UNIVERSITY OF NOTRE DAME
Keough School of Global Affairs

**MGA-60211: Advanced Econometrics for Policy & Public Finance**
**Syllabus, Spring 2020**

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Office hours: Friday 11am – noon (please email me in advance)

**Lecture hours and location**
Lectures: Tues/Thurs 2:00-3:15pm
Jenkins Hall B066

**Overview of the course**
The course covers the core methods necessary to read and conduct economic research using examples from the Public Finance literature. Students should have a good understanding of statistical inference and linear regression methods to be eligible. The course stresses the practical implementation of various econometric methodologies to analyze longitudinal datasets and "big data." Lectures will provide a comprehensive introduction to Randomized Controlled Trials (RCTs), non-parametric methods, quasi-experimental research designs, non-linear estimation (including MLE and GMM), time series econometrics, and modern machine learning. The course will also provide a refresher on hypothesis testing and model specification testing. Readings and practical problem sets will be posted each week to provide hands-on numerical experience to students.

**Textbooks**
The course will rely on articles, and some chapters of the following books will be of use at specific points of the course.
Angrist, J. D., & Pischke, J. S. (2008). *Mostly harmless econometrics: An empiricist's companion.* Princeton University Press.
Angrist, J. D., & Pischke, J. S. (2014). *Mastering 'metrics: The path from cause to effect.* Princeton University Press.
Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: methods and applications.* Cambridge University Press.
Hamilton, J. D. (1994). *Time series analysis*. Princeton, NJ: Princeton University Press.
Hayashi, F. (2000). *Econometrics.* Princeton University Press.
Gareth, J. (2010). *An introduction to statistical learning: with applications in R.* Springer.
Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The elements of statistical learning: data mining, inference, and prediction.* Springer Science & Business Media.
Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data.* Cambridge, MA: MIT Press.
Wooldridge, J. M. (2013). *Introductory econometrics: A modern approach.* Nelson Education.

**Prerequisites**
The course provides an advanced treatment of topics in Applied Econometrics. Students are expected to have command over basic Probability and Statistical Inference concepts. Additionally,

students should be acquainted with Linear Algebra and have a basic understanding of univariate and multivariate linear regression.

**Classroom policy**
Please bring your name tags to every class. Participation in discussions is encouraged. Do not use laptops or cell phones during class; the course web page contains detailed lecture notes that you can print. Avoid side conversations at all times. Students should leave the classroom for emergencies only. Consumption of food/drinks should be exercised responsibly.

**Disability services**
It is the policy and practice of the University of Notre Dame to provide reasonable accommodations for students with properly documented disabilities. Students who have questions about the Office of Disability Services or who have, or think they may have, a disability are invited to contact the Office of Disability Services for a confidential discussion in the Sara Bea Center for Students with Disabilities or by phone at 574-631-7157. Because the University's Academic Accommodations Processes generally require students to request accommodations well in advance of the dates when they are needed, students who believe they may need an accommodation for this course are encouraged to contact the Office of Disability Services at their earliest opportunity. Additional information about Disability Services and the process for requesting accommodations may be found at disabilityservices.nd.edu.

**Attendance requirement**
Students are required to attend two lectures each week. In lecture, we will cover the assigned readings and also go over complementary material.

**Academic integrity**
In line with the Academic Code of Honor of the University, any assignment or exam you submit is presumed to be original work. Whenever making use of the ideas of others, make sure to adequately cite them and acknowledge them in your work. Any violation of the honor code will be directly reported to the Provost as a dishonest offense.

**Marking scheme**
Final marks will be based on the following components:

| | |
|---|---|
| Problem sets | 60% |
| Midterm examination | 20% |
| Final examination | 20% |
| Total | 100% |

**Problem sets**
Problem sets will be due each week on Tuesday at the beginning of the class. They will usually consist of a simulation exercise and a reading in Public Finance. Please hand in a paper copy at the beginning of the class and upload an electronic version to Sakai (no late submissions to Sakai are accepted). Any programming language is accepted for the simulation exercises. If students

have any questions on Problem Sets they should ask staff at the Help Desk of the Center for Social Science Research first and ask me only if Quant Tutors are unable to help.

**Midterm & final examinations**

Exam materials will be taken from lectures. Both exams are closed-book examinations. In addition to carrying out various quantitative calculations, it is important that you are able to explain the reasoning behind these calculations. No calculator is required. You should also be able to summarize a method of analysis in words, identify important assumptions, and carefully define terms. Only absences due to force majeure will be tolerated. The written approval of the university will be required to justify any absence. Any unjustified absence will receive a zero mark.

