Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2024/2025

Course title	**Data Visualisation and Exploration**
Course code	76099
Scientific sector	ING-INF/01
Degree	Master in Computing for Data Science (LM-18)
Semester	1
Year	2
Credits	6
Modular	Yes

Total lecturing hours	40
Total lab hours	20
Attendance	Not compulsory. Non attending students have to agree with the lecturer on the modalities of independent study at the beginning of the course.
Prerequisites	Basic programming concepts
Course page	https://ole.unibz.it/ and https://teams.microsoft.com/

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche". The course is designed to acquire professional skills and knowledge useful when exploring datasets. In particular, the student will be able to visualize datasets choosing the most appropriate technique for the data at hand, and will be able to get insights from the data supported by the visualizations, using basic statistical tools. The student will also learn to avoid the common pitfalls in visualization that can mislead the analysis. Visualization and data handling are done using the R programming language, following the best practices of reproducible research.

Lecturer	Ozan Kahramanogullari
Contact	ozan.kahramanogullari@unibz.it
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	Arranged beforehand by email
Lecturing assistant (if any)	--
Contact LA	--
Office hours LA	--
Credits	6
Lecturing hours	40
Lab hours	20
List of topics	• Reproducible analysis practices • Human perception for effective visualization • Data types and visual encodings • Visualization idioms • Exploratory data analytics, data exploration, and feature engineering

	• Advanced libraries for data visualization
Teaching format	Frontal lectures, lab assignments, project work.

Learning outcomes	Knowledge and understanding: • D1.3 - Knowledge of principles, methods and techniques for processing data in order to make them usable for practical purposes, and understanding of the challenges in this field • D1.8 ability to read and understand specialist scientific documentation, such as conference proceedings, articles in scientific journals, technical manuals.Applying knowledge and understanding Applying knowledge and understanding: • D2.1 know how to apply the fundamentals of empirical analysis of ICT data for the construction of mathematical models for the evaluation and prediction of characteristics of applications and software systems; • D2.2 know how to design and carry out experimental analyses of software systems in order to acquire measurements of their behaviour and evaluate experimental hypotheses in different application fields, such as business, industry or research; Making judgments Making judgments: • D3.1 ability to independently select documentation from various sources, including technical books, digital libraries, technical scientific journals, web portals or open source software and hardware tools;Communication skills Communication skills: • D4.1 - Ability to use English at an advanced level with particular reference to disciplinary terminology • D4.2 - Ability to present one's work in a clear and comprehensible way in front of an audience, including non-specialists • D4.4 ability to prepare and deliver presentations with technical content in English; • D4.7 ability to synthesise knowledge gained from reading and studying scientific and technical documentation and to prepare reports and presentations. Learning skills Learning skills: • D5.1 ability to independently extend the knowledge acquired during the course of study by reading and understanding scientific and technical documentation in English; • D5.3 in the context of a problem solving activity, ability to extend even incomplete knowledge with regard to the final objective of the project; • D5.4 the ability to formulate and validate theories and define new methods by means of empirical induction and new generation scientific investigation tools.

Assessment	The exam modalities are the same for both the attending and the non-attending students. Project work (70% of the final grade) and oral exam (30% of the final grade).

	All project works must be submitted, at the very latest, 15 days ahead of the oral exam. In case of a positive mark, the projects will count for all 3 regular exam sessions.
Assessment language	English
Assessment Typology	Collegial
Evaluation criteria and criteria for awarding marks	70% project work, 30% oral exam. • Relevant for project work: clarity of presentation, ability to gain useful and novel insights from data, creativity, critical thinking, ability to adhere to reproducible research best practices • Ability to use R software to perform basic data preparation tasks, ability to properly use R plotting facilities, ability to summarize the concepts of the Grammar of Graphics and of human perception, ability to choose the best type of graphical representation for different types of data, correct usage of basic statistical tools • Ability to use Python to employ (understand, recall and use) data analytics methods in practical settings, from data collection and curation, to data analysis and visualization.

Required readings	• *Data Visualization. A practical introduction.* Haley. Available online • *R for Data Science*. Wickham. Available online • *A layered grammar of graphics*. Wickham. Available online • • *Python Data Science Handbook*, by Jake VanderPlas. O'Reilly Media (1st Edition, 2016). Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Supplementary readings	• *Fundamentals of Data Visualization*. Wilke. Available online • *Visualization Analysis and Design*. Munzer. Amazon • *Data Visualization: Charts, Maps, and Interactive Graphics.* Grant. Amazon • *Doing Data Science*. Cathy O'Neil, Rachel Schutt. O'Reilly, 2013, https://www.oreilly.com/library/view/doing-data-science/9781449363871/ • *Python for Data Analysis.* By Wes McKinney. O'Reilly, 2nd Edition, 2017, https://www.oreilly.com/library/view/python-for-data/9781491957653/
Software used	• Rstudio https://www.rstudio.com/ • Jupyter Notebook (for Python programing)