

PS355: STATISTICS FOR CAUSAL INFERENCE IN THE SOCIAL SCIENCES

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DESCRIPTION

The goal of this course is to have students propose research questions that they are interested in, and to examine how (or whether) these questions could be answered. The main concern is with thinking clearly about answering empirical questions.

To this end, we will study the statistical foundations of two frameworks for drawing causal inference based on observational data.

The first framework is based on approximating experimental design. I devote most attention to the potential outcome approach and matching. Instrumental variable methods are also discussed in this context. We will also consider for a small fraction of the course a second framework based on empirically testing the qualitative features of comparative statics of equilibrium relationships derived from a formal model.

As part of this course we will also pay particular attention to use of non-parametric tests for comparing empirical distributions.

PREREQUISITES

PS350A (probability and statistics) or equivalent.
PS350B (linear models) or equivalent can be taken concurrently.

TIMES AND LOCATIONS

Lecture/seminar: MW 02:15 PM-04:05 PM Building 160-332

Office Hours: Tu 1:30-2:30, Encina Hall West, Room 308

REQUIREMENTS

Problem sets and research proposal (10 page maximum).

MATERIALS AND SUPPLEMENTARY INFORMATION

Although most of the content of the course is derived from articles, I recommend that you obtain a copy of Rosenbaum, Paul R. 2002. *Observational studies*. New York: Springer, 2nd edition. It is a useful book, and provides a treatment of the concepts with a uniform notation. The 2nd edition is available at [amazon.com]

Other materials and information related to this course will be posted at:

<http://polisci355.stanford.edu>

COURSE OUTLINE

1. CAUSALITY

Illustrations of observational studies based on approximate experimental design or based on testing formal theories. Discussion of other competing frameworks for understanding causal effects.

- Holland, Paul W. 1986. Statistics and Causal Inference (with discussion). *Journal of the American Statistical Association*, 81(396):945–70 [[JSTOR ToC](#)]
- Little, R.J. and D.B. Rubin. 2000. Causal effects in clinical and epidemiological studies via potential outcomes: Concepts and analytical approaches. *Annual Review of Public Health*, 21:121–45 [[link](#)]

For an overview of some methods that will be presented, and others that may or many not be considered (depending on student interests), skim the following,

- Winship, Christopher and Stephen L. Morgan. 1999. The Estimation Of Causal Effects From Observational Data. *Annual Review of Sociology*, 25:659–706 [[link](#)]

2. RANDOMIZED EXPERIMENTS: THEORY AND INFERENCE

Properties of experiments, basic implementations. Methods of hypothesis testing and inference.

- Cox, D. R.. 1958. *Planning of Experiments*. New York: Wiley. Chapters 1 and 2. [[pdf](#)]
- Rosenbaum Chapter 2
- Cochran, William G. 1983. *Planning and Analysis of Observational Studies*. New York: Wiley. Chapters 1 and 7 [[pdf](#)]

3. UNCONFOUNDED ASSIGNMENT TO TREATMENT

Experimental and observational studies where assignment to treatment is done on observables. Stratification and matching.

- Rosenbaum Chapter 3.1–3.3
- Cox, D. R.. 1958. *Planning of Experiments*. New York: Wiley. Chapters 3 and 4. [[pdf](#)]
- Rubin, Donald B. 1991. Practical Implications of Modes of Statistical Inference for Causal Effects and the Critical Role of the Assignment Mechanism. *Biometrics*, 47(4):1213–34 [[JSTOR](#)]

4. TOOLS: NONPARAMETRIC STATISTICAL METHODS

Rank-based tests. Bootstrap and permutation procedures.

- Lehmann, E. L. 1975. *Nonparametrics: Statistical Methods Based on Ranks*. San Francisco: Holden-Day. Chapters 1 and 2.4–2.7 and 5.1–5.2 [[pdf](#)]

5. APPROACHES TO MATCHING

- Cochran, William G. 1983. *Planning and Analysis of Observational Studies*. New York: Wiley. Chapter 5.
- Rubin, Donald B. 1973. Matching to Remove Bias in Observational Studies. *Biometrics*, 29(1):159–83 [[JSTOR](#)]
- Rosenbaum, Paul and Donald B. Rubin. 1983. The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika*, 70:41–55 [[JSTOR](#)]
- Rubin, Donald B. and Neal Thomas. 1996. Matching Using Estimated Propensity Scores: Relating Theory to Practice. *Biometrics*, 52(1):249–64 [[JSTOR](#)]
- Imbens, Guido. 2004. Nonparametric Estimation of Average Treatment Effects Under Exogeneity: A Review. *The Review of Economics and Statistics*, 86(1):4–29 [[doi link](#)]
- Diamond, Alexis and Jasjeet S. Sekhon. 2005. Genetic Matching for Estimating Causal Effects: A General Multivariate Matching Method for Achieving Balance in Observational Studies. Mimeo [[pdf](#)]

