17.802 Quantitative Research Methods II

Spring 2017

MIT

Class Time:	T&R 9:30AM-11AM∗	**Recitation Time:**	TBA
Class Room:	E51–361	**Recitation Room:**	TBA

	Instructor	**TA**	**TA**
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Office Hours:	By appointment	Tuesday 2:30-4:00PM	Wednesday 3:00-4:30 PM

∗ Class will not meet on: Feb 21 (Monday schedule), Mar 28, 30 (spring break), Apr 18 (Patriots Day).

Purpose and Goals

This is the second course in the quantitative research methods sequence at the MIT political science department. The goal of the four-course sequence is to teach you how to understand and confidently apply a variety of statistical methods and research designs that are essential for political science research.

Building on the first course (17.800) which covered probability, statistics, and linear regression analysis, this second class provides a survey of more advanced empirical tools, with a particular focus on causal inference. We cover a variety of research designs and statistical methods for causal inference, including experiments, matching, regression, panel methods, difference-in-differences, synthetic control methods, instrumental variable estimation, regression discontinuity designs, causal mediation analysis, nonparametric bounds, and sensitivity analysis. We will analyze the strengths and weaknesses of these methods. Applications are drawn from various fields including political science, public policy, economics, and sociology.

The class is open to qualified students from other departments and undergraduates. However, the enrollment will be capped at 30 and priority will be given to graduate students in the political science department in the event of excess demand.

Prerequisites

There are three prerequisites for this course:

1. Mathematics: Basic college-level calculus and linear algebra.
2. Probability and statistics covered in 17.800 or an equivalent graduate-level course.
3. Computing: familiarity with at least one statistical software. We will use `R` in this course (more on this below).

For 1 and 3, we expect the level of background knowledge and skills equivalent to what is covered in the department's Math Camp and 17.800. For more information about the Math Camp see:

https://stellar.mit.edu/S/project/mathprefresher/index.html

Requirements

The final grades are based on the following items:

- **Problem sets** (40%): You can only learn statistics by doing statistics. Therefore, the homework for this course is extensive, including weekly homework assignments. The assignments consist of analytical, computational, and data analysis questions. They will usually be assigned on Thursday after class and due the following Thursday, prior to lecture. Each problem set will be counted equally toward the calculation of the final grade. All sufficiently attempted assignments will be graded on a three-point scale. You will receive a $\checkmark^+$ if you attempt all problems and complete them with only several minor errors; a $\checkmark$ if you attempt all problems and make either many minor errors or several major mistakes; and a $\checkmark^-$ if you make many major mistakes or if you do not attempt some of the problems. In the rare circumstance when you do an exceptionally good job, you may receive a special grade off the scale ($\checkmark^{++}$). The following additional notes will apply to all problem sets unless otherwise noted.
  - No late submission will be accepted, unless you ask for special permission from the instructor in advance of the deadline. (Permission may be granted or not granted, with or without penalty, depending on the specific circumstances.)
  - 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 must not simply copy and paste someone else's answers or computer code. *Violation of this policy will be considered an academic integrity issue and processed accordingly to MIT's rules and procedures for such violations*. 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.
  - Regardless of the grade you receive, you should go through your returned problem sets and read all the comments made by the TAs. Learning from your own mistakes is often the best way to accumulate knowledge and skills efficiently. Even a $\checkmark^+$ problem set usually contains several errors from which you can learn a lot. We will also post detailed example solutions on Stellar for each problem set; make sure to go through them as well.
- **Quizzes** (15%): Three in-class, closed-book 30 minute quizzes will take place on Thursday March 2, Tuesday March 23, and Thursday April 20 during the regular class time.
- **Project** (35%): The final project will be a short research paper which typically applies a method learned in this course to an empirical problem of your substantive interest. The paper should be around 10 pages in length and focus on the research question, data, empirical strategy, results, and conclusions. Literature reviews,

background, lengthy theoretical motivations, etc. should be omitted or may be included as an appendix. You also need to submit a copy of your analysis code. Students are free to choose any topic they want, as long as they have a clear research question that concerns causality. Projects co-authored with another student are generally encouraged. However, you should be mindful of the solo-authorship requirement for your second-year paper, if you are a first-year student in the political science department's Ph.D. program and you intend to use your project as a basis for your second year paper. Replication papers are accepted as long as they go beyond the original analysis in some significant way by applying techniques learned in the course.

