The Heller School for Social Policy and Management
HS405A: Applied Econometrics
Spring 2013 (updated 2/25/2013)

Prof. Betsy Brainerd            Office hours (Rabb 120a):
Sachar 126 and Rabb 120a             Wednesdays,
ebrainer@brandeis.edu                   10:00 am - 12:00 noon

TA: Sarah Tang, letang@brandeis.edu
Stata lab: Thursdays, 12:00 noon - 1:20 pm

Course description: This course is concerned with problems that arise in using ordinary least squares regression analysis; more broadly, the course is concerned with building econometric models to test hypotheses. You will learn about the obstacles encountered in empirical research, the econometric methods used to overcome these obstacles, and how to implement these methods using data. By the end of the course you will be able to (i) read, understand, and critique empirical papers, and (ii) work with data to produce your own research.

After reviewing ordinary least squares, we examine limited dependent variable problems and techniques to deal with them, including logit, probit, multinomial and ordered logit, the Poisson model, Tobit, and sample selection problems. This section will also discuss generalized least squares models to correct for heteroskedasticity and autocorrelation. We next consider the threats to internal validity for OLS which can lead to unreliable estimates. These threats include omitted variable bias, sample attrition, self-selection, and measurement error. Techniques to address these threats which we will cover include fixed effects, instrumental variables, experiments and quasi-experiments, and regression discontinuity designs. The goal is not to learn all of the mathematics behind these methods, but to gain an intuitive understanding of how to interpret them and implement them in your own research.

Learning goals: upon successful completion of the course you will:

• Understand the basic statistical assumptions underlying regression analysis and the situations in which these assumptions are appropriate
• Be able to identify when the basic regression assumptions may be violated and to correct for these violations using appropriate techniques
• Be able to critically assess empirical studies in professional journals
• Have proficiency in carrying out estimation using Stata, and
• Be able to implement original research using the empirical techniques you have learned.

Classroom discussion will focus on basic concepts, techniques, and the interpretation of results. Computer labs will focus on the use of Stata to carry out the estimation procedures, and will also address student questions.

Prerequisite: HS 404b

Course materials: The recommended textbook for the course is Jeffrey M. Wooldridge,
Introductory Econometrics. The 5th edition is the latest edition, but it is fine to use the 4th edition if you would like a cheaper option. We will also use several chapters of J. Scott Long and Jeremy Freese, Regression Models for Categorical Variables Using Stata (second edition, 2006). Additional supplemental readings for the course will be posted on LATTE.

Attendance: Learning in econometrics is cumulative; each topic builds on the previous one. As a result, attendance is extremely important. I strongly recommend that you attend every class, as well as every computer lab.

Course requirements: Each student will carry out an econometric project in which hypotheses are formulated and tested by applying econometric techniques to data. The results will be presented in a 15-20 page research paper. The paper will be written in stages throughout the course, and each student will give a presentation on his or her research at the end of the course. The following steps will be followed in preparing the paper (further information on how to write the research paper will be provided early in the semester):

1. A one-page written proposal will be handed in on Tuesday, February 12. This will include a statement of the subject, the hypotheses to be tested, and a brief description of the data source to be used.

2. A brief written report on preliminary results will be handed in on Tuesday, March 12. This report will include a table of means and results of initial tests of hypotheses. The report should present these results, discuss problems in the analysis, and indicate the steps that will be taken to complete the project.

3. A completed research paper will be submitted on Friday, May 3.

4. Students may discuss their work with others and get advice from them before completing each of the above three steps, but each student must have his or her own project and reports.

There will be additional homework assignments, some to be handed in and some done independently.

Computer lab
Computer lab sessions are an integral part of the course and will be in the computer room. There will be sessions on Thursdays from 12:00 noon to 1:20 pm following the class.

Provisions for feedback: Since the central assignment in the course is the econometric project, there will be feedback on it several times over the semester. There will be comments and suggestions on the proposal, on the preliminary results, and on the final paper. There will also be class days set aside for student presentations on projects. Homework assignments handed in will be graded. The final grade will be satisfactory or unsatisfactory.

Special accommodations: If you are a student with a documented disability on record at Brandeis University and require accommodations, please see me prior to the second meeting of
the class. If you have any questions about this process, contact Mary Brooks, disabilities coordinator for the Heller School at x6-2816, or at maryeliz@brandeis.edu.

**Academic integrity:** Academic integrity is central to the mission of educational excellence at Brandeis University. Each student is expected to turn in work completed independently, except when assignments specifically authorize collaborative effort. It is not acceptable to use the words or ideas of another person without proper acknowledgment of that source. This means that you must use footnote and quotation marks to indicate the sources of any phrases, sentences, paragraphs or ideas found in published volumes, on the internet, or created by another student. Violations of university policies on academic integrity, described in Section 3 of Rights and Responsibilities, may result in failure in the course or on the assignment, and could end in suspension from the University. If you are in doubt about the instructions for any assignment in the course, you must ask for clarification.
Course outline and assigned readings

I. Ordinary Least Squares (OLS) Model: Review of Basic Regression Concepts

The first three weeks will review basic regression concepts. A key objective is to understand the assumptions of OLS and the problems that arise when these assumptions are not met. It also considers ways to get flexibility in modeling and hypothesis testing within the confines of the OLS model.

