# ECG 790: Empirical Methods for Development Economics and Applied Microeconomics

NCSU, Spring 2017

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Lab Director:    Ruixue Wang

Lectures:        Mon & Wed, 8:45-9:55 am, 102 David Clark Labs

Lab:             F 1:30-2:45, 2112 Williams Hall

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                 Wang:   TBD

This course will provide a survey of the main tools used in applied development microeconomics. There will be a brief introductory section on causal inference and statistical inference, followed by 6 sections on core topics: randomization; matching and regression; difference-in-differences and panel data; instrumental variables; regression discontinuity; estimation of general equilibrium effects. Additional topics that may be covered, time permitting, include: selection models; GLS and SUR; interpretation of coefficients in nonlinear models; estimation of binary outcome models; GLM and the retransformation problem; quantile regression; other applied topics per student request.

This course is organized around tools rather than topics. That is, we will closely examine the empirical tools listed above and how they are used in a variety of applications. This course is *not* a survey of empirical research in various sub-fields. There are a few options for students interested in such a course; please talk to me if you are interested. While the particular applications we study will come largely from development economics, the course is intended to be useful to students in diverse areas of applied micro.

Because the primary goal of the course is to build understanding of identification strategies to estimate causal effects, we will focus on simple linear models. For the most part, the intuition for identification carries over to nonlinear models, but there are some important technical differences that we will not cover in detail. I will provide notes and citation for future reference. The same applies to quantile, semi-parametric and non-parametric estimators.

**Prerequisites:** Econometric Methods (ECG 751) and Microeconometrics (ECG 753) or equivalent. Students without these prerequisites may be admitted to the course subject to

the approval of the instructor, but neither the instructor nor the TA will be provide remedial instruction.

**Course requirements:** The course requirements are satisfactory completion of all problem sets and active participation in class discussion. Problem sets will comprise 50% of the grade (50% each), while discussion and participation will comprise the remaining 50%.

There are 5 problem sets planned, roughly two weeks apart, but the timing and number may be adjusted over the course of the semester. You are permitted (indeed, encouraged) to collaborate on problem sets, but each student must write up and submit an individual solution unless specific instruction to the contrary is given on the problem set.

Lectures will be divided roughly evenly between traditional lectures, to introduce concepts, and student-led discussions of published research papers applying these concepts. For days allocated to discussions, the class will be assigned a paper and provided a set of discussion questions. One student will be selected at random to lead the discussion, with a second student selected at random to provide comments on the initial discussion. All students will be expected to participate, and will be expected to hand in a set of notes. Each student will receive two free passes, i.e. will be able to withdraw his or her name from the donor pool *before* the outcome of the randomization is known. This includes days you are absent – if you must be absent more than two days, please contact the instructor in advance. Randomization is with replacement, but each student's relative probability will decrease by half each time he or she is selected.

**Software:**

You are welcome to use any software on the problem sets. Options include Stata, R, SAS, Matlab and Julia. My guess is that investing in R would be the most beneficial to you in the long run.

Aesthetics matter. In your professional lives, you will find that clarity of presentation is very important in communicating your ideas. Therefore, problem set grades will reflect the quality of the presentation, in addition to the substance of the work. You are encouraged to learn to produce professional-quality tables and figures quickly, correctly and in a way that allows for easy replication. This this requires some investment in learning up front but will save you untold amounts of time when you write papers. In Stata, the commands `-estout-`, `-esttab-`, and `-file write-` are useful.

LaTeX is the standard tool for producing written work in economics. It is incredibly useful but there are high startup costs. These startup costs can be reduced somewhat (although not eliminated) by using a document processor front end. The two most common programs are LyX and Scientific Workplace. I prefer LyX for many reasons, including that it is free

and works cross-platform. Tips on installing and using L$_Y$X are posted to the course website.

You are also encouraged to learn some of the standard software engineering tools like `git`, `make`, and the `Unix` shell. See the Gentzkow and Shapiro guide in the reading list, as well as the excellent resources at `https://software-carpentry.org/`. I have some notes on these tools posted to the course website.

**Website:** `https://moodle-courses1617.wolfware.ncsu.edu/course/view.php?id=4464`

**Texts:**

Required:

Joshua D. Angrist and Jörn-Steffen Pischke. *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton University Press, 2009

Shahidur R. Khandker, Gayatri B. Koolwal, and Hussain A. Samad. *Handbook on Impact Evaluation: Quantitative Methods and Practices.* World Bank, 2010. URL `https://openknowledge.worldbank.org/handle/10986/2693`

Paul Gertler, Sebastian Wilde Martinez, Patrick Premand, Christel Vermeersch, Laura Rawlings, World Bank Group, and Inter-American Development Bank. *Impact Evaluation in Practice.* 2016. URL `http://www.worldbank.org/ieinpractice`

A. Colin Cameron and Pravin K. Trivedi. *Microeconometrics Using Stata, Revised Edition.* Stata Press, 2nd edition, 2010. URL `http://cameron.econ.ucdavis.edu/musbook/mus.html`

A. Colin Cameron and Pravin K. Trivedi. *Microeconometrics: Methods and Applications.* Cambridge University Press, 2005. URL `http://cameron.econ.ucdavis.edu/mmabook/mma.html`

Jeffrey M. Wooldridge. *Econometric Analysis of Cross Section and Panel Data.* MIT Press, 2nd edition, 2010. URL `http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=11227&xid=13&xcid=16146`

Esther Duflo, Rachel Glennerster, and Michael Kremer. Using randomization in development economics research: A toolkit. In *Handbook of Development Economics*, volume 4, chapter 61, pages 3895–3962. Elsevier B.V., 2008. URL `http://dx.doi.org/10.1016/S1573-4471(07)04061-2`

The two World Bank books and the Cameron & Trivedi Stata book will be used extensively in lab as sources of hands-on, empirical applications. Be sure to visit their respective websites

to download datasets and do-files. Both of the World Bank books are available free as PDFs; see their respective websites. They can also be ordered in hard-copy form from the World Bank and other outlets. I have listed the revised edition (2010) of Cameron & Trivedi here, but my understanding is that there are only very small changes from the 2009 edition having to do with syntax changes between Stata 10 and Stata 11. If you already have the 2009 edition, you probably do not need to buy the new one, but keep in mind that the 2010 edition will be considered canonical for the purpose of this class.

Recommended:

Peter Kennedy. *A Guide to Econometrics.* Blackwell Publishing, 6th edition, 2008

Matthew Gentzkow and Jesse Shapiro, "Code and Data," March 2014. `https://web.stanford.edu/~gentzkow/research/CodeAndData.pdf`

Christopher F. Baum. *An Introduction to Stata Programming.* Stata Press, 2 edition, 2016. URL `http://www.stata-press.com/data/itsp2.html`

The Kennedy book is a great source of intuition and insight. The Gentzkow and Shapiro manuscript is very nice for learning to do reproducible research. You should invest in these skills now. The Baum book is great for both beginning and advanced Stata programmers.

Supplementary:

Imbens and Wooldridge, "What's New in Econometrics" Lecture Notes. Latest (2014): `http://www.cemmap.ac.uk/uploads/cemmap/forms/Imbens_Wooldridge_notes.pdf`

Bruce Hansen, "Econometrics" online text. Latest (2017): `http://www.ssc.wisc.edu/~bhansen/econometrics/`

Guido W. Imbens and Jeffrey M. Wooldridge. Recent developments in the econometrics of program evaluation. *Journal of Economic Literature*, 47(1):5–86, 2009. URL `http://www.aeaweb.org/articles.php?doi=10.1257/jel.47.1.5`

Joshua D. Angrist and Alan B. Krueger. Empirical strategies in labor economics. In Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics*, volume 3A, chapter 23, pages 1277–1366. Elsevier Science, Amsterdam, 1999. URL `http://dx.doi.org/10.1016/S1573-4463(99)03004-7`

