UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Inferential Stastics

2223-1-F5602M002-F5602M003M

Learning objectives

The module aims at providing adequate knowledge of some of the main inferential techniques for data analysis, with a focus on the estimation of unknown parameters and hypothesis testing.

Students will be able to identify suitable techniques for the type of data and for the inferential problem addressed. Students will develop a critical approach to the interpretation of analyses produced by others, with specific attention to the assessment of the validity of the assumptions made. Students will be able to select the correct way of presenting data analyses to a non-technical audience. Finally, students will develop autonomous instruments to understand more advanced statistical techniques which might go beyond those studied during the course.

Contents

Essential review of probability theory; Samples and sampling distribution; Convergence of random variables and limit theorems; Likelihood-based inference; Point and interval estimation; Hypothesis testing; Non-parametric methods.

Detailed program

Relevant probability distributions and their properties; Samples and sampling distributions; Convergences of sequences of random variables; Law of large numbers; Central limit theorem and its applications; Monte Carlo approximations; Random number generation; Statistical models; Bernoulli model; location Normal model; location-scale Normal model; Likelihood function; Estimators; Sufficient statistics; Maximum likelihood estimation; Mean squared error; Bias and variance of an estimator; Consistency of an estimator; Confidence intervals; Confidence intervals for the Bernoulli model; Confidence intervals for the location Normal model; Confidence intervals for the

location-scale Normal model; Hypothesis testing; P-values and statistical significance; One-sided and two-sided tests; Hypothesis assessment via confidence intervals; Testing hypotheses for the Bernoulli model; Testing hypotheses for the location Normal model; Testing hypotheses for the location-scale Normal model; Distribution-free (non parametric) methods: method of moments and Bootstrap method.

Prerequisites

Basic statistics; Descriptive statistics; Basic probability theory; Probability distributions.

Teaching methods

Frontal lectures (theory and examples).

Assessment methods

The exam is written and consists of questions about theory and exercises. The former verify students' knowledge and understanding of the main concepts of the subject; the latter measure students' ability in the application of such concepts to solve simple practical problems.

During the weeks of the course, problem sheets will be proposed, with exercises that can be solved by groups of students (up to 4 students per group). The submitted solutions will be marked and, in case of positive assessment for the three sheets, the overall mark can contribute, jointly with the result of the written exam, to determine the final mark. More details on this possibility will be given during the classes.

Textbooks and Reading Materials

The textbook is:

Evans, M.J., Rosenthal, J.S., *Probability and statistics. The science of uncertainty. (second edition)*. Ed. Freeman, 2010.

Further materials will be provided through the e-learning website. Reference to the textbook is crucial to attend the course and for the assignments.

Semester

Second cycle of first semester

Teaching language

English

Sustainable Development Goals