ARE 213 Syllabus
Applied Econometrics

Department of Agricultural and Resource Economics
UC Berkeley, Fall 2023

Lectures: Mon/Wed/Fri 1:00-2:00, 141 Giannini

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Course Description

The goal of this course is for students to learn a set of statistical tools and research designs that are useful in conducting high-quality empirical research on topics in applied microeconomics and related fields. Since most applied economic research examines questions with direct policy implications, this course will focus on methods for estimating causal effects. This course differs from many other econometrics courses in that it is oriented towards applied practitioners rather than future econometricians. It therefore emphasizes research design (relative to statistical technique) and applications (relative to theoretical proofs), though it covers some of each.

Prerequisites

Students should have taken at least one PhD-level econometrics course at the level of ARE 210 and 212. In Economics the equivalent level of preparation would be ECON 240A and 240B. Please contact me for approval if you have taken other courses. Roughly speaking, you can take ARE 213 if you know how to derive the asymptotic variance of OLS/IV estimators under heteroskedasticity and are familiar with GMM estimation.

Assignments and Grading

You will be assigned around 4 problem sets. You must work cooperatively on the problem sets in groups of 3 to 5 and submit them together as a group. Problem sets must be typed on a computer. Problems that require statistical analysis must be done in two different packages (e.g., R and Stata). Late problem sets will not be accepted. However, the lowest score among the problem sets will be dropped, no questions asked.

There will also be a final examination. Grades will be based on performance on problem sets (30% total), final exam (65%), and class participation (5%).

Information regarding the schedule and location of the final exam will be available at https://registrar.berkeley.edu/scheduling/academic-scheduling/final-exam-guide-schedules. Please do not ask me when or where the final is. We assume no responsibility for erroneous information if you ask us when/where the final is, as any information we give you on this matter can only be weakly *less* accurate than what is on the Registrar website.

Statistical Software

You may use any software that you wish but Stata and R are recommended. In the long run, if you are doing applied microeconometrics, you will likely encounter those packages. Problem set solutions will be posted in Stata. In some problem sets it will be required that you use more primitive commands, rather than the "canned" commands.

Textbooks

The course is not based on any one text. Some useful (but a bit dated) texts are below. I recommend getting a copy of *Mostly Harmless Econometrics* (but it is not required).

- [*MHE*] Angrist, Joshua and Jorn-Steffen Pischke (2009). *Mostly Harmless Econometrics*. Princeton University Press.

- [*CT*] Cameron, A. Colin and Pravin Trivedi (2005). *Microconometrics: Methods and Applications*. Cambridge University Press.

- [*IW*] Imbens, Guido and Jeffrey Wooldridge (2009). New developments in econometrics: Lecture notes. https://www.cemmap.ac.uk/resource/new-developments-in-econometrics/

- [*JW*] Wooldridge, Jeffrey (2002). *Econometric Analysis of Cross Section and Panel Data.* MIT Press.

Suggested readings by topic are listed below.

Classroom Climate

We are all responsible for creating a learning environment that is welcoming, inclusive, equitable, and respectful. If you feel that these expectations are not being met, please consult your instructors, or seek assistance from campus resources (please see Academic Accommodations).

Accommodations

Students with DSP accommodations should have the DSP office inform the instructor within the first three weeks of classes. In general it is logistically infeasible to grant last-minute requests for accommodations just prior to exams or assignment due dates. The purpose of academic accommodations is to ensure that all students have a fair chance at academic success. Disability, or hardships such as basic needs insecurity, uncertain documentation and immigration status, medical and mental health concerns, pregnancy and parenting, significant familial distress, and experiencing sexual violence or harassment, can affect one's ability to satisfy particular course requirements. Students have the right to reasonable academic accommodations, without having to disclose personal information to instructors, and thus arrangements should be made via DSP. For more information about

accommodations, scheduling conflicts related to religious creed or extracurricular activities, please see [Academic Accommodations](#).

Course Outline

A.   Introduction: regression and causality

    1.   Key facts about regression

    2.   Potential outcomes and randomized control trials

B.   Selection on observables

    1.   Regression adjustment

    2.   Matching and propensity score methods

    3.   Doubly-robust methods

C.   Panel data methods

    1.   Linear panel data methods recap

    2.   Canonical difference-in-differences (DiD) and event studies

    3.   DiD with staggered adoption

    4.   Synthetic control methods and factor models

D.   Instrumental variables (IVs)

    1.   IV idea and mechanics. Weak instruments

    2.   IV with heterogeneous effects

    3.   Shift-share IV and formula instruments

    4.   Examiner designs ("judge IVs"). (+A bit on control functions)

E.   Regression discontinuity (RD) designs

    1.   Sharp RD designs

    2.   RD extensions: fuzzy RD, spatial RD, RD extrapolation, and more

F.   Miscellaneous topics

    1.   Models with multiplicative effects; Poisson regression

    2.   More on statistical inference

Readings by Topic

A.   Introduction: regression and causality

    1.   Key facts about regression

        • MHE Chapter 3.1

- CT Chapter 4.1-4.4
- JW Chapter 2
- Kleinberg, J., Ludwig, J., Mullainathan, S., & Obermeyer, Z. (2015). Prediction policy problems. American Economic Review, 105(5), 491-495.

