

Mastering Mostly Harmless 'Metrics

MIT 14.381
Fall 2019

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This course covers empirical strategies for applied microeconomic research. The agenda includes regression and matching, instrumental variables, differences-in-differences, regression discontinuity designs, and standard errors.

All 14.381 participants are expected to:

- Miss no more than two classes
- Take an out-of-class final during MIT exam week
- Complete 3 problem sets with a grade of at least 7/10
- Answer questions when called upon in class

MIT Economics Ph.D. (MEP) students seeking credit for the econometrics core also complete a structured empirical project. 14.381 is open to MIT graduate students and full-time RAs, and to MIT undergraduates who have completed 14.32 with distinction. Others looking for an introductory econometrics experience are encouraged to consider 14.32. Unsure whether 381 or 32 is right for you? Try the 381 qualifying exam; 381-ready students should ace the test (this also serves as an ungraded review problem set).

Grading: 3 problem sets (10 points each); out-of-class final (60 points); attendance (10 points); empirical project (10 points)

The atmosphere is informal, but we ask you to put electronic devices away when class is in session.

We use the following texts:

J.D. Angrist and J.S. Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press, 2009 (MHE).

J.D. Angrist and J.S. Pischke, *Mastering 'Metrics: The Path from Cause to Effect*, Princeton University Press, 2015 (MM).

Articles are posted on LMOD at [14.381 Class home](#).

READINGS

Articles, handbook chapters are available through LMOD. Books are also on reserve. An (M) flags studies done as part of an MIT thesis.

I. RCT AND REGRESSION RECAP

MM Chapter 1 and MHE 1-2 introduce our experimentalist perspective on applied econometrics. MM Chapter 2 covers regression basics. MHE Chapter 3 presents more advanced material related to regression and matching.

MM, Chapters 1-2; *MHE*, Chapters 1-2 and 3.1-3.2

S. Carter, K. Greenberg, and M. Walker, "The Impact of Computer Usage on Academic Performance: Evidence from a Randomized Trial at USMA," *Econ Ed Rev* 56 (Feb 2017), 118-132.

A. Aron-Dine, L. Einav, and A. Finkelstein, "The RAND Health Insurance Experiment Three Decades Later," *J. of Economic Perspectives* 27 (Winter 2013), 197-222. (M)

R.H. Brook, et al., "Does Free Care Improve Adults' Health?," *New England J. of Medicine* 309 (Dec. 8, 1983), 1426-1434.

S. Taubman, et al., "Medicaid Increases Emergency-Department Use: Evidence from Oregon's Health Insurance Experiment," *Science*, Jan 2, 2014.

S.B. Dale and A.B. Krueger, "Estimating the Payoff to Attending a More Selective College: An Application of Selection on Observables and Unobservables," *The Quarterly Journal of Economics* 117, November 2002, 1491-152

S.B. Dale and A.B. Krueger, "Estimating the Return to College Selectivity Over the Career Using Administrative Earnings Data," *The JHR* 49 (Spring 2014).

Bad control and measurement error

MM, 6.1-6.2; Appendix to Chapter 6

Z. Griliches, "Estimating the Returns to Schooling – Some Econometric Problems," *Econometrica* 45 (January 1977).

O. Ashenfelter and A.B. Krueger, "Estimates of the Economic Returns to Schooling from a New Sample of Twins," *The AER* 84 (December 1994).

Limited dependent variables and marginal effects

MHE, Section 3.4.2

II. Conditional Independence Assumptions

Matching vs regression

MHE, Section 3.3.1

J. Angrist, "Estimating the Labor Market Impact of Voluntary Military Service Using Social Security Data on Military Applicants," *Econometrica* 66(2), 1998, 249-288.

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

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

The propensity score

MHE, Sections 3.3.2-3.3.3

J. Angrist and A. Krueger, "Empirical Strategies in Labor Economics," Chapter 23 in *The Handbook of Labor Economics, Volume III*, Elsevier, 1999; Section 2.2-2.3.

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

O. Ashenfelter 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, 648-66.

R. LaLonde, "Evaluating the Econometric Evaluations of Training Programs with Experimental Data," *The American Economic Review* 76, September 1986, 604-62.

J. Heckman and J. Hotz, "Choosing among Alternative Nonexperimental Methods for Estimating the Impact of Social programs: The Case of Manpower Training," *Journal of the American Statistical Association* 84(408), 1989, 862-874.

