PLSC 598: Causal Inference

Spring 2023

Wednesday, 2:00pm - 5:00pm

PhD Seminar
Penn State University
Sparks Bldg 009

Instructors

Professor: Kevin Munger
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Office hours: Schedule on website (Tuesdays 2-4pm)

Current version (subject to change!): February 16, 2023

Course Overview

This course provides a current perspective on identifying and estimating causal effects in social science research. We focus on non-parametric identification methods and then non-parametric and semi-parametric estimation and frequentist inference methods. We will emphasize research design and robust estimation and inference.

This course is an amalgamation of other Causal Inference course I've taken and other professors have developed. I'm grateful for the commitment to sharing teaching materials in the causal inference community, and would particularly like to thank Cyrus Samii, Ye Wang, Drew Dimmery, and Matthew Blackwell for producing material that I have used in designing this course; Professor Samii's course, in particular, was perhaps the most important class I've ever taken, and I'll be following his structure and materials as closely as I can manage.

Prerequisites

There are no official requirements for this course, but you will find it difficult without exposure to PhD-level statistics for social science.

The coding portion of the course will take place in R, and some knowledge of R is required; you will have to become comfortable with running functions and replicating materials from published

papers throughout the course. In particular, all of the problem sets will need to be completed with R. This is not a course about coding, but it is a course in which coding is essential.

Course Components and Grading

- **Homeworks (50%):** There will be a series of problem sets throughout the course to ensure that you're keeping up with the instruction and mastering the material. You will have to submit your completed assignment within a week; exact deadlines will be made clear on the assignment. You can work with others, but to receive credit, your homework must comply with the following guidelines:
  - You must turn in a PDF copy of your own homework by the stated deadline to the professor.
  - The assignment that you turn in must clearly reflect your own thinking. Sets of verbatim copies of homework will have credit reduced by half.
  - Homework assignments may be hand written or typed, but they must be clearly legible.
  - Estimates obtained from R must be formatted properly into tables or graphs resembling journal presentation styles. You should use a table formatting function (e.g. apsrtable or stargazer in R). Use a reasonable (2 or at most 3) number of digits after decimal points, report standard errors or confidence intervals along with coefficients, clarify what are the dependent variables in each table or figure, and explain in footnotes to your tables or figures what kinds of estimators or adjustments have been used. Print outs of "raw" screen output or commented logs will not receive any credit.
  - Mathematical derivations should include all key steps with explanations for important techniques.
- **Midterm Exam (15%):** An in-class mid-term exam will take place mid-way through the semester (exact date to be confirmed). The mid-term serves the purpose of evaluating individual progress, which in turn helps me to understand where to place emphasis for the remainder of the semester. If you are unable to make it to the exam, you must provide notice at least a week prior so that we can arrange an alternative time.
- **Final Exam (25%):** A take-home final exam will be scheduled during the final examination period. The final also serves the purpose of evaluating individual progress, which in turn allows me to provide individualized recommendations on where students should apply effort to strengthen their methodological foundations. If you are unable to work during the exam period, you must provide notice at least a week prior so that we can arrange an alternative time.
- **Attendance and Participation (10%):** Attendance and participation in class discussions is required.

Required Syllabi Statements

ACADEMIC INTEGRITY STATEMENT Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for

all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts. Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

DISABILITY ACCOMMODATION STATEMENT Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. Student Disability Resources (SDR) website provides contact information for every Penn State campus (http://equity.psu.edu/sdr/disability-coordinator). For further information, please visit the Student Disability Resources website (http://equity.psu.edu/sdr/). In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: See documentation guidelines at (http://equity.psu.edu/sdr/guidelines). If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early as possible. You must follow this process for every semester that you request accommodations.

COUNSELING AND PSYCHOLOGICAL SERVICES STATEMENT Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation. Counseling and Psychological Services at University Park (CAPS) (http://studentaffairs.psu.edu/counseling/): 814-863-0395 Counseling and Psychological Services at Commonwealth Campuses (http://senate.psu.edu/faculty/counseling-services-at-commonwealth-campuses/) Penn State Crisis Line (24 hours/7 days/week): 877-229-6400 Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

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Readings

Each week will have a number of required readings and some number of additional optional readings. These readings will be drawn from a variety of different textbooks and papers. We will draw heavily on the following textbooks, and I recommend that you buy them:

- Angrist and Pischke (2009) (Referred to as MHE)

- Cunningham (2021) (Referred to as Mixtape)

Students seeking to engage more deeply with the statistical foundations of this course should also consider the following texts:

- Imbens and Rubin (2015) (Referred to as CIS.)
- Aronow and Miller (2019)

Schedule

Week of January 11: Syllabus, Orientation

Complete review materials.

