PhD course Advanced causal inference

Contents

We, as human beings, tend to attribute cause and effect to observations quite quickly, even if such a causal relationship does not really exist. Causal inference is the science of the study of causal relationships and gives us tools to study rigorously if an intervention, action, or treatment actually casually determines a certain outcome. Causal inference is required to answer questions such as "What is the impact of social distancing on the spread of COVID-19?", "What is the effect of minimum wages on employment?", or "To what extent do increases in food prices increase conflict?" In this "Advanced Causal Inference" course five development economists from both Wageningen University (WUR) and Utrecht University (UU), will teach state-of-the-art causal inference methods for both experimental and quasi-experimental designs, and help students to apply these to their own research designs.

Learning objectives

After successful completion of this course students are expected to be able to:

1. Use economic theory to design a (quasi) experiment
2. Apply and evaluate statistical techniques in terms of valid causal inference
3. Appraise various experimental design choices
4. Appraise various quasi-experimental methods
5. Write a pre-analysis plan including power analysis

Course entry requirements

- DEC-32806 Impact Assessment of Policies and Programmes at WUR or ECRMRS1 Econometric Methods 1 at UU or a similar course at another university, and
- YSS-34306 Advanced Econometrics at WUR or ECRMRS1 Econometric methods 2 + Research skills: Data handling at UU or a similar course at another university, and
- Being able to program in Stata.

Activities

- Lectures: The course material will be discussed in twelve interactive lectures.
- Assignments: Students will replicate some empirical results from highly-cited papers by implementing estimation procedures in Stata.
- Research design: Students work on their own research idea, which will result in a research design and a pre-analysis plan.

Feedback

- Question hours to discuss progress with Stata assignments.
- Each Friday, Q&A to help students apply the material of the week in their own research design.

- Students will receive feedback on their research design from one of the teachers for further improvement after the course.

Examination

The student needs to pass each:

A. Assignments (pass/fail grading)
B. Research design (pass/fail grading)
C. Written exam with open questions (minimum 5.5 to pass)

Evaluation grid

Learning objective	**A**	**B**	**C**
1. Design a (quasi) experiment based on economic theory		X	X
2. Judge whether statistical techniques provide valid inference	X	X	X
3. Appraise various experimental design choices		X	X
4. Appraise various quasi-experimental methods		X	X
5. Write a pre-analysis plan including power analysis	X	X	X

Time allocation

	Number	Hours	Total hours
Lectures	12	2	24
Readings + assignments	12	5	60
Research design	1	20	20
Q&A	6	⅝	5
Exam	1	3	3
Total			112

Practical information

- Credits: 4 ECTS
- Language of instruction: English
- The course will be taught fully online

Staff

The course team consists of:

- Dr. Elena Fumagalli
- Dr. Karlijn Morsink
- Dr. Robert Sparrow
- Dr. Mark Treurniet (course coordinator)
- Dr.ir. Maarten Voors

Program

Date Time	**Topic**	**Literature (R=required, O=optional)**	**Person**
Week 1: From theory to design			
Mon 10-5 14:00	Lecture 1:	R: Cunningham (2021) Ch. 1-3	Karlijn
	What is a good research question		
	Theory (formal models, structual equations, DAGs)		
Wed 12-5 14:00	Lecture 2:		Karlijn
	Hypothesis testing		
	Causal attribution: Rubin causal model and potential outcomes	R: Cunningham (2021) Ch. 4-§4.1.2	
	Sample selection		
	Alignment between research question, hypothesis, design, estimand, estimator		
Wed 12-5 16:00	Q&A: Application to student's research design		Karlijn
Thu 13-5	Ascension Day		
Week 2: Causal inference in randomized experiments			
Mon 17-5 14:00	Lecture 3:		Mark
	Estimands and estimators (ATE, ATT, ATU, ITT,	R: Cunningham (2021)	

	LATE)	§4.1.3-§4.1.5	
	Pros and cons of collecting baseline data Stratification Controls (balance, precision, winsorizing)	O: Zwane et al (2011) O: McKenzie (2012)	
	When to cluster How to cluster (Monte Carlo simulation)	R: Abadie et al (2017) O: Deeb and de Chaisemartin (2020) O: Cameron et al (2008)	
Tue 18-5	Stata assignment Question hours from 12.00-13.00 and 16.00-17.00		Mark
Wed 19-5 14:00	Lecture 4:		Mark
	Randomization inference	R: Cunningham (2021) §4.2 O: Young (2019)	
	Correlated outcomes (SUR)	O: Christensen et al (2020)	Maarten
	Multiple hypothesis testing (FDR, FWER, Bonferroni)	O: Anderson (2008)	
Thu 20-5	Stata assignment Question hours from 12.00-13.00 and 16.00-17.00		Mark
Fri 21-5 14:00	Q&A: Application to student's research design		Mark
Week 3: Advanced randomized designs			
Mon 24-5	Whit Monday		
Tue 25-5 11:00	Lecture 5:	R: Voors et al (2021)	Maarten
	Factorial designs	R: Muralidharan et al (2019)	
	Heterogeneous effects analysis		
	Mediation analysis		
Thu 27-5 11:00	Lecture 6:		Maarten
	Spillovers: design and analysis		

