Intermediate Econometrics
Introduction

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Overview of Topics

This course focuses on linear regression model and its applications in causal inference.

The fundamental theme is to estimate causal effects using linear regression model.

This course includes the following topics tentatively:

- ▶ Simple Linear Regression Model
- ▶ Multiple Linear Regression Model
- ▶ Inference
- ▶ Panel Data
- ▶ Randomized Experiments
- ▶ Instrumental Variables
- ▶ Difference-in-Differences
- ▶ Regression Discontinuity

Introduction

What is Economics?

What is Econometrics?

▶ The history and development of Econometrics

Introduction

What is Information?

What is Data?

- ▶ the structure of Economic Data
    - ▶ Cross-Sectional Data
    - ▶ Time Series Data
    - ▶ Pooled Cross Sections
    - ▶ Panel or Longitudinal Data

What is Big Data?

- "long" data vs "wide" data

- The rise of data and empirical evidence

Introduction

What is causality?

- statistical causality - experiment based
    - $X \to Y$
    - *Average treatment effect* $= E(y|x=1) - E(y|x=0)$
- economic causality - model based
    - $y = f(x_1, x_2, \epsilon)$
    - $\frac{dy}{dx_1} = \frac{\partial y}{\partial x_1} + \frac{\partial y}{\partial x_2} * \frac{\partial x_2}{\partial x_1} + \frac{\partial y}{\partial \epsilon} * \frac{\partial \epsilon}{\partial x_1}$

Introduction

What is RCT?

Why RCT often fails in economic research?

How to deal with it using observable data?

Introduction

What is regression?

- $y = f(x_1, x_2, \epsilon)$
- $y = f(x_1, x_2) + \epsilon$

linear functions

- $y = \alpha_0 + \alpha_1 * x_1 + \alpha_2 * x_2 + \epsilon$

non-linear functions- Taylor expansion:

- $y = f(x, z) = f(x_1, z_1) + f'_x(x_1, z_1) * (x - x_1) + f'_z(x_1, z_1) * (z - z_1) + o^1$

How to carry out an empirical research project?

A research agenda starts with at least four questions:

- ▶ What is your research question?
- ▶ Why is it important?
- ▶ What has been done in the literature?
- ▶ What's your contribution?

An empirical research design involves the following:

- ▶ What is your causal relationship of interest?
- ▶ What would the ideal experiment look like?
- ▶ What is your identification strategy?
- ▶ What is your mode of statistical inference?