

Microeconometrics (Causal Inference)

Week 1 - Introduction

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

- ▶ 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

- ▶ 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

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

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

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

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)

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.

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

- ▶ The goal of TA sections is to help you with R and R Markdown
- ▶ For help with the actual material, please come to my office hours

Questions?

- ▶ Any questions about the course?

- ▶ 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>