THE UNIVERSITY OF CHICAGO

THE HARRIS SCHOOL OF PUBLIC POLICY

PPHA 42200:
APPLIED ECONOMETRICS III

Spring 2025: Monday and Wednesday at 10:30 am

Instructor: Professor Koichiro Ito
2071 Harris School
ito@uchicago.edu
Office hours: During class and after class

TA: Keisuke Ito (keisukeito@uchicago.edu)
Goya Razavi Ebrahimi (razavi@uchicago.edu)
TA office hours: TBA

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

- PPHA4200 and PPHA4201 (Applied Econometrics I and II) are the prerequisites for this course. Students should be familiar with PhD-level probability and statistics, matrix algebra, and the classical linear regression model at the level of PPHA4200 and PPHA4201. In the Economics department, the equivalent level of preparation would be the 1st year Ph.D. econometrics coursework.

- In general, I do not recommend taking this course if you have not taken PPHA4200 and PPHA4201 or a Ph.D. level econometrics coursework. This course is a core course for Ph.D. students and MACRM students at Harris School. Therefore, although the course

name is Applied Econometrics, we'll cover a lot of theoretical econometrics with intensive math. Your problem sets and exams will be based on these materials.

- Because this is a core course for PhD students, all students including master's students and undergraduates will be graded in the same way as PhD students

- Harris school's rule specifies the grading distribution for core courses: A (1/8), A- (1/4), B+ (1/4), B (1/4), and B- and below (1/8). Because non-PhD students will be graded in the same way as PhD students, please consider this point carefully before deciding to take this course

- In the past, many non-PhD students who did not have the prerequisite took this course anyway and ended up dropping out or getting low grades. So, please read this syllabus carefully before you take this course

Course design

I will adopt an instruction design called "flipped classroom design." In a traditional classroom setting, teachers give one-way lectures in class, often leaving limited time for answering questions, engaging in discussions, and opportunities for working on advanced materials in class. Then, students are usually asked to review class materials and work on advanced problems at home on their own. Recently, many teachers, including Eric Mazur, a Harvard Physics professor, have started questioning the effectiveness of this conventional-style of teaching. If you are interested, you can search on you tube "flipped classroom design" or "peer instruction." For example, this video is quite inspiring.
https://www.youtube.com/watch?v=Z9orbxoRofI&t=19s.

Nowadays, there are many resources to learn textbook knowledge (textbooks and online sources), and therefore, a key value in in-person classroom is 1) active discussions on your questions to make sure your understanding of materials and 2) problem solving to further enhance your leaning to be able to apply it to your own research & analysis.

The flipped classroom design aims to "flip" this conventional structure. I will upload 1) lecture slides and 2) pre-recorded lectures (40-50 minutes per lecture) in advance and require students to submit their answers to quiz questions that I ask in pre-recorded lectures as well as their questions about lecture materials via Google form:

https://forms.gle/TTtvQQgLi7pKB4Z98

Then, we get together in person in our regularly scheduled class times (twice a week), aiming to do three things: 1) I will answer your questions, 2) I will provide more instructions on

concepts that turn out to be harder for many students, and 3) we will work together on some of the problem set questions (and possibly more advanced questions) in class when we have time. To respect your time, I plan to finish each in-person session in 30-60 minutes. However, I will stay there fore the rest of the class time to do "office hours" right after the in-person sessions for students who have more questions.

Here is the current plan:

Date	Time	Item
Sunday	By 5 pm	Submit pre-class quiz answers via Google form
Monday	10:30 am	In-person class (attendance is required)
Tuesday	By 5 pm	Submit pre-class quiz answers via Google form
Wednesday	10:30 am	In-person class (attendance is required)

Technology

1. Canvas: Some course materials will be uploaded on Canvas.
2. Box: Pre-recorded lectures and lecture notes are uploaded to Box. If you do not have access to the course's box folder, please email TA.
3. Statistical software: You may use any software that you wish, but solutions for problem sets will be handed out in Stata. Demonstrations during lectures will also be conducted in Stata.
4. I will not record in-person lectures unless students need to be absent because of Covid-related symptoms. Please see below about the Covid guideline.