P. Rosenbaum and R. Rubin, "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score," *Journal of the American Statistical Association* 79(387), 1984, 516-524.

R. Lalonde, "The Promise of Public-Sponsored Training Programs," *The JEP* 9 (Spring 1995).

R. Dehejia and S. Wahba, "Causal Effects in Nonexperimental Studies: Re-evaluating the Evaluation of Training Programs," *Journal of the American Statistical Association* 94(448), 1999, 1053-1062.

J. Smith and P. Todd, "Does Matching Overcome LaLonde's Critique of Nonexperimental Estimators?" *Journal of Econometrics*, 125(1), 2005, 305-353.

P. Kline, "Oaxaca-Blinder as a Reweighting Estimator," *The American Economic Review* 101, May 2011, 532-37.

J. Hahn, "On the Role of the Propensity Score in Efficient Estimation of Average Treatment Effects," *Econometrica* 66(2), 1998, 315-331.

J. Angrist and J. Hahn, "When to Control for Covariates? Panel Asymptotics for Estimates of Treatment Effects," *The Review of Economics and Statistics* 86, February 2004, 58-72.

K. Hirano, G. Imbens, and G. Ridder, "Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score," *Econometrica* 71(4), 2003, 1161-1189.

T. Cook, W.R. Shadish, and V.C. Wong, "Three Conditions Under Which Experiments and Observational Studies produce Comparable Causal Estimate: New Findings from Within-Study Comparisons," *J. Policy Analysis and Management* 27 (Fall 2008).

D. Card, J. Kluve, and A. Weber, "Active Labour Market Policy Evaluations: A Meta-analysis," *The Economic Journal* 120 (November 2010), F452-F477.

A. Abadie and G. Imbens, "Matching on the Estimated Propensity Score." *Econometrica* 84 (2016).

New ways to use the CIA

A. Abadie, A. Diamond, and J. Hainmueller, “Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California’s Tobacco Control Program,” *Journal of the American Statistical Association* 105(490), 2010.

A. Abadie, “Semiparametric Differences-in-Differences Estimators,” *The Review of Economic Studies* 72 (2012), 1-19.

A. Belloni, C. Chernozhukov, and C. Hansen, “Inference on Treatment Effects After Selection Among High-Dimensional Controls,” *The ReStud* 81 (April 2014).

N. Doudchenko and G. Imbens, “Balancing, Regression, Difference-in-differences and Synthetic Control Methods: A Synthesis,” <https://arxiv.org/abs/1610.07748> (2017).

S. Athey, G.W. Imbens, and S. Wager, “Approximate Residual Balancing: De-Biased Inference of Average Treatment Effects in High Dimensions,” *J. Royal Statist. Soc. Series B* 80 (2018).

III. INSTRUMENTAL VARIABLES

2SLS with constant effects; the Wald estimator, grouped data

MM, Chapter 3; *MHE*, Section 4.1

J. Angrist and A. Krueger, “Instrumental Variables and the Search for Identification,” *Journal of Economic Perspectives* 15(4), 2001, 69-85.

J. Angrist, “Grouped Data Estimation and Testing in Simple Labor Supply Models,” *Journal of Econometrics* 47(2), 1991, 243-266.

J. Angrist, “Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records,” *The American Economic Review*, June 1990, 313-336.

J. Angrist and S. Chen, “Schooling and the Vietnam-Era GI Bill: Evidence from the Draft Lottery “,” *AEJ Applied*. April 2011.

J. Angrist, S. Chen, J. Song, “Long-Term Consequences of Vietnam-Era Conscription: New Estimates Using SSA Data,” *AER Papers and Proceedings*, May 2011.

A. Abdulkadiroglu, J. Angrist, S. Dynarski, T. Kane, and P. Pathak “Accountability and Flexibility in Public Schools: Evidence from Boston’s Charters and Pilots,” *The Quarterly Journal of Economics*, May 2011.

A. Abdulkadiroglu, J. Angrist, Y. Narita and P. Pathak, “Research Design Meets Market Design: Using Centralized Assignment for Impact Evaluation”, *Econometrica* 85, September 2017. (M)

Two-Sample IV and related estimators

MHE, Section 4.3

J. 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.

J. Angrist and A. Krueger, "Split-Sample Instrumental Variables Estimates of the Returns to Schooling," *Journal of Business & Economic Statistics* 13(2), April 1995, 225-235.

