

ECON5311 Applied Micro-econometrics (4 units)

2025/2026 Spring Semester

Department of Economics, Hong Kong University of Science and Technology

Instructor Information

Instructor	Email	Office Location	Office Hours
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Communication rule

- I set up a discord server for communicating with students. I share the link to the server in the first lecture.
- I post teaching materials and communicate with students on the Discord server.
- Discord should be the primary way of contacting me. If you send me a message by email, I may not respond to you.
- I will be responsive during the day but will be slow in the evening and weekend.
- You can make an appointment to see me in the office or zoom.

General Information

Enrollment requirement

The prerequisite is ECON 5300 Econometrics. The students are also recommended to take ECON4274 Programming Econometrics with R.

Course Description

This course teaches classical and recent applied econometric methods in empirical microeconomics for Ph.D. students. The goal of this course is to enable students to understand, design, and implement effective empirical strategies to support empirical claims, particularly causal claims, at the level required for professional researchers in empirical microeconomics. These empirical strategies include randomized experiments with and without compliance, regression discontinuity, difference-in-differences, and recent techniques such as causal machine learning. In addition, students will write code in R/Python to perform simulation, estimation, and inference and to learn how to read empirical microeconomics papers critically. Students also learn best practices for data science project management using modern tools including git/GitHub, VS Code/Cursor, and AI.

Intended Learning Outcomes

Upon successful completion of the course, students will be able to:

1. Understand empirical strategies as used in recent applied microeconomics studies.
2. Design empirical strategies as required in recent applied microeconomics studies.
3. Apply empirical strategies to data to write papers in applied microeconomics.
4. Manage data science projects using best practices and modern tools.
5. Critically read recent applied microeconomics studies.
6. Effectively present summaries of recent applied microeconomics research.
7. Potentially expand the frontier of applied econometrics.

Teaching and learning activities

The course adopts the following approaches to meet the objectives:

1. Give lectures on concepts and methods, showcasing the methods with simulated and actual data.
2. Assign homework to replicate and extend analyses and read papers critically.
3. Request students to read and present related literature.

Class Time

Tue, 9:00-12:50. We will have a break for snacks in the middle of the class.

Required Software

R, Python, Cursor or other VS Code forks, git, bash

Evaluation

Approximately A range for ≥ 85 , B range for ≥ 70 , and C range for ≥ 50 .

1. Assignment 20% (ILO 1,2,3,4,5): I will assign approximately ten pieces of homework. The score is based on the best 5 submissions. Students have to write the solution in Rmarkdown/Quarto and submit the original Rmd/Qmd file and the compiled HTML file in a project repository and push it to GitHub Education page.
 - Success criterion: Submit both the source file (Rmd/Qmd) and compiled HTML by the deadline; the document compiles without errors and the analysis is reproducible and clearly explained; modern project management and effective use of AI are evaluated from the submitted repository contents (file structure, documentation, configuration, reproducibility) and the git history (commit messages, incremental development, traceability of changes).
2. Participation 20% (ILO 1,5): Every time you ask a question during the class, you will earn 1 point up to 20 points. To claim a point, you have to note the question and

answer in the designated channel of the Discord server. The point per class is up to 2 points.

- Success criterion: Ask a substantive course-related question and post a clear question-and-answer note in the designated Discord channel (max 2 points per class).
- 3. Presentation 10% (ILO 1,5,6): 10% x 1. Each student picks up an empirical microeconomics paper published in the top 5 journals since 2010 and discusses the article in the classroom. The student summarizes the motivation, questions, and findings of the paper. Then, the student lists up the empirical claims and explains the methods the authors used to support the claims, the assumptions made for the methods, and the arguments to justify the assumptions. Finally, the student critically evaluates the authors' arguments. The time for each presentation depends on the classroom size.
 - Success criterion: Present an eligible paper and cover (i) motivation, questions, findings, (ii) empirical claims and supporting methods with assumptions and justification, and (iii) a critical evaluation, within the allotted time.
- 4. Closed-book Midterm exam 20% (ILO 1,2) (End of March): Analytical problems regarding the econometric methods taught in the course.
 - Success criterion: Provide correct solutions with clear derivations and explanations, using appropriate notation.
- 5. Closed-book Final exam 30% (ILO 1,2,5) (Exam period): Analytical problems regarding the econometric methods taught in the course and a discussion problem about an empirical microeconomics paper.
 - Success criterion: Provide correct analytical solutions and a well-reasoned, clearly written discussion of the assigned paper/question.

Schedule

The weekly schedule is tentative and may change.