Mandatory attendance and in-class short quiz

We will have an in-class short quiz in every lecture. The submission also serves as an attendance check. You are allowed to be absent from up to two lectures in this course and do not need to contact Tas or me about your absence. We will deduct your point if you are absent from more than two lectures.

Note that submission outside the classroom or submission on behalf of other students are prohibited and will be and treated as a violation of academic integrity, possibly resulting in the fail-grade in this course.

In-class attendance is mandatory, but I will aim to spend only one hour each day, leaving the remaining minutes for non-mandatory office hour session to answer your remining questions.

Assignments and Grading

1) Pre-class quiz submissions (10%): TAs will check the completion of your quiz submissions.

2) In-class short quiz submission (10%): TAs will check the completion.

2) Problem sets (20%)

- Students can work as a group
- **Each student must submit his/her problem set individually**
- Answers must be **typed.** Handwriting will not be accepted for problem sets.
- Please submit two separate PDF documents using the following file names (example for problem set 1):
    1. PS1_firstname_lastname_main.pdf: This PDF includes your answers with properly formatted tables and figures.
    2. PS1_ firstname_lastname_program_log.pdf: This PDF includes program files and log files from your statistical programs.
- Problem sets are due **5 pm on Fridays** as listed in the schedule below

3) Midterm (25%): Closed book. Topics includes materials covered before the midterm exam. One page cheat sheet is allowed. No collaboration is allowed.

4) Final (35%): Closed book. Topics include all course materials. One page cheat sheet is allowed. No collaboration is allowed.

Name tent

Please bring your name tent. I will try to remember everyone's name by the end of the quarter, and the name tent will be helpful for me to do that.

Late problem sets

To be fair to all students, late problem sets will incur a penalty of 50% of the total points per day except for medical or emergent reasons with a doctor's official note, or communication with instructor.

Re-Grading of Assignments

Instructor (not TAs) will handle re-grading. Note that when the instructor re-grades, re-grading will be for your entire problem set so that there is a chance that your total grade gets lower compared to the grading done by TAs.

Academic Integrity

Please do not cheat on exams. We want to trust all of you, but also TAs and I plan to implement exams that prevent the possibility of cheating and allow us to detect cheating. In case we find cheating, we will take actions according to Harris school's guidelines, so please do not cheat!

Generative AI (e.g. ChatGPT)

Although generative AI is a useful tool, the use of generative AI for your problem set, quiz, and exam submissions is prohibited in this course and treated as a violation of academic integrity, possibly resulting in the fail grade in this course.

Temporary accommodations for Covid symptoms

If you cannot attend in-person class because of COVID symptoms and want to have a recorded in-person lecture, please email TA. TA will arrange recording and share a link with you. Unless there is a request due to COVID symptoms, we will not record in-person lectures, although the pre-recorded lecture videos are always available in Box.

Course Schedule (subject to change)

Date	Lecture #	Topic	Deadline
3/24	1	Course Logistics, Randomized Controlled Trials	
3/26	2	Randomized Controlled Trials	
3/31	3	Randomized Controlled Trials	
4/2	4	Regression Discontinuity Design	
4/4 (F)			Problem Set #1 due
4/7	5	Regression Discontinuity Design	
4/9	6	Matching and Propensity Score Matching	
4/14	7	Matching and Propensity Score Matching	
4/16	8	Synthetic Control Method	
4/18 (F)			Problem Set #2 due
4/21	9	Discrete Choice Models with Individual Data	
4/23	10	**Midterm Exam (in-class)**	
4/28	11	Discrete Choice Models with Individual Data	
4/30	12	Numerical Optimization Methods	
5/5	13	Introduction to GMM	
5/7	14	Discrete Choice with Aggregated Data (BLP)	
5/9 (F)			Problem Set #3 due
5/12	15	Discrete Choice with Aggregated Data (BLP)	
5/14	16	Marginal Treatment Effects (MTE)	
5/19	17	Marginal Treatment Effects (MTE)	
5/21	18	Review session for final exam	
5/17 (F)			Problem Set #4 due
5/28		**Final exam (12:00-3:00 pm at Keller 0001)**	

Textbooks and Notes

The main materials for this course will be my lecture slides, two textbooks: 1) the econometrics notes at NBER econometrics courses written by Imbens and Woodridg [WNE] and 2) the econometrics textbook by Cameron and Trivedi [CT], and several academic papers listed below.

