

Quantitative Research Methods

Boston University
Political Science 841
Fall 2013

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Professor: Taylor C. Boas

Email: tboas@bu.edu

Office location: 232 Bay State Rd., rm. 311B

Office phone: 617-353-4214

Office hours: Monday 10-11:30, Wednesday 2-3:30

Course assistant: Claire Leavitt, claire.leavitt@gmail.com. Office hours (rm. 312-D):
Thursdays 12-3.

Lecture location: CAS 312

Lecture time: Monday/Wednesday 3:30-5

Course Description

Quantitative research methods are important tools that political scientists, sociologists, and others use to test empirical claims about the world around us. This course offers an introduction to probability, descriptive statistics, hypothesis testing, and regression analysis, the foundations upon which nearly all quantitative analysis in social science builds. We will place emphasis both on theory, i.e., the concepts, logic, and mathematics underlying statistics, and applications, using software to analyze real data and implement the techniques we have learned. We will also learn how to assess work done by other scholars that uses quantitative methods.

I do not assume that students have any prior mathematical background beyond (a) high school algebra, and (b) the material covered in the BU math boot camp. We will invoke calculus at times during lecture, but we will cover what we need to know as we go along, and homework and exams will not involve calculus. Toward the end of the course, I will introduce matrix algebra, the foundation for more advanced statistics, and some knowledge of matrix algebra will be required for the final exam, but we will learn as we go along.

As this is a required course for political science and sociology graduate students, it necessarily serves different constituencies. For all students, this course will give you a basic understanding of the tools used for empirical research in much of the social sciences, allowing you to better comprehend articles published in top journals. For those who are skeptical of quantitative research, this course will help inform your skepticism, showing explicitly the assumptions required for hypothesis testing and regression analysis, why these assumptions are often not met in practice, and what problems arise as a result. For those who find themselves inclined toward statistical analysis, this course will help teach you how to do good quantitative research rather than simply crunching numbers for numbers' sake. It also will prepare you to go on to advanced

courses, such as PO 843: Maximum Likelihood Estimation; MA 684: Applied Multiple Regression and Multivariable Methods; SI 915: Models & Methods for Causal Inference in Strategy Research (School of Management); or numerous courses offered through the summer program at ICPSR. Finally, for those who are agnostic about quantitative methods, I hope to convince you that they should be part of your research toolkit!

Software

The required computer software for the course is R, an open-source statistical analysis package that is increasingly becoming the standard for quantitative analysis in political science as well as other disciplines. In addition to being available for free (download at <http://www.r-project.org/>), it is powerful, flexible, and has a large user community with plenty of free advice and expertise available on the Internet. It is also the software used in PO 843 and more advanced courses at ICPSR. We will generally devote half of one weekly class session to covering material in R, which will complement lectures and readings. Please download and install R on your laptops and bring them to class so you will be prepared to participate.

I will be distributing various files related to the course via Dropbox, a file sharing system. This requires you to install a free application on your laptop. On the first day of class I will explain how Dropbox will work for our purposes.

Readings

The required textbook for the course is David S. Moore, George P. McCabe, and Bruce Craig, *Introduction to the Practice of Statistics*, 7th ed. (W.H. Freeman, 2012). Copies are available for purchase at the Boston University Barnes & Noble. Often, with statistics textbooks, little changes from one edition to the next except for some of the homework problems. Hence, you might be able to get by with purchasing an earlier edition of the textbook online (presumably for cheaper) and, if necessary, photocopying the homework problems from a friend. However, I can't vouch for how well this will work in practice as I have not systematically compared editions of the textbook.

Most statistics textbooks cover a pretty standard set of topics, yet with different levels of mathematical sophistication. Moore, McCabe, and Craig is somewhat middle-of-the-road. Depending on your background and learning style, you might want to supplement it by also reading about the topics we are covering in a different book. Here are some options I am familiar with. There are also countless others.

Richard J. Larsen and Morris L. Marx, *An Introduction to Mathematical Statistics and Its Applications*, 5th ed. (Prentice Hall, 2012). Much more mathematically intense. I used this text in prior versions of this course, so if you are up for more of a challenge, I can give you a syllabus with alternate readings and homework assignments from this book and you could use it instead.

David Freedman, Robert Pisani, and Roger Purves, *Statistics*, 4th ed. (W. W. Norton, 2007). Very little math; explains almost everything in words.

Toward the end of the course, we will be using some excerpts from other textbooks for topics not covered in Moore, McCabe, and Craig; I will distribute these at the appropriate time.

In addition to the assigned readings from the textbook, for most weeks of the course I have listed a political science journal article (indicated with an asterisk) that uses one or more of the techniques being covered that week. These are recommended rather than required readings, but they are valuable because they show you how political scientists actually use the tools we are learning. The political science journal articles are all available electronically on JSTOR.

If, while we are covering topics that invoke calculus or matrix algebra, you would like to do some reading on your own to solidify your knowledge, the following might prove useful:

Daniel Kleppner and Norman Ramsey, *Quick Calculus: A Self-Teaching Guide*, 2nd ed. (John Wiley and Sons, 1985).

