

Advanced Quantitative Methods
Texas Tech University
Political Science 5383
Spring 2008

Contact Information

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Course Introduction:

In this course, you will be introduced to the theory, methods, and practice of linear regression. By the end of the semester, you will be prepared to (1) read, understand, and evaluate political science research that utilizes regression analysis; (2) design and complete your own research using basic regression; (3) employ more advanced techniques of quantitative analysis.

Any basic regression course requires some knowledge of basic statistical concepts and techniques. While we won't dwell on statistical theory, we will begin with a brief review to insure familiarity with concepts such as descriptive statistics, sampling distributions, statistical inference, and hypothesis testing before moving on to the applied techniques central to the course. The focus will be on the nature of the basic linear regression model. This model relies heavily on several key assumptions. For this reason, we will examine these assumptions in depth and explore the consequences of violating them.

Course Objectives

- Calculate and interpret coefficients in multiple regression. (Method of Assessment: Assignments 1 and 2 and Final Paper)
- Explain the assumptions of the Ordinary Least Squares model. (Method of Assessment: Assignment 3)
- 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. (Method of Assessment: Assignment 3)

- Understand how to correctly calculate and interpret interaction terms in OLS models. (Method of Assessment: Assignment 4)
- Assess the problems created by using OLS in the presence of categorical or limited dependent variables. (Method of Assessment: Assignment 4, Final Exam)
- Utilize a maximum likelihood estimation technique when appropriate, including properly interpreting the results when MLE coefficients are presented. (Method of Assessment: Assignment 5)

Expectations

- Come to class. I know that seems like an obvious one, but it's important nonetheless. 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. Much like the practice required for learning a foreign language, you'll have to practice the techniques we learn in this class to get them to stick, and the homework is a good way to do that. These exercises will also help you familiarize yourself with the software packages necessary to perform even simple analysis in a timely fashion.
- Keep an open mind about the math. This course assume 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.

Required Texts

- Gujarati, Damodar. 2003. *Basic Econometrics*, 4th edition. McGraw-Hill.
- Long, Scott. 1997. *Regression Methods for Categorical and Limited Dependent Variables*. Sage.

Some additional readings appear on the syllabus and a few extras may be added as the semester progresses. These will either be handed out during class or are available via JSTOR.

Additional Useful References

- Kennedy. *A Guide to Econometrics*. (Available through NetLibrary through the TTU library website.)
- Agresti and Finlay. *Statistical Methods for the Social Sciences*.

- Fox. *Regression Diagnostics*.
- Greene. *Econometric Analysis*.
- Hamilton. *Modern Data Analysis: A First Course in Applied Statistics*.
- Maddala. *Introduction to Econometrics*.
- Wonnacott and Wonnacott. *Introductory Statistics*.
- Woolridge. *Introductory Econometrics: A Modern Approach*.

(You need not purchase these weighty tomes, but they do provide good points of references. They may also be books you want to pick up later.)

Grading

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

- Homework Exercises, 50% (each assignment weighted equally)
- Final Project, 50% (Due May 3rd)

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.

Course Outline

January 10: Math Review, Basic Tools & Notation

- Optional – Kennedy, 1-29.
- You may also want to review probability theory and the basic properties of estimators from Gujarati, 869-905.

January 15 and 17: Regression Revisited

- Gujarati, 58-81, 110-114, 202-215
- Optional – Kennedy, 42-53.

January 22 and 24: Inference and Hypothesis Testing

- Gujarati, 119-147, 229-233, 248-273
- Optional – Kennedy, 54-61.

January 29 and 31: Model Fit

- Gujarati, 81-87, 217-223
- 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 5: Dummy Variables and Nominal Independent Variables

- Gujarati, 297-333.
- Optional – Kennedy, 220-228.

February 7 and 12: Interaction Terms and Functional Forms

- Gujarati, 175-178, 248-273, 31-312
- Friedrich, Robert J. 1982. “In Defense of Multiplicative Terms in Multiple Regression Equations.” *AJPS* 26(November): 797-833.
- Garrett, Geoffrey and Peter Lange. 1985. “The Politics of Growth,” *Journal of Politics*. (Please make sure to read the appendix.)

February 14 and 19: Regression in Matrix Form

- Gujarati, 913-949.

February 21: 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.
- Kastellec, Jonathan and Eduardo Leoni. 2007. “Using Graphs Instead of Tables in Political Science.” (The easiest way to find this is to Google it.)

February 26 and 28: Model Specification

- Gujarati 506-523, 539-548, 556-560.
- Optional – Kennedy, 94-112.

March 4 and 6: Heteroskedasticity

- Gujarati, 387-440, (optional 856-862).
- Downs, George and David Rocke. 1979. “Interpreting Heteroskedasticity.” *AJPS* 23(4): 816-828.
- Optional – Kennedy, 116-121.

March 11 and 13: Autocorrelation and Intro to Time-Series

- Gujarati, 441-505.
- Optional – Kennedy, 121-126, 143-146.

Spring Break – No Class

March 25 and 27: Multicollinearity

- Gujarati, 335-375.
- Optional – Kennedy, 183-190.

April 1, 3, and 8: MLE and Dichotomous Outcomes

- Long, 34-112.
- Franklin, Charles H. “Eschewing Obfuscation? Campaigns and the Perceptions of US Senate Incumbents,” *APSR* 85(4): 1193-1214.
- Optional – Kennedy, 233-235.

April 10 and 15: Ordered Choice Models

- Long, 114-145.
- Gelpi, Chris. 1997. “Crime and Punishment: The Role of Norms in Crisis Bargaining.” *APSR* 91(2):339-60.

April 17 and 22: Unordered Choice Models

- Long, 148-178.

April 24 and 29: Dealing with Panel Data

- Gujarati, 636-652, 273-279.

May 3: Final Papers Due (1:30-4:00PM)