

Econometrics II Syllabus 2025

Instructors

- Konrad Burchardi (5 lectures): konrad.burchardi@iies.su.se
- Laia Navarro-Sola (6 lectures): laia.navarrosola@iies.su.se
- David Strömberg (guest lecture): david.stromberg@ne.su.se
- Simon Handreke (TA sessions): simon.handreke@iies.su.se

Course Goals

This is a PhD level course on modern econometric techniques with a focus on causal inference. It covers identification, estimation and inference principles, the experimental ideal, matching and propensity scores, instrumental variables, difference-in-differences, and regression discontinuity designs; and it provides an introduction to machine learning. The goals are to equip students with:

1. Formal tools to understand and express issues in modern applied econometrics.
2. Translating formal econometric language into estimators.
3. Apply and test estimators in simulated data.

Lectures Overview

- Lectures are 9:00-12:00 on Tuesdays and Thursdays, except Lectures 8, 9 and 12.
- See the schedule [here](#).
- All lectures are in person. There is no hybrid option.
- 10-minute break every hour.
- Lecture content:
 1. Identification of Causal Effects (Laia)
 2. Inference Principles (Konrad)
 3. Experiments (Konrad)
 4. Matching (Konrad)
 5. IV/2SLS (Konrad)
 6. Heterogeneous IV (Konrad)
 7. Fixed effects (Laia)
 8. Static DID (Laia)
 9. Dynamic DID (Laia)
 10. Matched DID and Synthetic Controls (Laia)
 11. Regression Discontinuity Design (Laia)
 12. (reserve slot)
 13. Machine Learning (David)

Communication and Materials

- *Slack*: Our primary platform for communication and links to materials.

- Click [here](#) to join our Workspace.
- We strongly encourage all of you to actively participate in discussions on Slack, both when you have doubts and questions about the material, and to help others out where you feel you can! The more actively you participate, the more others will also be inclined to participate.
- There are the following channels:
 - exam: information about the exam (close to exam date).
 - general: general course announcements.
 - lecture_##: link to slides and general discussion about each lecture.
 - problemset_##: link to problem set and discussion.
 - stata_coding: questions and tips on Stata coding problems.
 - random: anything else.
- Also feel free to use Slack's direct messaging (DM) system to message each other. For questions to Konrad or Laia, it is generally better to ask publicly rather than DM so others can benefit from the discussion. We will reply to DMs when it is a personal question that applies only to you. Any other questions you send us in DMs we will re-post in the appropriate public channel and answer there.
- *Athena*: Athena will be used for problem set submission
 - Click [here](#) to access our Athena website. We will post the problem sets and lecture slides on Athena, but note that all relevant material on Athena (i.e. lectures and problem sets) will also be accessible through links on Slack, which will be our primary way of communicating with you.
 - Please make sure you are registered with the correct email on Athena so we have you on the class roster.
 - Submit your problem set solutions through Athena.
 - Other than an initial welcome message, we won't use Athena for communication.
- *Email*: Please do write to us on Slack instead.

Problem Sets and TA Sessions

- Problem sets consist of both theory and coding questions (about 50/50). Coding exercises serve to help understand theory and to build coding skills.
- The primary coding language is Stata.
 - This is primarily due to its convenience for regressions and continued prevalence in economics (see [here](#)).
 - There is a 2-hour coding session (with Simon Handreke, on April 1, 13:00-15:00) which will go through examples of code meant to equip you with the core knowledge needed for the problem set.
 - Make sure to download and install Stata before the session! You should be able to obtain Stata licenses through your institutions.
 - Please also see these [UCLA](#) and [Princeton](#) Stata guides.
 - You are also encouraged to use [ChatGPT](#) to help you write Stata code. It makes mistakes, but it is very helpful to get started. However, it is not reliable for theory questions.
 - You can use R if you prefer but TA sessions and solutions will all be using Stata.

