Economics 4349 and 5349

Advanced Causal Inference

Tuesday and Thursday, Foster 402 11am-12:15pm

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This syllabus may change, but I am making an effort to make it fixed.

Course Description: Causal inference can be thought of as subfield of econometrics that is primarily built on the potential outcomes framework (Cunningham, 2021; Imbens and Rubin, 2015). It emphasizes design and model based inference, traditionally built on the applications described in chapters of Cunningham (2021). Our focus this semester will be on learning and applying the "robust difference-in-differences" literature and the new synthetic control literature, and if time, a deeper discussion of instrumental variables. Over half the class will cover in detail all of the difference-in-differences work, maybe 25-30% synthetic control, and the remainder IV. These models are advanced, both in terms of econometric content and programming, and thus I expect all of you to reach a conversant level of comprehension as well as successful programming-based execution. The main focus, with a few exceptions, will be application of DiD to replicating and extending the famous, and yet controversial, gun control study by Lott and Mustard (1997); Donohue, Aneja and Zhang (2011), but at times we will also stop to cover more simpler designs using DiD, and synthetic control. The hope is that by the end of the semester, you will possess more experience in applied research, as we will be working together to write an article suitable for publication. I will guide you through that process in a collectively written article on Overleaf which on the last day you will submit to the International Review of Law and Economics in what will be, hopefully, some of your first economics publication.
Prerequisite(s): Econometrics, Causal Inference.

Course Objectives:
The primary objective of this course is for students to understand a variety of econometric estimators and research strategies for inferring causal effects in observational data. Complementary course objectives consist of developing rudimentary programming skills in Stata and R, as well as competency in working with larger quantitative data sources. Finally, we will learn to conduct original empirical analysis on the Lott and Mustard (1997) dataset and research question by extending their analysis to use robust DiD methods and tools. Much of this will be somewhat canned

followed by group discussion on progress.

Grade Distribution:

Weekly google doc commentary	20%
Substack summary	10%
Lott and Mustard (1997) commentary and weekly progress	30%
Final project for submission	40%

Letter Grade Distribution:

>= 90-100	A	70 - 89.99	B
50 - 69.99	C+	<= 49.99	F

Classwork and your final grade:

- **Weekly google drafts (20%)**

  For each class, we will have a google document briefly describing the paper. Throughout the week, as you read the paper, you will discuss on the draft together the paper. For 10 minutes once class begins, you can review as well as contribute to the google document at which point it will close and we will begin class. We will discuss the technical details of the paper via lecture and discussion, ask and answer questions. This is called a silence model and it has been widely used in tech, as well as MIT, in place of meetings. It's my first time to do it, so it'll be an experiment. My hope is that it will help us move through papers more rapidly with greater comprehension. Feel free to share code, ask questions about code, as well as share insights, answer others' questions and anything you think of. You are graded by participation only, where participation is defined as comments made to the shared google document. The google document will be our main way of communicating, so I encourage everyone to start checking it regularly for updates throughout the week. THink of it as our class Slack channel (although you may want to use it to find a way to better communicate also). There will also be a standing Lott and Mustard (1997) google document for collaboration on that project.

- **Substack summary (10%)** At the end of each week, by Friday night at 8:00pm, you must write a substack entry "explaining" the 1-2 papers of the week. The newsletter must be well written with an intended of audience of PhD level economists and other social scientists who are interested in the "new difference-in-differences" or "new synthetic control" methods, but who do not have the time or the inclination to study it as closely as you have. These should be readable and interesting. Your focus should be to put the papers into accessible language but still being useful to the reader as possible. You will be graded according to a simple rubric: (3 points) showing you learned the papers well enough to communicate them, (3 points) well crafted and (+1 bonus points) if there is workable code (embedded using `https://gist.github.com`). The 3 point scale ranges from excellence (3), average (2), to below average but acceptable (1) to unacceptable (0). There are no late acceptances. Excellent is difficult but doable.