In addition, Angrist and Pischke [AP] provide intuitive, practical, and less mathematical explanations for some topics. Woodridge [JW] is at the same level of WNE and CT. For each topic, I reference chapters from these sources.

For discrete choice methods with individual data, the best textbook is Kenneth Train [KT]. We use its relevant chapters later in the course.

- [*WNE*] Imbens, Guido and Jeffrey Wooldridge (2007). *What's New In Econometrics*, NBER Summer Course.

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

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

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

- [*KT*] Train, Kenneth (2002). *Discrete Choice Model with Simulation.* Cambridge University Press. A copy is also available at: eml.berkeley.edu/books/**train**1201.pdf

References to each topic

Econometrics is hard, but I personally found that repeated learning is very helpful. For this reason, please do required readings before you come to class. Ask your questions in class. Then, read the relevant chapters and papers again after class. This process helps you to master the knowledge.

** The main textbook-style materials for each topic (required readings)
* Other references that I use for the topic
# Further readings for the topic, including more theoretical materials

1. Causality

** *WNE* Lecture 1, Section 2.

** *AP* Chapters 1 - 2.

CT Chapter 2.

*Holland, Paul "Statistics and Causal Inference." *Journal of the American Statistical Association*, 1986, 81, 945–960.

*Rubin, Donald "Statistics and Causal Inference: Comment: Which Ifs Have Causal Answers?" *Journal of the American Statistical Association*, 1986, 81, 961–962.

Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction 1st Edition, by Guido W. Imbens, Donald B. Rubin (2015)

2. RCT

** Sections 1,2,4,5,6 in:
E. Duflo, R. Glennerster, and M. Kremer. Chapter 61 using randomization in development economics research: A toolkit. In T. Paul Schultz and John A. Strauss, editor, Handbook of Development Economics, volume Volume 4, pages 3895–3962. Elsevier, 2007.

* Julian Cristia, Ana Santiago, Santiago Cueto, Pablo Ibarraran, and Eugenio Severio "Technology and Child Development: Evidence from the One Laptop per Child Program" (February, 2012) IDB Working Paper Series 304

Koichiro Ito, Takanori Ida, and Makoto Tanaka, "Moral Suasion and Economic Incentives: Experimental Evidence from Energy Demand," NBER Working Paper 20910

Koichiro Ito, Takanori Ida, and Makoto Tanaka, "Information Frictions, Switching Costs, and Selection on Elasticity: A Field Experiment on Electricity Tariff Choice," Working Paper

* Esther Duflo and Emmanuel Saez, "The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence from a Randomized Experiment," QJE (2003)

Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction 1st Edition, by Guido W. Imbens, Donald B. Rubin (2015)

3. Regression Discontinuity Designs

** Imbens, Guido and Thomas Lemieux. "Regression Discontinuity Designs: A Guide to Practice." *Journal of Econometrics*, 2008, 142, 615–635.

** *WNE* Lecture 3.

CT Chapter 25.6.

* *AP* Chapter 6.

** "A credible approach for measuring inframarginal participation in energy efficiency programs" by Judson Boomhower and Lucas W. Davis, Journal of Public Economics 113 (2014) 67-79

Gelman, Andrew and Guido Imbens. "Why High-order Polynomials Should not be Used in Regression Discontinuity Designs." 2014, *NBER Working Paper* No. 20405.

Lee, David and Thomas Lemieux. "Regression Discontinuity Designs in Economics." *Journal of Economic Literature*, 2010, 48, 281–355.

McCrary, Justin. "Manipulation of the Running Variable In the Regression Discontinuity Design: A Density Test." *Journal of Econometrics*, 2008, 142, 698–714.

* Angrist, Joshua and Victor Lavy. "Using Maimonides' Rule To Estimate The Effect Of Class Size On Scholastic Achievement." *Quarterly Journal of Economics*, 1999, 114, 533–575.

