Public Affairs 818:
Introduction to Quantitative Methods for Public Policy Analysts

Fall 2014

Monday/Wednesday 2:30 p.m. to 3:45 p.m.
Birge B302

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Office Hours: Mondays and Wednesdays, 10:00 a.m.–noon, 215 North Hall
Mondays 4:00 p.m.– 5:00 p.m., 215 North Hall
Appointments for other times welcome.

Policy analysts and public managers often use evidence and models to assess what has happened, what is happening, and what will happen under current policy or would happen under alternatives to it. Like social scientists, they seek to understand both associations (X and Y tend to occur together) and causality (X causes Y). They can draw on general principles of research design and statistical inference in their efforts. However, unlike social scientists who have the luxury of choosing questions that can be confidently answered, policy analysts and public managers must often assess and predict based on limited data, making an understanding of the concepts and limitations of methods of inference and prediction all the more important. In this course we seek to develop this understanding.

The course provides useful introductions to three topics: probability theory, statistical inference, and linear models. Aside from being foundational to statistical inference, probability theory provides tools for constructing models of random processes useful in assessing alternative policies. The concepts of statistical inference allow us to estimate parameters of probability models that generate samples of data, characterize our uncertainty about these estimates, and test hypotheses about their true values. One very useful branch of statistical inference involves the specification and estimation of linear regression models that assess the independent impacts of a number of variables on some other variable of interest.

At the conclusion of the course, you should be comfortable with basic concepts of probability theory and their application in simple models useful in policy analysis. You should also have a sound understanding of research design and statistical inference and know how to use and interpret simple linear models. In addition, you should have sufficient experience with Stata to be able to use it independently in the future. Finally, you should be well prepared to learn more about multivariate statistical methods in PA 819.

Assignments (30 percent of final grade)

We seek to learn by doing. Three types of exercises will help us do so:

> *Warm-Up Exercises*: The primary purpose of warm-up exercises is give you some exposure to topics *before* we cover them in class. A secondary purpose is to help you learn how to do things in Stata, a very powerful and flexible statistical package. Most weeks will have a warm-up exercise that you should complete *before* the Monday class. Although the warm-up exercises are not graded, they will sometimes ask you to bring specific results with you to class for reference in discussions. It would be a good idea to keep a list of all the Stata commands that you use in these exercises.
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> *Application Exercises*: The purpose of application exercises is to give you practice in applying the concepts we cover in class. The first exercise involves a simulation model. The others involve analyzing samples of data useful for answering some policy question. Some of these exercises require you to present your results in memorandum format. These exercises will be graded.
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> *Problem Sets*: The purpose of problem sets is to help reinforce and increase the depth of your understanding of the concepts covered in class. They range from simple to somewhat challenging. Put effort into these problems, but seek help from me or the teaching assistant if they become frustrating. Problem sets will be graded.

Examinations (60 percent of final grade)

A midterm examination (25 percent of final grade) will be held in class on November 5. A final examination (35 percent of the final grade) will be held on December 18 as scheduled. You may bring one standard-sized sheet of paper with notes to use in the final examination.

Data Analysis Project (10 percent of final grade)

Your task is to identify and use a data set relevant to some policy question. Although the more relevant statistical methods for projects will likely be covered toward the end of the course, I highly recommend identifying an interesting data set by mid-semester. Your analysis should be presented concisely in a memorandum format with supporting appendices. Your report is due December 10.

Textbook

We will be using a text available through a Creative Commons license. Although it can be downloaded from http://www.openintro.org/stat/ as a PDF file without charge, I highly recommend that you purchase a published copy, which can be ordered from Amazon for under $10.

David M. Diez, Christopher D. Barr, and Mine Cetinkaya-Rundel (2012) *OpenIntro Statistics* 2nd Ed. (Creative Commons). [Referred to as OIS in the schedule.]

