Objectives:

- To understand that Confidence intervals and tests of significance have different goals.
- To discover that a two-sided hypothesis test and a confidence interval will lead to the same conclusion.
- To understand the usefulness of creating a confidence interval to supplement a significance test.
- To discover the relative practicality of a result when large sample sizes are used.
- To understand the role that p-value plays in the conveying of results of a significance test beyond a yes or no answer.
- To understand the difference between Type I and Type II errors and how adjusting for the probability of one affects the other.

Duality: The concept that a two-sided hypothesis and a confidence interval will yield the same conclusion. *i.e.* A hypothesized value will be contained in a confidence interval if and only if the hypothesized value is significant at the associated α value (α = 1-CI%)

Significance vs. Intervals: Intervals try to estimate the value of an unknown parameter as well as the uncertainty of the estimate (wider == more uncertainty). A significance test tries to assess whether sample data provide evidence against a particular hypothesized value for the population parameter exists.

When doing a significance test:

It is often useful to also create a confidence interval. This provides an idea of how far off the hypothesized value was off and an idea of what a reasonable value may be for the parameter. It also gives an indication of how spread out the sample was to begin with.

Always report the *p-value* of a hypothesis test. This gives the reader an idea of the certainty of the results and allows the reader to make their own conclusion. What is significant to one person may not be significant to another.

Practical significance and large sample sizes: When very large sample sizes are employed significance may easily be shown for a value that is negligibly close to the actual value, *e.g.* Say it was reported that 2/3 of the population wants some sort of tax reform. You sample 1,000,000 people and your sample proportion was 65%. This value is found to be significantly different than 66.7% - but is it practically significant.

Type I: Type I error is when we incorrectly reject the null hypothesis when we should have failed to reject. The level of significance (α) is the probability of committing a type I error.

Type II: Type II error is when we fail to reject the null hypothesis when we should have rejected it. The probability of this error is equal to β.

Power: The probability that we will correctly fail to reject the null hypothesis (the opposite of β)

Generalizing results: Be careful not to generalize your findings to a population that was not randomly selected from. (either significance or intervals)

Population data: These inference procedures cannot be used when you have the data from the entire population. It makes no sense to apply inference to a population value since we already know the actual value – there is no reason to hypothesize nor estimate.