UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Statistics for Finance - 1

**2223-2-E1803M048-T1**

## Learning objectives

This course aims at giving students the means to describe and analyze relationships among statistical variables, the means to model stochastic phenomena as well as an introduction to statistical inference.

The topics covered in this course will be supplemented with examples and applications which illustrate their relevance economics and finance.

## Contents

The first part of this course deals with description and analysis of relationships among statistical variables. This part introduces the concept of least squares interpolation and provides the definitions of several descriptive statistics which are often used in regression analyses.

The second part of this course deals with modeling of stochastic phenomena. In this part of the course the concept of probabilistic model according to Kolmogorov's axiomatic approach will be introduced and the most relevant laws of probability theory will be derived. Moreover, based on the descriptions of some random experiments the most relevant discrete and continuous distributions will be derived.

The third and final part of this course deals with statistical inference. Some basic concepts as that of random sample, estimator, point estimate and confidence interval will be introduced, and applications with the aim of estimating unknown values of means and proportions will be considered.

## Detailed program

First part:
- Interpolation and interpolation methods
- The least squares method and least squares line fitting
- Properties of the residuals of the least squares interpolation line
- The deviance decomposition
- The coefficient of determination
- The linear correlation coefficient
- Log-linear interpolation functions
- Least squares plane fitting
- Properties of the residuals of the least squares interpolation plane
- 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
- Log-linear interpolation functions with two independent variables (the Cobb-Douglas model)
- Interpolation hyperplanes and extensions for the case of more than two independent variables

Second part:
- The definition of probabilistic model according to Kolmogorov's axiomatic approach
- Classes of events, fields and sigma-fields
- Kolmogorov's axioms
- The most relevant laws of probability theory
- Methods for assigning probabilities to events: the classical method, the frequentist method and the subjective method
- Some combinatorial methods for probability theory
- Conditional probability, (global) independence, the total probability law and Bayes' theorem
- Random variables, distribution functions, discrete probability functions, density functions and quantiles
- Joint distribution functions, (globally) independent random variables, joint discrete probability functions, conditional discrete probability functions, joint density functions
- Expected value, variance and moments
- Relevant discrete distributions: the distribution of an indicator random variable, the binomial distribution, the trinomial distribution, the geometric distribution, the negative binomial distribution, the Poisson distribution and the hypergeometric distribution
- Relevant continuous distributions: the exponential distribution, the gamma distribution, the normal distribution, the lognormal distribution and the Pareto distribution

Third part:
- Estimation problems, sample random variables, estimators
- Mean square error, unbiasedness, efficiency and consistency
- The sample mean, the sample proportion and the sample variance
- Confidence intervals for mean values and proportions
- Introduction to statistical hypothesis testing

## Prerequisites

Basic knowledge of mathematics and statistics.

## Teaching methods

Lectures and exercise sessions.

## Assessment methods

The exam is written and oral. In the written part of the 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 four exercises test students' ability to apply those contents in order to solve practical problems. The oral part of the exam is an open conversation about the topics treated during the course.

Students can choose to split the written part of the exam into two parts by taking the first part of the written exam at the end of April/the beginning of May and the second part of the written exam concomitantly with the regular exam sessions of June or July. Both parts of the written exam are made up of one open question and two exercises. Student who choose to split the written part of the exam into two parts are required to take the oral part of the exam after having completed both written parts.

## Textbooks and Reading Materials

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)

M. CAZZARO, F. GRESELIN, *Modelli statistici per l'analisi di problemi economici e finanziari*
Pearson, 2017

## Semester

Second semester.

## Teaching language

Italian

## Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE