

Economics 696F: Causal Inference and Program Evaluation
Spring 2007
Syllabus (updated 03/4/07)

Course meets Fridays 12:30-3:00 pm, McClelland 401KK

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Office Hours: Fridays, 3:00-4:00 pm, or by appt.

Course Description: This is a Ph.D. level topics course in causal inference and program evaluation methodology. We will focus on using the potential outcomes approach as a general organizing principle, and examine identification and estimation of treatment effects under various types of assumptions. A key theme is to show that certain treatment effects are identified under weak distributional assumptions (nonparametric identification), and then examine a range of estimation methods that incorporate additional "smoothing" assumptions.

Prerequisites: I assume familiarity with basic probability theory and statistics at the level of Economics 520, linear regression analysis at the level of Economics 522A, standard discrete choice models (such as logit and probit models and censored regression models), and generalized method of moments estimation (or equivalently, M-estimator theory). Some familiarity with nonparametric regression and Bayesian statistics would be useful but is not strictly required. There will be some empirical exercises that require statistical analysis of data sets. You should be familiar with at least one standard statistical software package (such as Matlab, Gauss, Stata, S-Plus, R, SAS) at the level where you could program new estimators in that language.

Evaluation: There will be a number of homework assignments. In addition, each student will give a short presentation (25 minutes) at the end of the semester. I will provide a list of topics for these presentations.

Special Lecture Time: there will be a special joint lecture on **Monday, Feb 5, from 5:30 - 8:00 pm**. This lecture will be jointly conducted with Economics 696A, Professor Dufwenberg's course on experimental economics, and will discuss statistical methods for evaluating laboratory experiments.

Reading List

Note: this syllabus lists many more papers and books than we will actually cover in lectures. I will generally try to announce which papers will be covered in class. The other references are included primarily to provide resources for those interested in exploring a particular topic in greater depth. This list of references will be updated as the semester progresses.

Articles marked with "+" are available electronically via the UA library system or JSTOR.

1. Counterfactual Causality

Cox, D. R., 1992, "Causality: Some Statistical Aspects," *Journal of the Royal Statistical Society, Series A*, 155, 291-301. +

Holland, P. W., 1986, "Statistics and Causal Inference" (with discussion), *Journal of the American Statistical Association* 81, 945-970. +

Lewis, D., 1973, "Causation," *The Journal of Philosophy* 70, 556-567. +

Neyman, J., 1923, "On the Application of Probability Theory to Agricultural Experiments. Essay on Principles. Section 9," *Roczniki Nauk Rolniczych Tom X (Annals of Agricultural Sciences)*, 1-51. Translated and edited by

D. M. Dabrowska and T. P. Speed, with introduction and discussion, in *Statistical Science*, 1990, Vol. 5, No. 4, 463-480. +

Pearl, J., (2000), "Epilogue: The Art and Science of Cause and Effect," in *Causality: Models, Reasoning, and Inference*, Cambridge: Cambridge University Press.

Rubin, D.B., (1974), "Estimating Causal Effects of Treatments in Randomized and Non-randomized Studies," *Journal of Educational Psychology* 66, 688-701.+

2. Randomized Experiments

Burtless, G., (1995), "The Case for Randomized Field Trials in Economic and Policy Research," *Journal of Economic Perspectives* 9: 63-84.+

Cox, D. R., (1958), *Planning of Experiments*, New York: Wiley. Chapters 1-3.

Fisher, R. A., (1935), *The Design of Experiments*, Ch. 2.

Heckman, J., (1992), "Randomization and Social Policy Evaluation," in *Evaluating Welfare and Training Programs*, ed. by C. Manski and I. Garfinkel, Cambridge: Harvard University Press.

Heckman, J., Lalonde, R., and Smith, J., (1999), "The Economics and Econometrics of Active Labor Market Programs," in *Handbook of Labor Economics*, Vol. 3, ed. by A. Ashenfelter and D. Card, Amsterdam: Elsevier Science.

Heckman, J., and Smith, J., (1995), "Assessing the Case for Social Experiments," *Journal of Economic Perspectives* 9: 85-110.+

Lalonde, R., (1986), "Evaluating the Econometric Evaluation of Training Programs," *American Economic Review* 76, 604-620.+

Neyman, J., (1935), "Statistical Problems in Agricultural Experimentation," (with discussion), *Supplement to the Journal of the Royal Statistical Society*, Vol. II, No. 2, 107-180.

Rosenbaum, P.R., (2002), "Randomized Experiments," chapter 2 of *Observational Studies*, 2nd ed., New York: Springer.

3. Selection on Observables

Abadie, A., and Imbens, G.W., (2006), "Large Sample Properties of Matching Estimators for Average Treatment Effects," *Econometrica* 74(1), 235-267.

