

Microeconometrics (Causal Inference)

Week 1 - Introduction

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Introductions

- ▶ Let's start with a little introduction
- ▶ Name, year, program, research interests, etc.
 - ▶ Why are you taking this class?

Course Overview

- ▶ Microeconometrics in R
- ▶ Major themes:
 - ▶ Regression analysis review
 - ▶ Including maximum likelihood estimation
 - ▶ Inference and uncertainty (e.g. bootstrapping)
 - ▶ Causal inference
 - ▶ Machine learning
 - ▶ **Reproducible research**
 - ▶ You will be doing assignments in R Markdown

Course Overview

- ▶ Today will just be a short introduction
- ▶ For next class, please come with R and R Studio installed on your computer
 - ▶ You can find instructions on the syllabus
 - ▶ You **must** bring a laptop to class. If you cannot do this, please speak with me.
- ▶ Course website: <https://github.com/JoshMerfeld/applied-microeconometrics>
 - ▶ You can find slides, assignments, and other materials here

Course Overview

- ▶ This is a brand new class, so I will likely be making changes as we go
- ▶ Please check the course website regularly for updates

Detailed outline (tentative)

- ① Linear regression (week 2)
 - ▶ Inference (confidence intervals, hypothesis testing, bootstrapping, etc.)
- ② Maximum likelihood estimation (week 3)
 - ▶ Discrete choice (logit, probit, multinomial logit, etc.)
- ③ Introduction to causality (week 4)
 - ▶ Potential outcomes framework
 - ▶ Problems with simple regression
 - ▶ Why randomization works

Detailed outline (tentative)

- ④ Differences-in-differences (weeks 5 and 6)
 - ▶ Fixed effects, including two-way fixed effects
 - ▶ Event studies
 - ▶ Synthetic control
- ⑤ Instrumental variables (weeks 7 and 8)
 - ▶ Assumptions
 - ▶ IVs in RCTs (LATE)
 - ▶ Some examples
 - ▶ Weak instruments
 - ▶ Bartik (shift-share) instruments

Detailed outline (tentative)

- ⑥ Regression discontinuity (week 9)
 - ▶ Canonical regression discontinuity
 - ▶ Parametric vs. non-parametric
- ⑦ Machine learning in economics (week 10)
 - ▶ ML for prediction (lasso, ridge, elastic net)
 - ▶ Cross validation
 - ▶ Heterogeneous treatment effects
 - ▶ Brief introduction to other supervised ML (time dependent)

Grading

- ① Homework - coding tasks (55%)
 - ▶ The homeworks form the main grading component of the course
 - ▶ The goal is to get you comfortable with coding *and writing* in R
 - ▶ I will also ask you to interpret things to make sure you understand what you are doing statistically
 - ▶ I expect you to do your homeworks in R Markdown and turn in the code along with a pdf output¹
 - ▶ I expect you will have four or five homeworks throughout the semester
 - ▶ For those of you without a background in R, the first few weeks will take a bit of effort. It will get easier, I promise.

¹ Note: If you have a strong preference for using a different language (e.g. Python), please let me know and we can discuss it. However, you **must** be able to produce a pdf output with your code and results. Using Word is a no-go.

Grading

- ① Final exam (35%)
 - ▶ This will be a take-home exam with a mix of theory and coding.
- ② Participation (10%)
 - ▶ I expect everyone to participate in class. That means asking questions, answering questions, and participating in discussions.

Questions?

- ▶ Any questions about the course?

Next class

- ▶ For next class, please come with R and R Studio installed
 - ▶ Another code editor is also acceptable. I use VS Code – not R Studio – for example.

- ▶ Course website: <https://github.com/JoshMerfeld/applied-microeconometrics>