Students need to meet the following milestones for their project:

- February to early March: **Start** thinking about possible topics, exploring data sources, and running simple analyses on acquired data sets. To guide your thoughts, we will post papers from previous iterations of this course that exemplify empirical studies using the main research designs and statistical methods covered in the course. You are encouraged to skim the posted papers to get the sense of what these methods are and whether they will be useful for answering empirical questions of your interest. Once you think you have a promising idea, go ahead and read more on the methods from the full reading list provided at the end of this syllabus. You should also run your ideas by the TAs and instructor during their office hours and after classes/recitations to obtain their reactions.
- March 14: Turn in a **brief description of your proposed project**. **By this date you need to have acquired the data you plan to use** and completed a descriptive analysis of the data (e.g. simple summary statistics, crosstabs and plots). Schedule a brief meeting with the instructor to discuss your proposal during office hours. You may be asked to revise and resubmit the proposal.
- May 4 and 9: Students will give **presentations** during the regular class time. Presentations should be approximately 10 minutes in length (determined based on the class size, but time limits will be strictly enforced) and will be oral accompanied by electronic slides, much like presentations at major academic conferences such as APSA and MPSA. Performance will be counted toward the class participation grade (see below).
- May 18: **Paper due**. Turn in the final version of your paper by the end of the day.

• **Participation and presentation** (10%): Students are strongly encouraged to ask questions and actively participate in discussions during lectures and recitation sessions.

In addition, the syllabus lists **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. The syllabus also lists suggested readings; once you have decided on a focus for your project, you should consider the relevant suggested readings very closely.

Recitation Sessions

Recitation sessions will be held in E53, room 438 on Fridays, 10-11AM. Sessions will cover various topics, including review of class materials and help with computing issues. The TA will run the sessions and can give more details. Attendance is *very strongly* encouraged.

Course Website

You can find the Stellar website for this course at:

https://learning-modules.mit.edu/class/index.html?uuid=/course/17/sp17/17.802

We will distribute course materials, including readings, lecture slides and problem sets, on this website.

Questions about Course Materials

In this course, we will utilize an online discussion board called *Piazza*. This is a question-and-answer platform that is easy to use and designed to get you answers to questions quickly. We encourage you to use the Piazza Q & A board when asking questions about lectures, problem sets, and other class materials outside of recitation sessions and office hours. You can sign up to the Piazza course page either directly from the below address or the link posted on the Stellar course website (there are also free Piazza apps for Android and iOS devices):

http://piazza.com/mit/spring2017/17802/home

Using Piazza will allow you to see and learn from questions others have. Both the TAs and the instructor will regularly check the board and answer questions posted, although everyone else is also encouraged to contribute to the discussion. Your respectful and constructive participation on the forum will count toward your class participation grade. *Do not email your questions directly to the instructors or TAs* (unless they are of a personal nature) — we will not answer them!

Books

- **Required books:** We will read chapters from the following books, which we strongly recommend that you purchase (they are *relatively* cheap; about $100 total). The books will be available for purchase at COOP and online bookstores (e.g. Amazon) and on reserve in the library.
  - Angrist, Joshua D. and Jörn-Steffen Pischke. 2008. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
  - Morgan, Stephen L. and Christopher Winship. 2014. *Counterfactuals and Causal Inference: Methods and Principles for Social Research*, 2nd ed. Cambridge University Press.
  - Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments*. W. W. Norton.

  Additionally, we will assign several book chapters and journal articles as required readings (see the reading list below). We will post either their scanned copies or links to electronic versions on Stellar.

- **Recommended books:** These books and review articles cover particular sections of the course more in depth and are recommended for your reference, particularly if the sections are directly relevant for your final project.
  - Imbens, Guido W. and Jeffrey Wooldridge. 2009. Recent Developments in the Econometrics of Program Evaluation. *Journal of Economic Literature*, 47(1): 5–86.
  - Imbens, Guido W. and Donald B. Rubin. 2015. *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. New York: Cambridge University Press.
  - Manski, Charles F. 1995. *Identification Problems in the Social Sciences*. Cambridge: Harvard University Press.
  - Pearl, Judea. 2009. *Causality: Models, Reasoning, and Inference*. New York: Cambridge University Press. 2nd edition.
  - Rosenbaum, Paul R. 2009. *Design of Observational Studies*. Springer Series in Statistics.
  - Wooldridge, Jeffrey M. 2002. Econometric Analysis of Cross Section and Panel Data. MIT Press.

