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Course Outline  
Econ 6250: Advanced Econometric Theory II  
Winter Term, 2024

Course objectives:

This is a special topics course with an emphasis on cross-sectional issues. We will first look at some core areas of econometrics, specifically: asymptotic theory, limited dependent variable analysis, count and duration models, longitudinal data, and nonparametric and semi-parametric estimation. Following that, we will explore various methods for improving on (first-order) asymptotic theory such as stochastic and Edgeworth expansions, saddlepoint approximations, the jackknife and bootstrapping. Time permitting we will conclude with some other topics such as estimation with weak instruments, quantile and Bayesian estimation, estimation of auction models and average treatment effects. The course will try to answer the needs of both applied researchers and more theoretical econometricians.

Textbooks:

Hansen, Bruce (2022a) Probability and Statistics for Economists, Princeton  
Hansen, Bruce (2022b) Econometrics, Princeton  
Wooldridge, Jeffrey M. (2010) Econometric Analysis of Cross Section and Panel Data, 2nd ed., MIT Press, Cambridge.

Recommended texts:

Amemiya, Takeshi (1985) Advanced Econometrics, Harvard University Press, Cambridge, Massachusetts  
Angrist, Joshua D. and Jorn-Steffen Pischke (2009) Mostly Harmless Econometrics, Princeton, Princeton  
Baltagi, Badi H. (2005) Econometric Analysis of Panel Data, Third Edition, John Wiley & Son Ltd, New York.  
Baltagi, Badi H., ed. (2001) A Companion to Theoretical Econometrics, Blackwell Publishers, Malden, Massachusetts.  
Bierens, Herman J. (2017) Econometric Model Specification, Cambridge, New York.  
Cameron, A. Colin and Pravin K. Trivedi (2005) Microeconometrics: Methods and Applications, Cambridge, New York  
Cramer, J.S., Econometric applications of Maximum Likelihood methods (1986) Cambridge University Press, New York.

Davidson, James, Stochastic Limit Theory (1994) Oxford, New York,

Davidson, Russell and James G. MacKinnon (2021a) Econometric Theory and Methods, pdf available on course website

Davidson, Russell and James G. MacKinnon (2021b) Estimation and Inference in Econometrics, pdf available on course website

Engel, R.F. and D. MacFadden, eds (1994) Handbook of Econometrics, Vol 4, North Holland, New York.

Gallant, A. Ronald (1997) An Introduction to Econometric Theory, Princeton University Press, Princeton.

Godfrey, L.G. (1988) Misspecification Testing in Econometrics: The Lagrange Multiplier Principle and Other Approaches, Cambridge University Press, New York.

Greene, William H. (2007) Econometric Analysis, 5th ed, MacMillan, New York.

Griliches, Zvi and Michael D. Intriligator (1983) Handbook of Econometrics, Vols 1–3, North Holland, New York.

Hardle, W. (1990) Applied Nonparametric Regression, Cambridge University Press, New York.

Heckman, James J. and Edward Leamer (2001) Handbook of Econometrics, Vol 5, North Holland, New York.

Heckman, James J. and Edward Leamer (2005) Handbook of Econometrics, Vol 6A, North Holland, New York.

Heckman, James J. and Edward Leamer (2007) Handbook of Econometrics, Vol 6B, North Holland, New York.

Hsiao, Cheng (2014) Analysis of Panel Data, Third ed., Cambridge University Press, New York

Linton, Oliver (2017) Econometric Model Specification, Academic Press, New York.

Maddala, G.S. (1983) Limited-Dependent and Qualitative Variables in Econometrics.

Matyas, Laszlo, Editor (1999) Generalized Method of Moments Estimation, Cambridge University Press, New York.

White, Halbert (2001) Asymptotic Theory for Econometricians, Revised Edition, Academic Press, New York.

## Grading

The final mark will be based on a final exam (50%) and a paper (50%). Research topics for the paper must be chosen within the first two weeks of class and you will make a short (2-3 minute) presentation of these in the third class. A short (one page) summary will be provided to me. The final papers will be presented and discussed in one of the last two or three classes. The quality of the presentations will contribute to the paper's grade. The papers may be either empirical or theoretical on a topic in this course. Papers are due in the last class.

