

Advanced Quantitative Methods

University of Mississippi
Political Science 552
Spring 2011

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Office Hours: MW 1:00 - 2:30pm

Introduction

Regression analysis is a powerful tool for understanding the world around us. This class introduces the theory, methods, and practical application of linear regression. By the end of the semester, you will be able to understand and evaluate social science research that uses regression analysis. You will use regression to address a research question of interest. Finally, you will learn and apply additional techniques of statistical analysis, including logit and probit.

Any regression course requires some knowledge of basic statistical concepts and techniques. We begin with a brief review to insure familiarity with descriptive statistics, sampling distributions, statistical inference, and hypothesis testing before moving on to applied techniques. The focus will be on the nature of the basic linear regression model. Regression makes several key assumptions. We will examine these assumptions in depth and explore the consequences of violating them.

Objectives

- Calculate and interpret coefficients in multiple regression.
- Explain the assumptions of the Ordinary Least Squares model.
- Diagnose violations of the assumptions of the OLS model, understand the consequences of those violations for estimation of coefficients and standard errors, and consider the advantages and disadvantages of different remedies for the violations of the assumptions.
- Understand how to correctly calculate and interpret interaction terms in OLS models.
- Assess the problems created by using OLS in the presence of categorical or limited dependent variables.

- Utilize a maximum likelihood estimation technique when appropriate, including properly interpreting the results when MLE coefficients are presented.

Expectations

- Come to class. Learning statistics is a cumulative practice; what we learn in one class will build upon what was covered in previous sessions. Missing class creates gaps in your knowledge that will be difficult to build on.
- Complete all assignments. This class is like yoga - each assignment builds upon and prepares you for the next, more difficult challenge (and similar to yoga, there's always more to learn). These exercises also familiarize you with the software packages necessary to perform even simple analysis in a timely fashion.
- Keep an open mind about the math. This course assumes no previous exposure to calculus or statistics, and we will walk through the essential mathematical concepts in a way I hope will be clear to everyone. If at any point, it is not clear, please let me know.
- Much of learning how to be a political scientist happens outside the classroom. You should go to department presentations, and you should particularly make an effort to attend the noon brownbag statistics group meetings. Those meetings are on the second and fourth Wednesday of every month in the Deupree conference room. Finally, you should visit and contribute to the graduate students' methods blog at <http://iheartstats.blogspot.com>.

Required Texts

- Gujarati, Damodar and Dawn Porter. 2008. *Basic Econometrics*, 5th edition. McGraw-Hill. ISBN: 978-0073375779

Some additional readings appear on the syllabus and a few extras may be added as the semester progresses. These will either be posted to Blackboard or are available via JSTOR.

Additional Useful References

- Kennedy. *A Guide to Econometrics*. (Available through NetLibrary on the Ole Miss library website.)
- Agresti and Finlay. *Statistical Methods for the Social Sciences*.
- Berry, William. *Understanding Regression Assumptions*. Sage.

- Fox. *Regression Diagnostics*.
- Greene. *Econometric Analysis*.
- Lewis-Beck, Michael. *Applied Regression: An Introduction*. Sage.
- Maddala. *Introduction to Econometrics*.
- Wonnacott and Wonnacott. *Introductory Statistics*.
- Woolridge. *Introductory Econometrics: A Modern Approach*.

You do not need to purchase all these books, but they are good additional references. The Sage monographs are inexpensive, so you may want to start there.

Grading

Grades for the course will be made up of two parts:

- Homework Exercises, 50% (each assignment weighted equally)
- Final Project, 50%

Homework exercises will be prepared using Stata statistical software. If you are more comfortable with another advanced package (such as R or SAS), please let me know and we'll see if it will be feasible for you to complete the analysis in your preferred package. Further details on the homework as well as the final project will be provided in class throughout the semester.

Your final projects will be roughly 15-20 pages and similar in format to a research note in *APSR* or *JOP*. The topic will be of your choosing (although I highly recommend you choose a topic in your major field). From there, develop a hypothesis and test it using techniques learned in this course. Unlike a paper for one of your substantive classes, you will focus heavily on the technical details of your analysis. This will require you to specify a hypothesis, identify and access an appropriate data set, conduct an analysis to test the hypothesis, and interpret coefficients.

Course Outline

January 24 and 26: Math Review, Basic Tools and Notation

- Gujarati and Porter, 1-12 and Appendix A, 801-837.
- Optional – Kennedy, 1-11.

January 31 and February 2: Regression

- Gujarati and Porter, 15 - 54.
- Optional – Kennedy, Chapter 3.

February 7 and 9: Inference and Hypothesis Testing

- Gujarati and Porter, Chapters 5 and 8.
- Optional – Kennedy, 51-70.

February 14 and 16: Model Fit

- Gujarati and Porter, 73-81, 196-206.
- Lewis-Beck, Michael S. and Andrew Skalaban. 1990. When to Use R-Squared. *The Political Methodologist* 3(2):11-12.
- King, Gary. 1990. When Not to Use R-Squared. *The Political Methodologist* 3(2):9-11.
- Ruskin, Robert C. R-Squared Encore. *The Political Methodologist* 4(1):21-23.

February 21 and 23: Dummy Variables and Nominal Independent Variables

- Gujarati and Porter, Chapter 9.
- Optional – Kennedy, Chapter 15.

February 28 and March 2: Interaction Terms and Functional Forms

- Gujarati and Porter, 288-294
- Brambor, Clark, and Golder. Understanding Interaction Models: Improving Empirical Analyses. *Political Analysis*
- Note: Fred Boehmke may give a presentation this week on interaction terms. If that is the case, class on Wednesday will be cancelled and you will be required to attend his presentation on Friday.

March 7 and 9: Interpretation and Presentation

- King, Gary. 1986. How Not to Lie with Statistics: Avoiding Common Mistakes in Quantitative Political Science. *AJPS* 30:666-687.
- King, Gary, Michael Tomz, and Jason Wittenberg. 2000. Making the Most of Statistical Analysis: Improving Interpretation and Presentation. *American Journal of Political Science* 44(2): 347-361.
- Nagler, Jonathan. 1995. Coding Style and Good Computing Practices. *PS: Political Science and Politics* 28(3): 488-492.
- Kastellec, Jonathan and Eduardo Leoni. 2007. Using Graphs Instead of Tables in Political Science. (The easiest way to find this is to Google it.)

March 21 and 23: Model Specification

- Gujarati and Porter, Chapter 13.
- Optional – Kennedy, Chapter 5.

March 28 and 30: Heteroskedasticity

- Gujarati and Porter, Chapter 11.
- Downs, George and David Roche. 1979. Interpreting Heteroskedasticity. *AJPS* 23(4): 816-828.
- Optional – Kennedy, Chapter 8.3.

April 4 and 6: Autocorrelation and Intro to Time-Series

- Gujarati and Porter, Chapter 12.
- Optional – Kennedy, Chapter 8.4.

April 11 and 13: Multicollinearity

- Gujarati and Porter, Chapter 10.
- Optional – Kennedy, Chapter 12.

April 18, 20, and 25: MLE and Dichotomous Outcomes

- Gujarati and Porter, Chapter 15.
- Franklin, Charles H. Eschewing Obfuscation? Campaigns and the Perceptions of US Senate Incumbents, *APSR* 85(4): 1193-1214.
- Optional – Kennedy, Chapter 16.

April 27 and May 2: Dealing with Time

- Gujarati and Porter, Chapter 21 and pages 618-623.

May 4: Catch up

May 11: Final papers due by 5pm