Syllabus
450B Political Methodology II: Causal Inference, Winter 2025

Professor: Jens Hainmueller
TAs: Alicia Chen and Andrew Myers

Time and Place
Class: Tuesday/Thursday 9:00-10:20am; Encina Hall West 219
Section: Friday 9.30-11.20am; Encina Hall West 219

Contact Information and Office Hours

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Mo 3:30-5:00pm	Thu 2-4pm (in Encina West 204)	Wed 3-5pm (in DPL)
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Overview and Class Goals

This is the third course in the course sequence on quantitative political methodology, by which we mean the application of statistical methods to problems in political science and public policy. The goal of the course sequence is to teach you (1) to understand and (2) to confidently apply a variety of statistical methods and research designs that are essential for political science and public policy research.

Building on the first two courses (Math Camp and 450A), which covered math, probability, and linear regression models, this third class provides a survey of more advanced empirical tools for political science research. The focus is on statistical methods for causal inference, i.e. methods designed to address research questions that concern the impact of some potential cause (e.g. an intervention, a change in institutions, economic conditions, government policies) on some outcome (e.g. vote choice, income, election results, levels of violence).

We cover a variety of causal inference designs and methods. These include experiments, matching, regression, panel methods, difference-in-differences, synthetic control methods, instrumental variable estimation, regression discontinuity designs, quantile regressions, and sensitivity analysis.

We will analyze the strengths and weaknesses of these methods, and throughout the course we will illustrate the methods with applications drawn from various fields, including political science, public policy, economics, public health, and sociology. The ultimate goal of this course is to provide students with adequate methodological skills for conducting causal empirical research in their own fields of substantive interest.

Prerequisites

This course assumes a graduate level knowledge of linear regression, probability, and statistical computing in `R` as covered in the political science Math Camp and 450A. Students need to have to completed 450A with a grade B or higher. Students from outside the department who have not taken 450A need to take a placement exam to test into the class.

Class Requirements

Reading
The syllabus lists the required readings for every week. This required reading should be completed prior to lecture in a given week. Students are expected to read the material very carefully. You may even find it

helpful to read the material multiple times.

Homework and Exams
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 weekly homework assignments. The assignments consist of analytical problems, computer simulations, and data analysis. They will usually be assigned on Th afternoon and be due the following Th, prior to lecture. No late homework will be accepted. All sufficiently attempted homework (i.e. a typed and well organized write-up with all problems attempted) will be graded on a (+,✓,-) scale. 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. We also ask that you write the names of your co-workers on your assignments. For analytical questions, you should include your intermediate steps, as well as comments on those steps when appropriate. For data analysis questions, include annotated code as part of your answers. All results should be presented so that they can be easily understood.

There will be a final exam and a midterm exam, both will be in-class exams.

Grading
Grades will be based on:

- homework assignments (20% of final grade)
- a midterm in-class exam (40% of final grade)
- final in-class exam (40% of final grade)

The midterm exam is in class on Feb 20. The final exam will take place during the exam week and scheduled by the registrar. Students are expected to attend class and be available for the exams as scheduled.

You will not be allowed to collaborate with anybody on the midterm and final exams. This is to test if you have developed sufficient skills to work through problems on your own. No re-write is permitted on the exams.

Finally, please note that *no incompletes will be given in this course.*

Notes on Academic Integrity

Please respect and follow the rules described in Stanford's Honor code, which is available at:

https://communitystandards.stanford.edu/student-conduct-process/honor-code-and-fundamental-standard

In particular, the following is a (partial) list of the acts we will consider academically dishonest:

- Obtaining or consulting course materials from previous years
- Sharing course materials with people outside of the class, such as problem sets and solutions
- Copying and pasting someone else's answers to problem sets electronically, even if you collaborated with the person in a legitimate way (as specified above)

Policy on Using ChatGPT

In an effort to keep up with modern teaching methods and to facilitate an effective learning experience, our class has integrated the use of ChatGPT into its curriculum. The following policy outlines the extent to which students may use ChatGPT in the classroom, for homework, and during exams.

