Individual Causal Effects

QTM 385

Instructor Info —

👤 Adam Glynn

🕑 Office Hrs: by appointment

📍 Tarbutton 303

ℹ️ Zoom Link

@ aglynn@emory.edu

👤 Elisha Cohen

🕑 Office Hrs: by appointment

📍 Tarbutton 113A

@ elisha.ann.cohen@emory.edu

Course Info ———

⚡ Prereq: QTM 220 or equiv.

📅 Tues & Thurs

🕑 1:00p - 2:15p

📍 Tarbutton 218

Overview

Modern approaches to causal inference focus on estimating average treatment effects, but in everyday life and in fields like business, the social sciences, and medicine, we are often interested in treatment effects for individuals. This course surveys estimation and inference techniques for individual treatment effects from the classical (Mill's methods) to the modern (synthetic control type methods). Topics covered include a review of methods for average treatment effects, frequentist and Bayesian approaches, prediction intervals, and permutation methods. Big data methods using multiple treated units are omitted from this course. While the course will emphasize the mathematical foundations of these concepts, each topic will also cover the implementation of the relevant methods in the statistical program R.

Learning Objectives

- Understand the differences between studies that assess individual effects and studies that assess average effects.
- Be able to choose appropriate techniques for the assessment of individual effects in many different contexts.
- Understand the properties of these techniques.
- Demonstrate the ability to carry out a project assessing individual effects from start to finish.

Material

Required Texts

[GG] Alan S Gerber and Donald P Green. *Field experiments: Design, analysis, and interpretation*. WW Norton, 2012 On course reserves
[FPP] Rob J Hyndman and George Athanasopoulos. *Forecasting: principles and practice*. OTexts, 2018 free online

Other
Any required journal articles and book chapters will be provided on Canvas.

Grading Scheme

30%	homework assignments
15% each	3 midterm exams
25%	project

Homework

The homework assignments will consist of analytical problems, data analysis, project check-ins with and without computer work. There would be around 6 homeworks. The homework must be word processed with tables and figures together in the document. If you are using R markdown make sure to knit it and submit as pdf or html (pdf is preferred). Each assignment will have its due date indicated and should be submitted through Canvas. Any assignment submitted after the due date/time will lose half a grade per day.

Working together on the homework assignments is encouraged, but you must write your own solutions. This includes R code. It is highly recommended that you make a solo effort on all the problems before consulting others.

FAQs

? What is an individual causal effect?

! Individual causal effects, often known as individual treatment effects, reflect the effect of a drug, a policy, or other types of actions, on an individual unit. For example, the effect of a blood pressure medicine on an individual's blood pressure is an individual effect, as opposed to the top line finding, reported in a blood pressure study, which represents the average effect of the drug on those in the study.

? Aren't average effects just averages of individual effects?

! Yes, but the techniques used and the assumptions needed to assess individual effects are different. In the absence of interference between units, average effects can be accurately estimated by large randomized controlled trials. Assessment of individual effects requires stronger assumptions and produces less precise conclusions.

Exams

There are three in-class midterm exams. There will be no make-up exams. However, with an Emory approved excuse exam points will be removed from both the numerator and denominator of the final score. Unexcused absences result in a grade of zero. No collaboration is allowed on the exams.

Project

Students will be required to identify a research question about an individual causal effect, carry out research on that effect, present findings in a class presentation and provide a 15 page (maximum) report (along with the R code required to produce the findings). A fair amount of class time will be devoted helping students in this process.

Accommodations for Students with Disabilities

If you are seeking classroom accommodations or academic adjustments under the Americans with Disabilities Act, you are required to register with Office of Accessibility Services (http://accessibility.emory.edu). To receive academic accommodations for this class, please obtain the relevant letter and meet with me at the beginning of the semester. Students are expected to give two weeks notice of the need for accommodations.

Honor Code

All students enrolled at Emory are expected to abide by the Emory College Honor Code. Any type of academic misconduct is not allowed which includes 1) receiving or giving information about the content or conduct of an examination knowing that the release of such information is not allowed and 2) plagiarizing, whether intentionally or unintentionally, in any assignment. For the activities that are considered to be academically dishonest, refer to the Honor Code:
http://catalog.college.emory.edu/academic/policies-regulations/honor-code.html.

Etiquette

Be professional in all course interactions.

Feedback Expectations

All feedback will be received within at most one week (e.g., feedback on homework and exams). Responses to email/canvas questions will often be given faster (with 48 hrs), but this depends on the urgency of the request and whether the response is best handled in a synchronous session.

Course Calendar (subject to change)

Course Calendar

Week	Date	Topic/Agenda	Reading to be completed by this date
Primer			
Week 1	2022-01-11	Introduction	GG Chap 1 pages 1 - 5
Week 1	2022-01-13	Unbiased Estimation of Average Effects 1	GG Chap 2
Week 2	2022-01-18	Unbiased Estimation of Average Effects 2	GG 2.7 & 3-3.3
Week 2	2022-01-20	Inference for Average Effects	GG 3.4 - 3.6
Week 3	2022-01-25	Effect Heterogeneity	GG Chap 9
Week 3	2022-01-27	Emory Classes Cancelled	
Week 4	2022-02-01	False Positive Rates	Benjamin et al. & Statistical Power Module
Week 4	2022-02-03	Overflow/Review	
Week 5	2022-02-08	Bayesian Prediction	Handout
Week 5	2022-02-10	Midterm 1	
Cross-sectional			
Week 6	2022-02-15	Time-series 1	FPP
Week 6	2022-02-17	Prediction and Prediction Intervals	Handout
Week 7	2022-02-22	ITEs with Binary Outcomes	Handout
Week 7	2022-02-24	ITEs with Binary Outcomes	Handout
Week 8	2022-03-01	TBD	Handout
Week 8	2022-03-03	ITEs with Ranked and Continuous Outcomes	Handout
Week 9	2022-03-08	Spring Break - No Class	
Week 9	2022-03-10	Spring Break - No Class	
Week 10	2022-03-15	ITEs with Ranked and Continuous Outcomes	Handout
Week 10	2022-03-17	Overflow/Review	
Week 11	2022-03-22	Midterm 2	
Time-series-cross-sectional			

Week 11	2022-03-24	Time-series 2	FPP
Week 12	2022-03-29	Synthetic Control	Handout
Week 12	2022-03-31	In sample	Handout
Week 13	2022-04-05	Out-of-sample	Handout
Week 13	2022-04-07	Software and Project Workday	
Week 14	2022-04-12	Overflow/Review	
Week 14	2022-04-14	Midterm 3	
Week 15	2022-04-19	Presentations	
Week 15	2022-04-21	Presentations	
Week 16	2022-04-26	Exam Period	
Week 16	2022-04-28	Exam Period	