



IDEM 185
Causal Inference: Methods and Applications
Course coordinator: Peter Eibich

Start date: 27th May, 2024

End date: 31st May, 2024

Location: Max Planck Institute for Demographic Research, Rostock.

Onsite-only course.

Instructor :

- Peter Eibich, Université Paris Dauphine-PSL

Course description

Many research questions in demography, social sciences, economics, or epidemiology deal implicitly or explicitly with causal effects or causal mechanisms. For example:

- How does education affect the timing of fertility?
- How does health affect labor market participation?
- What is the impact of overweight and obesity on healthcare utilization?

Unfortunately, conducting randomized experiments to study these questions is often infeasible, and we therefore rely on research designs and statistical and econometric methods to identify causal effects under certain assumptions.

In this course, we will review selected research designs and estimation methods that can be used to obtain causal estimates. Over the course of five days, we will review the theory behind these estimation methods and implement them in a series of practical exercises using real-world data from the Survey of Health, Aging and Retirement in Europe (SHARE).

Organization

On Monday through Thursday, there will be one lecture in the morning (9:00 – 12:00 CEST), in which we will review and discuss the theoretical background of the methods covered in this course. In the afternoons (13:30 – 17:00 CEST), we will conduct a tutorial in which we will apply the methods covered in the morning lecture to easySHARE data. These applications will be inspired by published research papers in population studies, economics and the social sciences. During these exercises, students will be encouraged to write the statistical code for the analysis on their own, before we review example solutions together and discuss the interpretation of the results.

On Friday, students who wish to obtain a certificate for participation in the course can give a brief presentation of their own research. These presentations will follow a “5-by-5” format, i.e., every student will have five minutes to present five slides. In the presentation, students will be asked to reflect on how the concepts and methods covered in the course might apply to their own research. For example, presentations could cover the following topics:

- “What challenges arise when estimating causal effects in my field of research?”
- “How important is a causal interpretation of results in my research?”
- Examples of how the methods covered in this class could be used to address these challenges

After each presentation, there will be five minutes for questions or suggestions from other course participants. Students will be given some time to work on these presentations during the tutorials for the course.

On Friday, there will also be some limited time for participants to discuss their own research with the course instructor in individual consultations.

In general students should expect to spend about 6-8 hours per day on the course (lectures, practical exercise sessions, readings, presentations).

Detailed schedule

The course will cover the following topics in this order.

Monday:

9 a.m. -12 a.m.: Lecture

1. Basic concepts
 - a. Potential Outcomes
 - b. Directed Acyclic graphs
2. Linear Regression
 - a. Basic overview
 - b. Randomization and differences-in-means
 - c. Exogeneity and sources of bias
 - d. Controlling for observable confounders
 - e. Panel data methods and causality

1.30 p.m. – 5 p.m.: Tutorial

Tuesday

9 a.m. -12 a.m.: Lecture

3. Difference-in-differences
 - a. Motivating example
 - b. Simple 2x2 DID
 - c. Two-way Fixed Effects estimation
 - d. “New” DID

1.30 p.m. – 5 p.m.: Tutorial

Wednesday

9 a.m. -12 a.m.: Lecture

4. Instrumental variables
 - a. Non-compliance in RCTs and ITT effects
 - b. General IV framework and 2SLS estimation
 - c. IV assumptions
 - d. LATE interpretation

1.30 p.m. – 5 p.m.: Tutorial

Thursday

9 a.m. -12 a.m.: Lecture

5. Regression Discontinuity Designs
 - a. Intuition and assumptions
 - b. Sharp and fuzzy regression discontinuity design
 - c. Visualisation
 - d. Estimation

1.30 p.m. - 5 p.m.: Tutorial

Friday

9 a.m. – 10 a.m.: Individual consultations (optional)

10 a.m. – 12 a.m.: Flash presentations I

1.30 p.m. – 4 p.m.: Flash presentations II

Course prerequisites

A working knowledge of STATA or R is recommended for the practical exercises. Students working with other statistical software packages can participate in the course, but support for the practical exercises will only be provided for STATA and R. The course assumes basic knowledge of linear regression and applied statistics. Students who wish to familiarize themselves with these topics before the course should refer to Chapter 2 in Cunningham (2021) or Chapter 13 in Huntington-Klein (2022) from the recommended reading list below (or Chapters 2-9 in Wooldridge's "Introductory Econometrics: A modern approach" for a technical treatment).

It is recommended that participants bring their own laptops for the afternoon tutorials, if possible, with their usual statistical software (Stata or R) already installed.

Examination

Students who wish to obtain a certificate for participation in the course will have the opportunity to give a short presentation on Friday, 31st May.

General readings

The course does not follow a single textbook, but draws from material across a number of resources.

- **Huntington-Klein, N. (2022):** The Effect. An Introduction to Research Design and Causality
- **Cunningham, S. (2021):** Causal Inference. The Mixtape
- **Angrist, J. and Pischke, J.S. (2009):** Mostly Harmless Econometrics
- **Ashworth, S., Berry, C., and Bueno de Mesquita, E. (2021):** Theory and Credibility
- **Wooldridge, J. (2011):** Econometrics of Cross-Section and Panel Data

Course Materials

Presentation slides for the lectures will be made available two weeks before the start of the course. Materials for the tutorials will be made available during the course as needed.

Tuition

There is no tuition fee for this course. Travel and accommodation expenses for admitted PHDS students will be covered by the MPIDR.

Application instructions for PHDS students and MPIDR scientific staff

A maximum of 20 students will be admitted.

There is an expedited application procedure for PHDS students and MPIDR scientific staff (pre-docs and post-docs).

- If you would like to enroll for this course, please send an email to phds@demogr.mpg.de. Begin your email message with a statement saying that you apply for course IDEM 185 - Causal Inference: Methods and Applications. You must also include a statement of motivation (PDF) that includes the following.
 - A paragraph about how your research relates to the topic of the course (half a page or less);
 - a paragraph about how you meet the prerequisites for this course (half a page or less).
- The application deadline is **March 15, 2024**.
- Applicants will be informed of their acceptance by March 29, 2024.

Recruitment of students external to the IMPRS-PHDS network

Since there are only 20 seats available, we will initially offer them to our PHDS students as well as MPIDR scientific staff (pre-docs and post-docs). After the PHDS students and MPIDR scientific staff are accommodated, we will offer the remaining seats (if any) to pre-docs and post-docs from elsewhere through our [IDEM website](#).

Email inquiries about the course and the application process should be sent to phds@demogr.mpg.de.