- You are welcome to work on problem sets together and you are strongly encouraged to discuss them on the corresponding Slack channels. But you have to hand in your own solution.
- Solutions include both answers to theory questions as well as the code that generated your results. Make sure your code runs and produces the desired result. This contributes to your problem set grade.
- Problem set submission:
 - They are due at 4pm the day *before the TA session*. Submit your solution on the Athena course page.
 - Later submissions will not be graded (and hence receive zero points).
- Problem set grading:
 - You can receive between 0 and 4 points for a solution. Full credit will be awarded if a serious, independent effort for each question has been made, and you've had at least partial success with your answers. Getting every answer right is not a requirement for full credit. Answers that are copied from others or previous years receive no credit.
 - If you feel like we have seriously misjudged the effort and success of your PS solution, you can submit a regrading request by Laia (PS1, PS4, and PS5) or Konrad (PS1, PS2, and PS3). Requesting a regrade may increase or decrease the credit you get for your PS submission.
 - By default, no personalized feedback to solutions will be provided, but you are strongly encouraged to discuss questions and solutions both before and after submission on the relevant Slack channel.
- Recommended for writing solutions: LaTeX or LyX. Paper and pen/pencil are also fine.

Schedule for problem sets:

- PS1: Identification and Inference Principles
 - available: Thursday, 3/4.
 - deadline: Monday, 14/4, 4pm.
 - TA Session 1: Tuesday, 15/4.
- PS2: Experiments and Matching
 - available: Thursday, 10/4.
 - deadline: Monday, 21/4, 4pm.
 - TA Session 2: Tuesday, 22/4
- PS3: IV and 2SLS
 - available: Tuesday, 22/4.
 - deadline: Monday, 28/4, 4pm.
 - TA Session 3: Tuesday, 29/4.
- PS4: Fixed Effects and DID
 - available: Wednesday, 30/4.
 - deadline: Wednesday, 7/5, 4pm.
 - TA Session 4: Thursday, 8/5.
- PS5: Synthetic Controls and RDD
 - available: Thursday, 8/5.
 - deadline: Thursday, 15/5, 4pm.
 - TA Session 5: Friday, 16/5.

Quizzes

- Quizzes are short multiple choice questions, released shortly after each lecture.
- They are automatically graded, so you see which questions you answered correctly right away, and you can also see a suggested solution.
- Note that you get points for participating (one per quiz, for a total of 11% of the grade), and importantly, independently of how many answers you get right! Just try your best, not any worse, not any better.
- The quizzes serve (i) as an opportunity to work through the material of the lectures again and deepen your understanding, (ii) test your understanding and receive feedback, (iii) and for us to get some feedback on which points have been understood well, and which ones less so.
- Time expectation: about one hour per quiz.
- You have one week to complete each quiz from when it is available (usually on the same day as the corresponding lecture).

Readings

- Our philosophy regarding readings:
 - Prioritize problem sets, lecture slides, and quizzes; only go to the readings if those materials are not clear enough.
 - Among the readings, the starred material should help to clarify the basics of the content in the lectures. Other material is only relevant insofar you are interested in the topic.
 - You are not expected to read any of the material before class.
- Main textbooks: (note however that we do not follow any textbook closely)
 - Angrist and Pischke (2008): *Mostly Harmless Econometrics*, Princeton University Press, [unpublished version](#).
 - Imbens and Rubin (2015): *Causal Inference for Statistical, Social, and Biomedical Sciences: An Introduction*, Cambridge University Press, [e-book](#).
 - Cunningham (2022): *Causal Inference: The Mixtape*. Yale University Press, [e-book](#).
- Also highly recommended are Paul Goldsmith-Pinkham's [lecture notes](#).
- Access to NBER working papers and journals for further readings through [SU Library](#).

