Econometrics I - Fundamentals

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Scheduled Class Time and Organization: For first part of the course, taught by Karun Adusumilli, the class will meet twice a week *Tuesdays and Thursdays from 13:45-15:15* for in person lectures. 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*

Piazza: We will be using an online discussion forum called Piazza, accessible via Canvas, for all written communication in this course. We will use Piazza to make course announcements, answer questions about course material and respond to private messages from individual students regarding personal issues. We will endeavor to respond within 24hrs of your asking the question on Piazza (except on weekends). 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. You can even post anonymously if you like. The instructors and TA will actively moderate Piazza both to answer questions and approve (or correct) answers written by your fellow-students. All written communication for Econ 7300 should be directed to Piazza, not to the instructors personal email accounts.

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 8 problem sets, i.e., 4 each for each part of the course. The problem sets are designed to give you 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. [20%]

- **Midterm Exam**: Tuesday, Oct 18 [40%] This will be a take home exam. Details to be announced. It will comprise of all material from the first half of the course.

- **Final Exam**: TBA. [40%]

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)

Berger, James O. (1985): *"Statistical decision theory and Bayesian analysis"*, Springer, ISBN 978-0387960982. (recommended)

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

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/*.

Econometrics I – Course Outline

Part I

<u>Probability</u>

- Definition and basic properties

- Random Variables, Distribution and Density Functions, Transformations, Expectations

- Common Families of Distributions

- Information Theory

- Multiple Random Variables

<u>Statistical Inference</u>

- Point Estimation and Decision theory

- Hypothesis Testing

- P-values and Coverage Sets

<u>Linear Regression</u>

- Least Squares and Projections

- Frequentist properties of OLS

- Penalized regressions: Ridge, LASSO and Best subset regression

<u>Asymptotics</u>

- 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 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.