Causal Inference, Spring 2018 (PLSC 30600)
Monday, Wednesday 130-250
Kersten Phys Teach Center 103

Contact Information
Justin Grimmer.
Pick Hall 423
Office Hours: Open Door
Contact Information: grimmer@uchicago.edu, gchat at justin.grimmer@gmail.com
Overview and Class Goals

This class is the third in the graduate quantiative methodology sequence. Building on the first two courses, which covered math, probability, and linear regression models, this third class provides a survey of more advanced empirical tools for causal inference in political science research. The focus is on statistical methods for causal inference. That is we examine the effect of some potential cause on some outcome of interest.

I will 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, and sensitivity analysis.

We will analyze the strengths and weaknesses of these methods, and throughout the course I will illustrate the methods with applications drawn from various fields, including political science, public policy, economics, and sociology. The ultimate goal of this course is to provide students with adequate methodological skills for conducting cutting-edge empirical research in their own fields of substantive interest. The more proximate goals will teach students about potential outcomes notation, offer clarity on what is (and is not) a causal effect, and provide guidance about how to evaluate research designs and to assess threats to validity.

Prerequisites

This course assumes a graduate level knowledge of linear regression, probability, and statistical computing in `R`.
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 Wednesday morning and be due the following Wednesday, 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 and receive full credit. I encourage students to work together on the assignments, but you always need to write your own solutions, and I 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. I 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. The midterm exam is an in-class exam. The final exam will consist of a week-long take-home exam that is similar to a more extensive problem set, and you are required to work on this exam alone.

Grading
Grades will be based on:

- homework assignments (35% of final grade)
- an in-class midterm exam (30% of final grade)
- final take-home exam (30% of final grade)
- participation (5% of final grade).

The midterm exam will take place on April 30th. The final exam will take place during the exam week, June 4th- June 7th (Mon-Thu).

Computation

In this course we use `http://www.r-project.org/`R.

Course Website

The course github is at:
`https://github.com/justingrimmer/CausalInf`

I will distribute course materials—including readings, lecture slides and problem sets—on the github.
The course discussion board is at:
`piazza.com/uchicago/spring2018/plsc30600/home` on Piazza.

On Piazza there is a question-and-answer platform that is easy to use and designed to get you answers to questions quickly. It supports LaTeX, code formatting, embedding of images, and attaching of files. I encourage you to ask questions on the Piazza forum in addition to attending recitation sections and office hours.

Using Piazza will allow students to see and learn from other students' questions. But I will regularly check the board and answer questions posted, although everyone else is also encouraged to contribute to the discussion. A student's respectful and constructive participation on the forum will count toward his/her class participation grade. *Do not email your questions directly to me* (unless they are of personal nature) — I will not answer them!

Schedule

Please notice the following scheduling issues:

- First day of class is March 26
- Last day of class is May 30
- No class on 5/28 (Memorial Day)
- I will be absent on 4/2 and 4/4 so there will be no class. To make up those classes I will hold a make up session on 3/30 and 4/6. Time TBA.

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.
  - Morgan, Stephen L. and Christopher Winship. 2015. *Counterfactuals and Causal Inference: Methods and Principles for Social Research*, **Second Edition**. Cambridge University Press.

Useful Summary Articles

- Guido W. Imbens and Jeffrey Wooldridge. 2008. `http://ftp.iza.org/dp3640.pdf`Recent Developments in the Econometrics of Program Evaluation. NBER Working Paper No. 14251.
- Joshua D. Angrist and Alan B. Krueger. 1999. `http://www.sciencedirect.com/science/article/pii/S1573446399030047`Empirical Strategies in Labor Economics. In Handbook of Labor Economics, ed. O. Ashenfelter and D. Card: Elsevier Science.

Optional Books

- *The following books are optional but may prove useful for additional coverage of some of the course topics.*
- *Reference Book for Panel Methods*
  - Wooldridge, Jeffrey. 2010. *Econometric Analysis of Cross Section and Panel Data*, 2nd ed. MIT 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.
  - 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.

