Causal Inference, Spring 2018

Lectures: Mondays, 10.00-11.00 ≻ Bush House S2.05

Seminars: Weeks 2 and 8, 16.00-17.00 ≻ Bush House S2.06

Labs: Weeks 3, 4, 9, and 11, 16.00-18.00 ≻ North Wing E1

Dr. Florian Foos, King's College London	florian.foos@kcl.ac.uk
Office Hours: Mon, 14.00-15.00; Tue, 14.00-15.00, BH(NE), 9.14	
Annabelle Wittels, University College London	annabelle.wittels.16@ucl.ac.uk
Office Hours: Mon, 14.00-15.00, BH(NE) 2.02	

Information: The use of experiments and quasi-experiments in Political Science and Public Policy has exploded over the last decade. This module introduces students to the most common methods of causal inference using potential outcomes notation. It starts with the ideal of a randomized field experiment, and as the semester progresses, moves further away from this ideal, imposing stronger assumptions in the process. The module covers an introduction to randomized field experiments, the regression discontinuity design, difference-in-differences estimation, as well as the synthetic control method. Teaching consists of a weekly lecture, as well as seminars and labs. In the labs students apply methods of causal inference to various causal questions in the fields of Political Economy, Public Policy and Political Science. Students can choose if they would like to conduct data analysis in Stata or in R (subject to demand, two groups will be offered).

Prerequisites: The only pre-requisite is any course covering (at any level of detail) linear regression. There is relatively little assumed knowledge, and the aim is to build the statistical foundations from the ground up. If you have conducted a hypothesis test of any kind, you probably have the requisite skills.

Learning Outcomes: Students will understand the potential outcomes framework, and the key assumptions underlying causal inference, and will be able to choose appropriate methods for a variety of research questions posing different identification challenges. Moreover, they will gain the practical skills of applying these insights and the statistical knowledge to several data problems.

Assessment: The assessment for this module consists of one problem set (40%) and one research design essay (60%). The deadline for the problem set is 14 February at 17.00, and the deadline for the research design essay is 24 April at 17.00.

The problem set combines short theoretical problems, and applied problems requiring data analysis using Stata or R. It will be made available on KEATS on 29 January.

In the research design essay (3500 words) you are asked to write an experimental/quasi-experimental design outlining how you would address a causal research question of your choice in the fields of Political Economy, Public Policy, or Political Science using one of two methods, either a randomized field experiment, or a regression discontinuity design, introduced in class. The research design should include a short literature review, hypotheses, research design, and pre-analysis plan.

Course Page: The course site is set up on KEATS.

Required Textbooks:
Weeks 1-5:
Gerber, Alan and Donald P. Green. *Field Experiments: Design, Analysis, and Interpretation*, New York: W.W. Norton, 2012.

Weeks 7-11:
Angrist, Joshua and Joern-Steffen Pischke. *Mostly Harmless Econometrics: An Empiricists Companion.*, Princeton: Princeton University Press, 2009.

Dunning, Thad. *Natural Experiments in the Social Sciences. A Design-Based Approach*, Cambridge: Cambridge University Press, 2012.

R Intro:
Imai, Kosuke. *Quantitative Social Science. An Introduction*. Princeton: Princeton University Press, 2017.

Recommended Texts on Field Experiments:
Glennerster, Rachel and Kudzai Takavarasha. *Running Randomized Evaluations: A Practical Guide*, Princeton University Press. 2013.

John, Peter. *Field Experiments in Political Science and Public Policy: Practical Lessons in Design and Delivery*, Routledge, 2017.

Karlan, Dean and Jacob Appel. *Failing in the Field*, Princeton University Press, 2016.

Recommended Texts on Quasi-Experiments:
Gertler, Paul J., Sebastian Martinez, Patrick Premand, Laura B. Rawlings, Christel M. J. Vermeersch. *Impact Evaluation in Practice.* Washington D.C.: The World Bank, 2011.

Imbens, Guido W. and Donald B. Rubin. *Causal Inference for Statistics, Social and Biomedical Sciences: An Introduction.* Princeton: Princeton University Press, 2015.

Software: Students will have a choice between using STATA or R. If you are unfamiliar with both languages, I would suggest using R, as it is free and open source. All analyses that we will consider are easily done in either language.

Lecture Outline

PART I: Randomized experiments

1. Introduction and basics
2. Sampling distribution and hypothesis testing
3. Using covariates in experimental designs
4. Non-compliance
5. Attrition and spillovers
6. Reading Week

PART II: Quasi-experiments

7. Regression Discontinuity Design (RDD): Basics

8. Regression Discontinuity Design (RDD): Robustness, fuzzy - and spatial RDD
9. Difference-in-Differences Design (DiD): Basics
10. Difference-in-Differences Design (DiD): Clustering and fixed effects generalisation
11. Synthetic Control Method (SCM)

PART I: Randomized experiments

Week 1, 15 January

Lecture: Introduction and basics

Gerber and Green: Chapter 1.

Holland, Fundamental Problem of Causal Inference

Gelman, Forward Causal Inference

- What is causal inference
- What is an experiment
- Unobserved heterogeneity
- Random assignment
- Potential outcomes
- Three core assumptions

Week 2, 22 January

Lecture: Sampling distribution and hypothesis testing

Gerber and Green: Chapters 2 and 3.

