Psych 102: Advanced Statistics for Psychological Sciences

Course Description.

This course is an upper division course that is designed to introduce students to the data analysis techniques that are used by researchers in the field of psychology. The students will also learn basic programming skills using the high-level language R. The data analysis methods include techniques for modeling data, multivariate statistics and data reduction and visualization techniques. The students will be introduced to the mathematics behind these various techniques and will learn how to use R to apply the methods to complex data sets. This is a required course for students who are doing an undergraduate research thesis and is highly recommended for all of those who are planning to apply to graduate school in psychology, cognitive sciences or neurosciences.

Course Logistics, Assignments and Tests.

The course meets on Mondays and Wednesdays from 9-10 AM in 240 Mulford for lecture sessions that will combine lecture material and hand on computer tutorials. These computer tutorials will be “unfinished” and your weekly homework will be to finish them.

Section 101 meets on Th 1-2P and Section 101 meets on Th 2-3 both in 2305 TOLMAN. Attending one of these sections is mandatory. During section you will receive additional tips and guidance for your homework. Homework will be assigned each week and due on Monday of the following week. Tests include two midterms and one final exam. The midterms will be during class time and last 50 minutes. There will be a final project that involves a detailed analysis of a data set chosen by the student. Grades will be based on class participation/homework (25%), tests 50% (Each midterm 10%, Final 30%) and final project (25%).

Prerequisites.

Psych 101 is required. Calculus and linear algebra are recommended (Math 10A-B or Math 1A, 1B and 54).

Textbooks.


Class Schedule

Week 0. Wednesday Mtg 1. Course introduction. Installing R.

Week 1. Mtg 2. Introduction to R programming language.
Reading: Fox R Ch4. Fitting linear models (Section 4.1-4.2)
Fox T. Ch 5 and Ch 6.

Reading: Fox R Ch. 4. (Section 4.3) Analysis of Variance Models
Fox T Ch 7 and Ch 8

Week 4. Mtg 5. Generalized Linear Model: The General Linear Model III. Multi-way ANOVA, ANACOVA.
Reading: Same as last week.

Reading: Fox T. Ch. 21.

Reading: Fox R. Ch. 5. Fitting Generalized Linear Models.
Fox T. Ch 14. Logit and Probit Models

Reading: Same as week 7.

Additional reading will be assigned for this section.


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**Week 13.** Mtg 15. Discriminant Function Analysis. Manova.

**Additional reading will be assigned for this section**

**Week 14.** Mtg 16. Tree Classifiers.

**Additional reading will be assigned for this section**

**Week 15.** Mtg 17. RRR week.

**Final:** Mtg 18

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**Final Project.**

The final project involves modeling and analyzing a data set of your choice. Preferably, the data set is one that you have collected or help collected as part of your honor thesis. But, it can also be a data set from one of your classmates or a data set from one of the R packages. If you chose one from an R package, you cannot repeat an analysis that is already published. The final project is due at the beginning of the final examination.

**Final Project Outline.**

**Introduction.** State the question/hypothesis that lead to the data acquisition with brief theoretical framework. Finish this introduction with a statement that says how this new data set addresses the question. This introduction should be one or two paragraph and include 2-5 critical references. (10 points).

**Methods.** Describe how the data was collected and the subject pool (5 points). One short paragraph.

**Results/Data Display.** Create figures to illustrate the major patterns in the data. The axis of the figures should be labeled and the figures need a title. Each figure will also need a short figure legend that you can write in your word processing software. I expect 2 to 5 figures. Embed the figures in your text. (20 points including the R code which will be in the Appendix).

**Model Description.** State what your competing models are both in English and with equations. The competing models can be just the null model (the mean) and a particular model that corresponds to your hypothesis as in a classical hypothesis testing procedure. But you can also decide that it is more relevant to compare different complex models. (10 points).

**Model Fitting.** Fit the parameter in your models and give short interpretations for the values of the coefficients (10 points including R code).

**Classical Statistical Analysis.** Perform the classical statistical analysis using the appropriate R commands. You might combine this section with the previous one but in that case remember to clearly separate the interpretation of the parameters with the statistical analysis. Additional figures might be helpful but are not required. (10 points including R code).

**Statistical Analysis by Resampling.** Perform a resampling or cross validation in R to perform a second statistical test. Additional figures might be helpful here as well but not required (25 points including R Code).
Conclusion. Write a brief conclusion of your modeling efforts, the statistical analysis and the implications for the question that was raised in the introduction. One or two paragraphs. (10 points)

Appendix. R code.