Office Hours: Tuesday and Thursday, 13:00-14:00

## Topics and Reading List

### 1. Asymptotic Theory

Amemiya, Takeshi (1985) *Advanced Econometrics*, Harvard University Press, Cambridge, Massachusetts, chapters 3–4

Davidson, Russell and James G. MacKinnon (1993) *Estimation and Inference in Econometrics*, Oxford University Press, New York, chapters 1–5, 16.1–16.3, 17

Gallant, A.Ronald and Halbert White (1988) *A Unified Theory of Estimation and Inference for Nonlinear Dynamic Models*, Basil Blackwell, New York

Newey, Whitney K. and Daniel McFadden (1994) Large sample estimation and hypothesis testing, in *Handbook of Econometrics*, Vol 4, 2113–2247

Potscher, B.M and I.R. Prucha (2001) Basic elements of asymptotic theory, Chapter 10 in Baltagi, Badi H., ed. (2001) *A Companion to Theoretical Econometrics*, Blackwell, Malden, Massachusetts

White, Halbert (2001) *Asymptotic Theory for Econometricians*, revised ed., Academic Press, New York, chapters 2, 3.1-3.2, 4.1, 5.1-5.2

### 2. Asymptotic Efficiency and Asymptotic Covariance Matrix Estimation

Andrews, D.W.K. (1991) Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation, *Econometrica*, 59, 817–858.

Cushing, J. Matthew and Mary G. McGarvey, Covariance matrix estimation, Chapter 3 in Matyas, Laszlo, Editor (1999) *Generalized Method of Moments Estimation*, Cambridge University Press, New York.

Newey, W.K. and K.D. West (1987) A Simple Positive Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica*, 55, 703–708.

Newey, Whitney K. and Daniel McFadden (1994) Large sample estimation and hypothesis testing, in *Handbook of Econometrics*, Vol 4, 2113–2247.

White, H. (1980) A Heteroskedasticity Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity, *Econometrica*, 48, 817–838.

### 3. Constrained Estimation, Hypothesis Testing and Model Specification

Andrews, D.W.K. (1998) Hypothesis testing with a restricted parameter space, *Journal of Econometrics*, 84, 155–199

Engel, Robert (1982) A general approach to Lagrange multiplier diagnostics, *Journal of Econometrics*, 20

Hall, Alastair, R. (1999) Hypothesis testing in models estimated by GMM, Chapter 4 in Matyas, Laszlo, Editor (1999) *Generalized Method of Moments Estimation*, Cambridge University Press, New York

Hausman, J.A. (1978) Specification testing in econometrics, *Econometrica* 46, 1251–1272

Godfrey, L.G. (1988) *Misspecification Testing in Econometrics: The Lagrange Multiplier Principle and Other Approaches*, Cambridge University Press, New York

- Gourieroux, C., A. Monfort, E. Renault and A. Trognon (1987) Generalized residuals, *Journal of Econometrics*, 5–32
- Newey, Whitney, K. (1985a) Generalized method of moments specification testing, *Journal of Econometrics* 29, 229–256
- Newey, W.K. (1985b) Maximum likelihood specification testing and conditional moment tests, *Econometrica* 53, 1047–70
- Newey, Whitney K. and Daniel McFadden (1994) Large sample estimation and hypothesis testing, in *Handbook of Econometrics*, Vol 4, 2113–2247
- Pagan, A.R. and A.D. Hall (1983) Residual analysis as diagnostic testing, *Econometric Reviews* 2, 159–218
- Pagan, A.R. and F. Vella (1989) Diagnostic tests for models based on individual data: a survey, *Journal of Applied Econometrics*, 4 29–59
- Tauchien, George (1985) Diagnostic testing and evaluation of maximum likelihood models, *Journal of Econometrics* 30, 415–443
- Halbert White (1996) *Estimation, Inference and Specification Analysis*, Cambridge

