Inspiring Greatness

INDEPENDENCE SCHOOL DISTRICT

Math Virtual Learning

AP Statistics

Two Tailed Tests of One Proportion

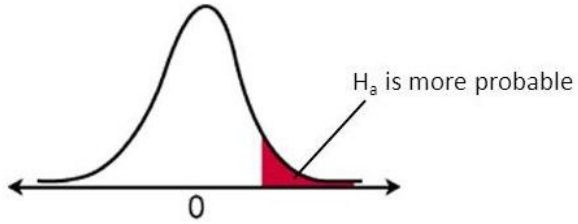
April 13th, 2020

Lesson: April 13th, 2020

Objective/Learning Target:

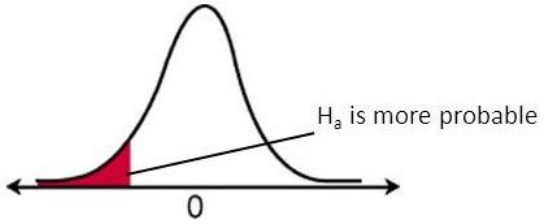
Students will be able to apply the 1 proportion Z test methods, to a two tailed hypothesis

One tailed vs. two tailed



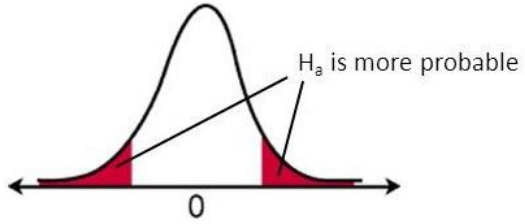
Right-tail test

$H_a: \mu > \text{value}$



Left-tail test

$H_a: \mu < \text{value}$



Two-tail test

$H_a: \mu \neq \text{value}$

Two tailed p-values

The single tailed p-value is simply the area on one side of the distribution that covers the desired area.

However, two tailed tests have split this area equally between the two tails. That means for an alpha = 0.1, that 5% will be in the lower tail and 5% in the upper. Thus the z statistic this test would be 1.960 instead of the typical 1.645 for 90% confidence.

Example

According to official census figures, 8% of couples living together are not married. A researcher took a random sample of 400 couples and found that 9.5% of them are not married. Test at the 15% significance level if the current percentage of unmarried couples is different from 8%.

State

We wish to test to see if the percent of unmarried couples that live together has changed.

P: The true proportion of couples living together that are unmarried.

$$H_0 : p = 0.08$$
$$H_1 : p \neq 0.08$$

Plan

1 prop z-test with an alpha = 0.15

Random: The data is taken from a random sample

Independent: It is reasonable to assume that one couple's response does not affect the other couple's response. In addition, the sample of 400 can safely be assumed to be less than 10% of the population.

Normal: np = 400*0.08=32, n(1-p) = 400(1-0.08) = 368

Because this sample meets the np and n(1-p) conditions, we can assume it is approximately normal.

Do

$$z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{.095 - .08}{\sqrt{\frac{.08(1-.08)}{400}}} = \frac{.015}{.013...} = 1.106$$

pvalue = 2normalcdf(1.106, 99999)=2(.134)=.269

Decision: Keep H_0. (because 26.9%>15%)

Conclude

At a significance level of 15%, there is not sufficient evidence to reject the null hypothesis. Therefore, there is no evidence to suggest that the true proportion of couples living together that are unmarried has changed from 8%.

You Try

USA Today reported that in 1992, 39% of all elementary school children claimed that when they grow up they want to do something to help other people. However, in 1995, 128 of a random sample of 317 of these same children claimed that when they grow up they want to do something to help other people. Does this information indicate that there has been an attitude change either way?

Answers

State: We want to test to see if the proportion of kids wanting to help people when they grow up has changed

p= prop of elementary kids wanting to help people when they grow up

H_0: p =0.39

H_a: p≠ 0.39

Answers

Plan: 1 prop z -test with alpha=0.05

Random: data is from a random sample

Independent: Student responses should not affect each other, and 317 students can fairly be assumed to be less than 10% of all students.

Normal: 317(0.39) >10, and 317(1-0.39)>10, This meets the condition for normality.

Answers

Do:

$$\sigma_p = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.39(1-0.39)}{317}} = 0.027$$

$$\textit{test statistic} = \frac{\hat{p}-p}{\sigma_p} = \frac{0.404-0.39}{0.027} = 0.51$$

We need the area above z=0.51 and below z=-0.51… You can do this with a z-table like we learned in chapter 2… or the calculator.

P-value = 2*normalcdf(0.51,999999999) = **0.62**

*note that normalcdf is found by pressing second and VARS. The first term is lower bound, second is upper bound. It returns the area between the two. When we do not have an upper bound choose something huge like a bunch of nines. If we do not have a lower bound choose something tiny, like a negative with a bunch of nines.

Conclude

With an alpha of 0.05, We fail to reject the null hypothesis. We do not have evidence that the true proportion of elementary students that want to help people when they grow up has changed from 39%.

Extra practice

Reading: pg 549-561

HW: 27–30, 41, 43, 45, 47, 49, 51, 53, 55