Causal Inference in Observational Settings

Book/Reader Proposal

Sage Benchmark Series

in Social Research Methods

Presentation Outline

- What's at issue
- Background to the idea
- Rationale of proposal
- Components of proposal
  - Volume I – Background
  - Volume II – Comparing like with like
  - Volume III – Panel data and instruments
  - Volume IV – Experimental analogues
- Where to from here

What's at Issue

- How to draw "credible" (causal?) inferences from observational data
- Causal identification is often a form of speculative post-mortem (Holland, 1986)
- Special pleading in claiming causality via statistical modelling (Freedman, 2005)
- Impossible to observe unit response under alternative conditions (Holland, 1986)

Background to the Idea

- Dalton Conley, New York University
  - "Slouching towards Causation"
- Development of policy tool
  - "What if" scenarios; criterion of statistics models
- Engagement from colleagues in Statistics
  - Association is not proof of causation!
- MSc Statistics project, LSE, 1974!
  - Applying econometric techniques to social data

Rationale of Proposal

- Statistical theory is basically about representation not causation (i.e. sampling)
- Random assignment and manipulation of treatment conditions addresses causation
- The counterfactual framework has been translated to the observational setting
- But forward causation only (cause-to-effect)
- Econometrics – parallel community of practice

Sage Handbook Series

- Sage Benchmarks in Social Research Methods
- Four-volume readers
- 75 “readings”
- Previous examples
  - Social Statistics
  - Causality
  - Computational Social Science
- Market – Asia?, universities without journals?

Current Structure of Proposal

- Volume I – Background
  - Causal inference – 7 readings
  - Potential outcomes – 7 readings
  - "Evaluation research" – 7 readings
- Volume II – Comparing like with like
  - Matching methods – 11 readings
  - Propensity scoring – 8 readings
- Volume III – Panel data and instruments
  - Fixed effects – 6 readings
  - Difference-in-difference – 1 reading
  - Instrumental variables – 7 readings
- Volume IV – Experimental analogues
  - Regression discontinuity – 6 readings
  - Quasi-experiments, natural experiments – 6 readings
  - Field experiments – 3 readings

Volume I - Background

- A. Causal inference from observational data
- B. Potential outcomes and counterfactuals
- C. Programme and policy evaluation

Causal Inference from Observational Data

DATE	AUTHOR(S)	TITLE	SOURCE
1986	Holland	Statistics and causal inference	JASA
1999	Winship, Morgan	The estimation of causal effects from observational data	Ann Rev Sociol
2000	Little, Rubin	Causal effects in clinical and epidemiological studies	Ann Rev Public Health
2000	Sobel	Causal inferences in the social sciences	JASA
2005	Heckman	The scientific model of causality	Sociol Methodology
2007	Rubin	The design versus the analysis of observational studies for causal effects	Statistics in Medicine
2010	Gangl	Causal inferences in sociological research	Ann Rev Sociology

Causal Inference from Observational Data

- Holland
  - » The analysis of causation should begin with studying the effects of causes.
  - » No causation without manipulation.
- Sobel
  - » Only causal sequences are counterfactually regular.
- Rubin
  - » Observational studies can and should be designed to approximate randomized experiments as closely as possible.

Potential outcomes and counterfactuals

DATE	AUTHOR(S)	TITLE	SOURCE
1951	Roy	Some thoughts on the distribution of earnings	Oxford Economic Papers
1990	Holland	Rubin's model and its application to causal inference …	American Journal of Epidemiology
1991	Fearon	Counterfactuals and hypothesis testing …	World Politics
2001	Morgan	Counterfactuals, causal effect heterogeneity, and the Catholic School	Sociology of Education
2003	Harding	Counterfactual models of neighbourhood effects	American Journal of Sociology
2005	Rubin	Causal inference using potential outcomes	JASA
2006	Sampson et al.	Does marriage reduce crime? A counterfactual approach …	Criminology