Tentative Schedule

Class 1: Introduction: Description, Stochastic Modeling, Estimation, Inference, Prediction

OIS, Chapter 1

Part I: Probability Theory and Stochastic Modeling

Week 1: Basic Concepts and Discrete Distributions

Warm-Up: Discrete Probability Distributions

OIS, Sections 2.1, 2.2, 3.3–3.5

Week 2: Continuous Distributions

Warm-Up: Continuous Probability Distributions

Problem Set 1 (due Friday, September 19)

OIS, Sections 2.5, 3.1

Week 3: Additional Topics and Stochastic Models: Monte Carlo and Queuing Models

Warm-Up: Monte Carlo Sensitivity Analysis

David L. Weimer and Mark A. Sager (2009) Early Identification and Treatment of Alzheimer's Disease: Social and Fiscal Outcomes. *Alzheimer's & Dementia* 5(3), 215–226. (Available at learn@uw)

Week 4: Agent-Based Models

Warm-Up: Dynamic Concentration

Mark A. R. Kleiman (2009) *When Brut Force Fails: How to Have Less Crime and Less Punishment* (Princeton, NJ: Princeton University Press), Chapter 4: Tipping, Dynamic Concentration, and the Logic of Deterrence. (Available at learn@uw)

Adam Thomas (2012) Three Strategies to Prevent Unintended Pregnancy. *Journal of Policy Analysis and Management* 31(2): 280–311. (Available at learn@uw)

Option Adam Thomas, Quentin Karpilow, and Alex Gold (2013) *FamilyScape 2.0: An Architectural Overview*. Center on Children & Families, Brookings (March). (Available at learn@uw)

Application Exercise 1 (due Friday, September 26)

Week 5: Decision Analysis: Extensive and Normal Forms

Warm-Up: Bayes' Rule

Detlof von Winterfeldt and Terrence M. O'Sullivan (2006) Should We Protect Commercial Airplanes Against Surface-to-Air Missile Attacks by Terrorists? *Decision Analysis* 3(2): 63–75.

Zeev Maoz (1981) The Decision to Raid Entebbe: Decision Analysis Applied to Crisis Behavior. *Journal of Conflict Resolution* 25(4), 677–707.

Problem Set 2 (due Friday, October 10)

Part II: Statistical Inference

Week 6: Experimental and Quasi-Experimental Design

Warm-Up: Contingency Tables

Anthony E. Boardman, David H. Greenberg, Aidan R. Vining, and David L. Weimer (2011) *Cost-Benefit Analysis: Concepts and Practice,* 4th ed. (Upper Saddle River, New Jersey: Prentice Hall). Chapter 12, pages 288–292. (Available at learn@uw)

Week 7: Classical Statistical Inference: Introduction to Hypothesis Testing

Warm-Up: χ^2, Student's t, and F Distributions

OIS, Sections 4.1–4.3, 4.5–4.6

Problem Set 3 (due Friday, October 24)

Week 8: Inference for Normal Samples Midterm on November 5

Warm-Up: Applying Student's t Test

OIS, Sections 5.1–5.4, 6.3–6.4

Week 9: Applications and Introduction to Multiple Variables

Warm-Up: Central Limit Theorem

OIS, Section 4.4

Application Exercise 2: (due Friday, November 14)

Part III: Linear Models

Week 10: Optimization and Introduction to Ordinary Least Squares

Warm-Up: Simple Regression

David Weimer and Aidan Vining (2011) *Policy Analysis: Concepts and Practice* 5th Ed. (Englewood Cliffs, N.J.: Prentice-Hall,), Chapter 17: "Revising the Lead Standard for Gasoline," 424–447. (Available at learn@uw)

Phil Cook's lessons on presenting statistical analyses. (Available at learn@uw)

Week 11: Properties of OLS Estimators

Warm-Up: Mean and Variance

OIS, Chapter 7

Problem Set 4 (due Friday, November 21)

Week 12: Multivariate Regression

Warm-Up: Multicollinearity

OIS, 8.1–8.3

Week 13: Maximum Likelihood Estimation and Discrete Dependent Variables

Warm-Up: Functional Form

OIS, 8.4

Application Exercise 3 (due Friday, December 5)

Week 14: Causality in Natural Experiments

Jens Ludwig and Douglas L. Miller (2007) Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design. *Quarterly Journal of Economics* 122(1),159–208.