

Topics in Applied Econometrics

MIT 14.387
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This course covers topics in econometrics and empirical modeling that are likely to be useful to applied researchers working on cross-section and panel data applications.

Requirements: There will be no exam in this course but students are expected to do the readings. In addition, there will be problem sets and a small project.

Articles by subject area (*=in the reading packet; ^J=available through JSTOR; ^L=MIT libraries e-journal; NBER working papers are available from www.nber.org). Articles for Parts I and II are in separate packets.

PART I (Angrist)

I. Estimation and Inference in Linear Models (review)

A. Basics

W. Newey and D. McFadden, "Large Sample Estimation and Hypothesis Testing," Chapter 36 in *The Handbook of Econometrics*, Volume IV, Amsterdam: North-Holland, 1994.

G. Chamberlain, "Panel Data," Chapter 22 in *The Handbook of Econometrics*, Volume II, Amsterdam: North-Holland, 1983.

A. Buse, "The Likelihood Ratio, Wald, and Lagrange Multiplier Tests: An Expository Note," *The American Statistician* 36, 1982, 153-157.

B. Instrumental Variables and GMM

W. Newey, "Generalized Method of Moments Specification Testing," *Journal of Econometrics* 29, 1985, 229-256.

^JW. Newey and K. West, "Hypothesis Testing with Efficient Method of Moments Estimation," *International Economic Review* 28, October 1987, 777-787.

*J. Angrist, "Grouped Data Estimation and Testing in Simple Labor Supply Models," *Journal of Econometrics*, February/March 1991.

II. Causal Inference

A. Methodological overview (see also *class notes* on Evaluation Research)

*J. Angrist and A. Krueger, "Empirical Strategies in Labor Economics," chapter in the *Handbook of Labor Economics*, Volume III, Amsterdam: North-Holland, 1999.

*Donald T. Campbell, "Reforms as Experiments," *American Psychologist* 24 (April 1969), 409-429.

Angrist, J.D., "Introduction to the *JBES* Symposium on Program and Policy Evaluation," April 1995.

Bruce Meyer, "Natural and Quasi-Experiments in Economics," *JBES*, April 1995.

P. Rosenbaum, *Observational Studies*, New York: Springer, 1995.

¹P. Holland, "Statistics and Causal Inference," *JASA* 81, 1986, 945-970, with discussion.

¹D. Rubin, "Comment: Neyman (1923) and Causal Inference in Experiments and Observational Studies," *Statistical Science* 5, 1990, 472-480. Also, Neyman (1923) translated in same issue.

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

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

¹Rubin, D. B., 1978, "Bayesian Inference for Causal Effects: The Role of Randomization," *Annals of Statistics* 6, 34-58.

¹Haavelmo, Trygve, 1944, *The Probability Approach in Econometrics*, Supplement to *Econometrica* 12, July 1944.

Rosenbaum, R., "Choice as an Alternative to Control in Observational Studies," *Statistical Science* 14 [3] (1999), 259-304.

B. The propensity score

¹D. Rubin, "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score," *JASA* 79, 1984, 516-524.

¹Rosenbaum, P. R. And D. B. Rubin, 1983, "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika* 70, 41-55.

*R. Dehejia and S. Wahba, "Causal Effects in Nonexperimental Studies: Re-evaluating the Evaluation of Training Programs," *JASA* 94 (Sept. 1999).

*J. Hahn, "On the Role of the Propensity Score in Efficient Estimation of Average Treatment Effects," *Econometrica* 66, March 1998.

*J. Angrist, "Conditional Independence in Sample Selection Models," *Economics Letters*, February 1997.

J. Angrist and J. Hahn, "When to Control for Covariates? Panel-Asymptotic Results for Estimates of Treatment Effects," NBER Technical Working Paper No. 241, May 1999.

K. Hirano, G. Imbens, and G. Ridder, "Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score," NBER Technical Working Paper 251, March 2000.