Class 1: Tuesday, Jan. 15
Review of basic regression model
Wooldridge, Ch. 1 and 2
Josh Angrist and Steve Pischke, *Mostly Harmless Econometrics: An Empiricists’ Companion*, 2009, Ch. 1

Class 2: Thursday, Jan. 17
Review, cont.
Wooldridge, Ch. 3

Class 3: Tuesday, Jan. 22
Hypothesis testing
Wooldridge, Ch. 4
Wooldridge, Ch. 19 (read to prepare for econometric project)

Class 4: Thursday, Jan. 24
Qualitative independent variables; using dummy variables to test for differences-in-differences
Wooldridge, Ch. 7, sections 7.1 - 7.4

Class 5: Tuesday, Jan. 29
Assorted regression topics
Wooldridge, Ch. 6
*Stata exercise #1 due*

Class 6: Thursday, Jan. 31
Heteroskedasticity
Wooldridge, Ch. 8

II. Limited Dependent Variable Models

In this unit we consider models in which the dependent variable is limited in some way. Generally, there is some departure from the OLS assumptions. These models arise, for example, when the dependent variable represents discrete categories. For now we consider cases where there are just two categories and will use logit and probit. When the dependent variable is continuous over a range, but is also truncated or censored, we consider the Tobit model as one alternative. The techniques for limited dependent variables are also useful in dealing with the important problem of sample selection bias, which can be a serious threat to validity in many estimation situations. Later in the course, we will consider more than two categories.
Class 7: Tuesday, Feb. 5  Binary choice models:
linear probability model, probit and logit
Wooldridge, Ch. 7, section 7.5, Ch. 17, section 17.1
Long and Freese, Ch. 3 and 4

Class 8: Thursday, Feb. 7  Binary choice models, cont.: maximum likelihood estimation; latent variable approach to logit or probit
Wooldridge, Ch. 17, section 17.1
Long and Freese, Ch. 3 and 4

Class 9: Tuesday, Feb. 12  Tobit model; two-part models
Wooldridge, Ch. 17, section 17.2

Class 10: Thursday, Feb. 14  Censored and truncated models
Wooldridge, Ch. 17, section 17.4

FEBRUARY 18 - 22: MIDTERM RECESS

Class 11: Tuesday, Feb. 26  Count data; Poisson model; negative binomial model
Wooldridge, Ch. 17, section 17.3

Class 12: Thursday, Feb. 28  Assessing internal validity; proxy variables; measurement error
Wooldridge, Ch. 9

III. BIAS AND ECONOMETRIC METHODS FOR REDUCING BIAS

This unit considers several sources of bias, including sample selection bias, omitted variables, and simultaneous equations. It introduces fixed effects, instrumental variables, experiments and quasi-experiments, and regression discontinuity designs as possible methods to deal with the bias. It also considers special procedures used in the case of simultaneous equations.

Class 13: Tuesday, March 5  Sample selection bias
Wooldridge, Ch. 17, 17.5
Stata exercise #2 due

Class 14: Thursday, March 7  Sample selection bias, continued
Propensity score matching
Class 15: Tuesday, March 12  Panel data and fixed effects
Wooldridge, Ch. 13 and 14.1
Report on preliminary results due

Class 16: Thursday, March 14  Instrumental variables
Wooldridge, Ch. 15

Class 17: Tuesday, March 19  Instrumental variables, cont.

Class 18: Thursday, March 21  Experiments and quasi-experiments
Stock and Watson, *Introductory Econometrics*, Ch. 13

**MARCH 25 - APRIL 3: PASSOVER AND SPRING RECESS**

Class 19: Thursday, April 4  Experiments and quasi-experiments, cont.
Regression discontinuity designs
*Stata exercise #3 due*

Class 20: Tuesday, April 9  Simultaneity; structural and reduced form equations;
the identification problem
Wooldridge, Ch. 16

Class 21: Thursday, April 11  Simultaneity issues, cont.

**IV. QUALITATIVE DEPENDENT VARIABLES WITH MULTIPLE CATEGORIES**

In unit II we dealt with limited dependent variables with two categories using logit or
probit. Now we will consider generalizations of these methods to multiple categories.
For cases in which there is no order to the categories, we introduce multinomial logit. For
cases in which the multiple categories are ordered, we introduce ordered logit.

Class 22: Tuesday, April 16  Ordered logit and probit
Long and Freese, Ch. 5

Class 23: Thursday, April 18  Multinomial logit; independence of irrelevant alternatives
assumption; multinomial probit
Long and Freese, Ch. 6

Class 24: Tuesday, April 23  Conditional logit
Long and Freese, Ch. 7
Class 25: Thursday, April 25  Student presentations

Class 26: Tuesday, April 30  Student presentations