Gudmund R. Iversen, *Calculus* (Sage, 1996).

Krishnan Namboodiri, *Matrix Algebra: An Introduction* (Sage, 1984).

And if you want a review of bits of high school algebra you might have forgotten, these books might prove useful:

Timothy M. Hagle, *Basic Math for Social Scientists: Concepts* (Sage, 1995).

Timothy M. Hagle, *Basic Math for Social Scientists: Problems and Solutions* (Sage, 1996).

Finally, the following book is a very comprehensive overview of all of the above:

Will H. Moore and David A. Seigel, *A Mathematics Course for Political & Social Research* (Princeton, 2013).

Assignments

Problem sets (20% of the final grade), consisting of both pencil-and-paper and computer exercises, will be assigned on an almost-weekly basis and will be due the following week. It is impossible to learn statistics without practice, so these problem sets are very important. Working in groups is encouraged and is often the best way to learn; however, each student must turn in their own write-up. If working in a group, make sure you understand all of the answers, because you will be on your own come exam time!

Two midterm exams (20% each) will be held in class, approximately one-third and two-thirds of the way through the course. The final exam (40%) will be held December 19, 3-5 p.m. The exams are closed-book, but you will be allowed to bring in a single page of notes.

Schedule and Readings

Sept. 4, 9: Introduction to Probability

Moore, McCabe, and Craig, §4.1-4.2; §4.5.

* Christopher H. Achen, "Advice for Students Taking a First Political Science Graduate Course in Statistical Methods," *The Political Methodologist* 10, 2 (Spring 2002): 10-12.

Sept. 11, 16: Random Variables and Expectations

Moore, McCabe, and Craig, §4.3-4.4.

Sept. 18, 23: Discrete Probability Distributions

Moore, McCabe, and Craig, §3.3, §5.2 (up through p. 323; stop at "Normal approximation for counts and proportions").

* Robert Weissberg, "Collective vs. Dyadic Representation in Congress," *American Political Science Review* 72, 2 (June 1978): 535-547.

Sept. 25, 30: Continuous Probability Distributions and the Central Limit Theorem

Moore, McCabe, and Craig, §1.3, §5.1, §5.2 (from p. 323 through the end).

* Donald E. Stokes, "Party Loyalty and the Likelihood of Deviating Elections," *Journal of Politics* 24, 4 (Nov. 1962): 689-702.

Oct. 2: Review

Oct. 7: Midterm Exam

Oct. 9, 15: Confidence and Significance

Moore, McCabe, and Craig, §6.1-6.3

* Michael Coppedge, "The Dynamic Diversity of Latin American Party Systems," *Party Politics* 4, 4: 547-568.

Oct. 16, 21: Power and Error

Moore, McCabe, and Craig, §6.4-6.5

* C. F. Larry Heimann, "Understanding the Challenger Disaster: Organizational Structure and the Design of Reliable Systems," *American Political Science Review* 87, 2 (June 1993): 421-435.

Oct. 23, 28: Inferences for Means

Moore, McCabe, and Craig, §7.1-7.2

* Thad Dunning and Lauren Harrison, “Cross-Cutting Cleavages and Ethnic Voting: An Experimental Study of Cousinage in Mali,” *American Political Science Review* 104, 1 (Feb. 2010): 21-39.

Oct. 30: Inferences for Tabular Data

Moore, McCabe, and Craig, §9.1-9.3

* Edward D. Mansfield and Jack Snyder, “Democratization and the Danger of War,” *International Security* 20, 1 (Summer 1995): 5-38.

Nov. 4: Midterm Exam

Nov. 6, 11, 13, 18: Bivariate Regression

Moore, McCabe, and Craig, §2.2-2.4, §10.1 (stop at “Confidence intervals for mean response,” p. 557), §10.2 (stop at “Confidence intervals for the mean response...,” p. 574)

John Neter, et al., *Applied Linear Regression Models* (Richard D. Irwin, Inc., 1983). Chapter 6: “Matrix approach to simple regression analysis” (skip material on weighted least squares).

* Jeffrey A. Segal and Albert D. Cover, “Ideological Values and the Votes of U.S. Supreme Court Justices,” *American Political Science Review* 83, 2 (June 1989): 557-565.

* Edward R. Tufte, “The Relationship between Seats and Votes in Two-Party Systems,” *American Political Science Review* 67, 2 (June 1973): 540-554.

Nov. 20, 25: Multiple Regression

Eric A. Hanushek and John E. Jackson, *Statistical Methods for Social Scientists* (Academic Press, 1977). Chapter 5: “Multivariate Estimation in Matrix Form.”

* John T. Gaspar and Andrew Reeves, “Make it Rain: Retrospection and the Attentive Electorate in the Context of Natural Disasters.” *American Journal of Political Science* 55, 2 (April 2011): 340-355.

Dec. 2, 4: Violating Regression Assumptions

Peter Kennedy, *A Guide to Econometrics* (MIT Press, 1998). Chapters 3, 6, 7, 8, 9, 10, 11.

Dec. 9, 11: Additional Topics and Review

Reading TBD

Dec. 19, 3-5 p.m.: Final exam