

## HCMG 901: Applied Econometrics

### Spring 2021

Atul Gupta  
Assistant Professor  
Wharton Health Care Management  
306 Colonial Penn Center  
[atulgup@wharton.upenn.edu](mailto:atulgup@wharton.upenn.edu)

### Overview

This course covers econometric methods widely used in current applied economics research. The main goal of the class is to prepare you to conduct high quality, econometrically sound empirical analysis. Concepts, applications, and practice are emphasized, as opposed to technical derivations of estimators and their properties. The focus is on linear (least squares), non-linear (e.g. quantile, discrete, count, two-part, and duration), and panel data regression models. We cover several modern research designs in detail - difference-in-differences, triple differences, selection on observables (matching, propensity score), instrumental variables, synthetic controls, regression discontinuity, regression kink, and bunching. Due to the large number of topics covered, the emphasis is on breadth, not depth.

### Readings

The reading list comprises published articles and some working papers, which should be read *prior* to class. The papers have been chosen to illustrate the application, generally recent, of different empirical methods and strategies or are classics that should be known. While the reading list is extensive, I will typically ask students to read only 2–3 papers (thoroughly) per class. The remaining papers are listed as useful references for future use in your research. I will post required papers on Canvas. While there is no assigned text book for the class, we will closely follow *Mostly Harmless Econometrics: An Empiricist's Companion* by Angrist and Pischke. In addition, you may refer to select chapters in Andrew Jones' primer, *Applied Econometrics for Health Economists: A Practical Guide* (OHE Research, 2<sup>nd</sup> ed., 2007) and J. Wooldridge, *Econometric Analysis of Cross Section and Panel Data*.

### Logistics

The class will meet online every Monday 3-6 pm.  
Meeting by appointment.

### Other Requirements and Grading

In addition to reading the assigned papers prior to class, you are required to:

- Complete 3-4 homework assignments. These will mainly involve hands-on data analysis by replicating existing papers.
- Data project - replicate analysis from a paper of your interest, or perform original analysis. Present your analysis to the class and submit a brief report.
- Present to the class a paper from the reading list (or a relevant paper of your interest)
- Final exam – this will draw on the class material and homework.

Grading: Project – 20%; class participation and assignments – 40%; final – 40%

## Topics and Readings

\* Indicates student presentation of a paper from the reading list for that class (45 min)

† Indicates papers to be read prior to the class (may change)

### I. Jan 25 - Introduction and recap of classical estimation

- A. Course overview
- B. Potential outcomes and causal inference
- C. Recap of basic estimators (OLS, GLS, WLS) and inference

MHE Chapter 2

†Krueger, Alan B. "How computers have changed the wage structure: evidence from microdata, 1984–1989." *The Quarterly Journal of Economics* 108, no. 1 (1993): 33-60.

†DiNardo, John E., and Jörn-Steffen Pischke. "The returns to computer use revisited: Have pencils changed the wage structure too?" *The Quarterly Journal of Economics* 112, no. 1 (1997): 291-303.

Imbens, Guido W., and Jeffrey M. Wooldridge. "Recent developments in the econometrics of program evaluation." *Journal of economic literature* 47, no. 1 (2009): 5-86. Sections 1-3, 5, 6.3–6.5.

† [optional] Angrist, Joshua D., and Jörn-Steffen Pischke. "The credibility revolution in empirical economics: How better research design is taking the con out of econometrics." *Journal of economic perspectives* 24, no. 2 (2010): 3-30.

Athey, Susan, and Guido W. Imbens. "The state of applied econometrics: Causality and policy evaluation." *Journal of Economic Perspectives* 31, no. 2 (2017): 3-32.

### II. Feb 1 - Classical estimation and testing (Contd.)

- A. Recap of basic estimators (OLS, GLS, WLS) and inference
- B. Weighting
- C. Log transformation

MHE Chapters 2, 3 (excl. 3.3)

Manning, Willard G. "The logged dependent variable, heteroscedasticity, and the retransformation problem." *Journal of health economics* 17, no. 3 (1998): 283-295.

