UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Statistical Methods for Business - 2

**2627-2-E1807M012-T2**

## Learning objectives

**Knowledge and understanding**
This course offers an introduction to 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 business management 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.
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## Contents

The first part of this course deals with the modeling of stochastic phenomena, i.e. the modeling of real-world processes with uncertain outcome. 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 and covariance. Some well known distribution families will be introduced as well (Bernoulli,

hypergeometric, binomial, trinomial, multinomial, geometric, negative binomial, Poisson, exponential, gamma, normal, lognormal and Pareto).

The second part of the course deals with statistical inference. It introduces basic concepts such as population, random sample, estimator and point estimate. The course moves on to interval estimation and statistical hypothesis testing and exposes a number of useful inferential procedures. Examples which illustrate their application in business management and/or finance are provided.

## Detailed program

Random experiments and probablity models. Methods for probability assignment. Kolmogorov axioms and probability laws. Basic combinatorial calculus for classical probability computations. Conditional probability. Product rule. Independent events. Total probability law and Bayes' rule. Random variables. Discrete and continuous distributions. Joint distributions and independence. Expectation, variance and covariance. Widely used distributions: Bernoulli, binomial, multinomial, hypergeometric, Poisson, exponential and normal. Normal approximations.

Sampling and sampling distributions. Finite and infinite populations. Parameters. Simple random sampling and other sampling designs. Sample statistics and point estimation. Sample mean and sample proportion.

Interval estimation. Confidence intervals, margin of error, confidence level. Confidence intervals for the population mean: known and unknown variance. Minimum sample size computations. Confidence intervals for a proportion.

Hypothesis testing. Null and alternative hypothesis. Type I and type II errors. Significance level of a test. Critical-value approach and p-value approach. One-sided and two-sided tests. Relationship between two-sided tests and confidence intervals. Tests about the population mean: known and unknown variance. Tests about a proportion.

Tests and confidence intervals for the difference between two means: paired and independent samples. Tests and confidence intervals for the difference between two proportions.

Two Chi-squared tests: goodness-of-fit and independence.

Linear regression model. Methods for testing the assumptions. Parameter estimation and confidence intervals. Significance test. Confidence intervals for conditional means and prediction intervals. Introduction to multivariate regression models.

## Prerequisites

Basic statistics. Descriptive statistics. Basic mathematics.

## Teaching methods

42 hours of frontal lessons (two-hour lessons).

## Assessment methods

The exam is written. The teacher might, at his own discretion, ask for an additional oral exam if the written exam is not fully sufficient and/or the answers to some questions in the written part require clarification. The written part of the exam it consists of four exercises (two about probability theory and two about statistical inference) which test the ability to solve practical problems. The exam contains also open questions to test knowledge and understanding of definitions, ability to motivate the method of choice in the solution of an exercise and the ability to interpret results. Evaluation of these questions depends heavily on proper use of technical language.

Students can choose to take the first half of the exam in April (the first half consists of the two exercises about probability theory) and are then required to complete the exam in one of the regular exam sessions of either June or July.

The first half of the exam can also be taken in the regular exam sessions of June, July, January and February. Students who take the first half in June or July are required to complete the exam within September, while those who take the first half in January or February are required to complete the exam within April.

## Textbooks and Reading Materials

D. Anderson, D. Sweeney, T. Williams “Statistica per le analisi economico-aziendali”, 2010, Apogeo Education – Maggioli Editore.

Lesson slides (on the course website in eLearning).

## Semester

Second semester.

## Teaching language

Italian.

## Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION