

# APPLIED ECONOMETRICS

## Economics 321

FALL 2007

Department of Economics, Cornell University

TR 1:25:2:40PM – RF 230

**INSTRUCTOR:** Prof. Francesca Molinari  
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**OFFICE HOURS:** Thursday 3:00-4:30PM

**TEACHING ASSISTANT:** Yusuke Tateno  
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**SECTIONS:** 1: F 9:05-9:55 am WN 345  
2: F 10:10-11:00 am WN 345  
**OFFICE HOURS:** TBA

### Course Description

Economics 321 is a one-semester introductory course in statistics and econometrics. The main objective of this course is to teach students to use and interpret a set of quantitative methods frequently employed in empirical analysis of economic phenomena. Applications of these methods will be emphasized throughout the course, but it is also an objective of this course to provide sufficient grounding in the underlying probability theory and statistics to enable students to understand the conceptual framework that has generated these methods, and to link these methods with more advanced ones that may be studied later.

The first part of the course will introduce the basic structure of probability theory, discuss random sampling from a population, and introduce the distributions of some sample statistics. From there we will move to the problem of estimation – the process of using data (in the best possible way) to learn about the value of the unknown parameters of a model. The first part of the

course will end with a thorough discussion of hypothesis testing about the mean of a population – i.e., how to use the data to confirm or reject hypotheses that we have formed about a certain (economic) variable.

In the second part of the course we will study how to analyze relationship among several (economic) variables. We will focus on one of the most common starting point in econometric studies: the linear regression model. Knowledge of the linear regression model and its extensions, as well as of its shortcomings, is essential for doing empirical work in economics, business, and other social sciences. The purpose of this course is to give students a working knowledge of the most important aspects of this model. The emphasis will be placed on application of the theory from a practical standpoint, but the underlying statistical theory will also be covered. Students will utilize the Minitab statistical package to implement many of the procedures introduced in class.

### **Prerequisites**

**Econ 101-102** and **Math 111-112** or equivalent. It is assumed that students have a basic knowledge of algebra, including differentiation and integration; both these tools will be used during the course. No previous courses in probability, statistics or computer programming are required.

### **Exams and Grade Policy**

Grades in this course will be based on the following:

1. **6 problem sets**, which will include empirical exercises, counting towards **25%** of the final grade. Problem sets will be due in class and the due dates will be firm. Late problem sets will not be accepted. The only exception is if you obtain my prior consent (not the TA's), or in unusual circumstances.
2. **3 tests** counting towards **75%** of the final grade (25% each). **Two of these tests will be given in class, during the 1:25-2:40PM lecture on Thursday afternoon:**

**Test 1: Thursday, October 4**

**Test 2: Thursday, November 8**

The final test will be given during finals period and is scheduled for **Thursday, December 13 2:00 - 4:30 PM. Note:** The third test will not be cumulative.

**The official policy of this course is that no makeup exams will be offered, because the first two exams are in class and the third exam is during finals.**

### **Sections**

There are 2 sections for the course. These meet on Fridays from 9:05-9:55AM and 10:10-11:00AM in WN345, and will be held by Yusuke Tateno. The Sections are informal and are used to go over problem sets and exams, to present supplemental and review material, and to answer questions. Note that on occasion I will lecture in sections **so keep the 10:10-11:00AM time free in your schedule.**

### **Computers**

In order to become skilled in applied econometrics, you need to be doing it in practice. Hence, most problem sets will contain empirical portions that require the use of computers. The statistical package that we will be using is Minitab, which can be downloaded for free after completing an order form at

<http://amber.cit.cornell.edu/citweb/software/sw1/studentminitab/studentorder.cgi>

Minitab is also available at many computer labs on campus. Support by myself and the TA will be given for Minitab. Students with access to statistical packages other than Minitab are free to use them, but no computer support can be offered to them.

### **Textbook**

There is one required textbook for the course: *Introductory Econometrics*, Third Edition by Jeffrey Wooldridge. This textbook is excellent. It is both readable and enjoyable, full of great examples and not too technical. I strongly recommend you read the textbook. My lectures will be based on this book, aiming at making technical material accessible. Therefore, **it is very important to attend all lectures.** In addition to the text, there will be handouts for some of the more technical parts of the course.

There is also a textbook, which you are *not* required to buy, to supplement the statistics and probability topics: *John E. Freund's Mathematical Statistics with Applications*, 7E, by Miller and Miller.

