LPO 8852: Regression II

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Fall 2022

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Course Description

This course builds on the concepts and tools learned in Regression I (LPO 8851). The focus is on making causal inferences from observational (i.e., non-experimental) data through the use of matching, longitudinal (panel) data, instrumental variables, regression discontinuity, and other statistical techniques. While we will cover the theory related to these methods, the emphasis will be on their practical, hands-on application. Examples and applications will come primarily from education research, although the skills taught in this course are broadly transferable across subject areas in the social, behavioral, and health sciences.

Prerequisites

Students are expected to have successfully completed Regression I (LPO 8851) or the equivalent. Students are also expected to be proficient in Stata. If you have concerns about your prior preparation for this class, please see me immediately.

Books

I make frequent use of the following books (shorthand name in parentheses). The starred titles are highly recommended for this course.

- ★ (MM) Angrist, Joshua D., & Pischke, Jörn-Steffen. (2015). *Mastering 'Metrics: The Path from Cause to Effect*. Princeton University Press. See http://masteringmetrics.com/
- ★ (MIX) Cunningham, Scott. (2021). *Causal Inference: The Mixtape*. New Haven: Yale University Press. See https://mixtape.scunning.com/
- ★ (MHE) Angrist, Joshua D., & Pischke, Jörn-Steffen. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press.

- (C&T) Cameron, A. Colin, & Trivedi, Pravin K. (2010). *Microeconometrics Using Stata, Revised Edition*. College Station, TX: Stata Press.
- (HK) Huntington-Klein, Nick. (2022). *The Effect: An Introduction to Research Design and Causality.* Boca Raton, FL: CRC Publishing. See https://theeffectbook.net/
- (MW) Murnane, Richard J., & Willett, John B. (2011). *Methods Matter: Improving Causal Inference in Educational and Social Research*. New York: Oxford University Press.
- (WOOL) Wooldridge, Jeffrey M. (2016). *Introductory Econometrics: A Modern Approach, 6th Edition*. Boston: Cengage Publishing.

If you have recently taken LPO 8851, you should already have the Wooldridge text. C&T recently released a new edition of their Stata Press book; this syllabus refers to the first edition. Other readings listed below will be made available via Github. You can also easily find them using Google Scholar.

Course Structure

The class will meet twice weekly, in person. Class meetings will be a mix of lecture and in-class lab exercises. In some cases, supplemental material will be provided online.

This is a graduate course designed for students at the doctoral and advanced master's level. I expect that students enrolled in the course are motivated by a desire to learn the course material. Please come to class having carefully read any relevant book chapters and supplemental materials. Attendance in class and participation in in-class lab exercises is extremely important.

Stata

Stata is the statistical software used in this course. I recommend the most recent release (Version 17), but other recent vintages are fine (e.g., 13-16). I presently use Stata 15. Be aware that small differences exist between versions, and that files created in recent versions of Stata may not open in older versions. Purchasing options are available via the following website: https://www.stata.com/order/new/edu/gradplans/student-pricing/. A 6-month license for Stata/BE can be purchased for $94, but if you intend to use Stata in your own work I recommend purchasing a perpetual license of Stata/SE or the more powerful multi-processor (MP) version. Stata is freely available to you in the Wyatt 132 computer lab and elsewhere on campus. Vanderbilt also makes Stata available to you virtually through VMWare: https://anywherevu.vanderbilt.edu/portal/webclient/index.html.

There are many great resources for learning Stata. See this site for a useful starting point: https://www.stata.com/links/resources-for-learning-stata/. There are some handy Stata "cheat sheets" posted here: https://geocenter.github.io/StataTraining/portfolio/01_resource/. I will also upload some Stata references to Github.

Course Requirements

Your grade for the course will be based on **nine** problem sets (50%), a midterm (25%), and final exam (25%). The problem sets will vary in length and points possible, but each will be weighted equally when calculating your final grade, using the percent correct on each.

The (tentative) schedule of problem set assignments is shown in the course schedule below. These are subject to change based on the pace of the course. Please submit your problem set solutions to me via email at sean.corcoran@vanderbilt.edu. Include your last name and problem set number in the filename (e.g., *Corcoran_PS1.pdf*). Late assignments will not be accepted, particularly after problem set solutions have been provided or discussed in class.