- **Lott and Mustard (1997) replications using TWFE and extensions using robust DiD (30%**

  This semester, we will be attempting to replicate Lott and Mustard (1997); Donohue, Aneja and Zhang (2011), a classic, yet controversial, study of concealed carry laws. Each week, you will update me on your progress by emailing me your progress. I will grade you each week based purely on substantial "good faith" effort to replicate (0 or 1 points), and then extend, their original analysis. This will collecting a state-level version of the same dataset as them (with the exception made because the county level data has come under scrutiny for measurement error). I would like you to use Donohue's dataset for this assignment. You are welcome to use whatever programming language you feel comfortable using, but most likely you will need to simultaneously invest in R and Stata throughout the semester. We will discuss your progress in class.

  This is a collaborative project. You are expected to help your classmates and assist your classmates at every juncture both privately and collectively in real life if necessary. The dataset we will use is based on state-level versions of the county-level version of Lott and Mustard (1997); Donohue, Aneja and Zhang (2011). You will need to read it closely, as well as Donohue, Aneja and Zhang (2011) closely. See `https://works.bepress.com/john_donohue/89/`

and scroll to the bottom for the data.

- **Draft (40%)**

  At the conclusion of the semester, you will produce a coauthored working draft that is ready to be submitted for publication. This draft will be collectively written on Overleaf. You will have complete freedom to design the paper's structure, tables, and figures. I expect there to be publication quality figures and tables with replicable code. This draft will utilize at least two of the robust DiD models, as well as TWFE replications, of the original paper. We will on the last day of class submit this paper. Co-authorship will be randomized on the first day of class with first and last authors expected to be team leaders.

Academic Honesty Policy Summary:

Introduction

In addition to skills and knowledge, Baylor University aims to teach students appropriate Ethical and Professional Standards of Conduct. The Academic Honesty Policy exists to inform students and Faculty of their obligations in upholding the highest standards of professional and ethical integrity. All student work is subject to the Academic Honesty Policy. Professional and Academic practice provides guidance about how to properly cite, reference, and attribute the intellectual property of others. Any attempt to deceive a faculty member or to help another student to do so will be considered a violation of this standard.

Academic Integrity

The student's work must match the instructor's intended purpose for an assignment. While the instructor will establish the intent of an assignment, each student must clarify outstanding questions of that intent for a given assignment.

Plagiarism or any form of cheating involves a breach of student-teacher trust. This means that any work submitted under your name is expected to be your own, neither composed by anyone else as a whole or in part, nor handed over to another person for complete or partial revision. Be sure to document all ideas that are not your own. Instances of plagiarism or any other act of academic dishonesty will be reported to the Honor Council and may result in failure of the course. Not understanding plagiarism is not an excuse. As a Baylor student, I expect you to be intimately familiar with the Honor Code at: http://www.baylor.edu/honorcode/

Academic Success

I believe every student who has been admitted to Baylor can be successful and I want to partner with you to help you thrive academically. Be sure to take advantage of the many resources available for academic success, including coming to see me during my office hours. Students who regularly utilize the great resources in the Paul L. Foster Success Center (http://www.baylor.edu/successcenter/) are among my most successful students. If your academic performance in this class is substandard, I will submit an Academic Progress Report to the Success Center so that the team of coordinated care professionals can ensure that you get the help you need.

Attendance

During this unprecedented time of a global pandemic, class attendance must be approached differently from the way it would in a standard semester. If you are sick or have any symptoms (even if they are slight) that might relate to COVID-19, please stay home to protect yourself, your classmates, and your professors. As your instructor, I will expect that you work with me to enable you to receive any necessary course content (including classroom lectures) and complete any assignments, quizzes, or exams that you may miss due to being sick or having COVID-19- related symptoms. I also expect you to notify me prior to class if you will be missing for COVID-19 or any other health-related reason. If you are well, have no symptoms, and are not required to remain at home for any COVID-19 or other health-related reason, you should attend class and abide by all of the University's health protocols. Attendance during this time may take many forms due to the various course formats being offered this fall. Be sure to pay careful attention to the additional details below that describe how attendance and class participation will be incorporated into my course.