Barnow, B., Cain, G., and Goldberger, A., (1980), "Issues in the Analysis of Selectivity Bias," *Evaluation Studies*, Vol. 5, ed. by E. Stromsdorfer and G. Farkas, 42-59.

Imbens, G. W., (2004), "Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review," *Review of Economics and Statistics* 86(1), 4-29.+

Imbens, G. W., Rubin, D.B., and Sacerdote, B., (2001), "Estimating the Effect of Unearned Income on Labor Supply, Earnings, Savings and Consumption: Evidence from a Survey of Lottery Players," *American Economic Review* 91, 778-794.+

Rubin, D. B., (1977), "Assignment to a Treatment Group on the Basis of a Covariate," *Journal of Educational Statistics* 2, 1-26.+

4. Propensity Scores

Dehejia, R., and Wahba, S., (1999) "Causal Effects in Non-Experimental Studies: Re-Evaluating the Evaluation of Training Programs," *Journal of the American Statistical Association* 94, 1053-1062.+

Hahn, J., (1998), "On the Role of the Propensity Score in Efficient Semiparametric Estimation of Average Treatment Effects," *Econometrica* 66, 315-332.+

Heckman, J., Ichimura, H., and Todd, P., (1998), "Matching as an Econometric Evaluation Estimator," *Review of Economic Studies* 65, 261-294.+

Hirano, K., Imbens, G., and Ridder, G., (2003), "Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score," *Econometrica* 71, 1161-1189.+

Rosenbaum, P. R., and Rubin, D. B., (1983), "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika* 70, 41-55.+

Rosenbaum, P.R., and Rubin, D.B., (1983), "Assessing Sensitivity to an Unobserved Binary Covariate in an Observational Study with Binary Outcome," *Journal of the Royal Statistical Society, Series B*, 45, 212-218.+

Rosenbaum, P.R., and Rubin, D. B., (1984), "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score," *Journal of the American Statistical Association* 79, 516-524.+

5. Dynamic and Multivalued Treatments

Abbring, J. H., and van den Berg, G. J., (2003), "The Nonparametric Identification of Treatment Effects in Duration Models," *Econometrica* 71, 1491-1517.+

Hernan, M.A., Brumback, B.A., and Robins, J.M., (2002), "Estimating the Causal Effects of Zidovudine on CD4 Count with a Marginal Structural Model for Repeated Measures," *Statistics in Medicine* 21, 1689-1709.+

Hirano, K., and Imbens, G.W., (2004), "The Propensity Score with Continuous Treatments," in *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives*, ed. by A. Gelman and X. Meng, New York: Wiley.

Imai, K., and van Dyk, D.A., (2004), "Causal Inference With General Treatment Regimes: Generalizing the Propensity Score," *Journal of the American Statistical Association* 99, 854-866.+

Imbens, G. W., (2000), "The Role of the Propensity Score in Estimating Dose-Response Functions," *Biometrika* 87, No. 3, 706-710.+

Lechner, M., and Miquel, R., (2002), "Identification of Effects of Dynamic Treatments by Sequential Conditional Independence Assumptions," working paper, University of St. Gallen.

Robins, J., (1998), "Marginal Structural Models," 1997 Proceedings of the American Statistical Association. Section on Bayesian Statistical Science, pp. 1-10.

Robins, J.M., Hernán, M. and, Brumback, B. (2000). Marginal structural models and causal inference in epidemiology. *Epidemiology*, 11(5):550-560.+

6. Instrumental Variables

Abadie, A., (2003), "Semiparametric Instrumental Variables Estimation of Treatment Response Models," *Journal of Econometrics*.+

Angrist, J., (1990), "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security

Administrative Records," *American Economic Review* 80, 313-335.+

Angrist, J. D., Imbens, G. W., and Rubin, D. B., (1996), "Identification of causal effects using instrumental variables" *Journal of the American Statistical Association* 91: 444-455.+

Angrist, J., and Krueger, A., (1991), "Does Compulsory School Attendance Affect Schooling and Earnings," *Quarterly Journal of Economics* 106, 979-1014.+

Chernozhukov, V., and Hansen, C., (2005), "An IV Model of Quantile Treatment Effects," *Econometrica* 73(1), 245-261.+

Heckman, J., and Vytlacil, E., (1999), "Local Instrumental Variables and Latent Variable Models for Identifying and Bounding Treatment Effects," *Proceedings of the National Academy of Sciences*, April 13, 1999, 96:4730-4734.+

Imbens, G. W., and Angrist, J. D., (1994), "Identification and Estimation of Local Average Treatment Effects," *Econometrica* 62, 467-475.+

7. Selection Models and Control Functions

Blundell, R., and Powell, J., (2003), "Endogeneity in Semiparametric Binary Response Models," *Review of Economic Studies* 71(3), 655-679.+

Blundell, R., and Smith, R., (1986), "An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply," *Econometrica* 54(3), 679-685.+

Blundell, R., and Smith, R., (1989), "Estimation in a Class of Simultaneous Equation Limited Dependent Variable Models," *Review of Economic Studies*, 56(1), 37-57.+

Heckman, J., (1979), "Sample Selection Bias as a Specification Error," *Econometrica* 47(1): 153-161.+

Heckman, J., and Robb, R., (1985), "Alternative Methods for Evaluating the Impact of Interventions," in J. Heckman and B. Singer, eds., *Longitudinal Analysis of Labor Market Data*, *Econometric Society Monograph Series*.

