. In a random sample of 100 adults, 15% say they have such an allergy. Test the researcher's claim at $\alpha = 0.01$.

SOLUTION

- The products $np = 100(0.20) = 20$ and $nq = 100(0.80) = 80$ are both greater than 10. So, you can use the z-test. The claim is "less than 20% are allergic to a medication." So the null and alternative hypothesis are:

H_o: $p = 0.2$ and H_a: $p < 0.2$ (Claim)

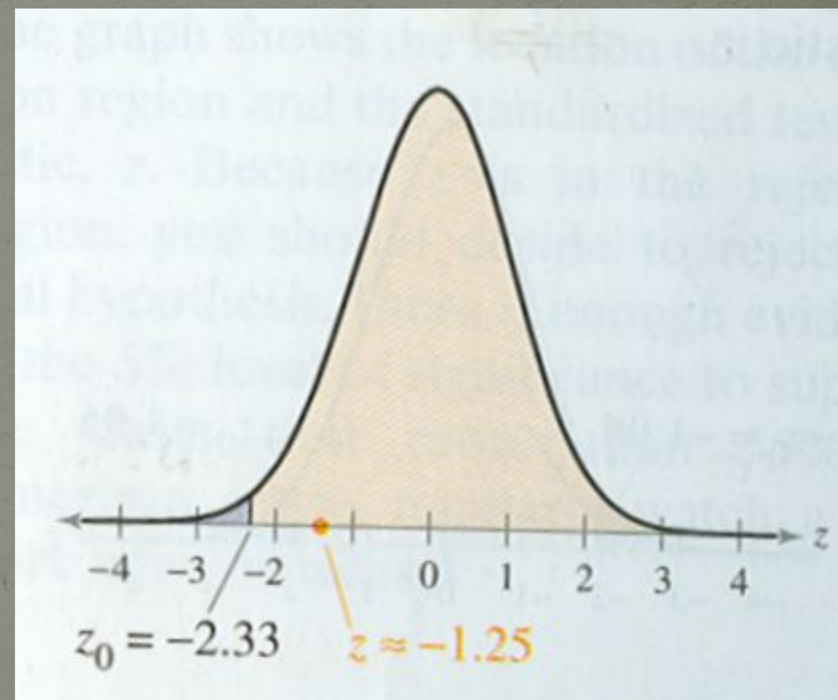
Solution By HAND continued . . .

- Because the test is a left-tailed test and the level of significance is α = 0.01, the critical value is $z_0 = -2.33$ and the rejection region is $z < -2.33$. Using the z-test, the standardized test statistic is:

$$z = \frac{\hat{p} - p}{\sqrt{\frac{pq}{n}}} = \frac{0.15 - 0.20}{\sqrt{\frac{(0.20)(0.80)}{100}}} \approx -1.25$$

SOLUTION Continued . . .

- The graph shows the location of the rejection region and the standardized test statistic, z. Because z is not in the rejection region, you should decide not to reject the null hypothesis. In other words, there is not enough evidence to support the claim that less than 20% of Americans are allergic to the medication.



Solutions Continued……

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$$H_0: p = 12 \text{ vs } H_a: p\ (<, >, \text{or} \neq)\ 12$$

Interpretation

- Since the .1056 **>** .01, I **fail to reject** the H_o There **is not** sufficient evidence to suggest that 20% of adults are allergic to medication.

Ex. 2 Hypothesis Test for a Proportion

- Harper's Index claims that 23% of Americans are in favor of outlawing cigarettes. You decide to test this claim and ask a random sample of 200 Americas whether they are in favor outlawing cigarettes. Of the 200 Americans, 27% are in favor. At $\alpha = 0.05$, is there enough evidence to reject the claim?

SOLUTION:

- The products np = 200(0.23) = 45 and nq = 200(0.77) = 154 are both greater than 5. So you can use a z-test. The claim is “23% of Americans are in favor of outlawing cigarettes.” So, the null and alternative hypotheses are:

H_o: p = 0.23 (Claim) and H_a: p ≠ 0.23

SOLUTION continued . . .