Importantly, Baylor's Health Services department on the Waco campus no longer provides notes to "excuse" students from missed classes. Please do not ask Health Services for such documentation.

Class Format Conversion

Due to the COVID-19 pandemic, this course may need to be converted to a [hybrid or] online format at some point in the semester. I have anticipated this possibility as I have prepared for

the course, and will provide necessary information for you in that event.

Face Coverings

Baylor University is committed to providing a safe educational environment for all students, faculty, and staff. In order to create the healthiest environment possible, students and instructors must properly wear face coverings over their mouths and noses while in Baylor buildings and while in the classroom. In addition, social distancing should be maintained within all classroom environments.

Any student who does not bring a face covering or refuses to wear one will be dismissed from class and be considered absent. If a student who is not wearing a face covering refuses to leave class, the instructor may dismiss in-person class for that day. Such a student will be subject to disciplinary action through the Student Code of Conduct.

First Generation College Students

Baylor University defines a first-generation college student as a student whose parents did not complete a four-year college degree. The First in Line program at Baylor is a support office on campus for first-generation college students to utilize if they have any questions or concerns. Please contact First in Line at firstinline@baylor.edu, call 254-710-6854, or visit www.baylor.edu/firstinline to learn more about the services available. [If you are a first gen college student, you may wish to add:] I was also the first in my family to graduate with a four-year bachelor's degree and can answer questions about experiences as a first-generation college student.

Military Student Advisory

Veterans and active duty military personnel are welcomed and encouraged to communicate, in advance if possible, any special circumstances (e.g., upcoming deployment, drill requirements, disability accommodations). You are also encouraged to visit the VETS Program Office with any questions at (254) 710-7264.

Office Hours

One of the best ways to take full advantage of learning in my course is by coming to my office hours. I look forward to guiding you in your academic pursuits. Take advantage of the hours listed above or email me for an appointment.

Office of Equity and Title IX

Civil Rights Policy and Sexual and Interpersonal Misconduct Policy

Baylor University does not tolerate unlawful harassment or discrimination on the basis of sex, gender, race, color, disability, national origin, ancestry, age (over 40), citizenship, genetic information or the refusal to submit to a genetic test, past, current, or prospective service in the uniformed services, or any other characteristic protected under applicable federal, Texas, or local law (collectively referred to as Protected Characteristics).

If you or someone you know would like help related to an experience involving:

1. Sexual or gender-based harassment, sexual assault, sexual exploitation, stalking, intimate partner violence, or retaliation for reporting one of these types of prohibited conduct, please visit www.baylor.edu/titleix, or contact us at (254) 710-8454, or TitleIX_Coordinator@baylor.edu.

2. Harassment (excluding those issues listed in #1) or adverse action based on Protected Characteristics, please visit www.baylor.edu/equity, or contact us at (254) 710-7100 or Equity@baylor.edu.

Optional add-ons:

The Office of Equity and Title IX understands the sensitive nature of these situations and can provide informationaboutavailableon-andoff-campusresources,suchascounselingand psychological services, medical treatment, academic support, university housing, advocacy services,

and other forms of assistance that may be available. Staff members at the office can also explain your rights and procedural options. You will not be required to share your experience. If you or someone you know feels unsafe or may be in imminent danger, please call the Baylor Police Department (254-710-2222) or Waco Police Department (9-1-1) immediately.

Except for Confidential Resources, all University Employees are designated Responsible Employees and thereby mandatory reporters of potential sexual and interpersonal misconduct violations. Confidential Resources who do not have to report include those working in the Counseling Center, Health Center and the University Chaplain, Dr. Burt Burleson.