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. http://www.jstor.org/stable/2289064 Statistics and Causal Inference. *Journal of the American Statistical Association* 81(396): 945-960. ($\star$)
- Sekhon, Jasjeet S. 2004. http://journals.cambridge.org/abstract_S1537592704040150 Quality Meets Quantity: Case Studies, Conditional Probability and Counterfactuals. *Perspectives on Politics* 2 (2): 281-293.
- Titiunik, Rocio. 2015. "Can Big Data Solve the Fundamental Problem of Causal Inference?" PS: Political Science & Politics 48(1): 75-79

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. ($\star$)
- 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]. http://www.jstor.org/stable/2245382 "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. http://arxiv.org/pdf/1208.2301.pdf "Agnostic Notes on Regression Adjustments to Experimental Data: Reexamining Freedman's Critique". *The Annals of Applied Statistics*.
- Banerjee, Abhijit and Duflo, Ester. *Handbook of Field Experiments*, Vol.1 and 2 North Holland (an imprint of Elsevier).

Readings: Application of Experiments

- Olken, Benjamin. 2007. http://www.journals.uchicago.edu/doi/abs/10.1086/517935 "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. http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=1720748 "Social Pressure and Voter Turnout: Evidence from a Largescale Field Experiment". *American Political Science Review* 102 (1): 1-48. ($\star$)

- Wantchekon, Leonard. 2003. http://www.jstor.org/stable/25054228 "Clientelism and Voting Behavior: Evidence from a Field Experiment in Benin" *World Politics* 55 (3), April: 399-422.

- Chattopadhyay, Raghabendra and Esther Duflo. 2004. http://www.jstor.org/stable/3598894 "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. http://muse.jhu.edu/journals/world_politics/v060/60.1.hyde.html "The Observer Effect in International Politics: Evidence from a Natural Experiment". *World Politics* 60(1): 37-63. ($\star$)

- Ferraz, Claudio, and Federico Finan. 2008. http://qje.oxfordjournals.org/content/123/2/703.short%E2%80%8E "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. http://poq.oxfordjournals.org/cgi/content/abstract/72/2/216 "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.

- Fehrer, Andrew and Titiunik, Rocio. "Legislative Behavior Absent Reelection Incentives: Findings from a Natural Experiment in the Arkansas Senate" *Journal of the Royal Statistical Society: Series A* 181 (2) 351-378, 2018. https://rss.onlinelibrary.wiley.com/doi/abs/10.1111/rssa.12293

Readings: Experiments Review Articles

- Palfrey, Thomas. 2009. http://arjournals.annualreviews.org/doi/pdf/10.1146/annurev.polisci.12.091007.122139 Laboratory Experiments in Political Economy. *Annual Review of Political Science* 12: 379-388.

- Druckman, James N., Donald P. Green, James H. Kuklinski, and Arthur Lupia. 2006. http://journals.cambridge.org/abstract_S0003055406062514 The Growth and Development of Experimental Research in Political Science. *American Political Science Review* 100(4): 627-635.

- Green, Donald P., Peter M. Aronow, and Mary C. McGrath. 2012. http://www.tandfonline.com/doi/abs/10.1080/17457289.2012.728223Field Experiments and the Study of Voter Turnout. *Journal of Elections, Public Opinion & Parties*: 1-22.

- Humphreys, Macartan, and Jeremy Weinstein. 2009. http://www.columbia.edu/~mh2245/papers1/HW_ARPS09.pdf Field Experiments and the Political Economy of Development. *Annual Review of Political Science* 12: 367-378.

- Harrison, Glenn and John A. List. 2004. http://people.hbs.edu/nashraf/Harrison_Field%20Experiments_2004.pdf Field Experiments. *Journal of Economic Literature*, XLII: 1013-1059.

