Syllabus
POLISCI 150C/355C
Causal Inference for Social Science
Spring 2024

Instructor: Jens Hainmueller
TA: Victoria Liu

Time & Location

Class: Monday and Wednesday, 10:30-11:50 am, Lathrop 180

Section: Fri 9:30-10:20 AM Room 160-123, 10:30-11:20 AM Room 160-328

Contact Information

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Overview and Class Goals

Causal inference methods have revolutionized the way we use data, statistics, and research design to move from correlation to causation and rigorously learn about the impact of some potential cause (e.g., a new policy or intervention) on some outcome (e.g., election results, levels of violence, poverty). This course provides an introduction to the toolkit of modern causal inference methods as they are now widely used across academic fields, government, industry, and non-profits. Topics include experiments, matching, regression, difference-in-differences, instrumental variable estimation, and regression discontinuity designs. We will illustrate and apply the methods with examples drawn from various fields including policy evaluation, political science, public health, economics, business, and sociology. We will further discuss in class relevant articles.

Prerequisites

Political Science 150A or an equivalent is required. The course assumes that you are proficient in `R`, as covered in 150A.

Class Requirements

Reading
The syllabus lists the required readings for each part of the course. Part of the reading is based on the text book, and should be completed prior to the corresponding lectures.
Additionally, we will discuss research studies that use the tools and methods of causal inference. For these discussions, it is essential that students have all ready the relevant articles carefully and are prepared to discuss the content in class. Participation grades will mainly reflect active contributions during these discussions.

Homework
This is a methodological course, developing skills in understanding and applying statistical methods. You can only learn statistics by doing statistics, and therefore the homework for this course is extensive, including a problem set roughly every two weeks. No late homework will be accepted. We encourage students to work together on the assignments, but you always need to write your own solutions, and we ask that you make a solo effort at all the problems before consulting others. In particular, you should not copy someone else's answers or computer code. For analytical questions, you should include your intermediate steps, as well as comments on those steps when appropriate. For data analysis questions, include annotated R code as part of your answers. All results should be presented so that they can be easily understood.

Exams and Project
There will be two midterm exams and a final exam. The midterms will take place during weeks 4 and 8. The final exam will take place during the exam period and scheduled by the registrar.

Grading
Grades will be based on:

- Homework assignments (35 %)
- Midterm exams (30 %)
- Final exam (30 %)
- Class participation (5 %)

Sections

A weekly section on Fridays will be held to review the material and provide help with computing issues. Victoria Liu will run the sections and provide more detail.

Computation

In this course, we will use R.

To refresh your R, you are expected to work through one of the following free tutorials unless you are well familiar with this material. All three tutorials cover similar material, just pick the one you like best:
Owen. *The R Guide.* At: http://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf
Venables and Smith. *An Introduction to R.* At: http://cran.r-project.org/doc/manuals/R-intro.pdf
Verzani. *Simple R.* At: http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf

In addition, there are many resources for R both new and advanced users:

- Wickham, Hadley and Garrett Grolemund. 2017 *R for Data Science.* Available for free online at here. (focused on 'tidyverse')
- Fox, John and Sanford Weisberg. 2010. *An R Companion to Applied Regression.* Sage Publications. (focused on regression analysis)
- Venables, W. N. and B. D. Ripley. 2002. *Modern Applied Statistics with S*, 4th ed. Springer. (general statistics)
- Teetor, Paul. 2011. *R Cookbook.* O'Reilly Press.
- For specific questions about R, searching the CRAN website with appropriate keywords will often yield satisfactory results.

Course Website

This course uses Slack. Please use the Slack channel to ask any questions relevant to the course. This will allow students to see and learn from other students' questions. We will both regularly check the channel and answer questions posted, although everyone else is also encouraged to contribute to the discussion. *Do not email your questions directly to the instructors or TAs* (unless they are of personal nature) — we will not answer them!

Books

- *Most required readings are from the following textbook.*
  - Angrist, Joshua D. and Jörn-Steffen Pischke. 2014. *Mastering Metrics.* Princeton University Press.

As an additional source, I can recommend *Causal Inference: The Mixtape* by Scott Cunningham, which can also be accessed freely online and includes example code. For a more advanced treatment of the material, I further recommend Angrist, Joshua D. and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion* or Imbens, Guido W., and Donald B. Rubin. *Causal inference in statistics, social, and biomedical sciences.*

Students with Documented Disabilities

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty. Unless the student has a temporary disability, Accommodation letters are issued for the entire academic year. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 650-723-1066, URL: https://oae.stanford.edu/).