William H. Greene. *Econometric Analysis.* Prentice-Hall, 5th edition, 2003. URL `http://pages.stern.nyu.edu/~wgreene/Text/econometricanalysis.htm`

Fumio Hayashi. *Econometrics.* Princeton University Press, 2000. URL `http://fhayashi.fc2web.com/hayashi_econometrics.htm`

**Course Outline**

Readings are listed in the following order: core instructional readings, marked *; recommended instructional readings, marked **; optional instructional readings, marked ***; applied papers used in lecture, marked #; applied papers for discussion or problem sets, marked ## (subject to change); supplementary applied papers, marked ###; full textbook treatments for review, marked ®; supplementary material that is more technically sophisticated than needed for the class, marked %. MHE = Mostly Harmless Econometrics; A&K = Angrist & Krueger HoLE chapter; I&W = Imbens & Wooldridge JEL article; HIE = Handbook on Impact Evaluation; IEP = Impact Evaluation in Practice; W = Wooldridge (2nd ed); C&T = Cameron & Trivedi; DGK = Duflo, Glennerster and Kremer HoDevEc 61.

*Core topics:*

1. Causal inference, counterfactuals and the evaluation problem

   We will discuss the fundamental problem of causal inference and give a preview of methods that can, in the right context, solve the evaluation problem.

   * MHE, Chap. 2.1-2.2

   * IEP, Chap. 3

   # John Snow. *On the mode of communication of cholera.* John Churchill, 1855. URL `http://johnsnow.matrix.msu.edu/work.php?id=15-78-52`

   # Michael A. Clemens and Gabriel Demombynes. When does rigorous impact evaluation make a difference? The case of the Millennium Villages. *Journal of Development Effectiveness*, 3(3):305–339, 2011. URL `http://www.tandfonline.com/doi/abs/10.1080/19439342.2011.587017`

   ## Scott Freeman, Sarah L. Eddy, Miles McDonough, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, and Mary Pat Wenderoth. Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23):8410–8415, 2014. URL `http://www.pnas.org/content/111/23/8410.abstract`

   ** I&W 1-3

   *** W 21.1-21.2

   *** C&T 2, 25.1-25.3

   *** HIE, Chap. 2

   *** A&K, 1, 2.1

2. Random Assignment

(a) Basics

   * MHE 2.2-2.3

   * IEP 4

   # Robert J. LaLonde. Evaluating the econometric evaluations of training programs with experimental data. *The American Economic Review*, 76(4):604–620, 1986. URL `http://www.jstor.org/stable/1806062`

   # Paul Glewwe, Michael Kremer, Sylvie Moulin, and Eric Zitzewitz. Retrospective vs. prospective analyses of school inputs: the case of flip charts in Kenya. 74(1):251 – 268, 2004. URL `http://dx.doi.org/10.1016/j.jdeveco.2003.12.010`

   ## Banerjee, Cole, Duflo and Linden, "Remedying Education," *QJE*, 2007.

   *** I&W 4.1

   *** HIE 3

(b) Threats to validity

   i. Noncompliance

      * DGK Section 6.2.1

      * IEP, Chapter 8

      # Joshua D. Angrist. Lifetime earnings and the vietnam era draft lottery: Evidence from social security administrative records. *The American Economic Review*, 80(3): 313–336, jun 1990. URL `http://www.jstor.org/stable/2006669`

   ii. Attrition

      * DGK 6.4

      # Dean Karlan and Martin Valdivia. Teaching entrepreneurship: Impact of business training on microfinance clients and institutions. *Review of Economics and Statistics*, 93(2):510–527, May 2011. URL `http://dx.doi.org/10.1162/REST_a_00074`

      % David S. Lee. Training, wages, and sample selection: Estimating sharp bounds on treatment effects. *The Review of Economic Studies*, 76(3):1071–1102, 2009. URL `http://restud.oxfordjournals.org/content/76/3/1071.short`

   iii. Spillovers

      * DGK 6.2.2, 6.3.