Students Needing Accommodations

Any student who needs academic accommodations related to a documented disability should inform me immediately at the beginning of the semester. You are required to obtain appropriate documentation and information regarding accommodations from the Office of Access and Learning Accommodation (OALA). Contact Information: (254) 710-3605 - Paul L. Foster Success Center, 1st floor on the East Wing of Sid Richardson.

University Writing Center

I encourage you to visit the University Writing Center (UWC) this semester and get feedback on your writing for this course. Located in Moody Library 2nd floor West, the UWC offers free assistance to you at any stage of the writing process (brainstorming, researching, outlining, drafting, revising, editing). In their feedback, the consultants focus on higher order concerns, such as content, thesis, evidence, and organization, before grammar or style.

The UWC tutors will not proofread, edit, or write your paper for you, but they will equip you with a toolbox of strategies to improve your writing, research, and editing skills. Please take the assignment prompt, your paper/text, and other materials you might need with you to your appointment. Please include my name as the professor, and a report will automatically be sent to me after your session. You can set up an appointment online at www.baylor.edu/uwc, call the UWC at (254)710-4849, or stop by in person.

Contact Sinda_Vanderpool@baylor.edu for more information.

Tentative Course Outline:
The weekly coverage might change as it depends on the progress of the class. However, you must keep up with the reading assignments.

Week	Content
Week 1	• Syllabus overview, introduction to causal inference and the potential outcomes model, estimands, DAGs • Reading assignment: Imbens and Rubin (2015) chapters 1 and 2; Imbens (2020); Cunningham (2021) (potential outcomes chapter, DAGs), Lundberg, Johnson and Stewart (2021)
Week 2	• Semiparametric DiD; doubly robust DiD; introduction to differential timing and the Bacon decomposition of TWFE: Tuesday August 24 on Twitch platform due to professor travel; Thursday August 26 canceled due to professor travel • Reading assignment: Abadie (2005); Sant'Anna and Zhao (2020); Chang (2020); Goodman-Bacon (2021); Cunningham (2021) DiD chapter (last part covering Bacon decomposition)
Week 3	• Manual aggregation estimators for robust DiD, including stacking, event studies and application • Reading assignment: Callaway and Sant'Anna (2020); Sun and Abraham (2020); Cengiz et al. (2019a,b); Gardner (2020); Borusyak and Jaravel (2018); Baker, Larcker and Wang (2021)
Week 4	• Get caught up, discuss replications • Reading assignment: Same from previous week
Week 5	• Imputation estimators, Fuzzy designs, MCNN, continuous treatments • Reading assignment: Borusyak, Jaravel and Spiess (2021); Gardner (2020); de Chaisemartin and D'Haultfoueille (2017); Athey et al. (2021); Callaway, Goodman-Bacon and Sant'Anna (2021)
Week 6	• Get caught up • Reading assignment: Review progress on replications, Roth and Sant'Anna (2021a)
Week 7	• Parallel trends • Reading assignment: Rambachan and Roth (2021); Roth and Sant'Anna (2021b); Roth (2021)
Week 8	• Something interesting
Week 9	• Something interesting • Reading assignment: Something interesting
Week 10	• Something interesting • Reading assignment: Something interesting
Week 11	• Something interesting • Reading assignment: Something interesting
Week 12	• Something interesting • Reading assignment: Something interesting
Week 13	• Something interesting • Reading assignment: Something interesting
Week 14	• Something interesting • Submission ready article

Articles and Books on the Syllabus

Abadie, Alberto. 2005. "Semiparametric Difference-in-differences estimators." Review of Economic Studies 72:1–19.

Athey, Susan, Mohsen Bayati, Nikolay Doudchenko, Guido Imbens and Khashayar Khosravi. 2021. "Matrix Completion Methods for Causal Panel Data Models." Journal of the American Statistical Association forthcoming:1–15.

Baker, Andrew C., David F. Larcker and Charles C. Y. Wang. 2021. "How Much Should We Trust Staggered Difference-in-Differences Estimates?" Unpublished Manuscript.

