RPAD 725: Quantitative Methods of Causal Inference

Lucy C. Sorensen – Spring 2021

Format: Synchronous Online
Time: Monday 4:30 - 6:30 PM

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Course Description

This course addresses the ubiquitous challenge in empirical research of navigating the path from cause to effect. Students will learn the theory and application of techniques such as: matching, difference-in-differences, instrumental variables, experiments, and regression discontinuity. However, the primary goal of this course is not to provide a ready-to-use "toolbox" of statistical methods. It is to study the more generalizable process of developing identification strategies to answer critical questions in the social sciences. Students will become critical consumers of empirical research, and in doing so, learn how to both harness the full power, and recognize the limitations, of their own research designs.

Of the 3 hours and 40 minutes of designated class time, 2 hours will be spent in a synchronous meeting, and the remainder will be dedicated to asynchronous activities or lab time.

Required Materials

We will use the following (freely available online) texts:

- Cunningham, Scott. (2020). Causal Inference: The Mixtape (v.1.8).
- Journal articles available through UAlbany library.

We will also regularly use the following technological tools:

- Zoom for synchronous class meetings,
- Slack for interactive discussion and group work,
- Blackboard for general course management, and
- Stata (IC or SE) for data analysis.

Stata is available on the Information Commons PCs in the Dewey Library or for purchase at a discount. If students already have expertise in different statistical software such as R, SAS , or SPSS, they may instead use that software, although class demonstrations will be in Stata.

Prerequisites

- RPAD 705 Advanced Quantitative Analysis, or equivalent coursework
- RPAD 688 Stata Programming Workshop, or equivalent statistical programming experience

Students should know inside-and-out the methods and assumptions of ordinary least squares regression and basic probability theory and statistics. This course does not require any specific knowledge of matrix algebra or multivariable calculus, but does require confidence when approaching mathematical concepts.

Course Objectives

By the end of the course, students will be able to:

1. Understand and articulate the underlying assumptions of regression-based quantitative research designs;
2. Read and critically assess methods and findings from sophisticated empirical research;
3. Implement a variety of statistical techniques with data to examine the causal impacts of a public policy, program, or practice; and
4. Complete an original empirical project using secondary data, moving from research question, to research design, to findings and interpretation.

Course Policies

Office Hours

I welcome visits for any purpose, but want to especially encourage students to meet with me regularly about their empirical study. Office hour appointments will be available on Tuesday and Friday afternoons from 2:00 to 5:00 PM. Please use the following link to make appointments: `https://lucysorensen.youcanbook.me/`. This automatically adds an appointment to my calendar. If you cannot find a time on the booking website that works for you, please email me to find an alternative time to meet.

Wellness

The health and wellbeing of students, to me, always takes higher priority than academic expectations. This is true at all times, but particularly so during a pandemic. Please speak to me if you are struggling to meet course deadlines or if something comes up in your personal or professional life that requires you to miss class or assignments. I will work with you to develop flexible accommodations. I also encourage you to use available campus resources if needed:

- Mental health: Counseling and Psychological Services.
- Food insecurity: Purple Pantry
- Sexual violence: Advocacy Center

Accommodations

Reasonable accommodations will be provided for students with documented physical, sensory, systemic, cognitive, learning and psychiatric disabilities. If you believe you have a disability requiring accommodation in this class, please notify the Director of the Disability Resource Center (Campus Center 130, 518-442-5490, DRC@albany.edu). That office will provide the course instructor with verification of your disability, and will recommend appropriate accommodations.

Attendance

Students should aim to attend every class. For any necessary absence, students should communicate with the instructor ahead of time, and coordinate with classmates to make up missed material. Students are never required to have their video turned on in virtual classes, but are encouraged to turn on their video when they are comfortable doing so, especially for breakout rooms.

Academic Integrity

Please familiarize yourself with university guidelines on academic integrity and conduct at `https://www.albany.edu/graduatebulletin/requirements_degree.htm#standards_integrity`. Plagiarism is a major offense and can receive severe consequences, from automatically failing the course to being expelled. If in doubt about acceptable use of sources, please ask.

