**Econometrics (curriculum Management of bank and insurances)**

## Prof. Andrea Monticini

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course objective is to provide a theoretical framework for modern econometrics instruments and the related implications for empirical econometric analysis. For this purpose, the lectures on theory will be matched by a basic cycle of assignments. In the course, two programming languages will be used to make the theoretical topics presented operational: R and Python.

At the end of the course:

* students will have acquired the theoretical and practical knowledge required to carry out independent empirical analyses with economic and financial data. In particular, they will be able to formulate empirical models to verify economic and/or financial hypotheses, estimate them, carry out appropriate diagnostic tests to verify the accuracy of the results obtained, and finally use the estimated models for both descriptive and predictive purposes;
* students will be able to understand empirical scientific articles on economic and financial issues;
* students will know an econometric statistical software to be able to carry out autonomous calculations.

***COURSE CONTENT***

1. *Regression models*

After this course topic has been dealt with, students will be able to:

– specify a linear regression model;

– understand the meaning of the random variables used in regression models;

– simulate a regression model;

– represent a regression model using matrix notation;

– estimate the regression model using the moments method;

2. *Geometric regression*

After this course topic has been dealt with, students will be able to:

– understand the geometric meaning of the least squares estimation method;

– understand the practical meaning of the Frish-Waugh-Lovell theorem;

– calculate the goodness of fit of an estimated model to observed data;

– understand the impact of anomalous observations in estimating a regression model.

3. *Statistical properties of least squares*

After this course topic has been dealt with, students will be able to:

– understand under which theoretical assumptions the least squares estimator provides undistorted estimates;

– understand under which theoretical assumptions the least squares estimator provides consistent estimates;

– understand the meaning of variance-covariance matrix;

– understand the accuracy of an estimate;

– understand the implications of an inaccurately specified model;

4. *Hypothesis testing in the linear regression model*

After this course topic has been dealt with, students will be able to:

– prepare an econometric test to verify a hypothesis involving a single restriction;

– prepare an econometric test to verify a hypothesis involving multiple restrictions;

– perform tests based on large data samples in order to exploit the asymptotic theory.

5. *Confidence intervals*

After this course topic has been dealt with, students will be able to:

– understand the difference between an exact and an asymptotic confidence interval;

– calculate an exact and an asymptotic confidence interval;

– understand the implications of heteroskedastic errors and calculate the robust variance covariance matrix for heteroskedasticity.

6. *Generalised least squares*

After this course topic has been dealt with, students will be able to:

– derive the generalised least squares estimator;

– carry out tests for the presence of heteroskedasticity;

– estimate an autoregressive-moving-average (ARMA) model;

– carry out an autocorrelation test;

– specify templates for Panel data;

– derive the fixed effects estimator for panel data;

– derive the random effects estimator for panel data;

– derive the between-groups estimator for panel data.

7. *Estimation through the use of instrumental variables (IV)*

After this course topic has been dealt with, students will be able to:

– understand the problems of estimating a model when the error term is correlated with the regressor;

– understand the problem that a simultaneous equations model poses for estimation;

– derive and calculate an estimator based on an instrumental variable;

– understand under what conditions the IV estimator is identified and consistent.

8. *The method of estimating the maximum likelihood*

After this course topic has been dealt with, students will be able to:

– understand the characteristics of a maximum likelihood estimation;

– derive the maximum likelihood estimation for a regression model with Gaussian error distribution;

– carry out hypothesis tests based on the maximum likelihood estimator.

9. Introduction to analysis of historical series

At the end of the course, the student should be able to:

– Understand the stochastic process concept;

– Estimate an auto regression model;

– Estimate a moving average model;

– Understand the principal characteristics of a random walk stochastic process;

– Effect a test in order to verify the presence of unitary roots in the data.

***READING LIST***

R. Davidson-J. MacKinnon, *Econometric Theory and Methods,* Oxford University Press, 2004.

Other useful textbooks for an in-depth study of some aspects of the topics covered in class are:

J. Johnston-J. Di Nardo, *Econometric Methods,* McGraw-Hill, 1997, 4th ed.

G.S. Maddala-K. Lahiri, *Introduction to Econometrics,* Wiley, 4th ed.

M. Verbeek, *A Guide to Modern Econometrics,* Wiley, 4th ed.

***TEACHING METHOD***

The course will include lectures (56 hours), supplemented by a basic series of assignments (20 hours).

Two programming languages will be used in the empirical analyses: R and Python. In addition, a group will be set up for attending students with the Telegram instant messaging programme. During the course, some empirical questions will be distributed; students are encouraged to solve them.

***ASSESSMENT METHOD AND CRITERIA***

The exam consists of a compulsory test via Blackboard for all students. Through the test students will have to demonstrate knowledge of the theoretical foundations of statistical theory, the constitutive elements of the econometric theory, the consequences for the estimation of a model for the failure to satisfy some of the hypotheses of the econometric regression theory. Furthermore, they will have to demonstrate that they are able to carry out an empirical analysis independently using an econometric software. The written test is divided into three parts: the first two concern the theory of financial econometrics, while the third concerns applied econometrics. The first part consists of six True or False questions, for which students are required to provide reasons for their answers. The second part consists of six multiple-choice questions, where there is only one possible correct answer. The third part is based on six questions where students are asked to analyse the result of the estimation of an empirical model. The final mark is calculated using a weighted average: the first two parts are worth 25% of the final mark each, and the third 50% of the final mark. In addition to the written exam described above, attending students have the possibility of submitting a written empirical analysis, carried out independently by the end of the course. In this case, the final mark is calculated using the following weighted average: the first two sections of the written test are worth 1/6 of the final mark each, the third section 2/6 of the final mark, the empirical analysis 2/6 of the final mark.

***NOTES AND PREREQUISITES***

*Prerequisites*

Before enrolling in the course, the student should be familiar with:

the main concepts of descriptive statistics;

matrix calculus;

the base concept of infinitesimal calculation.

basic concepts of microeconomics and macroeconomics

basic concept of business finance.

In case the current Covid-19 health emergency does not allow frontal teaching, remote teaching will be carried out following procedures that will be promptly notified to students.

Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.