

15M020

6 ECTS

## Quantitative and Statistics Methods

I

### Overview and Objectives

The objective of this course is to familiarize students with the basic most widely used and up-to-date methodologies of applied econometric data analysis, aimed at giving an understanding of the different techniques and enabling students to conduct empirical research projects.

The course covers basic tools needed for empirical economic research. The first part of the course focuses on the use of the linear regression model, including estimation and inference under basic assumptions. The second part of the course introduces other estimation methods (MLE, GMM) that allow for departures from these basic assumptions. Topics such as limited dependent variables, GARCH and DSGE models will be covered. Economic applications are discussed throughout the course.

### Course Outline

#### Part I. Basic Methods for Regression Analysis

##### Introduction to regression analysis

Objectives. Descriptive versus causal econometrics. Experimental versus observational data. Structure of the data. Conditional expectations and regressions.

##### Linear regression basics: Least squares estimation

Least squares estimator. Goodness of fit. Numerical properties. Influential Observations. Linear regression and functional form.

##### Least squares estimation: distribution

Least Squares estimation under ideal assumptions. Finite sample properties. Least squares and maximum likelihood estimation. Least squares and method of moments estimation. Least Squares Asymptotics. Robust standard errors.

##### Linear regression basics: Inference

Inference with exact tests. Testing parameter stability. Confidence intervals and confidence regions. Inference with large sample tests. Introduction to bootstrapping.

##### Data problems and specification analysis

Inference under collinearity · Measurement error in the variables · Missing Observations · Regression diagnostics · Specification tests.

#### Part II. Advanced Estimation Methods

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### **Extremum estimation**

Theory. Numeric optimization methods.

### **Maximum likelihood**

Theory. Limited dependent variables. ARCH/GARCH models. Estimation of linear DSGE models using Kalman filtering.

### **Generalized method of moments**

Theory. Instrumental variables estimation. Hausman-type tests. Estimation of portfolio and real business cycle models.

### **Introduction to Bayesian methods**

Theory. MCMC and sequential Monte Carlo. Examples.

### **Required Activities**

The course will be structured into 6 hours of lectures a week. In addition, the students will have to hand in assignments.

### **Evaluation**

Exam (80%) and problem sets / assignments (20%).

### **Materials**

#### **Introductory textbooks:**

Stock and Watson (2011). Introduction to econometrics. Pearson. 3rd edition.

Wooldridge (2013). Introductory econometrics. 5th edition.

#### **Advanced textbooks:**

Cameron & Trivedi (2005), Microeconometrics: methods and applications. Cambridge University Press.

Creel (2012), Econometrics (<http://pareto.uab.es/mcreel/Econometrics>).

Davidson & MacKinnon (2003), Econometric Theory and Methods. Oxford University Press.

Green (2008), Econometric Analysis. Prentice Hall. 6th edition.

Hayashi (2000), Econometrics. Princeton University Press.

#### **Companion textbooks:**

Angrist & Pischke (2008), Mostly Harmless Econometrics: An Empiricist's

Companion. Princeton University Press.

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Kennedy(2008) A Guide to Econometrics. Wiley-Blackwell. 6th edition.