G. Imbens, "The Role of the Propensity Score in Estimating Dose-Response Functions," NBER Technical Working Paper No. 237, April 1999.

*G. Imbens, D. B. Rubin, and B. Sacerdote, "Estimating the Effects of Unearned Income: Evidence from a Survey of Lottery Players," *American Economic Review*, September 2001.

C. Causal inference with instrumental variables

J. Angrist and G. Imbens, "Sources of Identifying Information in Evaluation Models," NBER Technical Working Paper No. 117, 1991.

¹J. Angrist, G. Imbens, and D. Rubin, "Identification of Causal effects Using Instrumental Variables," with comments and rejoinder, *JASA*, 1996.

¹G. Imbens and J. Angrist, "Identification and Estimation of Local Average Treatment Effects," *Econometrica*, March 1994.

¹J. Angrist and G. Imbens, "Two-Stage Least Squares Estimation of Average Causal Effects in Models with Variable Treatment Intensity," *JASA*, June 1995.

A. Abadie, "Semiparametric Estimation of Instrumental Variables Models for Causal Effects," NBER Technical Working Paper 260, September 2000.

*J. Angrist, "Estimation of Limited-Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice," *Journal of Business and Economic Statistics*, January 2001.

D. Quantile and distribution treatment effects

¹Freeman, R., 1980, "Unionism and the Dispersion of Wages," *Industrial and Labor Relations Review* 34, 3-23.

¹G. Imbens and D. Rubin, "Estimating Outcome Distributions for Compliers in Instrumental Variables Models," *Review of Economic Studies* 64, 1997.

*A. Abadie, J. Angrist, and G. Imbens, "Instrumental Variables Estimates of the Effect of Subsidized Training on the Quantiles of Trainee Earnings," forthcoming, *Econometrica* 2001.

E. Simultaneous equations models

*J. Angrist and A. Krueger, "Instrumental Variables and the Search for Identification," *Journal of Economic Perspectives*, Fall 2001.

¹T. Haavelmo, "The Statistical Implications of a System of Simultaneous Equations," *Econometrica* 11 (January 1943), 1-12.

J. Hausman, "Specification and Inference in Simultaneous Equations Models," Chapter 7 in *The Handbook of Econometrics*.

¹A. Goldberger, "Structural Equations Models in the Social Sciences," *Econometrica* 40, 1972, 979-1002.

*J. Angrist, G. Imbens, K. Graddy, "The Interpretation of Instrumental Variables Estimators in Simultaneous Equations Models with an Application to the Demand for Fish," *Review of Economic Studies*, July 2000.

III. Inference and Finite-Sample Problems

A. Instrumental variables

¹J. Bound, D. Jaeger, and R. Baker, "Problems with Instrumental Variables Estimation when the Correlation Between the Instruments and the Endogenous Regressors is Weak," *JASA*, June 1995.

¹A. R. Hall, G. D. Rudebusch, D. W. Wilcox, "Judging Instrument Relevance in Instrumental Variables Estimation," *International Economic Review* 37, May 1996, 283-296.

*J. Angrist and A. Krueger, "Split-Sample Instrumental Variables Estimates of the Returns to Schooling," *JBES*, April 1995.

¹J. Angrist, G. Imbens, and A. Krueger, "Jackknifed Instrumental Variables Estimation," *Journal of Applied Econometrics*, 1999.

G. Chamberlain and G. Imbens, "Hierarchical Bayes Models with Many Instrumental Variables," NBER Technical Working Paper 204, September 1996.

*S. Donald and W. Newey, "Choosing the Number of Instruments," *Econometrica*, September 2001.

G. Imbens and D. Rubin, "Bayesian Inference for Causal Effects in Randomized Experiments with Noncompliance," *Annals of Statistics* 25, 1997.

Bowden and Turkington, *Instrumental Variables*, Cambridge University Press, 1984, Section 4.8.

P.C.B. Phillips, 1983, "Exact Small-Sample Theory in the Simultaneous Equations Model," Chapter 8 in the *Handbook of Econometrics*.

