UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Statistics II

2122-2-E4102B081

Learning objectives

The course aims to provide students with an adequate command of the methodologies of statistical inference for the analysis of univariate phenomena that can be represented by stochastic models.

At the end of the course, the student will be able to:

1) apply the techniques for the precise estimation and interval of the parameters of the distribution of a random variable

2) construct statistical tests to verify assumptions about the distribution of a normal random variable and identify appropriate approximations in the case of any random variable

3) set up some recurrent sampling plans in many application contexts.

Contents

The course is divided into macro topics ranging from the definition of random variables to inference based on likelihood, including the point estimate the interval estimate and the hypothesis test. The last part of the course is designed to introduce the most common probabilistic sampling plans in the context of finite populations according to the classical approach.

Detailed program

The course is divided into macro topics:

The notion of sample and the sample space. Punctual estimation. Properties of estimators: correctness, consistency, absolute and relative efficiency. The theorem of Fréchet-Rao-Cramér. The average square error. Estimation methods: the method of maximum likelihood and the method OLS.

Estimate interval and methods for determining the confidence interval. The pivotal quantity. Statistical verification of hypotheses. Significance tests. The main statistical tests: the Z test, the T test, the chi-square test, the F test. The basis of Neyman-Pearson's theory. Error of first and second species. The most powerful test is Neyman-Pearson's lemma. The most uniformly powerful tests. The tests based on the relationship of likelihood. A series of tests to compare different populations including the Analysis of Variance (ANOVA). Sampling from finite populations. Estimation of the total, average and variance of a continuous variable. Estimate of the relative frequency of a binary variable. Simple random sampling. The stratified sampling.

Prerequisites

The course includes, as preparatory courses, Statistics I, Probability Calculation and Mathematical Analysis I.

Teaching methods

The course is delivered in Italian and includes frontal lessons and exercises. Given the Covid emergency that we are facing, the lessons will be delivered at a distance and mainly in synchronization. Occasionally it may happen that the lesson is delivered in asynchronous mode. In this case, students will be promptly notified and the lesson will be uploaded to the e-learning page at the scheduled time of the lesson.

The lesson calendar is available on the e-learning page and will be updated weekly in case of changes.

The lessons are aimed at deepening the theoretical knowledge of the student on the topics of the course. Here, ample space is given to the formalization and derivation of probabilistic and mathematical concepts relevant to the topics considered.

The exercises are aimed at enhancing the student's problem-solving skills. Here, space is given to the formalization of problems present in real situations in terms of statistical inference, to the identification of appropriate procedures for their solution and to the critical discussion of the procedures used and the results achieved.

Assessment methods

The assessment is based on a written test.

The written test is aimed at ascertaining the student's problem-solving skills. It will therefore consist of exercises of both applicative and theoretical type. During the assessment, the student's ability to: formalize the proposed problem in terms of statistical inference, identify the appropriate procedures for its solution and discuss critically the procedures used and the results achieved is considered.

During the written test the use of texts or other material is not allowed, except for the tables of variables and a form provided by the teacher. The use of cell phones or other electronic devices is not allowed during the test.

Whoever requests it, and with the teacher's consent, is allowed to take an oral integration of the examination test

Textbooks and Reading Materials

Cicchitelli G., D'Urso P., Minozzo M. 2018. Statistica: Principi e Metodi. Terza edizione. Pearson Italia, Milano-Torino

Piccolo, D. (2000). Statistica, Bologna. *Il Mulino*.

Further material (exercises and handouts on specific topics) will be available on the e-learning page of the course

Semester

The course is delivered during the first semester.

Teaching language

Italian