UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Statistics for Finance - 2

**2627-2-E1808M009-T2**

## Learning objectives

**Knowledge and understanding**
This course offers an introduction to regression analysis, probability theory and statistical inference.

**Applying knowledge and understanding**
All the methods covered in this course are supplemented with examples which illustrate their application in economics and finance.

**Making judgements**
Students will be trained to have a critical attitude towards results based on the methods taught in this course and to question underlying assumptions.

**Communication skills**
Students will learn to comunicate results based on the methods of this course using clear and accessible language.

**Learning skills**
Students will find it easier to increase their theoretical knowledge in case this should be needed for solving new problems.

## Contents

The first part of this course is about regression analysis based on the least squares method. This part introduces widely used methods and descriptive statistics and illustrates applications in economics and finance.

The second part of this course deals with the modeling of stochastic phenomena. This part introduces probability theory according to Kolmogorov's axiomatic approach as well as basic concepts such as random variables,

distributions, quantiles, joint distributions, expected value, variance, covariance, moments and moment generating functions. Some well known distribution families will be introduced too (Bernoulli, hypergeometric, binomial, trinomial, multinomial, geometric, negative binomial, Poisson, exponential, gamma, normal, lognormal and Pareto).

The third and final part of this course deals with statistical inference. It introduces basic concepts such as population, random sample, estimator and point estimate. Confidence intervals for means and proportions are also discussed. The course concludes with a brief introdution to statistical hypothesis testing.

## Detailed program

First part:

- Regression analysis: definition and aims
- Description of the main steps in a regression analysis: data preparation, the choice of a class of functions, the choice of a loss function, evaluation of the goodness of fit, interpretation of the regression function and hints about the range of applications.
- The least squares method and least squares regression lines
- Properties of residuals of least squares regression lines
- The deviance decomposition
- The coefficient of determination
- The linear correlation coefficient
- Interpolation with power functions
- Least squares regression planes
- Properties of residuals of least squares regression planes
- The deviance decomposition for the least squares interpolation plane
- The coefficient of determination of the least squares interpolation plane
- The coefficient of multiple correlation
- Partial correlation coefficients

Second part:

- The three main interpretations of probability: classical, frequentist and subjective
- Kolmogorov's axioms
- Classes of events, fields and sigma-fields
- The basic laws of probability
- Basic concepts of combinatorics
- Conditional probability, (global) independence, total probability law and Bayes' theorem
- Random variables, distribution functions, probability mass functions, density functions and quantiles
- Joint distribution functions, (globally) independent random variables, joint probability mass functions, conditional probability mass functions, joint density functions
- Expected value, variance and covariance
- Widely used discrete distributions: Bernoulli distributions, hypergeometric distributions, binomial distributions, trinomial distributions, geometric distributions, negative binomial distributions and Poisson distributions
- Widely used continuous distributions: exponential distributions, gamma distributions, normal distributions, lognormal distributions and the Pareto distributions
- Moments and moment generating function as a tool for simplifying proofs.

Third part:

- Estimation problems, sample random variables, estimators
- Mean square error, unbiasedness, efficiency and consistency

- Sample mean, sample proportion and the sample variance
- Confidence intervals for means and proportions
- Introduction to statistical hypothesis testing

## Prerequisites

Basic knowledge about mathematics and statistics.

## Teaching methods

56 hours of frontal lessons (each lesson is of either 2 or 3 hours) and 12 hours of interactive exercise lessons.

## Assessment methods

The exam is written and oral. The oral exam takes place some days after the written one. The oral and written exams contribute to the final grade in the same way.

In the written exam students are required to answer two open questions and to solve four exercises. The open questions test students' ability to explain the relevance of the course contents, while the exercises test students' ability to apply the contents in concrete problems. The oral exam is an open conversation about the course contents.

Students can choose to split the written exam into two parts which take place towards end of April (the first part) and concomitantly with the regular exam sessions of June or July (the second part). Both written parts are made up of one open question and two exercises. Student who choose to split the written exam are required to take just one oral exam which takes place after the second written part.

## Textbooks and Reading Materials

Lecture notes

M. Zenga “Metodi statistici per l’Economia e l’Impresa”, Ed. Giappichelli; 1994
M. Zenga “Modello probabilistico e variabili casuali”, Ed. Giappichelli, 1995;
M. ZENGA, Elementi di Inferenza, Vita e Pensiero;
S.M. ROSS, Introduzione alla Statistica, Apogeo 2008, (solo capitolo 9)

## Semester

Second semester.

## Teaching language

Italian

## Sustainable Development Goals

QUALITY EDUCATION