Grading and Exam

- Distribution of points for this class:
 - You can earn up to 101 points on the course.
 - You need 50 points to pass the course.
 - You can earn up to 70 points on the exam, up to 20 points for the 5 problem sets, and up to 11 points for filling out the quizzes. *Notice that the points on the quizzes are awarded for filling them in, and are independent of which answers you provide.*
- Exam information:
 - Date and time: 27th of May 2025, 08:00-13:00.

- Only theory questions, i.e. there will be no coding questions on the exam.
- Retake exam at end of summer (26th of August 2025, 14:00-19:00).

Lectures Details and Recommended Readings

L1 (1st of April, 9-12): Identification of Causal Effects

- **Topics:** descriptive versus causal; structural/reduced form; (non-)parametrics; identification; identification strategy / research design; potential outcomes, selection, Conditional Independence Assumption; assignment mechanisms
- **Readings:**
 - *Imbens and Rubin (2015): Chapters 1 and 2 [introduction]; Chapter 3 [assignment mechanism]
 - *Angrist and Pischke (2008): Chapter 1; Chapter 2.1 [selection bias]
 - Lewbel, Arthur (2019): "The Identification Zoo: Meanings of Identification in Econometrics", *Journal of Economic Literature*, 57(4), 835-903 [identification]
 - Currie, Janet and Kleven, Henrik and Zwieters, Esmée (2020): "Technology and Big Data Are Changing Economics: Mining Text to Track Methods", AEA Papers and Proceedings, 110, 42-48 [identification strategies]
 - Angrist, Joshua D. and Pischke, Jörn-Steffen (2010): "The Credibility Revolution in Empirical Economics: How Better Research Design Is Taking the Con out of Econometrics", *Journal of Economic Perspectives*, 24(2), 3-30. [research design]
 - Card, David (2011): "Model-Based or Design-Based? Competing Approaches in "Empirical Micro"", [slides](#) [model-based versus design-based identification]
 - Haile, Phil (2020): "Structural vs. Reduced Form", [slides](#) [structural identification]

Coding Camp: STATA (1st of April, 13-15)

- Participation is optional for those who do not feel comfortable using STATA.
- If you are joining, make sure you are familiar with the [UCLA](#) and [Princeton](#) guides!
- Fabian will go through examples of code relevant to the problem sets.

L2 (3rd of April, 9-12): Inference Principles

- **Topics:** large sample standard errors; clustering; design vs. sampling based uncertainty.
- **Readings:**
 - Imbens and Rubin (2015): Chapter 5 [randomization inference]
 - Hansen (2022): Chapter 4.11 and 4.13 [variance estimators]
 - Angrist and Pischke (2009): Chapter 8 [variance estimators]
 - Newey, KW and McFadden, D (1994): "Large Sample Estimation and Hypothesis Testing", *Handbook of Econometrics*, IV, 2112-2245. [canonical estimation]
 - Alberto Abadie and Susan Athey and Guido W. Imbens and Jeffrey M. Wooldridge (2020): "Sampling-based vs. Design-based Uncertainty in Regression Analysis", *Econometrica* 88:1, 265-296. [inference]
 - Cameron, A Colin and Miller, Douglas L (2015): "A Practitioner's Guide to Cluster-Robust Inference", *Journal of Human Resources*, 50(2), 317-372. [classic reference for clustering]

- Abadie, Alberto, Susan Athey, Guido Imbens and Jeffrey Wooldridge (2017): “When Should You Adjust Standard Errors for Clustering”. Working paper.

L3 (8th of April, 9-12): Experiments

- **Topics:** balance; power; stratification; paired experiments; controls; bad controls; attrition; Fisher Inference; canonical experimental designs; adaptive trials
- **Readings:**
 - *Angrist and Pischke (2008): Chapter 2 [introduction]; Chapter 3.2.3 [bad controls]
 - *Imbens and Rubin (2015): Chapter 4 [introduction]; Chapter 5 [Fisher inference], Chapter 7.5 [controls]
 - Kasy, Maximilian (2016) “Why Experimenters Might Not Always Want to Randomize, and What They Could Do Instead” *Political Analysis*: 1-15. [stratification]
 - Lee, D. S. (2009) “Training, Wages, and Sample Selection: Estimating Sharp Bounds on Treatment Effects”. *Review of Economic Studies* 76: 1071–1102. [attrition]
 - Bai, Yuehao (2021) “Optimality of Matched-Pair Designs in Randomized Controlled Trials”. Working Paper. [paired experiments]
 - Kasy, Maximilian and Anja Sautman (2021): “Adaptive Treatment Assignment In Experiments For Policy” *Econometrica* 89:1, 113–132.