- List, John A., and Steven Levitt. 2006. http://pricetheory.uchicago.edu/levitt/Papers/jep%20revision%20Levitt%20%26%20List.pdf What Do Laboratory Experiments Tell Us About the Real World? University of Chicago and NBER.

- Gaines, Brian J., and James H. Kuklinski. 2007. http://pan.oxfordjournals.org/cgi/content/abstract/15/1/1 The Logic of the Survey Experiment Reexamined. *Political Analysis* 15: 1-20.

Readings: Useful Methodological Guides for Experiments

- Duflo, Esther, Abhijit Banerjee, Rachel Glennerster, and Michael Kremer. 2006. http://economics.mit.edu/files/806Using 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. http://pubs.aeaweb.org/doi/pdfplus/10.1257/app.1.4.200In Pursuit of Balance: Randomization in Practice in Development Field Experiments. *American Economic Journal: Applied Economics* 1(4): 200-232.

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. ($\star$)
- Rubin, Donald B. 2008. http://arxiv.org/pdf/0811.1640 "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. http://stat.wharton.upenn.edu/~rosenbap/heteroReprint.pdf "Heterogeneity and Causality: Unit Heterogeneity and Design Sensitivity in Observational Studies". *The American Statistician* 59: 147-152.
- Acemoglu, Daron. 2005. http://economics.mit.edu/files/4468 "Constitutions, Politics, and Economics: A Review Essay on Persson and Tabellini's The Economic Effects of Constitutions". *Journal of Economic Literature* XLIII: 1025-1048.

4.2 Matching Methods

- Covariate Matching, Balance Checks, Properties of Matching Estimators

Readings: Matching Theory

- Morgan and Winship: Chapter 5. ($\star$)
- Imbens, Guido. 2014. http://www.nber.org/papers/w19959 "Matching Methods in Practice: Three Examples". *NBER Working Paper 19959.*
- Sekhon, Jasjeet S. 2009. http://arjournals.annualreviews.org/doi/abs/10.1146/annurev.polisci.11.060606.135444 "Opiates for the Matches: Matching Methods for Causal Inference". *Annual Review of Political Science* 12: 487-508.($\star$)
- Ho, Daniel E., Kosuke Imai, Gary King, and Elizabeth A. Stuart. 2007. http://pan.oxfordjournals.org/cgi/content/abstract/mpl013v1 "Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference". *Political Analysis* 15: 199-236.
- Stuart, Elizabeth A. 2009. http://www.biostat.jhsph.edu/~estuart/Stuart-MatchingMethods-pdf "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. http://www.jstor.org/stable/3598929 "Large Sample Properties of Matching Estimators for Average Treatment Effects", *Econometrica* 74: 235-267.

- Abadie, Alberto, and Guido W. Imbens. 2011. http://www.hks.harvard.edu/fs/aabadie/bcmp.pdf "Bias-Corrected Matching Estimators for Average Treatment Effects." *Journal of Business & Economic Statistics* 29(1): 1-11.

Readings: Matching Applications

- Lyall, Jason. 2010. http://journals.cambridge.org/action/displayFulltext?type=1&pdftype=1&fid=7449380&jid=PSR&volumeId=104&issueId=01&aid=7449372 "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. http://www.nowpublishers.com/article/Details/QJPS-6035 "The Effect of Electoral Competitiveness on Incumbent Behavior". *Quarterly Journal of Political Science* 2(2): 107-138.

- Eggers, Andrew and Jens Hainmueller. 2009. https://web.stanford.edu/~jhain/Paper/APSR2009.pdf "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. http://nowpublishers.com/article/Details/QJPS-7051 "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. http://www-personal.umich.edu/~titiunik/papers/SekhonTitiunik2012_APSR.pdf "When Natural Experiments Are Neither Natural nor Experiments". *American Political Science Review* 106(1): 35-57.

