

# Foundations of Econometrics

Fall Term - 6 ECTS

Mandatory Course

Prof. Laura Mayoral

Prof. Ursula Mello

## Prerequisites to Enrol

Not applicable.

## Overview and Objectives

This course is an introduction to empirical research. More specifically, it will focus on estimating causal relationships from observational data. The course will cover econometric theory, problem solving, STATA practice, article reading and student presentations (or group projects? ). We will start by observing that most empirical questions can be framed as "what is the (causal) impact of X on Y?". In most situations, a correlation between X and Y is not indicative of a causal relationship between X and Y. This central question of econometrics, the question of causality, is our approach to the standard tools of linear least squares, instrumental variable estimation, panel data analysis, matching, and regression discontinuity.

## Prerequisite reading / requirements

Mastering basic notions of probability, statistics and linear algebra will be useful. More specifically, we'll routinely employ concepts such as:

- Probability and statistics: random variables; density and cumulative distributions; moments of random variables (expectation, variance, conditional moments, correlation); Asymptotic theory: convergence of random variables, law of large numbers and central limits theorem. See Appendices B, C and D, Greene.
- Basic notions of matrix algebra: sum, multiplication, inversion of matrices; rank of a matrix. See Appendix A, Greene.

## Course Outline

### Part I. (Laura Mayoral)

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1. Introduction: The identification problem, randomized experiments as the golden benchmark. Quick review of probability and statistics (please review Greene, Appendices A, B, C and D). Conditional expectations. Asymptotic theory.
2. Linear Regression: Ordinary Least Squares, Best Linear Unbiased Estimator, asymptotic properties; Inference: confidence intervals; Tests: F-tests; The Frisch-Waugh-Lovell theorem.
3. Identification Issues in Linear Regressions. Omitted variable bias, Measurement error bias, Functional form misspecification.
4. Inference Issues in Linear Regressions Heteroscedasticity, Clustering, Autocorrelation, spatial correlation.
5. Instrumental variable estimation: IV estimator, exclusion restriction, consistency of the IV estimator, bias of the IV estimator, Hausman test. Weak Instruments. Weakly endogeneous instruments.

## Part II. Econometric Tools for Policy Evaluation (Ursula Mello)

- I. Potential Outcomes and Causality
  - A. Potential Outcomes, Selection Bias, and Treatment Effects
  - B. Identification of Treatment Effects under Different Assumptions
- II. Randomized Control Trials and Natural Experiments
  - A. Random Assignment and Treatment Effects
  - B. Introduction of Additional Regressors
  - C. Partial or Imperfect Compliance and Intention-to-Treat Analysis
  - D. Longer Run Interaction of Treatment and Intermediate Outcomes
- III. Matching
  - A. Selection Based on Observables and (Exact) Matching
  - B. The Common Support Condition
  - C. Propensity Score Matching
  - D. Estimation Methods
- IV. Instrumental Variables
  - A. Identification of Causal Effects in IV Settings
  - B. Homogeneous Treatment Effects
  - C. Heterogeneous Treatment Effects
  - D. Imperfect Compliance and IV
  - E. Local Average Treatment Effects (LATE)
  - F. Conditional Estimation with Instrumental Variables
- VI. Fixed Effects, Difference-in-Differences and Panel Data
  - A. Individual Fixed Effects

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- B. Differences-in-differences
- C. Triple Differences Model
- D. Fixed Effects versus Lagged Dependent Variables
- E. Picking controls: Synthetic Control Methods
- F. Recent advances in DiD and FE estimation
- V. Regression Discontinuity
  - A. The fundamental RD assumption
  - B. Homogeneous Treatment Effects
  - C. Heterogeneous Treatment Effects Sharp design Fuzzy design
  - D. Estimation Strategies
  - E. Conditioning on Covariates
- VI. Distributional Effects and Quantile Treatment Effects

### Required Activities and Evaluation

- Homeworks 20%
- Paper presentation 10%
- Group project 20%
- Exam 50%

### Competences

To be announced

### Learning Outcomes

To be announced

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## Materials

### Recommended Books:

- Wooldridge, *Econometrics of Cross Section and Panel Data*, MIT PRESS
- Colin Cameron, Pravin K. Trivedi (2009) *Microeconometrics Using Stata*, Stata Press. Good manual to learn how to apply STATA in econometrics applications.
- Angrist and S. Pischke (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press.

Other useful books:

- Greene (2012). *Econometrics*, Prentice Hall.
- Stock and Watson, *Introduction to Econometrics*.

### Recommended Articles:

Some interesting examples of how methods are applied to answer interesting questions:

- Randomized Control Trials and Natural Experiments
  - Chetty, R; Hendren, N and Katz, L. The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment. *American Economic Review* 106(4): 855-902, 2016
  - Bursztyn, L; González, A and Yanagizawa-Drott, D. Misperceived Social Norms: Women Working Outside the Home in Saudi Arabia. *American Economic Review*, Forthcoming
- Instrumental Variables
  - Acemoglu, Daron; Johnson, S. and Robinson, J. The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth. *American Economic Review*, vol 95, n.3, 2005.
  - The Vietnam Draft Lottery: The effect of military service during the Vietnam War on civilian wages (Angrist, 1990).
- Fixed Effects, Difference-in-Differences and Panel Data
  - Card, David and Alan Krueger. "Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania." *American Economic Review* 84, September 1994.

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- Miller, Grant (2008). Women's Suffrage, Political Responsiveness, and Child Survival in American History, *Quarterly Journal of Economics*, 123(3), 1287-1327.
- Regression Discontinuity
  - Dell, M. "The Persistent Effects of Peru's Mining Mita." *Econometrica* 78, no. 6 (2010): 1863-1903.
  - Fujiwara, Thomas (2015) Voting Technology, Political Responsiveness, and Infant Health: Evidence from Brazil, *Econometrica*.
- Synthetic Controls
  - Abadie, A. Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects. *Journal of Economic Literature*, forthcoming.