# Statistics (Data analysis and probability)

## Professor Roberta Paroli; Professor Laura Deldossi; Professor Alessia pini; Professor Silvia Osmetti; Professor Lucia Paci

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

The aim of the course is to provide students with the fundamentals of descriptive statistics, probability and statistical inference for solving typical problems on data analysis in economic, business and social phenomena.

Theoretical lectures will be followed by more practical sessions and examples. The following learning abilities are provided and expected to be achieved by participants at the end of the course:

1. Knowledge of concepts, terms and methods concerning probability, descriptive and inferential statistics.
2. Ability to correctly apply descriptive and inferential statistics as well as probability methods to real economics and management problems.
3. Quantitative thinking addressed to make independent judgements, driven by rigorous reasoning and inferential statements.
4. Ability to read, interpret and communicate data-driven results.
5. Mastery of tools useful for subsequent academic courses in the curriculum, as well as for quantitative analyses required in future careers involving management of data and data-driven decision-making.

***COURSE CONTENT***

*Univariate and bivariate descriptive statistics.* Data matrix, measurement scales and types of variables. Frequency distributions. Graphical representations. Location indices: mode, median and arithmetic mean. Indices to measure dispersion: indices of dissimilarity (mutability/heterogeneity) and variance.Box-plot.Bivariate frequency distribution. Stochastic independence andassociation. Mean dependence; covariance and correlation.

*Probability and random variables.* Definition of probability and basic theorems.Discrete and continuous random variables: mean and variance. Main univariate probability models: binomial, uniform, normal, and related continuous random variables. Central limit theorem.

*Fundamentals of statistical inference.* Elements ofsampling procedures. Point estimation: definition of estimators and sampling distribution of commonly -used statistics (e.g. mean, variance, proportion). Interval estimation: confidence interval for the mean of a Normal population (with known and unknown variance), confidence interval for the proportion*.* Elements of hypothesis testing.

*Linear regression.* The simple linear regression model: assumptions, parameter estimation, goodness of fit; confidence intervals and hypothesis testing for the model parameters. Brief introduction to the multiple linear regression model.

***READING LIST***

S. Borra-A. Di Ciaccio, *Statistica. Metodologie per le scienze economiche e sociali,* Mc-Graw-Hill, Milano, 2021, 4th ed. [The topics of the course are covered in chapters 1-4, 6, 8-13, 15-16].

A similar English textbook can be suggested on demand.

***TEACHING METHOD***

Lectures and practical exercises.

***ASSESSMENT METHOD AND CRITERIA***

The assessment consists of a written exam to be done in presence. The exam duration is 90 minutes, and it will be composed of:

1. Four exercises. The first exercise is referred to univariate and bivariate statistics; the second concerns the probability; the third is about inferential statistics and the fourth about the linear regression model.
2. Eight multiple choice questions on theory.

Students attending classes regular basis have the possibility to replace the written exam with two partial tests which contribute equally to the final evaluation: the first is planned during the class period and the second one during the winter exam session. More detailed information about the assessment process are available on the *Blackboard* e-learning platform*.*

The aim of the exam is to assess reasoning and analytic abilities on the course subjects. Properties of language and communication abilities are also assessed.

***NOTES*** ***AND PREREQUISITES***

To successfully attend the course and pass the relative exam, the competences in mathematics acquired in the course “Mathematics” (Matematica Generale) are required.

***OFFICE HOURS***

Teachers of all the groups receive the students as reported on their personal web page and/or on the Blackboard page of the course.