- Sen, Maya. 2014. http://scholar.harvard.edu/files/msen/files/sen_ratings.pdf"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. http://www.mitpressjournals.org/doi/abs/10.1162/003465304323023651 "Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review". *Review of Economics and Statistics* 86 (1): 4-29.

- Hainmueller, Jens. 2012. http://pan.oxfordjournals.org/content/20/1/25.abstract "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. http://pan.oxfordjournals.org/content/18/1/36 "An Introduction to the Augmented Inverse Propensity Weighted Estimator". *Political Analysis* 18(1): 36-56.

Readings: Propensity Score Methods Applications

- Rubin, Donald B. 2001. http://www.springerlink.com/index/R445GG1778314228.pdf"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. http://www.journals.cambridge.org/abstract_S0003055409090212 "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. http://web.uconn.edu/tripathi/397/Applied%20nonparametric%20methods.pdf "Applied Nonparametric Methods", in R. F. Engle and D. L. McFadden eds. *Handbook of Econometrics*, vol. 4. New York: Elsevier Science.

- White, H. 1980. http://www.jstor.org/stable/2526245 "Using Least Squares to Approximate Unknown Regression Functions". *International Economic Review* 21: 149-170.

4.5 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. http://www.jstor.org/stable/2669919 "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. http://www.jstor.org/stable/2566973 "Matching as an Econometric Evaluation Estimator", *Review of Economic Studies* 65: 261-294.

- Shadish, William R., M.H. Clark, and Peter M. Steiner. 2008. http://stat-athens.aueb.gr/~jpan/Shadish-JASA2008(1334-1356)-17mr09.pdf "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. http://pan.oxfordjournals.org/cgi/content/abstract/14/1/37 "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. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1557642/ "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. http://www.nejm.org/doi/full/10.1056/NEJM200006223422506 "A Comparison of Observational Studies and Randomized, Controlled Trials". *New England Journal of Medicine* 342(25): 1878-86.

4.6 Sensitivity Analysis

- Nonparametric Bounds

- Formal sensitivity tests

Readings

- Guido W. Imbens. 2003. http://www.jstor.org/stable/3132212 "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. http://journals.lww.com/epidem/Abstract/2011/01000/Bias_Formulas_for_Sensitivity_Analysis_of.8.aspx "Bias Formulas for Sensitivity Analysis of Unmeasured Confounding for General Outcomes, Treatments, and Confounders". *Epidemiology* 22 (1): 42.

- Rosenbaum, Paul R. 2009. http://www.tandfonline.com/doi/abs/10.1198/jasa.2009.tm08470 "Amplification of Sensitivity Analysis in Matched Observational Studies". *Journal of the American Statistical Association* 104 (488): 1398-1405.

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. http://qje.oxfordjournals.org/content/119/1/249.abstract "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119 (1): 249-275.

Readings: DID Applications

- Lyall, Jason. 2009. http://www.jstor.org/stable/20684590 "Does Indiscriminate Violence Incite Insurgent Attacks? Evidence from Chechnya". *Journal of Conflict Resolution* 53 (3): 331-62.
- Card, David. 1990. http://www.jstor.org/stable/2523702 "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. http://faculty.smu.edu/Millimet/classes/eco6352/papers/ck.pdf "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. http://onlinelibrary.wiley.com/doi/10.1111/j.1540-5907.2011.00533.x/abstract "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 ($\star$)
- Bai, Jushan. 2009. http://www.jstor.org/stable/40263859"Panel data models with interactive fixed effects". *Econometrica* 77(4): 1229-1279.