**Course schedule**

| Lecture No. | Day | Date | Topic |
|---|---|---|---|
| 1 | Tuesday | 14-Jan | Identification, random sampling, asymptotic theory |
| 2 | Thursday | 16-Jan | Hypothesis testing, model selection |
| 3 | Tuesday | 21-Jan | Linear regression topics I |
| 4 | Thursday | 23-Jan | Linear regression topics II |
| 5 | Tuesday | 28-Jan | Quantile regression, non-parametric methods |
| 6 | Thursday | 30-Jan | The Bootstrap |
| 7 | Tuesday | 4-Feb | Randomized Controlled Trials I |
| 8 | Thursday | 6-Feb | Randomized Controlled Trials II |
| 9 | Tuesday | 11-Feb | Instrumental Variables I |
| 10 | Thursday | 13-Feb | Instrumental Variables II |
| 11 | Tuesday | 18-Feb | Differences-in-differences I |
| 12 | Thursday | 20-Feb | Differences-in-differences II |
| 13 | Tuesday | 25-Feb | Regression Discontinuity |
| 14 | Thursday | 27-Feb | Matching I |
| 15 | Tuesday | 3-Mar | Matching II |
| 16 | Thursday | 5-Mar | The Control Function approach |
| *SPRING BREAK* | | | |
| 17 | Tuesday | 17-Mar | *MIDTERM EXAMINATION* |
| 18 | Thursday | 19-Mar | Maximum Likelihood Estimation I |
| 19 | Tuesday | 15-Mar | Maximum Likelihood Estimation II |
| 20 | Tuesday | 24-Mar | Maximum Likelihood Estimation III |
| 21 | Thursday | 26-Mar | Bayesian methods |
| 22 | Tuesday | 31-Mar | Generalized Method of Moments (GMM) |
| 23 | Thursday | 2-Apr | Factor or “information reduction” methods |
| 24 | Tuesday | 7-Apr | Structural modelling and counterfactual simulation |
| 25 | Tuesday | 9-Apr | Time-series Econometrics I |

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|---|---|---|---|
| 26 | Thursday | 14-Apr | Time-series Econometrics II |
| 27 | Tuesday | 16-Apr | Time-series Econometrics III |
| 28 | Thursday | 21-Apr | Machine Learning I |
| 29 | Tuesday | 23-Apr | Machine Learning II |
| 30 | Thursday | 28-Apr | Machine Learning III |
| *FINAL EXAMINATION: May 7th*, 9:30 am until 12.30 pm | | | |

**Econometrics references**

**The Bootstrap**

Efron, B. (1992). Bootstrap methods: another look at the jackknife. In *Breakthroughs in Statistics* (pp. 569-593). Springer, New York, NY.
Horowitz, J. L. (2001). The bootstrap. In *Handbook of Econometrics* (Vol. 5, pp. 3159-3228). Elsevier.

**Causal analysis**

Abbring, J. H. and Heckman, J. J. (2007). "Econometric Evaluation of Social Programs, Part III: Distributional Treatment Effects, Dynamic Treatment Effects, Dynamic Discrete Choice, and General Equilibrium Policy Evaluation," in *Handbook of Econometrics*, v. 6B, J. Heckman and E. Leamer, eds. Amsterdam: Elsevier. pp. 5145-5303.
Angrist, J. D., & Pischke, J. S. (2010). The credibility revolution in empirical economics: How better research design is taking the con out of econometrics. *Journal of Economic Perspectives*, 24(2), 3-30.
Heckman, J. J. (2008). Econometric causality. *International Statistical Review*, 76(1), 1-27.
Heckman, J. J., & Singer, B. (2017). Abducting economics. *American Economic Review*, 107(5), 298-302.
Heckman, James J. and Vytlacil, Edward J. (2007). "Econometric Evaluation of Social Programs, Part I: Causal Models, Structural Models and Econometric Policy Evaluation," in *Handbook of Econometrics*, Vol. 6B, J.
Heckman, James J. and Vytlacil, Edward J. (2007). "Econometric Evaluation of Social Programs, Part II: Using the Marginal Treatment Effect to Organize Alternative Economic Estimators to Evaluate Social Programs and to Forecast Their Effects in New Environments," in *Handbook of Econometrics*, Vol. 6B, J. Heckman and E. Leamer, eds. Amsterdam: Elsevier. pp. 4875-5144.
Arellano, M. & Honoré, B. (2001). "Panel Data Models: Some Recent Developments," in *Handbook of Econometrics*, Vol. 5, edited by Heckman, J.J. & Leamer, E. (Amsterdam: Elsevier Science), pp. 3229-3296, Sections 1-3.

**Randomized Controlled Trials (RCTs)**

Bitler, M. P., Gelbach, J. B., & Hoynes, H. W. (2006). What mean impacts miss: Distributional effects of welfare reform experiments. *American Economic Review*, 96(4), 988-1012.
Bursztyn, L., Ederer, F., Ferman, B., & Yuchtman, N. (2014). Understanding mechanisms underlying peer effects: Evidence from a field experiment on financial decisions. *Econometrica*, 82(4), 1273-1301.