L4 (10th of April, 9-12): Matching

- **Topics:** propensity score; achieving balance; matching; marginal treatment effects
- **Readings:**
 - *Imbens and Rubin (2015): Chapters 12.1-12.3 [propensity scores; all of Part III of this book is good if you want to learn more]
 - Angrist and Pischke (2008): Sections 3.3.1-3.3.3 [relation of matching and regression analysis]
 - McKenzie, David (2021) “What do you need to do to make a matching estimator convincing? Rhetorical vs statistical checks” *WorldBank Development Impact* blog post [good practical advice on convincing matching approaches]
 - Dagan, Noa, et. al. (2021) “BNT162b2 mRNA Covid-19 Vaccine in a Nationwide Mass Vaccination Setting” *New England Journal of Medicine*. [please also read “Supplementary Methods 3”; shows a great use of pseudo outcomes]
 - LaLonde, Robert J. (1986): “Evaluating the Econometric Evaluations of Training Programs with Experimental Data”, *American Economic Review*, 76(4)
 - Dehejia, Rajeev and Sadek Wahba (2002) “Propensity Score-Matching Methods for Nonexperimental Causal Studies” *The Review of Economics and Statistics*, February 2002, 84(1): 151–161
 - Zhou, Xiang and Yu Xie (2019): “Marginal Treatment Effects from a Propensity Score Perspective” *Journal of Political Economy* 127:6.

L5 (15th of April, 9-12): Instrumental Variables

- **Topics:** valid instruments: conditions and intuitions; common mistakes; understanding the IV bias; weak instruments; two-sample IV and split-sample IV; jackknife estimators; shift-share instruments.
- **Readings:**
 - *Angrist and Pischke (2008): Chapters 4.1-4.3; 4.6.1; 4.6.4
 - Angrist, Joshua, and Alan Krueger (1995) "Split-Sample Instrumental Variable Estimates of the Returns to Education" *Journal of Business & Economic Statistics* 13:2.
 - Borusyak, Kirill, Peter Hull, and Xavier Jaravel (forthcoming) "Quasi-Experimental Shift-Share Research Designs" *Review of Economic Studies*
 - Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift (forthcoming) "Bartik Instruments: What, When, Why and How" *American Economic Review*

TA Session 1 (15th of April, 13-15)

L6 (22nd of April, 9-12): IV: Heterogeneous Effects, Compliers, Marginal Effects

- **Topics:** Local Average Treatment Effects (LATE); compliers, always-takers and never-takers; characterizing compliers; generalizations; judges design.
- **Readings:**
 - *Angrist and Pischke (2008): Chapters 4.4 and 4.5
 - Imbens, Guido and Joshua Angrist (1994) "Identification and Estimation of Local Average Treatment Effects", *Econometrica* 62:2, 467-475.
 - Imbens, Guido, Joshua Angrist and Donald B. Rubin (1996): "Identification of Causal Effects Using Instrumental Variables", *Journal of the American Statistical Association*, 91(434), 444-455.