Readings: Panel Methods Applications

- Ladd, Jonathan McDonald, and Gabriel S. Lenz. 2009. http://onlinelibrary.wiley.com/doi/10.1111/j.1540-5907.2009.00377.x/abstract "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. http://journals.cambridge.org/abstract_S0003055408080246 "Are Voters Sensitive to Terrorism? Direct Evidence from the Israeli Electorate". *American Political Science Review* 102 (3): 279-301.
- Acemoglu, Daron, Simon Johnson, James A. Robinson, and Pierre Yared. 2008. http://www.nber.org/papers/w11205"Income and Democracy". *American Economic Review* 98 (3): 808-842.
- Hajnal, Zoltan, Nazita Lajevardi, and Lindsay Nielson. 2017. https://pdfs.semanticscholar.org/0720/58298e221f8959500f3515c36509ba97e25d.pdf "Voter Identification Laws and the Suppression of Minority Votes" *Journal of Politics*. 79 (2). 363-379.
- Grimmer, Justin, Eitan Hersh, Marc Meredith, Jonathan Mummolo, and Clayton Nall. 2018. https://www.dropbox.com/s/uz4xm2qjsv6ekeh/comment_final.pdf?dl=0 "Obstacles to estimating voter ID laws' effect on turnout" 80 (3).
- Hajnal, Zoltan, John Kuk, and Nazita Lajevardi. 2018. https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/YAGHTA "We all Agree: Strict Voter ID Laws Disproportionately Burden Minorities" Forthcoming. *Journal of Politics* 80 (3).

5.3 Synthetic Control Methods

Readings

- Abadie, Diamond, and Hainmueller. 2010. http://www.tandfonline.com/doi/abs/10.1198/jasa.2009.ap08746#.Voip1jZh23I "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. https://web.stanford.edu/~jhain/Paper/AJPS2015a.pdf "Comparative Politics and the Synthetic Control Method". *American Journal of Political Science*. 59(2): 495?510.
- Abadie, Alberto and Javier Gardeazabal. 2003. http://pubs.aeaweb.org/doi/pdfplus/10.1257/000282803321455188 "The Economic Costs of Conflict: A Case Study of the Basque Country". *American Economic Review* 92 (1). 113-132.

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. `http://www.jstor.org/stable/2291629`"Identification of Causal Effects Using Instrumental Variables." *Journal of the American Statistical Association* 91(434): 444-455. ($\star$)
- Abadie, Alberto 2003. `http://www.hks.harvard.edu/fs/aabadie/gtep.pdf` "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. `http://faculty.smu.edu/millimet/classes/eco6374/papers/sovey\%20green\%202011.pdf` "Instrumental Variables Estimation in Political Science: A Readers Guide". *American Journal of Political Science* 55 (1): 188-200.

Readings: Instrumental Variable Critique

- Deaton, Angus. 2010. `http://pubs.aeaweb.org/doi/abs/10.1257/jel.48.2.424`"Instruments, Randomization, and Learning About Development". *Journal of Economic Literature* 48(2): 424-455.
- Hernan, Miguel A., and James M. Robins. 2006. `http://www.jstor.org/stable/20486236?seq=1#page_scan_tab_contents` "Instruments for Causal Inference: An Epidemiologist's Dream?" *Epidemiology* 17(4): 360-72.
- Imbens, Guido W. 2010. `http://www.jstor.org/stable/20778730` "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

- Holger L. Kern and Jens Hainmueller https://web.stanford.edu/~jhain/Paper/PA2009.pdf "Opium for the Masses: How Foreign Free Media Can Stabilize Authoritarian Regimes". Political Analysis (2009).
- Angrist and Krueger. 2001 http://www.jstor.org/stable/2696517 "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments"
- Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. http://www.jstor.org/stable/2677930 "The Colonial Origins of Comparative Development: An Empirical Investigation". *American Economic Review* 91(5): 1369-1401.
- Clingingsmith, David, Asim Ijaz Khwaja, and Michael Kremer. 2009. http://qje.oxfordjournals.org/content/124/3/1133.short "Estimating the Impact of the Hajj: Religion and Tolerance in Islam's Global Gathering". *Quarterly Journal of Economics* 124(3): 1133-1170.
- Hidalgo, F. Daniel, Suresh Naidu, Simeon Nichter, and Neal Richardson. 2010. http://www.mitpressjournals.org/doi/abs/10.1162/REST_a_00007 "Economic Determinants of Land Invasions". *Review of Economics and Statistics* 92(3): 505-523.
- Angrist, Joshua D. 1990. http://www.jstor.org/stable/2006669 "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records". *American Economic Review* 80(3): 313-336.

