Syllabus

Descrizione corso

Titolo insegnamento	Fondamenti di Statistica
Codice insegnamento	42413
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	SECS-S/01
Lingua	Inglese
Corso di Studio	Corso di laurea in Ingegneria Elettronica e dei Sistemi ciberfisici
Altri Corsi di Studio (mutuati)	
Docenti	prof. Emanuele Taufer, Emanuele.Taufer2@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/7405
Assistente	
Semestre	Primo semestre
Anno/i di corso	2
CFU	9
Ore didattica frontale	54
Ore di laboratorio	36
Ore di studio individuale	135
Ore di ricevimento previste	27
Sintesi contenuti	The course covers fundamental topics of probability theory, descriptive statistics, statistical inference and statistical modelling. The theoretical aspects are complemented by labs where, among other things, the software R is used as a support to verify in practice theoretical concepts (for example convergences) or quickly implement and interpret statistical analyses (for example statistical tests, regression analysis).
Argomenti dell'insegnamento	Probability Theory • Fundamentals of probability: events and sample space. Definition

	of probability. • Kolmogorov's axioms and probability spaces. • Combinatorics and counting. • Conditional probability and independence. • Law of total probabilities and Bayes' theorem. • Random variables and probability distributions. • Expected value and variance. Moments of a random variable. Quantiles and percentiles. • Common random variables: discrete random variables. • Common random variables: continuous random variables. • Functions of a random variable. • Bivariate random variables: joint and marginal distributions. • Bivariate random variables: conditional distributions and independence. Covariance and correlation. • Convergence of sequences of random variable and limit theorems. Statistical Inference • Descriptive statistics. • Populations and their parameters. • Random sampling. Statistics and Sampling distributions . • Fundamentals of point estimation. Properties of point estimators. • Point estimation of the mean and the variance. • Interval estimation: introduction. • Confidence interval for the mean and the variance. • Hypothesis testing: introduction. • Hypothesis testing: the p-value, type I and II errors. Power and size. • Hypothesis testing for the mean. • Hypothesis testing for the difference of two means. • Chi-squared type tests for contingency tables. • Estimation methods: method of moments; Maximum likelihood; Least squares. The linear regression model • Introduction and assumptions • Parameter estimation. • Hypothesis testing and confidence intervals for the parameters of the model. • Model selection and goodness of fit. • Residuals analysis and diagnostics. • Violation of the assumptions and some extensions.

	Laboratory • Introduction to R • Probability and statistics with R
Parole chiave	Probability, Descriptive statistics, Statistical inference, Linear regression, Software R.
Prerequisiti	The course requires the concepts of elementary calculus and linear algebra, in particular: • Set theory • Limits of functions • Convergence of sequences and series • Derivatives and partial derivatives • Integrals • Matrix algebra
Insegnamenti propedeutici	
Modalità di insegnamento	In person lectures, exercises, lab sessions
Obbligo di frequenza	Attendance is not compulsory, but highly recommended.
Obiettivi formativi specifici e risultati di apprendimento attesi	The course belongs to the type "Attività formativa affine o integrativa nell'ambito della Statistica" The course covers the fundamental aspects of probability theory, and the principles of statistical inference and statistical modelling. The theoretical aspects are complemented by the use of dynamic documents and reproducible modern data analysis with R. The main objectives are to endow the student with the fundamental skills to solve real problems by using probability theory, and to perform a rigorous data analysis by using appropriate statistical methods.
Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)	Upon successful completion of this course, the students are expecte d to acquire the following Knowledge and understanding • basic descriptive statistics; • fundamental notions of probability theory; • fundamentals of statistical learning; • fundamentals of statistical modelling; • statistical lexicon;

	• formalize problems that involve randomness and uncertainty in terms of probability and statistics; • basics of statistical software; Applications • manipulate and summarize data; • visualize and understand relationships inside data; • apply the appropriate tools of inferential statistics and statistical modelling to extract useful information from data, test hypotheses and make predictions; • use R, knitr and Rmarkdown to perform a modern and reproducible data analysis. Interpretation and communication • use and interpret the results from a statistical analysis to take informed decisions • communicate appropriately and with rigour the results of a statistical analysis
Modalità di esame	A 2-hour written examination composed of • Exercises with pencil and paper or R • Theoretical questions Whenever feasible, the examination will be split in two modules: • Module 1: Probability and random variables – mid-term, 1.5 hours; • Module 2: Statistics - 2 hours.
Criteri di valutazione	• Correctness of the answers • Mastery of the technical language
Bibliografia obbligatoria	Ross, S. Introduction to Probability and Statistics for Engineers and Scientists. 6th Ed. 2020, Academic press, **ISBN:** 9780128243466
Bibliografia facoltativa	Provided by the lecturer during the course
Altre informazioni	Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it and Ilaria Miceli, Ilaria.Miceli@unibz.it Software used: R (https://cran.mirror.garr.it/CRAN/) The Rstudio IDE (https://posit.co/downloads/)

Obiettivi di Sviluppo Sostenibile (SDGs)	Istruzione di qualità