Unless otherwise indicated, the file you submit to me should be a log of your Stata session, saved as a text file (with the .txt extension) or—better yet—converted to a PDF. Begin by copying the problem set instructions into the Stata do-file editor. Comment out the questions. Insert after each question the commands you used to respond to that question. The resulting log file will include the instructions (in the form of comments), your commands, and the output. Edit this file as appropriate, for example by adding interpretations of your output and any other commentary that might be asked for. Graphical output can be submitted separately, preferably as a PDF file. (Combine all your PDFs if possible). You are encouraged to work together on the problem sets, but all work submitted must be that of the individual student. Duplicate assignments will not be accepted.

Other Important Information

1. **Github**: All materials pertaining to this course, including lecture notes, problem sets, and datasets, will be available on Github (https://github.com/spcorcor18/LP0-8852). Check in frequently for new material and announcements. Lectures will be posted in advance of class, but occasional delays and revisions are to be expected. The course is stored in what Github calls a "repository". You can "clone" (sync) this repository to your local drive using Github Desktop (https://desktop.github.com/). I recommend this easy approach to staying up to date with all of the course materials.

2. **Classroom etiquette**: Please bring your laptop to class. To help promote a productive learning environment, please devote your time and attention to the class itself. Please do not use Instagram/Snapchat, text messaging, email, or other digital distractions while in class. Please silence your cell phone as well.

3. **Health and safety**: Our mutual commitment to health and safety is vital. Toward that end, all students are expected to adhere to Vanderbilt health and safety protocols. Guidance may be updated throughout the semester.

4. **Names and pronouns**: If you would like to use a different name or pronouns than those provided through YES, please let me know at any time prior to or during the semester. Information is available through the LGBTQI Life offices about how to change either or both of these in YES.

5. **Academic integrity**: All academic work at Vanderbilt is done under the Honor System. Students are expected to conform to the highest standards of academic integrity in this course. Any attempt to pass off someone else's work as your own is a violation of this standard, and there are many ways this can happen beyond blatant cheating. Full details of the Vanderbilt Honor System may be found here: http://www.vanderbilt.edu/student_handbook/the-honor-system/ If you have any doubts about how the Honor Code applies to your work in this class, please ask me—not another student—for clarification. Uncertainty about application of the Honor Code does not excuse a violation.

6. **Accommodations**: Vanderbilt is committed to equal opportunity for students with disabilities. If you need course accommodations due to a disability, please contact VU Student Access Services to initiate the process: https://www.vanderbilt.edu/student-access/. After SAS has notified me of relevant accommodations, we will discuss how these accommodations may best be approached in this class, and I will facilitate the accommodations.

7. **Mandatory reporter obligation**: All university faculty and administrators are mandatory reporters. What this means is that all faculty, including me, must report allegations of sexual misconduct and intimate partner violence to the Title IX Coordinator (615-343-9004). In addition, all faculty are obligated to report any allegations of discrimination. I am willing to discuss such incidents with you, but I can only do so in the context of us both understanding my reporting obligations. If you want to talk with someone in confidence, officials in the Student Health Center, the University Counseling Center, and the Office of the Chaplain and Religious Life (when acting as clergy) can maintain confidentiality. In addition, officials in the Project Safe Center (Crisis Hotline: 615-322-7233) have limited confidentiality, in that they have to report the incidents they are told of, but can do so without providing identifying information about the victim(s). The Project Safe Center (https://www.vanderbilt.edu/projectsafe/) serves as the central resource for those impacted by sexual misconduct and intimate partner violence and can assist with navigating all facets of the University's resource and support network and other processes

8. **Mental health and wellness**: If you are experiencing undue stress during the semester that may be interfering with your ability to perform academically, Vanderbilt's Student Care Network offers a range of support services. I am available to speak with you about stresses related to your work in this course, and I can assist you in connecting with the Student Care Network. The Office of Student Care Coordination (OSCC) is the central and first point of contact to help students navigate and connect to appropriate resources on and off-campus, develop a plan of action, and provide ongoing support. You can schedule an appointment with the OSCC at https://www.vanderbilt.edu/carecoordination/ or call 615-343-WELL. The Student Care Network also offers drop-in services on campus on a regular basis. You can find a calendar of services at https://www.vanderbilt.edu/studentcarenetwork/satellite-services/

   If you or someone you know needs to speak with a professional counselor immediately, the University Counseling Center offers Urgent Care Counseling. Students should call the UCC at (615) 322-2571 during office hours to speak with an urgent care clinician. You can also reach an on-call counselor after hours or on the weekends by calling (615) 322-2571 and pressing option 2 at any time. You can find additional information at https://www.vanderbilt.edu//ucc/.

