PSC 404

Probability and Inference

Fall 2018
15:25-16:40 T/Th
Harkness 329

Kevin A. Clarke
Harkness 317
Office Hours: most afternoons
kevin.clarke@rochester.edu

TA: Varun Ramachandra
Harkness 338
Recitation: TBA
varunkr@rochester.edu

PURPOSE

This course in mathematical statistics provides graduate students in Political Science with a solid foundation in probability and statistical inference. The focus of the course is on the empirical modeling of non-experimental data. While substantive political science will never be far from our minds, our primary goal is to acquire the tools necessary for success in the rest of the econometrics sequence. As such, this course serves as a prerequisite for the advanced Political Science graduate courses in statistical methods (PSC 405, 505, and 506).

PREREQUISITES

The math "boot camp" is the only course prerequisite, as familiarity with calculus is necessary to understand the material. Students who remain uncomfortable with differentiation and integration may want to consider sitting in on a calculus course offered elsewhere in the University.

COURSE REQUIREMENTS

Evaluation is based on homework assignments (10%), a midterm exam (40%), and a final exam (50%). In addition to office hours, the teaching assistant will hold a weekly recitation. Attendance is mandatory. The purpose of the recitation is to cover material not covered in lecture, to go over homework problems, and to review for exams. Students are responsible for material covered in lecture, recitation, and the required readings. The course web site is here.

TEXT

The required texts for this course are:

DeGroot and Schervish. *Probability and Statistics.* 3rd ed.

COURSE SCHEDULE

Topic 1: Course Overview and Introduction to Empirical Modeling

Specifics: Course overview and business. Stochastic phenomena. Chance regularity. Characterizing data. Statistical models.

Topic 2: Probability

Specifics: Definition of probability. Conditional probability. Independent events. Bayes' Theorem.

Reading: DS Ch. 1 and 2

Topic 3: Random Variables and Distributions

Specifics: Random variables. PDFs and CDFs. Functions of random variables.

Reading: DS Ch. 3

Topic 4: Expectation

Specifics: Expectation of a random variable. Variance. Covariance and correlation. The sample mean.

Reading: DS Ch. 4

Topic 5: Special Distributions

Specifics: Named distributions. Central limit theorem.

Reading: DS Ch. 5

Midterm. Covers topics 1-5.

Topic 6: Estimation

Specifics: Inference. Prior and posterior distributions. Conjugacy. Bayes estimators. MLE.

Reading: DS Ch. 6

Topic 7: Sampling Distributions of Estimators

Specifics: Sampling distributions. χ^2 and t. Interval estimation. Bayesian analysis of samples from a Normal. Fisher information.

Reading: DS Ch. 7

Topic 8: Testing Hypotheses

Specifics: Fisher v. Neyman-Pearson. Simple hypotheses. UMP tests. F-tests.

Reading: DS Ch. 8

Topic 9: Categorical Data and Nonparametric Methods

Specifics: χ^2 tests. Simpson's paradox. Sign and rank tests.

Reading: DS Ch. 9

Topic 10: Linear Statistical Models

Specifics: Least squares. Regression. Inference.

Reading: DS Ch. 10

Topic 12: Simulation

Specifics: MCMC.

Reading: DS Ch. 11

Final Exam. Cumulative with weight on second half.