

ECON 590 (M1)
Applied Econometrics: Advanced Topics in Program Evaluation and Policy Analysis
MSPE, Department of Economics
Fall 2021

Instructor:

Alex Bartik (abartik@illinois.edu)
DKH 101-E
Office Phone: (217)-300-6027

Class meetings: Tuesday/Thursday, 11:00 am-12:20am CT in DKH 125.

Office Hours:

- Individual office hours: 4:00-5:30pm CT Mon, 2:00-3:30pm CT Tues Schedule time [here](#). Can also schedule alternative appointment if necessary. Office hours are an opportunity to discuss questions you have about the class, problems with the assignments, or broader topics related to the course material and economics/econometrics more broadly. Office hours are available in DKH 101-E or on zoom. Students attending Office Hours in person must wear a mask, per University guidelines. [Zoom link](#) is here.
- Group office hours: 2:30-3:30pm CT Wed. No appointment necessary. Group office hours will be held on zoom. [Zoom link](#) is here.

Electronic Communication:

- All email correspondence related to the class should have [590: APPLIED METRICS] in the subject line. I respond to email rapidly, but I cannot promise to respond to an email faster than 48 hours (excluding weekends). If you need an answer by a certain time, please email at least 48 hours in advance.
- I've created a slack workplace for the class (you'll each get an email invitation). I will answer questions on this channel a couple times per week.

Course Description: This course will cover modern econometric techniques for estimating causal effects including experiments, regression and matching, instrumental variables, difference-in-differences, synthetic control, and regression-discontinuity designs. We will discuss the properties of each of these techniques and illustrate them using examples from health policy, education policy, workforce development programs, environmental and labor market regulations, and economic development programs. Students will gain experience applying the techniques to study policies in real-data sets using the statistical programming language R. Emphasis will be placed on following good coding and data practices.

Course Goals: At the end of this course, students should be able to:

- 1) Be informed consumers of research & news regarding causal effects of public /private policies.
- 2) Describe advantages and limitations of different techniques for estimating causal effects.
- 3) Implement a variety of strategies for estimating causal effects using R programming language.

Prerequisites: Econ 502 and 503 are strongly recommended for individuals taking this course. Please schedule a meeting with me if you have not completed these courses. The course assumes that students have knowledge of calculus, linear algebra, and basic statistics and econometrics. In particular, students should be familiar with basic multivariate calculus (first and second derivatives and how to obtain them), matrix operations, basic properties of random variables, calculating expectations, variances, correlations, conditional expectations and variances, and multiple linear regression.

Credits: 4 credits

Course structure: The course will be a “flipped” course. I will post videos of lecture segments (usually one or two per class meeting) for the week the Sunday night before the course meets. This email will also include other information on the class schedule for the week. During our class meeting, we will then discuss the lecture and readings, have activities, go through coding examples, and provide feedback to one-another. Students are expected to attend all classes whenever possible and participate in all discussions. I will cold call throughout the semester.

Learning Resources:

The four required textbooks for this course are:

- *Mastering 'Metrics: The Path from Cause to Effect* by Josh Angrist and Jorn-Steffen Pischke (2014)
- *Foundations of Agnostic Statistics* by Peter Aronow and Benjamin Miller (2019)
- *Counterfactuals and Causal Inference, 2nd Edition* by Morgan and Winship (2015)
- *Introduction to Statistical Learning, Corrected 7th Edition* by James, Witten, Hastie, and Tibshirani (2017). Available for free [here](#).

Additional materials, as well as assignments and practice materials will be available on Illinois Canvas (<https://canvas.illinois.edu/>). Announcements about assignments, readings, and other course items will be posted on Canvas.

I’ve created a course Slack channel (Econ590M1) that all students will be invited to. Students are welcome to ask questions, discuss assignments, and post material they read or ideas related to the class. Note that direct messages between students are not allowed and that I can observe the conversations in all groups on the Slack channel.

This course will use R, which is a free statistical computing language. R can be downloaded at <http://www.r-project.org> . Additional background materials on R will be provided throughout the course. Students are strongly encouraged to take the introduction to R class offered by the economics department the first two weeks of the semester.

Requirements:

- **Assignments:** There will be 8 assignments that together will count for 15% of the grade. I will drop your two lowest assignment scores when computing this grade. The assignments will be due on:
 - Assignment 1: September 2nd
 - Assignment 2: September 14th
 - Assignment 3: September 28th
 - Assignment 4: October 12th
 - Assignment 5: October 28th
 - Assignment 6: November 9th
 - Assignment 7: November 18th
 - Assignment 8: December 7th
- **Midterms:** There will be 1 midterm that will count for 15% of the grade
 - Midterm, October 14th
- **Research Project:** Students will complete a research project worth a total of 40% of the grade
 - Topic brainstorming presentations: September 21st and 23rd (2.5% of grade)
 - First draft of proposal: October 21st (2.5% of grade)
 - Second draft of proposal: November 2nd (2.5% of grade)

- Peer feedback on proposal: November 4th (2.5% of grade)
- Final Proposal: November 11th (10% of the grade)
- Final Analysis and Report: December 10th (20% of the grade)
- **Final Exam:** There will be a 3-hour exam during finals week which will cover the entire course material and be worth 30% of the grade. The final exam is currently scheduled for Friday, December 15 from 8:00am-11:00am CT and will be held at a local TBA.

Assignments: Will be mixture of problem sets and other assignments.

Research Project: Students will propose their own program evaluation or other piece of policy analysis. There will be a series of deadlines to help students put together these projects, involving both peer and instructor feedback. More details to come.

Grading: Overall Grades will be on a +/- scale and may follow a light curve.

Assessment Policies:

Assignment Policies:

Student grades on their lowest three assignments will be dropped. All assignments are to be turned in at the beginning of the class in which they are due. Late assignments receive *no* credit without an instructor approved excuse. Acceptable excuses include physical and mental illness, and personal or family emergencies. A written request for an extension must be submitted at least 48 hours in advance.

Assignments should be uploaded to Canvas. You are encouraged to work as a group with your classmates on assignments (but NOT research projects), although you have to hand in your own solutions.

Note that we cannot grade assignments that we cannot read. Consequently, please be careful to make all assignments legible.

Exam Policy:

In the event that a student misses one of the exams, the instructor reserves the right to give the student a zero on that exam. There are no make-up exams without an instructor approved excuse. Instructor approved excuses include 1) medical reasons, in which case you should bring a letter from a medical professional describing your reason for missing the exam, 2) death or serious illness of an immediate family member or close friend (documentation required), or 3) conflict with a religious holiday. Requests for exam make-ups should be made as far in advance as possible.

We will follow the University guidelines on student conflicts with final exams. For this year's student code, see http://admin.illinois.edu/policy/code/article3_part2_3-201.html.

Regrades:

All regrade requests must be submitted in writing no more than one week after the assignment or exam is returned. The request must be written and include a detailed summary of why the student believes the grade they received was incorrect. I generally regrade the entire exam or assignment, so the grade may go up or down. Consequently, students should only request a regrade if they are very confident that the original grade they received was incorrect.

Statement on Academic Integrity

We will follow Articles 1-401 through 1-406 of the *Student Code* (beginning at http://studentcode.illinois.edu/article1_part4_1-401.html). This rule defines infractions of academic integrity, which include, but are not limited to, cheating, fabrication, and plagiarism. You are responsible

for following these guidelines (ignorance is no excuse). If you have any questions about whether something would be an infraction, consult with the instructor before proceeding.

Requests for Special Accommodations:

To obtain disability-related adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call (217)-333-4603, email disability@illinois.edu or go to the DRES website.

Please also schedule a private meeting with the course instructor to discuss your needs and requirements. The instructor will attempt to meet all reasonable course accommodations once the student self-identifies. Please note that accommodations are not retroactive to the beginning of the semester, but begin the day you contact the instructor with a current letter of accommodation from DRES.