#### 4. Discrete Choice Models

- Amemiya, T. (1981) Qualitative response model: A survey, *Journal of economic literature* 19, 1483–1526
- Amemiya, Takeshi (1985) *Advanced Econometrics*, Harvard University Press, Cambridge, Massachusetts, chapters 9–10
- Ben-Akiva, M. and S.R. Lerman (1985) *Discrete Choice Analysis*, MIT Press, Cambridge, Massachusetts
- Davidson, Russell and James G. MacKinnon (1993) *Estimation and Inference in Econometrics*, Oxford University Press, New York, Chapter 15
- Hausman, J. and D. Wise (1978) A conditional probit model for qualitative choice: Discrete decisions recognizing interdependence and heterogenous preference, *Econometrica* 47 403–426
- Heckman, J. (1976) Dummy endogenous variables in a simultaneous equation system, *Econometrica*, 931–961
- Heckman, J. (1979) Sample selection as a specification error, *Econometrica*, 153–161
- Lee, Lung-fei (2001) Self-selection, Chapter 18 in Baltagi, Badi H., ed. (2001) *A Companion to Theoretical Econometrics*, Blackwell, Malden, Massachusetts
- Maddala, G.S. (1983) *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge University Press, New York, chapters 2-3, 6, 8-9
- Maddala, G.S. and A. Flores-Lagunes (2001) Qualitative response models, Chapter 17 in Baltagi, Badi H., ed., *A Companion to Theoretical Econometrics*, Blackwell, Malden, Massachusetts

## 5. Count Models

Gurmu, Shiferaw and Pravin K. Trivedi (1994) Recent developments in models of event counts: A survey, mimeo, University of Virginia

Cameron, A. Colin and Pravin K. Trivedi (1998), Regression analysis of count data, New York, Cambridge University Press

Cameron, A. Colin and Pravin K. Trivedi (2001) Essentials of count data regression, Chapter 15 in Baltagi, Badi H., ed., A Companion to Theoretical Econometrics, Blackwell, Malden, Massachusetts

Greene, William H. (2012) Econometric Analysis, 7th ed, Prentice Hall, Upper Saddle River, NJ.

Winkelmann, Rainer (2000) Econometric Analysis of Count Data, Third edition, Springer, New York

## 6. Duration Models

Amemiya, Takeshi (1985) Advanced Econometrics, Harvard University Press, Cambridge, Massachusetts, chapter 11

Flinn, C.J. and J. Heckman (1982) Models for the analysis of labour market dynamics, in R Bassman and W. Rhodes, Advances in Econometrics, 35–95

Gourieux, C. (1989) Économétrie des Variables Qualitatives, second edition, Economica, Paris, chapter 11

Gourieux, Christian and Joann Jasiak (2001) Durations, Chapter 21 in Baltagi, Badi H., ed., A Companion to Theoretical Econometrics, Blackwell, Malden, Massachusetts

Heckman, J. and B. Singer (1984) A method for minimizing the impact of distributional assumptions in econometric models for duration data, *Econometrica*, 52, 271–320

Kiefer, Nicholas M. (1988) Economic duration data and hazard functions, *Journal of Economic Literature* 26, 646–679

Lancaster, T. (1990) The Econometric Analysis of Transition Data, Cambridge University Press, New York

## 7. Panel Data

Ahn, Seung C. and Peter Schmidt (1999) Estimation of Linear Panel Data Models Using GMM, Chapter 8 in Matyas, Laszlo, Editor, Generalized Method of Moments Estimation, Cambridge University Press, New York

Anderson, T.W. and Cheng Hsiao (1982) Formulation and estimation of dynamic models using panel data, *Journal of Econometrics*, 47–82

Arellano, Manuel (2003) Panel Data Econometrics, Oxford University Press, New York

Baltagi, Badi H. (2013) Econometric Analysis of Panel Data, 5th ed., John Wiley and Sons, New York

Hausman, J. and W. Taylor (1981) Panel data and unobserved individual effects, *Econometrica*, 1377–1397

Hsiao, Cheng (2014) *Analysis of Panel Data*, Third ed., Cambridge University Press, New York, chapters 1–4, 6

Hsiao, Cheng (2001) Panel data models, Chapter 16 in Baltagi, Badi H., ed. (2001) *A Companion to Theoretical Econometrics*, Blackwell, Malden, Massachusetts

Mundlak, Y. (1978) On the pooling of time series and cross section data, *Econometrica* 46, 69–85

## 8. Monte Carlo and Simulation Methods

Davidson, Russell and James G. MacKinnon (1993) *Estimation and Inference in Econometrics*, Oxford University Press, New York, Chapter 21

Hajivassiliou, V.A. (1993) Simulation estimation methods for limited dependent variables, in, *Handbook of Statistics*, 11, Elsevier Science Publishers

Hendry, David H. (1983) Monte Carlo simulation in econometrics, Chapter 16 in *Handbook of Econometrics*, Volume 2, North Holland, New York

McFadden, D. (1989) A method of simulated moments for estimation of discrete response models without numerical integration, *Econometrica*, 57, 995–1026

McFadden, Daniel and Paul A. Ruud (1994) Estimation by simulation, *The Review of Economics and Statistics*, 76, 591–608

Lerman, S. and C. Manski (1981) On the use of simulated frequencies to approximate choice probabilities, in C. Manski and D. McFadden, eds., *Structural Analysis of Discrete Data with Econometric Applications*

Pakes, A. and D. Pollard (1989) The asymptotics of simulation estimators, *Econometrica*

Steven Stern (1997) Simulation based estimation, *Journal of Economic Literature*

## 9. Nonparametric and Semiparametric Econometrics

Ai, Chungrong and Xiaohong Chen (2003) Efficient Estimation of Models with conditional moment restrictions containing unknown functions, *Econometrica*, 71 (6), 1795–1843

Andrews, D. (1991) Asymptotic normality of series estimation for nonparametric and semiparametric regression models, *Econometrica* 59, 307–345

Chamberlain, Gary (1992) Efficiency bounds for semiparametric regression, *Econometrica* 60, 567–626

Chen, Xiaohong (2007) *Large Sample Sieve Estimation of Semi-Nonparametric Models*, Handbook, Volume 6B

Hardle, W. (1990) *Applied Nonparametric Regression*, Cambridge University Press, New York.

Li, Qi and Jeffrey Scott Racine (2006) *Nonparametric Econometrics: Theory and Practice* Princeton University Press, Princeton University Press

Newey, Whitney (1994) Series estimation of regression functionals, *Econometric Theory*, 10, 1–28

Newey, Whitney (1989) Semiparametric efficiency bounds, *Journal of Applied Econometrics* 5, 99–136

Newey, Whitney and James Powell (2003) Instrumental Variables Estimation of Nonparametric Models, *Econometrica*, 71, 1557-1569

Pagan, Adrian and Aman Ullah (1999) *Nonparametric econometrics*, Cambridge University Press, New York

Robinson, P.M. (1988) Semiparametric econometrics: A survey, *Journal of Applied Econometrics* 3, 35–51

Silverman, B.W. (1986) *Density Estimation for Statistics and Data Analysis*, Chapman and Hall, New York

Stoker, Thomas M. (1992) *Lectures on Semiparametric Econometrics*, Core Foundation, Louvain-la-Neuve

Ullah, Aman (2001) Nonparametric kernel methods of estimation and hypothesis testing, Chapter 20 in Baltagi, Badi H., ed. (2001) *A Companion to Theoretical Econometrics*, Blackwell, Malden, Massachusetts

## 10. Empirical Likelihood Estimation

Imbens, G.W., R.H. Spady and P. Johnson (1998) Information theoretic approaches to inference in moment condition models, *Econometrica* 66, 333-357.

Kitamura, Y. and M. Stutzer (1997) An information-theoretic alternative to Generalized Method of Moments Estimation, *Econometrica* 65, 861–874.

Newey, Whitney K. and Richard J. Smith (2004) Higher order properties of GMM and Generalized Empirical Likelihood Estimators, *Econometrica*, 72(1), 219-255 .

Owen, A.B. (1988) Empirical likelihood ratio confidence intervals for a single functional, *Biometrika* 75, 237–249.

Qin, Jing and Jerry Lawless (1994) Empirical likelihood and general estimating equations, *Annals of Statistics* 22, 300–325.

## 11. Some Multivariate Calculus

MacRae, E.C. (1974) Matrix derivatives with an application to an adaptive linear decision problem, *Annals of Statistics*, 2, 337–346.

Magnus, Jan R. and Heinz Neudecker (1988) *Matrix Differential Calculus*, Wiley, New York, NY, 1988

Turkington, Darrell A. (2013) *Generalized Vectorization, Cross-Products and Matrix Calculus*, Cambridge, New York

## 12. Stochastic Expansions and Second-Order Moments

Rilstone, Paul, V.K. Srivastava and Aman Ullah (1996) The second-order bias and mean squared error of nonlinear estimators, *Journal of Econometrics* 75(2), 369–395.

Barndorff-Nielsen, O.E. and D.R. Cox (1989) *Asymptotic Techniques for Use in Statistics*, Chapman and Hall, New York, chapters 1-4.2

Newey, Whitney K. and Richard Smith (2004) Higher Order Properties of GMM and Generalized Empirical Likelihood Estimators, *Econometrica* 72(1) 219–255.

Hall, Peter (1992) *The Bootstrap and Edgeworth Expansion*, Springer-Verlag, New York, chapters 1-2

Rothenberg, T.A. (1984) Approximating the distributions of econometric estimators and test statistics in *Handbook of Econometrics*, vol 2, North Holland, New York

### 13. Edgeworth Expansions

Barndorff-Nielsen, O.E. and D.R. Cox (1989) *Asymptotic Techniques for Use in Statistics*, Chapman and Hall, New York, chapters 1-4.2

Bhattacharya R.N. and Ghosh J.K. (1978) On the Validity of the Formal Edgeworth Expansion, *The Annals of Statistics*, 6 (2), 434–451.

Bhattacharya R.N. and Rao, R.R. (1976) *Normal approximations and asymptotic expansions* Expansion, Wiley, New York

Chambers J.M. (1967) On Methods of Asymptotic Approximation for Multivariate Distributions, *Biometrika*, 50(3/4), 367–383

### 14. Saddlepoint Approximations

Butler R.W. (2007) *Saddlepoint Approximations with Applications*, Cambridge University Press, Cambridge, New York.

Reid N. (1988) Saddlepoint Methods and Statistical Inference, *Statistical Science* 3(2), 213–238

Daniels, H. E. (1954) Saddlepoint approximations in Statistics, *Annals of Mathematical Statistics*, 25, 631–650.

Daniels, H. E. (1980) Exact Saddlepoint approximations, *Biometrika*, 67, 59–63

Daniels, H. E. (1983) Saddlepoint approximations for Estimating Equations, 70, 89–96.

Easton, G.S. and E. Ronchetti (1986) General saddlepoint approximations with applications to L statistics, *Journal of the American Statistical Association*, 81, 420–430.

Lieberman, Offer (1994) On the Approximation of Saddlepoint Expansions in Statistics, *Econometric Theory*, 10, 900–916.

Ohman–Strickland, Pamela and George Casella (2002) Approximate and estimated saddlepoint approximations, *Canadian Journal of Statistics* 30(1), 97–108.

Jensen, Jens Ledet (1995) *Saddlepoint Approximations*, Oxford University Press, USA.

### 15. The Jackknife and the Bootstrap

Davidson, Russell and James G. MacKinnon (1993) *Estimation and Inference in Econometrics*, Oxford University Press, New York, Chapter 21

Hall, Peter (1992) *The Bootstrap and Edgeworth Expansion*, Springer-Verlag, New York, Appendix 2

Efron, B. and Tibshirani, R. (1993) *An Introduction to the Bootstrap*, Chapman and Hall, New York

Beran, R. and G.R. Ducharme (1991) *Asymptotic Theory for Bootstrap Methods in Statistics*, Les publications CRM, Montreal

Shao, Jun and Dongsheng Tu (1995) *The Jackknife and Bootstrap*, Springer-Verlag, New York



Efron, B. (1983) A leisurely look at the bootstrap, the jackknife, and cross-validation, *The American Statistician* 37, 36–48

Hall, Peter (1992) *The Bootstrap and Edgeworth Expansion*, Springer-Verlag, New York, Appendix 2

Hall, Peter (1994) Methodology and Theory for the Bootstrap, in *Handbook of Econometrics*, Vol 4, 2342–2383

## 16. Weak Instruments

Anderson, T. W., and H. Rubin (1949), Estimation of the parameters of a single equation in a complete system of stochastic equations, *Annals of Mathematical Statistics*, 20, 46-63.

Bekker, Paul A. (1994) Alternative Approximations to the Distributions of Instrumental Variable Estimators, *Econometrica* 62(3): 657-81

Imbens, Guido W. (2014) Instrumental Variables: An Econometrician’s Perspective, *Statistical Science* 29 (3) 323-58.

Mikusheva, A. (2010) Robust confidence sets in the presence of weak instruments, *Journal of Econometrics*, 157, 236-247.

Staiger, D. and James H. Stock (1997) Instrumental variables regression with weak instruments, *Econometrica*, 65, 557-586.

Stock, J., J. Wright and M. Yogo (2002) "A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments," *Journal of the American Statistical Association* 20 (4): 518-529.

Stock, J. H., and M. Yogo (2005) Testing for weak instruments in linear IV regression, in D. W. K. Andrews and J. H. Stock (eds.), *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, 80-108, Cambridge University Press.

Zivot, E., R. Startz, and C. R. Nelson (1998), Valid confidence intervals and inference in the presence of weak instruments, *International Economic Review*, 39, 1119-1144.

## 17. Quantile Estimation

Angrist and Pischke, chapter 7

Bushinsky, Moshe (1994) Changes in the U.S. Wage Structure 1963–1987: Application of Quantile Regression, *Econometrica* 62, 405-458

Hao, Lingxin and Daniel Q. Naiman (2007) *Quantile Regression*, Sage Publications, Thousand Oaks, California

Koenker, Roger (2005) *Quantile Regression*, Cambridge University Press, Cambridge, U.K.

Koenker, Roger and Gilbert (1978) Regression Quantiles, *Econometrica* 46, 33-50

## 18. Bayesian Methods

Box, George E.P. and George C. Tiao (1973) *Bayesian Inference in Statistical Analysis*, Addison-Wesley, Reading, Massachusetts

Casella, G. and E.I. George (1992) Explaining the Gibbs Sampler, *The American Statistician* 46, 167–174

Geweke, John (1986) Exact inference in the inequality constrained normal linear regression model, *Journal of Applied Econometrics* 1, 127–141

Lancaster, Tony (2004) *An Introduction to Modern Bayesian Econometrics*, Blackwell, Malden, MA.

Poirier, Dale J. (1988) Frequentist and subjectivist perspectives on the problems of model building in economics, with comments, *The Journal of Economic Perspectives* 2, 121–170

Poirier, Dale J. (1995) *Intermediate statistics and econometrics: A comparative approach*, MIT Press, Cambridge.

Zellner, Arnold (1971) *An Introduction to Bayesian Inference in Econometrics*, John Wiley and Sons, New York, chapters 1–3, 8

## 19. Auctions

Athey, Susan and Philip A. Haile (2005) Nonparametric Approaches to Auctions, in *Handbook of Econometrics*, Volume 6, James J. Heckman and Edward Leamer, eds., Elsevier, Amsterdam

Krishna, Vijay (2002) *Auction Theory*, Academic Press, San Diego

Paarsch, Harry and Han Hong (2006) *An Introduction to the Structural Econometrics of Auction Data*, MIT Press, Cambridge, Massachusetts

## 20. Average Treatment Effects, Differences in Differences, Discontinuous Regression and Propensity Score Methods

Angrist, J.D., G.W. Imbens and D.B. Rubin (1996) Identification and Causal Effects Using Instrumental Variables, *JASA* 91, 444-455.

