10.1 & 10.2 Hypothesis Testing/Population Proportion Test

We all make decisions every day of our lives. From deciding on a college to what you will eat for breakfast, our day is consumed by the decision making process. Statisticians are often tasked with making decisions based on the data that they have collected. They are aided in this process by "Hypothesis Testing" procedures. In its most basic form, hypothesis testing begins with a question/statement and a proposed response to that question/statement. In hypothesis testing, we are attempting to identify the likelihood that the response is valid.

It all begins with a choice between two opposing hypotheses. One is referred to as the **null hypothesis (H_o)** and the other is referred to as the **alternative hypothesis (H_1)**.

Null Hypothesis: We are actually testing the validity of the null hypothesis. Does the evidence seem to support it? It is assumed to be true until proven otherwise.

Alternative Hypothesis: This is the statement we are trying to find evidence to support it.

There are only 3 ways to set up a null and alternative hypothesis. Think of them as pairs. For every null hypothesis, an alternative hypothesis must exist.

Two-Tailed Test H_o: Null hypothesis = some value

H_1: Alternative hypothesis = some value

Left-Tailed Test H_o: Null hypothesis $\geq$ some value

H_1: Alternative hypothesis < some value

Right-Tailed Test H_o: Null hypothesis $\leq$ some value

H_1: Alternative hypothesis > some value

Every null and alternative pair must conform to one of the above pairs.

Ex. The salesman at a local car dealership states that the average price of a Chevy Corvette is $52000. A customer disagrees.

Ex. The salesman at a local car dealership states that the average price of a Chevy Corvette is at least $52000. A customer disagrees. She believes that the price is less than that stated by the salesman.

Ex. The salesman at a local car dealership states that the average price of a Chevy Corvette is at most $52000. A customer disagrees. She believes that the price is more than that stated by the salesman.

Remember, every scenario must be stated in one of the three given formats.

Ex. The ACME Drug Company states that 5% of patients who take drug XYZ experience headaches. An independent physician believes that this is incorrect.

Ex. The ACME Drug Company states that at most 5% of patients who take drug XYZ experience headaches. An independent physician believes that the actual proportion is higher.

Ex. The ACME Drug Company states that less than 5% of patients who take drug XYZ experience headaches. An independent physician believes this is false.

The conditions under which we will conduct our hypothesis testing are the same as those in the conficence interval unit (two types of population mean tests and one type of proportion test). The evidence that we use to prove or disprove the null hypothesis is some combination of sample and/or population data.

The procedure for testing a pair of hypotheses is as follows

1. State the hypothesis **and** identify the claim.
2. Find the critical value(s) from the Z or T distribution.
3. Compute the test value.
4. Make a decision to "reject" or "not reject" the null hypothesis.
5. Summarize what your decision in step 4 implies about the claim. Start with the phrases "Evidence supports the claim…" or "Evidence does not support the claim…".

Example 1: Americans were asked, "What do you think is more important – to protect the right of Americans to own guns or to control gun ownership?" 46% of all Americans said protecting the right to own guns is more important. The Pew Research Center surveyed 1267 randomly selected Americans with at least a bachelor's degree and found that 559 believed that protecting the right to own guns is more important. Does this result suggest the proportion of Americans with at least a bachelor's degree feel differently than the general American population when it comes to gun control? Use the α=0.1 level of significance.

Example 2: According to the US Department of Agriculture, 48.9% of males aged 20-39 years consume the recommended daily requirement of calcium. After an advertising campaign, The USDA conducts a survey of 50 randomly selected males aged 20 -39 and finds that 31 of them consume the recommended daily requirement of calcium. At the α=0.1 level of significance, is there enough evidence to conclude that the percentage has increased?