Math 244 Lecture Notes

Chapter 19: Hypothesis Tests for 1-Proportion

Overview: Today, we will practice hypothesis tests. This covers primarily topics from chapter 19 (H-Tests). Recall that there are four steps to testing claims about proportions:

(a) State the Hypotheses. These will look something like the following:

$$H_0 : \text{parameter} = \#$$

$$H_A : \text{parameter}[<, >, \neq]\#$$

(b) Determine the Model and Check Assumptions. For example, the model for analyzing proportions is

$$\hat{P} = N\left(p, \sqrt{\frac{pq}{n}}\right)$$

where the assumptions are

- Random [little to no bias]
- Independence/10% Rule
- Large n: $np \geq 10$ AND $nq \geq 10$

(c) Calculate the P-Value. This is the likelihood of your sample data or more extreme if H_0 is true. You should commit this to memory.

(d) Conclusion. If your $P - Val < \alpha$, then you reject H_0 and have evidence of the H_A. If your $P - Val \geq \alpha$, then you fail to reject H_0 and do NOT have evidence of the H_A.

NOTE: Recall that **parameters** are numbers that describe a population (μ, σ, p) and statistics are numbers that describe a **sample** $(\bar{x}, s, \hat{p})$. Let's practice forming hypotheses.

Example 1. Previously, 80% of Comcast customers were satisified with their service. They want to test if they have improved.

Example 2. Last year, the average length of a Delta flight from San Francisco to Portland was 90 minutes. They hope they have improved (more efficient).

Example 3. You want to test if a coin is fair.

Example 4. A ruler manufacturer states that their measuring sticks vary by 0.01 inches. You think they actually vary less.

Let's look at a test from start to finish.

Example 5. According to Time magazine, 33% of all cars sold in the US are SUVs. After some investigation, it appears that the actual value is less. Suppose a random sample of 500 recently sold cars shows that 145 are SUVS.

Example 6. National Geographic claims that 40% of individuals like cats more than dogs. An informal student survey at PCC shows that 80 people and 30 of those preferred cats over dogs. Test the claim that the actual proportion of those that prefer cats is less than what National Geographic claims.

Checking work with Calculator: In our calculator, we use "1-propZTest" to check our z-score and p-value. This is found in either [Stat]→[Tests] on the TI-83/84 OR [Stat/List]→[F6:Tests] on the TI-89. If it asks for P_0, then it wants the probability from the null-hypothesis!

Calc P-value:

It is now your time to try! Follow the four steps to do the following H-Tests.

(a) **Two-Tailed Tests:** How would the previous problem change if we thought that the actual value was **different**? That is according to Time magazine, 33% of all cars sold in the US are SUVs. After some investigation, it appears that the actual value is **different**. Suppose a random sample of 500 recently sold cars shows that 145 are SUVS.

(b) Census.gov claims that 29.7% of students work "full time". An informal student survey at PCC shows that 18 out of 68 students worked full time. Test the claim that the actual proportion is higher than claimed.

(c) USNews claims that 86.6% of Oregonians have health care (Q1 of 2014). We want to test if the actual proportion is different than claimed. An informal student survey at PCC shows that 64 out of 68 individuals had health care. Test the claim.

(d) It is estimated that 20% of all freshwater fish in the US have such high levels of mercury that they are dangerous to eat. Suppose a fish market has 250 fish tested, and 60 of them have dangerous levels of mercury. Test the claim that the true proportion of fish with high levels of mercury is different than claimed.

Using the above data, create a 90% CI for the proportion of fish with high levels of mercury: