Outline of the

Applied Economics and Econometrics sequence at the EUI

Academic year: 2020-21

This version: May 17, 2020

Courses and instructors

Core 1A: Pre-course on probability and statistics
Tiziano Arduini (tiziano.arduini@unibo.it)

Core 1B: Regression analysis
Andrea Ichino (andrea.ichino@eui.eu)

Core 2: Econometrics models for micro data
Sule Alan (sule.alan@eui.eu)

Core 3: Dynamics: Time Series and Simulation Based Estimators
Russell Cooper and Jesus Bueren (russellcoop@gmail.com jesus.bueren@eui.eu)

Optional 1: Introduction to the econometrics of causality
Andrea Ichino (andrea.ichino@eui.eu); Elias Dinas (elias.dinas@eui.eu); Miriam Golden (miriam.golden@eui.eu)

Optional 2: Field experiments
Sule Alan (sule.alan@eui.eu)

Optional 3: Topics in microeconometrics
Thomas Crossley (thomas.crossley@eui.eu)

Optional 4: Economic Measurement
Thomas Crossley (thomas.crossley@eui.eu)

Core 1A: Probability and statistics

Tiziano Arduini (tiziano.arduini@unibo.it)

The main goal of this Core course is to give an introduction to the axiomatic foundations of probability theory and to the basics of univariate and bivariate statistics. The pre-course will consist of two parts of approximately equal size. The first part will focus on probability theory and will provide a mathematical structure for measures of uncertainty. In the second part the concept of random variables will be introduced and its properties will be discussed. Both parts will contain examples illustrating the basic concepts.

There will be eight lectures and two exercise classes in this part.

Topics

Topic 1

Introduction. Set theory. Basic probability theory. Probability axioms. Joint, marginal and conditional probabilities. Random variables. Probability density and cumulative distribution functions.

Casella and Berger, chapter 1

Topic 2

Expected values. Moments and moment generating functions. Transformations of random variables.

Casella and Berger, chapter 2

Topic 3

Specific densities: discrete and continuous.

Casella and Berger, chapter 3

Topic 4

Multivariate random variables. Joint and marginal distributions. Conditional distributions and independence of random variables. Covariance and correlation. The distribution of order statistics. Bivariate and multivariate normal densities. Conditional normal densities. Bivariate transformations of random variables. Law of Iterated Expectations.

Casella and Berger, chapter 4

Topic 5

Large sample theory. Sums of random variables, convergence concepts. Laws of large numbers. Central limit theorems. The delta method.

Casella and Berger, chapter 5

Exercise classes

There will be 2 exercise classes.

Teaching material

- George Casella and Roger L. Berger. *Statistical Inference.* Thomson, Second Edition, 2002.
- Lecture notes by the instructor.
- Suggested: Richard J. Larsen and Morris L. Marx. *An introduction to mathematical statistics and its applications.* Prentice Hall, Fifth Edition, 2012.

Core 1B: Regression analysis

Andrea Ichino (andrea.ichino@eui.eu)

The main goal of this Core course is to give an introduction to the basic tools that an econometrician needs: the most popular estimation methods; inference and hypothesis testing; asymptotics; simple and multiple regression; instrumental variables.

In addition to the lectures there will be five exercise classes. Examples and applications will be used to illustrate the theoretical content of the course.

Topics

Topic 1

Introduction: what is econometrics about; the tool-box of econometrics; the econometrics sequence at the EUI; Content of this course.
Estimation: Estimators and estimates; the Method of maximum Likelihood; the Method of Moments.

Larsen and Marx, chapter 5. Casella and Berger, chapter 7 . Lecture notes.

Topic 2

Estimation: Finite sample properties of estimators; Unbiasedness, Efficiency,, Sufficiency, Minimum variance estimators; The Cramer-Rao Lower Bound, Invariance.

Larsen and Marx, chapter 5. Casella and Berger, chapter 7 and chapter 5. Lecture notes.

Topic 3

Estimation: Asymptotic properties of estimators; Asymptotic Unbiasedness, Asymptotic Efficiency, Consistency; Asymptotic Normality
Basic asymptotics: concepts of convergence; Law of Large Numbers; Central Limit theorem; Continuous Mapping Theorem, Slutzky Theorem and Delta Method.

Larsen and Marx, chapter 5. Casella and Berger, chapter 7 and chapter 5. Lecture notes.

Topic 4

Simple regression: The Conditional Expectation Function; The Population Regression Function; The Sample Regression Function; OLS,

Method of Moments and Maximum Likelihood estimation of a regression; Algebraic and geometric properties of the OLS-MM estimators.

Angrist and Pischke chapter 1, 2 and 3. Wooldridge part 1. Lecture notes.

