Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus

Descrizione corso

Titolo insegnamento	Optimization methods for decision making
Codice insegnamento	27511
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	NN
Lingua	Inglese
Corso di Studio	Corso di laurea magistrale in Data Analytics for Economics and Management
Altri Corsi di Studio (mutuati)	
Docenti	Prof. Dr. rer. nat. habil. Andreas Heinrich Hamel, Andreas.Hamel@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/33708 prof. Davide Ferrari, Davide.Ferrari2@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/39001 dr. Giulia Bertagnolli, Giulia.Bertagnolli@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/49312
Assistente	
Semestre	Tutti i semestri
Anno/i di corso	2
CFU	12
Ore didattica frontale	M1: - 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for re-watching) M2: - 24 hours of in-person lectures

	12 hours of video lectures (counted as 24 hours to account for re-watching)
Ore di laboratorio	-
Ore di studio individuale	-
Ore di ricevimento previste	M1: 18 hours M2: 18 hours
Sintesi contenuti	Module 1 deals with: • Linear optimization techniques • Nonlinear optimization techniques • Combinatorial optimization techniques • Multicriteria optimization and decision making • Decision making under uncertainty Module 2 focuses on the application of data science techniques to optimize resources, evaluate risks, and support sustainable decision-making in business and economic contexts. Students will work with spatio-temporal data, applying models for trend-surface estimation, spatial and temporal correlation, and prediction. The course also introduces robust statistical methods and outlier detection techniques to ensure reliability under data contamination and heavy-tailed distributions. Additional topics include tail dependence, extreme value modeling, and multivariate risk assessment, with real-world applications in finance, environmental planning, and policy evaluation. Emphasis is placed on interpreting results from empirical analyses and implementing solutions using modern statistical software.
Argomenti dell'insegnamento	M1: • Linear optimization techniques • Nonlinear optimization techniques • Discussion of combinatorial optimization problems • Multicriteria optimization and decision making • Decision making under uncertainty M2: Spatio-Temporal Data Analysis: Trend-surface estimation, spatial and temporal correlation, forecasting methods Robust Statistics & Outlier Detection: Data contamination and heavy tails, robust estimation and outlier analysis. Risk Modeling & Dependence Structures: Extreme value methods,

	multivariate risk assessment Applications: Finance and risk evaluation, environmental planning, policy and resource optimization
Parole chiave	
Prerequisiti	
Insegnamenti propedeutici	
Modalità di insegnamento	The course adopts a blended, student-centered approach that emphasises problem-based learning and active engagement. A portion of the lecture content is made available online in advance, allowing students to explore key concepts independently and at their own pace before attending class. This preparatory work enables in-person sessions to focus on the application of knowledge through real-world problems, collaborative activities, and guided discussions — fostering critical thinking and deeper learning. The course is fully aligned with the principles of the Italian Universities Digital Hub (EDUNEXT) initiative (https://edunext.eu), which promotes the integration of digital resources and active learning strategies within university teaching.
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: A written exam and a project presentation including an oral presentation. M2: Written exam: combination of multiple choice and essay questions. Project work: development of an individual project related to the methodologies studied, their implementation in statistical software, and their applications to empirical data.
Criteri di valutazione	M1:

	The written exam of 1 hour counts 50%, the project 50% towards the final grade. Evaluation criteria are understanding of modeling features, capability of applying solution methods (only small scale for the written exam) problems and the capability to interpret/discuss the results w.r.t. economic/managerial decision making. M2: To pass the M2 module exam students must obtain a positive evaluation on both final exam (50% of the grade) and project (50% of the grade).
Bibliografia obbligatoria	M1: Video lectures and slides provided during the course. M2: Lecture notes and selected readings from the following books: Wikle, Christopher K., Andrew Zammit-Mangion, and Noel Cressie. *Spatio-temporal statistics with R*. Chapman and Hall/CRC, 2019. Kolaczyk, Eric D., and Gábor Csárdi. *Statistical analysis of network data with R*. Vol. 65. New York: Springer, 2014.
Bibliografia facoltativa	M1: Boyd/Vandenberghe, Convex Optimization, Wright/Recht, Optimization for Data Analysis, Sundaram, A First Course in Optimization Theory.
Altre informazioni	
Obiettivi di Sviluppo Sostenibile (SDGs)	