Computation

We teach the course in `R`, an open-source statistical computing environment that is very widely used in statistics and political science. You can download it for free from www.r-project.org. The web provides many great tutorials and resources to learn `R`. A list of these is provided here. A nice way to start you off are the two video tutorials provided by Dan Goldstein here and also here. Another good resource is the set of tutorials provided by DataCamp.

If you are very familiar with another statistical software package you may use that for the course at your own risk. We can only support `R`.

Topics and Readings

Required readings are marked with a ($\star$) and are in **bold**.

1 Introduction

– Overview, course requirements, course outline

2 Statistical Models for Causal Analysis

– Causality as counterfactuals

– Potential outcomes

– The Fundamenal Problem of Causal Inference

– Identification and estimation

– Causal estimands

– Interference

– Causal graphs and other causal models

Readings: Basics

- **Morgan and Winship: Chapters 1, 2 and 3.** ($\star$)
- **Angrist and Pischke: Chapter 1.** ($\star$)
- Sekhon, Jasjeet S. 2004. "Quality Meets Quantity: Case Studies, Conditional Probability and Counterfactuals." *Perspectives on Politics* 2(2): 281-293.

Readings: Potential Outcomes

- Holland, Paul W. 1986. "Statistics and Causal Inference." *Journal of the American Statistical Association* 81(396): 945-960.

Readings: Causal Graphs

- Pearl, Judea. 1995. "Causal Diagrams for Empirical Research." *Biometrika*, 82(4): 779-710.

- Pearl, Judea. 2009. "Causal Inference in Statistics: An Overview." *Statistics Surveys*, 3: 96-146.

Readings: Alternative Causal Models

- Dawid, A. P. 2000. "Causal Inference Without Counterfractuals (with discussion)." *Journal of the American Statistical Association*, 95(450): 407-424.

3 Randomized Experiments

3.1 Identification and Estimation

– Identification of Causal Effects under Randomization

– Covariate adjustment

– Blocking

– Practical considerations

Readings: Theory

- **Angrist and Pischke: Chapter 2. (⋆)**
- **Gerber and Green: Chapters 2, 3 and 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.
- Freedman, D. A. 2008. "On Regression Adjustments to Experimental Data." *Advances in Applied Mathematics*, 40: 180-193.
- Lin, Winston. 2013. "Agnostic Notes on Regression Adjustments to Experimental Data: Reexamining Freedman's Critique." *Annals of Applied Statistics*. 7(5): 295-318.
- Baird, Sarah, J. Aislinn Bohren, Craig McIntosh, Berk Ozler. 2016. "Optimal Design of Experiments in the Presence of Interference." *Working Paper*

Readings: Field Experiments

- **Gerber, Alan S., Donald P. Green and Christopher W. Larimer. 2008. "Social Pressure and Voter Turnout: Evidence from a Large Scale Field Experiment." *American Political Science Review* 102(1): 1-48. (⋆)**
- Olken, Benjamin. 2007. "Monitoring Corruption: Evidence from a Field Experiment in Indonesia." *Journal of Political Economy* 115(2): 200-249.
- Wantchekon, Leonard. 2003. "Clientelism and Voting Behavior: Evidence from a Field Experiment in Benin." *World Politics* 55(3), April: 399-422.
- Chattopadhyay, Raghabendra and Esther Duflo. 2004. "Women as Policy Makers: Evidence from a Randomized Policy Experiment in India." *Econometrica*, 72(5): 1409-1443.

Readings: Natural Experiments

- Hyde, Susan D. 2007. "The Observer Effect in International Politics: Evidence from a Natural Experiment." *World Politics* 60(1): 37-63.

- 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.

- Washington, Ebonya L. (2008). "Female Socialization: How Daughters Affect Their Legislator Fathers' Voting on Women's Issues." *The American Economic Review*, 98(1), 311-332.

- Dunning, Thad. 2012. *Natural Experiments in the Social Sciences: A Design-Based Approach*. New York: Cambridge University Press.

Readings: Non-technical Overviews

- Druckman, James N., Donald P. Green, James H. Kuklinski, and Arthur Lupia. 2006. "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. "Field Experiments and the Study of Voter Turnout." *Journal of Elections, Public Opinion & Parties*: 1-22.

- Humphreys, Macartan, and Jeremy Weinstein. 2009. "Field Experiments and the Political Economy of Development." *Annual Review of Political Science* 12: 367-378.

- Levitt, Steven D. and John A. List. 2007. "What Do Laboratory Experiments Measuring Social Preferences Reveal About the Real World?" *Journal of Economic Perspectives* 21(2): 153-174.

