DEPARTMENT OF EDUCATION AND SPECIAL EDUCATION

QRM1809   Methods for causal inference in educational research, 7.5 credits

Metoder för kausal inferens i utbildningsvetenskaplig forskning, 7,5 högskolepoäng

Third-cycle level / Forskarnivå

Confirmation

This syllabus was confirmed by the Department of Education and Special Education on 2019-08-21, and is valid from Autumn semester 2019.

Responsible Department
Department of Education and Special Education, Faculty of Education

Entry requirements

For admission to the course, the applicant has to be a registered doctoral student in the third cycle or have a doctoral degree. The applicant should also have documented prior knowledge corresponding to the learning goals in the courses QRM1802 Regression Analysis for Educational Research, 7,5 higher education credits and QRM 1806 Structural Equation Modelling for Educational Research, 7,5 higher education credits.

Learning outcomes

The main purpose of the course is to give an introduction to techniques for making credible causal inferences from observational data and how such techniques can be used in educational research. While the randomized experiment is recognized as a superior design for determining the causal effect of a treatment on an outcome, it is often the case that ethical, practical, and economic reasons prevent such designs to be used to answer causal questions. Furthermore, even when an educational experiment can be conducted, the implementation is almost always imperfect because of attrition of participants, allocation of clusters rather than individuals to groups, and low fidelity of treatment implementation. However, within different disciplinary fields alternative techniques have been developed which under certain assumptions allow causal inferences to be made from observational data. Some examples of such techniques are instrumental variable regression (IV), regression discontinuity design (RDD), differences-in-differences (DID or DD), and propensity score matching (PSM). The course aims at developing participants' skills to choose and apply appropriate techniques for answering causal questions

on the basis of observational data, as well as to critically review educational research which aims to make causal inferences. On completion of the course, the student is expected to be able to:

Knowledge and understanding

- Distinguish causal from non-causal research questions.
- Explain why multiple regression analysis typically is not able to answer causal questions.
- Identify threats to the validity of inferences from randomized experiments.
- Explain the basic principles and assumptions of regression-discontinuity designs as a technique for answering causal questions.
- Explain the basic principles and assumptions of instrumental variable regression analysis as a technique for answering causal questions.
- Explain the basic principles and assumptions of difference-in-differences/fixed-effects modelling as techniques for answering causal questions.
- Explain the basic principles and assumptions of structural equation modeling (SEM) as a technique for answering causal questions.
- Explain the basic principles and assumptions of propensity score matching as a technique for answering causal questions.

Competence and skills

- Specify, estimate and evaluate models based on regression-discontinuity, instrumental variable regression and fixed effects/difference-in-differences designs.
- Use the statistical software R to estimate models and present results.
- Describe, evaluate and interpret modeling results orally and in writing, in accordance with the APA publication standard.

Judgement and approach

- Reflect on advantages and disadvantages of different designs to answer causal questions.
- Critically review publications in educational research that make use of empirical approaches to answer causal questions.
- Reflect on questions of research ethics related to collection and analysis of data to answer causal questions.

Course content

In the first part of the course the distinction between causal and non-causal research questions is introduced, and the reasons why it is generally impossible to answer causal questions through analyzing associations among observed variables are made explicit. The so called potential outcomes framework is introduced as a set of tools to understand causal inference in terms of counterfactual comparisons. Issues in causal inference are demonstrated through simulating and analyzing data with traditional regression techniques. In the second part of the course three frequently used approaches for answering causal questions are treated in some detail, namely . The logic upon which these approaches is based is presented, and the use and interpretation of the techniques is illustrated with both simulated and real data in the R system. In the third part of the course structural equation modelling (SEM) and propensity score matching (PSM) are presented as methods which use conditioning on observed and latent variables to prevent bias in estimates of causal effects. The fourth and final part of the course demonstrates how RD and IV

designs may be combined, and how IV models may be estimated with SEM techniques.

Types of instruction

The main part of the course will be carried out on-line. Early in the course there will be three campus days with lectures and hands-on training. After the campus days, the course continues as an on-line course, with lectures, assignments and discussion seminars on Canvas.

Course participants are expected to take responsibility for their own learning, independently and together with peer students, by reading the course literature and actively participate in seminars and group work, and by performing the practical exercises and complete the tasks that are assigned by the course leader.

Language of instruction
The course is given in English.

English, unless all of the course participants agree on Swedish.

Grades

The grade Pass (G) or Fail (U) is given in this course.

The grading scale comprises the grades Pass (G) or Fail (U).

Types of assessment

The course is examined through four assignments which are to be reported successively during the course, along with a final written report, which presents and discusses analyses data to answer a causal question. A pass grade for the course requires a pass grade on all assignments.

Course evaluation

A course evaluation will be carried out after the course. The course evaluation will be summarized, and made available to doctoral students. The evaluation will be used as a guide for the future development and planning of the course.

Other information

This is a third-cycle course and a specialised course within the national school of Quantitative Research Methods in education (QRM) for researchers. More information about QRM is available at qrm.gu.se.

Collaborating departments

Department of Education and Special Education, University of Gothenburg,and Department of Economics, Umeå University.

Technical equipment

In order to participate in the course, access to own computer / laptop is needed together with computer accessories for online communication which includes camera and a headset with

headphones and mic, and the required statistical software (see list of literature).

Participant limitation and priority

The number of participants is limited to 15. Priority will be given to doctoral students within the Educational sciences if the number of applicants for the course is exceeding the number of places.

The course literature list is available in the form of an appendix