B. Two-sample estimation

¹J. Angrist and A. Krueger, "The Effect of Age at School Entry on Educational Attainment: An Application of Instrumental Variables with Moments from Two Samples," *JASA* 87 (June 1992), 328-336.

*J. Angrist and A. Krueger, "Split-Sample Instrumental Variables Estimates of the Returns to Schooling," *JBES*, April 1995.

Jappelli, Tuilio, Jorn-Steffen Pischke and Nicholas Souleles (1998) "Testing for Liquidity Constraints in Euler Equations with Complementary Data Sources," *ReStat* 80, 251-262.

¹G. Imbens and T. Lancaster, "Combining Micro and Macro Data in Microeconomic Models," *Review of Economic Studies*, October 1994.

C. Clustering, serial correlation, and the Moulton problem

*Bertrand, Marianne, E. Duflo, and S. Mullainathan, "How Much Should We Trust Differences-in-Differences Estimates?," MIT Department of Economics, mimeo, July 2001.

Braun, Thomas.M., and Z. Feng, "Optimal Permutation Tests for the Analysis of Group Randomized Trials," *JASA* 96 (December 2001), 1424-1432.

Cornfeld, J., "Randomization by Group: A Formal Analysis," *American Journal of Epidemiology* 198 (1978), 100-2.

Donald, S., and K. Lang, "Inference with Differences-in-Differences and Other Panel Data," Boston University department of Economics, mimeo, March 2001.

*Feng, Ziding, P. Diehr, A. Peterson, and D. McLerran, "Selected Statistical issues in Group Randomized Trials," *Annual Review of Public Health* 22 (2001), 167-87.

Gail, M.H., S. Mark, R. Carroll, S. Green, and D. Pee, "On Design Considerations and Randomization-Based Inference for Community Intervention Trials," *Statistics in Medicine* 15 (1996), 1069-1092.

¹Liang, Kung-ye, and Scott L. Zeger, "Longitudinal Data Analysis Using Generalized Linear Models," *Biometrika* 73 (1986), 13-22.

*Moulton, Brent, "Random Group Effects and the Precision of Regression Estimates," *Journal of Econometrics* 32 (1986), pp. 385-97.

P. Rosenbaum, Chapters 2 and 3 (on exact inference for treatment effects) in *Observational Studies*, New York: Springer, 1995.

IV. Evaluation Studies by Topic

A. Effects of military service

C. Seltzer and S. Jablon, "Effects of Selection on Mortality," *American Journal of Epidemiology* 100(5), 1974.

N. Hearst, T. Newman, and S. Hulley, "Delayed Effects of the Military Draft on Mortality: A Randomized Natural Experiment," *New England Journal of Medicine* 314 (March 6, 1986): 620-624.

¹J. Angrist, "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records," *American Economic Review*, June 1990.

*J. Angrist, "Using Social Security Data on Military Applicants to Estimate the Effect of Military Service on Earnings," *Econometrica*, March 1998.

¹J. Angrist and A. Krueger, "Why do World War II Veterans Earn More than Nonveterans?," *Journal of Labor Economics*, January 1994.

G. Imbens and W. van der Klauuw, "Evaluating the Costs of Conscription in the Netherlands," *Journal of Business and Economic Statistics*, April 1995.

B. Manpower training

¹Lalonde, R., "The Promise of Public Sector-Sponsored Training Programs," *The Journal of Economic Perspectives* 9 (Spring 1995), 149-168.

¹Ashenfelter, O.A., "Estimating the Effect of Training Programs on Earnings," *The Review of Economics and Statistics* 60 (February 1978), 47-57.

¹Ashenfelter, O.A. and D. Card, "Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Programs on Earnings," *The Review of Economics and Statistics* 67 (1985): 648-660.

¹LaLonde, R., "Evaluating the Econometric Evaluations of Training Programs with Experimental Data," *American Economic Review* 76 (September 1986): 604-620.

