MOEC0338: Program Evaluation and Causal Inference

Spring Term 2021

Pietro Biroli
Email: pietro.biroli@econ.uzh.ch

Description

This course provides an introduction to the most common statistical methods used in **program evaluation**, which is the subfield of econometrics focusing on the causal estimation of treatment effects.

In other words, this course will provide you with some tools to answer the questions: "What are the consequences of participating in this particular program? **What are the causal effects of this specific public policy?**"

The lectures will be theoretical and centered around the concepts of causal inference and estimation, although real world examples in the field of health and labor economics will be used to illustrate the statistical methods. The TA sessions, the problem sets, and the exam will be more practical and empirical.

We will first discuss the general framework based on counterfactual outcomes, and then we will go through the main methods available to the empirical researcher to estimate causal parameters. We will stress how these methods require different assumptions about the assignment mechanism, i.e. the mechanism used to assign individuals to the treatment or the control group. We will start with the assumption that assignment is (conditionally) random, and discuss suitable methods such as OLS regression and matching. We will then consider a confounded assignment mechanism, and discuss instrumental variable analysis (IV) as well as methods that leverage particular policy designs, such as differences-in-difference (DiD) – which relies on the longitudinal nature of the data – or regression discontinuity design (RDD) – which exploits changes in the probability of receiving treatment due to discontinuities in the assignment mechanism. Finally, we will discuss the empirical validity of these different methods in recovering the underlying causal parameters of interest.

Target Audience and Prerequisites

The course is targeted at students at the master level who want to become familiar with modern econometric methods for causal inference. Although the course will cover some details and derivations, we will focuses mainly on practical applications and intuition behind identification and inference. Participants are expected to have basic knowledge of statistics and regression models at the level of Green (2012), Wooldridge (2013) or Stock (2012). A good preparatory class for this course is *Empirical Methods (MOEC0021)*.

Rules of the Game

Come to class prepared: do the necessary readings **beforehand**! Download the lecture slides before and be prepared to participate to the class discussion.

TA Session

Exercises will take place every week, paralleling the material discussed in the lectures and covering both hands-on and computer exercises. We expect students to have some working knowledge of a statistical software, i.e. R or STATA. R is open source, you can download it for free. STATA is commercial software. Moreover, the first series of exercises will review some of the concepts which are used throughout the lecture (e.g. some basics from statistics and the linear regression model).

Evaluation and Grading

Causal inference and proper estimation procedures are better understood when digested slowly over time. Therefore, attendance and class participation are fundamental, along with careful and timely completion of problem sets. The final grade will be on the usual scale of 1 to 6, and will be determined according to the following weights:

- Class Participation – 20%
- Problem Sets – 30%
- Final Project – 50%

Class Participation: besides active participation to the class discussion with fruitful and insightful questions or comments, you will be required to present the summary of a paper during the TA session. The short presentation will be made by a *small group* of students; it will summarize the results of one paper from the reading list which uses the tools studied during the previous lectures. (See the presentation handout for guidelines and suggestions.)

Problem Sets: A new problem set will be due (roughly) every two weeks. It will involve both theoretical and practical questions on the methods studied during class, with a strong focus on hands-on approaches in STATA or R. Expect challenging problem sets that might take many hours (possibly days if you are not familiar with statistical software). The problem sets have to be completed in *small* groups.

Final Project: By the end of the class you will be equipped with the necessary tools to plan a research project of your own. Therefore I will ask you to design the evaluation of a program or a public policy that you care about. A final paper of about 10 pages describing such evaluation will be due on June 15 (See the 'final project' handout for guidelines and suggestions.)

Office Hours

Please contact Annemarie Kaufmann (Email: annemarie.kaufmann@econ.uzh.ch) for an appointment. If you have any questions concerning class and exam schedule, problem sets or the TA sessions, please contact Miriam Venturini (Email: miriam.venturini@econ.uzh.ch).