      # Mohammad Ali, Michael Emch, Lorenz von Seidlein, Mohammad Yunus, David A. Sack, Malla Rao, Jan Holmgren, and John D. Clemens. Herd immunity conferred by killed oral cholera vaccines in Bangladesh: a reanalysis. (366), July 2005. URL `http://dx.doi.org/10.1016/S0140-6736(05)66550-6`

      ## Edward Miguel and Michael Kremer. Worms: Identifying impacts on education and health in the presence of treatment externalities. *Econometrica*, 72(1):159–217,

January 2004. URL http://www.jstor.org/stable/3598853

** I&W 2.3

3. Statistical Inference

In the context of very straightforward randomized trials, for example medical trials under ideal experimental conditions.

* MHE, Chap. 8

* A. Colin Cameron and Douglas L. Miller. A Practitioner's Guide to Cluster-Robust Inference. *Journal of Human Resources*, 50(2):317–372, March 2015. URL http://dx.doi.org/10.3368/jhr.50.2.317

# Marianne Bertrand, Esther Duflo, and Sendhil Mullainathan. How much should we trust differences-in-differences estimates? *Quarterly Journal of Economics*, 119(1):249–275, 2004. URL http://dx.doi.org/10.1162/003355304772839588

** Brownstone, David and Valletta, Robert. The bootstrap and multiple imputations: Harnessing increased computing power for improved statistical tests. *The Journal of Economic Perspectives*, 15(4):129–141, 2001. URL http://www.jstor.org/stable/2696521

*** A. Colin Cameron, Jonah B. Gelbach, and Douglas L. Miller. Bootstrap-based improvements for inference with clustered errors. *Review of Economics and Statistics*, 90(3):414–427, 2008. URL http://www.mitpressjournals.org/doi/abs/10.1162/rest.90.3.414

*** A. Colin Cameron, Jonah B. Gelbach, and Douglas L. Miller. Robust inference with multiway clustering. *Journal of Business and Economic Statistics*, 29(2):238–249, 2011. URL http://pubs.amstat.org/doi/abs/10.1198/jbes.2010.07136

® C&T 11

® W 12.8, 20

% I&W 4.2

% What's New Lecture 7 ("Cluster Sampling")

% Joel L. Horowitz. The bootstrap. In J.J. Heckman and E. Leamer, editors, *Handbook of Econometrics*, volume V, chapter 52, pages 3159–3228. Elsevier, 2001. URL http://dx.doi.org/10.1016/S1573-4412(01)05005-X

4. Shenanigans

Non-experimental methods are just as vulnerable, but the issues are particularly clear with RCTs so we will primarily discuss these issues in the context of RCTs.

(a) Multiple outcomes

** Jeffrey R. Kling, Jeffrey B. Liebman, and Lawrence F. Katz. Experimental analysis of neighborhood effects. *Econometrica*, 75(1):pp. 83–119, 2007. URL `http://www.jstor.org/stable/4123109`

# Craig M. Bennett, Abigail A. Baird, Michael B. Miller, and George L. Wolford. Neural correlates of interspecies perspective taking in the post-mortem Atlantic Salmon: An argument for proper multiple comparisons correction. *Journal of Serendipitous and Unexpected Results*, 1(1):1–5, 2010. URL `http://www.jsur.org/v1n1p1`

## John Gibson, David McKenzie, and Steven Stillman. The impacts of international migration on remaining household members: Omnibus results from a migration lottery program. *Review of Economics and Statistics*, 93(4), November 2011. URL `http://dx.doi.org/10.1162/REST_a_00129`

® C&T 6.9

® W 7.2-7.3, 7.7.

