Syllabus

Course Description

Course Title	Advanced Statistics
Course Code	73066
Course Title Additional	
Scientific-Disciplinary Sector	STAT-01/A
Language	English
Degree Course	Master in Computing for Data Science
Other Degree Courses (Loaned)	
Lecturers	dr. Mufutau Ajani Rufai, MufutauAjani.Rufai@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/48142
Teaching Assistant	
Semester	Second semester
Course Year/s	1
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	90
Planned Office Hours	
Contents Summary	- Parameter estimation: maximum likelihood methods - Parameter estimation: Bayesian inference - Time series: components and forecasting - Time series: causal relationship tests - Missing data - Elements of statistics for Big Data
Course Topics	This is a second course in statistics covering selected topics in statistical inference, time series, and computational statistics. Topics include the method of moments, maximum-likelihood and Bayesian estimation, Monte Carlo methods and the bootstrap, and

	likelihood ratio testing. ARMA and regression modelling for time-series data and forecasting. Techniques for dealing with missing data. The course alternates front classes and lab activity, where the methodologies discussed are applied to real and simulated data. This course, by combining theory, computer simulations, and applications, aims to provide a deep understanding and operational knowledge of core techniques in statistical analysis that can be applied to both applied data analysis and theoretical research.
Keywords	Statistical Inference; Parameter Estimation; Time Series Analysis; Computational Statistics; Statistical and Data Analysis.
Recommended Prerequisites	The course builds on fundamental concepts of mathematics and statistics. In particular, students are expected to have basic knowledge of Calculus, Linear Algebra, Probability Theory, and Mathematical Statistics, as well as good programming skills. Students should not worry if some of these topics are not fully mastered. A recap of the essential concepts, including key definitions and examples, will be provided during the first week of the course to ensure students feel supported and confident in following the course.
Propaedeutic Courses	
Teaching Format	Frontal lectures, discussions and exercises on computer.
Mandatory Attendance	Attendance of classes and labs is not compulsory but highly recommended. Non-attending students have to contact the lecturer at the start of the course to agree on the modalities of the independent study.
Specific Educational Objectives and Learning Outcomes	The course belongs to the type "affini o integrative – formazione affine" in the curriculum “Data Analytics”. This course, by combining theory and computer simulations and applications, aims at providing deep understanding and operational knowledge of some core techniques of statistical analysis which can be exploited either for applied data analysis or theoretical research.

	Knowledge and understanding: • D1.1 - Knowledge of the key concepts and technologies of data science disciplines • D1.8 - Knowledge of the mathematical-statistical principles required for data analysis Applying knowledge and understanding: • D2.1 - Practical application and evaluation of tools and techniques in the field of data science • D2.2 - Ability to address and solve a problem using scientific methods • D2.7 - Practical application of mathematical-statistical tools and methods from the field of data science Making judgments • D3.2 - Ability to autonomously select the documentation (in the form of books, web, magazines, etc.) needed to keep up to date in a given sector Communication skills • D4.1 - Ability to use English at an advanced level with particular reference to disciplinary terminology Learning skills • D5.3 - Ability to deal with problems in a systematic and creative way and to appropriate problem solving techniques.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The assessment is based on class and lab participation, homework exercises and a final written exam. The final written exam will include open-ended questions and exercises for students to work out, as well as computational exercises to be solved using tools and programming languages of their choice, e.g., R, Python, MATLAB.
Evaluation Criteria	The final grade will be determined by the homework evaluation (30%) and the final written exam (70%). A 2-hour and 30-minute written examination covering all course topics, comprising exercises (to be solved with or without the use of programming languages) and theoretical questions.

Required Readings	Randall Pruim, 2018, *Foundations and Applications of Statistics: An Introduction Using R.* American Mathematical Society, Providence. ISBN 9781470428488. From this book, we discuss topics from chapters 4 and 5. Robert Shumway and David Stoffer, 2019. *Time Series: A Data Analysis Approach Using R*. CRC Press, Boca Raton. ISBN 9780367221096. From this book, we discuss chapters 1 to 4 and some optional topics from chapters 5 and 8. Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Supplementary Readings	The lecturer will provide additional materials and readings in class.
Further Information	Software used: Students are free to use tools and programming languages of their choice, e.g., R, Python, and MATLAB, for the homework and the final written exam.
Sustainable Development Goals (SDGs)	Quality education