†Manning, Willard G., and John Mullahy. "Estimating log models: to transform or not to transform?" *Journal of health economics* 20, no. 4 (2001): 461-494.

Solon, Gary, Steven J. Haider, and Jeffrey M. Wooldridge. "What are we weighting for?" *Journal of Human resources* 50, no. 2 (2015): 301-316.

### III. Feb 8 - Classical estimation and testing (contd.) and Matching

- A. Nonparametric matching
- B. Propensity score matching

MHE Chapter 3.3

†LaLonde, Robert J. "Evaluating the econometric evaluations of training programs with experimental data." *The American economic review* (1986): 604-620.

Heckman, James J., Hidehiko Ichimura, and Petra E. Todd. "Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme." *The review of*

*economic studies* 64, no. 4 (1997): 605-654.

†Dehejia, Rajeev H., and Sadek Wahba. "Propensity score-matching methods for nonexperimental causal studies." *Review of Economics and statistics* 84, no. 1 (2002): 151-161.

Abadie, Alberto, David Drukker, Jane Leber Herr, and Guido W. Imbens. "Implementing matching estimators for average treatment effects in Stata." *The stata journal* 4, no. 3 (2004): 290-311.

†Smith, Jeffrey A., and Petra E. Todd. "Does matching overcome LaLonde's critique of non-experimental estimators?" *Journal of econometrics* 125, no. 1-2 (2005): 305-353.

Abadie, Alberto, and Guido W. Imbens. "On the failure of the bootstrap for matching estimators." *Econometrica* 76, no. 6 (2008): 1537-1557.

Blackwell, Matthew, Stefano Iacus, Gary King, and Giuseppe Porro. "CEM: Coarsened exact matching in Stata." *The Stata Journal* 9, no. 4 (2009): 524-546.

Hainmueller, Jens. "Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies." *Political analysis* (2012): 25-46.

**\* Davis, Steven J., John Haltiwanger, Kyle Handley, Ron Jarmin, Josh Lerner, and Javier Miranda. "Private equity, jobs, and productivity." *American Economic Review* 104, no. 12 (2014): 3956-90. - Sathya**

#### **IV. Feb 15 - Instrumental variables (I)**

- A. Motivation
- B. Constant treatment effects

MHE Chapter 4

†Angrist, Joshua D. "Lifetime earnings and the Vietnam era draft lottery: evidence from social security administrative records." *The American Economic Review* (1990): 313-336.

Angrist, Joshua D., and Alan B. Keueger. "Does compulsory school attendance affect schooling and earnings?" *The Quarterly Journal of Economics* 106, no. 4 (1991): 979-1014.

†Angrist, Joshua D., Guido W. Imbens, and Donald B. Rubin. "Identification of Causal Effects Using Instrumental Variables." *Journal of the American Statistical Association* 91, no. 434 (1996): 444-55.

Angrist, Joshua D., and William N. Evans. "Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size." *American Economic Review* 88, no. 3 (1998): 450-477.

† [optional] Angrist, Joshua D., and Alan B. Krueger. "Instrumental variables and the search for identification: From supply and demand to natural experiments." *Journal of Economic perspectives* 15, no. 4 (2001): 69-85.

#### **V. Feb 22 - Instrumental variables (II)**

- A. Heterogeneous treatment effects and LATE

†Imbens, Guido W., and Joshua D. Angrist. "Identification and Estimation of Local Average Treatment Effects." *Econometrica* 62, no. 2 (1994): 467-475.

Imbens, Guido W., and Donald B. Rubin. "Estimating outcome distributions for compliers in instrumental variables models." *The Review of Economic Studies* 64, no. 4 (1997): 555-574.

Abadie, Alberto. "Semiparametric instrumental variable estimation of treatment response models." *Journal of econometrics* 113, no. 2 (2003): 231-263.

Finkelstein, Amy, Sarah Taubman, Bill Wright, Mira Bernstein, Jonathan Gruber, Joseph P. Newhouse, Heidi Allen, Katherine Baicker, and Oregon Health Study Group. "The Oregon health insurance experiment: evidence from the first year." *The Quarterly journal of economics* 127, no. 3 (2012): 1057-1106.