(b) Subgroup analysis

# Günther Fink, Margaret McConnell, and Sebastian Vollmer. Testing for heterogeneous treatment effects in experimental data: False discovery risks and correction procedures. *Journal of Development Effectiveness*, 6(1):44–57, January 2014

(c) Data-mining and pre-analysis plans

# Joseph P. Simmons, Leif D. Nelson, and Uri Simonsohn. False-positive psychology : Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science*, (22):1359–1366, 2011. URL `http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1850704`

## Katherine Casey, Rachel Glennerster, and Edward Miguel. Reshaping institutions: Evidence on aid impacts using a preanalysis plan. *The Quarterly Journal of Economics*, 127(4):1755–1812, 2012. URL `http://qje.oxfordjournals.org/content/127/4/1755.abstract`

(d) Prior (im)plausibility and refutability

* John P. A. Ioannidis. Why most published research findings are false. *PLoS Med*, 2 (8), August 2005. URL `http://dx.doi.org/10.1371/journal.pmed.0020124`

* A&K, 2.4

** Ramal Moonesinghe, Muin J Khoury, and A. Cecile J. W Janssens. Most published research findings are false but a little replication goes a long way. *PLoS Med*, 4(2):e28, 02 2007. URL `http://dx.doi.org/10.1371/journal.pmed.0040028`

### Paul A. Offit. Studying complementary and alternative therapies. *JAMA: The Journal of the American Medical Association*, 307(17):1803–1804, May 2012. URL `http://dx.doi.org/10.1001/jama.2012.518`

5. Matching and regression

   * MHE 3

   ** IEP, Chap. 7

   ** HIE, Chap. 4

   ** Guido W. Imbens. Matching methods in practice: Three examples. *Journal of Human Resources*, 50:373–419, March 2014. URL `http://dx.doi.org/10.3368/jhr.50.2.373`

   *** A&K 2.2.1, 2.3.1-2.3.3

   ® W 4.3

   (a) OLS

   ## Altonji, Elder and Taber, "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools," Journal of Political Economy, 2005.

   The Imbens matching review paper above has an important critique of OLS methods. See Section 3.

   (b) Matching

   # Joshua D. Angrist, "Estimating the Labor Market Impact of Voluntary Military Service using Social Security Data on Military Applicants," Econometrica, 66, 313-335 (1998).

   ## Galiani, Sebastian, Paul Gertler, and Ernesto Schargrodsky. 2005. Water for Life: The Impact of the Privatization of Water Services on Child Mortality." Journal of Political Economy 113 (1): 83-120.

   ### Jalan, Jyotsna and Martin Ravallion (2003) "Does Piped Water Reduce Diarrhea for Children in Rural India," Journal of Econometrics, 112(1), 153-173.

   % I&W 5

   % James J. Heckman, Hidehiko Ichimura, Petra Todd, Matching as an Econometric Evaluation Estimator, Review of Economic Studies, Vol. 65, No. 2 (Apr., 1998), pp. 261-294. `http://www.jstor.org/stable/2566973`

   % Heckman, J., Ichimura, H., Smith, J., Todd, P. (1998). "Characterizing selection bias using experimental data". Econometrica 66 (5), 1017–1098.

6. Difference-in-differences, fixed effects and panel data

* MHE 5

# Esther Duflo. Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment. *American Economic Review*, 91(4): 795–813, September 2001. URL http://www.jstor.org/stable/2677813

# David Card. The impact of the Mariel boatlift on the Miami labor market. *Industrial and Labor Relations Review*, 43(2):245–257, 1990. URL http://www.jstor.org/stable/2523702

## Hathi, P., Haque, S., Pant, L. et al., "Place and Child Health: The Interaction of Population Density and Sanitation in Developing Countries," Demography (2017) 54: 337. doi:10.1007/s13524-016-0538-y.

## Duflo, E. (2003). Grandmothers and Granddaughters: Old Age Pension and Intrahousehold Allocation in South Africa. World Bank Economic Review, 17(1), 1–25. https://doi.org/10.109

## Field, Erica (2007), "Entitled to Work: Urban Property Rights and Labor Supply in Peru," *Quarterly Journal of Economics* 122 (4): 1561-1602. doi:10.1162/qjec.2007.122.4.1561.