- Gaines, Brian J., and James H. Kuklinski. 2007. "The Logic of the Survey Experiment Reexamined." *Political Analysis* 15: 1-20.

Readings: Implementation and Practical Guides

- Duflo, Esther, 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.

- Glennerster, Rachel and Kudzai Takavarasha. 2013. *Running Randomized Experiments: A Practical Guide*. Princeton University Press.

- MIT Committee on the Use of Humans as Experimental Subjects (COUHES) http://web.mit.edu/committees/couhes/.

3.2 Inference

- Variance estimation under the Neyman model

- Clustered designs

- Randomization inference

- Bootstrap
- Power analysis

Readings: Theory

- **Angrist and Pischke: Chapter 8.1 (⋆)**
- **Fisher, Ronald Aylmer. 1966 [1935]. *The Design of Experiments*. Edinburgh; London: Oliver and Boyd. Part II. (⋆)**
- **Efron, Bradley, and R. J. Tibshirani. 1993. *An Introduction to the Bootstrap.* New York: Chapman and Hall/CRC. Chapters 2 and 6. (⋆)**
- Rosenbaum, Paul R. 2010. *Design of Observational Studies*. Springer. Chapter 2.
- Abadie, Alberto, Susan Athey, Guido Imbens, and Jeffrey Wooldridge. 2014. "Finite Population Standard Errors". *NBER Working Paper*.

Readings: Application

- Ho, D. E. and K. Imai. 2006. "Randomization Inference with Natural Experiments: An Analysis of Ballot Effects in the 2003 California Recall Election." *Journal of the American Statistical Association*, 101(475): 888-900.

4 Observational Studies

4.1 Identification

- Selection on observables
- Post-treatment bias
- Subclassification

Readings

- **Morgan and Winship: Chapter 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. 1984. "The Consquences of Adjustment for a Concomitant Variable That Has Been Affected by the Treatment." *Journal of the Royal Statistical Society*. Series a (General), 147(5), 656-666.
- Cochran, W. G. 1968. The Effectiveness of Adjustment by Subclassification in Re-moving Bias in Observational Studies, *Biometrics*, vol. 24: 295-313.
- Jacob Montgomery, Brendhan Nyhan, and Michelle Torres. 2016. "How Conditioning on Post-Treatment Variables Can Ruin Your Experiment and What to Do About It." *Working Paper*.

4.2 Matching and Weighting

– Covariate matching

– Balance checking

– Propensity scores

Readings: Theory

- **Morgan and Winship: Chapter 5. (⋆)**
- 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. 2010. "Matching Methods for Causal Inference: A Review and a Look Forward." *Statistical Science* 25(1):1-21.
- Imbens, Guido W. 2004. Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review. *Review of Economics and Statistics* 86 (1): 4-29.
- 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.
- Imai, K., and D. A. van Dyk. 2004. Causal Inference With General Treatment Regimes. *Journal of the American Statistical Association*, 99(467), 854–866.
- Rubin, Donald. 2006. *Matched Sampling for Causal Effects*. Cambridge University Press. Chapters 3, 4, 5, 10, 11 and 14.
- Hirano, K., Imbens, G. W., and Ridder, G. 2003. Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score. *Econometrica*, 71(4), 1161-1189.
- 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.

Readings: 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, Jasjeet, and Rocło Titiunik. 2012. When Natural Experiments Are Neither Natural nor Experiments. *American Political Science Review* 106(1): 35-57.

- 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.

4.3 Regression

– OLS as an estimator of causal effects

Readings

- **Angrist and Pischke: Chapter 3.** ($\star$)

- **Morgan and Winship: Chapters 6 and 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.

4.4 Partial Identification and Sensitivity Analysis

– Nonparametric bounds

– Sensitivity analysis

Readings: Theory

- **Morgan and Winship: Chapter 12** ($\star$)

- Guido W. Imbens. 2003. Sensitivity to Exogeneity Assumptions in Program Evaluation. *The American Economic Review* 93 (2): 126–32.

- 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.

- Joseph Altonji, Todd E. Elder, and Christopher Taber. 2005. Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools. *Journal of Political Economy* Vol. 113: 151-184.

- 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.

Readings: Applications

- **Blattman, Christopher and Jeannie Annan. 2010. The Consequences of Child Soldiering. *Review of Economics and Statistics*, 42(4): 882–898.** ($\star$)

Readings: Comparison of Experimental and Observational Studies

- 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.
- 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.
- Heckman, J., Ichimura, H., Smith, J., and Todd, P. 1998. Characterizing Selection Bias Using Experimental Data. *Econometrica*, 66(5), 1017-1098.
- 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.