Times and Locations

Lecture: Tuesday, 08:15 - 09:45, Zoom link
TA session: Wednesday, 16:15 - 17:45, Zoom link

Final Project Deadline: Tuesday, 15.06.2021, 10:00

Tentative Schedule

Week	Date	Lecture
1	23/02	Introduction
2	02/03	Treatment Parameters
3	09/03	Experiments (I)
4	16/03	Experiments (II)
5	23/03	Instrumental Variables (I)
6	30/03	Instrumental Variables (II)
7	13/04	Panel Data Methods (I)
8	20/04	Panel Data Methods (II)
9	27/04	Regression Discontinuity Design
10	04/05	Matching (I)
11	11/05	Matching (II)
12	18/05	Evaluation of Econometric Models
13	25/05	Guest Lecture by Claudio Schilter
14	01/06	Conclusion and Take-Home Message

Week	Date	Tutorial
2	03/03	Basics Turn in Problem Set 1 Hand out Problem Set 2
3	10/03	Tips for working in Stata
4	17/03	Turn in Problem Set 2 Hand out Problem Set 3
5	24/03	Students' Presentations
6	31/03	Turn in Problem Set 3 Hand out Problem Set 4
7	14/04	Students' Presentations
8	21/04	Turn in Problem Set 4 Hand out Problem Set 5
9	28/04	Students' Presentations
10	05/05	Turn in Problem Set 5 Hand out Problem Set 6
12	19/05	Students' Presentations
13	26/05	Turn in Problem Set 6 Hand out Problem Set 7
14	02/06	Turn in Problem Set 7

Lecture 1: Introduction

Purpose of the course; purpose of program evaluation; common mistakes; the evaluation problem; the selection problem; the potential outcomes approach.

Lecture 2: Treatment Parameters

Average treatment effect, Treatment on the Treated, Treatment on the Untreated

Tutorial 1: Background: Math and Statistics
Review of the basic principles of OLS and regression
Turn in Problem Set 1. Go over the solutions in class
Hand out Problem Set 2: Treatment parameters

Lecture 3: Experiments (I)

The rationale of random assignment, internal validity, external validity.

Tutorial 2: Background: Effective Working with Stata, Presentations
Tips for working with Stata
Guidelines for students' presentations

Lecture 4: Experiments (II)

Threats: randomization, compliance, confusion

Tutorial 3: PS solutions
Turn in Problem Set 2: Treatment parameters. Go over the solutions in class
Hand out Problem Set 3: Experiments

Lecture 5: Instrumental Variables (I)

Instrumental Variables and 2-Stage-Least-Squares

Tutorial 4: Students' presentations
First session of students' presentations

Lecture 6: Instrumental Variables (II)

Local Average Treatment Effect, weak instruments, overidentification test

Lecture 7: Panel Data Methods (I)

Natural experiments, Differences-in-Differences

Tutorial 5: PS Solutions and students' presentation
Second session of students' presentations
Turn in Problem Set 3: Experiments. Go over the solutions in class

Lecture 8: Panel Data Methods (II)

Fixed effects and DiD generalization

Tutorial 6: PS solutions

Turn in Problem Set 4: IV. Go over the solutions in class
Hand out Problem Set 5: DiD

Lecture 9: Regression Discontinuity Design

Sharp and fuzzy Regression Discontinuity Design

Tutorial 7: PS solutions and students' presentations

Third session of students' presentations
Turn in Problem Set 5: DiD. Go over the solutions in class.
Hand out Problem Set 6: RDD

Lecture 10: Matching (I)

Selection on observables, regression, and matching

Lecture 11: Matching (II)

Propensity score matching and weighting

Lecture 12: Evaluation of Econometric Models

The Lalonde Critique: do we have the right statistical and economic model?

Tutorial 8: PS solutions and students' presentations

Fourth session of students' presentations
Turn in Problem Set 6: RDD Go over the solutions in class.
Hand out Problem Set 7: Matching

Lecture 13: Guest Lecture by Claudio Schilter — Introduction to Machine Learning

Lecture 14: Conclusions and take home message

Tutorial 9: PS solutions and students' presentations

Fifth session of students' presentations
Turn in Problem Set 7: Matching. Go over the solutions in class

Readings

The course will be structured around the slides, which will be presented in class at every lecture. These are based on the following books and three academic articles. By the end of the course, you should be very familiar with these books and know every detail of these three articles:

Angrist, J.D., and J.S. Pischke (2009). "Mostly Harmless Econometrics: An Empiricist Companion." Princeton University Press.

