General Strategy for Constructing Confidence Intervals

Hypothesis Testing Strategy: Remember that hypothesis test are used to test claims by evaluating statistically significance evidence for a change or difference from an initially proposed/accepted value. The structure of a hypothesis test is as follows:

I. Carefully read the scenario (problem statement) and decide what it is you are testing a claim about (a mean? a proportion? a comparison of means or proportions across multiple groups/populations?).

II. State the hypotheses for the test

   H_0: The *null hypothesis* (the status quo, the initially proposed value, "nothing to see here" – "boring" – always involves the "equals" symbol)

   H_a: The *alternative hypothesis* (the claim to be tested – a statement of difference or change – involving one of the following symbols: $<, \neq, >$)

III. Draw a picture of the samples that would provide evidence in favor of your alternative hypothesis. If your alternative hypothesis uses the $\neq$ symbol then both tails of your distribution will be shaded, otherwise only one of the tails will be.

IV. Set the level of significance (α) for the test. The level of significance is the "cut-off" for an observed sample being *unusual/unlikely* under the null hypothesis. Remember that our standard approach is to use $\alpha = 0.05$ unless we are told otherwise.

V. Use the sample data, null value, and any other known information to compute the test statistic (representing the *number of standard errors above or below the expected outcome our sample falls*)

$$test\ statistic = \frac{(point\ estimate) - (null\ value)}{S_E}$$

   a. Recall that the point estimate comes from the sample data, the null value comes from the null hypothesis, and the standard error can be identified from the *Standard Error Decision Tree*.

VI. Notice that the *test statistic* is nothing more than a boundary value. We use it to compute a *p*-value, which measures the probability of observing a sample at least as extreme (at least as favorable to the alternative hypothesis) as ours, under the assumption that the null hypothesis is true.

   a. If the box determining your standard error (S_E) **does not contain** information about degrees of freedom (df), then use Excel's $NORM.DIST()$ function to determine the area from your sample into the tail of the normal distribution.
   b. If the box determining your standard error (S_E) **does contain** information about degrees of freedom (df), then use Excel's $T.DIST()$ function to determine the area from your sample into the tail of the normal distribution.
   c. If your picture from Step III. has just a single tail shaded, then the result from either a. or b. is your *p*-value. If your picture from Step III. has two tails shaded, then multiply your result from either a. or b. by 2 to obtain the *p*-value

VII. Compare your *p*-value to the level of significance (α) demanded by your test.

   a. If $p < \alpha$, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a)
   b. If $p \geq \alpha$, we do not have enough evidence to reject the null hypothesis (H_0)
      i. Note that we do not "accept" the null hypothesis here – these tests are not designed to test whether the null hypothesis is *true*, so we can **never accept the null hypothesis** with the tools from MAT240.

VIII. Interpret the result of your hypothesis test in the context appropriate for your scenario.