Course outline

Starred readings are required/highly recommended. Others are for your reference.

Lecture 1: Regression and causality

- ★ MM chapters 1-2 and appendix to chapter 2
- ★ MHE chapters 1-3
- ★ MIX, *Introduction* and *Probability and Regression Review* (especially pp. 36-93)
- HK chapters 10 and 13
- C&T chapters 3 and 5
- Stine, R. (1989). An Introduction to Bootstrap Methods: Examples and Ideas. *Sociological Methods & Research* 18(2-3): 243–291. https://doi.org/10.1177/0049124189018002003

Lecture 2: Matching estimators

- ★ MM chapter 2 (especially pp. 47-59)
- ★ MIX, *Matching and Subclassification*
- ★ MW chapter 12
- Guo & Fraser (2015), *Propensity Score Analysis: Statistical Methods and Applications, 2e*.
- HK chapter 14
- Caliendo, M., & Kopeinig, S. (2008). Some Practical Guidance for the Implementation of Propensity Score Matching. *Journal of Economic Surveys*, 22(1), 31–72. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-6419.2007.00527.x
- Imbens, G. W. (2015). Matching Methods in Practice: Three Examples. *Journal of Human Resources*, 50(2), 373–419. https://doi.org/10.3368/jhr.50.2.373
- Morgan, S. L., & Harding, D. J. (2006). Matching Estimators of Causal Effects: Prospects and Pitfalls in Theory and Practice. *Sociological Methods & Research*, 35(1), 3–60. https://doi.org/10.1177/0049124106289164

Lecture 3: Difference-in-differences

- ★ MM chapter 5
- ★ MIX, *Difference-in-Differences*
- ★ Clarke, D., & Schythe, K. T. (2020). Implementing the Panel Event Study. IZA Discussion Paper Series No. 13524. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3660271

★ Roth, J., Sant'Anna, P. H. C., Bilinski, A., & Poe, J. (2022). What's Trending in Difference-in-Differences? A Synthesis of the Recent Econometrics Literature. Working paper available at https://jonathandroth.github.io/assets/files/DiD_Review_Paper.pdf

- MHE chapter 5
- HK chapters 17-18
- WOOL chapter 13
- Bertrand, M., Duflo, E., & Mullainathan, S. (2004). How Much Should We Trust Differences-in-Differences Estimates? *Quarterly Journal of Economics*, 119(1), 249–275. https://academic.oup.com/qje/article-abstract/119/1/249/1876068
- Goodman-Bacon, A. (2021). Difference-in-Differences with Variation in Treatment Timing. *Journal of Econometrics*, 225(2), 254-277. https://doi.org/10.1016/j.jeconom.2021.03.014
- Jakiela, P. (2021). Simple Diagnostics for Two-Way Fixed Effects. Working paper available at https://arxiv.org/pdf/2103.13229.pdf
- Olden, A., & Møen, J. (2022). The Triple Difference Estimator. *The Econometrics Journal*. https://doi.org/10.1093/ectj/utac010

Lecture 4: Panel data

★ MIX, *Panel Data*

★ MHE chapter 5

★ C&T chapter 8

- WOOL chapter 13-14
- Raudenbush, S. W. (2009). Adaptive Centering with Random Effects: An Alternative to the Fixed Effects Model for Studying Time-Varying Treatments in School Settings. *Education Finance and Policy*, 4(4), 468–491. https://doi.org/10.1162/edfp.2009.4.4.468

Lecture 5: Instrumental variables

★ MM chapter 3

★ MIX, *Instrumental Variables*

★ C&T chapter 6

- MHE chapter 4
- MW chapters 10-11
- WOOL chapter 15

Lecture 6: Regression discontinuity

★ MM chapter 4

★ MIX, *Regression Discontinuity*

★ MW chapter 9

★ Bloom, H. S. (2012). Modern Regression Discontinuity Analysis. *Journal of Research on Educational Effectiveness*, 5(1), 43–82. https://doi.org/10.1080/19345747.2011.578707

★ Cattaneo, Idrobo and Titiunik. (2020). *A Practical Introduction to Regression Discontinuity Designs: Foundations.* Cambridge Elements: Quantitative and Computational Methods for Social Science, Cambridge University Press. https://rdpackages.github.io/references/Cattaneo-Idrobo-Titiunik_2020_CUP.pdf