- Potential outcome and assignment mechanism: Week 1
- Project management: Week 2
- effective use of AI: Week 3
- Classical randomized experiments: Week 4 and 5
- Regular assignment mechanism
 - Without noncompliers: Week 6
 - With noncompliers: Week 7
- Regression discontinuity
 - Basics: Week 8
 - Advanced: Week 9
- Difference-in-difference

- Basics: Week 10
- Advanced: Week 11
- Other topics
 - Multiple testing: Week 12
 - Heterogeneous treatment effects: Week 13
- Presentations and discussions
 - Every week

Academic Integrity

Without academic integrity, there is no serious learning. Thus, you are expected to hold the highest standard of academic integrity in the course. You are encouraged to study and do homework in groups. However, no cheating, plagiarism will be tolerated. Anyone caught cheating, plagiarism will fail the course. Please make sure adhere to the HKUST Academic Honor Code at all time (see <http://www.ust.hk/vpaa0/integrity/>).

Course Materials

I post all teaching materials on the Discord server.

Recommended Materials

I update the reference during the semester.

Randomized experiments

General

- Guido W. Imbens and Donald B. Rubin, 2015, Causal Inference for Statistics, Social, and Biomedical Sciences, Cambridge University Press.
- Athey, Susan, and Guido Imbens. 2016. “The Econometrics of Randomized Experiments.” arXiv [stat.ME]. arXiv. <http://arxiv.org/abs/1607.00698>.
- Duflo, Esther, Rachel Glennerster, and Michael Kremer. 2007. “Chapter 61 Using Randomization in Development Economics Research: A Toolkit.” In Handbook of Development Economics, edited by T. Paul Schultz and John A. Strauss, 4:3895–3962. Elsevier.

Papers

- Imbens, Guido W., and Joshua D. Angrist. 1994. “Identification and Estimation of Local Average Treatment Effects.” *Econometrica: Journal of the Econometric Society* 62 (2): 467.
- Angrist, Joshua D., Guido W. Imbens, and Donald B. Rubin. 1996. “Identification of Causal Effects Using Instrumental Variables.” *Journal of the American Statistical Association* 91 (434): 444–55.

- Heckman, James J., and Edward Vytlacil. 2005. “Structural Equations, Treatment Effects, and Econometric Policy Evaluation.” *Econometrica: Journal of the Econometric Society* 73 (3): 669–738.
- Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey M. Wooldridge. 2020. “Sampling-based versus Design-based Uncertainty in Regression Analysis.” *Econometrica: Journal of the Econometric Society* 88 (1): 265–96.
- Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey Wooldridge. 2017. “When Should You Adjust Standard Errors for Clustering?” Working Paper Series. National Bureau of Economic Research. <https://doi.org/10.3386/w24003>.

Applications

- Duflo, Esther, Rema Hanna, and Stephen P. Ryan. 2012. “Incentives Work: Getting Teachers to Come to School.” *The American Economic Review* 102 (4): 1241–78.
- Banerjee, Abhijit V., Shawn Cole, Esther Duflo, and Leigh Linden. 2007. “Remedying Education: Evidence from Two Randomized Experiments in India.” *The Quarterly Journal of Economics* 122 (3): 1235–64.
- Imbens, Guido W., Donald B. Rubin, and Bruce I. Sacerdote. 2001. “Estimating the Effect of Unearned Income on Labor Earnings, Savings, and Consumption: Evidence from a Survey of Lottery Players.” *The American Economic Review* 91 (4): 778–94.
- Angrist, Joshua D. 1990. “Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records.” *The American Economic Review* 80 (3): 313–36.

Regression discontinuity

General

- Cattaneo, Matias D., Nicolás Idrobo, and Rocío Titiunik. 2020. *A Practical Introduction to Regression Discontinuity Designs: Foundations*. Cambridge University Press.
- Cattaneo, Matias D., Nicolas Idrobo, and Rocio Titiunik. 2020. *A Practical Introduction to Regression Discontinuity Designs: Extension*. Cambridge University Press.

Papers

- Hahn, Jinyong, Petra Todd, and Wilbert Van der Klaauw. 2001. “Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design.” *Econometrica: Journal of the Econometric Society* 69 (1): 201–9.
- McCrary, Justin. 2008. “Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test.” *Journal of Econometrics* 142 (2): 698–714.
- Calonico, Sebastian, Matias D. Cattaneo, and Rocio Titiunik. 2014. “Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs.” *Econometrica: Journal of the Econometric Society* 82 (6): 2295–2326.

