Hypothesis Testing

Step 1: Formulate the hypothesis

H_0: Null hypothesis
H_1: Alternative hypothesis

Step 2: identify the test statistic.

The test statistic will assess the evidence against the null hypothesis.

Step 3: P-Value

A probability statement which determines the strength of the null hypothsesis.
The smaller the p-value, the stonger the evidence against H_0.

Step 4: Compare the P-value to the Significance Level α.

A test is statistically significant if p-value $\leq \alpha$

Step 5: State your conclusion.

Significance Level:
The significance level, α ,defines the sensitivity of the test.
A value of α = 0.05 means that we inadvertently reject the null hypothesis 5% of the time when it is in fact true. The choice of is somewhat arbitrary, although in practice values of 0.1, 0.05, and 0.01 are commonly used.

Conclusion Template:

If you reject H_0:
There is sufficient evidence at the ____ signnificance level to show that __________ is true.
σ H_1 in words

If you fail to reject H_0:
There is not sufficient evidence at the ____ signnificance level to show that __________ is true.
σ H_1 in words

To reject a hypothesis is to conclude that it is false. However, to accept a hypothesis does not mean that it is true, only that we do not have evidence to believe otherwise.

Hypothesis test on your calculator:

Test for p: 1-PropZTest
Test for μ, σ known: ZTest
Test for μ, σ unknown: TTest

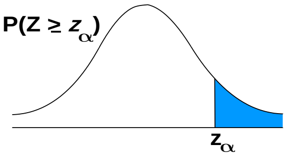
Significance Test for a Proportion

Draw an SRS of size n from a larger population that contains an unknown proportion p of successes. To test the hypothesis $H_0: p = p_0$, compute the Z statistic.

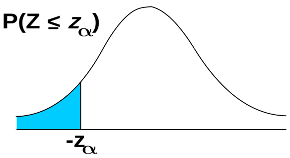
$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

In terms of the variable Z having the standard Normal distribution, the approximate P-value for a test of H_0 against

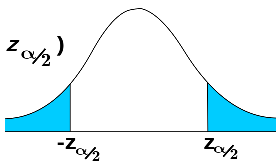
$H_1: p > p_0$ is $P(Z \geq z_\alpha)$



$H_1: p < p_0$ is $P(Z \leq z_\alpha)$

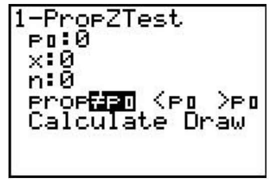


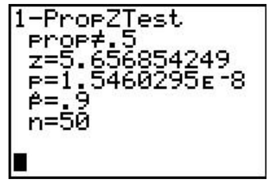
$H_1: p \neq p_0$ is $P(Z \neq z_{\alpha/2})$



Use this test when the sample size n is no large that both np_0 and $n(1-p_0)$ are 10 or more.

1-PropZTest





P_0: value of the null hypothesis
x: success in the sample
n: the total size of the sample
prop: alternative hypothesis
calculate
After calculation:
Prop= alternative hypothesis
z = test statistic
p = probability
p̂= p-hat is the sample proportion
n: the total size of the sample

<u>Note:</u>
Z statistic:
If the null hypothesis is true, it should be close to 0.
P
P is the probability that the difference between the proportion and p_0 would occur if the null hypothesis is true. When the value is sufficiently small, we reject the null hypothesis and conclude that the alternative hypothesis is true.

Example (#14):

In 1990, 5.8% of job applicants who were tested for drugs failed the test. At the 0.01 significance level, test the claim that the failure rate is now lower if a simple random sample of 1520 current job applicants results in 58 failures. Does this suggest that fewer job applicants now use drugs?

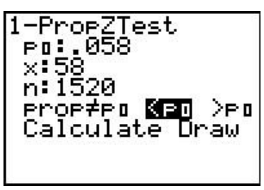
Given: $\alpha = 0.01$ $p = 0.058$ $x = 58$ $n = 1520$

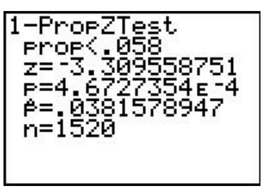
Step 1:

$H_0: p = 0.58$
$H_1: p < 0.58$

Step 2 & 3:

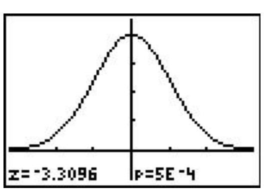
Since we are testing for p, we use the z distribution. That is 1-PropZTest on the calculator.





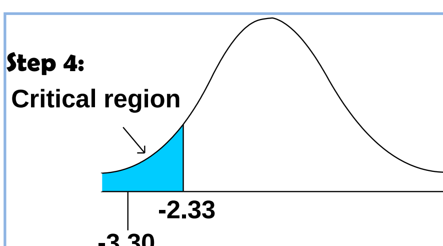
Test statistic = -3.31
P-value = 0.00047
$\hat{p}$ = 0.0382

Draw



Since it is so small, it does not show very well on the calculator.
Since $\alpha = 0.01$, $z_\alpha = -2.33$

Step 4:



Since the test statistic is in the critical region and the p-value is less than the significance level 0.01, we reject the null hypothesis.

Step5:

There is sufficient evidence at the 0.01 significance level to show that fewer job applicants now use drugs.
We can conclude that few jobs applicants now use drugs.