

Econometrics I

Lecture 0: Introduction

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Grad IO

Econometrics Overview

Course Description

The aim of the course is to teach you to use popular applied econometric methods while developing your theoretical understanding of those methods. Topics include least squares, asymptotic theory, hypothesis testing, instrumental variables, difference-in-differences, regression discontinuity, treatment effects, panel data, maximum likelihood, and discrete choice models.

Prerequisites for Studying Econometrics

Ideally, you should have experience with

- ▶ Calculus
- ▶ Basic Probability and Statistics
- ▶ Linear Algebra
- ▶ Data analysis software such as R, Python/Numpy, Matlab, Julia, Stata, or similar (Excel doesn't count)

Assignments and Grading

- ▶ 4 Problem sets: 10% each
 - ▶ You may use any software you like. When giving examples, I will use R.
 - ▶ To compose, consider using software like LaTeX, R Markdown, and Jupyter.
- ▶ Two in-class quizzes: 10% each
- ▶ Group project: 40%
 - ▶ A research project on any topic (subject to my approval) using econometric analysis.
 - ▶ I suggest choosing a published paper to replicate and finding a way to extend, test, or improve on it. Ideally, choose something on a topic that interests you. I will also share a list of suggestions.
 - ▶ 1-3 students per group
 - ▶ Proposal due in middle of semester.
 - ▶ Presentations in final class session
 - ▶ Paper due at end of semester

What is Econometrics?

- ▶ **Experiments and Research Design:**

- ▶ In natural sciences, randomized controlled trials are considered the gold standard.
- ▶ In the social sciences, it's often hard to run experiments: macroeconomic policy, mergers and antitrust policy.
- ▶ This is perhaps the main reason we have econometrics: in the absence of controlled experiments, we need to figure out how to learn what we want to learn from naturally occurring data.

What is Econometrics?

- ▶ **Econometric Questions:**

- ▶ Often about *causality*
 - ▶ About individuals: *What is the effect of education on wages?*
 - ▶ About markets (micro): *How does the price of the iPad affect the number of units that will be sold?*
 - ▶ About markets (macro): *How does raising the minimum wage affect employment?*
- ▶ Some studies are primarily descriptive
 - ▶ *How many home runs will Aaron Judge hit in 2025?*
 - ▶ *How has the distribution of real income in the US changed since 1990?*

What is Econometrics?

► Challenges:

- Endogeneity: general term for an observed variable's being correlated with things we can't observe. Related: omitted variables.
- Selection: economic agents (people, firms, etc.) are purposeful and know more than we do about their personal situations!
- Simultaneity: is the relationship between price and quantity increasing (supply) or decreasing (demand)? What is driving the changes? The world is complicated, and it's often too simplistic to say *"this is the effect of X on Y"*.
- External validity:
 - What will happen if we raise the minimum wage to levels not before seen?
 - Is the price variation in the data short-run or long-run? Do consumers/firms respond differently to the two types of variation?
 - Related: structural econometrics, theory building.