



## DEPARTMENT OF ECONOMICS

# CAUSAL MODELING IN ECONOMICS AND PUBLIC POLICY

**SPRING 2023**

Prof. Michael Moore  
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Classes: Tu/Th 3:30-4:45. WNR 104

Office: Monroe 247

Office Hours: By appointment. Zoom appointments OK.

### **Required textbook:**

(APMM): Angrist, Joshua D., and Jorn-Steffen Pischke (2015).  
*Mastering 'Metrics: The Path from Cause to Effect*. Princeton University Press.

Available from UVA Bookstore (hard copy) & Amazon (hard copy & digital). Might be some used copies out there too.

### **Recommended books and monographs:**

For students interested in a deeper dive into this rapidly growing literature, here is a selection of books and other readings. All of these are available on Amazon.

[MHE]: Angrist, Joshua D., and Jorn-Steffen Pischke (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

[MIP]: Manski, Charles F. (1995). *Identification Problems in the Social Sciences*. Harvard University Press.

[MXX]: Manski, Charles F. *Identification for Prediction and Decision*.

[IR]: Imbens, Guido, and Donald B. Rubin (2015). *Causal Inference for Statistics, Social, and Biomedical Sciences*. Cambridge University Press.

[ROS]: Rosenbaum, P. (1995, 2002). *Observational Studies*. Springer-Verlag.

[RMS]: Rubin, Donald (2006). *Matched Sampling for Causal Effects*. Cambridge University Press.

\_\_\_\_\_ and Winship (20XX). *Counterfactuals and Causal Inference*.

Pearl, Judea. *The Book of Why*.

Pearl, Judea (2009). *Causality: Models, Reasoning, and Inference*. Cambridge University Press.

Campbell and Stanley

Cameron and Trivedi (20XX). *Microeconometrics*

Cameron and Trivedi (20XX). *Microeconometrics using Stata*

## **Course overview and objectives**

This course is designed for undergraduate economics majors with an interest in understanding the nature of causal relationships, i.e., the nature of cause and effect. Typically, these relationships are captured by estimates derived from micro-econometric models. At least we hope they are...

Emphasis in this course will be on the analysis of **non-experimental data**, which is the stuff of most empirical economic research. We will look at experimental data from certain well-known sources, such as the RAND Health Insurance Experiment and Project STAR to establish benchmarks for the non-experimental analysis.

Any student with an interest in applied microeconomics and micro-econometrics would benefit from this course, including those interested in careers in finance, marketing, consulting and economic litigation

The course is taught at the intermediate level. Students should be comfortable with basic calculus, statistics, and econometrics. We will review these materials briefly at the outset, covering topics such as estimation and hypothesis testing, largely in the context of the Classical Normal Linear Regression Model (CNRLM). Please review your notes on these topics as soon as feasible. Familiarity with more advanced topics, such as non-linear estimation, instrumental variables and two-stage least squares, and maximum likelihood estimation are a plus, but are not required.

The discussion centers on empirical analyses of non-experimental interventions. Students will be expected to submit regular write-ups of problem sets. Every student (as part of a team) must make an in-class presentation of results from one of the problem sets. **Preparation and in-class participation are essential parts of the course.**

There will also be a term paper requirement. The proposal will count as the midterm for the course. The final paper will be due at the end of the Exam Period. Each student must prepare and submit their own paper.

The fundamental question of causal modeling easily asked: “Does variation in *X* cause variation in *Y*.” Answering this question is not so straightforward. As we will see, measures of association such as covariances and correlations, while a necessary part of most (if not all) causal analyses, are usually not sufficient for making a causal interpretation. The important exception is estimated average

differences in the outcomes of randomized experiments, i.e. situations where subjects are randomly assigned to either a treatment or a control group. This is an important case, to be sure, but it is exceptional. Most economic analyses use real-world data. As such, we can not assume independence of assignment effects (selection biases) and treatment effects.

Learning how far we can go in making causal inferences from non-experimental data is the primary aim of this course. Life is not a clinical trial, and interpretations of measured covariances between interventions and outcomes are fraught with peril. I like to contrast statistics and econometrics by saying that econometrics is the art (science?) of making real-world data behave like it comes from a clinical trial. Another way to say this is to ask, of any empirical study, “would you give your kids a drug that was found “effective” using this technique?”