TA Session 2 (22nd of April, 13-15)

L7 (24th of April, 9-12): Fixed Effects

- **Topics:** generic FE; panel FE and incidental parameters problem; two-way FE; AKM; Empirical Bayes
- **Readings:**
 - *Angrist and Pischke (2008): Chapter 5.1
 - Ashenfelter, Orley and Alan Krueger (1994): "Estimates of the Economic Return to Schooling from a New Sample of Twins", *American Economic Review*, 84(5), 1157--1173 [fixed effects]
 - Bonhomme, Stéphane and Manresa, Elena (2015): "Grouped Patterns of Heterogeneity in Panel Data", *Econometrica*, 83(3), 1147--1184 [group FE]

- Card, David and Heining, Jörg and Kline, Patrick (2013): “Workplace Heterogeneity and the Rise of West German Wage Inequality”, *Quarterly Journal of Economics*, 128(3), 967-1015 [AKM]
- Chetty, Raj and Friedman, John N. and Hilger, Nathaniel and Saez, Emmanuel and Schanzenbach, Diane Whitmore and Yagan, Danny (2011): “How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project Star”, *Quarterly Journal of Economics*, 126(4), 1593-1660 [random effects]
- Nickell, Stephen (1981): “Biases in Dynamic Models with Fixed Effects”, *Econometrica*, 49(6), 1417-1426. [incidental parameters]
- Morris, Carl N. (1983): “Parametric Empirical Bayes Inference: Theory and Applications”, *Journal of the American Statistical Association*, 78(381), 47-55 [Empirical Bayes]
- Searle, Shayle R and Casella, George and McCulloch, Charles E (2009): *Variance Components*, John Wiley & Sons [random & fixed effects]
- Wooldridge, Jeffrey M (2010): *Econometric Analysis of Cross Section and Panel Data*, MIT Press [within/between transformation]

L8 (28th of April, 9-12): Static Difference-in-Differences

- **Topics:** panel SUTVA; anticipation and memory; group-time ATEs; identification in DID with potential outcomes; block structures; dynamic effects; staggered rollouts; inference issues
- **Readings:**
 - *Angrist and Pischke (2008): Chapter 5.2
 - *Card, David and Krueger, Alan B (1994): “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania”, *American Economic Review*, 84(4), 772--793 [leading example]
 - Freyaldenhoven, Simon and Hansen, Christian and Shapiro, Jesse M. (2019): “Pre-event Trends in the Panel Event-Study Design”, *American Economic Review*, 109(9), 3307-38 [auxiliary IV correction of pre-trends]
 - Bertrand, Marianne and Duflo, Esther and Mullainathan, Sendhil (2004): “How Much Should We Trust Differences-In-Differences Estimates?”, *Quarterly Journal of Economics*, 119(1): 249: 275. [inference]
 - de Chaisemartin, Clément and D'Haultfœuille, Xavier (2020): “Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects”, *American Economic Review*, 110(9), 2964-96 [heterogeneous effects in panels]
 - Goodman-Bacon, Andrew (2018): “Difference-in-Differences with Variation in Treatment Timing”, *NBER Working Paper* 25018 [weighted 2x2 DIDs]

TA Session 3 (29th of April, 13-15)

L9 (30th of April, 13-16): Dynamic DID

- **Topics:** Ashenfelter’s Dip; pre-trend violations; functional form issues; heterogeneous treatment effects in panel data; event studies; heterogeneity in staggered rollout designs;
- **Readings:**