Cunningham, Scott (2021) "Causal Inference: *The Mixtape*" https://mixtape.scunning.com/

Blundell, R., and M. Costa Dias (2009). "Alternative Approaches to Evaluation in Empirical Microeconomics." Journal of Human Resources, 44(3), 565–640.

Imbens, G., and J.F. Wooldridge (2009). "Recent Developments in the Econometrics of Program Evaluation." Journal of Economic Literature, 47(1): 5-8.

Here below a list of topic-specific readings as well as some useful books. **Items marked with a star * must be read before class**; items marked with two stars ** will be presented by students. Items without any star are complementary readings for the interested student.

Introduction

* Blundell and Costa Dias (2009), section I

* Imbens and Wooldridge (2009), section 1 and 2

* Cunningham (2021), Chapter 1

Angrist and Pischke (2009), Chapter 1

Manski, C. F., and Nagin, D. S. (1998). "Bounding Disagreements About Treatment Effects: A Case Study of Sentencing and Recidivism." Sociological Methodology, 28(1), 99–137.

Heckman, J. J. (2005). "The scientific model of causality." Sociological Methodology, 35(1), 1–97.

Heckman, J. J., and Vytlacil, E. (2007). "Econometric evaluation of social programs, part I: Causal models, structural models and econometric policy evaluation." Handbook of Econometrics, 6, 4779–4874.

Treatment Parameters

* Blundell and Costa Dias (2009), section II

* Imbens and Wooldridge (2009), section 3

* Cunningham (2021), Chapter 4

Heckman, J. J., and E. Vytlacil (2001). "Policy-relevant Treatment Effects." The American Economic Review, 91(2), 107–111.

Heckman, J. J., and E. Vytlacil (2007). "Econometric evaluation of social programs, part I: Causal models, structural models and econometric policy evaluation." Handbook of Econometrics, 6, 4779–4874.

Roy, A. D. (1951). "Some thoughts on the distribution of earnings." Oxford Economic Papers, 3(2), 135–146.

Experiments

Angrist and Pischke (2009), Chapter 2

* Blundell and Costa Dias (2009), section III

* Imbens and Wooldridge (2009), section 4

* Duflo, E., R. Glennerster and M. Kremer (2008). "Using Randomization in Development Economics Research: A Toolkit." in T.P. Schultz and J.A. Strauss eds. Handbook of Development Economics, vol. 4. New York: Elsevier Science. Section 1, 2 and 8.

Krueger, A. B. (1999). "Experimental Estimates of Education Production Functions." The Quarterly Journal of Economics, 114(2), 497–532.

Bloom, H.S., L. L. Orr, S.H. Bell, G. Cave, F. Doolittle, W. Lin and J.M. Bos (1997). "The Benefits and Costs of JTPA Title II-A Programs." Journal of Human Resources, 32, 549-576.

Rosenbaum, P.R. (1995). "Observational Studies." New York: Springer-Verlag. Chapter 2.

DiNardo J. and D. S. Lee (2010). "Program Evaluation and Research Design," Handbook of Labor Economics, Vol. 4A.

Miguel E. and M. Kremer (2004). "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities," Econometrica 72(1), 159-217.

List, J. A., S. Sadoff and M. Wagner (2011). "So you want to run an experiment, now what? Some simple rules of thumb for optimal experimental design." Experimental Economics, 14(4), 439–457.

The New York Times (March 9, 1993). "Like a New Drug, Social Programs Are Put to the Test." By Peter Passell.

** Kuziemko, Ilyana, Norton, Michael I., Saez, Emmanuel, & Stantcheva, Stefanie (2015). How elastic are preferences for redistribution? Evidence from randomized survey experiments. *American Economic Review, 105*(4), 1478-1508.

** Jonathan L. Weigel. "The Participation Dividend Of Taxation: How Citizens In Congo Engage More With The State." (2019). *Working Paper*

Instrumental Variables

Angrist and Pischke (2009), Chapter 4

* Cunningham (2021), Chapter 7

* Blundell and Costa Dias (2009), section VI

* Imbens and Wooldridge (2009), section 6.3

Angrist, J.D. and A. Krueger (1991). "Does Compulsory School Attendance Affect Schooling and Earnings?" Quarterly Journal of Economics, 106(4), 979-1014.

Angrist, J.D., G.W. Imbens and D.B. Rubin (1996). "Identification of Causal Effects Using Instrumental Variables." Journal of the American Statistical Association, 91(434), 444-472.

