Overview

The Advanced Topics in Quantitative Methods (PSYC 757) covers fundamental probability theory, Bayesian statistics, and Bayesian applications using common social science statistics. Jim Thompson and I co-teach the course and alternate primary responsibilities each year; this year (2013), I (Patrick) teaches the course. I intend to conduct the course as a flipped-mastery class whereby students read assignments and/or watch videos prior to class but then come to class to work on problems.

Flipped-Mastery Classroom

A flipped classroom merely indicates that the time typically assigned for lectures now reverts to homework time and, in turn, the time expected for you to do homework you will use as lecture time. Each of you will be responsible for pacing yourselves each week with lecture material. The course is designed to allow each student to tailor the timing to his/her needs. Thus, the responsibility is yours to pace yourself to learn and master the requisite skills (see below). Each student must demonstrate independent mastery of each level (specified below) before advancing to the next level. Mastery, rather than achievement, will be the marker for your success. Thus, the flipped aspect changes the lecture and homework locations whereas the mastery aspect changes the course pacing and student evaluation. I provide more details about these two novel aspects during the first day, however, the syllabus ought to suffice for your introduction.

All lecture materials are provided as assigned readings from the book and supplemented with videos as needed. A course website (listed above) provides access to the entire list of readings, videos, and relevant links for each level. Additionally, I listed the assignments relevant to each level. These assignments ought to be done in class or at home but you must show your proficiency before moving on to the next level.

Prerequisites

Due to the nature of the material and the relevance to research, we assume all students will have successfully completed the introductory graduate course sequence in statistics (PSYC 611/612 or its equivalent). We do not intend to cover in great detail the statistical models underlying frequentist models so you may want to reread some material on ANOVA and regression if you feel weak in those areas. Additionally, Bayesian statistics requires programming and, for this course, requires all students use R (and JAGS). The course text guides you through the programming language but you need to have a computer that has R and JAGS installed. I highly recommend that every student use Rstudio (http://rstudio.org) as an integrated development environment.

Course Requirements and Grading

The course demands that students learn two things - R/JAGS and then Bayesian statistics. Given that load, I expect students to first demonstrate a moderate level of proficiency in R and JAGS before the end of the drop date (February 22nd). Failure to do so will lead to a strong recommendation to drop the course. Without these essential skills, the subsequent skills will be impossible to master. Thus, focus on R and JAGS first. You - the student - determine what demonstrates mastery. I strongly suggest you think about what might be indicative of mastery and show me in class for each level listed below. I will keep track of everyone’s progress and post it online. The aim is not to race through the course but master the material at your own pace.

Required, Recommended, and Supporting Materials

Your lecture material consists of a required text (abbreviated from here on out as K2011):


and several strongly recommended resources:

Bayesian Statistics and Estimation for Social Scientists. New York: Springer.

Any additional videos, readings, and links will be available on the course website.

Disability Accommodations
If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Official Communications via GMU E-mail
Mason uses electronic mail to provide official information to students. Examples include communications from course instructors, notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their mason e-mail account, and are required to activate that account and check it regularly.

Topic Outline
The following outline lists unit levels and not lectures. These “levels” simply provide us an opportunity to break up the semester into digestable pieces. Once each of you masters a level, you may move on to the next level. The assigned readings for each level are not long but they are technical. We strongly suggest you start reading early, watch the supporting videos, and keep practicing the exercises even if you find yourself ahead of the class.

Introduction
Level 0: Why take this course?
Mastery Skills: Excitement about upcoming semester and material; understand the 3 goals of statistics; know what to read and in what order.

Part 1: The Basics
Level 1: R
Suitable Lecture Material: Online R docs, JAGS docs, and online videos.
Mastery Skills: Read, write, manipulate, and analyze data in R. Basic understanding and ability to run JAGS programs.

Must demonstrate mastery of Level 1 before February 22nd

Level 2: Probability Theory
Suitable Lecture Material: Kahn Academy Videos,
Mastery Skills: Key concepts and applications in basic probability theory.

Level 3: Bayes’ Rule
Suitable Lecture Material: K2011 - c4, Kahn Academy (parts 7 & 8), online videos.
Mastery Skills: Apply bayes’ rule in novel domain - explain results and implications.

Level 4: Binomial Proportions and Inference
Suitable Lecture Material: K2011 - c5-6, Kahn Academy video, Cartoon guide to statistics.
Mastery Skills: Apply binomial logic to a novel example - explain results and implications.

Level 5: MCMC
Suitable Lecture Material: K2011 - c7, Kahn Academy video, Cartoon guide to statistics.
Mastery Skills: Apply bayes’ rule in novel domain - explain results and implications.

Level 6: Testing Differences Hierarchically
Suitable Lecture Material: K2011 - c8-10, online videos
Mastery Skills: Differentiate Metropolis from Gibbs sampling in an explicit test of differences between two proportions.

Level 7: NHST
Suitable Lecture Material: K2011 - c11-13, online videos
Mastery Skills: Demonstrate NHST in frequentist and subjectivist approaches and compare/contrast.

Level 8: Single Group Models
Suitable Lecture Material: K2011 - c14-15
Mastery Skills: Demonstrate statistical approach with single-group models using both frequentist and subjectivist approaches.

Must pass Level 8 to pass class

Level 9: Regression Models
Suitable Lecture Material: K2011 - c16-17
Mastery Skills: Demonstrate regression model with continuous outcome using both frequentist and subjectivist approaches.

Level 10: ANOVA Models
Suitable Lecture Material: K2011 - c18-19
Mastery Skills: Demonstrate ANOVA model analysis using both frequentist and subjectivist approaches.

Must demonstrate mastery of Level 10 for an “A”

Level 11: BONUS
Suitable Lecture Material: K2011 - c20-23
Mastery Skills: Demonstrate frequentist and subjectivist approaches to categorical data analysis.

Demonstrate mastery of Level 11 for an “A+” and a commendation to the department and program chairs.