Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	**Statistical Methods** M1 Statistical methods for business analysis *(loaned from course 25559 Statistical methods for business analysis – Master in Entrepreneurship and Innovation LM-77)* M2 Advanced statistics *(loaned from course 73006 Advanced Statistics – Master in Master in Computing for Data Science (LM-18)*
Course code	27502
Scientific sector	SECS-S/01
Degree	Master in Data Analytics for Economics and Management
Semester and academic year	2nd semester a.y. 2023/2024
Year	1st study year
Credits	12 (6+6)
Modular	Yes

Total lecturing hours	76 (M1: 36 + M2: 40)
Total lab/exercise hours	M1: 18 M2: 20
Attendance	suggested, but not required
Prerequisites	No formal prerequisite is set; nevertheless, the frequency of a pre-course in Mathematics is suggested in order to properly follow the lectures.
Course page	https://www.unibz.it/en/faculties/economics-management/master-data-analytics-economics-management/

Specific educational objectives	The course refers to the typical educational activities and belongs to the scientific area of Statistics-Mathematics M1: This course aims to develop a wide range of applied statistical tools for making inferences and predictions from data, including regression, classification, supervised methods and unsupervised methods. All the methods covered in class are illustrated using real datasets, commonly found in business and management. Analyses will be performed within the R statistical computing environment. At the end of the course, the students will be able to select and use properly a wide range of statistical learning and forecasting tools. They will be also able to draw conclusions from their analyses in the context of real data. M2: A second course in statistics on selected topics of statistical inference. Compared to the first module, the emphasis in the second module is to provide students with knowledge on mathematical statistics and the

	formal mathematical treatment of statistical mehtods, including the study of their properties. Topics discussed include • Montecarlo methods, bootstrap methods, methods for deriving estimators such as the maximum likelihood and • Bayesian estimation and techniques for dealing • with missing data. • Nonparametric density estimation and goodness of fit testing (optional). The course alternates front classes and lab activity where the methodology discussed is applied on real and simulated data. The software R will be used. 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.

Module 1	**M1 Statistical methods for business analysis**
Lecturer	Alessandro Casa, Office I3.01 alessandro.casa@unibz.it Tel. 0471 013 040 https://www.unibz.it/en/faculties/economics-management/academic-staff/person/46549-alessandro-casa
Scientific sector of the lecturer	SECS-S/01
Teaching language	English
Office hours	please refer to the lecturer's timetable
Lecturing assistant	None
Teaching assistant	None
List of topics covered	• Principles of statistical inference: confidence intervals and hypothesis tests • Introduction to statistical learning: basic notions and concepts • Linear regression and its extensions • Other regression methods (trees, splines, additive models) • Logistic regression and other classification tools • Model selection, model assessment and evaluation of model complexity • Unsupervised learning: principal components and clustering techniques • Application with the software R
Teaching format	Frontal lectures and computer labs.

Module 2	**M2 Advanced statistics**
Lecturer	TBA
Scientific	TBA

sector of the lecturer	
Teaching language	English
Office hours	please refer to the lecturer's timetable
Lecturing assistant	TBA
Teaching assistant	None
Office hours	please refer to the lecturer's timetable
List of topics covered	• 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
Teaching format	Frontal lectures, theoretical exercises and exercises on computer.

Learning outcomes	**M1:** **1) Knowledge and understanding:** - basic notions and concepts on statistical inference methods in large or finite samples - understanding a variety of statistical models, their statistical properties andtheir use in the context of business and economic analysis **2) Applying knowledge and understanding:** - ability to find and select relevant data for management and business innovation - ability to identify the statistical models that are suitable to analyze correctly a specific socio-economic and industrial framework - ability to provide forecasts in different application scenarios - ability to classify and analyze specific innovations and their potential development **3) Making Judgements:** - ability to select and apply appropriate models and tools of statistical analysis **4) Communication skills:** - ability to communicate precisely the results of statistical analyses to a general audience **5) Learning skills:** - ability to establish links among different statistical models **M2:** 1) Knowledge and understanding: • Knowledge of the key concepts and technologies of data science disciplines

	• Knowledge of the mathematical-statistical principles required for data analysis 2) Applying knowledge and understanding: • Practical application and evaluation of tools and techniques in the field of data science • Ability to address and solve a problem using scientific methods • Practical application of mathematical-statistical tools and methods from the field of data science 3) Making judgments • Ability to select the appropriate procedures for certain data types and interpret results • Ability to autonomously select the documentation (in the form of books, web, magazines, etc.) needed to keep up to date in a given sector 4) Communication skills • Ability to use English at an advanced level with particular reference to disciplinary terminology 5) Learning skills • Ability to deal with problems in a systematic and creative way and to appropriate problem solving techniques.

Assessment	Each module will be assessed through a written exam and a project assignment: - written exam with exercises, conceptual questions, review questions and questions concerning interpretation of results (70% of the final grade, if the project has been done); - project done during the semester, for attending students and iis centered on the application of methods on various datasets using R (30% of the final grade). Assessment is the same for attending and non-attending students. In both modules knowledge and key concepts (Learning Outcome 1) are assessed through the final exam, while the ability to apply appropriate techniques, interpret analysis results and make judgments (Learning Outcomes 2,3 and 4) will be assessed through the final exam and project assignments. Learning skills (Learning Outcome 5) will be assessed indirectly through individual preparation towards activities necessary to conduct class discussions, flipped classroom exercises and will be instrumental for passing the written exam.
Assessment language	English
Evaluation criteria and criteria for awarding marks	To obtain a positive evaluation in the subject, students must obtain a positive evaluation in both written exam and project assignment. In both modules the final grade will be determined by the evaluations of the final exam (70%) and project assignment (80%).

Required readings	**M1:** James, G., Witten, D., Hastie, T., Tibshirani, R. *An Introduction to Statistical Learning with Applications in R*. Springer, 2013. Freely available at http://www-

	bcf.usc.edu/~gareth/ISL/ Additional lecture notes will be provided **M2:** TBA
Supplementary readings	**M1:** Agresti, A., Finlay, B. *Statistica per le scienze sociali*, Pearson, 2009. Hyndman, R.J. and Athanasopoulos, G. *Forecasting: principles and practice*, 2nd edition, OTexts: Melbourne, 2018. Cicchitelli, Giuseppe. *Statistica. Principi e metodi*. Pearson, 2008. Azzalini, Adelchi, and Bruno Scarpa. *Data analysis and data mining: An introduction*. OUP USA, 2012. Grigoletto, Matteo, Laura Ventura, and Francesco Pauli. *Modello lineare: teoria e applicazioni con R*. G Giappichelli Editore, 2017. Johnson, Richard A., and Dean W. Wichern. "Applied multivariate statistical analysis." *New Jersey* 405 (1992). **M1:** TBA