** IEP, Chap. 6

** HIE, Chap. 5

*** A&K 2.2.2

### Robert Jensen. The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector. *The Quarterly Journal of Economics*, 122(3):879–924, 2007. URL http://qje.oxfordjournals.org/content/122/3/879.abstract

### Card, David, and Alan Krueger (1994): Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania, American Economic Review, 84, 772-784.

### Rosenzweig, M.R., Wolpin, K.I. (1986). "Evaluating the effects of optimally distributed public programs: Child health and family planning". American Economic Review 76 (3), 470–482.

### Doug Almond, "Is the 1918 Influenza Pandemic Over? Long-term Effects of In Utero Influenza Exposure in the Post-1940 U.S. Population," Journal of Political Economy (August 2006). http://www.journals.uchicago.edu/doi/abs/10.1086/507154

® W 6.5, 10-11.

® C&T 21-22

% I&W 6.5

7. Instrumental variables

   * MHE 4

   * A&K 2.2.3, 2.3.4

   * C&T 4.8-4.9

   # Joshua D. Angrist and Alan B. Krueger. Does compulsory school attendance affect schooling and earnings? *Quarterly Journal of Economics*, 106(4):979–1014, November 1991. URL http://www.jstor.org/stable/2937954

   # Kasey S. Buckles & Daniel M. Hungerman, 2013. "Season of Birth and Later Outcomes: Old Questions, New Answers," The Review of Economics and Statistics, vol. 95(3), pages 711-724, July. doi:10.2139/10.1162/REST_a_00314

   ## Geruso, Michael and Spears, Dean, "Neighborhood Sanitation and Infant Mortality," May 2015. doi:10.2139/ssrn.2605479

   ## Lipscomb, Molly, A. Mushfiq Mobarak and Tania Barham. 2013. "Development Effects of Electrification: Evidence from the Topographic Placement of Hydropower Plants in Brazil." American Economic Journal: Applied Economics, 5(2): 200-231, doi:10.1257/app.5.2.200.

   ** HIE, Chap. 6

   ** MHE, Chap. 4

   *** Hahn, J., and J. Hausman, "Weak Instruments: Diagnosis and Cures in Empirical Econometrics," American Economic Review Papers and Proceedings, May 2003, 93(2), 118–125.

   ### K. Daron Acemoglu, Simon Johnson, and James A. Robinson. The colonial origins of comparative development: An empirical investigation. *American Economic Review*, 91(5): 1369–1401, December 2001. URL http://www.e-aer.org/archive/9105/91051369.pdf

   ### Thomas, Duncan and John Strauss, "Health and wages: Evidence on men and women in urban Brazil," *Journal of Econometrics*, 77(1), March 1997, Pages 159-185, doi:10.1016/S0304-4076(96)01811-8.

   ### Edward Miguel, Shanker Satyanath, and Ernest Sergenti. Economic shocks and civil conflict: An instrumental variables approach. *Journal of Political Economy*, 112(4):725–753, August 2004. URL http://www.journals.uchicago.edu/JPE/journal/issues/v112n4/112408/brief/112408.abstract.html

® W 5, 6.2.

® C&T 6.3-6.5.

% Stock, J. (2015). "AEA Continuing Education Lectures on Time Series." Lectures 5 & 6, Weak Identification and Many Instruments in IV Regression and GMM. `http://scholar.harvard.edu/files/stock/files/aea_2014_lecture5_6_weakid_rev.pdf`

% John Bound, David A. Jaeger, and Regina M. Baker. Problems with instrumental variables estimation when the correlation between the instruments and the endogeneous explanatory variable is weak. *Journal of the American Statistical Association*, 90(430): 443–450, 1995. URL `http://www.jstor.org/stable/2291055`

% John Bound and David A. Jaeger. On the validity of season of birth as an instrument in wage equations: A comment on Angrist & Krueger's "Does compulsory school attendance affect schooling and earnings?". Working Paper 5835, National Bureau of Economic Research, November 1996. URL `http://www.nber.org/papers/w5835`

