14.385 Nonlinear Econometric Analysis

Class Meetings:
Lectures: Mon/Wed 1:00-2:30pm at E51-057
Recitations: Fri 1:00-2:30pm at E51-361

Instructors:
First half:
Isaiah Andrews, E52-404
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Office hours: Wed 2:30-4pm

Second half:
Alberto Abadie, E52-546
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Office hours: Wed 2:30-4:00pm

Teaching Assistant:
Yaroslav Mukhin
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Office Hours: Friday 2.30-3.30 in E52-468 or by appointment

Course Outline:
This course covers nonlinear econometric methods for cross-sectional data, including large sample theory for estimation and hypothesis testing, generalized method of moments, weak and partial identification, discrete choice models, nonparametric and semiparametric estimation, and treatment effects estimators. Methods illustrated with economic applications. Enrollment limited.

Course Information:
Lectures will be on Mondays and Wednesdays, starting on Wednesday, September 7, and ending on Wednesday, December 14. There will be weekly sections on Fridays. There will be no classes on Monday, October 10 (Columbus day holiday) and no recitation on Friday, September 23rd (student holiday). Grading will be based on problem sets. These will involve both theoretical calculations and computer exercises in which you will be asked to analyze data sets. You can use any computer package you wish. Solutions will be handed out written in Matlab. Problem sets will be due at the beginning of class, and in order to allow us to post the solutions quickly on the course’s web page we will not accept late
problem sets. Students are allowed to collaborate in small groups (of no more than four students) for the assignments. Students in a group are allowed to share jointly written computer code and to work together to solve the assignments. However, each student must write up her or his answers completely independently. At the beginning of the code please write down the names of all the people who helped create it.

Prerequisites:

14.382 (or equivalent with the permission of the instructor).

Readings:
The course material is self contained and there is no required textbook for the course. Handouts covering most of the material will be distributed in class or through the website. Some students might find it useful to have a textbook as an additional reference. Good reference books are:


This syllabus also includes a list of additional readings that are not essential for following the lectures, but useful for a deeper understanding of the material. Many of these are available electronically.

Code of Conduct:

All course activities, including class meetings and homework assignments are subject to MIT’s academic integrity policies as detailed at https://integrity.mit.edu/. Please be on time and make sure that your cell phone is turned off during class time.

Accommodations for Students with Disabilities:
The Department of Economics values an inclusive environment. If you need a disability accommodation to access this course, please communicate with us early in the semester. If you have your accommodation letter, please meet with the faculty so that we can understand your needs and implement your approved accommodations. If you have not yet been approved for accommodations, please contact Student Disability Services at uaap-sds@mit.edu to learn about their procedures. We encourage you to do so early in the term to allow sufficient time for implementation of services/accommodations that you may need.

Laptop Policy:

Laptops may be used in class.
Contents of the first half of the course:

1. Large Sample Theory
   1.1 Extremum Estimation: Maximum Likelihood, Generalized Methods of Moments, Nonlinear Least Squares, Classical Minimum Distance.
   1.2 Large Sample Properties of Extremum Estimators. Two-Step Estimators.
   1.3 Examples and Applications. Computation.
   1.4 Simulation-Based Estimators: Method of Simulated Moments, Maximum Simulated Likelihood
   1.5 Efficiency, Testing

2. Bayesian and Quasi-Bayesian Methods
   2.1 Motivation and Asymptotic Properties
   2.2 Computation, MCMC

3. Non-Uniformity and Robust Inference
   3.1 Pretesting and Model Selection
   3.2 Weak Identification

4. Partial Identification
   4.1 Moment Inequalities
   4.2 Inference

Contents of the second half of the course:

5. Discrete Choice Models
   5.1 Binary Choice Models
   5.2 Multinomial Choice Models

6. Nonparametric and Semiparametric Methods
   6.1 Nonparametric Density Estimation
   6.2 Nonparametric Regression
   6.3 Semiparametric Two-Step Estimators

7. Estimation of Treatment Effects
   7.1 Causality, Counterfactuals, and Potential Outcomes.
   7.2 Randomized Experiments. Fisher's Exact Test.
7.3 Introduction to Observational Studies.
7.4 Matching and Selection on Observables. Directed Acyclic Graphs.
7.5 Robustness, Sensitivity, Falsification.
7.6 Differences-in-Differences. Synthetic Controls.
7.7 Instrumental Variable. Local Average Treatment Effects.
7.8 Distributional Treatment Effects
7.9 The Regression Discontinuity Design
List of Readings:

*Introductory readings are listed first and preceded by a star (*). Other readings are included for your reference.*

1 Large Sample Theory

1.1 Extremum Estimation

* Cameron and Trivedi: Chapters 5, 6 and 10.


Wooldridge: Chapters 13 and 14.

1.2 Simulation-Based Estimators


1.3 Efficiency, Testing


2 Bayesian and Quasi-Bayesian Methods


3 Non-Uniformity and Robust Inference

3.1 Pretesting and Model Selection

3.2 Weak Instruments


4 Partial Identification


5 Discrete Choice Models

5.1 Binary Choice Models

5.2 Multinomial Choice Models
* Cameron and Trivedi: Chapters 14 and 15.
Wooldridge: Chapters 15 and 16.


6 Nonparametric and Semiparametric Methods

6.1 Nonparametric Density Estimation

6.2 Nonparametric Regression

6.3 Semiparametric Two-Step Estimators

* Cameron and Trivedi: Chapter 9.


7 Estimation of Treatment Effects

The following two readings are overviews of the material that we will cover in this section.


7.1 Causality, Counterfactuals, and Potential Outcomes.


7.2 Randomized Experiments. Fisher’s Exact Test.


Imbens and Rubin: Chapter 5.


7.3 Introduction to Observational Studies


7.4 Matching and Selection on Observables. Directed Acyclic Graphs.


Imbens and Rubin: Chapters 12-18.


7.5 Robustness, Sensitivity, Falsification


Imbens and Rubin: Chapter 22.

7.6 Differences-in-Differences. Synthetic Controls.


7.7 Instrumental Variable. Local Average Treatment Effects.


Imbens and Rubin: Chapters 23 and 24.


7.8 Distributional Treatment Effects


7.9 The Regression Discontinuity Design

