Lab Project #13
Tests of Significance

I. In our first lab, we used a triangle taste test to see whether people could tell a difference between an expensive brand of bottled water and a store brand. Recall that with the triangle taste test, a taster is presented with three items to taste of which 2 are alike of one type and 1 which is of the other type. The tester is then asked to tell which of the three items tasted is different from the other two, i.e. to identify the "odd" item.

(a) If there is really no difference in taste between the two food products, then you would expect the tasters to correctly choose the odd item about $33.33\%$ of the time. (Hint: they will have to guess)

\[ \frac{1}{3} \times 100 \]

(b) If there is some difference between the two products, then you would expect more than $33.33\%$ of the testers to correctly identify the odd product.

(c) Suppose 45 people tested the products using the triangle taste test and suppose that 19 of the testers correctly identified the odd item. Is this significant evidence that there is some difference between the two products? Set up the null and alternative hypotheses, find the P-value and draw your conclusions.

1. State the null hypothesis for this problem.

   \[ \text{There is no difference between the two products.} \]

2. State the alternative hypothesis.

   \[ \text{There is some difference between the two products.} \]

3. Calculate the test statistic

\[ \text{sample } \% = \hat{p} \times 100 = \frac{19}{45} \times 100 = 42.22\% \]

\[ \text{pop } \% = p \times 100 = \frac{1}{3} \times 100 = 33.33\% \]

\[ \text{SE(sample } \%) = \frac{\sqrt{p(1-p)}}{n} \times 100 = \frac{\frac{1}{3} \times (1-\frac{1}{3})}{45} \times 100 = 7.03\% \]

4. Find the P-value

\[ \text{P-value} = \text{area} = \frac{100 - \text{P} \cap \cap}{2} = 10.565\% \]

5. State your conclusions in the language of the problem.

   Since the P-value is greater than 5%, the results are not significant.

   (That is, we do not reject the null hypothesis.)
II. *Fortune* magazine compiled salary information for various occupational groups (*Fortune*, June 26, 1995). According to this information, television news anchorpersons earned an average annual salary of $65,824. Assume that this average was for all television anchorpersons in 1995. It seems reasonable to expect that the average has increased over what it was in 1995. A recent sample of 30 news anchorpersons showed that they earn an average annual salary of $73,500 with a standard deviation of $12,500. Is this sufficient evidence to indicate that the true average salary has increased? Perform a test of significance, find the P-value, and state your conclusions.

1. **Null hypothesis**: the true average salary has not increased.

2. **Alternative hypothesis**: the true average salary has increased.

3. **Test statistic**:

   \[ z = \frac{\text{Value (of } \bar{x}) - \mu}{\text{SE} (\bar{x})} \]

   \[ = \frac{73,500 - 65,824}{12,500 / \sqrt{30}} \]

   \[ = \frac{7,676}{2,282.2} \]

   \[ = 3.363 \]

4. **P-value**

   Based on the normal curve, we see that there is 0.04% chance of getting a sample mean as large or larger than 3.363. In fact, the true mean is 65,824.

   \[ p\text{-value} = \text{area} = \frac{100 - 99.919}{2} \]

   \[ = 0.04 \% \]

5. **Conclusion**: Since p-value is less than 5%, the results are statistically significant.

   (In other words, we reject the null hypothesis.)

   (The true average salary has increased.)
III. A gasoline additive has been developed in order to improve gas mileage. Gas mileage is measured by driving test cars of the same model in an identical manner using one gallon of gasoline. Extensive testing of the gasoline without the additive showed that the cars traveled an average of 18 miles on the gallon of gas. In order to test the additive, 36 cars were tested in this fashion. These cars traveled an average of 19 miles with an SD of 4.0 miles. Is there conclusive evidence that the additive improves gas mileage? Perform a test of significance, find the P-value, and state your conclusions.

1. Null hypothesis: The additive does not improve gas mileage.

2. Alternative hypothesis: The additive improves gas mileage.

3. Test Statistic:

\[ Z = \frac{\text{Value of } \bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} \]

where \( SE(\bar{x}) = \frac{SD}{\sqrt{n}} = \frac{4}{\sqrt{36}} = 0.67 \)

\[ z = \frac{19 - 18}{0.67} = 1.5 \]

4. P-value = area = \( \frac{100 - 86.64}{2} \) = 6.68%

5. Conclusion: Since the P-value is greater than 5%, the results are not significant. That is, we do not reject the null hypothesis.