- Calonico, Sebastian, Matias D. Cattaneo, and Rocío Titiunik. 2015. “Optimal Data-Driven Regression Discontinuity Plots.” *Journal of the American Statistical Association*.
- Cattaneo, Matias D., Michael Jansson, and Xinwei Ma. 2020. “Simple Local Polynomial Density Estimators.” *Journal of the American Statistical Association* 115 (531): 1449–55.
- Calonico, Sebastian, Matias D. Cattaneo, and Max H. Farrell. 2018. “On the Effect of Bias Estimation on Coverage Accuracy in Nonparametric Inference.” *Journal of the American Statistical Association* 113 (522): 767–79.
- Calonico, Sebastian, Matias D. Cattaneo, Max H. Farrell, and Rocío Titiunik. 2019. “Regression Discontinuity Designs Using Covariates.” *The Review of Economics and Statistics* 101 (3): 442–51.
- Kolesár, Michal, and Christoph Rothe. 2018. “Inference in Regression Discontinuity Designs with a Discrete Running Variable.” *The American Economic Review* 108 (8): 2277–2304.
- Dong, Yingying, and Arthur Lewbel. 2015. “Identifying the Effect of Changing the Policy Threshold in Regression Discontinuity Models.” *The Review of Economics and Statistics* 97 (5): 1081–92.
- Card, David, David S. Lee, Zhuan Pei, and Andrea Weber. 2015. “Inference on Causal Effects in a Generalized Regression Kink Design.” *Econometrica: Journal of the Econometric Society* 83 (6): 2453–83.
- Cattaneo, Matias D., Brigham R. Frandsen, and Rocío Titiunik. 2015. “Randomization Inference in the Regression Discontinuity Design: An Application to Party Advantages in the U.S. Senate.” *Journal of Causal Inference* 3 (1): 1–24.

Application

- Meyersson, Erik. 2014. “Islamic Rule and the Empowerment of the Poor and Pious.” *Econometrica: Journal of the Econometric Society* 82 (1): 229–69.
- Amarante, Verónica, Marco Manacorda, Edward Miguel, and Andrea Vigorito. 2016. “Do Cash Transfers Improve Birth Outcomes? Evidence from Matched Vital Statistics, Program, and Social Security Data.” *American Economic Journal: Economic Policy* 8 (2): 1–43.
- Nielsen, Helena Skyt, Torben Sørensen, and Christopher Taber. 2010. “Estimating the Effect of Student Aid on College Enrollment: Evidence from a Government Grant Policy Reform.” *American Economic Journal: Economic Policy* 2 (2): 185–215.
- Dell, Melissa. 2010. “The Persistent Effects of Peru’s Mining ‘Mita.’” *Econometrica: Journal of the Econometric Society* 78 (6): 1863–1903.
- Keele, Luke J., and Rocío Titiunik. 2015. “Geographic Boundaries as Regression Discontinuities.” *Political Analysis: An Annual Publication of the Methodology Section of the American Political Science Association* 23 (1): 127–55.

Background

- Fan, Jianqing, Irene Gijbels, D. R. 1996. *Local Polynomial Modelling and Its Applications: Monographs on Statistics and Applied Probability 66*. 1st ed. Taylor & Francis Group.

Difference-in-difference

- Roth, Jonathan, Pedro H. C. Sant'Anna, Alyssa Bilinski, and John Poe. "What's Trending in Difference-in-Differences? A Synthesis of the Recent Econometrics Literature." *Journal of Econometrics* 235, no. 2 (August 1, 2023): 2218–44.

2 x 2 design

- Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-In-Differences Estimates?" *The Quarterly Journal of Economics* 119 (1): 249–75.
- Heckman, James J., Hidehiko Ichimura, and Petra E. Todd. 1997. "Matching As An Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme." *The Review of Economic Studies* 64 (4): 605–54.
- Abadie, Alberto. 2005. "Semiparametric Difference-in-Differences Estimators." *The Review of Economic Studies* 72 (1): 1–19.
- Sant'Anna, Pedro H. C., and Jun Zhao. 2020. "Doubly Robust Difference-in-Differences Estimators." *Journal of Econometrics* 219 (1): 101–22.
- Chaisemartin, C. de, and X. D'Haultfœuille. 2018. "Fuzzy Differences-in-Differences." *The Review of Economic Studies* 85 (2): 999–1028.

Multi-period design

- Goodman-Bacon, Andrew. 2018. *Difference-in-Differences with Variation in Treatment Timing*. National Bureau of Economic Research.
- Callaway, Brantly, and Pedro H. C. Sant'Anna. 2020. "Difference-in-Differences with Multiple Time Periods." *Journal of Econometrics*.
- Sun, Liyang, and Sarah Abraham. 2020. "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects." *Journal of Econometrics*, December.
- Chaisemartin, Clément de, and Xavier D'Haultfœuille. 2020. "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects." *The American Economic Review*, 110 (9): 2964–96.
- Athey, Susan, and Guido W. Imbens. 2021. "Design-Based Analysis in Difference-In-Differences Settings with Staggered Adoption." *Journal of Econometrics*, April.
- Wooldridge, Jeffrey M. 2021. "Two-Way Fixed Effects, the Two-Way Mundlak Regression, and Difference-in-Differences Estimators," August. https://www.researchgate.net/publication/353938385_Two-Way_Fixed_Effects_the_Two-Way_Mundlak_Regression_and_Difference-in-Differences_Estimators.