★ Cattaneo, Idrobo and Titiunik. (2021). *A Practical Introduction to Regression Discontinuity Designs: Extensions.* Cambridge Elements: Quantitative and Computational Methods for Social Science, Cambridge University Press. https://rdpackages.github.io/references/Cattaneo-Idrobo-Titiunik_2021_CUP.pdf

- MHE chapter 6
- Imbens, G. W., & Lemieux, T. (2008). Regression Discontinuity Designs: A Guide to Practice. *Journal of Econometrics*, 142(2), 615–635. http://dx.doi.org/10.1016/j.jeconom.2007.05.001
- Lee, D. S., & Lemieux, T. (2010). Regression Discontinuity Designs in Economics. *Journal of Economic Literature*, 48(2), 281-355. https://doi.org/10.1257/jel.48.2.281
- What Works Clearing House Standards Handbook Version 4.0 (2017), https://ies.ed.gov/ncee/wwc/Docs/ReferenceResources/wwc_standards_handbook_v4_draft.pdf

Lecture 7: Synthetic control methods

★ MIX, *Synthetic Control*

- Abadie, A. (2021). Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects. *Journal of Economic Literature*, 59(2), 391-425. https://www.aeaweb.org/articles?id=10.1257/jel.20191450

Other recommended readings

- Abadie, A., & Cattaneo, M. D. (2018). Econometric Methods for Program Evaluation. *Annual Review of Economics*, 10(1), 465–503. https://doi.org/10.1146/annurev-economics-080217-053402
- Angrist, J. (2022). Empirical Strategies in Economics: Illuminating the Path from Cause to Effect. National Bureau of Economic Research Working Paper Series, No. 29726. https://doi.org/10.3386/w29726

- Hill, C. J., Bloom, H. S., Black, A. R., & Lipsey, M. W. (2008). Empirical Benchmarks for Interpreting Effect Sizes in Research. *Child Development Perspectives*, 2(3), 172–177. https://doi.org/10.1111/j.1750-8606.2008.00061.x
- Kraft, M. A. (2020). Interpreting Effect Sizes of Education Interventions. *Educational Researcher*. https://doi.org/10.3102/0013189X20912798
- Schlotter, M., Schwerdt, G., & Woessmann, L. (2011). Econometric Methods for Causal Evaluation of Education Policies and Practices: A Non-Technical Guide. *Education Economics*, 19(2), 109–137. https://doi.org/10.1080/09645292.2010.511821

Schedule at a glance

Aug 25	Lecture 1: Regression and causality	
Aug 30	Lecture 1: Regression and causality	PS1 assigned
Sep 1	Lecture 1: Regression and causality	
Sep 6	Lecture 2: Matching estimators	PS2 assigned
Sep 8	Lecture 2: Matching estimators	
Sep 13	Lecture 2: Matching estimators	PS3 assigned
Sep 15	Lecture 2: Matching estimators	
Sep 20	Lecture 3: Difference-in-differences	
Sep 22	Lecture 3: Difference-in-differences	PS4 assigned
Sep 27	Lecture 3: Difference-in-differences	
Sep 29	Lecture 3: Difference-in-differences	
Oct 4	Review for midterm	
Oct 6	**Midterm**	
Oct 11	Lecture 4: Panel data	PS5 assigned
Oct 13	**NO CLASS - VU Fall break**	
Oct 18	Lecture 4: Panel data	
Oct 20	**VEAM seminar 2-3:30 Buttrick 344**	
Oct 25	Lecture 4: Panel data	
Oct 27	Lecture 5: Instrumental variables	PS6 assigned
Nov 1	Lecture 5: Instrumental variables	
Nov 3	Lecture 5: Instrumental variables	PS7 assigned
Nov 8	**NO CLASS - Prof. Corcoran traveling**	
Nov 10	Lecture 5: Instrumental variables	
Nov 15	Lecture 6: Regression discontinuity	
Nov 17	**NO CLASS - APPAM**	
Nov 22	**NO CLASS - Thanksgiving**	
Nov 24	**NO CLASS - Thanksgiving**	
Nov 29	Lecture 6: Regression discontinuity	PS8 assigned
Dec 1	Lecture 6: Regression discontinuity	
Dec 6	Lecture 7: Synthetic control methods	PS9 assigned
Dec 8	Lecture 7: Synthetic control methods	
Dec 8	**Final–take-home**	

Note: dates of problem set assignments are subject to change based on the pace of the course.