

PhD Econometrics 2 (ECON50580)

Lecturer

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Course Description and Learning Outcomes

Good empirical economics is a combination of asking an interesting research question and finding an empirical approach — an identification strategy — that enables you to provide a *causal* answer to this question. The aim of this module is to equip you with the most commonly used methods of causal inference. The focus of the course is on the applications. I will introduce each topic, demonstrate its theoretical underpinnings and provide empirical examples. In the assignments, students evaluate the methods using simulations as well as apply them to real data. Over the past couple of years, causal inference has become a vibrant field of methodological research. Where possible, I will refer students to the latest developments in this literature and incorporate new methods in the assignments.

By the end of this course, you should be able to:

- Develop research designs that allow for the causal estimation of relevant parameters
- Apply the appropriate causal inference techniques — including the latest methods — to own research
- Critically assess the limitations of each method, in particular identification assumptions and interpretation
- Assess the techniques using Monte Carlo simulations
- Communicate research results appropriately in written and oral formats.

I highly recommend using the **statistical software R**. R is free, extremely versatile, and thanks to RStudio more user-friendly than it used to. You can download the desktop version of RStudio for free. Compared to other softwares, R has a slightly higher start-up cost. But incurring this cost will pay off soon.

Logistics

Credits: 10 ECTS

Office Hours: Wednesday 2-3pm (need to email me before); office G208

Time: Wednesday, 3-5pm, except in week 1 (January 23, Thursday 9-11)

Venue: D201 ART, except on January 23 (G108 ART).

The course consists of 12 sessions. The final two sessions are reserved for student presentations. One session is a buffer. The first session takes place on January 23. Note that the first session takes place at a different time and in a different location.

Prerequisites: Students should have a solid background in Econometrics (M.Sc-level). I recommend the module PhD Econometrics 1 offered by UCD, but it is not strictly necessary that students have taken this module.

Brightspace: All materials will be available on Brightspace, UCD's Virtual Learning Environment. UCD students automatically have access to this platform. Non-UCD students need to contact Nicolas Clifton (nicolas.clifton@ucd.ie) to register and get access.

Registration: UCD students register through the CoSSL Graduate School. Non-UCD students please contact Nicolas Clifton (nicolas.clifton@ucd.ie).

Version Control: For the reproducibility of research, it is critical that researchers use version control. Once you formed your groups for the problem sets, please set up individual git accounts. Github, gitlab and bitbucket offer free options. If you use a Windows computer, you need to install TortoiseGit. For Mac, I recommend Fork.

Assessment and Feedback

The assessment will be based on the following components:

- Final exam: 30%
- Replication and practice exercise: 20%
- 5 problem sets: 40%
- Research proposal: 5%
- Presentation: 5%

Participants have to complete all components to pass the course. Any assignments need to be submitted by the deadline. If you cannot submit an assignment by the deadline, please inform me immediately. The UCD late submission policy does not apply for this course.

Replication and practice exercise: The goal of this exercise is to i) learn how empirical research is done, ii) apply the latest methods. Material for the replication exercise will be provided in mid February. The deadline for submissions will be in mid April. Students will work in randomly assigned groups of three to five students. The exercise will comprise of four tasks: i) you replicate a study that uses a technique covered in this course; ii) you will apply a refinement of this technique; iii) write up the results as well as a 5-page memo summarizing the method; iv) present your results. With your consent, we will circulate the memos among the group. That way, everyone is up to date with the latest methods.

Problem sets: The problem sets consist of theoretical and empirical exercises. Students work in teams of minimum three and maximum five students and jointly submit a solution.

Research proposal: Each student writes a research proposal of 2-3 pages on a topic of their choice, with particular emphasis on research design.

Submission: All submissions will be made through Brightspace. Any assignment should be submitted as one pdf file. Derivations can be done by hand and submitted as a scan and incorporated in the pdf. Empirical results should be presented in graphs or well-formatted regression tables. I do not accept screenshots of outputs of statistical software. Your code has to be attached as an appendix. You are free to write your assignments in any software, although I strongly recommend LaTeX and/or RMarkdown.

