Quantitative Political Analysis 3

Ohio State University

Syllabus: Autumn 2016

Instructor:	William Minozzi	Class location:	0150 Derby Hall
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TA:	Drew Rosenberg	Recitation loc:	TBD
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Description

The purpose of this class is to introduce the modern language of causal inference, a large and growing field across the social sciences. In this class, we will build a formal model of causation, here defined as "something that makes a difference...from what would happened without it" (Lewis 1973). Identifying such a difference meaning thinking about things that never happened, and so causal inference is impossible without assumptions about such events. The majority of the endeavor is comprised of making credible assumptions about things we will never observe, divining clever ways to falsify those assumptions, and probing the sensitivity of one's findings to circumstances in which those assumptions fail.

Assignments & grading

Course notebook

There will be no traditional problem sets for this course. Instead, you will be responsible for producing a detailed course notebook. The purpose of the notebook is to have you compile a resource that will serve you throughout your career, while simultaneously giving us some way to gauge your grasp of the material. Portions of this notebook will be handed in every two weeks for review. At the end of the term, a complete hard copy of your notebook will be submitted and should incorporate all comments made during the section reviews.

Due dates: Installments are due on 8/30, 9/13, 9/27, 10/11, 10/25, 11/8, and 12/6.

Format: The notebook must be typed in LaTeX. There are numerous free, high quality packages available for working with LaTeX on both the Mac and Windows platforms. Details on where you can find these will be provided in the first recitation session.

Code: All code to produce your notebook must be submitted in hard copy and electronically to the TA.

Late assignments: Unless you have made prior arrangements with the instructor, you will get no credit for submitting your notebook late. But you should turn them in *even if they're late*, as the comments you receive will improve the quality of the final product.

Credit: This project will be worth 50% of your grade, with 30% allocated to the reports and 20% to the final product.

Project

Instead of a final exam, students will complete short research projects, which will include a written component (no more than 15 pages) and a replication component (an R package). The project should apply methods from the course. Co-authorship is encouraged.

Due dates:

9/6 : Submit a short (no more than 1 page) description of your project to the instructor and TA. Arrange a short meeting to discuss your plan.

9/20, 10/4, 10/18, 11/1, 11/15, 11/29 : Submit short progress reports (no more than 1 pages of text) to the instructor and TA. The report should outline goals for the next submission date.

12/13 : Submit your paper and package to the instructor, TA, and class.

Code: All code to produce your project must be submitted in hard copy and electronically.

Late assignments: Unless you have made prior arrangements with the instructor, you will get no credit for submitting material late.

Credit: This project will be worth 50% of your grade, with 30% allocated to the reports and 20% to the final product.

Books

I have tried (and almost certainly failed) to be exhaustive when compiling this list. You are not required to buy all of these books, but we will use material from many of them.

(AP) Angrist, Joshua D., and Jörn-Steffen Pischke. 2008. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

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

Freedman, David A. 2010. *Statistical Models and Causal Inference: A Dialogue with the Social Sciences*. Ed. by David Collier, Jasjeet S. Sekhon, and Philip B. Stark. Cambridge University Press.

Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments: Design, Analysis, and Interpretation*. Norton.

Gelman, Andrew, and Jennifer Hill. 2007. *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press.

(HR) Hérnan, Miguel A., and James M. Robins. 2016. *Causal Inference*. Cambridge University Press.
URL:http://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/

(IR) Imbens, Guido W., and Donald B. Rubin. 2015. *Causal Inference in Statistics, Social, and Biomedical Sciences*. Cambridge University Press.

(Manski) Manski, Charles F. 2007. *Identification for Prediction and Decision*. Harvard University Press.

(MgW) Morgan Stephen L., and Christopher Winship. 2007. *Counterfactuals and Causal Inference*. Cambridge University Press.

Morton, Rebecca B., and Kenneth C. Williams. 2010. *Experimental Political Science and the Study of Causality: From Nature to the Lab*. Cambridge University Press.

Pearl, Judea. 2009. *Causality*. 2nd edition. Cambridge University Press.

Rosenbaum, Paul R. 2002. *Observational Studies*. Springer-Verlag.

(DOS) Rosenbaum, Paul R. 2009. *Design of Observational Studies*. Springer-Verlag.

Spirtes, Peter, Clark Glymour, and Richard Scheines. 2000. *Causation, Prediction, and Search*. 2nd edition. MIT Press.

Topic schedule

Introduction, Probability & statistics review

Readings. MgW Chapter 1.

Topics. Random variables. Cumulative distribution functions. Mean and variance. Law of iterated expectations. Law of total probability. Sampling. Estimation. Bias and consistency. Inference. Conditional mean function. Best linear predictor.

Potential outcomes

Readings. MgW Chapters 2-3.

Topics. Association. Counterfactuals. The fundamental problem of causal inference. Potential outcomes. Temporal stability. Unit homogeneity. Interference. Treatment variation. SUTVA. Causal estimands.

Causal Graphs

Readings. MgW Chapters 3 & 4.

Topics. Graphical models. DAGs. Intervention/*do*-calculus. Causal Markov assumption. Colliders. Back-door and front-door criteria. Confounding.

Inference

Readings. Gerber and Green (2012), Chapter 3. Leamer (2010).

Topics. Internal and external validity. Problems with statistical significance. Classical (Neyman) inference. Weak null hypothesis of zero average effect. Repeated sampling. Superpopulation. Randomization/permutation (Fisher) inference. Sharp null hypothesis of no effect. Bootstrapping.

Observational studies

Readings. Rosenbaum *Design of Observational Studies* Chs. 3-5 (on slack). Also optional (but awesome) is Rubin (2008) "Design Trumps Analysis."

Topics. Regular Assignment mechanisms. Exchangeability. Positivity/overlap. Balance. Ignorability/selection on observables. Selection bias. Placebo outcomes & treatments. Elaborate theories. Coherence. Dose-response.

Matching, weighting, & regression

Readings. MgW Chapters 5-7.

Topics. Propensity score. Subclassification. Matching and varieties thereof. Inverse probability of treatment weighting. Varieties of regression.

Using time

Readings. AP Chapter 5. MgW Chapter 9,11.

Topics. Difference in differences. Identification. Fixed effects vs. random effects. Parallel paths. Falsification checks. Synthetic cohorts. Marginal structure models.

Instrumental variables

Readings. MgW Chapter 9.

Topics. Encouragement. Intention-to-treat. As-treated. Compliance. Exclusion restriction. LATE/CACE. Wald estimator. Two-stage least squares. Principal stratification. Generalized endogenous treatment.

Discontinuities

Readings. MgW Chapter 11.

Topics. Sharp design. Identification. Fuzzy regression discontinuity. Estimation via local polynomials. Binning/windows. Falsification checks.

Mechanisms and attribution

Readings. MgW Chapter 10.

Topics. Direct and indirect effects. Sequential ignorability. Front-door criterion. Causes of effects vs. effects of causes.

Credibility, partial identification, & design sensitivity (Time Permitting)

Readings. MgW Chapter 12

Topics. Law of Decreasing Credibility. Bounding the effect of treatment. Worst case bounds. Monotone treatment response. Monotone treatment selection.