†Maestas, Nicole, Kathleen J. Mullen, and Alexander Strand. "Does disability insurance receipt discourage work? Using examiner assignment to estimate causal effects of SSDI receipt." *American Economic Review* 103, no. 5 (2013): 1797-1829.

Doyle Jr, Joseph J., John A. Graves, Jonathan Gruber, and Samuel A. Kleiner. "Measuring returns to hospital care: Evidence from ambulance referral patterns." *Journal of Political Economy* 123, no. 1 (2015): 170-214.

Mogstad, Magne, Alexander Torgovitsky, and Christopher R. Walters. Identification of causal effects with multiple instruments: Problems and some solutions. No. w25691. National Bureau of Economic Research, 2019.

**\* Currie, Janet, and David Slusky. Does the Marginal Hospitalization Save Lives? The Case of Respiratory Admissions for the Elderly. No. w26618. National Bureau of Economic Research, 2020. - Sasmira**

## **VI. Mar 1 - Instrumental variables (III) and student project proposals**

- A. Marginal Treatment Effects
- B. Project proposal presentations (10-15 min each)

Heckman, James J., Sergio Urzua, and Edward Vytlacil. "Understanding instrumental variables in models with essential heterogeneity." *The Review of Economics and Statistics* 88, no. 3 (2006): 389-432.

†Basu, Anirban, James J. Heckman, Salvador Navarro-Lozano, and Sergio Urzua. "Use of instrumental variables in the presence of heterogeneity and self-selection: an application to treatments of breast cancer patients." *Health economics* 16, no. 11 (2007): 1133-1157.

†Doyle Jr, Joseph J. "Child protection and child outcomes: Measuring the effects of foster care." *American Economic Review* 97, no. 5 (2007): 1583-1610.

Zhou, Xiang, and Yu Xie. "Marginal treatment effects from a propensity score perspective." *Journal of Political Economy* 127, no. 6 (2019): 3070-3084.

**\*Cornelissen, Thomas, Christian Dustmann, Anna Raute, and Uta Schönberg. "Who benefits from universal child care? Estimating marginal returns to early child care attendance." *Journal of Political Economy* 126, no. 6 (2018): 2356-2409. - Aaron**

## **VII. Mar 8 - Panel data approaches (I)**

- A. Differences in differences, triple differences
- B. 'Bartik' variation

MHE Chapter 5

Card, David, and Alan B. Krueger. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania." *The American Economic Review* 84, no. 4 (1994): 772-793.

Gruber, Jonathan. "The Incidence of Mandated Maternity Benefits." *The American Economic Review*, vol. 84, no. 3, 1994, pp. 622-641.

†Finkelstein, Amy. "The aggregate effects of health insurance: Evidence from the introduction of Medicare." *The quarterly journal of economics* 122, no. 1 (2007): 1-37.

†Goodman-Bacon, Andrew. *Difference-in-differences with variation in treatment timing*. No. w25018. National Bureau of Economic Research, 2018.

De Chaisemartin, Clement, and Xavier d'Haultfoeuille. "Two-way fixed effects estimators with heterogeneous treatment effects." *American Economic Review* 110, no. 9 (2020): 2964-96.

Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift. "Bartik instruments: What, when, why, and how." *American Economic Review* 110, no. 8 (2020): 2586-2624.

Freyaldenhoven, Simon, Christian Hansen, and Jesse M. Shapiro. "Pre-event trends in the panel event-study design." *American Economic Review* 109, no. 9 (2019): 3307-38.

**\*Craig Garthwaite, Tal Gross, and Matthew Notowidigdo, Public Health Insurance, Labor Supply, and Employment Lock, *Quarterly Journal of Economics* (2014): 653-696. – Kathy**

**\*Iyer, L., Mani, A., Mishra, P., & Topalova, P. (2012). The power of political voice: women's political representation and crime in India. *American Economic Journal: Applied Economics*, 4(4), 165-93. - Rithika**

### VIII. March 15 - Panel data approaches (II)

A. Synthetic controls

B. Clustering

†Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. "Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program." *Journal of the American statistical Association* 105, no. 490 (2010): 493-505.

Moulton, Brent R. "Random group effects and the precision of regression estimates." *Journal of econometrics* 32, no. 3 (1986): 385-397.

Moulton, Brent R. "An illustration of a pitfall in estimating the effects of aggregate variables on micro units." *The review of Economics and Statistics* (1990): 334-338.

Cameron, A. Colin, Jonah B. Gelbach, and Douglas L. Miller. "Bootstrap-based improvements for inference with clustered errors." *The Review of Economics and Statistics* 90, no. 3 (2008): 414-427.

†Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey Wooldridge. "When should you adjust standard errors for clustering?" No. w24003. National Bureau of Economic Research, 2017.

**\*Bertrand, M., E. Duflo, and S. Mullainathan, (2004): "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, Vol 119, 249-275. - Aparajita**

### IX. March 22 – Density based designs

A. RD, RD-DD

B. RK

MHE Chapter 6

Black, Sandra E. "Do better schools matter? Parental valuation of elementary education." *The Quarterly Journal of Economics* 114, no. 2 (1999): 577-599.

Hahn, J., P. Todd, and W. Van der Klaauw, (2001), "Identification and Estimation of Treatment Effects with a Regression Discontinuity Design", *Econometrica*, Vol 69, No. 1, 201-209.

Lee, David S. "Randomized experiments from non-random selection in US House elections." *Journal of Econometrics* 142, no. 2 (2008): 675-697.

McCrary, Justin. "Manipulation of the running variable in the regression discontinuity design: A density test." *Journal of econometrics* 142, no. 2 (2008): 698-714.

Lalive, Rafael. "How do extended benefits affect unemployment duration? A regression discontinuity approach." *Journal of econometrics* 142, no. 2 (2008): 785-806.

†Card, David, Carlos Dobkin, and Nicole Maestas. "Does Medicare save lives?" *The quarterly journal of economics* 124, no. 2 (2009): 597-636.

†Lee, David S., and Thomas Lemieux. "Regression discontinuity designs in economics." *Journal of economic literature* 48, no. 2 (2010): 281-355.

Card, David, David S. Lee, Zhuan Pei, and Andrea Weber. *Regression Kink Design: Theory and Practice*. No. w22781. National Bureau of Economic Research, 2016.

Gelman, Andrew, and Guido Imbens. "Why high-order polynomials should not be used in regression discontinuity designs." *Journal of Business & Economic Statistics* (2018): 1-10.

**\*Anderson, Michael, Carlos Dobkin, and Tal Gross. "The effect of health insurance coverage on the use of medical services." *American Economic Journal: Economic Policy* 4, no. 1 (2012): 1-27. - Scott**

## **X. March 29 – Bunching and Quantile regression**

A. Quantile regression

B. Bunching

MHE Chapter 7

Koenker, Roger, and Gilbert Bassett Jr. "Regression quantiles." *Econometrica: journal of the Econometric Society* (1978): 33-50.

Buchinsky, Moshe. "Changes in the US wage structure 1963-1987: Application of quantile regression." *Econometrica: Journal of the Econometric Society* (1994): 405-458.

Goldberg, Pinelopi. "Dealer price discrimination in new car purchases: Evidence from the consumer expenditure survey." *Journal of Political Economy* 104, no. 3 (1996): 622-654.

†Abadie, Alberto, Joshua Angrist, and Guido Imbens. "Instrumental variables estimates of the effect of subsidized training on the quantiles of trainee earnings." *Econometrica* 70, no. 1 (2002): 91-117.

Kowalski, Amanda. "Censored quantile instrumental variable estimates of the price elasticity of expenditure on medical care." *Journal of Business & Economic Statistics* 34, no. 1 (2016): 107-117.

†Manoli, Day, and Andrea Weber. "Nonparametric evidence on the effects of financial incentives on retirement decisions." *American Economic Journal: Economic Policy* 8, no. 4 (2016): 160-182.