Feedback: I will provide general feedback to the entire group after each assignment. Individual feedback can be given during office hours.

Reading Materials

The course will be based on a textbook as well as papers. References to the papers will be given in the lecture slides. For an introduction to causal inference, I recommend *Mastering 'Metrics* [MM] by Joshua Angrist and Steve Pischke (undergraduate level) and *Causal Inference — The Mixtape* [CIM] by Scott Cunningham (M.Sc-level). The main PhD-level textbook on causal inference is *Mostly Harmless Econometrics* by Joshua Angrist and Steve Pischke (references see below).

[MHE] Angrist, Joshua and Pischke, Jorn-Steffen, (2009), *Mostly Harmless Econometrics: An Empiricist's Companion*, 1 ed., Princeton University Press.

[MM] Angrist, Joshua and Pischke, Jorn-Steffen, (2014), *Mastering 'Metrics: The Path from Cause to Effect*, Economics Books, Princeton University Press, edition 1, number 10363.

[CIM] Cunningham, Scott, (2019), *Causal Inference — The Mixtape*, free (!) e-book can be downloaded here: <http://scunning.com/mixtape.html>.

Useful reference books are (any editions of)

[CT] Cameron, A. and Trivedi, Pravin, (2005), *Microeconometrics*, Cambridge University Press.

[GRE] Greene, William, (2008), *Econometric Analysis*. Macmillan Publishing Company. 7.

[WO] Wooldridge, Jeffrey M., (2010), *Econometric Analysis of Cross Section and Panel Data*, MIT Press Books, The MIT Press, edition 2, volume 1.

Topics Covered in the Course

- **Research Design** [CIM, ch. 4]
 - Directed Acyclical Graphs
 - Common pitfalls: confounders, colliders, bad controls
 - Recap: ATE, ATT and all that
- **Good Research Practice**
 - Soft coding
 - Version control
 - Automation
 - Project management
- **Instrumental Variables and Marginal Treatment Effects** [MHE, Ch. 4]
 - Identification
 - 2SLS estimation
 - IV with heterogeneous treatment effects
 - Inference
 - Marginal Treatment Effects (MTE)
- **Regression Discontinuity and Kink Designs** [MHE, Ch. 6]
 - Sharp and fuzzy regression discontinuity designs
 - Optimal bandwidth selection
 - Regression kink design

- **Difference-in-Differences (Advanced)** [MHE, Ch. 5]
 - Semi-parametric diff-in-diffs
 - Heterogeneous Treatment Effects
 - Event Studies and Staggered Adoption Designs
- **Synthetic Controls**[CIM, Ch. 11]
- **Advanced topics (time permitting)**
 - New developments in Fixed Effect Estimation
 - Shift-share instruments
 - Bounding methods
 - Mediation Analysis

FAQs

Q: I don't have time/don't want to work in groups. Can I submit individual solutions to problem sets?

A: No. In all assignments except the research proposal you are required to work in groups of 3-5 students and submit one solution.

Q: I don't have funding to buy a Stata license. What should I do?

A: R is free. It costs time. It's a steep learning curve but a great investment in your future.

Q: Will you coordinate the submission deadlines with other module coordinators at UCD?

A: Yes. Note, however, that it may not always be possible to ensure an even distribution of your workload while at the same time sticking to the course outline. If there is a general issue with timing (for example several deadlines within a short space of time), please approach me and we can see if we can find a solution.

Q: Will you provide written solutions for the problem sets?

A: I will provide general feedback but no written solutions.

Q: I take this module as an elective. Can I take the module for less than 10 ECTS?

A: No. I only offer the course as one elective.

Q: I did not take PhD Econometrics 1. Can I take this module?

A: Yes. I expect that students have a solid background in econometric theory, especially estimation and testing. But it is possible to take this course without having taken PhD Econometrics 1.