

EC 320: Introduction to Econometrics

Lecture Notes

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1 Session Overview

- Date: 9/30/2025
- Topic: Intro & Potential Outcomes
 - Chapters (Dougherty): R
- Goals/Objectives:
 1. Introduce Causal Inference
 2. Explain the potential outcomes model

1.1 Before Class:

Since this is the first class, ensure you have:

- Sent out the syllabus ahead of time.
- Asked them to review their statistics — I won't spend a lot of time on it.

2 During Class:

2.1 Introduce Myself

Via this article, here are the introductions I'll be making:

- My name is David Hall, I am a fourth year PhD student in the econ department.
- I study health economics, specifically illicit drug policy and within that substance use disorder treatment.

- I'm on a grant studying M110, was NIH funded prior: happy to discuss any of this with anyone.
- In general happy to talk about the opioid epidemic, etc. — there are a lot of econometric intricacies surrounding it!
- My wife and I moved here for my program, we moved with one cat (Conan) and adopted another (Eevee).
 - Eevee was my wife's idea but I was excited about the name because of Pokemon.
- I enjoy cooking, golfing, watching TV.
- I am very excited to be teaching this class because:
 - I have a background in econometrics and find it really interesting.
 - It feels like there is more of a "right" answer, or at least a "better" answer, within econometrics that is less visible in theory courses.
 - Everyone has some insight into econometrics, but this is something you can really specialize in!
 - You are answering questions!!!
- One thing I want to get across early is that I care about this course and I care about your success. That is a value I hold, and I ask that you assist me in maintaining it.

Today's goals are:

- Get to know you, your goals for the course.
- Introduce the course syllabus, the fundamental econometric question.
 - In doing so, also discuss class expectations.

Research has found that allowing students to ask questions to the instructor fosters increased rapport, so what we'll do is have everyone introduce themselves (yeah, it'll be a lot, but I find it important).

- Name, pronunciation/nickname/pronouns are fine but not mandatory, major, year, and either:
 1. Ask a question to me (saving syllabus questions until later probably).
 2. Favorite thing from the summer.

Take about 30 mins to introduce students, leaving 40 mins for syllabus and intro to causal inference.

2.2 Syllabus

Just want to point you to the things that need discussing most:

- Page 1:
 - Note my drop in hours, also note that you can best contact me through email!
- Page 2
 - The textbook is "recommended", I'd say get it personally or find an online copy. There are also plenty of other econometrics textbooks you can find — just ask me.
- Grading
 - Let's jump to grading, noting that we will discuss R and your thoughts in the reflection assignment.
 - 5% of your grade is to attendance, of which there will be 25 sessions including labs you can attend. You have up to five misses, reason neutral. Don't tell me you'll miss. Note it is best to attend anyhow since I don't have slides, so you'll need to get notes from someone or come to office hours if you miss.
 - Class will be lecture based with some activities, then at the end I will open up the class reflection which just invites you to reflect on what you've learned any prompt you to ask questions you didn't get a chance to before.
 - You will not really need your laptop for lectures, but will need some access for the labs or at least to do some assignments after. Labs on Wednesday are a great way to learn R, get practice, also ask your GE questions about class or assignments.
 - 20% of your grade is for assignments - worth 5% each with a firm due date for full credit. If you turn it in late, the highest you can get is 70%. I will also allow you to revise up to two of your assignments, if they were turned in on time, one week after receiving feedback for a maximum grade of 90%.
 - We have a midterm covering chapters 1-3 worth 25% of your grade, same with a final for chapters 4-6. So there will not be a cumulative final.
 - The way that I'll be testing your cumulative knowledge is through a project.
 - * It will effectively be a replication of a prior econometrics paper that is in your area of interest.
 - * We will discuss more about this as time goes on.
- You can use AI, but everything you turn in should be written by you.
 - Our assignments will be partial coding partial theory. You can use AI to help code, but frankly it won't be much help for the theory as it'll throw you some weird writing that you won't be used to.

- One thing I want you to practice if you’re using it for code: don’t just copy and paste whatever it spits out. Practice writing that code, understanding and taking notes on each part.
- The rest just discusses your job, what I somewhat expect of you basically. I expect you to work hard, give it your all, but note that I also don’t expect you to be at 100%, 100% of the time. There are days when we might not be at our best; that is okay. Just give all of what you physically can.
- I gave you a schedule of things, subject to change though.

2.3 Potential Outcomes

There are two ways to think about econometrics that I want to briefly introduce.

1. (What is written in the syllabus): Econometrics is the toolkit that allows us to test our economic models using real data.
2. We have to be careful in what our econometrics say, though, if we are to make causal inferences.

Economic theory predicts many causal relationships. For example: when demand increases, we expect both quantity and price to increase as a direct result. What you’ll learn in this course is that we have to be very careful to ensure that what we truly estimate is just the change in demand.

The complexity of the economy means that we will never be able to view things in a black box.

Another way to put this is through the potential outcomes framework: suppose I am truly trying to measure the increase in price of labubus due to a huge demand shock after the UO duck mascot dressed as one.

- The only outcomes I ever witness are just before the duck puts on the labubu costume and then after the duck puts on the labubu costume.
- Suppose that we witness prices for labubus increase by 50%. Can I be sure that the price increase was due to the duck costume?
- In the ideal, I would be able to estimate the effect of the duck putting on a costume by looking at the difference in price between the world in which the duck did and did not put the labubu costume on at the same time.
 - But I can only ever witness one of these events! We call the other event a “counterfactual.”

We, as researchers, need to be able to estimate a causal relationship using only observed outcomes, and we have to do a lot of work (and convincing) to do so.

If time:

Specifically, we call the change in demand in this case, or the event that we're trying to estimate the effect of, the "treatment." For some unit, in this case labubu price, we want to find the impact of treatment on that unit.

A unit's outcome is a function of its potential outcomes.

$$Y_i = D_i Y_i^1 - (1 - D_i) Y_i^0$$

- For unit i , with actual outcome Y_i .
- D_i takes the value of 1 if the treatment happens vs not.
 - So when $D_i = 1, Y_i = Y_i^1$.
- We want the "treatment effect" which is defined as $\delta_i = Y_i^1 - Y_i^0$.
 - The issue: we only observe either Y_i^1 OR Y_i^0 , never both for a single unit.
- Therefore, much of causal inference lies in identifying other parameters that still speak to the relationship of a treatment but are identifiable under our observed outcomes.
 - Specifically, the ATE and ATT.
 - $ATE = E[\delta_i] = E[Y_i^1] - E[Y_i^0]$
 - $ATT = E[\delta_i | D_i = 1] = E[Y_i^1 - Y_i^0 | D_i = 1]$
- The above can actually be estimated under certain assumptions.

If you want to dig into this more, and I encourage you to do so, I recommend reading up on causal inference specifically from Scott Cunningham (The Mixtape).