UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Probability

**2425-1-E4102B006**

## Learning objectives

The course aims at introducing the basics of probability, which are needed both in many working activities and in the following courses of the undergraduate program. Specifically, students will be provided with the main tools to solve simple decisional problems under uncertainty and with the fundamentals needed to study inferential analysis of data.

This course aims at providing knowledge and understanding related to:

- how to measure the uncertainty arising in decision making
- the rules underlying a coherent system of measurement of the uncertainty
- the properties and the limitations of commonly used probabilistic models

At the end of the course, students will be able:

- to locate the essential elements of a random process
- to build a suitable probabilistic model for a given framework
- to derive indicators supporting decision making from the chosen model
- to understand the use of probability in common statistical models for the analysis of data

## Contents

Probability and its rules. Random variables. Main distributions. Random vectors. Limit theorems.

## Detailed program

Combinatorics. Events and their algebra. Probability measures. Rules of probability. Assignment of a probability measure. Conditional probabilities. Bayes theorem. Independent events. Random variables. Cumulative distribution function, probability function, density function. Summary of a random variable: expected value, variance, percentiles, moments. Moment generating function. Distribution of functions of a random variable. Relevant discrete distributions: Bernoulli, binomial, Poisson, geometric, negative binomial, hypergeometric. relevant continuous distributions: uniform, normal, negative exponential, gamma, chi-squared. Bivariate and multivariate random variables. Functions of random vectors. Limit theorem of probability theory: law of large numbers, central limit theorem.

## Prerequisites

There are no propaedeutic exams; however, familiarity with the subjects of the courses of Analisi Matematica I and Statistica I is highly recommended. Specifically, students must be familiar with limits, series, integrals and the main summaries (both numerical and graphical) of datasets.

## Teaching methods

The course is taught by 63 hours of in-person lessons and practical sessions (exercises).

Tutoring is also provided in preparation to exams.

## Assessment methods

The exam consists of a written test, containing both exercises 'open' questions about theory, and of a compulsory oral test. Only students with a grade of at least 18/30 can take the oral test.

Questions about theory aim at testing knowledge and understanding of the rules of probability and of the main probabilistic models. Exercises aim at testing the ability to analyze a random process, the ability to choose a suitable probabilistic model and the ability to derive synthetic indicators from the model. Moreover, both questions about theory and exercises aim at testing the ability to report results in a suitable technical language.

## Textbooks and Reading Materials

The textbook is :

Ross, S. M. “*Calcolo delle probabilità (terza edizione italiana)*”, Maggioli, 2016.

Reference to the textbook is crucial to attend lessons and practical sessions. Additional materials are provided by the e-learning website.

## Semester

II semester (III and IV cycle)

## Teaching language

Italian

## Sustainable Development Goals

QUALITY EDUCATION