## **Course content**

The course covers several major XXXX. These XXX constitute the intellectual tools and conceptual frameworks useful for answering the question “Does X cause Y?”

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## **Prerequisites**

The course prerequisites are intermediate micro, basic statistics, and econometrics. An understanding of basic price theory and a willingness to think hard, like an economist – intermediate supply-demand analysis rigorously applied - are essential. Likewise, knowledge of elements of statistics and econometrics is assumed. There are not a lot of proofs and derivations in this course. Rather, the emphasis of the course is to *use* basic price theory to structure economic policy models, to estimate key parameters of these models using real-world data, and to evaluate the extent to which we can attribute a known treatment to an observed effect. Policy analyses on topics such as health insurance and health, gun control, abortion policy, substance abuse, education, tort reform, and discrimination. Because of my own background, there will be a heavy dose of antitrust policy, economics and econometrics thrown in at various junctures.

## **Teaching Approach**

Because the aim of the course is to build your own ability to formulate and analyze economic policy problems, you will spend much of your time working on empirical problems as a prerequisite to preparing for and engaging in class discussion. Your most important task in this course is to develop your own research hypothesis and test it. This is so different from the norm - learning what other people have discovered - that it might seem daunting to you. But anyone interested in knowing how to address heretofore unseen questions, and how to create new knowledge, must cross this intellectual divide.

## **Preparation**

## **READINGS**

The **required** textbook is Angrist, Joshua D., and Jorn-Steffen Pischke (2015). *Mastering 'Metrics: The Path from Cause to Effect*. Princeton University Press. Additional resources are noted above. Relevant research articles will be posted to Canvas, and are noted below as relevant to the course schedule.

Background readings - See **Schedule of Course Readings** below.

## **Additional Materials**

The following materials will be posted on the course's Canvas website.

- **Course announcements:** Course announcements will be emailed to you via Canvas. I generally put critical course-related information in an email announcement rather than announcing it in class, so please do pay attention to such emails.
- **Assignments:** The website will contain problem sets and assignments for each class day, as well as preparation guidance. These will be in the "Assignments" section of the Canvas site. You will also submit your assignments through this section of the website.

- **Slides and handouts from class:** Class slides will be posted to the Canvas site for each scheduled class day. Anything additional that I hand out in class will also be posted. If you miss something or lose something, you can find it there.
- **Extras and Updates:** I will sometimes post additional items related to our class discussion. These items, labeled “Extras and updates” are **optional** reading. They give further information about policy issues we have discussed in class or provide additional examples where the tools or frameworks discussed in class would have useful application.

## **Assignments and Assessments**

### **Individual problem sets (30%)**

During the semester, you are required to write a response to preparation questions for N assigned problem sets. These N problem sets will be graded on a credit/no-credit basis, 30/N points each, up to a maximum of 30 points. I will provide guidelines for self-assessment after the responses have been turned in. I will not provide detailed comments on individual write-ups.

Together these written assignments will account for 30% of your final grade. The preparation questions for each assignment will be posted in the “Assignments” section of the Canvas site. You may discuss these assignments with members of a study group (no more than 5 students/group), or with others in the course, but the final write-up must be your own. See the “Academic Integrity” section of the syllabus for more detailed guidance. You will submit your assignments online through Canvas.

**Note on formatting:** The formatting of the assignments should be 1-inch margins, 10- or 12-point font, and 1.5 line-spacing. Assignment write-ups should be uploaded via the “Assignments” section of Canvas.

### **Midterm Proposal (15%)**

**Final Paper (40%) –DUE AT END OF EXAM PERIOD.**

## **Class Participation (15%)**

The class participation grade provides you with an *added* incentive to prepare for class—the value of your own learning should be the primary incentive.

Your participation will be graded on quality, not quantity. You should try to provide insights, observations, inferences, or conclusions that not only express your viewpoint, but *also* be able to defend your analysis. Your comment should be relevant to the topic at hand and should advance the discussion. A simple opinion or viewpoint is not very valuable without any justification. I value comments that respond to, elaborate on, lend support to, contradict, or correct a comment by one of your classmates. Counter-productive comments include opinions without a justifying argument, pure repetition of previous point, and rambling, vacuous or disparaging comments.

