L32 Pol Sci 5024: Causal Inference

Prof. Christopher Lucas

Fall, 2020

Office Hours: M 1:00-3:00pm   Class Hours: M/W 4:00pm-5:50pm
Office: Seigle Hall 284   Class Room: Cupples II L001

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Course Description

This is an introduction to causal inference for Ph.D. students in the WUSTL Political Science Department. We theoretically define causal effects and subsequently introduce methods for their estimation, including experiments, matching, regression, panel designs, difference-in-differences, instrumental variables, regression discontinuities, bounds, and sensitivity analysis. This course requires L32 Pol Sci 5052: Mathematical Modeling in Political Science. It is open to qualified graduate students from other departments and undergraduates, subject to enrollment constraints.

Materials

- Angrist, Joshua D., and Jörn-Steffen Pischke. *Mostly harmless econometrics: An empiricist's companion*. Princeton university press, 2008.

- Hernán, Miguel A., and James M. Robins. "Causal inference: What If." Boca Raton: Chapman & Hall/CRC, 2018.

Assignments

Assignment Weights

- Problem Sets (60% total, 6% each)

- Participation (10%)

- Project (30%)

Problem Sets

No credit will be given for late assignments. There are no exceptions. Problem sets will be graded on a ($\checkmark -$, $\checkmark$, $\checkmark +$) scale. You are encouraged to discuss problem sets with each other. However, all code and words must be your own, and you are strongly encouraged to attempt all problem sets independently before working collaboratively. You must use R to complete these problem sets.

Reading

Required reading should be completed *before* the relevant unit.

Participation

Lecture and lab attendance is mandatory. Additionally, students are expected to participate actively when relevant, especially during research presentations.

Project

Write a 10-page paper applying methods introduced in this course to a research question of your choice. The paper should state the research question and describe the data, research design, and results. Literature review and extended motivation of the research question should be omitted or included in the appendix. You may coauthor with one student, but coauthored projects must be of higher quality than those done by a single author. You are strongly encouraged to work on a project that you intend to develop into a publishable paper. The project is composed of the following requirements.

- By 2/17: Submit a short description of the proposed project (less than a page). You are encouraged to meet with the instructor and TA in office hours to discuss the project prior to submitting a description.
- By 3/16: Submit a description of progress and preliminary results.
- By 4/13: Submit a first draft of the project. These will be read by the class prior to your presentation.
- 4/20: Present projects to class. Presentations are no more than 10 minutes and should be accompanied by 2-5 slides.
- By 4/24: Submit the final version of the project.

Preliminary Schedule

Potential Outcomes

Topics
- Causality with Potential Outcomes
- SUTVA
- Causal Graphs

Readings
- AP Chap. 1, 2.1
- HR Chap. 1 & 6

Randomized Control Trials

Topics
- Identification and Inference in RCTs
- Covariate Adjustment
- Threads to Validity
- Ethics

Readings

- AP Chap. 2.2 - 2.3
- HR Chap. 2.1-2.3

Inference

Topics

- Sample vs. Population
- Cluster Randomization
- Block Randomization
- Power Analysis
- Randomization Inference
- Bootstrap

Readings

- HR Chap. 4.1-4.4, 10

Observational Identification

Topics

- Identification Under Conditional Ignorability
- Back-Door Criterion
- Estimation by Suclassification

Readings

- HR Chap. 3, 7

Observational Estimation

Topics

- Matching
- Weighting
- Regression

Readings

- AP Chap. 3
- HR Chapt. 4.5 - 4.6, 15

Nonparametric Bounds and Sensitivity Analyses

Topics

- Nonparametric Bounds
- Sensitivity Analysis

Readings

- Imbens, Guildo W. "Sensitivity to exogeneity assumptions in program evaluation." American Economic Review 93, no. 2 (2003): 126-132.
- Rosenbaum, Paul R., and Donald B. Rubin. "Assessing sensitivity to an unobserved binary covariate in an observational study with binary outcome." Journal of the Royal Statistical Society: Series B (Methodological) 45, no. 2 (1983): 212-218.

Instrumental Variables

Topics

- Intention-to-Treat Effect
- Principal Stratification and Compliance Types
- Instrumental Variables Assumptions
- One-sided Noncompliance
- Violations of Instrumental Variables Assumptions
- Estimators for the LATE

Readings

- AP Chap. 4
- HR Chap. 16

Regression Discontinuity Designs

Topics

- Sharp RD
- Fuzzy RD

Readings

- AP Chap. 6

Difference-in-Differences

Topics

- Identification, Estimation and Inference
- Diagnostics and Extensions

Readings

- AP Chap. 5.2

Fixed Effects

Topics

- Panel Data as a Block Randomized Experiment
- Properties of the Fixed Effects Estimator

Readings

- AP Chap. 5.1, 5.3 - 5.4, 8.2