Topic 5

Simple regression: Goodness of fit and the R-Squared; Statistical Properties of the OLS-MM estimator; The Gauss-Markov Theorem'.

Angrist and Pischke chapter 1, 2 and 3. Wooldridge part 1. Lecture notes.

Topic 6

Simple regression: Causality and Regression.

Angrist and Pischke chapter 1, 2 and 3. Lecture notes.

Topic 7

Multiple regression: The Conditional Independence Assumption; Interpretation of the partial Multiple Regression Coefficient; Multiple Regression in matrix notation; Omitted variable bias and inclusion of irrelevant regressors.

Angrist and Pischke chapter 1, 2 and 3. Wooldridge part 1. Lecture notes.

Topic 8

Multiple regression: The Gauss-Markov Theorem and Multiple Regression; "Partialling out" and the interpretation of coefficients; Good and bad habits concerning control variables;

Angrist and Pischke chapter 1, 2 and 3. Wooldridge part 1. Lecture notes.

Topic 9

Inference and Hypothesis testing: what is a statistical test and how it is constructed; The decision rule; Type I and type II errors; Power of a test.

Larsen and Marx, chapters 6 and 9. Casella and Berger, chapter 8. Lecture notes.

Topic 10

Inference and Hypothesis testing: finite sample and asymptotic tests in the context of a regression model.

Larsen and Marx, chapters 6 and 9. Casella and Berger, chapter 8. Lecture notes

Topic 11

Instrumental Variable estimation: The traditional interpretation and the Angrist-Imbens-Rubin interpretation of IV; Average Treatment Effect; Average Treatment Effect for the Treated; Local Average Treatment Effect.

Woolridge (2009); Angrist and Pischke (2013). Lecture notes

Exercise classes: TBD

There will be 6 exercise classes.

Teaching material

- Richard J. Larsen and Morris L. Marx. *An introduction to mathematical statistics and its applications.* Prentice Hall, Fifth Edition, 2012.
- George Casella and Roger L. Berger. *Statistical Inference.* Thomson, Second Edition, 2002.
- Jeffrey Wooldridge, *Introductory Econometrics. A Modern Appproach.* South Western Cengage Learning, 2009
- Joshua Angrist and Jorn-Steffen Pischke. *Mostly Harmless Econometrics. An Empiricist's Companion.* Princeton University Press, 2013.
- Lecture notes by the instructor.

Final exam and Grading

There will be two separate class room exams for Core 1A and Core 1B, but a single final grade based on:

- problem sets (for Core 1A and Core 1B) that will count for 20% of the final grade;
- the exam for Core 1A will count for 20% of the final grade;
- the exam for Core 1B will count for 60% of the final grade.

Core 2: Econometrics models for micro data

Sule Alan (sule.alan@eui.eu)

The course is intended to introduce students to some standard methods specifically designed for the analysis of particular types of microeconomic data. For each method the general theoretical background will be provided, followed by the critical discussion of one or more applied papers.

Topic 1 (4.5 hours)

Introduction: Content of this course.
Binary choices: Linear probability models; Non-linear probability models; Probit, logit; Maximum Likelihood methods.

Wooldridge, Chapter 15

Topic 2 (3 hours)

Multiple choices: Ordered probit models, Multinomial logit models; Independence of irrelevant alternatives.

Wooldridge, Chapter 15

Topic 3 (4.5 hours)

Panel data: Fixed effects models; Random effects models; Conditional logit model, Difference in differences

Wooldridge, Chapter 15

Topic 4 (4.5 hours)

Standard errors: Clustering, Moulton factor, Introduction to basic methods of bootstrapping

Angrist and Pischke, Chapter 8

Topic 5 (4.5 hours)

Count data and duration models: Poisson and negative binomial models, introduction to duration analysis

Wooldrige, Chapters 19 and 20

Exercise classes

There will be 6-8 exercise classes

Teaching material

- Jeffrey Wooldridge, *Introductory Econometrics. A Modern Appproach.* South Western Cengage Learning, 2009
- Lecture notes by the instructor.

Final exam and Grading

There will be final exam.

Core 3: Dynamics: Time Series and Simulation Based Estimators

Russell Cooper (russellcoop@gmail.com)
Jesus Bueren (jesus.bueren@eui.eu)

The first part of the course introduces students to the analysis and modelling of time series processes, including stationary and non-stationary stochastic processes, estimation and shock identification in multivariate time series. The second part focuses on estimation and inference using generalized method of moments and simulation based estimators.

Topic 1 (2 h)

Basic Time Series concepts: Stationarity, Ergodicity and Markovian Transition.

Hamilton (Chapters 2, 7), Lecture notes.

Topic 2 (4 h)

Univariate ARMA Models: Identification (ACF and PAF) and Estimation.

Hamilton (Chapter3), Lecture notes.