- Abraham, Sarah and Liyang Sun (2021): “Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects”, *Journal of Econometrics*, 225(2), 175-199. [heterogeneous event studies]
- Borusyak, Kirill and Jaravel, Xavier and Spiess, Jann (2021): “Revisiting Event Study Designs: Robust and Efficient Estimation”, *Working Paper*.
- Callaway, Brantly and Sant’Anna, Pedro H.C. (2020): “Difference-in-Differences with multiple time periods”, *Journal of Econometrics* [group-time ATEs]
- Davis, Lucas W. (2004): “The Effect of Health Risk on Housing Values: Evidence from a Cancer Cluster”, *American Economic Review*, 94(5), 1693-1704.
- Duflo, Esther (2001): “Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment”, *American Economic Review*, 91(4), 795-813.
- Freyaldenhoven, Simon and Hansen, Christian and Shapiro, Jesse M. (2019): “Pre-event Trends in the Panel Event-Study Design”, *American Economic Review*, 109(9), 3307-38.
- Jackson, C. Kirabo and Johnson, Rucker C. and Persico, Claudia (2016): “The Effects of School Spending on Educational and Economic Outcomes: Evidence from School Finance Reforms”, *Quarterly Journal of Economics*, 131(1), 157-218.
- Jensen, R. (2007): “The Digital Divide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector”, *Quarterly Journal of Economics*, 122(3), 879-924.
- Lester, R. A. (1937): “The Gold-parity Depression in Norway and Denmark, 1925-28”, *Journal of Political Economy*, 45(4), 433-465.
- Rambachan, Ashesh, and Roth, Jonathan (2022): “A More Credible Approach to Parallel Trends”, *Working Paper*.
- Roth, Jonathan (2022): “Pre-test with Caution: Event-study Estimates After Testing for Parallel Trends”. *American Economic Review: Insights* (Forthcoming)
- Roth, Jonathan and Sant’Anna, Pedro HC (2021): “When Is Parallel Trends Sensitive to Functional Form?”, *Working Paper* [functional form]
- Roth, Jonathan, Sant’Anna, Pedro HC, Bilinski, Alyssa, and Poe, John (2022): “What’s Trending in Difference-in-Differences? A Synthesis of the Recent Econometrics Literature”, *Working Paper*.
- de Chaisemartin, Clément and D’Haultfœuille, Xavier (2022): “Two-Way Fixed Effects and Differences-in-Differences with Heterogeneous Treatment Effects: A Survey”, *Working Paper*.

L10 (6th of May, 9-12): Matched DID and Synthetic Control Methods

- **Topics:** matched DID, synthetic control methods; horizontal and vertical regressions, matrix completion methods
- **Readings:**
 - Abadie, Alberto (2005): “Semiparametric Difference-in-Differences Estimators”, *The Review of Economic Studies*, 72(1), 1-19.
 - Abadie, Alberto and Gardeazabal, Javier (2003): “The Economic Costs of Conflict: A Case Study of the Basque Country”, *American Economic Review*, 93(1), 113-132 [basic SCM example]

- Abadie, A. and Imbens, G.W. (2006): “Large Sample Properties of Matching Estimators for Average Treatment Effects”, *Econometrica*, 74: 235-267.
- Andersson, Julius J. (2019): “Carbon Taxes and CO2 Emissions: Sweden as a Case Study”, *American Economic Journal: Economic Policy*, 11(4), 1-30.
- Ben-Michael, Eli and Feller, Avi and Rothstein, Jesse (2022): “Synthetic controls with staggered adoption”, *Journal of the Royal Statistical Society: Series B*, 84(2).
- Doudchenko, Nikolay and Imbens, Guido W (2016): “Balancing, Regression, Difference-In-Differences and Synthetic Control Methods: A Synthesis”, *NBER Working Paper 22791* [hybrid methods]
- Goldschmidt, Deborah and Schmieder, Johannes F. (2017): “The Rise of Domestic Outsourcing and the Evolution of the German Wage Structure”, *The Quarterly Journal of Economics*, 132(3), 1165-1217.
- Levy, Roee and Mattsson, Martin (2020): “The Effects of Social Movements: Evidence from #MeToo”, *Working Paper*.
- Roth, Jonathan, Sant’Anna, Pedro HC, Bilinski, Alyssa, and Poe, John (2022): “What’s Trending in Difference-in-Differences? A Synthesis of the Recent Econometrics Literature”, *Working Paper*.
- Chernozhukov, Victor, Wuthrich, Kaspar, and Zhu Yinchu (2023): “A t-test for synthetic controls”, *Working Paper*.

