

Economics 20900: Introduction to Econometrics: Honors

Department of Economics

University of Chicago

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Lecturer: Devesh Raval, devesh@uchicago.edu

Teaching assistant: Pietro Biroli, biroli@uchicago.edu

All course materials will be posted on the class Web page at chalk.uchicago.edu.

1 Class times and office hours

- **Lectures:** 9:00 to 10:20 a.m. Mondays and Wednesdays in Rosenwald 011.
- **Problem sessions:** 4 to 5 p.m. Thursdays in Rosenwald 011.
- **Devesh's office hours:** 5 to 6 p.m. Wednesdays at Stuart Cafeteria
- **Pietro's office hours:** 12:30 to 1:30 p.m. Tuesdays at Stuart Cafeteria

2 Course description

This course is an introduction to empirical methods in economics. We will discuss how economists combine statistical tools and economic theory to answer questions about the world.

Example: People who go to college receive a great deal of training. Does their education allow college graduates to earn higher wages than high school graduates? Can we answer the question simply by comparing the wages of some randomly chosen college and high school graduates?

Objectives: By the end of the course, you should be able to perform basic empirical analyses; critically evaluate and explain basic econometric work done by other people; and analyze the theoretical properties of estimators commonly used in basic empirical work.

Prerequisites: This course is intended for students who are contemplating graduate study in economics and have substantial previous background in mathematics and statistics. Statistics 24400 or the equivalent would be ideal. Compared with Economics 21000 (Econometrics A), this course puts more emphasis on abstract statistical theory. The last page of this syllabus is a math and statistics pre-test. If the material on the pre-test is unfamiliar to you, you should consider taking Econometrics A instead of this course.

3 Grading and policies

- Final exam – 8 a.m. to 10 a.m. Friday, June 11. Closed book, closed notes.
- Midterm exam – Most likely in the fifth week of the quarter. Closed book, closed notes.
- Problem sets – About seven, due most Wednesdays at the beginning of class. The purpose of the problem sets is almost entirely to give you practice in doing econometrics, not to evaluate your progress. We will grade one randomly chosen problem on each problem set and drop the lowest problem set. You will need to use the software program Stata, which is available in the public computer labs. You may work with classmates but must write up your own answers. Late problem sets will not be accepted.
- Projects – I will assign two empirical projects in this class- one due in the fourth week and one due in the ninth week. At least one project will be a chapter from:
 - Ernst Berndt, *The Practice of Econometrics: Classic and Contemporary*

Each chapter starts with an economic theory and then goes through a bunch of empirical exercises to test the theory. For example, one chapter tests the Capital Asset Pricing Model (CAPM) and another chapter explores the determinants of wages (such as the example given earlier on education). I will circulate the chapter so there is no need to buy the book, though it is a nice complement to the standard books as its emphasis is on going through applications of the theory.

I may have the second project be a replication exercise of an economics paper. If so, I will distribute a published econometrics paper from a professional journal and the raw data used in that paper. You must then use Stata to attempt to replicate all of the empirical results in the paper. Your write-up should be about five pages and should consist of 1) a critical summary of the paper, describing the economic question it asks, the data and methods used to answer this question, and your views on whether the results are credible; 2) a description of your efforts to reproduce the empirical results, including an explanation of any difficulties encountered; and 3) the Stata program you used to try to reproduce the results. Replication code for the papers may already be available on the Web; if so, you are not permitted to look at or use it.

For both of these projects, you are encouraged to work with classmates but must ultimately write your own programs and your own report. Except in case of a documented medical or family emergency, late assignments will lose one letter grade per day or fraction thereof that they are late.

- Grading – Because this is an honors course, I will not grade on a curve. I encourage you to help each other learn the material. I will weight the items according to whichever of the following schemes is better for you:

- Final 40%, midterm 30%, problem sets 10%, replication exercises 20%.
- Final 65%, problem sets 10%, replication exercises 25%.

This scheme effectively makes the midterm optional (although I very strongly encourage you to take it); hence, there will be no make-up exams for students who miss the midterm for any reason. If you require accommodations for a disability, please see me as soon as possible.

Any student who cheats on an exam or engages in any other form of academic dishonesty will fail the course and be reported to the dean.

