ECON 7309 Econometrics II

Dr. Dong Li — Section 001
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TuTh 10:00-11:15 (GR 3.402A) — Office Hours: TuTh 11:15–12:00pm or by appointment
Course Web: `http://www.utdallas.edu/elearning/` — Teaching Assistant: TBA

Prerequisites

Students must have taken ECON6309 (Econometrics I). You are expected to know statistics, probability, calculus, and linear algebra reasonably well. In other words, you should feel comfortable reading Appendix A (Matrix Algebra), Appendix B (Probability and Distribution Theory), Appendix C (Estimation and Inference), and Appendix D (Large-Sample Distribution Theory) in Greene (2012). (It is understandable if you do not remember all the technical details.)

Course Description

This is the second core course in the econometrics sequence of the economics PhD program. The course extends the topics covered in the first course and covers topics such as maximum likelihood, bootstrapping, seemingly unrelated regressions, simultaneous equation models, GMM, limited dependent variables, and panel data. Emphasis is placed on both theory and empirical applications. I expect enthusiasm and curiosity from you.

Student Learning Objectives/Outcomes

After taking the course, students are expected to be able to: (1) conduct literature review to follow and understand the recent advances in econometrics; (2) understand the necessary econometric software/tools to analyze economic data/models; (3) implement various econometric analyses and interpret the results; (4) communicate the results to peers, professionals, and undergraduate students.

Main Textbook

(G2012) *Econometric Analysis* (7th ed), Greene, Prentice-Hall, 2012.

Recommended Textbooks

(AP2008) *Mostly Harmless Econometrics: An Empiricist's Companion*, Angrist and Pischke, Princeton University Press, 2008.

(AP2015) *Mastering 'Metrics: The Path from Cause to Effect*, Angrist and Pischke, Princeton University Press, 2015.

(B2011) *Econometrics* (5th Ed), Baltagi, Springer, 2011.

(B2013) *Econometric Analysis of Panel Data* (5th Ed), Baltagi, Wiley, 2013.

(B2006) *An Introduction to Modern Econometrics Using Stata*, Baum, Stata Press, 2006.

(CT2005) *Microeconometrics: Methods and Applications*, Cameron and Trivedi, Cambridge, 2005.

(CT2009) *Microeconometrics Using Stata*, Cameron and Trivedi, Stata Press, 2009.

(GHJ1993) *Learning and Practicing Econometrics*, Griffiths, Hill and Judge, Wiley, 1993.

(JD1997) *Econometric Methods* (4th Ed), Johnston and DiNardo, McGraw-Hill, 1997.

(ML2009) *Introduction to Econometrics* (4th Ed), Maddala & Lahiri, Wiley, 2009.

(W2010) *Econometric Analysis of Cross Section and Panel Data* (2nd Ed), Wooldridge, MIT, 2010.

(W2013) *Introductory Econometrics* (5th Ed), Wooldridge, South-Western, 2013.

Topics and Academic Calendar

Week 1-2	Introduction/Projections/FWL
Week 3-4	Maximum Likelihood Estimation and Maximum Simulated Likelihood
Week 5	Asymptotic Theory/Delta Method/Bootstrapping
Week 6	Asymptotic Properties of OLS and IV
Week 7	SUR
Week 8	Midterm
Week 9	GMM
Week 10	Simultaneous Equations
Week 11	Limited Dependent Variables
Week 12	Panel Data
Week 13	Treatment Effects
Week 14	Thanksgiving Holiday
Week 15	Difference-in-Differences
Week 16	ARMA, Unit Roots, Cointegration, and (G)ARCH
Finals Week	Final Exam

This is a very ambitious plan and I do not expect us to cover all the topics.

Exams and Homework

There will be two exams: a midterm and a final. The dates of the exam will be announced when they are available. Notes/books/conversation/cellular phones are prohibited during the exams unless otherwise instructed. However, a one-page "cheat-sheet" attached at the end of this syllabus will be provided in the two exams. There is no make-up exam for the midterm. If you miss the midterm with an excuse that is consistent with university policies, your final exam score will be used for the midterm. If you miss the final exam with an excuse that is consistent with university policies, you will be given a make-up exam at the discretion of the instructor.

There will be homework assignments, including both theoretical and empirical questions, throughout the semester. The due date of each assignment will be announced in class. *No late assignment will be accepted.* Students are encouraged to use Stata software. However, students can choose other statistical software.

Guidelines for Homework Assignments:

1. The assignments must be well written (or typed) and complete. Any assignment not legible (to be determined by the instructor) or incomplete will receive partial or no credit for that assignment. In your homework you should **answer the questions**. You should not give me pages after pages of software output.

2. Students are encouraged to discuss with each other and work in groups. At most three students' names can appear on one copy of homework. All students in the same group will receive the same grade regardless of the order of the authorship.

Project

Students will choose a published paper to replicate and present the paper/replication. At most three students can work jointly on one project. The paper must be related to the course. For example, an economic growth paper using limited dependent variables is fine, but a clever proof of the second welfare theorem is not. More details about the project will be announced in class.

Grading

Grades will be based on the assignments (20%), the project/presentation (10%), and the two exams (30% and 40%, respectively).

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.

Please visit `http://go.utdallas.edu/syllabus-policies` for these policies.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the instructor.

Formula Sheet for ECON7309

This formula sheet will be provided in your midterm and final exams.

