

## Statistics 411/511

### Homework 7

Due Tuesday, November 24 by midnight Pacific time

- **Instructions:** Upload homework to Gradescope via Canvas (access specific homework assignments from the [Assignments](#) link on the Canvas course page). Your file must be a pdf document. Please see the end of the syllabus for formatting guidelines.
- The problems are assigned from the **third edition** of the textbook. If you have another edition, consult the copy on reserve at the library website for the homework problems.
- **Academic Integrity** You are encouraged to *discuss* the homework with other students, but what you turn in must be your own work in your own words. **DO NOT** copy someone else's homework. You may share ideas and R code, but do not share R output or written language. The syllabus contains details and links to OSU's Student Conduct Code and procedure for reporting suspected academic misconduct.
- **Please assign pages when submitting to Gradescope.** See [Gradescope help](#) for instructions and a video. Papers without assigned pages will lose 0.5 points.

This homework deals with data from a study comparing three methods (MU=Meniscus Arrow, VS=Vertical suture, FF=Fast-Fix) of meniscus repair surgery. Six subjects were randomly assigned to each method. The response variable is Stiff=stiffness of the joint in newtons per millimeter (N/mm). The data are in [Meniscus.csv](#) on Canvas. Source: P. Borden, J. Nyland, D.N.M. Caborn, D. Pienkowski (2003). "Biomechanical Comparison of the Fast-Fix Meniscal Repair Suture System with Vertical Mattress Sutures and Meniscus Arrows," *The American Journal of Sports Medicine* 31(3), pp. 374-378.

1. Do a preliminary analysis by completing the following steps.
  - (a) Produce side-by-side boxplots of stiffness for each repair methods.
  - (b) Produce an ANOVA table.
  - (c) Produce a plot of the residuals vs. fitted values. Comment on the plausibility of the equal variance and normality assumptions based on this plot.
2. Suppose the researchers had preplanned to estimate all pairwise comparisons among population means.
  - (a) Use the Tukey-Kramer procedure to calculate simultaneous 95% confidence intervals for all three pairwise comparisons. Include your R code and output.
  - (b) Write a statistical conclusion for the Tukey-Kramer results stating which pair(s) of means are found to be different.
3. Suppose the researchers had preplanned to compare FF to each of the other two methods.
  - (a) Use Dunnett's method to estimate these two pairwise comparisons at a 95% familywise confidence level. Include your R code and output.
  - (b) Write a statistical conclusion for the Dunnett's results stating which pair(s) of means are found to be different.

4. Suppose the researchers had preplanned to compare the mean of FF to the average of the means of MA and VS, and to compare the means of MA and VS to each other. Use the Bonferroni procedure to estimate these comparisons with a familywise confidence level of 95%. Include your R code. State the resulting intervals (don't make the grader find them in your R output). Suggestion: include comments in your code so you can make sense of it later.
5. Suppose after looking at side-by-side boxplots, the researchers decided to compare the population mean for MA with the average population mean for the other two methods.
  - (a) Use Scheffé's method to estimate this comparison with a confidence level of 95%. Include your R code. State the resulting confidence interval.
  - (b) Does your Scheffé confidence interval tell you that the population mean stiffness for method MA is different from the average population mean stiffness for the other two methods? Briefly explain.