Athey, Susan and Guido W. Imbens (2017) The State of Applied Econometrics: Causality and Policy Evaluation, *The Journal of Economic Perspectives*, Vol. 31 (2), pp. 3-32

Card, David (1990) The Impact of the Mariel Boatlift on the Miami Labor Market, *Industrial and Labor Relations Review* 43 (2) : 245-57

Doudchenko, Nikolay, and Guido W. Imbens (2016) Balancing, Regression, Difference-in-Differences and Synthetic Control Methods: A Synthesis, arXiv: 1610.07748.

Heckman, J.J., H. Ichimura and P. Todd (1997) Matching as an Econometric Evaluation Estimator, *Review of Economic Studies* 65, 261–294.

Heckman, James J., and Edward Vytlacil (2007) *Econometric Evaluation of Social Programs, Part I: Causal Models, Structural Models and Econometric Policy Evaluation*, in *Handbook of Econometrics* 6B , edited by James Heckman and Edward Learner, 4779-4874. Elsevier.

Imbens, Guido W. (2000) The Role of the Propensity Score in Estimating Dose-Response Functions., *Biometrika* (3): 706-10

Imbens, Guido W. (2015) Matching Methods in Practice: Three Examples, *Journal of Human Resources* 50(2) 373-419.

Imbens, G.W. and J.D. Angrist (1994) Identification and Estimation of Local Treatment Effects, *Econometrica* 74, 467–476.

Lee, David S. and Thomas Lemieux (2010) Regression Discontinuity Designs in Economics, *Journal of Economic Literature* 48(2), 281-355.

McCaffrey, Daniel F., Greg Ridgeway and Andrew R. Morral (2004) Propensity Score Estimation with Boosted Regression for Evaluating Causal Effects in Observational Studies, *Psychological Methods* 9(4) 403-25

Oster, Emily (2015) Diabetes and Diet: Behavioural Response and the Value of Health, NBER Working Paper 21600.

Rosenbaum, Paul (1987) The Role of a Second Control Group in an Observational Study, *Statistical Science* 2(3): 292-306.

Rosenbaum, Paul R. (2002) Observational Studies, in *Observational Studies*, 1-17. Springer.

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

Wyss, Richard, Allan Ellis, Alan Brookhart, Cynthia Girman, Michele Jonsson Funk, Robert LoCasale and Til Strümer (2014) The Role of Prediction Modeling in Propensity Score Estimation: An Evaluation of Logistic Regression, bCART, and the Covariate-Balancing Propensity Score, *American Journal of Epidemiology* 180(6): 645-55.

## 21. Machine Learning

Tibshirani, Robert (1996) Regression shrinkage and selection via the lasso, *Journal of the American Statistical Association, Series B*, 58, 267-288.

Hansen (2021b) Chapter 29

Chernozhukov, Victor, Denis Chetverikov, Mert Demirer, Esther Duflo, Christian B. Hansen, Whitney Newey, and James Robins (2018) Double/debiased machine learning for treatment and structural parameters, *The Econometrics Journal*, 21, C1-C68.

Chernozhukov, Victor, Christian B. Hansen and Martin Spindler (2015): “Post-selection and postregularization inference in linear models with many controls and instruments,” *American Economic Review Papers and Proceedings*, 105: 486-490

Chetverikov, Denis, Zhipeng Liao, and Victor Chernozhukov (2020) On cross-validated Lasso in high dimensions, *Annals of Statistics*, forthcoming

Athey, Susan and Guido W. Imbens (2019) Machine learning methods economists should know about, *Annual Review of Economics*, 11: 685–725.

Breiman, Leo (2001) Statistical Modelling: The Two Cultures, *Statistical Science*, 16,:3, 226-231

Mullainathan, Sendhil, and Jann Spiess (2017) Machine Learning: An Applied Econometric Approach, *Journal of Economic Perspectives*, 31(2): 87–106.

Chan, Felix and Laszlo Matyas (2022) *Econometrics with Machine Learning*

Wager, Stefan and Susan Athey (2018) Estimation and inference of heterogenous treatment effects using random forests, *Journal of The American Statistical Association*, 113: 1228-1242

Other readings may be suggested during the course.