Introduction to Statistics in Political Science

Political Science 812 Fall 2017

Lecture Location Ingraham 225
Lecture Time Monday and Wednesday, 1:20–2:35 p.m.
Section Location Van Hise 250
Section Times Friday, 9:55–10:45 a.m. and 11:00–11:50 a.m.

Instructor Dave Weimer
Email weimer@lafollette.wisc.edu
Office 215 North Hall
Office Hours Mondays and Wednesdays, 10–11:30 a.m. and 2:45–4 p.m.

Teaching Assistant Christopher Krewson
Email krewson@wisc.edu
Office Hours Tuesdays and Thursdays, noon to 1:00 p.m., North Hall 121

Overview

Political scientists employ increasingly sophisticated statistical methods to make inferences from data. Understanding these methods—and new ones that will undoubtedly become available—requires a firm foundation in mathematical statistics. This course is intended to provide this foundation so that students can continue their methods training with subsequent courses in the department (PS 813 and PS 818) as well as other advanced courses and, most importantly, through independent learning. It also provides some applications that illustrate concepts and introduce students to empirical political science research.

I seek to help every student achieve basic competence in the material. Please use my office hours to get help on the material covered in lecture. Do NOT allow yourself to fall behind. If necessary, I am willing to slow the pace to keep everyone moving forward. However, I cannot make adjustments unless you communicate to me any problems you are having with the material. Please do not hesitate to use office hours.

Textbook

The primary textbook (WMS) for this course is


Sections

Weekly sections will focus primarily on statistical computing, including instruction in using statistical software and practical computer exercises. Time will also be set aside to go over problem sets.
**Statistical computing**

The course will give you experience with two computational resources. One resource is the widely used statistical package, Stata, which has capabilities for implementing stochastic simulations. The other resource is R, an implementation of the S statistical programming language. It can be downloaded for free from [http://www.r-project.org/](http://www.r-project.org/).

**Grading**

Grading will be divided between problem sets (15 percent), a midterm exam (25 percent), a final exam (50 percent), and a data analysis report (10 percent).

**Problem sets**

Short problem sets will be handed out in class or posted on learn@uw, typically due the following week. The problem sets will cover both theory and application. You are welcome to discuss the problem sets with each other and run programs together, but the final write-ups should be your own. Also, note that simply copying Stata or R output without reformatting is not appropriate. Almost every week, you will be expected to work through a Stata warm-up exercise before the Monday class. These exercises simply require you to follow instructions in Stata to learn the language and gain a preview of material to be covered in the course. Although these exercises will not be graded, it is important that you do them on time. Skill in R will be developed through translation of Stata warm-up exercises during the section meeting.

**Midterm exam**

There will be an in-class midterm on **October 25**. In addition to counting towards your final grade, the exam should serve as an indicator of your progress in the course.

**Final exam**

There will be a *cumulative* final exam held during exam week. The date will be scheduled early in the semester.

**Data analysis report**

Complete a report employing basic methods to answer an empirical question of your own choosing. Data will typically come from a common political science data set (American National Election Study, Correlates of War, etc.). A literature review is unnecessary. Papers should be roughly five pages with appendices as needed. They should be submitted at the last class (**December 13**).
Topics and readings

The dates are tentative and will be adjusted to reflect our progress in learning. I suggest that you read through the material before class and again after it is discussed in class. Even a quick skim of the material beforehand is very beneficial.

Introduction and Overview (Sept. 6)
Overview of estimation, inference, and presentation in political science; frequentist and subjectivist interpretations

Introductory case: The Butterfly Ballot


WMS, Chapter 1

Probability Foundations (Sept. 11, 13, 18, and 20)
Laws of probability
Bayes’ theorem
Decision analysis

WMS, Chapter 2


Calculus Review (Sept. 25, 27, and Oct. 2)
Differential calculus
Integral calculus

WMS, Chapter 3

Common Discrete Random Variables (Oct. 4, 9, and 11)
Cumulative distribution functions
Central and Non-central Moments
Moment Generating Functions


WMS, Chapter 3
**Common Continuous Random Variables** (Oct. 16, 18, and 23)
Cumulative distribution functions
Central and Non-central Moments
Moment generating functions
Normal distribution and related distributions

WMS, Chapter 4

**Midterm Exam** (Oct. 25)

**Multivariate Distributions** (Oct. 30 and Nov. 1)
Bivariate and multivariate distributions
Marginal distributions
Conditional distributions
Mathematical covariance and correlation
Bivariate normal distribution
Functions of random variables

WMS, Chapter 5

**Stochastic Simulation** (Nov. 6)
Monte Carlo Simulation
Agent-based models


**Limits and Asymptotic Distributions** (Nov. 7)
Probability limits
Law of large numbers
Central limit theorem
Normal approximation to the binomial distribution

WMS, Chapter 7

**Estimation** (Nov. 9, 13, 15, 20, and 22)
Desirable Properties of Estimators
Maximum likelihood
Method of moments

WMS, Chapter 8 and 9
**Classical Inference and Hypothesis Testing** (Nov. 27, 29, and Dec. 4)
Introduction to hypothesis testing
Neyman-Pearson lemma
Tests of hypothesis about parameters of normal populations

WMS, Chapter 10

**Analysis of Categorical Data** (Dec. 6)
Contingency tables
Chi-square test
Fisher exact test

WMS, Chapter 14


**Introduction to Ordinary Least Squares** (Dec. 12 and 14)
Linear statistical models
Bivariate ordinary least squares

WMS, Chapter 11