A. Inoue and G. Solon, "Two-Sample Instrumental Variables Estimators," *The Review of Economics and Statistics* 92, 2010, 557-561.

Pacini, David, and Frank Windmeijer, "Robust Inference for the Two-Sample 2SLS Estimator," *Economics Letters* 146, 2016, 50-54.

2SLS details

2SLS mistakes: *MHE*, Section 4.6.1

The bias of 2SLS: *MHE*, Section 4.6.4

J. Angrist, G. Imbens, and A. Krueger, "Jackknife Instrumental Variables Estimation," *Journal of Applied Econometrics* 14(1), 1999, 57-67.

Flores-Lagunes, Alfonso, "Finite-Sample Evidence on IV Estimators with Weak Instruments," *Journal of Applied Econometrics* 22, 2007, 677-694.

J. Stock and D. Staiger, "Instrumental Variables Regression with Weak Instruments," *Econometrica* 65, 1997.

J. Bound, D. Jaeger, and R. Baker. "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, 1995, 443-450.

I. Andrews, J. Stock, and L. Sun, "Weak Instruments in IV Regression: Theory and Practice," *Annual Review of Economics* 11 (2019). (M)

IV with heterogeneous potential outcomes

MHE, Section 4.4

G. Imbens and J. Angrist, "Identification and Estimation of Local Average Treatment Effects," *Econometrica* 62(2), March 1994, 467-475.

J. Angrist, G. Imbens, and D. Rubin, "Identification of Causal Effects Using Instrumental Variables," with comments and rejoinder, *JASA* 91(434), 1996, 444-455.

A. Abadie, "Bootstrap Tests for Distributional Treatment Effects in Instrumental Variables Models," *Journal of the American Statistical Association* 97, March 2002, 284-292. (M)

A. Abadie, "Semiparametric Instrumental Variable Estimation of Treatment Response Models," *Journal of Econometrics* 113, 2003, 231-263. (M)

A. Abadie, J. Angrist, and G. Imbens. "Instrumental Variables Estimates of the Effect of Subsidized Training on the Quantiles of Trainee Earnings," *Econometrica* 70(1), 2002, 91-117. (M)

J. Angrist, S. Cohodes, S. Dynarski, P. Pathak and C. Walters, "Stand and Deliver: Effects of Boston's Charter High Schools on College Preparation, Entry, and Choice," *Journal of Labor Economics* 34(2), April 2016.

Models with variable, continuous, and multiple treatments

MHE, Section 4.5.3

J. Angrist and G. Imbens, "Two-Stage Least Squares Estimation of Average Causal Effects in Models With Variable Treatment Intensity," *Journal of the American Statistical Association* 90(430), 1995, 431-442.

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

D. Card, "The Causal Effect of Education on Earnings," *The Handbook of Labor Economics, Volume IIIA*, Elsevier Science Publishers, 1999.

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* 67(3), July 2000, 499-528.

D.E. Powers and S.S. Swinton, "Effects of Self-Study for Coachable Test Item Types," *Journal of Educational Psychology* 76, 1984, 266-78.

L. Behaghel, B. Crepon, and M. Gurgand, "Robustness of the Encouragement Design in a Two-Treatment Randomized Control Trial," IZA DP No. 7447, June 2013.

A. Abdulkadiroğlu, J. Angrist, P. Hull, and P. Pathak, "Charters without lotteries: Testing Takeovers in New Orleans and Boston," *The American Economic Review* 106(7), 2016, 1878-1920.

J. Angrist, P. Hull, P. Pathak, and C. Walters, "Leveraging Lotteries for School Value-Added: Testing and Estimation," *The Quarterly Journal of Economics* 132(2), May 2017, 871-919. (M)

External validity

J. Angrist, "Treatment Effect Heterogeneity in Theory and Practice," *The Economic Journal* 114, March 2004, C52-C83.

P. Oreopoulos, "Estimating Average and Local Average Treatment Effects of Education when Compulsory Schooling Laws Really Matter," *The American Economic Review* 96, March 2006, 152-175; see also Oreopoulos' Corrigendum posted on the AER web site.

J. Angrist, V. Lavy, and Analia Schlosser, "Multiple Experiments for the Causal Link Between the Quantity and Quality of Children," *Journal of Labor Economics* 28(4), October 2010, 773-824.

J. Angrist and I. Fernandez-Val, "ExtrapoLATE-ing: External Validity and Overidentification in the LATE Framework," in *Advances in Econometrics Theory and Applications*, Tenth World Congress, Volume III, 2013.