6. REGRESSION ADJUSTMENTS: COMPARISON AND CONNECTIONS WITH MATCHING

- Cochran, William G. 1983. *Planning and Analysis of Observational Studies*. New York: Wiley. Chapter 6

7. APPLICATIONS

- Lalonde, R. 1986. Evaluating the Econometric Evaluations of Training Programs. *American Economic Review*, 76(4):604–20 [[JSTOR](#)]
- Dehejia, R. and S. Wahba. 1999. Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programs. *Journal of the American Statistical Association*, 94(448):1053–62 [[JSTOR](#)]
- Diamond, Alexis and Jasjeet S. Sekhon. 2005. Genetic Matching for Estimating Causal Effects: A General Multivariate Matching Method for Achieving Balance in Observational Studies. Mimeo

8. ASSESSING UNCONFOUNDEDNESS, SENSITIVITY ANALYSIS, AND BOUNDS

Multiple control groups, zero-effect outcomes, bounds, ...

- Rosenbaum Chapters 4 and 8
- Rosenbaum, Paul W. and Donald B. Rubin. 1985. The Bias Due to Incomplete Matching. *Biometrics*, 41:103–116 [[JSTOR](#)]
- Manski, Charles F. 1990. Nonparametric Bounds on Treatment Effects. *American Economic Review Papers and Proceedings*, 80(2):319–23 [[JSTOR](#)]

9. INSTRUMENTAL VARIABLES (IV)

- Angrist, Joshua D. and Alan B. Krueger. 2001. Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments. *Journal of Economic Perspectives*, 15(4):69–85 [[pdf](#)]
- Angrist, Joshua D., Guido W. Imbens, and Donald B. Rubin. 1996. Identification of Causal Effects Using Instrumental Variables (with discussion). *Journal of the American Statistical Association*, 91(434):444–72 [[JSTOR ToC](#)]
- Heckman, James J. 1997. Instrumental Variables: A Study of Implicit Behavioral Assumptions Used in Making Program Evaluations. *Journal of Human Resources*, 32(3):441–62 [[JSTOR](#)]

10. APPLICATIONS AND CAVEATS

- Rosenzweig, Mark R. and Kenneth I. Wolpin. 2000. Natural “Natural Experiments” in Economics. *Journal of Economic Literature*, 38(4):827–74 [[JSTOR](#)]
- Bound, John, David A. Jaeger, and Regina M. Baker. 1995. Problems with Instrumental Variables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variable is Weak. *Journal of the American Statistical Association*, 90(430):443–50 [[JSTOR](#)]

11. PRACTICAL ADVICE: SENSITIVITY TESTS AND BOUNDS

- Sekhon, Jasjeet and Jonathan Wand. “Counterfactuals and Sensitivity Analysis for Instrumental Variable Models.” mimeo.
- Manski, Charles F. and Daniel S. Nagin. 1998. Bounding Disagreements about Treatment Effects: A Case Study of Sentencing and Recidivism. *Sociological Methodology*, 28:99–137 [[JSTOR](#)]

12. FORMAL MODELS AND CAUSAL INFERENCE I

- Wand, Jonathan. 2005. “Partisan Preferences and Investment Motives among Special Interest Groups”. Mimeo.
- Manski, Charles F. 1993. Identification Problems in the Social Sciences. *Sociological Methodology*, 23:1–56 [[JSTOR](#)]
- Beresteanu, Arie. 2004. “Nonparametric Estimation of Regression Functions under Restrictions on Partial Derivatives”. Mimeo. [[link](#)]

13. HYBRID COMPARATIVE STUDIES: SYNTHETIC COHORTS AND EVENT ANALYSIS

- Abadie, Alberto and J. Gardeazabal. 2003. The Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review*, 93(1):113–32 [DOI: 10.1257/000282803321455188]

14. EVALUATING OBSERVATIONAL STUDIES

- Rosenbaum Chap 9,11,12
- *Student proposed articles*

15. FIXING BROKEN EXPERIMENTS AND A CONTROVERSY

- Gerber, Alan S. and Donald P. Green. 2000. "The Effects of Canvassing, Telephone Calls, and Direct Mail on Voter Turnout: A Field Experiment." *American Political Science Review* 94(3): 653-663.
- Imai, Kosuke. "Do Get-Out-The-Vote Calls Reduce Turnout? The Importance of Statistical Methods for Field Experiments." *American Political Science Review*
- Green and Gerber Reply
- Bowers, Jake and Ben Hansen. 2005. "Attributing Effects to a Get-Out-The-Vote Campaign Using Full Matching and Randomization Inference." Working Paper.

16. AN OVERVIEW OF METHODS AND APPROACHES NOT DISCUSSED IN DETAIL

17. PRESENTATION OF PROJECT PROPOSALS