Week 10:

What do we cover?

We cover material related to all rows in this table from the main StatKey menu.

Material related to the first column here is considered prerequisite material and not explicitly discussed in this course.

Descriptive Statistics and Graphs	Bootstrap Confidence Intervals	Randomization Hypothesis Tests
One Quantitative Variable	CI for Single Mean, Median, St.Dev.	Test for Single Mean
One Categorical Variable	CI for Single Proportion	Test for Single Proportion
One Quantitative and One Categorical Variable	CI for Difference In Means	Test for Difference in Means
Two Categorical Variables	CI for Difference In Proportions	Test for Difference In Proportions
Two Quantitative Variables	CI for Slope, Correlation	Test for Slope, Correlation

Where is it in the Lock text?

Our work in the course assumes knowledge of most material in Chapters 1 and 2.

This week's material is based on material in Chapters 3 and 4, which have examples for many of the types of problems the second and third columns here. The crucial idea is that the general method of statistical analysis is the same for all of these.

Questions here and in later weeks assume knowledge of the material covered in Weeks 4 and 5.

Two relevant ideas discussed elsewhere in the text:

- Proportions: We use "difference of proportions" only when these are independent proportions. This means that the proportions are taken from two distinct groups. (Explicitly discussed in Sec. 6.3 D)
- Paired Difference in Means: The experimental design of matched pairs is discussed in Ch. 1. The data are analyzed as data on a single mean which is the mean of the differences in the values in the pairs. Section 6.5 has the best presentation of this I have seen in an elementary statistics text.

More depth on simulation-based statistics than we will discuss:

How is the randomization done for randomization tests?

Sec. 4.5 addresses this. StatKey provides some choices for problems involving two quantitative variables and two categorical variables. Here are the choices for two quantitative variables:

In our class, we will ALWAYS use the first one in the list – not because it is always the best one, but because we don't have time to go into the details of when these all give reasonably equivalent results. and when they don't, and why.

If you want to see more about the different methods of randomization, the Lock text provides that in Section 4.5. The conclusion of that discussion is, basically, the "Combine Groups" choice uses the assumptions of a two-sample t-test where we assume the population variances are equal and the other two choices are more appropriate if we do not make that assumption.

This is similar to, in a normal-theory based analysis, the distinction between using $df = n_1 + n_2 - 2$ for problems where the population variables are equal and, if you don't make that assumption, using the smaller of $n_1 - 1$ and $n_2 - 1$ for the degrees of freedom (or letting the software calculate an estimate of the degrees of freedom, in which case, you are using the Satterthwaite approximation to the degrees of freedom.)

Are there refinements of the bootstrap procedures that could be used?

Here are two resources to further explore these topics:

- **Textbook:** Mathematical Statistics with Resampling and R, 2nd Edition. Laura Chihara and Tim Hesterberg

- **Article:** What every teacher should know about the bootstrap: Resampling in the Undergraduate Curriculum. Tim Hesterberg *The American Statistician*, Volume 69, 2015, Issue 4, pages 371-386 https://amstat.tandfonline.com/doi/full/10.1080/00031305.2015.1089789#.YXMjOBxOmUk