UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Statistics

2526-1-F1602M004

Learning objectives

1. Knowledge and understanding
Students should acquire a thorough knowledge of the principles and techniques of statistical inference, such as point estimates and confidence intervals, and hypothesis testing. They must understand how these methodologies allow reliable conclusions to be drawn from data, even in the presence of uncertainty or variability.

2. Applied knowledge and understanding
Students will be able to apply statistical inference techniques to complex problems, using advanced statistical software. They will be able to design studies, analyze real data, interpret results, and make informed decisions in research, economics, finance, or other scientific disciplines.

3. Autonomy of judgment
Students will develop the ability to critically evaluate inference methodologies, recognizing the limitations and assumptions of each method. They will be able to compare different approaches, interpret results in an informed manner, and evaluate the reliability of statistical conclusions, even in the presence of complex data or limited samples.

4. Communication skills
Students will learn to communicate the results of inferential analyses clearly and precisely, adapting language and graphic representations to different audiences, including colleagues, decision makers or non-specialists. They will be able to write technical reports and present their results in an effective and understandable way, also through graphic representations.

5. Learning skills
Finally, students will be encouraged to work autonomously, taking responsibility for their own analyses and data-based decisions. They should be able to design statistical studies, choose the most appropriate techniques and critically evaluate the results, having acquired an ethical and professional attitude.

Contents

This course provides a basic understanding of the uses of statistical inference. Particular attention is devoted to problems of estimation and to hypothesis testing that frequently occur in economic applications and in finance.

Detailed program

Sample distribution

- Population and random sample; statistics and sample moments; Cebiceff's inequality; weak law of large numbers; central limit theorem; sample mean and sample variance distributions; Chi-squared, Student's, Fisher's distributions.
- Applications in R: generation of random samples, visualization of sampling distributions through Monte Carlo simulations, verification of the Central Limit Theorem with R.

Parametric inference

- Method of moments, maximum likelihood estimator; properties of estimators; Rao-Cramer inequality; exponential family; confidence intervals; pivotal quantity.
- Applications in R: estimation of parameters through the method of moments and maximum likelihood, construction and interpretation of confidence intervals in R for mean, proportion and variance. Use of the optim or nlm functions for maximization of the likelihood.

Hypothesis testing

- Test for parameters of normal distribution; Slutsky's theorem. Test and confidence interval for two independent samples. Analysis of Variance. The Chi-square test. P-value.
- Applications in R: execution of common hypothesis tests (t-test, Z-test, ANOVA with aov(), Chi-square test with chisq.test()), calculation and interpretation of the p-value. Practical examples of tests on economic/financial data.

Prerequisites

Probability and main random variables.

Teaching methods

56 hours of lectures, delivered in presence.

Teachers will be supported by a tutor. Practical exercises are planned, also with the help of the R software, during the course and tutoring activities, both during the course and in proximity to the exams.

Assessment methods

The exam includes theory questions and exercises. The theory questions test the knowledge and understanding of the main concepts of the subject. The exercises measure the student's ability to apply these concepts to solve practical problems, including those that require the use of R. The student who obtains at least 18/30 in the written test can take an additional oral test, which can change the score. Before the oral test, the student looks at the assignment and can ask for clarifications. Normally, the oral test is optional; however, in doubtful cases, the teacher can make it mandatory at his discretion.

Textbooks and Reading Materials

M. Zenga, Inferenza statistica, Giappichelli, Torino, 1996

A. Agresti, C. Franklin, B. Klingenberg, The Art and Science of Learning from Data, 5th edition, Pearson Education Limited, 2022

Teacher-produced materials.

Semester

First semester.

Teaching language

Italian.

Sustainable Development Goals

QUALITY EDUCATION