TA Session 4 (8th of May, 15-17)

L11 (8th of May, 9-12): Regression Discontinuity Design

- **Topics:** assumptions for LATE identification, visualization, global and local estimation, sharp and fuzzy designs, spatial RD
- **Readings:**
 - *Lee, David S. and Lemieux, Thomas (2010): “Regression Discontinuity Designs in Economics”, *Journal of Economic Literature*, 48(2), 281-355
 - Barreca, Alan I. and Guldi, Melanie and Lindo, Jason M. and Waddell, Glen R. (2011): “Saving Babies? Revisiting the effect of very low birth weight classification”, *The Quarterly Journal of Economics*, 126(4), 2117-2123.
 - Calonico, Sebastian and Cattaneo, Matias D. and Titiunik, Rocio (2014): “Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs”, *Econometrica*, 82(6), 2295--2326.
 - Card, David and Lee, David S. and Pei, Zhuan and Weber, Andrea (2015): “Inference on Causal Effects in a Generalized Regression Kink Design”, *Econometrica*, 83(6), 2453-2483.
 - Cattaneo, Matias D., Nicolas Idrobo and Rocio Titiunik (2020): “A Practical Introduction to Regression Discontinuity Designs: Foundations”, *Cambridge Elements: Quantitative and Computational Methods for Social Science*, Cambridge University Press, February 2020, [final draft](#)
 - Cattaneo, Matias D., Nicolas Idrobo and Rocio Titiunik (forthcoming): “A Practical Introduction to Regression Discontinuity Designs: Extensions”, *Cambridge Elements: Quantitative and Computational Methods for Social Science*, Cambridge University Press, [preliminary draft](#)

- Cheng, Ming-Yen (1997): "Boundary Aware Estimators of Integrated Density Derivative Products", *Journal of the Royal Statistical Society: Series B*, 59(1), 191-203.
- Dong, Yingying (2015): "Regression Discontinuity Applications with Rounding Errors in the Running Variable", *Journal of Applied Econometrics*, 30(3), 422-446.
- Fan, Jianqing and Gijbels, Irene (1992): "Variable Bandwidth and Local Linear Regression Smoothers", *The Annals of Statistics*, 20(4), 2008-2036.
- Fredriksson, Peter and Öckert, Björn and Oosterbeek, Hessel (2012): "Long-Term Effects of Class Size", *The Quarterly Journal of Economics*, 128(1), 249-285.
- Gelman, Andrew and Imbens, Guido (2019): "Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs", *Journal of Business & Economic Statistics*, 37(3), 447-456.
- He, Guojun and Wang, Shaoda and Zhang, Bing (2020): "Watering Down Environmental Regulation in China", *The Quarterly Journal of Economics*, 135(4), 2135-2185.
- Kolesár, Michal and Rothe, Christoph (2018): "Inference in Regression Discontinuity Designs with a Discrete Running Variable", *American Economic Review*, 108(8), 2277-2304.
- Londoño-Vélez, Juliana and Rodríguez, Catherine and Sánchez, Fabio (2020): "Upstream and Downstream Impacts of College Merit-Based Financial Aid for Low-Income Students: Ser Pilo Paga in Colombia", *American Economic Journal: Economic Policy*, 12(2), 193-227.
- McCrary, Justin (2008): "Manipulation of the running variable in the regression discontinuity design: A density test", *Journal of Econometrics*, 142(2), 698 - 714.
- Pei, Zhuan, Lee, David S., Card, David and Weber, Andrea (2021): "Local Polynomial Order in Regression Discontinuity Designs", *Journal of Business & Economic Statistics*, forthcoming.

L12 (12th of May, 13-16): reserve slot

L13 (15th of May, 9-12): Machine Learning

- *Topics:* supervised and unsupervised learning methods used by economists
- *Readings:*
 - Mullainathan, Sendhil, and Jann Spiess (2017): "Machine learning: an applied econometric approach." *Journal of Economic Perspectives* 31.2, 87-106.

TA Session 5 (16th of May, 13-15)