Persson, Petra. "Social insurance and the marriage market." *Journal of Political Economy* 128, no. 1 (2020): 252-300.

**\*Gruber, Jonathan, Thomas P. Hoe, and George Stoye. *Saving lives by tying hands: The unexpected effects of constraining health care providers*. No. w24445. National Bureau of Economic Research, 2018. - William**

## **XI. April 5 – Limited dependent variables**

- A. Logit, Probit
- B. Count data models

Jones Chapters 3-6, 9-10

Ethan Katz, Bias in Conditional and Unconditional Fixed Effects Logit Estimation, *Political Analysis* 9(2001): 379-384.

†Mullahy, John. "Heterogeneity, excess zeros, and the structure of count data models." *Journal of Applied Econometrics* 12, no. 3 (1997): 337-350.

†Mullahy, John. "Instrumental-variable estimation of count data models: Applications to models of cigarette smoking behavior." *Review of Economics and Statistics* 79, no. 4 (1997): 586-593.

**\*Budish, Eric, Benjamin N. Roin, and Heidi Williams. "Do firms underinvest in long-term research? Evidence from cancer clinical trials." *American Economic Review* 105, no. 7 (2015): 2044-85. - Catherine**

## **XII. April 12 – Selection models and Duration models**

- A. Selection models
- B. Duration models

Heckman, James. "Shadow prices, market wages, and labor supply." *Econometrica: journal of the econometric society* (1974): 679-694.

Kiefer, Nicholas M. "Economic duration data and hazard functions." *Journal of economic literature* 26, no. 2 (1988): 646-679.

†Meyer, Bruce D. "Unemployment Insurance and Unemployment Spells." *Econometrica* 58, no. 4 (1990): 757-782.

Cutler, David M. "The Incidence of Adverse Medical Outcomes Under Prospective Payment." *Econometrica: Journal of the Econometric Society* (1995): 29-50.

†Wainer, Howard, Samuel Palmer, and Eric T. Bradlow. "A selection of selection anomalies." *Chance* 11, no. 2 (1998): 3-7.

Melinda Buntin and Alan Zaslavsky, Too Much Ado about Two-Part Models and Transformation? Comparing Methods of Modeling Medicare Expenditures, *Journal of Health Economics* 23 (2004): 525-542.

Ronen Avraham and Max Schanzenbach, The Impact of Tort Reform on Intensity of Treatment: Evidence from Heart Patients, *Journal of Health Economics* 39(2015): 273-288.

**\*Mauro Laudicella, Paolo Li Donni, and Peter Smith, Hospital Readmission Rates: Signal of Failure or Success, *Journal of Health Economics* 32(2013): 9-21. - Seyoun**

## **XIII. April 19 - Field experiments**

- A. Guest lecture - Profs. David Abrams (Penn Law) and Mark Neuman (Penn Med)

†Bertrand, Marianne, and Sendhil Mullainathan. "Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination." *American economic review* 94, no. 4

(2004): 991-1013.

Duflo, Esther, Rachel Glennerster, and Michael Kremer. "Using randomization in development economics research: A toolkit." *Handbook of development economics* 4 (2007): 3895-3962.

†Finkelstein, Amy, Annetta Zhou, Sarah Taubman, and Joseph Doyle. "Health care hotspotting—a randomized, controlled trial." *New England Journal of Medicine* 382, no. 2 (2020): 152-162.

Bloom, Nicholas, Benn Eifert, Aprajit Mahajan, David McKenzie, and John Roberts. "Does management matter? Evidence from India." *The Quarterly Journal of Economics* 128, no. 1 (2013): 1-51.

**\*Haushofer, Johannes, Robert Mudida, and Jeremy P. Shapiro. The Comparative Impact of Cash Transfers and a Psychotherapy Program on Psychological and Economic Well-being. No. w28106. National Bureau of Economic Research, 2020. - Advait**

#### **XIV. April 26 - Student project presentations**

**Final Exam (May TBD)**