% I&W 6.3

% Altonji, Joseph, Timothy Conley, Todd Elder, and Christopher Taber, 2013. "Methods for Using Selection on Observed Variables to Address Selection on Unobserved Variables." `https://www.msu.edu/~telder/ou0413.pdf`

8. Regression discontinuity

   * MHE 6

   # Douglas Almond and Joseph J. Doyle. After midnight: A regression discontinuity design in length of postpartum hospital stays. *American Economic Journal: Economic Policy*, 3 (3):1–34, September 2011. URL `http://www.aeaweb.org/articles.php?doi=10.1257/pol.3.3.1`

   ## Yuyu Chen, Avraham Ebenstein, Michael Greenstone, and Hongbin Li. Evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River policy. *Proceedings of the National Academy of Sciences*, 2013. URL `http://www.pnas.org/content/early/2013/07/03/1300018110.abstract`

   ** David S Lee and Thomas Lemieux. Regression discontinuity designs in economics. *Journal of Economic Literature*, 48(2):281–355, Jun 2010. URL `http://dx.doi.org/10.1257/jel.48.2.281`

   *** Guido W. Imbens and Thomas Lemieux. Regression discontinuity designs: A guide to practice. *Journal of Econometrics*, 2007. URL `http://dx.doi.org/10.1016/j.jeconom.2007.05.001`

\*\*\* IEP 5

\*\*\* HIE 7

\#\#\# David Lee, "Randomized experiments from non-random selection in U.S. House elections," Journal of Econometrics, 2008.

\#\#\# Mark Pitt and Shahidur Khandker. The impact of group-based credit programs on poor households in Bangladesh: Does the gender of participants matter? 106(5):958–996, October 1998. URL `http://www.jstor.org/stable/10.1086/250037`

\#\#\# Almond, Doyle, Kowalski and Williams, "Estimating marginal returns to medical care: evidence from at-risk newborns," QJE 2010.

% I&W 6.4

% Andrew Gelman and Guido Imbens. Why high-order polynomials should not be used in regression discontinuity designs. Working Paper 20405, National Bureau of Economic Research, August 2014. URL `http://www.nber.org/papers/w20405`

9. General equilibrium

   \* DGK 2.2, 6.3, 8

   \# Guiteras, Levinsohn and Mobarak, "Encouraging Sanitation Investment in the Developing World: A Cluster-Randomized Trial," *Science*, 348(6237), pg. 903-906, May 2015. `http://go.ncsu.edu/rpguiter.bgd.san.sci`.
   \#\# Jayachandran, S. (2006). Selling Labor Low: Wage Responses to Productivity Shocks in Developing Countries. Journal of Political Economy, 114(3), 538–575. https://doi.org/10.1086/503579
   \#\# Duflo, E. (2004). The medium run effects of educational expansion: Evidence from a large school construction program in Indonesia. Journal of Development Economics, 74(1), 163–197.
   \*\* Acemoglu, D. (2010). Theory, General Equilibrium, and Political Economy in Development Economics. Journal of Economic Perspectives, 24(3), 17–32. https://doi.org/10.1257/jep.24.3.17

   \#\#\# Mobarak and Rosenzweig, "Risk, Insurance and Wages in General Equilibrium," NBER WP 19811, 2014.
   \#\#\# Bruno Crépon, Esther Duflo, Marc Gurgand, Roland Rathelot, and Philippe Zamora. Do Labor Market Policies have Displacement Effects? Evidence from a Clustered Randomized Experiment. *The Quarterly Journal of Economics*, 128(2):531–580, January 2013. URL `http://dx.doi.org/10.1093/qje/qjt001`.

   % Todd, Petra. Handbook of Development Economics, Chapter 60, Section 4.

   % Abbring and Heckman, Handbook of Econometrics, Chapter 72, Section 4.

