University of Pennsylvania **ECON7300, Fall 2023**

Econometrics I: Fundamentals

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Lectures: Part I (Wayne Gao), Aug 29 - Oct 17

Tue & Thu, 3:30-5:00pm, PCPCE 203

Part II (Xu Cheng), Oct 19 - Dec 7

Tue & Thu, 8:30-10:00am, PCPSE 203

Recitations: TBA

Course Description: This is the first econometrics course in the first-year Econ Ph.D. sequence at Penn. The course consists of two parts. Part I covers selected topics in probability, mathematical statistics, least squares estimation and asymptotic theory. Part II 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

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

Course Requirements:

- **Problem Sets**: There will be 8 problem sets for the whole semester, i.e., 4 for each part of the course. The problem sets will be posted roughly every other Thursday, and will be due on the Thursdays in the following weeks. You should upload your problem set answers as PDF files on Canvas before the due dates. [20%]
- **Exam for Part I**: Tuesday, October 17, in class. [40%]
- **Exam for Part II**: TBA. [40%]

Course Texts for Part I:

Hansen, Bruce E. (2022): "*Probability and Statistics for Economists,"* Princeton University Press, ISBN 9780691235943.

Hansen, Bruce E. (2022): "*Econometrics,"* Princeton University Press, ISBN 9780691235899.

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

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

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

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
- Multiple Random Variables

Treatment Effects and its Identification

- Potential Outcome Framework
- ATE, ATET and CATE
- Propensity Score and Inverse Probability Weighting

Statistical Inference

- Point Estimation
- Hypothesis Testing
- Coverage Sets
- Statistical Decision Theory

Linear Regression

- Least Squares and Linear Projections
- Small Sample Inference for Linear Regressions
- Modes of Convergence
- Asymptotic Analysis of Linear Regressions
- Asymptotics: Likelihood Function, Wald, LR, and LM Tests
- Regressor selection

Course Outline: 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/
  90 nergetic, 2-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
  Online version of the same book 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.