Angrist, J.D. (1990). "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records." American Economic Review, 80(3), 313-336.

Imbens, G. and J. D. Angrist, (1994). "Identification and Estimation of Local Average Treatment Effects." Econometrica 62(2), 467-475.

Stock, J. H. and M. Yogo (2005). "Testing for Weak Instruments in Linear IV Regression." Ch. 5 in D. W. K. Andrews (ed.), Identification and Inference for Econometric Models, New York, Cambridge University Press.

** Blanes i Vidal, Jordi, & Tom Kirchmaier (2018). "The effect of police response time on crime clearance rates." *The Review of Economic Studies, 85*(2), 855-891.

** Manacorda, Marco, & Tesei, Andrea (2018). "Liberation technology: mobile phones and political mobilization in Africa." *(forthcoming Econometrica)*

Control Functions

* Blundell and Costa Dias (2009), section VIII

Heckman J.J (1990). "Varieties of Selection Bias." American Economic Review, 80(2), 313-18.

Heckman J.J. (1979). "Sample Selection Bias as a Specification Error." Econometrica, 47(1), 153-161.

Panel Data Methods: Diff-In-Diff

Angrist and Pischke (2009), Chapter 5.1 and 5.2

* Cunningham (2021), Chapter 9

* Blundell and Costa Dias (2009), section IV

* Imbens and Wooldridge (2009), section 6.5

Card, D. and A.B. Krueger (1994). "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania." American Economic Review, 84(4), 772-793.

Card, D. and A.B. Krueger (2000). "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Reply." American Economic Review, Vol. 90, No. 5, pp. 1397–1420.

Ashenfelter, O. and D. Card (1985). "Using the Longitudinal Structure of Earnings to Estimate the Effects of Training Programs." Review of Economics and Statistics, 67(4), 648-660.

Card, D. (1990). "The Impact of the Mariel Boatlift on the Miami Labor Market." Industrial and Labor Relations Review, 43(2), 245-257.

Duflo E. (2001), "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment." American Economic Review, 91(4), 795-813.

Bertrand M., E. Duflo, and S. Mullainathan (2004). "How Much Should We Trust Differences-In-Differences Estimates?" The Quarterly Journal of Economics, 119(1), 249-275.

** Cantoni, Davide, Chen, Yuyu, Yang, David Y., Yuchtman, Noam, and Y. Jane Zhang, (2017). "Curriculum and Ideology." *Journal of Political Economy. 125* (2).

** Jensen, Robert (2007). "The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector." *The Quarterly Journal of Economics, 122*(3), 879-924.

** Marie, Olivier, & Ulf Zölitz. (2017). ""High" achievers? cannabis access and academic performance." *The Review of Economic Studies, 84*(3), 1210-1237.

Regression Discontinuity Design: RDD

Angrist and Pischke (2009), Chapter 5.2.1

* Cunningham (2021), Chapter 6

* Blundell and Costa Dias (2009), section VII

* Imbens and Wooldridge (2009), section 6.4

Ludwig, J., and D. L. Miller (2007). "Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design." The Quarterly Journal of Economics, 122(1), 159–208.

Lee, D.S, and T. Lemieux (2010). "Regression Discontinuity Designs in Economics." Journal of Economic Literature, 48(2), 281-355.

Hahn, J., P. Todd and W. van der Klaauw (2001). "Identification and Estimation of Treatment Effects with a Regression Discontinuity Design." Econometrica, 69(1), 201-209.

Angrist, J. D. and V. Lavy (1999). "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement." Quarterly Journal of Economics, 114(2), 533-775.

Imbens, G. and T. Lemieux (2007). "Regression Discontinuity Designs: A Guide to Practice." Journal of Econometrics, 142(2), 615-635.

Hainmueller, J., D. Hangartner, and G. Pietrantuono (2015). "Naturalization fosters the long-term political integration of immigrants." Proceedings of the National Academy of Sciences, 112(41), 12651–12656.

Card, D., D.S.-Y. Lee, and Z. Pei (2009). "Quasi-experimental identification and estimation in the regression kink design."

Card, D., D. Lee, Z. Pei, and A. Weber (2012). "Nonlinear Policy Rules and the Identification and Estimation of Causal Effects in a Generalized Regression Kink Design." Cambridge, MA: National Bureau of Economic Research.

