UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Statistics (blended)

2021-3-E3201Q086

Aims

Know and understand the basic concepts of probability and statistics.

Know and understand how to apply those concepts to random phenomena and measurements, in particular to real situations' data.

In particular

- understand when a phenomenon can be modeled as random
- learn to choose the most plausible model for your problem among different random models
- understand the limit behavior of averages of independent random quantities having equal distribution
- estimate unknown parameters starting from the observation of a random sample
- discuss the plausibility of hypotheses on the parameters of the distribution of the collected data and correctly interpret the answer of a hypothesis test
- know how to discuss the theoretical and concrete aspects of the concepts mentioned above, as well as apply them to data sets collected personally or by third parties

Contents

It is a first level course on the basic tools of descriptive and inferential statistics:

- descriptive statistics
- probability/random models
- inferential statistics: punctual and interval estimates, hypothesis testing

Detailed program

The program is the same for both attending and not attending students.

Descriptive Statistics

Data vectors, mean,variance, standard deviation. Histograms. Median, quartiles, quantiles, Boxplot. Covariance and correlation, scatterplot.

Probability

Probability of events; independence of events. Discrete random variables, density, distribution function, mean and variance of discrete random variables. Examples: discrete uniform, binomial, geometric, Poisson. Continuous random variables, density, distribution function, mean, variance. Examples: continuous uniform, exponential, Gaussian. Law of largenumbers. Central limit theorem (use of the tables of the standard normal).

Inferential Statistics

Samples, estimators, unbiased estimators. Estimator of the mean. Unbiased estimator of the variance.

Confidence intervals for the mean (with known or unknown variance).

Test of hypothesis. First and second type error. Level of a test, P-value.

Test on a mean (monolateral and two-sided with known or unknown variance). Test on two averages. Chi-squared test of adaptation and of independence.

Linear regression.

Prerequisites

Set theory; real functions; calculus (minima and maxima of functions, series and integration of real functions).

Teaching form

- Lessons in the classroom: 20 hours

- Online lessons on elearning.unimib.it (blended learning): 28 hours

During the Covid-19 emergency, the lessons which are usually in the classroom are provided through asyncronous videolessons and live events through videoconference.

Textbook and teaching resource

Textbooks:

- Calcolo delle probabilità e Statistica, di Marco Bramanti, Esculapio Editore.
- Esercizi di probabilità e statistica, di Bertacchi, Bramanti e Guerra, Esculapio Editore

Other material on elearning.unimib.it:

- Lecture slides
- Video of some lessons
- Video of exercises
- Multiple answer quizzes
- Interactive exercises on the platform wims.matapp,unimib.it

Semester

Second semester (March-June)

Assessment method

The assessment is based on online work and a written exam.

During the COVID emergency, a brief oral examination (with some questions on definitions and theoretical results of the course) is compulsory, while the open questions on the theoretical aspects of the course are usually not inserted in the written examination. All students with a mark larger or equal to 16/30 in the written exam are admitted to the oral examination. The oral examination takes place through videoconference. In case of end of the COVID Emergency, the oral examination is on request by the student and/or the professor.

*For technical details about the written exam, see the related notices in the forum in the course***.**

- The written exam contains multiple choice questions (of the kind present in the e-learning platform), open-ended theoretical questions (on definitions or theoretical results highlighted in the transparency of the lessons) and exercises (of the type present on the wims platform). The oral exam is requested by the teacher and / or student (whenever the lecturer or student feel that it is needed, in particular it is mandatory for those who have a grade between 16 and 18/30 in the written exam, while those who got a vote less than 16 cannot request the oral examination, and are judged insufficient).
- The written exam can be replaced by two intermediate tests, one scheduled in mid-term (generally in April) and the other in June. The first test focuses on the first part of the program, the second on the second part. Those who have obtained a mark of at least 14/30 in the first intermediate test are admitted to the second intermediate test. The average grade obtained in the two tests therefore replaces the vote of the written exam. *In case of a prolonged COVID emergency, the possibility of cancelling the intermediate exams will be pondered.*
- In the written / oral exams (as in the intermediate tests) the correctness and completeness of the answers is evaluated. In questions and exercises are evaluated, among other things, the ability to choose appropriate random models, know their characteristic properties, estimate the probabilities or parameters, discuss the properties of the model parameters by testing.
- The online work consists of quizzes and exercises on the e-learning and wims platform and in a group work

(optional) in which the concepts of the course are applied to a set of data. In the online work the correctness of the answers given is evaluated (automatically). Since the questions and exercises are similar to the ones in the exams, they evaluate the same skills that are evaluated in the exam (see the previous paragraph). Group work is an analysis of a data set chosen by the students (the data set must be approved by the teacher, who eventually may propose a different data set), and delivered through the e-learning platform for correction by the teacher and tutor, which assesses the capacity for critical analysis and application of the concepts of the course to a real case (in particular the ability to extract information from data). The online and group work are optional, if the student does not do them, his/her exam will not be evaluated more than 25/30. Without a group work with a positive evaluation the maximum final grade is 28/30.

More details about the online work can be found in the presentation section of the e-learning course (accessible after the beginning of the course in the academic year).

Office hours

By appointment