4. Advanced Topics in Instrumental Variables

A. The IV Estimator

** *CT* Chapter 4.8.

** *AP* Chapter 4.1 - 4.3.

JW Chapter 5.

*Angrist, Joshua. "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records." *American Economic Review*, 1990, 80, 313–336.

*Angrist, Joshua and Alan Krueger, "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives*, 2001, 15, 69–86.

B. Heterogeneous Treatment Effects

** *CT* Chapter 25.7.** *AP* Chapter 4.4 - 4.5.

** *WNE* Lecture 5.

JW Chapter18.4.

*Angrist, Joshua, Guido Imbens, and Donald Rubin. "Identification of Causal Effects Using Instrumental Variables." *Journal of the American Statistical Association*, 1996, 91, 444–455.

C. 2SLS and Weak Instruments

** *CT* Chapter 4.9.

**AP* Chapter 4.6.

* *WNE* Lecture 13.

*Angrist, Joshua and Alan Krueger. "Does Compulsory School Attendance Affect Schooling and Earnings?" *Quarterly Journal of Economics*, 1991, 106, 979–1014.

Bound, John, David Jaeger, and Regina Baker. "Problems With Instrumental Variables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variable Is Weak." *Journal of the American Statistical Association*, 1995, 90, 443–450.

Small, Dylan and Paul Rosenbaum. "War and Wages: The Strength of Instrumental Variables and Their Sensitivity to Unobserved Biases." *Journal of the American Statistical Association*, 2008, 103, 924–933.

D. Marginal Treatment Effects (MTE)

** Heckman, James J. 2010. "Building Bridges between Structural and Program Evaluation Approaches to Evaluating Policy." Journal of Economic Literature, 48(2): 356–398.

* Brinch, Christian N., Magne Mogstad, and Matthew Wiswall. 2017. "Beyond LATE with a discrete instrument. Heterogeneity in the quantity-quality interaction of children." Journal of Political Economy, 125(4): 985–1039.

Carneiro, Pedro, James J. Heckman, and Edward J. Vytlacil. 2011. "Estimating Marginal Returns to Education." American Economic Review, 101(6): 2754–2781.

Carneiro, Pedro, James J. Heckman, and Edward Vytlacil. 2010. "Evaluating Marginal Policy Changes and the Average Effect of Treatment for Individuals at the Margin." Econo- met- rica, 78(1): 377–394.

Eisenhauer, Philipp, James J. Heckman, and Edward Vytlacil. 2015. "The Generalized Roy Model and the Cost-Benefit Analysis of Social Programs." The journal of political economy, 123(2): 413–443.

Heckman, James J., and Edward J. Vytlacil. 2007. "Using the Marginal Treatment Effect to Organize Alternative Econometric Estimators to Evaluate Social Programs, and to Forecast their Effects in New Environments." Handbook of Econometrics, 6: 4875–5143. DOI: 10.1016/S1573- 4412(07)06071-0.

Heckman, James J., and Edward Vytlacil. 2001. "Policy-Relevant Treatment Effects." The American Economic Review, 91(2): 107–111.

Heckman, James J., and Edward Vytlacil. 2005. "Structural equations, treatment effects, and econometric policy evaluation." Econometrica, 73(3): 669–738.

5. Selection on Observables, Lalonde's Critique, Matching, Propensity Score Matching

** Robert J. LaLonde. "Evaluating the Econometric Evaluations of Training Programs with Experimental Data," *American Economic Review* 76(4): 604-620.

** *CT* Chapter 25.

** *AP* Chapter 3.

** *WNE* Lecture 1.

* Rosenbaum, Paul and Donald Rubin. "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score." *Journal of the American Statistical Association*, 1984, 79, 516–524.

* Dehejia, Rajeev and Sadek Wahba. "Causal Effects in Non-Experimental Studies: Reevaluating the Evaluation of Training Programs." *Journal of the American Statistical Association*, 94, 1999, 1053–1062.

* Smith, Jeffrey and Petra Todd. "Does Matching Overcome LaLonde's Critique of Non-experimental Methods?" *Journal of Econometrics*, 2005, 125, 305–353.