Calonico, S., M. D. Cattaneo, R. Titiunik(2014). "Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs." Econometrica, 82(6), 2295–2326.

Calonico, S., M. D. Cattaneo, and R. Titiunik(2014). "Robust data-driven inference in the regression-discontinuity design." Stata Journal, 14(4), 909–946.

** Dell, Melissa and Pablo Querubin (2018). "Nation Building Through Foreign Intervention: Evidence from Discontinuities in Military Strategies." *Quarterly Journal of Economics133* no.

2, 701-764.

** Fujiwara, Thomas. (2015) "Voting Technology, Political Responsiveness, and Infant Health: Evidence from Brazil." *Econometrica, 83*(2).

** Lowes, Sara, Nunn, Nathan, Robinson, James A., and Jonathan L. Weigel (2017). "The Evolution of Culture and Institutions: Evidence from the Kuba Kingdom." *Econometrica*, 85(4).

** Dell, Melissa. (2010) "The persistent effects of Peru's mining mita." *Econometrica* 78, no. 6: 1863-1903.

Matching

Angrist and Pischke (2009), Chapter 3.3

* Cunningham (2021), Chapter 5

* Blundell and Costa Dias (2009), section V

* Imbens and Wooldridge (2009), section 5

Dehejia R. H. and S. Wahba (1999). "Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programs." Journal of the American Statistical Association, 94(448), 1053-1062.

Angrist, J. (1998). "Estimating the Labor Market Impact of Voluntary Military Service Using Social Security Data on Military Applicants." Econometrica, 66(2), 249-288.

Smith, J. A. and P. E. Todd (2005). "Does Matching Overcome Lalonde's Critique of Nonexperimental Estimators?" Journal of Econometrics, 125(1-2), 305-353.

Heckman, J.J., H. Ichimura and P.E. Todd (1997). "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme." Review of Economic Studies, 64(4), 605-654.

Rosenbaum, P.R., and D. B. Rubin (1983). "The Central Role of the Propensity Score in Observational Studies for Causal Effects." Biometrika, 70(1), 41-55.

Evaluation of Models

* LaLonde, R. (1986). "Evaluating the Econometric Evaluations of Training Programs with Experimental Data." American Economic Review, 76(4), 604-620.

Smith, J. and P. Todd (2005). "Does Matching Overcome LaLonde's Critique of Nonexperimental Estimators." Journal of Econometrics, 125(1-2), 305-353.

Machine learning

* Hastie, Trevor, Tibshirani, Robert, & Friedman, Jerome (2017). "The Elements of Statistical Learning." **Introduction, page 20 to 27 of the pdf** available here.

Hastie, Trevor, Tibshirani, Robert, & Friedman, Jerome (2017). "The Elements of Statistical Learning." pdf available here.

James, Gareth, Witten, Daniela, Hastie, Trevor, & Tibshirani, Robert (2013) "An introduction to statistical learning." pdf available here

** Bursztyn, Leonardo, Fujiwara, Thomas, & Amanda Pallais (2017). "'Acting Wife': Marriage Market Incentives and Labor Market Investments." *American Economic Review*, 107(11), 3288-3319.

** Dube, , & Harish, S. P. (2020). "Queens", *Journal of Political Economy*, vol 128(7), pages 2579-2652.

Useful Econometric Books

Prerequisites

Greene, W. H. (2012). Econometric Analysis (7th intern). Boston: Pearson.

Stock, J. H., and Watson, M. W. (2015). Introduction to econometrics. Harlow: Pearson Education.

Wooldridge, J. M. (2013). Introductory Econometrics: A Modern Approach (5th intern). Australia: South-Western Cengage Learning.

Microeconometrics and Impact Evaluation

Cameron, A. C. and P. K. Trivedi (2005). Microeconometrics: Methods and Applications, Cambridge University Press, New York, Chapters 21- 23.

Wooldridge, J. M. (2002). Econometric Analysis of Cross Section and Panel Data, MIT Press, Cambridge MA.

Gertler, P. J., S. Martinez, P. Premand, L.B. Rawlings, and C.M.J. Vermeersch (2016). "Impact Evaluation in Practice. Second Edition" World Bank. ®World Bank. (PDF here)