5 Instrumental Variables

- Treatment noncompliance
- Principal stratification
- Local average treatment effects
- Wald estimator and two-stage least squares

Readings: Theory

- **Angrist and Pischke: Chapter 4** ($\star$)
- **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.
- Balke, Alexander and Judea Pearl. 1997. Bounds on Treatment Effects from Studies with Imperfect Compliance. *Journal of the American Statistical Association*, 92: 1171–1176.

Readings: Critiques

- 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: Applications

- **Ananat, Elizabeth Oltmans, and Ebonya Washington. 2009. Segregation and Black Political Efficacy. Journal of Public Economics 93(5-6): 807-22. (⋆)**
- Iyer, L. (2010). Direct versus Indirect Colonial Rule in India: Long-Term Consequences. *The Review of Economics and Statistics*, 92(4), 693-713.
- Angrist and Krueger. 2001 Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments
- Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. 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. Estimating the Impact of the Hajj: Religion and Tolerance in Islam's Global Gathering. *Quarterly Journal of Economics* 124(3): 1133-1170.
- Angrist, Joshua D. 1990. Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records. *American Economic Review* 80(3): 313-336.

6 Regression Discontinuity

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

Readings: Theory

- **Angrist and Pischke: Chapter 6 (⋆)**
- **Skovron, Christopher and Roco Titiunik. 2015. A Practical Guide to Regression Discontinuity Designs in Political Science. *Working paper.* (⋆)**
- **de la Cuesta, Brandon and Kosuke Imai. 2016. Misunderstandings about the Regression Discontinuity Design in the Study of Close Elections. *Annual Review of Political Science* 19. (⋆)**
- Imbens, Guido W., and Thomas Lemieux. 2008. Regression Discontinuity Designs: A Guide to Practice. *Journal of Econometrics* 142 (2): 615-35.
- Hahn, Jinyong, Petra Todd and Wilbert Van der Klaauw. 2001. Identification and Estimation of Treatment Effects with a Regression Discontinuity Design, *Econometrica* 69 (1): 201-209.
- Keele, Luke and Rocio Titiunik. 2015. Geographic Boundaries as Regression Discontinuities. *Political Analysis* 23 (1): 127-155.

Readings: Applications

- Lee, David S. 2008. Randomized Experiments from Non-random Selection in U.S. House Elections. *Journal of Econometrics* 142 (2): 675-697.
- Caughey, Devin, and Jasjeet Sekhon. 2011. Elections and the Regression Discontinuity Design: Lessons From Close U.S. House Races, 1942-2008. *Political Analysis* 19 (4): 385-408.
- Eggers, Andrew, Olle Folke, Anthony Fowler, Jens Hainmueller, Andrew Hall, and James Snyder. 2015. 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.

7 Fixed Effects and Difference in Differences

– Selection on time-invariant unobservables

Readings: Theory

- **Angrist and Pischke: Chapter 5 (⋆)**
- Kim, In Song and Kosuke Imai. On the Use of Linear Fixed Effects Regression Estimators for Causal Inference. *Working Paper*.
- 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.

Readings: Fixed Effects Applications

- **Acemoglu, Daron, Simon Johnson, James A. Robinson, and Pierre Yared. 2008. Income and Democracy. *American Economic Review* 98 (3): 808-842. (⋆)**
- La Ferrara, Eliana, Albert Chong, and Suzanne Duryea. 2012. Soap Operas and Fertility: Evidence from Brazil. *American Economic Journal: Applied Econometrics* 4(4): 10-1.
- 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.
- 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.

Readings: Difference in Differences Applications

- **Sances, Michael. 2015. The Distributional Impact of Greater Responsiveness: Evidence from New York Towns. *Journal of Politics* 78(1):105-119. (⋆)**
- Lyall, Jason. 2009. Does Indiscriminate Violence Incite Insurgent Attacks? Evidence from Chechnya. *Journal of Conflict Resolution* 53 (3): 331-62.
- 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.

8 Synthetic Control Methods

Readings

- **Abadie, A., A. Diamond, and J. 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: 493–505. (⋆)**
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9 Causal Mechanisms

– Direct and indirect effects

– Sequential ignorability

– Sensitivity analysis and research designs

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10 External Validity

– Population Average Treatment Effects

– Extrapolation to Other Populations

– Meta-Analysis

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