	Difference-in-Differences	R: Cunningham (2021) Ch. 8	
Fri 28-5 14:00	Q&A: Application to student's research design		Maarten/ Mark
Week 4: Quasi-experimental methods I			
Mon 31-5 14:00	Lecture 9:		Elena
	Instrumental Variables	R: Cunningham (2021) Ch. 7 O: Lee at al (2020)	
Wed 2-6 14:00	Lecture 10:		Mark
	Synthetic control method	R: Cunningham (2021) Ch. 10 O: Abadie and Hainmueller (2015) O: Abadie (2020)	
Fri 4-6 14:00	Q&A: Application to student's research design		Elena/ Mark
Week 5: Quasi-experimental methods II			
Mon 7-6 14:00	Lecture 7:		Robert
	Propensity score matching vs. exact matching	R: Cunningham (2021) Ch. 5 O: Iacus et al (2012) O: King and Nielsen (2019)	
Wed 9-6 14:00	Lecture 8:		Robert
	Regression Discontinuity	R: Cunningham (2021) Ch. 6	
Fri 11-6 14:00	Q&A: Application to student's research design		Robert
Week 6: Power, ethics and pre-analysis plans			
Mon 14-6 14:00	Lecture 11:	R: Voors et al (2021)	Maarten
	Power analysis and designing for sufficient power	O: McKenzie (2012) R: Muralidharan et al (2019)	
Wed	Lecture 12:		Karlijn/

16-6 14:00	Ethics		Maarten
	Pre-registration and pre-analysis plans		
	Data management and open science		
Thu 17-6 14:00	Q&A: Application to student's research design		Maarten/ Karlijn
Week 7: Exam			
Fri 14:00	Written exam		
Week 8: Finalize research design			
Fri 14:00	Hand-in research design		

Literature

Abadie, A. (2020). Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects. *Journal of Economic Literature*, forthcoming.

Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey Wooldridge. 2017. When Should You Adjust Standard Errors for Clustering? NBER Working Paper No. 24003.

Abadie, A., Diamond, A. and Hainmueller, J. 2015. Comparative Politics and the Synthetic Control Method. *American Journal of Political Science*, 59: 495-510.

Anderson, Michael L. 2008. Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects, *Journal of the American Statistical Association*, 103(484): 1481-1495.

Cameron, A. Colin, Jonah B. Gelbach, and Douglas L. Miller. 2008. Bootstrap-Based Improvements for Inference with Clustered Errors. *The Review of Economics and Statistics* 90(3): 414-427.

Christensen, Darin, Oeindrila Dube, Johannes Haushofer, Bilal Siddiqi, Maarten Voors. 2020. Building Resilient Health Systems: Experimental Evidence from Sierra Leone and the 2014 Ebola Outbreak. *The Quarterly Journal of Economics*, forthcoming.

Cunningham, Scott. 2021. Causal Inference: The Mixtape.

Deeb, Antoine, and Clément de Chaisemartin. 2020. Clustering and External Validity in Randomized Controlled Trials. Working paper.

Iacus, S., King, G., & Porro, G. 2012. Causal Inference without Balance Checking: Coarsened Exact Matching. *Political Analysis*, 20(1): 1-24.

King, G., & Nielsen, R. 2019. Why Propensity Scores Should Not Be Used for Matching. *Political Analysis*, 27(4): 435-454.

Lee, D. L., J. McCrary, M. J. Moreira, and J. Porter. 2020. Valid t-ratio Inference for IV. Working Paper.

McKenzie, David. 2012. Beyond baseline and follow-up: The case for more T in experiments. *Journal of Development Economics*, 99(2): 210-221.

Muralidharan, Karthik, Mauricio Romero and Kaspar Wüthrich. 2019. Factorial Designs, Model Selection, and (Incorrect) Inference in Randomized Experiments. NBER Working Paper No. 26562.

Young, Alwyn. 2019. Channeling Fisher: Randomization Tests and the Statistical Insignificance of Seemingly Significant Experimental Results. *The Quarterly Journal of Economics*, 134(2): 557-598

Voors, Maarten, Jake Bowers, and Nahomi Ichino. 2021. Designing and Understanding Field Experiments: Resources from the EGAP Learning Days.

Zwane, Alix Peterson, Jonathan Zinman, Eric Van Dusen, William Pariente, Clair Null, Edward Miguel, Michael Kremer, Dean S. Karlan, Richard Hornbeck, Xavier Giné, Esther Duflo, Florencia Devoto, Bruno Crepon, and Abhijit Banerjee. 2011. Being surveyed can change later behavior and related parameter estimates. *PNAS*, 108(5): 1821-1826.