- **In-Class Usage**
  - *Permitted Activities:* Students may consult ChatGPT for clarifications on coding problems, syntax, or other related coding queries. Students can seek guidance on statistics-related issues from ChatGPT.
  - *Prohibited Activities:* Directly copying code or statistical methodologies without attempting the problem first is discouraged. Reliance solely on ChatGPT for answering in-class questions without engagement in class discussions is not allowed.
- **Homework Assignments**
  - *Permitted Activities:* Students are allowed to consult ChatGPT to assist with their homework assignments. If guidance from ChatGPT is utilized, it should serve as a supplementary tool and not as the primary source of information.
  - *Mandatory Reporting*: If a student uses ChatGPT for assistance on a homework assignment, the degree of usage should be detailed explicitly. This includes specifying which portions of the assignment were completed with the help of ChatGPT. Such details should be stated at the beginning of the assignment in a separate section titled **ChatGPT Assistance**. Using ChatGPT appropriately for assignments, as outlined, will not incur any grading penalties.
  - *Prohibited Activities:* Submitting work solely generated by ChatGPT as one's own without any personal understanding or contribution is a breach of this policy.
- **Examinations**
  - ChatGPT is strictly prohibited during the midterm and final exam. **Any** use of ChatGPT in these exams will be considered as violating the Honor Code.

Recitation Sections

Weekly recitation sections will be held on Fridays. The sections will cover a review of the theoretical material and also provide help with computing issues. The TAs will run the sections and can give more detail.

Computation

In this course we use R.

Since the assignments involve numerous programming tasks, we recommend following a consistent style guide. Some helpful guides are

- Tidyverse style guide
- Google's R style guide

Communication

We will use Slack to run the communication for the class. We will invite all registered students to the Slack workspace for the class.
If you have a question outside of lecture or the recitation, please post your questions on the `questions` thread on the course slack whenever possible; this is the most efficient way to answer questions and also helps your classmates.

You can also sign up for one-on-one office hours with the teaching staff using the links provided above for each person. Email / Slack us if you cannot make the scheduled office hours.

Schedule

Required Books

- *Most required readings are from the following two textbooks:*
  - Angrist, Joshua D. and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton University Press. (A standard reference for applied researchers for most topics covered in the first part of the course.)
  - Morgan, Stephen L. and Christopher Winship. 2015. *Counterfactuals and Causal Inference: Methods and Principles for Social Research*, **Second Edition**. Cambridge University Press. (This is the second edition of a standard reference for applied researchers for most topics covered in the first part of the course. There are considerable differences between the first and second edition. The assigned readings correspond to the second edition.)

Useful Summary Articles

- *The following papers summarize the main methods learned in this course. They are dense and detailed and you might not understand all of the details the first time you read through them. However, if you plan to conduct applied empirical work that involves causal inference, you should revisit these again and again as reference.*
  - Guido W. Imbens and Jeffrey Wooldridge. 2009. Recent Developments in the Econometrics of Program Evaluation. Journal of Economic Literature vol. 47, no. 1, March 2009.
  - Joshua D. Angrist and Alan B. Krueger. 1999. Empirical Strategies in Labor Economics. In Handbook of Labor Economics, ed. O. Ashenfelter and D. Card: Elsevier Science.
  - Susan Athey and Guido W. Imbens. 2017. The State of Applied Econometrics: Causality and Policy Evaluation. *Journal of Economic Perspectives* 31(2): 3–32.

Optional Books. *The following books are optional but prove useful for additional coverage of some of the course topics.*

- *Probability and Regression*
  - Aronow, Peter M., and Benjamin T. Miller. 2019. *Foundations of agnostic statistics.* Cambridge University Press
- *Causal Inference*
  - Imbens, Guido and Donald B. Rubin. 2015. *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction.*1st Edition. Cambridge University Press.
  - Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments.* W. W. Norton.
  - Cunningham, Scott. 2021. *Causal Inference, the Mixtape.* Online Version
  - Frölich, Markus and Stefan Sperlich. 2019. *Impact evaluation: treatment effects and causal analysis* Online Version (SUID required)
  - Rosenbaum, Paul R. 2009. *Design of Observational Studies.* Springer Series in Statistics.
  - Rosenbaum, Paul R. 2002. *Observational Studies.* Springer-Verlag. 2nd edition.
  - Pearl, Judea. 2009. Causality: Models, Reasoning, and Inference. New York: Cambridge University Press. 2nd edition.
  - Manski, Charles F. 1995. *Identification Problems in the Social Sciences.* Cambridge: Harvard University Press.