Ashenfelter, O.A., "The Case for Evaluating Manpower Training Programs with Randomized Trials," Industrial Relations Section Working Paper No. 203, Princeton University, January 1986.

V. J. Hotz, G. W. Imbens, and J. H. Mortimer, "Predicting the Efficacy of Future Training Programs Using Past Experiences," NBER Technical Working Paper No. 237, May 1999.

¹Heckman, J.J., and J.V. Hotz, "Choosing Among Alternative Nonexperimental Methods for Estimating the Impact of Social programs: The Case of Manpower Training," *JASA* 84(408) (December 1989): 862-880.

¹Burtless and Heckman exchange in Spring 1995 *JEP*.

C. Manski and I. Garfinkel, Introduction to *Evaluating Welfare and Training Programs*, Harvard University Press, 1992.

C. School Inputs: Experiments and Regression-Discontinuity Methods

¹A. Krueger, "Experimental Estimates of Education Production Functions," *QJE*, May 1999.

¹J. Angrist and V. Lavy, "Using Maimonides' Rule to Estimate the Effect of Class Size on Student Achievement," *QJE*, May 1999.

Thistlewaite, D.L., and D.T. Campbell, "Regression-Discontinuity Analysis: An Alternative to the Ex Post Facto Experiment," *Journal of Educational Psychology* LI (1960), 309-317.

Trochim, William K., *Research Design for Program Evaluation: The Regression-Discontinuity Approach*, (Beverly Hills: Sage, 1984).

van der Klaauw, Wilbert, "A Regression-Discontinuity Evaluation of the Effect of Financial Aid Offers on College Enrollment," Manuscript, New York University Economics department, December 1996.

J.Hahn, P. Todd, and W. van der Klauuw, "Estimation of Treatment Effects with a Quasi-Experimental Regression-Discontinuity Design," *Econometrica*, January 2001 (for anti-discrimination application, see NBER WP 7131, May 1999)

Porter, Jack R., "Semiparametric Estimation of Regression Discontinuity Models," Harvard Department of Economics, mimeo, April 1999.

D. Anti-discrimination policies

K. Chay, "The Impact of Federal Civil Rights Policy on Black Economic Progress: Evidence from the Equal Employment Opportunity Act of 1972," *Industrial and Labor Relations Review*, 1998.

D. Acemoglu and J. Angrist, "Consequences of Employment Protection? The Case of the Americans with Disabilities Act," *Journal of Political Economy*, October 2001.

E. Returns to Schooling

D. Card, "The Casual Effect of Education on Earnings," The Handbook of Labor Economics, North Holland: Elsevier Science Publishers.

O. Ashenfelter, C. Harmon, and H. Oosterbeek, "A Review of Estimates of the Schooling/Earnings Relationship, with Tests for Publication Bias," NBER Working Paper 7457, January 2000.

PART II (Chernozhukov)

Quantile regression is a natural extension of mean regression that provides a more complete picture of relationships among economic variables. The first part of the course covers various practical and theoretical aspects of quantile regression. Another important topic – *bootstrap* – will be integrated within the QR theme and treated in depth. In particular, we will discuss bootstrap and sub-sampling for various types of data and models, including dependent data (time series and panel data).

A. Quantile Regression: Modern Regression

Topics:

1. Quantile Regression Models and Quantile Regression.
2. Basic Properties in Small and Large Samples.
3. Inference: Analytical Inference and Bootstrap.
4. Quantile Regression in the Tails (Conditional Extremes).
5. Censoring and Sample Selection.
6. Endogeneity and Treatment Effects.
7. Duration Models.
8. Models for Times Series (depending on student interest)
9. Various Unsolved (!) Problems.

Readings:

*A. Abadie, J. Angrist, and G. Imbens, “Instrumental Variables Estimates of the Effect of Subsidized Training on the Quantiles of Trainee Earnings,” forthcoming, *Econometrica* 2001.