Discussion constitutes a large portion of our class time; you will have ample opportunity to participate. I will cold call in class, both to give you an incentive to prepare for class, and to make sure the discussion is not dominated by a handful of students. At a minimum, everyone in class should be prepared to answer all of the preparation questions provided in advance.

## **Missing Classes**

Learning to articulate your arguments and to evaluate and respond to the arguments of others is an important part of what you will learn in this class. If you miss class time, you will miss this, and there isn't a way to "make it up." In addition, your participation is a key component of the learning for all students, and therefore missing class creates a negative externality. Similarly, entering the class late is disruptive and creates a negative externality for your classmates and for me. As a result, you should make every effort not to miss or be late to your class. ***If you are enrolled in the course and miss the first two classes, you will be dropped from the course.*** If you miss class or are late to class more than twice, it will begin to lower your class participation grade. If you must miss class, you should do the readings, prepare and turn in the assignments on time (late assignments will be accepted, but there will be points deducted if they are late), and arrange to get notes from a classmate about what you missed in class. Recall that I will post the presentation slides (and anything else that I hand out in class) to the Canvas website. **You do not need to inform me that you will be missing class - I take attendance and record class participation for every class.** Excessive absences will adversely affect your final grade.

## **Grading**

The problem sets have a core set of analyses that, if properly executed, indicate **control** of the topic. I assign grades so that evidence of control is roughly equal to average, or slightly above average, performance. Typically, evidence of control would yield a grade of about 75-85%.

Beyond these core issues are more complex and/or subtle analyses and findings that indicate deeper understanding and **mastery** of the course concepts.

It is important that you understand the implications of my grading scale. Course grades are assigned using the weights above. The following guidelines for this course will be applied: no more than 30-40% A/A-, about 10% C+ or lower, and 50-60% or so B+/B/B—.

Scores on graded submissions are weighted and added up. The recorded scores are then fit to the distribution. I will post relevant summary statistics for the various deliverables after they are graded.

As noted above, deliverables are structured so that any student with decent command of the material should be able to “get” the core ideas. There will also be, by design, some “deeper” insights that go beyond these core ideas, and that require mastery of the material. Typically, these deeper insights will constitute 10-20% of the grade for an assignment.

Two things to understand are 1) that the grading system necessarily entails that some very good, often excellent work, might not guarantee an A/A-, if a large number of the submissions are uniformly very good or excellent. The good news is that really bad work might not guarantee a C either (I guess that’s good news—although true in theory, it certainly has never happened!), and 2) that relatively small differences in overall performance can fall on one side or the other of a letter-grade threshold.

You are welcome to inquire any time as to where you stand in the class.

## **How to study for this course**

[TO BE ADDED]



4. **Review the preparation questions.** Go back and review the preparation questions after class. What is your answer to the question after hearing the discussion? Pay particular attention to how the frameworks from the course help you to answer the question.

5. **Practice.** The only way to get good at thinking in a new way is to practice it. When you come across a causal statement somewhere (in the news, talking with someone, in another course, out shopping), use the tools and frameworks of the course to understand it. If you see something relevant elsewhere, by all means bring it up I class!

6. **Consider studying with a group.** Some people find it helpful to study and discuss things with a group, some don't. You are looking for a group that discusses carefully and thoroughly but doesn't descend into a protracted argument about who's right. If you form a group and a member decides to "free ride," you are entirely within your rights to kick that person out of the group. Once you've discussed as much as you productively can, drop it and pick up the discussion in class rather than beating it to death.

### **Problem Sets and class preparation: Some guidelines**

**[TO BE ADDED]**

Second, note that you can often push the analysis much deeper.

Third, and finally, clear, concise explanations are essential. Thinking and writing are highly complementary skills. If your writing is not clear, then neither is your thinking. Ask yourselves what is important or essential. What is a detail that can be ignored? Avoid **laundry lists** and/or "**kitchen sink**" **explanations**. It's often helpful to have someone else read what you've written. **Read for clarity. If it's not clear to the reader, it's not clear!!**

### **Contact information**

**Contact information:** You can reach me by email at [mjm8w@virginia.edu](mailto:mjm8w@virginia.edu). I will be available for office hours by appointment only. Zoom meetings are fine. If you need to reach me by phone, my office phone is 312-925-3315. Email is a much more reliable way to leave me a message than voicemail or text message.

### **Classroom Etiquette**

Students are expected to adhere to UVA's Honor Code.