- *Matching*
  - Rubin, Donald. 2006. *Matched Sampling for Causal Effects*. Cambridge University Press.
- *Panel Methods*
  - Wooldridge, Jeffrey. 2010. *Econometric Analysis of Cross Section and Panel Data*, 2nd ed. MIT Press.

Preliminary Schedule

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

1 Introduction

- Overview, Course Requirements, Course Outline

2 The Potential Outcome Model

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

Readings

- Morgan and Winship: Chapter 1-2. ($\star$)
- Angrist and Pischke: Chapter 1. ($\star$)
- Holland, Paul W. 1986. Statistics and Causal Inference. *Journal of the American Statistical Association* 81(396): 945-960. ($\star$)
- Sekhon, Jasjeet S. 2004. Quality Meets Quantity: Case Studies, Conditional Probability and Counterfactuals. *Perspectives on Politics* 2 (2): 281-293.

3 Randomized Experiments

- Identification of Causal Effects under Randomization
- Implementation, Estimation, Diagnostics, Blocking
- Threats to Validity

Readings: Theory of Experiments

- Angrist and Pischke: Chapter 2. ($\star$)
- Athey, Susan, and Guido W. Imbens. 2016. The Econometrics of Randomized Experiments.
- Rosenbaum, Paul R. 2002. *Observational Studies*. Springer-Verlag. 2nd edition. Chapter 2.
- Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments*. W. W. Norton. Chapters 2-4.

- Neyman, Jerzy. 1923 [1990]. On the Application of Probability Theory to Agricultural Experiments. Essay on Principles. Section 9. *Statistical Science* 5 (4): 465-472. Trans. Dorota M. Dabrowska and Terence P. Speed.
- Lin, Winston. 2013. Agnostic Notes on Regression Adjustments to Experimental Data: Reexamining Freedman's Critique. *The Annals of Applied Statistics* 7(1): 295–318.

Readings: Application of Experiments

- Broockman, David, and Joshua Kalla. 2016. Durably reducing transphobia: A field experiment on door-to-door canvassing. *Science* 352.6282 (2016): 220-224.
- Olken, Benjamin. 2007. Monitoring corruption : Evidence from a field experiment in Indonesia. *Journal of Political Economy* 115 (2): 200-249.
- Gerber, Alan S., Donald P. Green and Christopher W. Larimer. 2008. Social Pressure and Voter Turnout: Evidence from a Largescale Field Experiment. *American Political Science Review* 102 (1): 1-48. ($\star$)
- Chattopadhyay, Raghabendra and Esther Duflo. 2004. Women as Policy Makers: Evidence from a Randomized Policy Experiment in India. *Econometrica*, 72 (5): 1409-1443.

Readings: Application of Natural Experiments

- Hyde, Susan D. 2007. The Observer Effect in International Politics: Evidence from a Natural Experiment. *World Politics* 60(1): 37-63. ($\star$)
- Ferraz, Claudio, and Federico Finan. 2008. Exposing Corrupt Politicians: The Effects of Brazil's Publicly Released Audits on Electoral Outcomes. *Quarterly Journal of Economics* 123(2): 703-45.
- Ho, Daniel E., and Kosuke Imai. 2008. Estimating Causal Effects of Ballot Order from a Randomized Natural Experiment: The California Alphabet Lottery, 1978-2002. *Public Opinion Quarterly* 72(2): 216-40.
- Dunning, Thad. 2012. *Natural Experiments in the Social Sciences: A Design-Based Approach*. New York: Cambridge University Press.

Readings: Experiments Review Articles

- Druckman, James N., and Donald P. Green, eds. 2021. Advances in experimental political science. Cambridge University Press, 2021.
- Palfrey, Thomas. 2009. Laboratory Experiments in Political Economy. *Annual Review of Political Science* 12: 379-388.
- Humphreys, Macartan, and Jeremy Weinstein. 2009. Field Experiments and the Political Economy of Development. *Annual Review of Political Science* 12: 367-378.
- Harrison, Glenn and John A. List. 2004. Field Experiments. *Journal of Economic Literature*, XLII: 1013-1059.
- List, John A., and Steven Levitt. 2006. What Do Laboratory Experiments Tell Us About the Real World? University of Chicago and NBER.