Topic 4 (4 h) *Multivariate VAR Models and the State Space Representation*: Specification, Estimation and Structural Shocks Identification, the Kalman Filter.

Hamilton (Chapter 11, 13), Lecture notes.

Topic 5 (4 h)

Generalized Method of Moments: Estimation and Inference

- Adda and Cooper, Chpt. 4
- Hansen, L. and K. Singleton, "Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models," *Econometrica*, 50 (1982), 1269-86.
- J. Wooldridge,(2010) *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Chpt. 8

Topic 6 (7 h)

Simulated Method of Moments: Estimation and Inference

- Adda and Cooper, Chpts. 5-8.
- Adda, J. and R. Cooper, "Balladurette and Juppette: A Discrete Approach," *Journal of Political Economy*, August, 2000.
- Cooper, R. and G. Zhu, "Household finance over the life-cycle: What does education contribute?" *Review of Economic Dynamics*, 20 (2016), 63-89.
- Cooper, R. and J. Haltiwanger, "On the Nature of Capital Adjustment Costs," *Review of Economic Studies*, 73 (2006), 611-33.
- Gourierous, C. and A. Monfort,(1996) *Simulation Based Econometric Methods*, Oxford University Press.
- Smith, A. "Estimating Nonlinear Time-Series Models using Simulated Vector Autoregressions," *Journal of Applied Econometrics*, 8 (1993), S63-84.

Exercise classes

There will be 6-8 exercise classes

Teaching material

- Adda, J. and R. Cooper, *Dynamic Economics: Quantitative Methods and Applications*, MIT Press.
- Hamilton, J. H. (1994), *Time Series Analysis*, Princeton University Press
- Harvey, A,C. (1993), *Time Series Models*, Harvester-Wheatsheaf
- J. Wooldridge,(2010) *Econometric Analysis of Cross Section and Panel Data*, MIT Press,
- Lecture notes by the instructor.

Final exam and Grading

There will be problems set to be graded by TAs in classes (20%) and a final exam (80%).

Optional 1: Introduction to the econometrics of causality

Andrea Ichino (andrea.ichino@eui.eu)
Elias Dinas (elias.dinas@eui.eu)
Miriam Golden (miriam.golden@eui.eu

This course will be taught jointly with the SPS department. It will feature 20 lectures from mid September until December and it will give two credits to students passing the final exam. Students are allowed to attend also half of the lectures (at their choice) in which case the course will give 1 credit.

1. Introduction to Causality (1 lectures) ANDREA, MIRIAM
    - The problem and examples
    - The potential outcomes framework
    - Why the naive estimator is not a solution
    - Sample selection bias
2. Randomized experiments (1 lecture) ELIAS
    - The best solution with some cons: theory, external validity
    - Randomization inference
    - Randomized control trials
    - Examples
3. Standard regression analysis and causality (1 lecture) ANDREA
    - The Population Regression function
    - Conditions under which it has a causal interpretation
    - RCT and regression
    - Alternatives when Randomization is not an option: the rest of the course
4. Difference in difference (3 lectures) ELIAS
    - The identification strategy
    - What must be true for the strategy to work: pros and cons
    - Implementation

- Examples

5. Solutions based on control functions (2 lectures) ANDREA
    - Heckman two step procedure
    - Generalized control function approach
    - What must be true for the strategy to work: pros and cons
    - Examples
6. Instrumental variables (2 lectures) ANDREA
    - The traditional intepretation of IV
    - The LATE interpretation of IV
    - What must be true for the strategy to work: pros and cons
    - Examples
7. Regression discontinuity designs (3 lectures) ELIAS (Andrea on multiple threshold and some examples from his work)
    - The identification strategy
    - Sharp RDD
    - Fuzzy RDD and the local LATE interpretation of RDD
    - What must be true for the strategy to work: pros and cons
    - The actual implementation and its problems o Testing identification conditions o Multiple thresholds
    - Examples
8. Natural Experiments (1 lectures) MIRIAM
    - An encompassing logic of design-based causal inference with observational data
    - Examples and Applications
    - What can go wrong
9. Matching methods (1 lecture) ANDREA
    - The identification strategy
    - What must be true for the strategy to work: pros and cons
    - Exact matching

- Propensity score matching
- examples

10. Synthetic control methods (1 lecture) ELIAS
    - The identification strategy
    - What must be true for the strategy to work: pros and cons
    - examples
11. Mediation Analysis (1 lecture) ELIAS
    - Introduction to Directed Acyclic Graphs
    - The back-door criterion
    - The front-door criterion
    - What must be true for the strategy to work: pros and cons
    - examples
12. Uncertainty (2 lectures) ELIAS
    - Parametric Inference
    - Non-parametric inference: resampling with replacement
    - Randomization inference
    - Clustering
13. Wrap Up (1 lecture) ANDREAS, ELIAS, MIRIAM
    - Summary, applications and extensions

Exercise classes

No exercise class

Teaching material

- Articles in journals
- Lecture notes by the instructor.