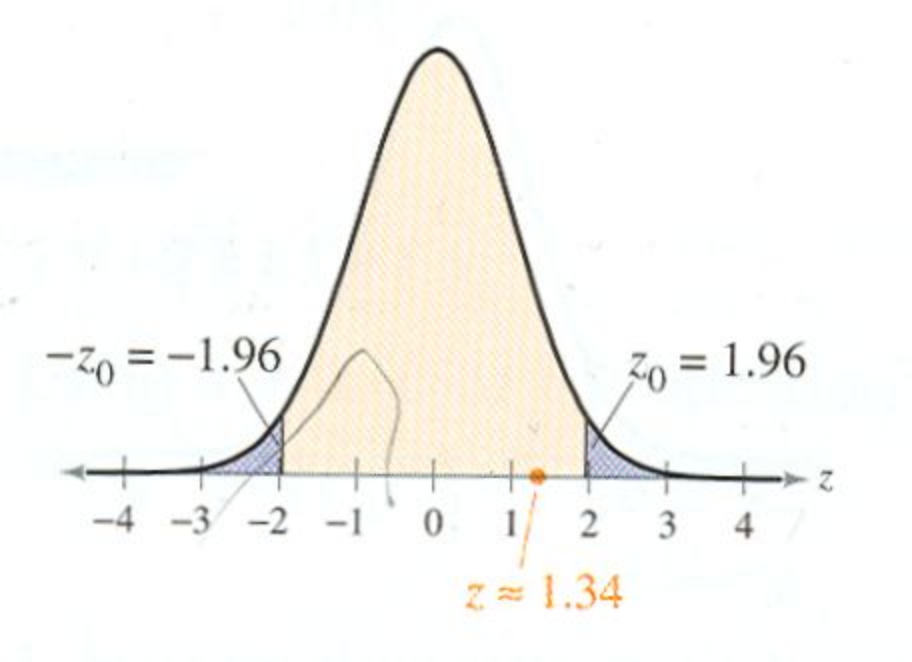
- Because the test is a two-tailed test, and the level of significance is $\alpha = 0.05$.

- $Z = 1.344$
- $P = .179$

- Since the .179 > .05, I **fail to reject** the H_0 There is **not sufficient** evidence to suggest that more or less than 23% of Americans are in favor of outlawing cigarette's.

SOLUTION Continued . . .

- The graph shows the location of the rejection regions and the standardized test statistic, z.
- Because z is not in the rejection region, you should fail to reject the null hypothesis. At the 5% level of significance, there is not enough evidence to reject the claim that 23% of Americans are in favor of outlawing cigarettes.



Ex. 3 Hypothesis Test a Proportion

- The Pew Research Center claims that more than 55% of American adults regularly watch a network news broadcast. You decide to test this claim and ask a random sample of 425 Americans whether they regularly watch a network news broadcast. Of the 425 Americans, 255 responded yes. At $\alpha = 0.05$, is there enough evidence to support the claim?

SOLUTION:

- The products $np = 425(0.55) = 235$ and $nq = 425(0.45) = 191$ are both greater than 5. So you can use a z-test. The claim is "more than 55% of Americans watch a network news broadcast." So, the null and alternative hypotheses are:

H_o: $p = 0.55$ and H_a: $p > 0.55$ (Claim)

SOLUTION continued . . .

- Because the test is a right-tailed test, and the level of significance is $\alpha = 0.05$.

- $Z = 2.072$
- P-value = .019

- Since the 0.019 < .05, I **reject** the H_0. There **is** sufficient evidence to suggest that 20% of adults are allergic to medication.

SOLUTION Continued . . .

- The graph shows the location of the rejection region and the standardized test statistic, z. Because z is in the rejection region, you should decide to There is enough evidence at the 5% level of significance, to support the claim that 55% of American adults regularly watch a network news broadcast.