2. Potential outcomes and randomized control trials
- MHE Chapters 1, 2, plus subsection "Even more on regression and matching" in Chapter 3.3.1
- CT Chapter 2
- Holland, P. W. (1986). Statistics and causal inference. Journal of the American Statistical Association, 81(396), 945-960.
- Heckman, J. J., & Vytlacil, E. J. (2007). Econometric evaluation of social programs, part I: Causal models, structural models and econometric policy evaluation. Handbook of econometrics, 6, 4779-4874. *Sections 1-2, 4.4; optionally Sections 3, 6*

B. Selection on observables
- MHE Chapter 3.2, 3.3
- IW Lectures 1 and 2
- 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.
- Belloni, A., Chernozhukov, V., & Hansen, C. (2014). High-dimensional methods and inference on structural and treatment effects. Journal of Economic Perspectives, 28(2), 29-50.
- Victor Chernozhukov's talk on post-double-selection LASSO and DML: [Double Machine Learning for Causal and Treatment Effects](https://bfi.uchicago.edu/wp-content/uploads/4A_Victor_talk_DoubleML.pdf) (slides: https://bfi.uchicago.edu/wp-content/uploads/4A_Victor_talk_DoubleML.pdf)

C. Panel data methods
1. Linear panel data methods recap
- JW Ch.10
- MHE Ch.5.1

2. Canonical difference-in-differences (DiD) and event studies
   - MHE Ch.5.2
3. DiD with staggered adoption
   - Borusyak K., Jaravel X., Spiess J. (forthcoming). Revisiting Event Study Designs: Robust and Efficient Estimation.
   - de Chaisemartin C., d'Haultfoeuille X. (2023). Two-Way Fixed Effects and Differences-in-Differences with Heterogeneous Treatment Effects: A Survey. The Econometrics Journal, 26(3), C1-C30.
4. Synthetic control methods and factor models
   - Abadie, A. (2021). Using synthetic controls: Feasibility, data requirements, and methodological aspects. Journal of Economic Literature, 59(2), 391-425.

D. Instrumental variables (IVs)
   1. Recap of IV mechanics. Weak instruments
      - MHE Ch. 4.1, 4.2.1, 4.6.4
      - JW Ch. 5
      - IW Lecture 15
      - Andrews, I., Stock, J. H., & Sun, L. (2019). Weak instruments in instrumental variables regression: Theory and practice. Annual Review of Economics, 11, 727-753.
   2. IV with treatment effect heterogeneity
      - MHE Ch 4.4, 4.5
      - IW Lecture 5
   3. Shift-share IV designs and formula instruments
      - Borusyak, K., Hull, P., & Jaravel, X. (2022). Quasi-experimental shift-share research designs. The Review of Economic Studies, 89(1), 181-213.
      - Borusyak, Kirill & Hull, P. (2023). Non-random exposure to exogenous shocks. Econometrica, 91(6), 2155-2185.
   4. Examiner designs ("judge IVs")
      - Cunningham, S. (2021). Causal Inference: The Mixtape. Chapter 7.8.2.

E. Regression discontinuity (RD) designs

1. RD basics
    - Cattaneo, M. D., Idrobo, N., & Titiunik, R. (2019). A practical introduction to regression discontinuity designs: Foundations. Cambridge University Press.
2. RD extensions
    - Cattaneo, M. D., Idrobo, N., & Titiunik, R. (2023). A practical introduction to regression discontinuity designs: Extensions. arXiv preprint arXiv:2301.08958.

F. Miscellaneous topics
1. Multiplicative effects
    - Chen, J. & J. Roth (forthcoming). Logs with zeros? Some problems and solutions. Quarterly Journal of Economics.
2. More on standard errors
    - Cameron, A. C., Gelbach, J. B., & Miller, D. L. (2011). Robust inference with multiway clustering. Journal of Business & Economic Statistics, 29(2), 238-249.
    - MacKinnon, J. G., Nielsen, M. Ø., & Webb, M. D. (2023). Cluster-robust inference: A guide to empirical practice. Journal of Econometrics, 232(2), 272-299.