Casual Inference, Unconfoundedness, Regression Discontinuity Designs, and Instrumental Variables

Dates: 1 – 4 July 2024

Instructor: Scott Cunningham
               Ben H. Williams Professor of Economics
               Baylor University

Host: University of Stirling

Workshop Summary

Causal inference uses comparable groups to identify causal effects, but which causal effects, and how do we achieve comparability? The gold standard, as it is sometimes described, is the randomized controlled trial, very common in medicine, agriculture, and some parts of the social sciences as well (e.g., education, development). But randomized experiments are not always feasible, ethical or practical. Furthermore, the randomized experiment is not the only way to achieve comparability. This week we will cover four other methods: the foundations of casual inference, unconfoundedness methods, regression discontinuity designs, and instrumental variables. Our goal is to take you to a place of competency, comprehension and confidence.

Daily Structure

This is a four-day workshop of approximately five hours of lectures per day. The goal of the workshop is for students to gain enough knowledge from the lectures and experience from the programming activities that they become confident and capable to implement and interpret these methods in their own work, as well as continue to learn this new material on their own after the workshop concludes.

Audience

This Summer School is intended primarily for PhD students conducting research in Economics and in other disciplines within the Social Sciences. Staff are also welcome to attend.

Workshop Description

Day 1: Foundations of Casual Inference

On the first day, we will start by introducing the potential outcomes framework, as well as explain a bit about the distinctions between a design approach to causal inference and a model approach. We will introduce the basic definitions of treatment effects we use in causal inference, which we will then also use to explain selection bias and heterogenous treatment effects bias. Randomization is introduced, and a method of making deductions using assumptions like randomization is illustrated. We then move into the use of covariates to solve the problem of causal inference, or what is called unconfoundedness, or sometimes selection on observables. Directed acyclic graph basics is then introduced to guide the selection of those covariates.

Day 2: Unconfoundedness/ Selection on Observables

On day two, more or less, we will introduce the minimum assumptions needed to estimate aggregate causal effects under unconfoundedness. We then introduce the weighting methods and matching methods. The first weighting method is called subclassification. Though it is no longer used, it helps us better understand the challenges we face with all of the nonparametric methods – namely the curse of dimensionality. We then move to exact matching making both subclassification and exact matching the simplest methods when using covariates (but the former is weighting and the latter is imputation). When curse of dimensionality happens, we cannot use either of those "exact" methods, so we move into approximate matching and start with distance minimization methods with and without bias adjustment. We then conclude with regression adjustment and a simulation showing the bias of OLS and additive controls under heterogenous treatment effects.

Day 3: Regression Discontinuity Designs

On the third day, we are either wrapping up regression adjustment or we have already done it. Now we focus on the standard OLS model with additive controls to better understand the underlying weights that it generates and how paradoxical they are with heterogenous treatment effects. After that, we introduce the propensity score and discuss both matching and inverse probability weighting and conclude with a discussion of the double debiased machine learning method.

Day 4: Instrumental Variables

On the last day, we introduce instrumental variables. We focus initially on the Wald estimator so that people understand the basics of IV. We use DAGs to illustrate what constitutes a credible instrumental variables design. We derive the two stage least squares model from the Wald estimator and show that the two are in fact numerically identical. We then go into the weak instrument problem and report the contemporary recommendations for evaluating whether one has a weak instrument problem. We then introduce the LATE theory and move into a discussion of the leniency design and estimating the price elasticity of demand. If on day 4 we still have the time, then we will also review continuous instruments and marginal treatment effects.

Schedule

*** Subject to change ***

Day 1: Monday 1st July Foundations of Casual Inference	
0845	**Arrival and registration** **Welcome from Dr Hector Gutierrez Rufrancos (University of Stirling)**
0900 - 1030	Lecture
1030 - 1045	**Refreshment break**
1045 - 1230	Lecture
1230 - 1330	**Lunch**
1330 - 1530	Lecture
1530 - 1545	**Refreshments**
1600 - End	Visit to the National Wallace Monument (visit begins 1630)

Day 2: Tuesday 2nd July Unconfoundedness/ Selection on Observables	
0845	**Arrival**
0900 - 1030	Lecture
1030 - 1045	**Refreshment break**
1045 - 1230	Lecture
1230 - 1330	**Lunch**
1330 - 1530	Lecture
1530 - 1545	**Refreshment break**
1545 - End	Lecture

Schedule (continued)

Day 3: Wednesday 3rd July Regression Discontinuity Designs	
0845	**Arrival**
0900 - 1030	Lecture
1030 - 1045	**Refreshment break**
1045 - 1230	Lecture
1230 - 1330	**Lunch**
1330 - 1530	Lecture
1530 - 1545	**Refreshment break**
1545 - 17:00	Lecture
18:00 - 20:00	**Dinner at the Stirling Court Hotel**

Day 4: Thursday 4th July Instrumental Variables	
0845	**Arrival**
0900 - 1030	Lecture
1030 - 1045	**Refreshment break**
1045 - 1230	Lecture
1230 - 1330	**Lunch**
1330 - 1530	Lecture
1530 - 1545	**Refreshment break**
1545 - 17:00	Lecture

Fees and Registration

	Course Fee only*	Course Fee with Accommodation	Application Portal Opens	Application Portal Closes
PhD students from within Scotland	£200	£300	14 May 2024	14 June 2024
Members of staff affiliated with an SGPE-member HEI	£300	£400	14 May 2024	14 June 2024
External Participants	£400	£500	14 May 2024	14 June 2024

* Apart from the costs directly associated with the Summer School, the course fees cover lunch each day and refreshments provided during the morning and afternoon breaks. The fees also cover a visit to the National Wallace Monument on the afternoon of July 1st, and a group dinner on the evening of July 3rd at the Stirling Court Hotel.

Delegates who apply for accommodation will be housed on campus in University of Stirling student accommodation in self-contained flats with 5 bedrooms each.

Those selecting Course Fee only must arrange accommodation separately.

Nearby Hotels

- Stirling Court Hotel
- Stirling Highland Hotel
- The Golden Lion
- The Old Tram House B&B
- Castle Walk B&B
- Robert the Bruce Apartment

For further information and to apply, please go to:
SGPE PhD Summer School

Admission decisions will be communicated within a week of the respective application deadline. Registration is to be completed within a week of admission notification, as otherwise the admission decision will be rescinded.

Please direct any queries to the SGPE Office: sgpe@ed.ac.uk