Borusyak, Kirill and Xavier Jaravel. 2018. "Revisiting Event Study Desigsn, with an Application to the Estimation of the Marginal Propensity to Consume." Unpublished Manuscript.

Borusyak, Kirill, Xavier Jaravel and Jann Spiess. 2021. "Revisiting Event Study Designs: Robust and Efficient Estimation." Unpublished Manuscript.

Callaway, Brant, Andrew Goodman-Bacon and Pedro H. C. Sant'Anna. 2021. "Difference-in-differences with a continuous treatment." Unpublished Manuscript.

Callaway, Brant and Pedro H. C. Sant'Anna. 2020. "Difference-in-differences with Multiple Time Periods." Journal of Econometrics .

Cengiz, Doruk, Arindrajit Dube, Attila Lindner and Ben Zipperer. 2019a. "The Effect of Minimum Wages on Low-Wage Jobs." Quarterly Journal of Economics pp. 1405–1454.

Cengiz, Doruk, Arindrajit Dube, Attila Lindner and Ben Zipperer. 2019b. "The Effect of Minimum Wages on Low-Wage Jobs." Quarterly Journal of Economics Online Appendix .

Chang, Neng-Chieh. 2020. "Double/Debiased Machine Learning for Difference-in-differences Models." The Econometrics Journal 23(2):177–191.

Cunningham, Scott. 2021. Causal Inference: The Mixtape. 1st ed. Yale University Press.

de Chaisemartin, Clement and Xavier D'Haultfoueille. 2017. "Fuzzy Difference-in-differences." Review of Economic Studies 01:1–30.

Donohue, John J., Abhay Aneja and Alexandria Zhang. 2011. "The Impact of Right to Carry Laws and the NRC Report: Lessons for the Empirical Evaluation of Law and Policy." American Law and Economics Review 13(2):565–632.

Gardner, John. 2020. "Two-stage differences-in-differences." Unpublished Manuscript.

Goodman-Bacon, Andrew. 2021. "Difference-in-differences with variation in treatment timing." Journal of Econometrics .

Imbens, Guide W. and Donald B. Rubin. 2015. Causal Inference for Statistics, Social and Biomedical Sciences: An Introduction. 1st ed. Cambridge University Press.

Imbens, Guido W. 2020. "Potential Outcome and Directed Acyclic Graph Approaches to Causality: Relevance for Empirical Practice in Economics." Journal of Economic Literature 58(4):1129–1179.

Lott, John R. and David B. Mustard. 1997. "Crime, Deterrence and the Right-to-Carry Concealed Handguns." Journal of Legal Studies 26:1–68.

Lundberg, Ian, Rebecca Johnson and Brandon M. Stewart. 2021. "What is Your Estimand? Defining the Target Quantity Connects Statistical Evidence to Theory." American Sociological Review https://doi.org/10.1177

Rambachan, Ashesh and Jonathan Roth. 2021. "Design-Based Uncertainty for Quasi-Experiments." Unpublished Manuscript.

Roth, Jonathan. 2021. "Pre-Test with Caution: Event-Study Estimates After Testing for Parallel Trends." Unpublished Manuscript.

Roth, Jonathan and Pedrdo H. C. Sant'Anna. 2021a. "Efficient Estimation for Staggered Rollout Designs." Unpublished Manuscript.

Roth, Jonathan and Pedro H. C. Sant'Anna. 2021b. "When Is Parallel Trends Sensitive to Functional Form?" Unpublished Manuscript.

Sant'Anna, Pedro and Jun Zhao. 2020. "Doubly Robust Difference-in-Differences Estimators." Journal of Econometrics 219:101–122.

Sun, Liyang and Sarah Abraham. 2020. "Estimating Dynamic Treatment Effects in Event Studies with Heterogenous Treatment Effects." Journal of Econometrics Forthcoming.