Heckman, J., and Robb, R., (1985), "Alternative Methods for Evaluating the Impact of Interventions," *Journal of Econometrics* 30, 239-267.+

Imbens, G., and Newey, W., (2003), "Identification and Estimation of Triangular Simultaneous Equations Models without Additivity," working paper.

Newey, W., and Powell, J., (2003), "Instrumental Variables Estimation of Nonparametric Models," *Econometrica* 71, 1565-1578.+

Newey, W., Powell, J., and Vella, F., (1999), "Nonparametric Estimation of Triangular Simultaneous Equations Models," *Econometrica* 67(3), 565-603.+

8. Bounds on Treatment Effects

Balke, A., and Pearl, J., (1999), "Nonparametric Bounds on Causal Effects from Partial Compliance Data," working paper, Cognitive Systems Laboratory, UCLA.

Heckman, J., Smith, J., and Clements, N., (1997), "Making the Most Out of Programme Evaluations and Social Experiments: Accounting for Heterogeneity in Programme Impacts," *Review of Economic Studies* 64, 487-535.+

Horowitz, J., and Manski, C., (1995), "Identification and Robustness with Contaminated and Corrupted Data,"

Econometrica 63, 281-302.+

Manski, C., (1990), "Nonparametric Bounds on Treatment Effects," American Economic Review Papers and Proceedings 80, 319-323.+

Manski, C., (1997), "The Mixing Problem in Programme Evaluation," Review of Economic Studies 64, 537-553.+

9. Differences in Differences

Abadie, A., (2005), "Semiparametric Differences-in-Differences Estimators," Review of Economic Studies 72(1), 1-19.+

Angrist, J., and Krueger, A., (1999), "Empirical Strategies in Labor Economics," Handbook of Labor Economics, Vol. 3, ed. by A. Ashenfelter and D. Card, Amsterdam: Elsevier.

Athey, S., and Imbens, G. W., (2006), "Identification and Inference in Nonlinear Differences-in-Differences Models," Econometrica 74(2), 431-497.+

Card, D., and Krueger, A., (1994), "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania," American Economic Review 84: 772-93.+

Heckman, J., Lalonde, R., and Smith, J., (1999), "The Economics and Econometrics of Active Labor Market Programs," in Handbook of Labor Economics, Vol. 3, ed. by A. Ashenfelter and D. Card, Amsterdam: Elsevier Science.

10. Regression Discontinuity

Angrist, J., and Lavy, V., (1999), "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement," Quarterly Journal of Economics 533-575.+

Black, S., (1999), "Do Better Schools Matter? Parental Valuation of Elementary Education," Quarterly Journal of Economics, 577-599.+

Hahn, J., Todd, P. and van der Klaauw, W., (2001), "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design," Econometrica, 69(1), 201-209.+

Lee, D. S., (2003), "Randomized Experiments from Non-random Selection in U.S. House Elections," forthcoming, Journal of Econometrics.

Porter, J. R., (2003), "Estimation in the Regression Discontinuity Model," working paper, Harvard University.

Van der Klaauw, W., (2002), "Estimating the Effect of Financial Aid Offers on College Enrollment: A Regression-Discontinuity Approach," International Economic Review 43, 1249-1287+

11. Decision Theory for Treatment Assignment

Dehejia, R., (2005), "Program Evaluation as a Decision Problem," Journal of Econometrics 125, 141-173.+

Hirano, K., and Porter, J. R., (2005), "Asymptotics for Statistical Treatment Rules," working paper, University of Arizona.

Manski, C. F., (2002), "Treatment Choice Under Ambiguity Induced by Inferential Problems," Journal of Statistical Planning and Inference 105, 67-82.+

Manski, C. F., (2004), "Statistical Treatment Rules for Heterogeneous Populations," Econometrica 72,

1221-1246.+

General References (including references on missing data):

Gelman, A., and Meng, X., ed. (2004), *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives*, New York: Wiley.

Little, R.J.A., and Rubin, D.B., (1986), *Statistical Analysis with Missing Data*, New York: Wiley.

Manski, C.F., (1995), *Identification Problems in the Social Sciences*, Cambridge: Harvard University Press.

Manski, C.F., (2003), *Partial Identification of Probability Distributions*, New York: Springer-Verlag.

Pearl, J., (2000), *Causality: Models, Reasoning, Inference*, New York: Cambridge University Press.

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