UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Statistics

2526-1-E3304M003

Learning objectives

In terms of knowledge and understanding, the course will provide students with the theoretical and practical foundations of descriptive statistics and probability theory, with particular emphasis on their applications in economics, environmental contexts, and the natural sciences. Students will acquire a solid understanding of fundamental statistical concepts, such as frequency distributions, measures of central tendency, variability, and probability, equipping them with the necessary tools for quantitative data analysis.

Regarding the ability to apply knowledge and understanding, by the end of the course, students will be able to effectively use statistical tools to analyze data from economic, environmental, and scientific domains. They will be able of applying statistical techniques to process and interpret complex data.

In terms of autonomy of judgment, students will develop the ability to critically evaluate data using statistical methods, interpreting results with rigor and awareness.

As for communication skills, the course will provide students with the tools to solve statistical problems rigorously and present them clearly, using appropriate mathematical and statistical language. They will be able to communicate the results of their analyses effectively, both in written and oral form.

Finally, in terms of learning skills, students will acquire the fundamental competencies necessary to understand and apply basic statistical models, and to effectively address advanced concepts of statistical inference. Additionally, they will be prepared to handle complex data analyses from both the natural and social sciences, developing a deep understanding of statistical methodology to interpret and make data-driven decisions.

Contents

The course is divided into two parts. The first part focuses on univariate and bivariate descriptive statistics, with particular attention to frequency distributions, measures of central tendency, variability and shape. Additionally,

relationships between pairs of statistical variables will be studied. The second part of the course aims to introduce the main concepts of probability, including discrete and continuous random variables, the central limit theorem, and the law of large numbers.

Detailed program

1. Univariate and Bivariate Descriptive Statistics.

- Introduction to statistics: descriptive and inferential statistics.
- Frequency distributions.
- Measures of central tendency: mean, mode, and median.
- Measures of variability and concentration.
- Measures of shape: skewness and kurtosis.
- Analysis of bivariate distributions: contingency tables, variable dependence, correlation.
- Simple linear regression.

2. Probability.

- Definition of probability: sample space and events.
- Conditional probability and Bayes' theorem, independence of events.
- Discrete and continuous random variables. Specific examples of random variables: Bernoulli, binomial, Poisson, exponential, uniform, normal, chi-square.
- Introduction to bivariate random variables: bivariate normal distribution.
- Asymptotic theorems: law of large numbers and central limit theorem.

Prerequisites

Knowledge acquired in the Mathematics course, taught in the first semester, is required.

Teaching methods

Lectures and practical exercises. Applications of the proposed methods in ecology and economics will be discussed and presented. 24 hours will be devoted to exercises in class.

Assessment methods

The exam consists of a written test, with an optional oral exam. The written test includes exercises and some theoretical questions. The exercises aim to assess the student's understanding of the topics covered and their ability to apply concepts of descriptive statistics and probability. The theoretical questions serve to verify knowledge and comprehension of probability concepts.

Textbooks and Reading Materials

For the part on descriptive statistics:
Cicchitelli, G., D'Urso, P., Minozzo, M. (2021). Statistics: Principles and Methods. Pearson.

For the part on probability:
Samaniego, F.J. (2014). Stochastic Modeling and Mathematical Statistics: A Text for Statisticians and Quantitative Scientists. New York, Chapman and Hall.

Semester

Second semester.

Teaching language

English.

Sustainable Development Goals

QUALITY EDUCATION