Econ 104: Introduction to Econometrics

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Office Hours: Tuesdays 3:15-5:15p

Scheduled Class Time and Organization:

- Lectures: *Tuesdays* and *Thursdays* from 1:30p-3:00p.
- Recitation Sessions: one hour per week as scheduled.

Course Description: This course is designed to introduce you to econometric techniques and their applications in economic analysis and decision making. The main objective of the course is to train you in (i) handling economic data; (ii) quantitative analysis of economic models with probabilistic tools; (iii) econometric techniques, their application as well as their statistical and practical interpretation; (iv) implementing these techniques on a computer.

The course focuses on practical and conceptual issues involved in substantive applications of econometric techniques. Estimation and inference procedures are formally analyzed for simple econometric models and illustrated by empirical case studies using real-life data. The course covers linear regression models, simultaneous-equations models, discrete choice models, time series models, and panel data models. Estimation and inference is conducted using least squares, instrumental variable, and likelihood based techniques.

Prerequisites: ECON 101 and ECON 103; MATH 104 and MATH 114 or MATH 115.

Courseware: We will be using an online discussion forum called PIAZZA for this course, which you can access directly from CANVAS. PIAZZA is where we will make all course announcements, assign homework and readings, post homework assignments, lecture slides, exam practice problems, and solutions throughout the semester. Piazza is also the best place to ask any question you have about course material or logistics. By asking your question and getting an answer on PIAZZA, you create a positive externality: other students benefit from

your questions and you benefit from theirs. The instructor and RIs will actively moderate PIAZZA both to answer questions and approve (or correct) answers written by your fellow-students. As an incentive you will receive up to 5% credit toward your final grade (see below).

Course Text: The required textbook for this course is Stock, James and Mark Watson (2010, 3rd Edition): *"Introduction to Econometrics"*. Prentice Hall, ISBN-13: 978-0-13-800900-7. Moreover, I will post some slides and lecture notes. You will be responsible for all the material covered in the lectures and the recitation sessions. However, you will not be responsible for additional material contained in the textbook that is not covered in lectures and recitations.

Statistical Software: We will use the statistical package *R* via a front-end called RStudio throughout the course. Both programs are free and open source. See the last page of this document for instructions on how to configure your computer to run *R* and RStudio. Both programs are also available in the Undergraduate Data Analysis Lab (UDAL) in McNeil rooms 104 and 108-9.

Course Requirements and Grading: You are expected to attend the lectures and your assigned recitation session. You have to attend the recitation session for which you are registered. The overall course grade is based on your participation on PIAZZA and your performance on problem sets and exams.

- **PIAZZA Participation [5%]**: You will earn participation credit based on the frequency and quality of your contributions to the PIAZZA discussion board. Contributions include questions, answers, and follow-ups. If you participate actively, you will receive full credit. You must contribute to earn points, but spamming the board with clearly unhelpful contributions will not gain you credit.

- **Problem Sets [20%]**: There will be 9 problem sets, assigned during the semester (see table below for schedule). The problem sets are designed to give you the opportunity to review and enhance the material learned in class. Solutions must be submitted on the specified due dates (see below for further details). Each problem set will be graded on a scale from 0 to 10. Late submissions are penalized with -1 point per day (weekend days and holidays count as well). The 7 problem sets with the highest scores count toward the grade. No excuses for missed assignments/deadlines will be accepted.

- **Midterm Exam 1 [25%]**: *Thursday 02/13*, closed books and notes, in class.

- **Midterm Exam 2 [25%]**: *Tuesday 04/01*, closed books and notes, in class.
- **Final Exam [25%]**: *To be given on the date scheduled in the University Calendar for final exams*, closed books and notes.

Your scores on the various assignments will be aggregated at the end of the semester and converted into a letter grade. I will not assign letter grades to individual assignments. While the grades for this course are not "curved," I expect there to be about 30-35% A grades and 35-40% B grades.

Missed Exams: If you do not have a valid excuse for missing an exam you will receive a score of zero.

There will be no make-up examination for the midterm. If you do have a valid excuse (see departmental course policies below) for missing a midterm, then the remaining examinations will be reweighted as follows:

- If you miss Midterm 1, then Midterm 2 will count 35% and the Final will receive 40%.
- If you miss Midterm 2, then the Final will count 50%.
- If you miss both midterms, then your Final will count 65% (meaning that you will loose 10% of the potential exam credit).

If you are excused from the final exam, then a make-up final exam is to be taken during the designated make-up week, usually at the beginning of the following semester.

Course Absence Reporting: You must use the Course Absence Reporting (CAR) system to communicate with me about exam absences. Since I do not take attendance during lectures, you do not need to alert me if you are unable to attend a specific lecture.

Departmental Course Policies: All course policies of the Economics Department apply to Econ 104 even if not explicitly listed on this syllabus. See: http://economics.sas.upenn.edu/undergraduate-program/course-information/guidelines/policies for full details.