Deaton, A., & Cartwright, N. (2018). Understanding and misunderstanding randomized controlled trials. *Social Science & Medicine*, 210, 2-21.
Duflo, E., Glennerster, R., & Kremer, M. (2007). Using randomization in development economics research: A toolkit. *Handbook of Development Economics*, 4, 3895-3962.
Heckman, J. J., & Smith, J. A. (1995). Assessing the case for social experiments. *Journal of Economic Perspectives*, 9(2), 85-110.
Romano, J. P., & Wolf, M. (2005). Stepwise multiple testing as formalized data snooping. *Econometrica*, 73(4), 1237-1282.
Romano, J. P., Shaikh, A. M., & Wolf, M. (2010). Hypothesis testing in econometrics. *Annual Review of Economics*, 2(1), 75-104.
Romano, J. P., & Shaikh, A. M. (2006). Stepup procedures for control of generalizations of the familywise error rate. *The Annals of Statistics*, 34(4), 1850-1873.

**Matching**

Angrist, Joshua D. and Jorn Stefan Pischke. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton, NJ: Princeton University Press. Chapter 3.
Dale, S. B., & Krueger, A. B. (2002). Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables. *Quarterly Journal of Economics*, 117(4), 1491-1527.
Dehejia, R. H., & Wahba, S. (1999). Causal effects in nonexperimental studies: Reevaluating the evaluation of training programs. *Journal of the American Statistical Association*, 94(448), 1053-1062.
Dehejia, R. H., & Wahba, S. (2002). Propensity score-matching methods for nonexperimental causal studies. *Review of Economics and Statistics*, 84(1), 151-161.
Dehejia, R. (2005). Practical propensity score matching: a reply to Smith and Todd. *Journal of Econometrics*, 125(1-2), 355-364.
Heckman, J. J., & Hotz, V. J. (1989). 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), 862-874.
Heckman, J., Ichimura, H., Smith, J., & Todd, P. (1998). *Characterizing selection bias using experimental data* (No. w6699). National Bureau of Economic Research.
Heckman, J. J., Ichimura, H., & Todd, P. E. (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. *Review of Economic Studies*, 64(4), 605-654.
Heckman, J., & Navarro-Lozano, S. (2004). Using matching, instrumental variables, and control functions to estimate economic choice models. *Review of Economics and Statistics*, 86(1), 30-57.
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. (2015). Matching methods in practice: Three examples. *Journal of Human Resources*, 50(2), 373-419.
LaLonde, R. J. (1986). Evaluating the econometric evaluations of training programs with experimental data. *American Economic Review*, 604-620.
Neal, D. A., & Johnson, W. R. (1996). The role of premarket factors in black-white wage differences. *Journal of Political Economy*, 104(5), 869-895.

Smith, J. A., & Todd, P. E. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators?. *Journal of Econometrics*, 125(1-2), 305-353.

**Instrumental Variables (IV)**

Angrist, J. D., Imbens, G. W., & Rubin, D. B. (1996). Identification of causal effects using instrumental variables. *Journal of the American Statistical Association*, 91(434), 444-455.
Angrist, J. D., & Imbens, G. W. (1995). Two-stage least squares estimation of average causal effects in models with variable treatment intensity. *Journal of the American Statistical Association*, 90(430), 431-442.
Andrews, I., Stock, J. H., & Sun, L. (2019). Weak Instruments in Instrumental Variables Regression: Theory and Practice. *Annual Review of Economics*, 11, 727-753.
Angrist, J., & Evans, W. (1998). Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size. *American Economic Review*, 88(3), 450-77.
Angrist, Joshua D. and Pischke, J. S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton, NJ: Princeton University Press. Chapter 4.
Imbens, G. W., & Angrist, J. D. (1994). Identification and Estimation of Local Average Treatment Effects. *Econometrica*, 62(2), 467-475.

**Regression Discontinuity (RD)**

Angrist, J. D., & Lavy, V. (1999). Using Maimonides' rule to estimate the effect of class size on scholastic achievement. *Quarterly Journal of Economics*, 114(2), 533-575.
Angrist, Joshua D. and Pischke, J. S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton, NJ: Princeton University Press. Chapter 6.
Lee, D. S., & Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature*, 48(2), 281-355.
Dahl, G. B., Løken, K. V., & Mogstad, M. (2014). Peer effects in program participation. *American Economic Review*, 104(7), 2049-74.

**Differences-in-Differences (DiD)**

Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program. *Journal of the American Statistical Association*, 105(490), 493-505.
Abraham, S., & Sun, L. (2018). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Available at SSRN 3158747.*
Angrist, Joshua D. and Pischke, J. S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton, NJ: Princeton University Press. Chapter 5.
Athey, S., & Imbens, G. W. (2006). Identification and inference in nonlinear difference-in-differences models. *Econometrica*, 74(2), 431-497.
Ashenfelter, O., & Card, D. (1985). Using the longitudinal structure of earnings to estimate the effect of training programs. *Review of Economics and Statistics*, 67(4), 648-660.
Callaway, B., & Sant'Anna, P. H. (2019). Difference-in-differences with multiple time periods. *Available at SSRN 3148250.*
Cameron, A. C., & Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, 50(2), 317-372.

Heckman, J. J., & Robb, R. (1986). Alternative identifying assumptions in econometric models of selection bias. *Advances in Econometrics*, 5, 243-287.
Freyaldenhoven, S., Hansen, C., & Shapiro, J. M. (2019). Pre-event trends in the panel event-study design. *American Economic Review*, 109(9), 3307-38.
Meyer, B. D., Viscusi, W. K., & Durbin, D. L. (1995). Workers' compensation and injury duration: evidence from a natural experiment. *American Economic Review*, 322-340.

**The control function approach**

Wooldridge, J. M. (2015). Control function methods in applied econometrics. *Journal of Human Resources*, 50(2), 420-445.

**Time-Series Econometrics**

Brockwell, P. J., Davis, R. A., & Fienberg, S. E. (1991). *Time Series: Theory and Methods: Theory and Methods.* Springer Science & Business Media.
Durbin, J., & Koopman, S. J. (2012). *Time series analysis by state space methods.* Oxford University Press.
Newey, W. K., & West, K. D. (1987). A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica*, 55(3), 703-708.
Canova, F. (2011). *Methods for applied macroeconomic research.* Princeton University Press.
Fuller, W. A. (2009). *Introduction to statistical time series.* John Wiley & Sons.
Bernanke, B.S., J. Boivin and P. Eliasz (2005), "Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach", *Quarterly Journal of Economics* 120: 387–422.
Stock, J. H., & Watson, M. W. (2016). Dynamic factor models, factor-augmented vector autoregressions, and structural vector autoregressions in macroeconomics. In *Handbook of Macroeconomics* (Vol. 2, pp. 415-525). Elsevier.
Bernanke, B. S., Boivin, J., & Eliasz, P. (2005). Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. *Quarterly Journal of Economics*, 120(1), 387-422.
Uhlig, H. (2017, November). Shocks, Sign Restrictions, and Identification. In *Advances in Economics and Econometrics: Volume 2: Eleventh World Congress* (Vol. 59, p. 95). Cambridge University Press.
Ramey, V. A. (2016). Macroeconomic shocks and their propagation. In *Handbook of Macroeconomics* (Vol. 2, pp. 71-162). Elsevier.
Blanchard, O. J., & Quah, D. (1993). The dynamic effects of aggregate demand and supply disturbances: Reply. *American Economic Review*, 83(3), 653-658.

**Generalized Method of Moments (GMM)**

Hansen, L. P. (2008). Generalized method of moments estimation. *The New Palgrave Dictionary of Economics*: Volume 1–8, 2428-2435.

**Machine Learning and "Big Data"**

Einav, L., & Levin, J. (2014). Economics in the age of big data. *Science*, 346(6210), 1243089.
Kleinberg, J., Ludwig, J., Mullainathan, S., & Obermeyer, Z. (2015). Prediction policy problems. *American Economic Review*, 105(5), 491-95.

Varian, H. R. (2014). Big data: New tricks for econometrics. *Journal of Economic Perspectives*, 28(2), 3-28.

**Maximum Likelihood Estimation**

Train, K. E. (2009). *Discrete choice methods with simulation.* Cambridge University Press. Chapters 1 through 8.
Heckman, J. J., & Honore, B. E. (1990). The empirical content of the Roy model. *Econometrica*, 58(5), 1121-1149.
Keane, M. P., & Wolpin, K. I. (1997). The career decisions of young men. *Journal of Political Economy*, 105(3), 473-522.

**Structural modeling**

Hansen, L. P., & Heckman, J. J. (1996). The empirical foundations of calibration. *Journal of Economic Perspectives*, 10(1), 87-104.
Kydland, F. E., & Prescott, E. C. (1996). The computational experiment: an econometric tool. *Journal of Economic Perspectives*, 10(1), 69-85.
Keane, M. P. (2010). A structural perspective on the experimentalist school. *Journal of Economic Perspectives*, 24(2), 47-58.
Keane, M. P., Todd, P. E., & Wolpin, K. I. (2011). The structural estimation of behavioral models: Discrete choice dynamic programming methods and applications. In *Handbook of Labor Economics* (Vol. 4, pp. 331-461). Elsevier.