Other rules:

- **Electronics must NOT be connected to the internet during class.**(except for assistive technologies with appropriate accommodation notification).<sup>1</sup> **You may not use tablets, laptops, mobile phones, or related devices in class to surf the web, text, email, chat, etc. This is for your benefit. You can use them for note-taking. Violating this policy will meaningfully affect your class participation grade**

**If you are texting, surfing the internet, or otherwise distracting me and/or your classmates, you will be instructed to leave the classroom.**

**No recording of lectures is allowed without my permission. Unapproved recordings violate the intellectual property rights embodied in my copyrights and will be treated as a violation of the Honor Code, since these are effectively stealing.**

- **Punctuality.** Class starts on time. It is distracting to your classmates and me for you to be climbing to your seat and settling in while they are trying to pay attention to the class. **If you are absent or late more than twice, it will lower your class participation grade.**
- **Seating chart.** Your assigned seat for the course will be the seat you choose for the class on **January 26**. I use assigned seats to help me keep track of class discussion and attendance, and also to have a place to direct prospective students and visitors to sit.
- **Beverages and snacks.** Out of courtesy to your classmates, don't bring something messy, noisy, or smelly to eat or drink in class.

Additional guidance on whatever issues arise will be provided during the semester, as needed.

## ACADEMIC INTEGRITY

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<sup>1</sup> Any student requesting accommodations related to a disability or other condition is required to register with the appropriate UVA office and provide me with an accommodation notification from that office, preferably within the first two weeks of class. All information will remain strictly confidential.

Students are expected to adhere to UVA's Honor Code at all times. The consequences of cheating can be failing an assignment for the course, or suspension or dismissal from the university.

## **Assignments**

Written assignments must be the efforts solely of the individual turning them in. For individual assignments, you may use discussion with classmates to brainstorm issues, evaluate alternative approaches, and consider the merits of your recommendations. Use your own judgment to identify the important issues, to construct arguments and to develop correct conclusions. The same rules apply to groups for group assignments. You are not to consult the Internet, friends at other schools, or people who have taken the course already. Sharing our course materials with students outside the class will likewise be treated as a violation of the Honor Code.

## **Plagiarism**

The members of any academic community are expected to NOT present material from other sources as their own work. UVA's academic integrity guidelines state: "A conscientious writer always distinguishes clearly between what has been learned from others and what he or she is personally contributing to the reader's understanding."

If you use text that is **exactly, mostly, or even partially someone else's words**, it needs to be attributed to that source and the quoted portion needs to be in quotation marks. If you use text that is **paraphrased** from another source, it needs to be attributed.

I **strongly** recommend against the practice of cutting and pasting from a source into a "working document" that will eventually become the final document handed in, unless you insert the appropriate quotation marks and citations at the same time.

In the context of this course, it is acceptable to refer to concepts, frameworks, and analytical tools from the readings or class lectures without citation. You may also refer to the factual material in cases without citation.

**Passages downloaded, copied, cut and pasted from any source, including but not limited to internet sites, without attribution will be treated as plagiarized submissions.**

## **Exams**

There are no exams for this course.

## **Schedule of Topics and Readings**

[APMM]: Angrist, Joshua D., and Jorn-Steffen Pischke (2015).  
*Mastering 'Metrics: The Path from Cause to Effect.*

[MHE]: Angrist, Joshua D., and Jorn-Steffen Pischke (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.*

[MIP]: Manski, Charles F. (1995). *Identification Problems in the Social Sciences.*

[MPD]: Manski, Charles F. *Identification for Prediction and Decision.*

[IR]: Imbens, Guido, and Donald B. Rubin (2015). *Causal Inference for Statistics, Social, and Biomedical Sciences.*

[ROS]: Rosenbaum, P. (1995, 2002). *Observational Studies.*

[RMS]: Rubin, Donald (2006). *Matched Sampling for Causal Effects.*

\_\_\_\_\_ and Winship (20XX). *Counterfactuals and Causal Inference.*

[P1] Pearl, Judea. *The Book of Why.*

[P2] Pearl, Judea (2009). *Causality: Models, Reasoning, and Inference.*

[P3] Pearl, Judea, M. Glymour, and N. P. Jewell (2016). *Causal Inference in Statistics.*

[CS] Campbell and Stanley. *Experimental and quasi-experimental designs for research.*

[CT] Cameron and Trivedi (20XX). *Microeconometrics*.

