

Description

The goal of this course is to familiarize students with a variety of techniques employed in empirical economic analysis, with a focus on causal inference (six weeks) and on methods adopted from the machine learning literature (six weeks). The best way to learn these techniques is to practice them, and a substantive part of this class will involve empirical exercises in R. We will discuss applications in finance, macroeconomics, labor economics, behavioral economics and other fields.

Topics

1. Conditional expectation function and linear regression review
2. Causal inference
 - a. Potential outcomes
 - b. Randomized Experiments
 - a. Power calculations
 - c. Quasi-experiments
 - a. Instrumental variables
 1. Weak instruments
 - b. Regression discontinuity
 1. Sharp/Fuzzy designs
 2. Local polynomial approximations
 - c. Difference in Differences
 - d. Matching
 1. Propensity score
 2. Nearest neighbors / Synthetic controls
3. Regularized Linear Regression
 - a. Prediction error
 - b. K-fold cross validation
 - c. Lasso, Ridge and elastic net regressions
 - d. Post-LASSO and applications to treatment effects and IV
4. Non-linear methods
 - a. Regression splines
 - a. Generalized additive models (GAM)
 - b. Multivariate adaptive regression splines (MARS)
 - b. Decision trees
 - c. Support vector machines
 - d. Ensemble methods
 - a. Random forests

- b. Boosted trees
 - e. Neural networks and deep learning
 - a. Applications and deep IV
- 5. Text as data
 - a. Sentiment analysis
 - b. Topic modeling

Literature

I will include references throughout lectures. Most of the materials are treated in one or more of the textbooks below (the first two relevant for the causal inference part, the latter two for the regression techniques part):

- **[MM]** Angrist and Pischke: Mastering Metrics
- **[MHE]** Angrist and Pischke: Mostly Harmless Econometrics (main reference for first part)
- **[ISL]** Hastie and Tibshirani: Introduction to Statistical Learning (available as pdf online)
- **[ESL]** Friedman, Hastie and Tibshirani: Elements of Statistical Learning (available as pdf online)