Correct citations are one of the most important elements in avoiding plagiarism. When you use a source, make sure to both include in-text citations and create a bibliography using either the `APA formatting style` or `Chicago Author-Date formatting style`.

Grading Policies

Late work. Please speak to me if circumstances arise such that you need an extension. Most assignments are due one half-hour before class. Work turned in after this will receive a grade deduction of 5 percentage points, and then an extra 5 percentage points deducted for each additional day that passes after the original deadline.

Regrading. If you believe that an error has been made in the grading of your assignment, you may make a written appeal describing why you think the grade should be changed. To be considered, this appeal should be emailed to me *within two days* of receiving your assignment back. On review, your grade may be lowered, increased, or remain the same.

Course Assignments

Grading

Below is the breakdown of graded items for the course. Rubrics will be provided to students to clarify the expectations for each graded component.

Component	Description	Points
Assignments	Problem Set 1 (10 pts.)	40
	Problem Set 2 (10 pts.)	
	Problem Set 3 (10 pts.)	
	Problem Set 4 (10 pts.)	
Empirical Paper	Paper proposal (10 pts.)	40
	Final paper (30 pts.)	
Participation	Paper critiques (16 pts.)	20
	Peer feedback (4 pts.)	
Total		100

A student's final grade will be calculated as the sum of the elements above. These numerical final grades will then be converted (*without rounding*) to a final letter grade as follows:

Percent Grade	Letter Grade
93-100	A
90-93	A-
87-90	B+
83-87	B
80-83	B-
77-80	C+
73-77	C
70-73	C-
67-70	D+
63-67	D
60-63	D-
Below 60	E

Problem Sets (40 points)

For this course you will complete a total of four assignments, which incorporate questions on:

- Conceptual understanding from readings,
- Mathematical understanding of methods, and
- Statistical programming and analysis.

Students are strongly encouraged to discuss and work closely with their classmates, provided that each student individually writes their own code, performs their own analysis, and creates their own written responses. Copying answers or code directly from another student will be considered academic dishonesty.

Empirical Paper (40 points)

One of the intended benefits of this course is that students will finish the semester with an empirical research paper that incorporates robust causal analysis of a question within the student's own area of interest. For students in the Public Administration and Policy department, this paper

could serve as the seed of the candidacy paper or potentially one chapter in a dissertation. For all students, this paper should move forward their research trajectories either formally (e.g. turn into a publishable article) or informally (e.g. provide practice with a relevant dataset).

A written paper proposal and presentation is due mid-semester (10 pts.) that should identify and motivate a research question, a dataset, and a proposed research design. During a classwide project workshop, students will have the opportunity to share their research project ideas with each other and provide peer feedback. The final research paper (30 pts.) will be due by the final class period, along with full replication materials adhering to the `TIER protocol`.

Participation (20 points)

Students will benefit from regularly asking questions, engaging in friendly class debate, coming to class well prepared, consulting regularly about their empirical project, and contributing to the group's learning. For each of 9 weeks during the semester when applied papers are assigned, students will turn in an applied paper summary/analysis to their team, and then the team will discuss the paper together and submit an integrated group critique. Your participation in these critiques will be worth 2 points per paper, and you may skip one paper during the semester without any penalty. (2 points * (9 weeks - 1 week) = 16 points). Participation in the student project workshop and submission of quality peer feedback will be worth 4 points. Students are welcome to speak with the instructor at any time regarding their current participation, or any concerns or challenges they are facing in meeting participation expectations.

Course Schedule

Check Blackboard regularly for changes to the schedule and readings. Please check the UAlbany academic calendar for dates regarding adding, dropping, and withdrawing from the course. Readings are classified throughout this document as follows:

- "(†)" methodological readings, for which you will submit weekly questions.
- "(*)" applied empirical papers, for which you will prepare paper critiques.

