SYLLABUS DEL CORSO

Matematica e Statistica

1920-1-E1301Q071

Aims

The course Mathematics and Statistics gives the background to acquire the basic knowledge about the fundamental definitions and results of calculus and statistical methods. In particular: 1. Knowledge and understanding: at the end of the course the student will know the basic definitions and their meaning. 2. Ability to apply knowledge and understanding: at the end of the course the student will be able to apply the definitions to solve the proposed exercises in mathematics and statistics. 3. Making judgment: the student will be able to process the acquired knowledge identifying the appropriateness of the applications of the definitions. 4. Communicative skills: at the end of the course the student will be able to communicate with appropriate language and efficiently. 5. Learning ability: at the end of the course the student will have acquired the necessary competences to tackle in autonomy the mathematical and statistical problems that he/she will encounter during the course of studies and will be able to apply the learned skills in those courses that have these as prerequisites.

Contents

- Mathematics: vector calculus, matrix algebra, eigenvalues and eigenvectors, asymptotic behaviour and study of function, derivation, expansion in power series of elementary functions, integration of elementary functions, integration of elementary ordinary differential equations.
- Statistics: analysis of frequencies and statistical indexes of position and variability to synthetize the sampling data, basics of probability (conditional or not) and independence between variables, frequency, probability and density distributions sampling distributions (of Bernoulli, normal and Poisson type), confidence intervals and hypothesis tests for proportions and means.

Detailed program

- Mathematics: vector calculus (scalar and vector product, equation of a straight line in vector form), matrix algebra (basic definitions, algebra of matrices, determinant, inverse, transpose, eigenvalues and eigenvectors), asymptotic behaviour and study of function (basic definitions, elementary functions, trigonometric functions, power laws, exponential functions, logarithmic functions, limits , asymptotes, rules of differentiation, stationary points, maxima and minima of function), expansion in power series of elementary functions (power series, Taylor's expansion of a function, expansion of exponential, expansion of elementary trigonometric functions), integration of elementary functions (basic definitions, rules of integration, integration by change of variable, integration by parts), integration of elementary ordinary differential equations (integration by separation of variables, general solution, particular solution, application to population dynamics).
- Statistics: use of frequencies (absolute, relative and density) and statistical index of position (mean median mode) and variability (range, interquartile range, variance and standard deviation), concepts of probability and conditional probability. Bayes theorem. Random variables: distribution of probability / density, mean and variance. Binomial and normal models. Descriptive statistics. The sample mean: its properties and use in inferential statistics. "Chi squared" test for independence and goodness of fit. Point estimates, intervals and hypothesis testing for one or two independent samples. Point estimates, intervals and hypothesis testing for two paired samples. Overview of variance analysis.
The course includes hours of tutorials on both modules, aimed at improving capabilities and knowledge of the material presented during lecturing.

Prerequisites

- Mathematics: basic concepts of algebra and geometry, concept of number, elementary and periodic function, calculus on power laws, concept of equation and inequality, fundamental equation of straight line, circle and parabola.
- Statistics: basic knowledge of mathematics.

Teaching form

The teaching of the course includes both lectures and exercises. Lectures are theoretical lessons in which the knowledge of definitions, results and relevant examples is given. The exercises involve the resolution of exercises and the analysis of mathematical and statistical problems, allowing the student to verify his/her ability to apply the theoretical notions acquired during the lectures.
For both modules, there will be tutorials aimed at improving the capabilities of students.

Textbook and teaching resource

- Mathematics: material presented on the board by the lecturer. Auxiliary recommended textbook: D. Benedetto, M. Degli Esposti, C. Maffei, "Matematica per le scienze della vita", Casa Editrice Ambrosiana, or any other equivalent textbook for undergraduates in physical sciences.
- Statistics: material showed during the lectures (slides), made available on the e-learning platform of the University. Recommended textbook: Whitlock MC, Schluter D, "Analisi statistica dei dati biologici", Zanichelli (2009).

Semester

Matematica: first semester

Statistica: second semester

Assessment method

The examination consists of a written exam on the mathematics and statistics material presented during the whole course and it lasts 3 hours. There is no oral examination. First-year students regularly enrolled can take partial trials on portions of the programme, following the same methodology proposed for the official examination.
- Mathematics: the written exam paper consists of solving 4 assigned questions, each regarding a particular topic presented during the course. The trial consists of an individual exposition of the solution to each of the 4 assigned questions (complete with all necessary computations) done without any auxiliary equipment, such as textbooks, pocket computers or personal notes. Questions reproduce similar exercises proposed during the course.
 - Statistics: the written test consists of about 6 exercises on the topics covered during the lectures and exercises in order to verify that the student has understood the explained concepts and has developed the ability to understand which statistical technique is most appropriate for the analysis of proposed data. Students have at their disposal a formulary, the tables of the main statistical distributions and the calculator.
The written exam paper must show operational capability to tackle and solve the proposed questions by using the acquired knowledge and the necessary competence to reproduce the topics presented during the course.

Office hours

Contact by appointment