**Unit 1**

* Understand how study design affects inferences that can be made

-Observational vs. Experimental design

-An observational study does not allow researcher control over the independent variable – the dependent variable is measured in a natural state

-An experimental study allows the researcher to control the independent variable

* Apply the difference between experiment and observational study to different types of inferences

-Causal inference: an inference that the independent variable affects the dependent variable

-Causal inference can only be drawn in an experimental study, not in an observational study

* Learn terms such as sample, population, statistic, parameter

-Population: the group of interest for a study

-Sample: a smaller subset of the population created through a selection mechanism for the purpose of the study

-Parameter: a numeric observation of a population

-Statistic: a numeric observation of a sample created during a study

* Understand the difference between random assignment and random sampling

-Random sampling: the mechanism by which individuals are selected from the population to be part of the study sample

-Random assignment: the mechanism by which members of the sample are partitioned into research groups within the study

* Understand the principles behind permutation tests

-Permutation tests randomize outcomes across the treatment group

**Unit 2**

* Use appropriate inferential tools for the independent sample and paired sample design settings

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* Understand the conceptual basis for confidence intervals and *p*-values in a one- and two-sample setting

-A way to measure how large or small a population parameter value could be, estimated using the sample mean

-Multiple “answers” will result from multiple sample means – CI’s indicate where the answers should lie for the answers to be statistically significant

-Alpha dictates the confidence interval – 95% CI means that 95% of the means should fall within 1.96 SD intervals of the population means (provided H0 is false)

-Formula uses population standard deviation instead of sample, this reduces error

-"With 95% confidence, the true mean μ is between Lower CI and Upper CI, based on a sample n from this population."

-Four steps to setting test: correct significance level (alpha), directionality (one or two tailed), quality assumption (quantitative, reliable, normal distribution, outliers accounted for), randomly sampled

* Calculate *p*-values and confidence intervals using the *t*-distribution

-CI=X(bar)±tcrit(s/√n)

-p-value: the chance of obtaining a certain sample result if H0 is true (smaller disproves H0)

-t=(x(bar)−μ0)/(s/√n)

-p-value is the area past the t-value

**Unit 3**

* Use appropriate graphics and statistics to examine mathematical assumptions
* Understand the effect of violations of assumptions on the validity of *t*-distribution based tests

-Sample must be randomly drawn

-Observations must be independent

-Sample must be representative of the populations

-Observations must be normally distributed

-Two sample t-tests must have equal variances

* Learn and apply methods of correcting for assumption violations

**Unit 4**

* Determine when analysis methods based on the t-tools are inappropriate for a data set

-Nonparametric (does not assume that data comes from normal, etc, population

-Wilcoxon Rank Sum test – places all m and n observations, sorts regardless of membership, assigns numbers 1:N(where N=m+n) where ties receive average rank, sums should be relatively equal

-Fully parametric: find all possible permutations, build vector of ranks from each permutation, determine CI’s and p-value, and calculate number of sum ranks above observed value and divide by permutations

-True p value is the relative frequency

-Permutation test – randomly assign observations to 2 treatments and compute differences between means; continue reshuffling until a k number of times, compute difference D between means for each treatment and p value

-Permutation tests can be used to test subsets of means, medians, mean ratios, variance ratios, or sums of items, and the null distribution is built from test statistic56

* Understand the principles behind the rank-sum and signed-rank tests
* Apply such tests when appropriate and interpret their results