Week of 2/1: 725 Bootcamp

What is causal inference and why is it important within social science research? What are the main assumptions and properties of OLS regression? What mathematical, programming, and workflow skills will be necessary for the semester ahead? This week we will take a moment to review, and then jump right into the first assignment.

- †Mixtape Chapter 2: Probability and Regression Review.
  - Read 2.7 to 2.16 and 2.25 to 2.26
  - (Skip 2.1 to 2.6, 2.17 to 2.24, and 2.27)
- For fun: Carroll, Aaron E. 2016. "Sorry, There's Nothing Magical About Breakfast." *The New York Times*, May 23.

Week of 2/8: Models of Causality

Assignment #1 Due

How has the philosophy of causality developed across different fields? How can we use directed acyclic graphs to define causal questions and identify potential confounders? This week we learn the fundamentals of graphical models of causality and practice identifying potential violations of the exogeneity assumption.

- †Mixtape Chapter 3: Directed Acyclical Graphs
- For fun: Thurman, Walter N. and Mark E. Fisher. 1988. "Chickens, Eggs, and Causality, or Which Came First?" *American Journal of Agricultural Economics* 70 (2): 237-238.
- For fun: Heckman, James J. 2010. "The Effect of Prayer on God's Attitude Toward Mankind." *Economic Inquiry* 48 (1): 234-235.

Week of 2/15: Randomized Experiments

How do we assess potential outcomes under different counterfactuals? What is the logic underlying randomized experiments? What are some practical and methodological issues associated with randomization? This week we will learn the potential outcomes framework and how randomized experiments can capture the average treatment effect.

- †Mixtape Chapter 4: Potential Outcomes Causal Model
  - Read 4.0, 4.1, and 4.3
  - (Skip 4.2 Randomization inference)
- †Murnane, Richard J. and John B. Willett. 2011. Chapter 5: Challenges in Designing Implementing, and Learning from Randomized Experiments. In *Methods Matter: Improving Causal Inference in Educational and Social Science Research*.
- *Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz. 2016. "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment." *American Economic Review* 106 (4): 855-902.

Week of 2/22: Matching and Selection on Observables

In absence of randomized treatment assignment, how can we structure observable data so that the treatment group more closely resembles the control group? What is the conditional independence assumption and when is it reasonable? What are common methods of matching and weighting? In this week we examine the shared principles underlying control variables, propensity score matching, inverse probability weighting, and coarsened exact matching.

- †Mixtape Chapter 5: Matching and Subclassification
  - Read 5.0 to 5.2, 5.3.1, and 5.3.3-5.3.8

  - (Skip 5.3.2 Bias correction)

- †Stuart, Elizabeth A. 2002. "Matching Methods for Causal Inference: A Review and a Look Forward." *Statistical Science* 84 (1): 151-161.

- *Grissom, Jason A. and Lael R. Keiser. 2011. "A Supervisor Like Me: Race, Representation, and the Satisfaction and Turnover Decisions of Public Sector Employees." *Journal of Policy Analysis and Management* 30 (3): 557-580.

Week of 3/1: Instrumental Variables I

Assignment #2 Due

- †Mixtape Chapter 7: Instrumental Variables
  - Read 7.0 to 7.4

- †Rosenzweig, Mark R. and Kenneth I. Wolpin. 2000. "Natural 'Natural Experiments' in Economics." *Journal of Economic Literature* 38 (4): 827-874.

- *Hoxby, Caroline M. 2000. "Does Competition Among Public Schools Benefit Students and Taxpayers?." *American Economic Review* 90: 1209-1238.

Week of 3/8: Instrumental Variables II

- †Mixtape Chapter 7: Instrumental Variables
  - Read 7.5 to 7.9

- †Sovey, Allison J. and Donald P. Green. 2011. "Instrumental Variables Estimation in Political Science: A Readers' Guide." *American Journal of Political Science* 90(430): 443-450.

- *Kling, Jeffrey R. 2006. "Incarceration Length, Employment, and Earnings." *American Economic Review* 96(3): 863-876.