Readings: Useful Methodological Guides for Experiments

- Duflo, Esther, Abhijit Banerjee, Rachel Glennerster, and Michael Kremer. 2006. Using Randomization in Development Economics: A Toolkit. *Handbook of Development Economics.*
- Bloom, Howard S. 2008. "The Core Analytics of Randomized Experiments for Social Research." In The SAGE Handbook of Social Research Methods, eds. Pertti Alasuutar, Leonard Bickman, and Julia Brannen. London: SAGE.

- Bruhn, Miriam, and David McKenzie. 2009. In Pursuit of Balance: Randomization in Practice in Development Field Experiments. *American Economic Journal: Applied Economics* 1(4): 200-232.
- Abadie, Alberto, et al. 2023. When should you adjust standard errors for clustering?. *The Quarterly Journal of Economics* 138.1 (2023): 1-35.
- Stanford Administrative Panels for the Protection of Human Subjects http://humansubjects.stanford.edu/#start (⋆).

4 Causal Effects under Selection on Observables

4.1 Selection on Observables

- Identification under Selection on Observables
- Subclassification

Readings

- Morgan and Winship: Chapters 3-4. (⋆)
- Rubin, Donald B. 2008. For Objective Causal Inference, Design Trumps Analysis. *Annals of Applied Statistics* 2(3): 808-840.
- Rosenbaum, Paul R. 2002. Observational Studies. Springer-Verlag. 2nd edition. Chapter 3.
- Rosenbaum, Paul R. 2005. Heterogeneity and Causality: Unit Heterogeneity and Design Sensitivity in Observational Studies. *The American Statistician* 59: 147-152.
- Acemoglu, Daron. 2005. Constitutions, Politics, and Economics: A Review Essay on Persson and Tabellini's The Economic Effects of Constitutions. *Journal of Economic Literature* XLIII: 1025-1048.
- Athey, Susan, and Guido W. Imbens. 2015. A Measure of Robustness to Misspecification. *American Economic Review* 105(5): 476–480.

4.2 Matching Methods

- Covariate Matching, Balance Checks, Properties of Matching Estimators

Readings: Matching Theory

- Morgan and Winship: Chapter 5. (⋆)
- Imbens, Guido. 2014. Matching Methods in Practice: Three Examples. *NBER Working Paper 19959.*
- Sekhon, Jasjeet S. 2009. Opiates for the Matches: Matching Methods for Causal Inference. *Annual Review of Political Science* 12: 487-508.(⋆)
- Ho, Daniel E., Kosuke Imai, Gary King, and Elizabeth A. Stuart. 2007. Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference. *Political Analysis* 15: 199-236.
- Stuart, Elizabeth A. 2009. Matching methods for causal inference: A review and a look forward
- Rubin: Chapters 3 to 5.
- Rosenbaum, Paul R., 1995. *Observational Studies.* New York: Springer-Verlag. Chapter 3.
- Abadie, Alberto and Guido W. Imbens. 2006. Large Sample Properties of Matching Estimators for Average Treatment Effects, *Econometrica* 74: 235-267.

- Abadie, Alberto, and Guido W. Imbens. 2011. Bias-Corrected Matching Estimators for Average Treatment Effects. *Journal of Business & Economic Statistics* 29(1): 1-11.

Readings: Matching Applications

- Lyall, Jason. 2010. Are Co-Ethnics More Effective Counter-Insurgents? Evidence from the Second Chechen War. *American Political Science Review*, 104:1 (February 2010): 1-20.
- Gordon, Sanford and Gregory Huber. 2007. The Effect of Electoral Competitiveness on Incumbent Behavior. *Quarterly Journal of Political Science* 2(2): 107-138.
- Eggers, Andrew and Jens Hainmueller. 2009. MPs for Sale? Estimating Returns to Office in Post-War British Politics. *American Political Science Review*. 103 (4): 513-533.
- Gilligan, Michael J. and Ernest J. Sergenti. 2008. Do UN Interventions Cause Peace? Using Matching to Improve Causal Inference. *Quarterly Journal of Political Science* 3 (2): 89-122.
- Sekhon, J., and R. Titiunik. 2012. When Natural Experiments Are Neither Natural nor Experiments. *American Political Science Review* 106(1): 35-57.
- Sen, Maya. 2014. How Judicial Qualification Ratings May Disadvantage Minority and Female Candidates. *Journal of Law and Courts*. 2 (1): 33-65.