Preliminary Schedule

The following is a preliminary schedule of course topics. Notice that required readings are marked with a ($\star$).

1 The Potential Outcome Model

- Counterfactual Responses and the Fundamental Identification Problem
- Estimands and Assignment Mechanisms
- Heterogeneity and Selection

Readings:

- *Mastering Metrics*, Ch. 1 p.1-17

2 Randomized Trials

- Estimation and Hypothesis testing
- Covariate adjustment, Examples, Blocking
- Complete, Block, and Cluster Randomization

Readings:

- *Mastering Metrics*, Ch. 1: p. 17-33

Articles:

- Gerber, Alan S., Donald P. Green, and Christopher W. Larimer. "Social pressure and voter turnout: Evidence from a large-scale field experiment." American political Science Review 102.1 (2008): 33-48.
- Slemrod, Joel, Marsha Blumenthal, and Charles Christian. "Taxpayer response to an increased probability of audit: evidence from a controlled experiment in Minnesota." Journal of public economics 79.3 (2001): 455-483.

3 Selection on Observables and Matching

- Identification under Selection on Observables
- *Readings: Selection on Observables*
  - *Mastering Metrics*, Ch. 2
- Matching
- *Readings: Matching*
  - Angrist and Pischke, *Mostly Harmless Econometrics*, Ch. 3, Section 3.3.1

Articles:

- Glynn, Adam N., and Maya Sen. "Identifying judicial empathy: does having daughters cause judges to rule for women's issues?." American Journal of Political Science 59.1 (2015): 37-54.
- Hainmueller, Jens, and Dominik Hangartner. "Who gets a Swiss passport? A natural experiment in immigrant discrimination." American political science review 107.1 (2013): 159-187.

4 Instrumental Variables

- Identification: Using Exogenous Variation in Treatment Intake Given by Instruments
- Imperfect Compliance in Randomized Studies
- Wald Estimator, Local Average Treatment Effects, 2SLS

Readings:

- *Mastering Metrics*, Ch. 3

Articles:

- Sherman, Lawrence W., and Richard Alan Berk. The Minneapolis domestic violence experiment. Vol. 1. Washington, DC: Police Foundation, 1984.
- Sarah Taubman, Heidi Allen, Bill Wright, Katherine Baicker, Amy Finkelstein, and the Oregon Health Study Group, "Medicaid Increases Emergency Department Use: Evidence from Oregon's Health Insurance Experiment", Science, 2014 Jan 17; 343(6168): 263-268.

5 The Regression Discontinuity Design

- Sharp and Fuzzy Designs, Identification, Estimation, Falsification Checks

Readings:

- *Mastering Metrics*, Ch. 4

Articles:

- Ludwig, Jens, and Douglas L. Miller. "Does Head Start improve children's life chances? Evidence from a regression discontinuity design." The Quarterly journal of economics 122.1 (2007): 159-208.
- Hainmueller, J., Lawrence, D., Martén, L., Black, B., Figueroa, L., Hotard, M., ... and Laitin, D. D. (2017). "Protecting unauthorized immigrant mothers improves their children's mental health." Science, 357(6355), 1041-1044.

6 Difference-in-Differences

- Identification, Estimation, Falsification tests

Readings:

- *Mastering Metrics*, Ch. 5

Articles:

- Card, David, and Alan B. Krueger. "Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania." The American Economic Review 84.4 (1994): 772.
- Foos, Florian, and Daniel Bischof. "Tabloid media campaigns and public opinion: Quasi-experimental evidence on Euroscepticism in England." American Political Science Review 116.1 (2022): 19-37.

7 Panel Data Methods

- Panel Data Methods and Fixed Effects Estimation

Readings:

- Angrist and Pischke, *Mostly Harmless Econometrics*, Ch. 5

Calendar (preliminary and subject to change)

Week	Monday	Wednesday	Friday
1 (4/1)	PO 1	PO 2	
2 (4/8)	RT 1	RT 2	
3 (4/15)	Observables 1	Observables 2	PS 1 due
4 (4/22)	Observables 3	Midterm 1	
5 (4/29)	IV 1	IV 2	PS 2 due
6 (5/6)	IV 3	RDD 1	
7 (5/13)	RDD 2	RDD 3	PS 3 due
8 (5/20)	Midterm 2	DiD 1	
9 (5/27)	No Class	DiD 2	PS 4 due
10 (6/3)	Panel 1	Panel 2	