

Outline of the Econometrics sequence at the EUI

August 2018

Instructors

Part 1: Pre-course on probability and statistics

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Part 2: Regression analysis

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Part 3: Econometrics for macro-economics

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Part 4: Econometrics for micro-economics

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1 Part 1: Pre-course on probability and statistics

The main goal of this Part 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.

2 Part 2: Regression analysis

Andrea Ichino (andrea.ichino@eui.eu)

The main goal of this Part 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. Approximately two lectures will be devoted to each of the first three topics while regression will absorb four lectures.

Therefore, there will be ten lectures in this Part plus five exercise classes. Examples and applications will be used in the lectures and particularly in the exercise classes, 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, Slutsky 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

Introduction to Instrumental Variable estimation: .

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

Topic 12

Difference in difference methods: .

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

Exercise classes: Jandarova Nurfatima

There will be 5 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 Approach*. 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 a joint exam for Part 1 (pre-course on probability and statistics) and Part 2 (regression analysis).

The grade will be based on:

- seven problem sets (two for the Pre-course and five for Regression analysis) which will count for 20% of the final grade;

- a final classroom exam in which questions on the material of the Pre-course will count for 20% of the final grade and questions on the material of Part 2 will count for 60% of the final grade.

3 Part 3: Econometrics for macro-economics

Juan Dolado (juan.dolado@eui.eu)

The course is intended to introduce students to the analysis and modelling of time series processes, including stationary and non-stationary stochastic processes, asymptotic theory for regression with integrated variables, estimation and shock identification in multivariate time series, and econometric techniques for the estimation and inference of macro panel data

Topic 1 (4.5 h)

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

Hamilton (Chapters 2, 7), Harvey (Chapter 2), Lecture notes.

Topic 2 (4.5 h)

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

Hamilton (Chapter 3), Harvey (Chapter 5), Lecture notes.

Topic 3 (4.5)

Unit Roots: Asymptotic Theory, Testing and Co-integration.

Banerjee, Dolado, Galbraith and Hendry (Chapter 3), Hamilton (Chapters 17, 18, 19), Lecture notes.

Topic 4 (3.0 h)

Multivariate VAR Models: Specification, Estimation and Structural Shocks Identification.

Hamilton (Chapter 11), Harvey (Chapter 7), Lecture notes.

Topic 5 (4.5 h)

Macro Panel Data: GMM Estimation and Inference

Arellano (Chapter 6), Lecture notes.

Exercise classes

There will be 6-8 exercise classes

Teaching material

- Arellano, M. (2003), *Panel Data Econometrics*, Oxford University Press.
- Banerjee, A., Dolado, J., Galbraith, J. and D. Hendry (1993), *Co-integration, Error Correction, and the Econometric Analysis of Non-Stationary Data*, Oxford University Press
- Hamilton, J. H. (1994), *Time Series Analysis*, Princeton University Press
- Harvey, A.C. (1993), *Time Series Models*, Harvester-Wheatsheaf
- 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%).

4 Part 4: Econometrics for micro-economics

Michele Belot (michele.belot@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 (1.5 hour)

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; Bias in dynamic micro panel data; IV approach; Conditional logit model

Wooldridge, Chapter 15

Topic 4 (3 hours)

Standard errors

Angrist and Pischke, Chapter 8

Topic 5 (3 hours)

Count data and duration models

Woodrige, Chapters 19 and 20

Topic 6 (1.5 hours)

Quantile regression

Angrist and Pische, Chapter 7.

Topic 7 (1.5 hours)

Evaluating an empirical paper

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.