^JT. Amemiya, “Two Stage Least Absolute Deviations Estimators,” *Econometrica* Vol. 50, No. 3. (May, 1982), pp. 689-712.

*M. Buchinsky, “Recent Advances in Quantile Regression Models: A Practical Guideline for Empirical Research,” *Journal of Human Resources*, 33 (1), 1998, p 88-126.

^J R. Koenker and G. Bassett, "Regression Quantiles," *Econometrica*, 1978, 33-50.

*Koenker and Hallock, “Quantile Regression: an Introduction,” mimeo, UIUC, 2000

*Koenker and Geling “Reappraising Medfly longevity: A Quantile Regression Survival Analysis,” mimeo, UIUC, 2000

^J Hogg, “Estimates of Percentile Regression Lines Using Salary Data” (in Applications) *Journal of the American Statistical Association*, Vol. 70, No. 349. (Mar., 1975), pp. 56-59.

*G. Chamberlain, 1991, "Quantile Regression, Censoring, and the Structure of Wages," Chapter 5 in C.A. Sims, ed., *Advances in Econometrics Sixth World Congress*, Volume I, Econometric Society Monograph No. 23, Cambridge, Cambridge University Press.

*M. Buchinsky, "Changes in the U.S. Wage Structure 1963-1987: Application of Quantile Regression," *Econometrica*, 62, 1994 405-458.

*M. Buchinsky, "Women's Return to Education in the U.S.: Exploration by Quantile Regression with Nonparametric Sample Selection Correction," October 1995, mimeo, Brown

*V. Chernozhukov, "Conditional Extremes and Near Extremes," mimeo, MIT, 2000

*V. Chernozhukov and L. Umantsev, "Value-at-Risk: Modelling and Estimation", forthcoming in *Empirical Economics*, 2001

*V. Chernozhukov and H. Hong, "A Simple Approach to Censored Quantile Regression," mimeo, 2000.

*V. Chernozhukov and C. Hansen, "An IV Model of Quantile Treatment Effects," mimeo, 2000.

J. Hahn, "Bootstrapping Quantile Regression Estimators," *Econometric Theory*," 11, March 1995, pp. 105-21.

*J. Powell, "Least Absolute Deviations Estimation for the Censored Regression Model," *Journal of Econometrics*, 25, 1984, 303-25.

*S. Portnoy, "Censored Regression Quantiles", mimeo, 2001.

*B. Honore, S. Khan, J. Powell, "Quantile Estimation under Random Censoring", mimeo, Princeton, 2000.

C. Manski, "Semi-parametric Analysis of discrete response asymptotic properties of the maximum score estimator", *J. Econometrics*, 27, 1985, 205-228.

*G. Kordas, "Binary Quantile Regression," mimeo, 2000, UIUC

B. Bootstrap, Jackknife, and Other Re-sampling Plans

Topics:

1. Confidence Intervals
2. Hypothesis Testing
3. Refinements
4. Regular and Non-Regular Cases
5. Non-linear Models
6. Panel Data – Large T and/or Large N cases
7. Time Series Data.

Readings:

D.W.K. Andrews and Moshe Buchinsky, "Evaluation of a Three-step Method of Choosing the Number of Bootstrap Repetitions" September, 1998, mimeo, Brown and Yale

*B. Efron and R. Tibshirani, "Bootstrap Methods for Standard Errors, Confidence Intervals, and Other Measures of Statistical Accuracy," *Statistical Science*, 1, 1986, 54-77.

*Horowitz, "Bootstrap", mimeo, University of Iowa, 2000

*Politis, Romano, Wolf, "Subsampling" Chapters 1-3 of Lecture Notes, Stanford University

B. Efron, Bradley and R.J. Tibshirani, Robert J., *An Introduction to the Bootstrap*, Monographs on Statistics and Applied Probability, vol. 57., New York and London: Chapman and Hall, 1993.

J. Hahn, "A Note on Bootstrapping Generalized Method of Moments Estimators," *Econometric Theory* 12, March 1996, pp. 187-97.