Modulo del corso

Titolo della parte	M1 - Optimization methods for economics and business

costituente del corso	
Codice insegnamento	27511A
Settore Scientifico-Disciplinare	MAT/06
Lingua	Inglese
Docenti	Prof. Dr. rer. nat. habil. Andreas Heinrich Hamel, Andreas.Hamel@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/33708
Assistente	
Semestre	Primo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	- 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for re-watching)
Ore di laboratorio	-
Ore di studio individuale	-
Ore di ricevimento previste	18
Sintesi contenuti	The module deals with: • Linear optimization techniques • Nonlinear optimization techniques • Combinatorial optimization techniques • Multicriteria optimization and decision making • Decision making under uncertainty
Argomenti dell'insegnamento	• Linear optimization techniques • Nonlinear optimization techniques • Discussion of combinatorial optimization problems • Multicriteria optimization and decision making • Decision making under uncertainty
Modalità di insegnamento	The module adopts a blended, student-centered approach that emphasizes problem-based learning and active engagement. A portion of the lecture content is made available online in advance, allowing students to explore key concepts independently and at their own pace before attending class. This preparatory work enables in-person sessions to focus on the application of

	knowledge through real-world problems, collaborative activities, and guided discussions — fostering critical thinking and deeper learning. The course is fully aligned with the principles of the Italian Universities Digital Hub (EDUNEXT) initiative (https://edunext.eu), which promotes the integration of digital resources and active learning strategies within university teaching.
Bibliografia obbligatoria	Video lectures and slides provided during the course.
Bibliografia facoltativa	Boyd/Vandenberghe, Convex Optimization, Wright/Recht, Optimization for Data Analysis, Sundaram, A First Course in Optimization Theory.

Modulo del corso

Titolo della parte costituente del corso	M2 - Data science applications for resource optimization, risk evaluation and sustainability
Codice insegnamento	27511B
Settore Scientifico-Disciplinare	SECS-S/01
Lingua	Inglese
Docenti	prof. Davide Ferrari, Davide.Ferrari2@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/39001 dr. Giulia Bertagnolli, Giulia.Bertagnolli@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/49312
Assistente	
Semestre	Secondo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	- 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for

	re-watching)
Ore di laboratorio	-
Ore di studio individuale	-
Ore di ricevimento previste	18
Sintesi contenuti	This module focuses on the application of data science techniques to optimize resources, evaluate risks, and support sustainable decision-making in business and economic contexts. Students will work with spatio-temporal data, applying models for trend-surface estimation, spatial and temporal correlation, and prediction. The course also introduces robust statistical methods and outlier detection techniques to ensure reliability under data contamination and heavy-tailed distributions. Additional topics include tail dependence, extreme value modeling, and multivariate risk assessment, with real-world applications in finance, environmental planning, and policy evaluation. Emphasis is placed on interpreting results from empirical analyses and implementing solutions using modern statistical software.
Argomenti dell'insegnamento	Spatio-Temporal Data Analysis: Trend-surface estimation, spatial and temporal correlation, forecasting methods Robust Statistics & Outlier Detection: Data contamination and heavy tails, robust estimation and outlier analysis. Risk Modeling & Dependence Structures: Extreme value methods, multivariate risk assessment Applications: Finance and risk evaluation, environmental planning, policy and resource optimization
Modalità di insegnamento	The module adopts a blended, student-centered approach that emphasizes problem-based learning and active engagement. A portion of the lecture content is made available online in advance, allowing students to explore key concepts independently and at their own pace before attending class. This preparatory work enables in-person sessions to focus on the application of knowledge through real-world problems, collaborative activities, and guided discussions — fostering critical thinking and deeper learning. The course is fully aligned with the principles of the Italian Universities Digital Hub (EDUNEXT) initiative

	(https://edunext.eu), which promotes the integration of digital resources and active learning strategies within university teaching.
Bibliografia obbligatoria	Lecture notes and selected readings from the following books: Wikle, Christopher K., Andrew Zammit-Mangion, and Noel Cressie. *Spatio-temporal statistics with R*. Chapman and Hall/CRC, 2019. Kolaczyk, Eric D., and Gábor Csárdi. *Statistical analysis of network data with R*. Vol. 65. New York: Springer, 2014.
Bibliografia facoltativa	