6.2 The Regression Discontinuity Design

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

Readings: RDD Theory

- Imbens, Guido W., and Thomas Lemieux. 2008. http://linkinghub.elsevier.com/retrieve/pii/S0304407607001091 "Regression Discontinuity Designs: A Guide to Practice". *Journal of Econometrics* 142 (2): 615-35. (Part of special issue on RDD, all of which is of interest.) ($\star$)
- Angrist and Pischke: Chapter 6 ($\star$)
- Hahn, Jinyong, Petra Todd and Wilbert Van der Klaauw. 2001. http://www.jstor.org/stable/2692190 "Identification and Estimation of Treatment Effects with a Regression Discontinuity Design", *Econometrica* 69 (1): 201-209.

Readings: RDD Applications

- Eggers, Andrew, Fowler, Anthony, Hainmueller, Jens, Hall, Andrew B. and Snyder, James M. 2015. http://onlinelibrary.wiley.com/doi/10.1111/ajps.12127/abstract "On the Validity of the Regression Discontinuity Design for Estimating Electoral Effects: New Evidence from over 40,000 Close Races". *American Journal of Political Science* 59(1): 259-274 ($\star$).

- Hidalgo, F. Daniel. 2012. Fraud or Enfranchisement? The Consequences of Electronic Voting for Political Representation in Brazil. Working Paper.

- Lee, David S. 2008. http://linkinghub.elsevier.com/retrieve/pii/S0304407607001121 "Randomized Experiments from Non-random Selection in U.S. House Elections". *Journal of Econometrics* 142 (2): 675-697. ($\star$)

- Hainmueller, Jens, and Holger Lutz Kern. 2008. http://www.sciencedirect.com/science/article/pii/S0261379407000996 "Incumbency as a Source of Spillover Effects in Mixed Electoral Systems: Evidence from a Regression- Discontinuity Design". *Electoral Studies* 27: 213-27.

- Caughey, Devin, and Jasjeet Sekhon. 2011. http://pan.oxfordjournals.org/content/19/4/385.abstract "Elections and the Regression Discontinuity Design: Lessons From Close U.S. House Races, 1942-2008". *Political Analysis* 19 (4): 385-408.

- Eggers, Andrew, Freier, Ronny, Grembi, Veronica and Nannicini, Tommaso. 2016. http://andy.egge.rs/papers/EggersFreierGrembiNannicini_pop_thresholds.pdf "Regression Discontinuity Designs Based on Population Thresholds: Pitfalls and Solutions".

- Calonico, Sebastian, Cattaneo, Matias, and Titiunik, Rocio. 2014. http://onlinelibrary.wiley.com/doi/10.3982/ECTA11757/abstract "Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs" *Econometrica* 82(6): 2295-2326.

- Hainmueller, Jens, Hall, Andrew, and Snyder, James. 2015. http://www.jstor.org/stable/10.1086/681238 "Assessing the External Validity of Election RD Estimates: An Investigation of the Incumbency Advantage" *Journal of Politics.* 77(3): 707-720.

- Hainmueller, Jens, Hangartner, Dominik, and Pietrantuono, Giuseppe. 2015. http://www.pnas.org/content/112/41/12651.abstract?sid=8efc8281-95c9-4973-9a2c-bae8df47fd4a Fosters the Long-Term Political Integration of Immigrants". *Proceedings of the National Academy of Sciences.* 112 (41) 12651-12656.

- Bertanha M, Imbens G. http://www.nber.org/papers/w20773 "External Validity in Fuzzy Regression Discontinuity Designs". 2014. Working Paper.