Application

- Card, David, and Alan B. Krueger. 1994. “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania.” *The American Economic Review* 84 (4): 772–93.
- Meer, Jonathan, and Jeremy West. 2016. “Effects of the Minimum Wage on Employment Dynamics.” *The Journal of Human Resources* 51 (2): 500–522.
- Dobkin, Carlos, Amy Finkelstein, Raymond Kluender, and Matthew J. Notowidigdo. 2018. “The Economic Consequences of Hospital Admissions.” *The American Economic Review* 102 (2): 308–52.

Synthetic control

General

- Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2010. “Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California’s Tobacco Control Program.” *Journal of the American Statistical Association*.
- Firpo, Sergio, and Vitor Possebom. 2018. “Synthetic Control Method: Inference, Sensitivity Analysis and Confidence Sets.” *Journal of Causal Inference* 6 (2). <https://doi.org/10.1515/jci-2016-0026>.
- Abadie, Alberto. 2021. “Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects.” *Journal of Economic Literature* 59 (2): 391–425.
- Abadie, Alberto, and Jérémy L’Hour. 2021. “A Penalized Synthetic Control Estimator for Disaggregated Data.” *Journal of the American Statistical Association*, August, 1–18.
- Arkhangelsky, Dmitry, Susan Athey, David A. Hirshberg, Guido W. Imbens, and Stefan Wager. n.d. “Synthetic Difference in Differences.” *The American Economic Review*. Accessed September 2, 2021.

Application

- Abadie, Alberto, and Javier Gardeazabal. 2003. “The Economic Costs of Conflict: A Case Study of the Basque Country.” *The American Economic Review* 93 (1): 113–32.
- Cavallo, Eduardo, Sebastian Galiani, Ilan Noy, and Juan Pantano. 2013. “Catastrophic Natural Disasters and Economic Growth.” *The Review of Economics and Statistics* 95 (5): 1549–61.
- Marx, Matt, Deborah Strumsky, and Lee Fleming. 2009. “Mobility, Skills, and the Michigan Non-Compete Experiment.” *Management Science* 55 (6): 875–89.
- Hinrichs, Peter. 2012. “The Effects of Affirmative Action Bans on College Enrollment, Educational Attainment, and the Demographic Composition of Universities.” *The Review of Economics and Statistics* 94 (3): 712–22.

Shift-share design

General

- Adao, Rodrigo, Michal Kolesár, and Eduardo Morales. 2019. “Shift-Share Designs: Theory and Inference.” *The Quarterly Journal of Economics* 134 (4): 1949–2010.
- Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift. 2020. “Bartik Instruments: What, When, Why, and How.” *The American Economic Review* 110 (8): 2586–2624.
- Borusyak, Kirill, Peter Hull, and Xavier Jaravel. 2021. “Quasi-Experimental Shift-Share Research Designs.” *The Review of Economic Studies*, June. <https://doi.org/10.1093/restud/rdab030>.

Application

- Card, David. 2001. “Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration.” *Journal of Labor Economics* 19 (1): 22–64.
- Autor, David H., David Dorn, and Gordon H. Hanson. 2013. “The China Syndrome: Local Labor Market Effects of Import Competition in the United States.” *The American Economic Review* 103 (6): 2121–68.
- Hummels, David, Rasmus Jørgensen, Jakob Munch, and Chong Xiang. 2014. “The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data.” *The American Economic Review* 104 (6): 1597–1629.

Multiple testing

- Anderson, Michael L. 2008. “Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects.” *Journal of the American Statistical Association* 103 (484): 1481–95.
- Young, Alwyn. 2019. “Channeling Fisher: Randomization Tests and the Statistical Insignificance of Seemingly Significant Experimental Results.” *The Quarterly Journal of Economics* 134 (2): 557–98.
- List, John A., Azeem M. Shaikh, and Yang Xu. 2019. “Multiple Hypothesis Testing in Experimental Economics.” *Experimental Economics* 22 (4): 773–93.
- Chen, Yuyu, and David Y. Yang. “The Impact of Media Censorship: 1984 or Brave New World?” *American Economic Review* 109, no. 6 (June 1, 2019): 2294–2332.

Other topics

- Colin Cameron, A., and Douglas L. Miller. 2015. “A Practitioner’s Guide to Cluster-Robust Inference.” *The Journal of Human Resources* 50 (2): 317–72.
- Wager, Stefan, and Susan Athey. 2018. “Estimation and Inference of Heterogeneous Treatment Effects Using Random Forests.” *Journal of the American Statistical Association* 113 (523): 1228–42.

GitHub Repository

- Project management: <https://github.com/kohei-kawaguchi/Economics>

- Effective use of AI: <https://github.com/kohei-kawaguchi/TestAI>