Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus

Descrizione corso

Titolo insegnamento	Statistical Methods
Codice insegnamento	27502
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	SECS-S/01
Lingua	Inglese
Corso di Studio	Corso di laurea magistrale in Data Analytics for Economics and Management
Altri Corsi di Studio (mutuati)	M1 Statistical methods for business analysis is loaned from course 25559 – Master in Entrepreneurship and Innovation (LM-77 EI) M2 Advanced statistics is loaned from course 73006 – Master in Computing for Data Science (LM-18)
Docenti	prof. Alessandro Casa, Alessandro.Casa@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/46549
Assistente	
Semestre	Secondo semestre
Anno/i di corso	1
CFU	12
Ore didattica frontale	M1: 36 hours M2: 40 hours
Ore di laboratorio	M1: 18 hours M2: 20 hours
Ore di studio individuale	-
Ore di ricevimento previste	M1: 18 hours M2: 18 hours
Sintesi contenuti	M1: This module begins with a review of key principles of statistical inference and then introduces core concepts in statistical learning. Topics include linear regression and its extensions, advanced

	regression techniques such as decision trees, logistic regression, classification methods, model selection strategies, and unsupervised learning approaches like principal component analysis and clustering. Throughout the course, students will work hands-on in R, applying techniques to real-world datasets drawn from business scenarios. By the end, students will be able to choose suitable statistical models, apply them to a range of business problems, and effectively communicate their analytical insights M2: • 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
Argomenti dell'insegnamento	M1: - Review of statistical inference: random variables, confidence intervals, and hypothesis testing. - Introduction to statistical learning concepts: basic vocabulary and notions, parametric and nonparametric approaches, predictive and inferential objectives, bias-variance trade off, supervised and unsupervised learning - Linear regression and extensions: simple and multiple linear regression, model estimation and assessment, model assumptions, inferential tools, qualitative predictors, interaction effects, polynomial regression, basic notions on nonparametric regression - Classification: introduction to classification, logistic regression, model estimation, evaluation of classifiers - Other supervised learning techniques: trees, splines, additive models - Model selection/assessment and evaluation of model complexity: resampling methods, cross-validation and information criteria - Unsupervised learning: clustering tools such as k-means and hierarchical clustering, principal component analysis - Applications with the R software M2: - 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
Parole chiave	Statistical learning, regression, classification, clustering, dimensionality reduction, model selection , statistical inference, Bayesian statistics, time series modelling, big data
Prerequisiti	M1: No formal prerequisites are required. Nonetheless, knowledge of basic concepts in descriptive and inferential statistics is useful, and attending a pre-course in mathematics/statistics is recommended. M2: the knowledge provided by a course in calculus and one in probability and statistics
Insegnamenti propedeutici	
Modalità di insegnamento	M1: In-person lectures and computer labs. Whenever possible, lectures will be structured to prioritize in-class time for discussions, and practical applications. M2: Frontal lectures, discussions and exercises on computer.
Obbligo di frequenza	Recommended, but not required.
Obiettivi formativi specifici e risultati di apprendimento attesi	
Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)	
Modalità di esame	The overall exam mark will be determined by the assessment of the two modules (M1+M2). M1: Assessment (for both attending and non-attending students): - Written Exam: Exercises and review questions (65% of the final grade). - Data Analysis Project: Group project in which students select and analyze an interesting dataset using the tools learned in the

	course. Groups will present their work at the end of the course (35% of the final grade; optional). Notes: - For students who do not complete the project, the written exam will count for 100% of the final grade. - Project grades remain valid for one academic year. 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.
Criteri di valutazione	M1: - Written exam: understanding of statistical concepts, correct interpretation of results of statistical analyses, clarity and precision of explanations. - Data Analysis Project: Quality and clarity of the presentation, adequacy and appropriateness of analyses with respect to dataset characteristics M2: For attending students the final grade will be determined by the evaluation of homeworks, class and lab participation (20%) and the evaluation of a final written exam (80%). The homeworks and the final written exam are separately evaluated with a score expressed in 30/30. 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.
Bibliografia obbligatoria	**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/ Slides and lecture notes 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.
Bibliografia facoltativa	**M1:** Bishop, C. M. (2006). Pattern recognition and machine learning. New York: Springer. 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.
Altre informazioni	
Obiettivi di Sviluppo Sostenibile (SDGs)	Buona salute, Lotta contro il cambiamento climatico, Ridurre le disuguaglianze, Buona occupazione e crescita economica

Modulo del corso

Titolo della parte costituente del corso	M1 - Statistical methods for business analysis
Codice insegnamento	27502A
Settore Scientifico-Disciplinare	SECS-S/01
Lingua	Inglese
Docenti	prof. Alessandro Casa, Alessandro.Casa@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/46549
Assistente	
Semestre	Secondo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	36
Ore di laboratorio	18
Ore di studio individuale	-
Ore di ricevimento previste	18
Sintesi contenuti	This module begins with a review of key principles of statistical inference and then introduces core concepts in statistical learning. Topics include linear regression and its extensions, advanced regression techniques such as decision trees, logistic regression, classification methods, model selection strategies, and unsupervised learning approaches like principal component analysis and clustering. Throughout the course, students will work hands-on in R, applying techniques to real-world datasets drawn from business scenarios. By the end, students will be able to choose

	suitable statistical models, apply them to a range of business problems, and effectively communicate their analytical insights
Argomenti dell'insegnamento	- Review of statistical inference: random variables, confidence intervals, and hypothesis testing. - Introduction to statistical learning concepts: basic vocabulary and notions, parametric and nonparametric approaches, predictive and inferential objectives, bias-variance trade off, supervised and unsupervised learning - Linear regression and extensions: simple and multiple linear regression, model estimation and assessment, model assumptions, inferential tools, qualitative predictors, interaction effects, polynomial regression, basic notions on nonparametric regression - Classification: introduction to classification, logistic regression, model estimation, evaluation of classifiers - Other supervised learning techniques: trees, splines, additive models - Model selection/assessment and evaluation of model complexity: resampling methods, cross-validation and information criteria - Unsupervised learning: clustering tools such as k-means and hierarchical clustering, principal component analysis - Applications with the R software
Modalità di insegnamento	In-person lectures and computer labs. Whenever possible, lectures will be structured to prioritize in-class time for discussions, and practical applications.
Bibliografia obbligatoria	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/ Slides and lecture notes provided
Bibliografia facoltativa	Bishop, C. M. (2006). *Pattern recognition and machine learning*. New York: Springer. 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).

Modulo del corso

Titolo della parte costituente del corso	M2 - Advanced statistics
Codice insegnamento	27502B
Settore Scientifico-Disciplinare	SECS-S/01
Lingua	Inglese
Docenti	
Assistente	
Semestre	Secondo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	40
Ore di laboratorio	20
Ore di studio individuale	-
Ore di ricevimento previste	18
Sintesi contenuti	• 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
Argomenti dell'insegnamento	
Modalità di insegnamento	Frontal lectures, discussions and exercises on computer.
Bibliografia obbligatoria	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.
Bibliografia facoltativa	Additional material and readings provided in class by the lecturer.