- Matrix Calculus:

$$\begin{aligned}\partial \boldsymbol{a}'\boldsymbol{x}/\partial \boldsymbol{x} &= \boldsymbol{a}. \\ \frac{\partial \boldsymbol{x}'\boldsymbol{B}\boldsymbol{x}}{\partial \boldsymbol{x}} &= \boldsymbol{B}\boldsymbol{x} + \boldsymbol{B}'\boldsymbol{x} \\ &= 2\boldsymbol{B}\boldsymbol{x} \text{ if } \boldsymbol{B} \text{ is symmetric.}\end{aligned}$$

- Convergence in Probability (Definition): Let $x_1, x_2, \ldots, x_n$ be a sequence of random variables indexed by the sample size. The random variable x_n converges in probability to a constant c if $\lim_{n\to\infty} \text{Prob}(|x_n - c| > \varepsilon) = 0$ for any $\varepsilon > 0$. We use the notation plim $x_n = c$.
- Convergence in Mean Square (Theorem): If x_n has mean μ_n and variance σ_n^2 and the ordinary limits of μ_n and σ_n^2 are c and 0, respectively, then x_n converges in mean square to c, and plim $x_n = c$.
- Convergence in Distribution (Definition): x_n converges in distribution to a random variable x with cdf $F(x)$ if $\lim_{n\to\infty} |F_n(x_n) - F(x)| = 0$ at all continuity points of $F(x)$.
- Weak Law of Large Numbers (LLN): The mean of a random sample from any population with finite mean μ and finite variance σ^2 is a consistent estimator of μ.
- Slutsky Theorem: For a continuous function $g(\cdot)$ that is not a function of n, plim $g(x_n) = g(\text{plim } x_n)$.
- Lindberg–Levy Central Limit Theorem (Univariate): If $x_1, \ldots, x_n$ are a random sample from a probability distribution with finite mean μ and finite variance σ^2 and $\bar{x}_n = \frac{1}{n}\sum_{i=1}^n x_i$, then $\sqrt{n}(\bar{x}_n - \mu) \xrightarrow{d} N(0, \sigma^2)$.
- Lindberg–Feller Central Limit Theorem (Univariate with Unequal Variances): Suppose that $\{x_i\}$, $i = 1, \ldots, n$, is a sequence of independent random variables with finite means μ_i and finite positive variances σ_i^2. Let $\bar{\mu}_n = \frac{1}{n}\sum_{i=1}^n \mu_i$ and $\bar{\sigma}_n^2 = \frac{1}{n}\sum_{i=1}^n \sigma_i^2$. If no single variance dominates the average variance, $\lim_{n\to\infty} \frac{max(\sigma_i^2)}{n\bar{\sigma}_n^2} = 0$, and if the average variance converges to a finite constant, $\bar{\sigma}^2 = \lim_{n\to\infty} \bar{\sigma}_n^2$, then $\sqrt{n}(\bar{x}_n - \bar{\mu}_n) \xrightarrow{d} N(0, \bar{\sigma}^2)$.
- Multivariate Lindberg–Levy Central Limit Theorem: If $\boldsymbol{x}_1, \ldots, \boldsymbol{x}_n$ are a random sample from a multivariate distribution with finite mean vector $\boldsymbol{\mu}$ and finite positive definite covariance matrix $\boldsymbol{Q}$, then $\sqrt{n}(\bar{\boldsymbol{x}}_n - \boldsymbol{\mu}) \xrightarrow{d} N(\boldsymbol{0}, \boldsymbol{Q})$.
- The univariate delta method: If $\sqrt{n}(z_n - \mu) \xrightarrow{d} N(0, \sigma^2)$ and if $g(z_n)$ is a continuous function not involving n, then $\sqrt{n}(g(z_n) - g(\mu)) \xrightarrow{d} N(0, (g'(\mu))^2\sigma^2)$ where $g'(\mu)$ is the gradient.
- The multivariate delta method: If $\boldsymbol{z}_n$ is a $K \times 1$ sequence of vector-valued random variables such that $\sqrt{n}(\boldsymbol{z}_n - \boldsymbol{\mu}) \xrightarrow{d} N(\boldsymbol{0}, \boldsymbol{\Sigma})$ and if $\boldsymbol{c}(\boldsymbol{z}_n)$ is a set of J continuous functions of $\boldsymbol{z}_n$ not involving n, then $\sqrt{n}(\boldsymbol{c}(\boldsymbol{z}_n) - \boldsymbol{c}(\boldsymbol{\mu})) \xrightarrow{d} N(\boldsymbol{0}, \boldsymbol{C}(\boldsymbol{\mu})\boldsymbol{\Sigma}\boldsymbol{C}(\boldsymbol{\mu})')$ where $\boldsymbol{C}(\boldsymbol{\mu})$ is the $J \times K$ matrix $\partial \boldsymbol{c}(\boldsymbol{\mu})/\partial \boldsymbol{\mu}'$. The jth row of $\boldsymbol{C}(\boldsymbol{\mu})$ is the vector of partial derivatives of the jth function with respect to $\boldsymbol{\mu}'$.
- Some properties of the Kronecker product (all notations are matrices):

$$\begin{aligned}A \otimes B \otimes C &= (A \otimes B) \otimes C = A \otimes (B \otimes C) \\ (A+B) \otimes (C+D) &= A \otimes C + A \otimes D + B \otimes C + B \otimes D \text{ if } A+B \text{ and } C+D \text{ exist} \\ (A \otimes B)(C \otimes D) &= AC \otimes BD \text{ if } AC \text{ and } BD \text{ exist} \\ (A \otimes B)' &= A' \otimes B' \\ (A \otimes B)^{-1} &= A^{-1} \otimes B^{-1} \text{ if } A \text{ and } B \text{ are non-singular.}\end{aligned}$$