Spec Tests Come LATEly

MHE, Section 4.2.2

G. Imbens and D. Rubin, “Estimating Outcome Distributions for Compliers in Instrumental Variable Models,” *Review of Economic Studies* 64, 1997, 555-574.

T. Kitagawa, “A Test for Instrument Validity,” *Econometrica* 83(5), 2015, 2043-2063.

M. Huber, “Testing the Validity of the Sibling Sex Ratio Instrument,” *Labour* 29(1), 2015, 1-14.

De Chaisemartin, Clement. "Tolerating Defiance? Local Average Treatment Effects Without Monotonicity." *Quantitative Economics* 8.2 (2017): 367-396.

J. Angrist, P. Hull, P. Pathak, and C. Walters, “Interpreting Tests of School VAM Validity,” *The American Economic Review: Papers and Proceedings* (May 2016).

IV. REGRESSION-DISCONTINUITY DESIGNS

Basics, sharp and fuzzy

MM, Chapter 4; *MHE*, Chapter 6

T. Cook, “Waiting for Life to Arrive: A History of the Regression-Discontinuity Design in Psychology, Statistics, and Economics,” *Journal of Econometrics* 142(2), 2008, 636-654.

G. Imbens and T. Lemieux, “Regression Discontinuity Designs: A Guide to Practice,” *Journal of Econometrics* 142(2), 2008, 615-635.

D. Lee, “Randomized Experiments from Non-Random Selection in U.S. House Elections,” *Journal of Econometrics* 142(2), 2008, 675-697.

C. Carpenter and C. Dobkin, “The Effect of Alcohol Consumption on Mortality: Regression Discontinuity Evidence from the MLDA,” *AEJ:AE*, January 2009.

J. Angrist and V. Lavy, “Using Maimonides Rule to Estimate the Effect of Class Size on Scholastic Achievement,” *The Quarterly Journal of Economics* 114(2), May 1999, 533-575.

A. Abdulkadiroglu, J. Angrist, and P. Pathak, “The Elite Illusion: Achievement Effects at Boston and New York Exam Schools,” *Econometrica* 82(1), January 2014, 137-196.

J. Angrist, P. Pathak, and R.A. Zrate, “Choice and Consequence: Assessing Mismatch at Chicago Exam Schools,” NBER working paper 26137 (August 2019). (M)

Heaping

D. Almond, J. Doyle, A. Kowalski, and H. Williams, “Estimating the Marginal Returns to Medical Care: Evidence from At-Risk Newborns,” *The Quarterly Journal of Economics* 125(2), 2010, 591-634.

A. Barreca, M. Guildi, J. Lindo, and G. Waddell, "Saving Babies? Revisiting the Effect of Very Low Birthweight Classification," *The QJE* 126(4), November 2011, 2117-2123.

D. Almond, et al., "Reply to Barreca, et al.," Same issue.

Y. Dong, "Regression Discontinuity Applications with Rounding Errors in the Running Variable," *Journal of Applied Econometrics*, 2014.

F. Gerard, M. Rokkanen, and C. Rothe, "Bounds on Treatment Effects in Regression Discontinuity designs with a Manipulated Running Variable," University of Mannheim Dept of Economics, manuscript, January 2019.

J. Angrist, V. Lavy, J. Leder-Luis, and A. Shany, "Maimonides' Rule Redux," *American Economic Review: Insights* 1(3) 2019, 1-16. (M)

Nonpara- 'metrics

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

J. Ludwig and D. Miller, "Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design," *The Quarterly Journal of Economics* 122, 2007, 159-208.

B. Frandsen, M. Frölich, and B. Melly, "Quantile Treatment Effects in the Regression Discontinuity Design," *Journal of Econometrics* 168(2), 2012, 382-395. (M)

G. Imbens and K. Kalyanaraman, "Optimal Bandwidth Choice for the Regression Discontinuity Estimator," *Review of Economic Studies* 79, 2012, 933-959.

S. Calonico, M. Cattaneo, and R. Titiunik, "Robust Nonparametric Confidence Intervals for Regression Discontinuity Designs," *Econometrica* 82(6), 2014, 2295-2326.

S. Calonico, M. Cattaneo and R. Titiunik, "Optimal Data-Driven Regression Discontinuity Plots," *Journal of the American Statistical Association* 110(512), December 2015, 1753-1769.

