Syllabus

Course Description

Course Title	Probability Theory and Statistics
Course Code	76210
Course Title Additional	
Scientific-Disciplinary Sector	MATH-03/B
Language	German
Degree Course	Bachelor in Computer Science
Other Degree Courses (Loaned)	
Lecturers	Prof. Werner Nutt, Werner.Nutt@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/7380
Teaching Assistant	Dott. Anton Gnatenko Dott. Sergei Katkov
Semester	First semester
Course Year/s	2
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	90
Planned Office Hours	
Contents Summary	The course offers an overview of the theory of probability in connection to its use in computer science and the use of statistics in analysing and understanding empirical data.
Course Topics	- Basic concepts: probability spaces, conditional probability, Bayes' Theorem, independent events - Random variables: distribution, density, expectation, variance, covariance, law of large numbers - Special distributions: Bernoulli, Binomial, Poisson, Exponential, Normal, Chi-Square, t-Distribution

	- Sampling: sums of random variables, central limit theorem, sample variance - Parameter Estimation: maximum likelihood estimates, interval estimates, confidence intervals - Hypothesis testing: significance levels, test statistics, p-values
Keywords	probability theory, statistics, random variables, probability distributions, hypothesis testing
Recommended Prerequisites	Students should be familiar with basic mathematical objects such as sets and functions and be able to manipulate them. In particular, they should be familiar with the convergence of sequences and series, exponential and logarithmic functions, derivatives and partial derivatives, and integration at the level of the introductory course Analysis.
Propaedeutic Courses	
Teaching Format	The course combines lectures, exercise groups with instructors, and coursework assignments that are corrected and commented on by Teaching Assistants. In the lectures, the instructor introduces new concepts and techniques using board work and projected material, complemented by short in-class exercises. The assignments give students the opportunity to consolidate these concepts by applying them to selected problems. In the exercise groups, students discuss possible approaches to the assignment tasks with the instructors and compare alternative solutions. They also work on additional problems, independent of the assignments, to deepen their understanding of the material covered in the lectures.
Mandatory Attendance	Attendance is not mandatory but strongly recommended. The lectures combine visual presentations (board and projection), exercises, and discussions aimed at developing problem-solving skills in probability and statistics through practice. All materials and assignments are available on the OLE page, but slides and notes alone are not sufficient to master the course. Regular attendance, active participation in exercises, and timely submission of coursework are essential for success.

Specific Educational Objectives and Learning Outcomes	Knowledge and Understanding - D1.1 Have a solid knowledge of mathematical , algebra, numerical calculus, and elementary logic that are in support of computer science. - D1.18 Have a solid knowledge of statistics and probability theory. Applying knowledge and understanding - D2.1 Be able to use the tools of mathematics and logic to solve problems. - D2.21 Be able to apply the tools of statistics and probability theory to solve information technology issues Ability to make judgments - D3.2 Be able to work autonomously according to the own level of knowledge and understanding. - D3.5 Ability to discern between various probability models and capability to find appropriate models for a given application Communication skills - D4.1 Be able to use one of the three languages English, Italian and German, and be able to use technical terms and communication appropriately. Learning skills - D5.1 Have developed learning capabilities to pursue further studies with a high degree of autonomy.
Specific Educational Objectives and Learning Outcomes (additional info.)	Use of software tools: Students will be able to use R and Java for basic statistical computations. Application of statistical concepts: Students will be able to apply probabilistic and statistical methods to simple real-world scenarios, such as determining sample sizes for surveys, calculating posterior probabilities for diagnostic tests, or assessing the applicability of the central limit theorem in a given situation.
Assessment	The assessment is based on coursework assignments (30%) and a written final exam (70%). Both assignments and the exam consist of groups of questions built around a hypothetical scenario or a mathematical setting. The questions require students to explore

	different aspects of the scenario or to investigate properties of the setting. Assignments are intended to help students review and deepen the material covered in the lectures, while the exam assesses whether they have achieved the learning outcomes of Knowledge and understanding, Applying knowledge and understanding, and Making judgments.
Evaluation Criteria	Assignments and exams are assessed based on the correctness and clarity of the answers. For students who submit all assignments, the final grade is the weighted average of the exam mark (70%) and the assignment mark (30%). If not all assignments are submitted, the assignment component is reduced in proportion to the number of assignments handed in. In addition, if the mark for a question in an assignment is lower than the corresponding exam mark, the higher exam mark will apply.
Required Readings	Sheldon M. Ross. Introduction to Probability and Statistics for Engineers and Scientists. Academic Press, London, England. 6th, 2021. ISBN : 0-12-817747-0
Supplementary Readings	Joseph K. Blitzstein, Jessica Hwang. Introduction to Probability. Chapman and Hall/CRC, Boca Raton, USA. 2nd edition, 2019. ISBN : 978-1-1383-6991-7
Further Information	R can be downloaded from: https://www.r-project.org R Studio, the IDE for the R language, can be downloaded from: https://posit.co/download/rstudio-desktop/
Sustainable Development Goals (SDGs)	Quality education