Economics 7300, Fall 2024
Econometrics I - Fundamentals

University of Pennsylvania

Instructors

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Teaching Assistants

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Scheduled Class Time and Organization

For the first part of the course, taught by Karun Adusumilli, the class will meet twice a week on Tuesdays and Thursdays from 12:00-13:30 for in-person lectures in PCPE 202. The teaching assistant will conduct a one-hour discussion and review session once a week. Details will be announced.

Course Description

This is the first econometrics course in the first-year Econ Ph.D. sequence at Penn. The course consists of two parts. The first part covers selected topics in probability, mathematical statistics, least squares estimation, and asymptotic theory. The second part covers endogeneity, generalized methods of moments (GMM), maximum likelihood estimation of linear and nonlinear models, analysis of panel data models, as well as re-sampling techniques.

Prerequisites

Calculus, Linear Algebra, Probability, and Statistics

Courseware

Course documents and information are available via Canvas: `https://canvas.upenn.edu`

Ed Discussion

We will be using an online discussion forum called Ed Discussion, accessible via Canvas, for all written communication in this course. We will use Ed Discussion to make course announcements, answer questions about course material, and respond to private messages from individual students regarding personal issues.

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.

Course Requirements

- **Problem Sets:** There will be 10 problem sets, i.e., 5 each for each part of the course. For the first part of the course, we will drop the lowest scoring problem set (the details for the second part will be announced in due course). The problem sets are designed to give the students the opportunity to review and enhance the material learned in class. The problem sets are uploaded on a Thursday and will be due the following week. You should upload these problem sets as PDF files on Canvas before the due dates. [50%]

- **Midterm Exam I:** Tuesday, Oct 15 [25%] This will be an in-person exam, held during the lecture hours. Details to be announced. It will comprise all material from the first half of the course.

- **Midterm Exam II:** TBA. [25%]

Course Texts

- Casella, George, and Roger Berger (2001): *Statistical Inference*, Duxbury Press, ISBN: 9780534243128 (highly recommended)

- Christopher M. Bishop (2006) *Pattern recognition and machine learning*, Free access at: `https://www.microsoft.com/en-us/research/uploads/prod/2006/01/Bishop-Pattern-Recognition-and-Machine-Learning-2006.pdf` (highly recommended)

- Hayashi, Fumio (2000): *Econometrics*, Princeton University Press, ISBN 0-691-01018-8, HB139.H39 2000. (highly recommended)

- Whitney Newey and Daniel McFadden (1994): *Large Sample Estimation and Hypothesis Testing,* Handbook of Econometrics, volume IV (reference)

Econometrics Software

The problem sets will involve computer-based exercises in which the econometric techniques introduced in the lectures will be applied. The recommended software for this course is R. It is available free of charge at: `http://www.r-project.org/`.

Course Outline

Part I

- Probability

  - Definition and basic properties
  - Random Variables, Distribution and Density Functions, Transformations, Expectations
  - Common Families of Distributions
  - Information Theory
  - Multiple Random Variables

- Statistical Inference

  - Point Estimation
  - Hypothesis Testing
  - P-values and Coverage Sets

- Linear Regression

  - Least Squares and Projections
  - Frequentist properties of OLS
  - Penalized regressions: Ridge, LASSO, and Best subset regression

- Asymptotics

  - Modes of Convergence
  - Large Sample Analysis of Linear Regression Model

Part II

TBA

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 OReilly (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.