C. Rothe and M. Kolesar, "Inference in Regression Discontinuity Designs with a Discrete Running Variable," *The AER* 108 (August 2018).

Regression kinks

D. Card, D. Lee, Z. Pei, and A. Weber, "Inference on Causal Effects in a Generalized Regression Kink Design," *Econometrica* 83 (November 2015).

P. Ganong and S. Jäger, "A Permutation Test for the Regression Kink Design," *Journal of the American Statistical Association*, May 2017.

Extrapolation

J. Angrist and M. Rokkanen, "Wanna Get Away? RD Identification Away from the Cutoff," *Journal of the American Statistical Association*, December 2015. (M)

Y. Dong and A. Lewbel. "Identifying the Effect of Changing the Policy Threshold in Regression Discontinuity Models," *Review of Economics and Statistics* 97(5), 2015, 1081-1092.

R. Maynard, K. Couch, C. Wing, and T. Cook, "Strengthening the Regression Discontinuity Design Using Additional Design Elements: A Within-Study Comparison," *JPAM* 32(4), 2013, 853-877.

A. Abdulkadiroglu, J. Angrist, Y. Narita and P. Pathak, "Impact Evaluation in Matching Markets with General Tie-Breaking," NBER WP No. 24172, December 2017.

V. NON-STANDARD STANDARD ERROR ISSUES

Review of large-sample theory

MHE, Section 3.1.3

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

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

Finite-sample and cluster-robust inference

MHE, Chapter 8

A. Chesher and I. Jewitt, "The Bias of a Heteroskedasticity-Consistent Covariance Matrix Estimator," *Econometrica* 55, September 1987, 1217-1222.

Moulton, B., "Random Group Effects and the Precision of Regression Estimates," *Journal of Econometrics* 32(3), 1986, 385-397.

M. Bertrand, E. Duflo, and S. Mullainathan, "How Much Should We Trust Differences-in-Differences Estimates?" *The Quarterly Journal of Economics* 119, February 2004, 249-275.

Hansen, C., "Asymptotic Properties of a Robust Variance estimator for Panel Data When T is Large", *Journal of Econometrics* 141(2), 2007, 597-620. (M)

Hansen, C., "Generalized Least Squares Inference in Panel and Multilevel Models with Serial Correlation and Fixed Effects," *Journal of Econometrics* 140(2), 2007, 670-694. (M)

C. Cameron, J. Gelbach, and D. Miller, "Bootstrap-Based Improvements for Inference with Clustered Errors," *The Review of Economics and Statistics* 90(3), August 2008, 414-427.

C. Cameron and D. Miller, "A Practitioner's Guide to Cluster-Robust Inference," *Journal of Human Resources* 50(2), February 2015, 317-372.

G. Imbens and M. Kolesar. "Robust Standard Errors in Small Samples: Some Practical Advice," *Review of Economics and Statistics* 98(4), 2016, 701-712.

A. Abadie, G. Imbens, and F. Zheng, "Inference for Misspecified Models with Fixed Regressors," *Journal of the American Statistical Association* 109(508), December 2014, 1601-1614.

M. Cattaneo, M. Jansson, and W. Newey, “Inference in Linear Regression Models with Many Covariates and Heteroskedasticity,” *JASA* 113(523), 2018.

A. Abadie, S. Athey, G Imbens, and J. Wooldridge, “When Should You Adjust Standard Errors for Clustering?” NBER Working Paper No. 24003, November 2017.

Permutation inference

M. Cattaneo, B. Frandsen and R. Titiunik, “Randomization Inference in the Regression Continuity Design: An Application of Party Advantages in the U.S. Senate,” *Journal of Causal Inference* 3(1), 2015, 1-24.

A. Abadie, S. Athey, G Imbens, and J. Wooldridge, “Sampling-based vs. Design-based Uncertainty in Regression Analysis,” *Econometrica* (forthcoming), 2019.

A. Young, “Channeling Fisher: Randomization Tests and the Statistical Insignificance of Seemingly Significant Experimental Results,” *The QJE* 134 (May 2019).

V. MACHINE LABOR

Time-permitting/TBD

Mullainathan/Spiess JEP 2017

BCCH ECMA 2012

BCH ReStud 2014

BCFH ECMA 2017

Chernozhukov, Hansen, and Spindler Annual Review 2015

Athey, Tibishrani, and Wager AMS 2019