Week of 3/15: Regression Discontinuity I

- †Mixtape Chapter 6: Regression Discontinuity
  - Read 6.0, 6.1, and 6.2.1 to 6.2.5

- †Skim: Lee, David S. and Thomas Lemieux. 2010. "Regression Discontinuity Designs in Economics." *Journal of Economic Literature* 48: 281-355.

- Tuttle, Cody. 2019. Snapping Back: Food Stamp Bans and Criminal Recidivism. *American Economic Journal: Economic Policy* 11(2): 301-327.

Week of 3/22: Regression Discontinuity II

- †Mixtape Chapter 6: Regression Discontinuity
  - Read 6.2.7 and 6.3 to 6.6
- †Jacob, Robin, Pei Zhu, Marie-Andree Somers, and Howard Bloom. A Practical Guide to Regression Discontinuity.
- *Lee, David S. 2008. "Randomized Experiments from Non-Random Selection in U.S. House Elections." *Journal of Econometrics* 142(2): 675-697.

Week of 3/29: Panel Data Methods

Assignment #3 Due

- †Mixtape Chapter 8: Panel Data
- †Mixtape Chapter 2, section 2.27 Cluster robust standard errors
- †Skim: Moulton, Brent R. 1990. "An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units." *Review of Economics and Statistics* 72(2): 334-338.
- *Wen, Hefei, Jason M. Hockenberry, and Janet R. Cummings. 2015. "The Effect of Medical Marijuana Laws on Adolescent and Adult Use of Marijuana, Alcohol, and Other Substances." *Journal of Health Economics* 42: 64-80.

Week of 4/5: Difference-in-Differences I

- †Mixtape Chapter 9: Differences-in-Differences
  - Read 9.0 to 9.3
- †Skim: Bertrand, Marianne, Esther Duflo, Sendhil Mullainathan. 2004. "How Much Should We Trust Difference-In-Differences Estimates?" *Quarterly Journal of Economics* 119 (1): 249-275.
- * Kearney, Melissa S. and Phillip B. Levine. 2015. "Media Influences on Social Outcomes: The Impact of MTV's 16 and Pregnant on Teen Childbearing." *American Economic Review* 105 (12): 3597-3632.

Week of 4/12: Student Project Workshop I

Paper Proposal Due

- †Christensen, Garret and Edward Miguel. 2018. "Transparency, Reproducibility, and the Credibility of Economics Research." *Journal of Economic Literature* 56(3): 920-980.

- †Project TIER. TIER Protocol.
  - Read "Process" and "Specifications" sections.
  - Download the Demo Project.
  - Create an Open Science Framework account.

Week of 4/19: Difference-in-Differences II

- †Mixtape Chapter 9: Differences-in-Differences
  - Read 9.4 to 9.7
- Skim: Schmidheiny, Kurt and Sebastian Siegloch. 2019. On Event Study Designs and Distributed-Lag Models: Equivalence, Generalization and Practical Implications. IZA Discussion Paper No. 12079.
- *Wolfers, Justin. 2006. "Did Universal Divorce Laws Raise Divorce Rates? A Reconciliation and New Results." *American Economic Review* 96 (5): 1802-1820.

Week of 4/26: Synthetic Control

Assignment #4 Due

- †Mixtape Chapter 10: Synthetic Control
- †Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2015. "Comparative Politics and the Synthetic Control Method." *American Journal of Political Science* 59(2): 495-510.
- *Eren, Ozkan and Serkan Ozbeklik. 2016. "What Do Right-to-Work Laws Do? Evidence from a Synthetic Control Method Analysis." *Journal of Policy Analysis and Management* 35(1): 173-194.

Week of 5/3: Student Project Workshop II

Week of 5/10: Machine Learning

Final Paper Due

- † Mullainathan, Sendhil, and Jann Spiess. 2017. Machine Learning: An Applied Econometric Approach. *Journal of Economic Perspectives* 31(2): 3-32.
- † Mergel, Ines, R. Karl Rethemeyer, and Kimberley Isett. 2016. Big Data in Public Affairs. *Public Administration Review* 76(6).