Econometric Theory and Methods II (90-907)
FALL 2016

Instructor
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Lectures:
Tuesday and Thursday, 10:30 – 11:50am, HBH 1208
Review sessions:
Friday, 3:00 – 4:20pm, HBH 1208

Grading:
40% homework (approximately every two weeks)
20% midterm exam (in class, late October)
40% final exam

Prerequisites:
Statistical Theory for Social and Policy Research (90-905) and
Introduction to Econometric Theory (90-906), or equivalent PhD-level
econometrics with extensive coverage of linear regressions and sufficient
treatment of asymptotic theory. It is assumed that students are familiar
with basic linear algebra, multivariate calculus, probability theory, and
statistical convergence concepts.

Textbooks/Website
Wooldridge, Econometric Analysis of Cross Section and Panel Data, 1st or 2nd edition. (required)
Cameron and Trivedi, Microeconometrics: Methods and Applications, 2005. (recommended)

Course website is on Blackboard. Readings and assignments will be posted there.

Computer Software

Many homework assignments will involve data analysis that requires specialized statistical
software. You are free to use any software that you like. We will provide instruction and
support for Stata, which is available on the Heinz PhD server and via the virtual lab. Some
assignments will require a symbolic programming language (i.e., not pre-packaged estimation
commands), and for this we will provide instruction and support for R. Some class examples
may be given in Matlab.
**Course Description**

This course covers a number of econometric models and techniques that are commonly used in applied microeconomics. The core topics are discrete outcome models, sample selection (and related limited dependent variable or switching models), panel data, including dynamic panel models, and duration models, an overview of methods to estimate treatment effects, a section on variance estimation, and non-parametric techniques. The course is designed for PhD students who have completed their first-year econometrics sequence.

**Course Objectives**

1. Understand the fundamental properties of M-estimators, both formally and intuitively.
2. Formulate appropriate econometric models for specific applications within the classes of data covered by the course, addressing issues of endogeneity and error correlation.
3. Derive properties of the estimators based on the above models.
4. Apply these estimators to data provided as part of course assignments.

**Course Policies**

Please turn in homework at the beginning of class when it is due; late assignments are not accepted. Students may work on the assignments in groups—in fact this is recommended—but each student must write their own submission and these cannot be direct copies of each other’s work or be copied from any other source (e.g., something online). Exams are closed book. Any suspected incidents of cheating or plagiarism will be recorded with Heinz College administration at the same time the student is notified.

**COURSE OUTLINE**

1. Frameworks for Estimators (4 lectures)
   1. General theory for M-estimators
   2. Maximum Likelihood Estimation
   3. Generalized Method of Moments
   4. Numerical optimization methods
   5. Hypothesis testing
      1. (Non-linear) testing for parameters
      2. Specification Tests

2. Discrete Outcome Models (4)
   1. Binary Logit, probit, and linear probability models
   2. Specification issues: heteroskedasticity and distributional assumptions
   3. Endogenous explanatory variables (if time)
   4. Multinomial logit, nested logit, multinomial probit
   5. Ordered logit and probit (if time)
3. Selection Models (4)
   1. Censored and truncated dependent variables
   2. ML estimation of the above
   3. Motivation for selection – agent choices affect observations
   4. Selection model variants
   5. ML and two-step estimation
   6. Specification issues

4. Duration Models (1)
   1. Typical duration outcomes and data
   2. Hazard functions
   3. ML estimation with continuous or discrete time
   4. Unobserved heterogeneity and other specification issues

MIDTERM

5. Survey Weights and Variance Estimation (3)
   1. Weighted estimation: theory and practice
   2. Heteroskedasticity- and cluster-robust standard errors
   3. Bootstrapped standard errors

6. Panel Data Models (3)
   1. Linear panel model framework and permanent unobserved heterogeneity
   2. Estimation with heterogeneity: random effects, fixed effects, and first differencing
   3. Dynamic linear panel models: predetermined and endogenous explanatory variables
   4. Binary outcome panel models, MLE

7. Estimation of Treatment Effects (6)
   1. The counterfactual framework
   2. Randomized experiments
      1. Power calculations (if time)
   3. Instrumental variables and regression discontinuity
      1. Local average treatment effects
   4. Difference-in-Differences, triple difference
   5. Regression discontinuity
   6. Matching Methods
      1. Propensity Score Matching, Doubly Robust
      2. Synthetic Control Group
   7. Comparison of “causal effects” and “structural” frameworks

8. Non-parametric and Semi-parametric Estimation Methods (2)
   1. Density Estimation
   2. Kernel Regression
   3. Robinson's Semi-parametric Estimator
   4. Non-parametric Hypothesis Tests