4.3 Propensity Score Methods

- Identification, Propensity Score Estimation, Matching on the Propensity Score, Weighting on the Propensity Score, Reweighting methods

Readings: Propensity Score Methods Theory

- Morgan and Winship: Chapter 5. ($\star$)
- Rubin: Chapters 10, 11 and 14 (all with Paul R. Rosenbaum).
- Imbens, Guido W. 2004. Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review. *Review of Economics and Statistics* 86 (1): 4-29.
- Hainmueller, Jens. 2012. Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies. *Political Analysis* 20 (1): 25-46.
- Glynn, Adam, and Kevin Quinn. 2010. An Introduction to the Augmented Inverse Propensity Weighted Estimator. *Political Analysis* 18(1): 36-56.
- Zubizarreta, José R. Stable weights that balance covariates for estimation with incomplete outcome data. *Journal of the American Statistical Association* 110.511 (2015): 910-922.

Readings: Propensity Score Methods Applications

- Rubin, Donald B. 2001. Using Propensity Scores to Help Design Observational Studies: Application to the Tobacco Litigation. *Health Services and Outcomes Research Methodology* 2 (3-4): 169-188.
- Blattman, Christopher. 2009. From Violence to Voting: War and Political Participation in Uganda. *American Political Science Review* 103 (2): 231-247.

4.4 Regression

- Agnostic Regression framework, Non-parametric Regression, Identification with Regression

Readings

- Angrist and Pischke: Chapter 3. ($\star$)
- Morgan and Winship: Chapters 6-7. ($\star$)
- Härdle, W and Linton, O. 1994. Applied Nonparametric Methods, in R. F. Engle and D. L. McFadden eds. *Handbook of Econometrics*, vol. 4. New York: Elsevier Science.
- White, H. 1980. Using Least Squares to Approximate Unknown Regression Functions. *International Economic Review* 21: 149-170.
- Hainmueller, J. and Hazlett, C. 2014. Kernel Regularized Least Squares: Reducing Misspecification Bias with a Flexible and Interpretable Machine Learning Approach. *Political Analysis* 22(2): 143-168. 2014.
- Chattopadhyay, A., and J. R. Zubizarreta. (2022): On the Implied Weights of Linear Regression for Causal Inference," *Biometrika*, Volume 110, Issue 3, September 2023, Pages 615–62
- Abadie, Alberto, Athey, Susan, Imbens, Guido, and Jeffrey Wooldridge. 2020. Sampling-based vs. Design-based Uncertainty in Regression Analysis. *Econometrica* 88.1 (2020): 265-296.

4.5 Double Debiased Machine Learning

Readings

- Chernozhukov, Victor, et al. "Double/debiased machine learning for treatment and causal parameters." *The Econometrics Journal*, Volume 21, Issue 1, 1 February 2018, Pages C1–C68,.

4.6 Conclusion: Selection on Observables

- Can Non-Experimental Method Recover Causal Effects?

Readings: Comparison of Experimental and Non-experimental Methods

- Dehejia, Rajeev H. and Sadek Wahba. 1999. Causal Effects in Non-Experimental Studies: Re-Evaluating the Evaluation of Training Programs, *Journal of the American Statistical Association* 94 (448): 1053-1062.
- Heckman, James J., Hidehiko Ichimura and Petra Todd. 1998. Matching as an Econometric Evaluation Estimator, *Review of Economic Studies* 65: 261-294.
- Shadish, William R., M.H. Clark, and Peter M. Steiner. 2008. Can Nonrandomized Experiments Yield Accurate Answers? A Randomized Experiment Comparing Random and Nonrandom Assignments. *Journal of the American Statistical Association* 103 (484): 1334-1344. ($\star$)
- Arceneaux, Kevin, Alan S. Gerber, and Donald P. Green. 2006. Comparing Experimental and Matching Methods using a Large-Scale Voter Mobilization Experiment. *Political Analysis* 14 (1): 1-36.
- John Concato, Nirav Shah, and Ralph Horwitz. 2000. Randomized, Controlled Trials, Observational Studies, and the Hierarchy of Research Designs. *New England Journal of Medicine* 342 (25): 1887-92.
- Benson, Kjell and Arthur J. Hartz. 2000. A Comparison of Observational Studies and Randomized, Controlled Trials. *New England Journal of Medicine* 342(25): 1878-86.

