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, time series and computational statistics. Topics discussed include Montecarlo methods and the bootstrap; maximum likelihood and Bayesian

	estimation, likelihood ratio testing. ARMA and regression modelling for time series data and forecasting. 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	Ferraccioli Federico
Scientific sector of the lecturer	SECS-S/01
Teaching language	English
Office hours	please refer to the lecturer's timetable
Lecturing assistant	Nai Ruscone Marta
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	Emanuele Taufer
Scientific sector of the lecturer	Secs-S/01
Teaching language	English
Office hours	please refer to the lecturer's timetable
Lecturing	Laura Di Lucchio

assistant	
Teaching assistant	None
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, discussions 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 and their 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	M1: Attendings Students: Written exam and project assignment: - written exam with exercises and review questions for both attending and non-attending students (60% of the final grade, if the projects have been done); - projects done during the semester, for attending students (40% of the final grade) Non-attending Students: written exam (100%) *Note: project assignment is valid for 1 academic year and cannot be carried over beyond that time-frame* M2: The assessment is based on class and lab participation, home-work exercises and a final written exam. The final written exam will include open questions and exercises to be worked out by the students as well as computational exercises to be solved with R.
Assessment language	English
Evaluation criteria and criteria for awarding marks	**M1:** The written exam consists of exercises and review questions. The project assignment involves statistical analyses on real data related to the contents of the course, using the statistical software R. To pass the exam, students must obtain a positive evaluation in both written exam and project assignment. **M2:** For attending students the final grade will be determined by the evaluation of home-works, class and lab participation (20%) and the evaluation of a final written exam (80%). The home-works and the final written exam are separately evaluated with a score expressed in 30/30. Both parts need to reach the minimum threshold of 18/30 in order to pass the exam. For non-attending students the final grade will be determined by the evaluation of a final written exam (100%). The final written exam is evaluated with a score expressed in 30/30.

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:** 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	**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). **M2:** Additional material and readings provided in class by the lecturer.
Software used	The software R (https://cran.r-project.org/) and RStudio (https://posit.co/) , freely available, will be used during the course, for the home-works and for the final written exam.