Potential outcomes and counterfactuals

- Harding
  - » This study employs counterfactual models … to estimate the effects of neighborhood poverty …
- Sampson et al.
  - » Our approach is to extent "counterfactual" methods for time-varying covariates to a within-individual analysis of the role of marriage …

Programme and policy evaluation

DATE	AUTHOR(S)	TITLE	SOURCE
1969	Campbell	Reforms as experiments	Amer Psych
1975	Alwin, Sullivan	Issues of design and analysis in evaluation research	Sociological Methods & Res
1994	Imbens, Angrist	Identification and estimation of local average treatment effects	Econometrica
1999	Dehejia, Wahba	Causal effects in non experimental studies	JASA
2009	Ahern et al.	Estimating the effects of potential public health interventions …	American Journal of Epidemiology
2009	Imbens, Wooldridge	Recent developments in the econometrics of program evaluation	Journal of Economic Lit
2010	Angrist, Pischke	The credibility revolution in empirical economics: how better …	J Economic Perspectives

Programme and policy evaluation

- Ahern et al.
  - » Causal inference methods allow estimation of the effects of potential public health interventions …
- Alwyn, Sullivan
  - » The principal inferential device whereby the effects of various policies are made known involves the incorporation of valid comparison into research design …

Volume II – Comparing like with like

- D. Matching methods
- E. Propensity scoring

Matching methods

DATE	AUTHOR(S)	TITLE	SOURCE
1968	Cochran	The effectiveness of adjustment by sub-classification in removing bias …	Biometrics
1984	Rosenbaum, Rubin	Reducing bias in observational studies using sub-classification	JASA
1985	Rosenbaum, Rubin	Constructing a control group using multivariate matched sampling …	The American Statistician
1997	Smith	Matching with multiple controls to estimate treatment effects in observational studies	Sociological Methodology
1998	Heckman et al.	Matching as an econometric evaluation estimator	Review of Economic Stud
2003	Christakis, Iwashyna	The health impact of health care on families: a matched cohort study …	Social Science and Medicine
2004	DiPrete, Engelhardt	Estimating causal effects with matching methods …	Sociol Methods and Research
2005	Smith, Todd	Does matching overcome Lalonde's critique of nonexperimental estimators?	J Econometrics
2006	Morgan, Harding	Matching estimators of causal effects. Prospects, and pitfalls	Sociol Methods and Research
2008	Gilligan, Sergenti	Do UN interventions cause peace?	Q J Pol Sci
2010	Stuart	Matching methods for causal inference	Statistical Science

Matching methods

- Morgan, Harding
  - » … matching techniques can be used effectively to strengthen the prosecution of causal questions in sociology
- Stuart
  - » When estimating causal effects using observational data, it is desirable to replicate a randomized experiment as closely as possible by obtaining treated and control groups with similar covariate distributions.

Propensity scoring

DATE	AUTHOR(S)	TITLE	SOURCE
1983	Rosenbaum, Rubin	The central role of the propensity score in observational studies for causal effects	Biometrika
1997	Rubin	Estimating causal effects from large data sets using propensity scores	Ann Internal Medicine
2001	Hirano et al.	Efficient estimation of average treatment effects using the estimated propensity score	Econometrica
2002	Dehejia, Wahba	Propensity score-matching methods for nonexperimental causal studies	Rev Econom Statist
2002	Woodridge	Inverse probability weighted estimation for general missing data problems	J Econom
2004	Lunciford, Davidian	Stratification and weighting via propensity scores…	Statistics in Medicine
2006	Baser	Too much ado about propensity score models?	Value in Health
2007	Austin et al.	A comparison of the ability of different propensity score models to balance …	Statistics in Medicine

Volume III – Panel data and instruments

- F. Fixed effects
- G. Difference-in-difference
- H. Instrumental variables.