10. Other topics, time permitting (some may be covered as topics in lab)

  (a) GLS and SUR

    ** W 7

    # Esther Duflo and Rohini Pande. Dams. *Quarterly Journal of Economics*, pages 601–646, May 2007

    % Christian Hansen. Generalized least squares inference in panel and multilevel models with serial correlation and fixed effects. *Journal of Econometrics*, 140:670–694, 2007. URL `http://dx.doi.org/10.1016/j.jeconom.2006.07.011`

    % Jerry Hausman and Guido Kuersteiner. Difference in difference meets generalized least squares: Higher order properties of hypotheses tests. *Journal of Econometrics*, 144 (2):371–391, June 2008. URL `http://dx.doi.org/10.1016/j.jeconom.2008.04.003`

  (b) Interpretation of coefficients in nonlinear models

    * E. C. Norton, H. Wang, and C. Ai. Computing interaction effects and standard errors in logit and probit models. *Stata Journal*, 4(2):154–167(14), 2004. URL `http://www.stata-journal.com/article.html?article=st0063`

    * Chunrong Ai and Edward C. Norton. Interaction terms in logit and probit models. *Economics Letters*, 80:123–129, 2003. URL `http://dx.doi.org/10.1016/S0165-1765(03)00032-6`

  (c) Estimation of binary outcome models

    i. General theory of maximum likelihood estimation
       ® C&T 5
       ® W 12.1-12.7, 13.

    ii. Single-equation models
       MHE 3.4.2
       ® C&T 14.
       ® W 15.1-15.7

    iii. Nonlinear IV
       * MHE 3.4.2
       * Richard C. Chiburis, Jishnu Das, and Michael Lokshin. A practical comparison of the bivariate probit and linear iv estimators. *Economics Letters*, 117(3): 762 – 766, 2012. URL `http://www.sciencedirect.com/science/article/pii/S0165176512004727`
       ** C&T 6.5

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    iv. Nonlinear panel data

      * W 15.8.

      ® C&T 23

(d) GLM and the retransformation problem

(e) Measurement error

* Jerry A. Hausman. Mismeasured variables in econometric analysis: Problems from the right and problems from the left. *Journal of Economic Perspectives*, 15(4):57–67, 2001. URL `http://links.jstor.org/sici?sici=0895-3309%28200123%2915%3A4%3C57%3AMVIEAP%3E2.0.CO%3B2-T`

* W 4.4

** A&K Sec. 4

*** C&T 26

(f) Missing data

    ® C&T 27

(g) Quantile regression

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(h) Selection models

* CT 16.2 16.3 16.5 16.7

** W 17.1-17.4

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**Various necessary statements**

*Incomplete grades:* A grade of "Incomplete" will not be considered unless approved by the counseling center.

*Academic honesty:* Every student is expected to be familiar with and to adhere to the NCSU Code of Student Conduct, presented at http://www2.ncsu.edu/ncsu/stud_affairs/policies/code95.ht Also see http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty. Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment." You are permitted (indeed, encouraged) to collaborate on problem sets, but each student must write up and submit an individual solution unless specific instruction to the contrary is given on the problem set.

*Illness:* For complete attendance and excused absence policies, please see http://policies.ncsu.edu/regula 02-20-03

*Religious observances:* I will make every effort to accomodate students' religious observances. By Monday, January 23, students must provide me in writing a request for accomodation if some requirement of the class will conflict with a specific and required religious observance. Please specify the observance and date.

*Students with disabilities:* Any student with a documented disability may request arrangements to accommodate their disability. Such arrangements include the provision of services and reasonable accommodations appropriate to the student's disability. This should be arranged through the DSS office. For more information, see http://www.ncsu.edu/provost/offices/affirm action/dss/. You should provide me with documentation of the arrangement you have made with DSS no later than Monday, January 23.

*Decorum:* Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to show civility with one another or with the instructors will be subject to being referred to the Office of Student Conduct or to Campus Police. You are expected to adhere to the Code of Student Conduct at all times.

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