Econometrics I

Lecture 0: Introduction

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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.