Fixed effects

DATE	AUTHOR(S)	TITLE	SOURCE
1998	Cherlin et al.	Effects of parental divorce on mental health throughout the life course	American Sociological Rev
1998	Duncan et al.	How much does childhood poverty affect the life chances of children?	American Sociological Rev
1999	Guo, van Wey	Sibship size and intellectual development	Am Soc Rev
2000	Conley, Bennett	Is biology destiny? Birth weight and life chances	Am Soc Rev
2004	Halaby	Panel models in sociological research: Theory and practice.	Annual Review of Sociology
2011	Gunasekara et al.	Change in income and change in self-rated health: Systematic review	SSM

Fixed effects

- Halaby
  - » The fundamental structure of panel data provides the analytical leverage for … the estimation of causal effects
- Duncan et al.
  - » We use whole-childhood data from the PSID to relate children's completed schooling and nonmarital fertility to parental income …
- Gunsekara et al.
  - » … the true causal short-term relationship between income and health … may be much smaller than that suggested by previous, mostly cross-sectional research.

Difference-in-difference

DATE	AUTHOR(S)	TITLE	SOURCE
2004	**Bertrand et al.**	**How much should we trust differences-in-differences estimates?**	**Quarterly Journal of Economics**

Instrumental variables

DATE	AUTHOR(S)	TITLE	SOURCE
1993	Manski	Identification of endogenous social effects: the reflection problem	Review of Economic Stud
1995	Bound et al.	Problems with instrumental variables estimation…	JASA
1996	Angrist et al.	Identification of causal effects using instrumental variables	JASA
1996	Heckman	Randomisation as an instrumental variable	Rev Econ Stat
1997	Staiger, Stock	Instrumental variables regression with weak instruments	Econometrica
2011	Denny	Instrumental variable estimation of the effect of prayer on depression	SSM
2011	Sovey, Green	Instrumental variables estimation in political science. A readers' guide	Am J Pol Sci

Instrumental variables

- Denny
  - » Using Instrumental Variables estimation, which allows one to isolate exogenous variation in prayer, leads to the conclusion … there may be some benefit to prayer …

Volume IV – Experimental analogues

- I. Regression discontinuity
- J. Quasi-experiments and natural experiments
- K. Field experiments.

Regression discontinuity

DATE	AUTHOR(S)	TITLE	SOURCE
1960	Thistlethwaite, Campbell	Regression-discontinuity analysis: an alternative to ex post facto experiment	Journal of Educational Psych
1983	Berk, Rauma	Capitalising on non-random assignment to treatments: a regression discount ..	JASA
1995	Myer et al.	Workers' compensation and injury duration: evidence from a natural exp	American Economic Rev
1999	Berk, de Leeuw	An evaluation of California's inmate classification system using a generalised regression discount design	JASA
2001	Hahn et al.	Identification of treatment effects by regression discontinuity designs	Econom trica
2008	Imbens, Lemieux	Regression discontinuity designs: a guide to practice	J Econom

Quasi-experiments and natural experiments

DATE	AUTHOR(S)	TITLE	SOURCE
1985	Berk, Newton	Does arrest really deter wife battery?	Am Soc Rev
1994	Card and Krueger	Minimum wages and employment: a case study …	American Economic Review
1995	Myer et al.	Workers' compensation and injury duration: evidence from a natural exp	American Economic Rev
2002	Schneeweiss et al.	Quasi-experimental longitudinal designs to evaluate drug benefit policy..	Journal of Clinical Epidemiology
2009	Kirk	A natural experiment on residential change and recidivism …	American Sociological Rev
2010	Strully et al.	Effects of prenatal poverty on infant health	ASR

Field experiments

DATE	AUTHOR(S)	TITLE	SOURCE
2008	Clampet-Lundquist, Massey	Neighborhood effects on economic self-sufficiency: a reconsideration of the MTO experiment	American Journal of Sociology
2008	Ludwig et al.	What can we learn from neighbourhood effects from MTO?	American Journal of Sociology
2008	Sampson	Moving to inequality: neighborhoods and experiments meet social structure	American Journal of Sociology