Week of January 18: What is the Goal of Social Science?

- Grossmann (2021) Ch 8
- Spirling and Stewart (N.d.)
- Watts (2014)
- Turco and Zuckerman (2017)
- Almaatouq et al. (2022)
- *Optional:* Kuhn (2012), Feyerabend (2010)

Week of January 25: Foundations of Causal Inference

- MHE CH1
- Mixtape Ch4
- *Optional:* CIS Ch1-2, Angrist and Pischke (2010),
- Greenland, Pearl and Robins (1999)

Week of February 1: Identification, Estimation, and Inference in Randomized Experiments

- MHE CH2
- Schrodt (2014)
- *Optional:* CIS Ch6

Week of February 8: Regression and Causal Inference

- MHE CH3.1-3.2
- Aronow and Samii (2016)

Week of February 15: Conditioning to Identify Causal Effects

- MHE CH3.3
- Mixtape Ch5

Week of February 22: Robust Statistical Inference, Limited Dependent Variables

- MHE CH3.4 (p 91 - 99)
- MHE CH8 (up to page 315, star'd portion of section 8.1 optional)

Week of March 1: MIDTERM EXAM

Week of March 8: NO CLASS SPRING BREAK

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Week of March 15: Instrumental Variables & Regression Discontinuity

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- *Optional:*

Week of March 22: Repeated Observations

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- *Optional:*

Week of March 29: Mediators, Moderators and Causal Explanation

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- *Optional:*

Week of April 5: Interference and Spillover Effects & Missing Data and Attrition

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- *Optional:*

Week of April 12: Machine Learning for Causal Inference

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- *Optional:*

Week of April 19: Generalizability

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- *Optional:*

Week of April 26: Course Review for Final Exam

References

Almaatouq, Abdullah, Thomas L Griffiths, Jordan W Suchow, Mark E Whiting, James Evans and Duncan J Watts. 2022. "Beyond Playing 20 Questions with Nature: Integrative Experiment Design in the Social and Behavioral Sciences." *PsyArXiv. November* 22.

Angrist, Joshua D and Jörn-Steffen Pischke. 2009. *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.

Angrist, Joshua D and Jörn-Steffen Pischke. 2010. "The credibility revolution in empirical economics: How better research design is taking the con out of econometrics." *Journal of economic perspectives* 24(2):3–30.

Aronow, Peter M and Benjamin T Miller. 2019. *Foundations of agnostic statistics*. Cambridge University Press.

Aronow, Peter M and Cyrus Samii. 2016. "Does regression produce representative estimates of causal effects?" *American Journal of Political Science* 60(1):250–267.

Cunningham, Scott. 2021. *Causal inference*. Yale University Press.

Feyerabend, Paul. 2010. *Against method: Outline of an anarchistic theory of knowledge*. Verso Books.

Greenland, Sander, Judea Pearl and James M Robins. 1999. "Causal diagrams for epidemiologic research." *Epidemiology* pp. 37–48.

Grossmann, Matt. 2021. *How Social Science Got Better: Overcoming Bias with More Evidence, Diversity, and Self-reflection*. Oxford University Press.

Imbens, Guido W and Donald B Rubin. 2015. *Causal inference in statistics, social, and biomedical sciences*. Cambridge University Press.

Kuhn, Thomas S. 2012. *The structure of scientific revolutions*. University of Chicago press.

Schrodt, Philip A. 2014. "Seven deadly sins of contemporary quantitative political analysis." *Journal of peace research* 51(2):287–300.

Spirling, Arthur and Brandon M Stewart. N.d. "What Good is a Regression?" . Forthcoming.

Turco, Catherine J and Ezra W Zuckerman. 2017. "Verstehen for sociology: Comment on Watts." *American Journal of Sociology* 122(4):1272–1291.

Watts, Duncan J. 2014. "Common sense and sociological explanations." *American Journal of Sociology* 120(2):313–351.