Final exam and Grading

There will be final class room exam (referee report) and a take home exam (simulation exercise).

Optional 2: Field Experiments: Research Design and Impact Evaluation using RCTs

Sule Alan (sule.alan@eui.eu)

Topic 1

Introduction to Impact Evaluation: Thinking about a major policy problem, designing an experiment to evaluate a program that aims to solve this problem, and evaluating the program in a causal manner to guide policy.

Lecture notes.

Topic 2

Theory of Change and Data: Establishing theory of change and underlying mechanisms in evaluation designs.

Lecture notes.

Topic 3

Randomization in Practice: Random assignment of program participation, cluster designs, phase-in designs, balance checks, research ethics in program participation.

Lecture notes.

Topic 4

Indicators and Measurement: Determining outcomes of interests: Real outcomes, behavioural (incentivized) outcomes, lab-in the field, survey outcomes.

Lecture notes.

Topic 5

Sampling: Determining optimal sample size, power calculations, study registration, pre-analysis plan (PAP). *Lecture notes.*

Topic 6

Threats and analysis: Dealing with missing data, non-compliance, demand effects, and attrition.

Topic 7

Evaluation: ATEs, ITTs LATEs, inference, small sample permutation, mechanism search, mediation analysis.

Lecture notes.

Topic 8

An evaluation from A to Z: Student presentations of the outline of the take home project, receiving feedback.

Teaching material

Course materials will be lecture notes, lecture slides (provided by S. Alan), and assigned journal articles.

Evaluation

Course work will be 20 percent outline presentation 80 percent take home project. The project will be a case study where students are expected to replicate a well-known RCT from design stage to dissemination of the results. There will be no exercise classes.

Optional 3: Topics in Microeconometrics

Thomas Crossley (thomas.crossley@eui.eu)

A course of further topics in microeconometrics with a particular emphasis on problems likely to be encountered in real micro data, and techniques for dealing with those.

Topic 1

The Analysis of Survey Data: How survey data are collected and organized and the implications for econometric analysis. Comparing surveys with administrative and other "naturally occurring" data sources.

Lecture notes and assigned readings.

Topic 2

Data Problems: How missing data and measurement error arise in survey and administrative data; consequences for estimation; econometric and other solutions.

Lecture notes and assigned readings.

Topic 3

Further Topics in Inference: More on nonstandard-standard-errors. The bootstrap. Design-based versus sampling-based approaches to inference. Multiple testing. The role of replication.

Lecture notes and assigned readings.

Topic 4

Introduction to nonparametric and semiparameteric methods: nonparametric methods, semiparametric methods, quantile regression.

Lecture notes and assigned readings.

Exercise classes

No exercise class

Teaching material

- Selected journal articles and additional reading assigned with each lecture.
- Lecture notes provided by the instructor.

Final exam and Grading

There will be final class room exam and a take home exam.

Optional 4: Economic Measurement

Tom Crossley (thomas.crossley@eui.eu)

A first course in Economic Measurement, covering both "micro" and "macro" topics.

Topic 1

Introduction to National Accounting: Output, income and expenditure GDP; Intermediate consumption and value added. Supply-use balancing. Sectoral accounts. National and sectoral balance sheets.

Lequiller and Blades (2014), chapters 1, 4-8, and 10; Lecture notes and additional assigned readings.

Topic 2

Price-Volume Decomposition: Price and quantity Indices. Axiomatic and economic approaches. The CPI in practice. Multilateral price indices and international comparisons.

Lequiller and Blades (2014), chapters 2 and 3; Lecture notes and additional assigned readings.

Topic 3

The Labour Market: Labour market states and labour market flows.

Lecture notes and assigned readings.

Topic 4

Investment, Capital and Productivity: Measuring investment. Estimation of the capital stock. Productivity measurement.

Lecture notes and assigned readings.

Topic 5

Poverty and Inequality: Household income, consumption and wealth. Poverty lines and measures. Inequality measures.

Lecture notes and assigned readings.

Topic 6

Distributional National Accounts: Integrating micro- and macro-data to better understand economic growth.

Lecture notes and assigned readings.

Exercise classes

No exercise class

Teaching material

- Lequiller, F. and D. Blades, (2014). Understanding National Accounts, 2nd Ed. OECD. (available here: http://www.oecd.org/std/UNA-2014.pdf)
- Selected journal articles and additional reading assigned with each lecture.
- Lecture notes provided by the instructor.

Final exam and Grading

There will be final class room exam and a take home exam.