[CTMS] Cameron and Trivedi (2010). *Microeconometrics using Stata*.

[W1] Wooldridge, Jeffrey (2009). *Introductory Econometrics: A Modern Approach*.

[W2] Wooldridge, Jeffery (2020). *Econometric Analysis of Cross-Section and Panel Data*.

## **JAN 19 (Thursday)**

**CLASS 1: Introduction to Causal Modeling. Potential Outcomes and Selection Bias. Omitted Variable Bias: Science and Simplicity in *Deflategate*.**

### **Readings**

**Required:** [APMM] Introduction

**Recommended:** [IR] Chapter 1 Causality: The Basic Framework

## **JAN 24 (Tuesday)**

**CLASS 2: Introduction to Causal Modeling, cont. The Potential Outcomes Approach. The Common Structure of Economic Policy Analyses. Gary Becker's Contributions to Economic Analysis. Regression Analysis.**

**Required:**

**Recommended:**

**JAN 26 (Thursday)**

**CLASS 3: An Overview of Selected Topics in Economic Policy**  
**Analysis: Health Insurance and Health Outcomes; Class Size, Charter Schools, and Education Outcomes; Gun Control; Indoor Air Quality and Passive Smoking; Abortion Funding and Birth Outcomes; Environmental Policy, Economic Discrimination.**

**JAN 31 (Tuesday)**

**CLASS 4: An Introduction to Empirical Law and Economics: Empirical Analysis of Contracts, Tort Rules, and Antitrust. Inferential Reasoning and Causation in the Law. Real Effects of Tort Rules and Their Implications. Statistical Proofs of Cartel Participation. Specification Testing in Cartel Damages Models. The Econometrics of Class Certification.**

**FEB 2 (Thursday)**

**CLASS 5: Elements of Causal Modeling I. Principles of Experimental Design. Estimation and Hypothesis Testing with Random Assignment.**

**FEB 7 (Tuesday)**

**CLASS 6: Elements of Causal Modeling II. Principles of Experimental Design. Estimation and Hypothesis Testing with non-Random Assignment.**

**FEB 9 (Thursday)**

**CLASS 7:**

**FEB 11 (Tuesday)**

**CLASS 8: Elements of Causal Modeling II. Principles of Experimental Design. Estimation and Hypothesis Testing with non-Random Assignment, cont.**

**FEB 13 (Thursday)**

**CLASS 9: Elements of Causal Modeling III. Principles of Experimental Design. Estimation and Hypothesis Testing with non-Random Assignment, cont.**

**FEB 18 (Tuesday)**

**CLASS 10: Health Insurance and Health. The RAND/OREGON Health Insurance Experiments. A Comparison with Evidence from the National Health Interview Surveys.**

**FEB 20 (Thursday)**

**CLASS 11: Control Theory Estimation. Matching, Propensity Scoring, Self-Selection. Selectivity Corrections and Two-Part Estimation. Non-linear Models.**

**FEB 25 (Tuesday)**

**CLASS 12: Further Analyses of the RAND/OREGON and NHIS Data.**

**FEB 27 (Thursday)**

**CLASS 13: Statistical Graphics. Halftime Review.**

**SPRING BREAK, MARCH 4 - 12**

**MAR 14 (Tuesday)**

**CLASS 14**

**MAR 17 (Thursday)**

**CLASS 15: FINAL PAPER PROPOSAL DUE.**

**MAR 21 (Tuesday)**

**CLASS 16:**

**MAR 23 (Thursday)**

**CLASS 17**

**MAR 28 (Tuesday)**

**CLASS 18:**

**MAR 30 (Thursday)**

**CLASS 19:**

**APR 4 (Tuesday)**

**CLASS 20:**

**APR 6 (Thursday)**

**CLASS 21:**

**APR 11 (Tuesday)**

**CLASS 22:**

**APR 13 (Thursday)**

**CLASS 23:**

**APR 18 (Tuesday)**

**CLASS 24:**

**APR 20 (Thursday)**

**CLASS 25:**

**APR 25 (Tuesday)**



**CLASS 26:**

**APR 27 (Thursday)**

**CLASS 27:**

**MAY 2 (Tuesday)**

**CLASS 28: Final Thoughts, Directions for Further Study and Research**

**FINAL PAPER**