4 Readings

There is no perfect advanced econometrics book. The only required textbook is

- Hansen, Bruce, 2007, *Econometrics*, PDF available for free on Chalk and at the author's Web site: <http://www.ssc.wisc.edu/~bhansen/econometrics/>. This book is very concise.

You are responsible for material in Hansen only if we also cover it in class or on an assignment. You may want to consult other books as well, though which books depend on your needs. Two good undergraduate treatments of econometrics are:

- Wooldridge, Jeffrey M., 2005, *Introductory Econometrics: A Modern Approach*, Thomson South-Western
- Stock and Watson, *Introduction to Econometrics*. This book is the Econ 210 required textbook.

Some of the many graduate first year books are:

- Ruud, Paul A., 2000, *An Introduction to Classical Econometric Theory*, Oxford University Press. Berkeley's first year book.
- Davidson, Russell, and James G. MacKinnon, 1993, *Estimation and inference in econometrics*, Oxford University Press. Slightly easier than other graduate-level books.
- Goldberger, Arthur S., 1991, *A Course in Econometrics*, Harvard University Press. A classic older graduate-level book.
- Greene, William H., 2003, *Econometric Analysis*, Prentice Hall. The standard encyclopedia but awful to learn from.
- Hayashi, Fumio, 2000, *Econometrics*, Princeton University Press. Emphasizes GMM as a unifying framework.
- Wooldridge, Jeffrey M., 2002, *Econometric Analysis of Cross Section and Panel Data*, MIT Press. Typically used for second-year graduate courses, but the first four chapters are a good review of basic asymptotic theory. A good choice if you want to work in microeconometrics.

A nice complementary guide to econometrics, to provide intuition and background, is:

- Kennedy, Peter. A Guide to Econometrics, Wiley-Blackwell. I like the old editions better than the newest ones as they are more compact.

I have asked for all of these books to be placed on reserve at the Regenstein library.

5 Course outline

1. Introduction to Statistics and Estimation

- (a) What are the basic building blocks of statistics? (Hansen, chapter 2 and appendix B)
 - i. Distributions and densities
 - ii. Moments: Expectation, Variance, Covariance
 - iii. Conditioning on Variables
- (b) What happens to these elements as the sample size gets large? (Hansen, appendix C)
 - i. Convergence
 - ii. Law of Large Numbers
 - iii. Central Limit Theorem
- (c) How can we predict or estimate one of these elements? (Hansen, appendix D)
 - i. Prediction Problems
 - ii. Maximum Likelihood
 - iii. Method of Moments
 - iv. Nonparametrics

2. Ordinary Least Squares

- (a) How do we compute OLS? (Hansen, sections 3.1-3.5)
- (b) When does OLS make sense? Why does it make sense? (Hansen, sections 3.6-3.10, 4.1-4.3 and 4.11)
 - i. Basic assumptions of the Classical Regression Model
 - ii. Interpretations of OLS: projection, method of moments, maximum likelihood.
 - iii. Small sample: Unbiasedness, normality?
 - iv. Large Sample: Consistency, Asymptotic Normality, Gauss-Markov Thm

3. Inference

- (a) How precise are our results? (Hansen, sections 4.4-4.5)
 - i. Variance of the LS estimator

- ii. R^2
 - iii. Estimation
- (b) How can we test hypotheses? (Hansen, sections 4.6-4.10)
- i. Confidence Intervals
 - ii. Univariate Tests
 - iii. Joint Tests
- (c) What happens if the conditional variance is not constant? What happens if there is dependence across observations? (Hansen, section 5.1)
- i. Generalized Least Squares
 - ii. HAC Estimation

4. Economics and Econometrics

- (a) What model should we use? (Hansen, sections 5.8 and 5.9)
- i. Irrelevant variables and omitted variables.
 - ii. Nonlinear transformations
 - iii. Dummy variables
- (b) What happens if our data is not measured perfectly? (Hansen, introduction to Chapter 9)
- (c) How can we separate demand and supply? (Hansen, sections 9.2 and 9.3)
- i. Reduced form and structural equations
 - ii. Identification
- (d) How can we deal with variables that are endogenous? (Hansen, sections 9.4 and 9.5)
- i. 2SLS and IV

Time permitting, I will also cover other fun topics such as nonparametrics, quantile estimation, or Generalized Method of Moments (GMM).