### **Handouts**

Solutions to the problem sets and occasionally other handouts will be available in lecture. Problem set questions and some handouts will be made available on the course web page. Solutions will not be posted on the web page. Extra copies of problem sets solutions and handouts will be placed in a box outside Uris 492. If these boxes are ever missing something you need, see the TAs or me.

### **Course Outline**

W denotes Wooldridge's book, MM denotes Miller and Miller's.

1. What is Econometrics? Motivation and Background (W – Chapter 1)
2. Probability
  - (a) Sample Spaces, Events and Probabilities (MM – Sections 2.2-2.5)
  - (b) Conditional Probabilities and Independent Events, Bayes' Theorem (MM – Sections 2.6-2.8)
3. Random Variables and Probability Distributions
  - (a) Continuous and Discrete Random Variables (W – Appendix B1, MM – Section 3.1, 3.3)
  - (b) Probability Distributions (W – Appendix B1, MM – Sections 3.2, 3.4)
  - (c) Joint Distributions, Marginal Distributions and Conditional Distributions (W – Appendix B2, MM – Sections 3.5-3.7)
4. Mathematical Expectation
  - (a) Expected Value of a Random Variable (W – Appendix B3, MM – Sections 4.1-4.2)

- (b) Variance and Covariance (W – Appendix B3-B4, MM – Sections 4.3, 4.6)
  - (c) Linear Combinations of Random Variables (MM – Section 4.7)
5. Special Probability Distributions
- (a) Bernoulli Distribution (MM – Section 5.3)
  - (b) Normal Distribution (W – Appendix B5, MM – Section 6.5)
  - (c) Chi-Square Distributions (W – Appendix B5, MM – Section 8.4)
  - (d) t Distribution (W – Appendix B5, MM – Section 8.5)
  - (e) F Distribution (W – Appendix B5, MM – Sections 8.6)
6. Estimation of the Mean
- (a) Point Estimators: Bias and Efficiency (W – Appendix C2, MM – Sections 10.2-10.3)
  - (b) Estimation and Confidence Intervals for the Mean (MM – Sections 11.2-11.3, W – Appendix C5)
  - (c) Distribution of the Mean and Central Limit Theorem (MM – Sections 8.1-8.2)
  - (d) Estimation and Confidence Intervals for Proportions (MM – Sections 11.4-11.5)
7. Hypothesis Testing for the Mean (W – Appendix C6, Handout)
8. Two-variable Linear Regression Model (W – Chapter 2)
- (a) Motivation and Definitions (W – Section 2.1)
  - (b) Ordinary Least Squares (OLS) estimation (W – Section 2.2)
  - (c) Mechanics of OLS (W – Section 2.3)
  - (d) Correlation coefficient and  $R^2$  (W – Section 2.3)
  - (e) Units of Measurement (W – Section 2.4)
  - (f) Sampling Properties of OLS estimates (W – Section 2.5)
  - (g) Inference (not in book)

9. The Multiple Regression Model (Cross Section Regressions)
  - (a) Motivation and Interpretation (W – Section 3.1)
  - (b) OLS estimation and mechanics (W – Section 3.2)
  - (c) Sampling Properties of the OLS estimator and estimation of error variance (W – Section 3.3 and 3.4 and Section 5.1)
  - (d) Gauss-Markov Theorem (W – Section 3.5)
10. Inference in the OLS Model (W – Chapter 4)
  - (a) Significance of coefficients, asymptotic normality and t-tests (W – Sections 4.2 and 5.2)
  - (b) Testing linear hypotheses, F-tests (W – Sections 4.4 and 4.5)
    - i. Significance of groups of variables
    - ii. Testing equality among a subset of variables
    - iii. Restricted/Unrestricted regressions
    - iv. Algebra of restricted OLS
11. Scaling Data and Functional Forms Issues (W – Chapter 6)
12. Use of Dummy Variables (W – Chapter 7)
  - (a) General descriptions and interpretations (W – Sections 7.1 and 7.2)
  - (b) Multiple categories and interaction variables (W – Section 7.3 and 7.4)
  - (c) Policy analysis and program evaluation (W – Section 7.6)
13. Multicollinearity and Specification Error
  - (a) Multicollinearity (W – Section 3.4)
  - (b) Omitted variable bias and faulty inclusion (W – Section 3.3)