Course Outline and Schedule

Date	Event	Topic
		Linear Regression with One Regressor
Th 01/16	Lecture 1	Probabilistic Modeling and Regression
Tu 01/21	Lecture 2	Linear Regression and OLS
Th 01/23	Lecture 3	Large Sample Distribution of OLS Estimation
As sched.	Recitation	Review of Probability and Statistics
Tu 01/28	Lecture 4	Hypothesis Testing
Th 01/30	Lecture 5	Hypothesis Testing and Confidence Intervals
As sched.	Recitation	Regressions in R; Exercises: Inference in Regression Models
Tu 02/04	Lecture 6	Prediction
Th 02/06	Lecture 7	Heteroskedasticity
As sched.	Recitation	Exercises: Prediction
		Regression With Multiple Regressors
Tu 02/11	Lecture 8	Multiple Regression Topics
Th 02/13	Midterm 1	Lectures 1-7 and Recitations
As sched.	Recitation	Exercises: Multiple Regression Analysis
Tu 02/18	Lecture 9	Variable Selection
Th 02/20	Lecture 10	Testing Generalized Hypotheses
As sched.	Recitation	Exercises: Variable Selection and Hypothesis Testing
		Nonlinearities
Tu 02/25	Lecture 11	Polynomials and Logarithmic Transformations
Th 02/27	Lecture 12	Binary Regressors and Interactions
As sched.	Recitation	Exercises: Nonlinearities
Tu 03/04	Lecture 13	Linear Probability Model, Logit, and Probit
Th 03/06	Lecture 14	Linear Probability Model, Logit, and Probit

Date	Event	Topic
		Endogeneity
Tu 03/18	Lecture 15	Endogeneity Bias and IV Estimation
Th 03/20	No Class	
As sched.	Recitation	Exercises: Binary Choice Models
Tu 03/25	Lecture 16	Endogeneity Bias and IV Estimation
Th 03/27	Lecture 17	Simultaneous Equations Models
As sched.	Recitation	Exercises: IV Estimation
Tu 04/01	Midterm 2	Lectures 8-16 and Recitations
Th 04/03	Lecture 18	Simultaneous Equations Models
As sched.	Recitation	Exercises: Demand and Supply Model
		Time Series Analysis
Tu 04/08	Lecture 19	Intro to Time Series Analysis
Th 04/10	Lecture 20	AR(1) Model: Theoretical Properties
As sched.	Recitation	Exercises: Temporal Dependence
Tu 04/15	Lecture 21	AR(1) Model: Estimation and Prediction
Th 04/17	Lecture 22	ARMA Models, Trends
As sched.	Recitation	Exercises: ARMA Models
Tu 04/22	Lecture 23	Vector Autoregressive Models
		Panel Data
Th 04/24	Lecture 24	Panel Data Analysis
As sched.	Recitation	Exercises: Panel Data
Tu 04/29	Lecture 25	Panel Data Analysis
Tu 05/06	Final Exam	9:00-11:00a (date and time determined by registrar)
		Focus on lectures 17-15 and recitations.

Schedule for Problem Sets

Problem sets are due by 2:50 pm in class. If you do not submit the problem set in class, you have to submit it directly to your recitation instructor. Submissions received after 6:00 pm on the due date will receive a penalty for late submission. You have to submit a hardcopy. Electronic submissions are not accepted.

Assignment	Date Posted	Due Date
Problem Set 1	Tu 01/21	Tu 01/28
Problem Set 2	Tu 01/28	Tu 02/04
Problem Set 3	Tu 02/04	Tu 02/11
Midterm 1		
Problem Set 4	Tu 02/18	Tu 02/25
Problem Set 5	Tu 02/25	Th 03/06
Problem Set 6	Tu 03/18	Th 03/27
Midterm 2		
Problem Set 7	Th 04/03	Th 04/10
Problem Set 8	Th 04/10	Tu 04/22
Problem Set 9	Tu 04/22	Tu 04/29
Final Exam		

R Resources

Installing R and RStudio: First, download and install *R* from http://cran.r-project.org/. Second, download and install RStudio by visiting http://rstudio.org/download/desktop and clicking the link listed under "Recommended for Your System."

References: While not required, these references may be useful if you need some extra help learning *R*, or want to go beyond the material covered in the course.

- Contributed Documentation by Comprehensive R Archive Network (CRAN) http://cran.r-project.org/other-docs.html Comprehensive list of freely available reference material for R.
- *R Twotorials* by Anthony Damico http://www.twotorials.com/
  Ninety energetic, two-minute video tutorials on statistical programming with R.
- Google Developers R Programming Video Lectures
  http://www.r-bloggers.com/google-developers-r-programming-video-lectures/
  R Programming video tutorials from beginning to advanced.
- *Econometrics in R* by Grant Farnsworth
  http://cran.r-project.org/doc/contrib/Farnsworth-EconometricsInR.pdf
- *Resources to help you learn R* by UCLA Academic Technology Services
  http://www.ats.ucla.edu/stat/R/ A wealth of information about R, conveniently arranged in one place. The R Starter Kit is particularly helpful.
- *R in a Nutshell* by Joseph Adler
  http://proquestcombo.safaribooksonline.com/book/programming/r/9781449377502
  Electronic version of the book of the same name published by O'Reilly (Accessible on the UPenn Network). Provides a comprehensive reference guide to R.
- R-bloggers http://www.r-bloggers.com A blog aggregator for R news and tutorials, with lots of applications.