- Difference-in-means estimator of the ATE
- Sampling distribution of the ATE
- The sharp null hypothesis
- Randomization Inference
- Confidence intervals

Seminar: Discussion of readings

- Page, Steward. 1998. Accepting the Gay Person. *Journal of Homosexuality* 36(2): 31-39.
- Rind, Bruce and Bordia, Pheasant, 1996. *Effect on Restaurant Tipping of Male and Female Servers Drawing a Happy, Smiling Face on the Backs of Customers' Checks.* Journal of Applied Social Psychology 26(3): 218-225.

Practice problems

- Gerber and Green Chapter 1, Question 4
- Gerber and Green Chapter 2, Questions 2, 6, 9, and 12.
- To get feedback on your practice, please email your answers to Annabelle on Monday of week 3.

Week 3, 29 January

Lecture: Using covariates in experimental designs

Gerber and Green: Chapter 4

- Use of covariates in an experimental design
    1. Blocks
    2. Clusters
- Use of covariates in an experimental analysis
    1. Inclusion of pre-treatment covariates
    2. Inverse-probability-weights
    3. Difference scores
    4. Balance checks
    5. Avoiding post-treatment bias

Lab: Basics of experimental analysis

- Load in a simulated dataset that includes $Y(0)$ and $Y(1)$.
- Simulate a random assignment
- Generate a sampling distribution
- Learn to obtain a p-value via randomization inference

Week 4, 5 February

Lecture: Non-compliance

Gerber and Green: Chapter 5 and 6

- One-sided noncompliance
- Two-sided noncompliance
- The Intent-to-Treat Effect (ITT)
- The Complier Average Causal Effect (CACE)
- Two-stage least squares estimation
- Design-based solutions (placebo-designs)

Lab: Use of covariates and estimating the CACE

- Learn how clustering can widen a sampling distribution
- Learn how blocking can tighten a sampling distribution
- Learn how covariate adjustment can tighten a sampling distribution
- How to estimate the CACE

Week 5, 12 February

Lecture: Attrition and spillovers

Gerber and Green: Chapter 7 and 8

- Attrition:
    1. Attrition as a potential outcome
    2. MIPO
    3. MIPO | X and IPW
    4. MITA
    5. How to avoid attrition
    6. What to do about attrition (Manski- and Lee bounds, double sampling)
    7. What not to do (introducing post-treatment bias)
- Spillovers:
    1. Violations of the non-interference assumption
    2. Localised interference
    3. Extending schedule of potential outcomes
    4. New estimands
    5. Analysis and design-based solutions to spillovers

Week 6, Reading Week

PART II: Quasi-Experiments

Week 7, 26 February

Lecture: Regression Discontinuity Design (RDD)

Angrist and Pischke, chapter 6

Dunning, chapters 1 and 3

Campbell, Donald T. 1969. Reforms as experiments. *American Psychologist* 24(4): 409-429.

- What is a quasi-experiment
- RDD assumptions
- The running and assignment variables
- Polynomial estimation
- Different bandwidth estimators

Week 8, 5 March

Lecture: Robustness, fuzzy - and spatial RDD

Imbens, Guido W., and Thomas Lemieux. 2008. "Regression discontinuity designs: A guide to practice." *Journal of econometrics* 142(2): 615-635.

Caughey, Devin, and Jasjeet S. Sekhon. 2011. "Elections and the regression discontinuity design: Lessons from close US house races, 19422008." Political Analysis 19(4): 385-408.

Keele, Luke, and Rocio Titiunik. 2016. "Natural experiments based on geography." *Political Science Research and Methods* 4(1): 65-95.

- Non-parametric estimation
- Robustness checks: Balance tests, McCrary sorting test
- Fuzzy RDD
- Spatial RDD

Seminar: Discussion of readings

Lee, David S. 2008. "Randomized experiments from non-random selection in US House elections." *Journal of Econometrics* 142(2): 675-697.

Dinas, Elias, and Florian Foos. 2017. "The National Effects of Subnational Representation: Access to Regional Parliaments and National Electoral Performance." *Quarterly Journal of Political Science* 12(1): 1-35.

Week 9, 12 March

Lecture: Difference-in-differences design (DiD)

Angrist and Pischke, chapter 5

Imai, chapter 2

- Basics
- Parallel trends assumption
- Confounding

Week 10, 19 March

Lecture: Extention to multiple groups and time periods

- Multiple groups and treatment periods
- Standard errors and clustering (bootstrap)

Bechtel, Michael M., Dominik Hangartner, and Lukas Schmid. "Does compulsory voting increase support for leftist policy?" *American Journal of Political Science* 60(3): 752-767.

Week 11, 26 March

Lecture: Synthetic Control Method

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2010. "Synthetic control methods for comparative case studies: Estimating the effect of Californias tobacco control program." *Journal of the American Statistical Association* 105(490: 493-505.

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2015. "Comparative politics and the synthetic control method." *American Journal of Political Science* 59(2): 495-510.

Abadie, Alberto, and Javier Gardeazabal. 2003. "The economic costs of conflict: A case study of the Basque Country." *The American Economic Review* 93(1): 113-132.

- Basics
- Assumptions
- Robustness

Lab: DiD and SCM

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2011. "Synth: An R Package for Synthetic Control Methods in Comparative Case Studies." J*ournal of Statistical Software* 42(13): 1-17.

- Estimate the DiD
- Apply the SCM using the Synth package