Emergency Response Recommendations:

The university maintains guidelines for emergency responses. A list of recommendations when to evacuate and when to find shelter are available at:

http://illinois.edu/cms/2251/general_emergency_response_recommendations_8_16_13_final.docx

Floor plans for specific buildings are available at: <http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/>

Course Schedule (tentative)

1	Aug 24	Course overview, logistics, and introduction to causality
	Aug 26	Introduction to causality: Potential Outcomes
2	Aug 31	Introduction to causality: Directed Acyclic graphs (DAGs)
	Sept 2	Randomization Day #1
3	Sept 7	Randomization Day #2
	Sept 9	Statistical programming in R Day #1
4	Sept 14	Statistical programming in R Day #2
	Sept 16	Statistical inference in experiments day #1
5	Sept 21	Statistical inference in experiments day #2
	Sept 23	Power Day #1
6	Sept 28	Power Day #2
	Sep 30	Block randomization
7	Oct 5	Noncompliance and Instrument Variables Day #1
	Oct 7	Noncompliance and Instrument Variables Day #2
8	Oct 12	When experiments go wrong: i) bad control, ii) SUTVA violations
	Oct 14	Introduction to observational studies: basics of matching
9	Oct 19	Conditional Independence Assumption/Back-Door Criterion

	Oct 21	Midterm
10	Oct 26	OLS and causal inference
	Oct 28	Regression discontinuity
11	Nov 2	Differences-in-differences
	Nov 4	Difference-in-differences continued
12	Nov 9	Synthetic control and inference complications in synth/did
	Nov 11	Instrumental variables in observational settings
13	Nov 16	When is a causal estimate not enough?
	Nov 18	Introduction to prediction day 1: bias/variance tradeoff
14	Nov 23	Thanksgiving Break
	Nov 25	Thanksgiving Break
15	Nov 30	Introduction to prediction day 2: regularization
	Dec 3	Introduction to prediction day 3: tree based methods
16	Dec 7	Limits of quantitative analysis

Course Readings (tentative – will be updated frequently)

Week 1: Basics of causal questions

- *Mastering 'Metrics (MM): Introduction (xi-xv) and Chapter 1 (pages 1-17)*
- *Mostly Harmless Econometrics: Chapter 1, Chapter 2 pages 12-15 (posted on canvas)*
- *"What is causality?" article by Jim Manzi (posted on Canvas)*

Weeks 2: Potential Outcomes and DAG Frameworks for Causal Inference

- *Morgan and Winship: Chapter 2 (pages 37-74 – posted on canvas)*
- *Morgan and Winship: Chapter 3 (pages 77-84 – posted on canvas)*

Week 3: Randomization

- *Mastering 'Metrics: Pages 17-46*
- *Fundamentals of Agnostic Statistics: Pages 89-116*

Week 4: Programming

- *Grant McDermott's data science lectures 3, 4, and 5. They're at <https://github.com/uo-ec607/lectures>*

Week 5: Statistical inference in Randomized Experiments

- *Fundamentals of Agnostic Statistics: Pages 124-135*
- Imbens reading on p-values and confidence intervals in econometrics (uploaded on Canvas)

Week 6: Statistical Power

- *Running Randomized Experiments, Chapter 6 (posted on canvas)*
- *Green and Gerber, Chapter 3 (posted on canvas)*

Week 7: Non-compliance and instrumental variables

- *Mastering Metrics, pages 98-139*

Week 8: Bad control / conditioning on colliders

- *Mastering Metrics, Chapter 6, pages 209-217*
- *Elwert and Winship (2014) Article: Endogenous Selection Bias: The Problem of Conditioning on a Collider Variable (uploaded)*

Week 9: Selection on observables and the back-door criterion

- *Mastering Metrics: pages 47-97*
- *Morgan and Winship: Chapters 4 and 5, pages 105-187 (posted on canvas)*

Week 10: Regression in OLS and regression discontinuity (two separate topics)

- *Mastering Metrics: Pages 147-177*
- *Additional reading to-be-announced.*

Week 11: Differences-in-differences

- *Mastering Metrics: Pages 178-209*

Week 12: Observational IV

- *Mastering Metrics: Pages 115-146*

Weeks 13-14: Prediction basics: cross-validation

- *Introduction to Statistical Learning: Chapter 2, Pages 15-42 (uploaded)*
- *Introduction to Statistical Learning: Chapter 5, Pages 175-197 (uploaded)*

Week 15: Prediction methods: regularization and tree-based methods

- *Introduction to Statistical Learning: Chapter 6, Pages 203-259* (uploaded)
- *Introduction to Statistical Learning: Chapter 8, Pages 303-332* (uploaded)

Week 16: Limits to quantitative analysis

- *To be announced*