LUND UNIVERSITY
Faculty of Social Sciences

SAGM002, Causal inference in environmental and social science, 3 credits, third cycle

The syllabus was adopted and approved by the Board of the Department of Political Science, Lund University, on 2021-04-zy. The syllabus is valid from the spring semester 2021.

1. Type of Course & General Information

The course is an interdisciplinary third-cycle course offered by the Department of Political Science and financed by the two-year graduate research school ClimBEco – Climate Biodiversity and Ecosystem Services in a changing world.

Language of instruction: English

2. Learning Outcomes

Participants will be able to accomplish the following objectives by the end of the course:

1. understand theoretical frameworks in causal inference and appropriately apply them to case studies.
2. apply quantitative causal inference methods in R and critically assess the estimates in terms causal inference
3. analyse and evaluate the quality and robustness of causal inference approaches
4. design a causal inference research project with a selection of a reliable methodology.

3. Course Content

In socio-ecological systems, there are many types of human interventions. Some aim for environmental protection and nature conservation. Yet only few things humans do with the environment are systematically designed, such that we can easily infer the effects of such measures. Unintended consequences may occur, and the outcomes may not be planned either. Observational data is thus often noisy. We may have multiple causes and interactions of factors at once. We can nevertheless use these messy real-world observations to learn something about the (socio-ecological) consequences of human actions in the environment.

This course gives an overview of statistical techniques that are employed in social and environmental sciences to estimate causal effects of

interventions such as targeted (environmental) policies from observations. The course starts from gold-standard techniques for controlled experiments and develops an understanding of alternative techniques for settings where experimentation is not feasible or morally justifiable. The course will consist of theoretical lectures and applied showcases in R, replicating seminal studies in lab sessions.

Based on different concepts and theories of causal inference, the course seeks to provide Ph.D. students from different disciplines with an understanding of the current state of quantitative causal inference. The main modules of the course are:

- *Module 1*: The gold-standard – experiments. including an introductory note on causality and causation, randomized-controlled trials, and differences-in differences;
- *Module 2*: (Semi) Natural Experiments, including panel data estimations and staggered treatment corrections;
- *Module 3*: Simulated counterfactuals, including matching methods and synthetic control groups;
- *Module 4*: instruments, interruptions, and other cutting edges, including instrumental variables, regression discontinuity designs, and a note on structural equation models.

Each of the modules above will contain a lecture on the state-of-the-art and a seminar with applied replications of seminal papers in environmental policy evaluation. In the seminars students will also have to (collaboratively) solve causal inference problems. Moreover, students will, after the end of the course, write a short research project report of a causal inference project of their own choice to help them to apply causal inference techniques in their own field of Ph.D. research.

4. Teaching and Assessment

The course will consist of 10 sessions that will all take place in one week, including five interactive seminars where students engage in group work and coding exercises.

The course is particularly designed to be accessible for students from very different backgrounds, including different social and natural science disciplines. Therefore, the introduction of different traditions of causal inference will include some elementary aspects. Students with a more advanced statistical background will nonetheless benefit from the application of statistical concepts and methods in a setting of causal inference.

Evaluation will take place on the basis of participation and a short final project report of about 30hrs workload to be submitted about 3-4 weeks after the end of the course. In the project, participants will apply the presented methodologies to their own field of research or to an equivalent issue of their choice.

Re-examination is offered after the conclusion of the course. If necessary, a second opportunity for re-examination will be arranged at a later date.

5. Grades

The grades awarded are Pass or Fail. To be awarded a Pass the student must fulfill the learning outcomes specified and demonstrate an independent, reflective, and critical approach to the research field and to the methods presented in the course. Replicable data and code must be provided (except for cases with confidentiality issues where toy data can be accepted).

6. Admission Requirements

The course is open to Ph.D. students from all disciplinary backgrounds. The number of participants is limited; however, in case of too many applications, priority will be given to students of the ClimBEco graduate research school and Ph.D. students of the department of political science at Lund University.

Before applying (by e-mail to nils.droste@svet.lu.se), please liaise with your supervisor on the acceptance of course credits in your programme or university. After sending an application e-mail, we will respond within two weeks.

B.A. and M.A. students as well as post-doctoral fellows are more than welcome to participate as guests. Please note that we cannot provide support for travel or accommodation.

Preliminary Schedule: Causal inference in environmental and social science – SAGM002

	Time	**Day 1:** May 10 2021	**Day 2:** May 11 2021	**Day 3:** May 12 2021	**Day 4:** May 13 2021	**Day 5:** May 14 2021
Lectures	10-12h	Greetings, *Introduction to Causal inference*, and randomized controlled trials	*(Semi) Natural Experiments*: Panel data regressions, two-way fixed effects, and recent corrections for staggered treatment	*Simulated Counterfactuals*: matching methods synthetic controls, and Bayesian Structural time series	*Instruments & Interruptions*: instrumental variables, regression discontinuity design	*Cutting edges:* Structural equation modelling for causal inference (and machine learning techniques?)
Seminars (may be subject to changes)	13-15h	*Replication:* Jayachandran, S. et al. (2017). Cash for carbon: A randomized trial of payments for ecosystem services to reduce deforestation. *Science*, *357*(6348), 267-273.	*Replication:* Marcus, M., & Sant'Anna, P. H. (2021). The role of parallel trends in event study settings: An application to environmental economics. *Journal of the Association of Environmental and Resource Economists*, *8*(2), 235-275.	*Replication:* Ferraro, P. J., & Hanauer, M. M. (2014). Quantifying causal mechanisms to determine how protected areas affect poverty through changes in ecosystem services and infrastructure. *PNAS*, 111(11), 4332-4337.	*Replication:* Kim, S. E., & Urpelainen, J. (2017). The polarization of American environmental policy: A regression discontinuity analysis of Senate and House votes, 1971–2013. *Review of Policy Research*, 34(4), 456-484.	*Student presentations of own project ideas*
Consultations	15-16h	./.	./.	./.	./.	./.