

## *Ljubljana Doctoral Summer School*

**8 – 12 July 2024**

9:00 – 13:00 (CET, Ljubljana)

### **APPLIED ECONOMETRICS USING STATA (ECTS: 4)**

**Rok SPRUK**

University of Ljubljana, School of Economics and Business, Slovenia

#### **Aims of the course**

This course comprises a short introduction to more advanced econometric techniques in modern empirical research using Stata statistical software. The course consists of the brief review of econometric methods such as linear OLS regression, statistical inference and hypothesis testing, functional forms and model specification, heteroskedasticity and serial correlation, limited dependent variable model and panel data. This part of the course will discuss the assumptions on which basic econometrics techniques are built as well as some empirical applications. The second part of the course consists of the rigorous treatment of main microeconomic techniques used to deal with endogeneity, sample selection, and parameter sensitivity. This part of the course will also discuss the cutting-edge techniques used to address causal relationship and evaluate policy interventions such as difference-in-differences, randomized experiments, local average treatment effect (LATE) and instrumental variables (IV) propensity scores and matching, regression discontinuity design (RD), quantile regressions, synthetic control methods, and the standard error issue. Substantial attention is paid to issues of empirical design and microeconomic evaluation methods such as internal and external validity, counterfactuals, confounders, compliers, always takers, parallel trend assumption, treatment effects and quasi-natural experiments.

By the end of the course, the participants will understand the mechanics, assumptions and statistical properties of econometric techniques, derive the key estimators and testing procedures, select the estimation technique, apply the estimator and interpret the estimation results. By the end of the second part of the course, the participants will be able to understand the issue of causality, model selection and endogeneity, select the empirical methods that enable the causal interpretation of the parameter estimates. They will be able to gain further insights into the cutting-edge techniques that drove the credibility revolution in empirical microeconomics such, recognize and build an econometric program design and apply the research design to test empirically the theoretical models.

#### **Syllabus**

1. The ABC of Linear Regression: Review of probability theory, basic concepts, OLS and linear regression, statistical inference and hypothesis testing, function forms and model specification, non-linear regression models, dummy variables, heteroskedasticity and serial correlation, generalized least squares (GLS), outliers, interaction terms, heterogeneity

2. Panel Data Techniques: linear regression model with unobserved spatial and temporal heterogeneity, fixed effects-, between effects-, and random-effects estimator, model specification and Mundlak-Hausman specification tests, first-differences vs. fixed-effects
3. Limited Dependent Variable Models: linear probability model (LPM), probit estimator, logit estimator, marginal effects, regression diagnostics and statistical inference with limited dependent variables
4. Difference-in-differences (DD) and randomized experiments: main assumptions, model construction and hypothesis testing, policy evaluation with diff-in-diff, parameter sensitivity, parallel trend assumption, DD under two- and multiple-treatment regimes, DD vs. classical fixed-effects estimator, randomized experiments, quasi experiments and natural experiments, selection bias, average treatment effect (ATE)
5. Instrumental Variables (IV): omitted variable bias and the endogeneity dilemma, instrumental variables, relevance and exogeneity conditions, Wu-Hausman endogeneity test, tests of overidentifying restrictions and instrument validity, underidentification and weak identification tests, first-stage parameter estimates, reduced-form estimates, local average treatment effect (LATE), two-stage least squares (2SLS)
6. Propensity Scores and Matching: statistical methods for observational data, main assumptions and parameter inference, confounding bias, Rosenbaum-Rubin causal model, standard unit treatment value assumption, nearest-neighboring matching models
7. Regression Discontinuity Design: basic concepts and main assumptions, sharp RD, fuzzy RD, treatment and assignment mechanism, f-discontinuity function estimation, non-parametric vs. polynomial function estimation, graphical analysis of RD estimates, lowess estimator, validity of RD empirical design, Maimonides rule, regression kink design
8. Synthetic Control Method and Quantile Regressions: Abadie-Gardeazabal synthetic control method, main assumptions, econometric model specification, parameter estimation and evaluation, determination of treatment, parameter sensitivity, non-parametric synthetic control method, quantile regression function and estimation, main assumptions, quantile distribution function, distributional vs. non-distributional effects, effect simulation, empirical applications
9. Standard Errors: the bias of classical standard errors, Huber-Eicker-White robust OLS variance-covariance matrix estimator, Moulton bias, clustering and serial correlation in cross-section and panel model, over-rejection rates under standard hypothesis testing, Cameron-Gelbach-Miller multiway clustering scheme and error components, wild bootstrapping

### **Course materials / List of readings**

- Angrist, Joshua D., Pischke J.S. Mostly Harmless Econometrics: An Empiricist's Companion. Princeton University Press, 2009.

- Angrist, Joshua D., Pischke J.S. Mastering Metrics: The Path from Cause to Effect. Princeton University Press, 2015.
- Wooldridge, Jeffrey. Introductory Econometrics: A Modern Approach. Cengage Learning, 2012.
- Stock, James H. & Watson, Mark W. Introduction to Econometrics. Addison-Wesley Series in Economics, 2010.

A reader will be provided to the participants with the selection of journal articles.

## Prerequisites

This course has two formal entry requirements. The first requirement is that participants should be familiar with advanced undergraduate statistics and first-year graduate econometrics. Taking classes in these courses before this course is highly desirable. Second, prior knowledge of introductory and some advanced statistics and econometrics is obligatory and essential.

## Course leader

*Rok Spruk obtained a PhD in Quantitative Economic History in 2016 from Utrecht University, the Netherlands. He is an Assistant Professor at the School of Economics and Business of the University of Ljubljana and is a joined member of Econometric Society, American Economic Association, Austrian Society for New Institutional Economics, American Law and Economics Association and German Law and Economics Association. In 2010, he started working at the European Enterprise Institute in Brussels and published two reports on Iceland's economic and financial crisis. In 2012, he enrolled in a Master program on international economics specializing in the globalization and development track at Utrecht School of Economics and graduated in the same year with a thesis on the augmented Solow growth model with institutions. In the same year, he was employed to prepare the proposal for the PhD in Economics and Social History under the supervision of prof. dr. Jan Luiten van Zanden. In 2013, he obtained the PhD position at the Department of Economics and Social History in a research project on institutions, growth and long-run development which resulted in this thesis. In 2015, he won Young Scholar Prize at the International Law and Economics conference in Ankara, Turkey for the paper on electoral law enforcement, political institutions and Latin America's long-run development. His research interests encompass economic growth and development, new institutional economics, applied econometrics, causal inference methods, intellectual property and economic history. At the moment, he has published six high-ranked SSCI publications. His work has been accepted for full presentation at several high-profile conferences such as American Economic Association's Annual Meeting.*

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