Arceneaux, Kevin, Alan Gerber, and Donald Green. "Comparing Experimental and Matching Methods Using a Large-Scale Voter Mobilization Experiment." *Political Analysis*, 2006, 14, 37–62.

Shadish, William, M. H. Clark, and Peter Steiner. "Can Nonrandomized Experiments Yield Accurate Answers? A Randomized Experiment Comparing Random and Nonrandom Assignments." *Journal of the American Statistical Association*, 2008, 103, 1334–1356.

Millimet, Daniel and Rusty Tchernis. "On the Specification of Propensity Scores, With Applications to the Analysis of Trade Policies." *Journal of Business and Economic Statistics*, 2009, 27, 397–415.

5. DID, Fixed Effects, Synthetic Controls

** *WNE* Lecture 10.

** *CT* Chapter 25.

** *AP* Chapter 5.

Card, David. "The Impact of the Mariel Boatlift on the Miami Labor Market." *Industrial and Labor Relations Review*, 1990, 43, 245–257.

Card, David and Alan Krueger. "Minimum Wages and Employment: A Case Study of the Fast-food Industry in New Jersey and Pennsylvania." *American Economic Review*, 1994, 84, 487–496.

*Abadie, Alberto, Alexis Diamond and Jens Hainmueller. "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program." *Journal of the American Statistical Association*, 2010, 105, 493–505.

Currie, Janet and Duncan Thomas. "Does Head Start Make a Difference?" *American Economic Review*, 1995, 85, 341–364.

Ashenfelter, Orley, and Michael Greenstone. "Using Mandated Speed Limits to Measure the Value of a Statistical Life." *Journal of Political Economy*, 2004, 112(1), S226–67.

Deschênes, Olivier and Michael Greenstone. "The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather." *American Economic Review*, 2007, 97, 354–385.

Kellogg, Ryan and Hendrik Wolff. "Daylight Time and Energy: Evidence from an Australian Experiment." *Journal of Environmental Economics and Management*, 2008, 56, 207–220.

6. Clustering and Bootstrapping Standard Errors

** *CT* Chapter 24.5.

** *AP* Chapter 8.2.

** Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, 2004, 119, 249–275.

Cameron, Colin, Jonah Gelbach, and Doug Miller. "Robust Inference with Multi-way Clustering." *Journal of Business and Economic Statistics*, 2011, 29, 238–249.

** *CT* Chapter 11.

Efron, Bradely and Robert Tibshirani. "Bootstrap Methods for Standard Errors, Confidence Intervals, and Other Measures of Statistical Accuracy." *Statistical Science*, 1986, 1, 54–75.

Cameron, Colin, Jonah Gelbach, and Doug Miller. "Bootstrap-Based Improvements for Inference With Clustered Errors." *Review of Economics and Statistics*, 2008, 90, 414–427.

7. Maximum likelihood Estimation

A. Introduction to Maximum likelihood Estimation

** *CT* Chapters 5.1 - 5.3, 5.6, 5.7

JW Chapter 13.

B. Limited Dependent Variables Models

** *CT* Chapters 14.1 - 14.5., 16

JW Chapter 15, 16.

Angrist, Joshua. "Estimation of Limited Dependent Variable Models With Dummy Endogenous Regressors: Simple Strategies for Empirical Practice." *Journal of Business and Economic Statistics,* 2001, 19, 2–16.

C. Multinomial Discrete Choice (Discrete Choice with Individual Data)

** *CT* Chapter 15.

** *WNE* Lecture 11.

JW Chapter 15.9.

** *KT* Chapters 1, 2, 3, 5

8. Generalized Method of Moments

** *CT* Chapter 6.

** *WNE* Lecture 15.

** Nevo, Aviv. "A Practitioner's Guide to Estimation of Random-Coefficients Logit Models of Demand," Journal of Economics & Management Strategy (2000), 9, 4, 513-548.

* Koichiro Ito and Shuang Zhang. “Willingness to Pay for Clean Air: Evidence from Air Purifier Markets in China,” NBER Working Paper, 22367, June 2016.

9. Numerical Optimization Methods

** *CT* Chapter 10

** *KT* Chapter 8