4.7 Sensitivity Analysis

- Nonparametric Bounds
- Formal sensitivity tests

Readings

- Guido W. Imbens. 2003. Sensitivity to Exogeneity Assumptions in Program Evaluation. *The American Economic Review* 93 (2): 126–32.
- Morgan and Winship: Chapter 12 ($\star$)
- Rosenbaum, Paul R. 2002. Observational Studies. Springer-Verlag. 2nd edition. Chapter 4.
- Manski, Charles F. 1995. *Identification Problems in the Social Sciences*. Cambridge: Harvard University Press. Chapter 2.
- VanderWeele, Tyler J. , and Onyebuchi A. Arah. 2011. Bias Formulas for Sensitivity Analysis of Unmeasured Confounding for General Outcomes, Treatments, and Confounders. *Epidemiology* 22 (1): 42.
- Rosenbaum, Paul R. 2009. Amplification of Sensitivity Analysis in Matched Observational Studies. *Journal of the American Statistical Association* 104 (488): 1398-1405.
- Paul Rosenbaum and Donald Rubin. 1983. Assessing Sensitivity to an Unobserved Binary Covariate in an Observational Study with Binary Outcome. Journal of the Royal Statistical Society. Series B (Methodological) 45(2): 212-18.
- Cinelli, C., and C. Hazlett. (2020): "Making sense of sensitivity: extending omitted variable bias," Journal of the Royal Statistical Society. Series B, Statistical methodology, 82, 39–67.

5 Causal Effects under Selection on Time-Invariant Characteristics

5.1 Difference-in-Differences Estimators

- Identification, Estimation, Falsification tests

Readings: DID Theory

- Angrist and Pischke: Chapter 5.2-5.4 ($\star$)
- Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. How Much Should We Trust Differences-in-Differences Estimates? *Quarterly Journal of Economics* 119 (1): 249-275.
- Athey, Susan, and Guido W. Imbens. 2022. Design-based analysis in difference-in-differences settings with staggered adoption. *Journal of Econometrics* 226.1 (2022): 62-79.

Readings: DID Applications

- Lyall, Jason. 2009. Does Indiscriminate Violence Incite Insurgent Attacks? Evidence from Chechnya. *Journal of Conflict Resolution* 53 (3): 331-62.
- Card, David. 1990. The Impact of the Mariel Boatlift on the Miami Labor Market, *Industrial and Labor Relations Review* 44 (2): 245-257.
- Card, David. and Alan B. Krueger. 1994. Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania," *American Economic Review* 84 (4): 772-793.
- Bechtel, Michael M. and Jens Hainmueller. 2011. How Lasting Is Voter Gratitude? An Analysis of the Short- and Long-Term Electoral Returns to Beneficial Policy. *American Journal of Political Science* 55 (4): 852-868.

5.2 Panel Data Methods

- Fixed Effects and Random Effects Estimation

Readings: Panel Methods Theory

- Angrist and Pischke: Chapter 5.1 ($\star$)
- Angrist and Pischke: Chapter 8 ($\star$)
- Roth, Jonathan, et al. 2023. What's trending in difference-in-differences? A synthesis of the recent econometrics literature. *Journal of Econometrics* (2023).
- Bai, Jushan. 2009. Panel data models with interactive fixed effects. *Econometrica* 77(4): 1229-1279.
- Callaway, B., and P. H. C. Sant'Anna. (2020): "Difference-in-Differences with multiple time periods," Journal of econometrics.
- Liu, L., Y. Wang, and Y. Xu. (2021): "A Practical Guide to Counterfactual Estimators for Causal Inference with Time-Series Cross-Sectional Data," arXiv [stat.ME]
- De Chaisemartin, Clément, and Xavier d'Haultfoeuille. "Two-way fixed effects estimators with heterogeneous treatment effects." American Economic Review 110.9 (2020): 2964-96.
- Sun, Liyang, and Sarah Abraham. "Estimating dynamic treatment effects in event studies with heterogeneous treatment effects." Journal of Econometrics 225.2 (2021): 175-199

