Causal Inference: Beyond the Basics

Jake Bowers
jwbowers@illinois.edu
Online: http://jakebowers.org/

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Overview

Where/When We will meet Tuesday and Wednesday, July 16 and 17, 0900–1200.

Introduction This course builds on the Introduction to Causal Inference course given earlier in the Institute of Political Methodology Summer School of 2019. We will focus on deepening and applying the concepts introduced in that course, especially with regards to the use and diagnosis of matching techniques for non-parametric adjustment in non-randomized research designs and design-based statistical inference based on the resulting matched research designs.

Schedule

Class 1: Doing Matching, Assessing Matched Designs, Estimating Effects

Topics: **How to use optimal, full matching to produce a matched-research design?** Multivariate optimal matching review using `optmatch` in R: producing matched research designs using matching on scalars, propensity scores, and Mahalanobis distances.

How to reason about whether we have a good matched research design? Multivariate balance assessment using null hypothesis testing using the `RItools` package for R (and perhaps also using equivalence testing).

How to customize and focus the matched research design creation? Multivariate optimal matching; calipers; penalties; combining scores

How to estimate the ATE and test hypotheses about causal effects given a matched research design? Estimating ATE and Std Errors from Matched Designs using the Block Randomized Experiment as an Analogy.

References Rosenbaum, 2010, Chap 1,3,7,8,9,13 (http://www.springerlink.com/content/978-1-4419-1212-1/contents/)

Gelman and Hill, 2007, Chap 9.0–9.2 (on causal inference and the problems of interpolation and extrapolation)

Hansen, 2004 on full matching for adjustment

Hansen and Bowers, 2008 on assessing balance.

Class 2: Going Beyond Two Treatment Groups

Topics: **Matching with more than one treatment** Multivariate optimal **nonbipartite** matching review using the `nbpMatching` package for R: producing matched research designs using matching on scalars, propensity scores, and Mahalanobis distances.

Balance assessment after non-bipartite matching. Multivariate balance assessment using null hypothesis testing (and using equivalence testing).

Focusing and customizing non-bipartite matched designs Multivariate optimal matching; calipers; penalties; combining scores

Statistical inference after non-bipartite matching Estimating ATE and Std Errors from Matched Designs using the Block Randomized Experiment as an Analogy.

References: Rosenbaum, 2010, Chap 11 & 12

Lu et al., 2011

References

Gelman, A. and Hill, J. (2007). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press.

Hansen, B. (2004). Full matching in an observational study of coaching for the SAT. *Journal of the American Statistical Association*, 99(467):609–618.

Hansen, B. and Bowers, J. (2008). Covariate balance in simple, stratified and clustered comparative studies. *Statistical Science*, 23:219.

Lu, B., Greevy, R., Xu, X., and Beck, C. (2011). Optimal nonbipartite matching and its statistical applications. *The American Statistician*, 65(1):21–30.

Rosenbaum, P. R. (2010). *Design of Observational Studies*. Springer.