Readings: Panel Methods Applications

- Ladd, Jonathan McDonald, and Gabriel S. Lenz. 2009. Exploiting a Rare Communication Shift to Document the Persuasive Power of the News Media. *American Journal of Political Science* 53 (2): 394-410. ($\star$)
- Berrebi, Claude. and Esteban F. Klor. 2008. Are Voters Sensitive to Terrorism? Direct Evidence from the Israeli Electorate. *American Political Science Review* 102 (3): 279-301.
- Hainmueller, Jens and Dominik Hangartner. 2016. Does Direct Democracy Hurt Immigrant Minorities? Evidence from Naturalization Decisions in Switzerland. *American Journal of Political Science.*

5.3 Synthetic Control Methods

Readings

- Abadie, Diamond, and Hainmueller. 2010. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association* 105(490): 493-505.
- Abadie, Diamond, and Hainmueller. 2014. Comparative Politics and the Synthetic Control Method. *American Journal of Political Science.* 59(2): 495?510.
- Xu, Yiqing. 2017. Generalized Synthetic Control Method: Causal Inference with Interactive Fixed Effects Models. *Political Analysis* 25(1): 57—76.
- Doudchenko, Nikolay and Guido W. Imbens. 2016. Balancing, Regression, Difference-In-Differences and Synthetic Control Methods: A Synthesis.
- Arkhangelsky, Dmitry, et al. Synthetic difference-in-differences. *American Economic Review* 111.12 (2021): 4088-4118.
- Abadie, Alberto and Javier Gardeazabal. 2003. The Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review* 92 (1). 113-132.

- Abadie, Alberto. 2021 Using synthetic controls: Feasibility, data requirements, and methodological aspects. *Journal of Economic Literature* 59.2 (2021): 391-425.
- Samartsidis, P., S. R. Seaman, A. M. Presanis, M. Hickman, and D. De Angelis. (2019): "Assessing the causal effect of binary interventions from observational panel data with few treated units," Statistical science: a review journal of the Institute of Mathematical Statistics, 34, 486–503.
- Athey, Susan, et al. "Matrix completion methods for causal panel data models." Journal of the American Statistical Association 116.536 (2021): 1716-1730.
- Ben-Michael, Eli, Avi Feller, and Jesse Rothstein. "The augmented synthetic control method." Journal of the American Statistical Association 116.536 (2021): 1789-1803.

6 Causal Effects under Selection on Time-variant Characteristics

6.1 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: Instrumental Variable Theory

- Angrist and Pischke: Chapter 4 ($\star$)
- Morgan and Winship: Chapter 8
- Morgan and Winship: Chapter 9 ($\star$)
- Angrist, Joshua D., Guido W. Imbens, and Donald B. Rubin. 1996. Identification of Causal Effects Using Instrumental Variables. *Journal of the American Statistical Association* 91(434): 444-455.
- Abadie, Alberto 2003. Semiparametric instrumental variable estimation of treatment response models. Journal of Econometrics 113 (2003) 231-263.
- Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments.* W. W. Norton. Chapters 5-6.
- Sovey, Allison J. and Donald P. Green 2011. Instrumental Variables Estimation in Political Science: A Readers' Guide. *American Journal of Political Science* 55 (1): 188-200.
- Lal, A., Lockhart, M. W., Xu, Y., & Zu, Z. (2021). How much should we trust instrumental variable estimates in political science?
- Lee, D. S., McCrary, J., Moreira, M. J., & Porter, J. (2022). Valid t-ratio Inference for IV. American Economic Review, 112(10), 3260-90.
- Young, A. (2022). Consistency without inference: Instrumental variables in practical application. European Economic Review, 104112.

Readings: Instrumental Variable Critique

- Deaton, Angus. 2010. Instruments, Randomization, and Learning About Development. *Journal of Economic Literature* 48(2): 424-455.
- Hernan, Miguel A., and James M. Robins. 2006. Instruments for Causal Inference: An Epidemiologist's Dream? *Epidemiology* 17(4): 360-72.
- Imbens, Guido W. 2010. Better LATE Than Nothing: Some Comments on Deaton (2009) and Heckman and Urzua (2009). *Journal of Economic Literature* 48(2): 399-423.

Readings: Instrumental Variable Applications

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