Syllabus

Course Description

Course Title	Econometrics for data science
Course Code	27522
Course Title Additional	
Scientific-Disciplinary Sector	
Language	English
Degree Course	Master in Data Analytics for Economics and Management
Other Degree Courses (Loaned)	
Lecturers	Prof. Francesca Marta Lilja Di Lascio, Marta.DiLascio@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/32845 Prof. Francesco Ravazzolo, Francesco.Ravazzolo@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/36066 dr. Aldo Paolillo, Aldo.Paolillo@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/48246
Teaching Assistant	
Semester	All semesters
Course Year/s	1st study year
CP	12
Teaching Hours	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)
Lab Hours	M1: 18 hours
Individual Study Hours	-
Planned Office Hours	M1: 18 hours M2: 18 hours
Contents Summary	The first module (M1) equips students with practical skills to manage, clean, integrate, and use economic and business data for empirical analysis. It introduces database management, data quality, and relational modelling, using SQL and R for data extraction and transformation. Students build reproducible workflows and prepare well-structured datasets for econometric applications using real-world data. The second module (M2) introduces the fundamentals of stochastic process theory, stationary and heteroskedastic models, and the principles of forecasting. It covers the core workflow of time-series analysis - from exploratory visualization and summarization to decomposition, model building, and forecasting. The theoretical aspects are complemented by modern data analysis with R.
Course Topics	M1 - Concepts of data and information in economic and organizational settings. Relational databases, design principles, integrity, and SQL for data extraction and transformation. - Data cleaning and transformation: missing values, inconsistencies, outliers, validation, reshaping, and reproducible documentation. - Integration of cross sectional, time series, panel, and financial data across sources, frequencies, and aggregation levels. - Preparing model ready datasets for regression, panel data, forecasting, and volatility applications. - End to end case studies, from raw data to applied empirical analysis, using real world economic and business data. M2 - Basics of stochastic processes theory and characteristics of time series data - Smoothing, filtering and decomposing a time series - Introduction to AR, MA, ARIMA and SARIMA models - Maximum likelihood estimation

	- Box & Jenkins procedure to analyse a time series - Forecasting methods: time series forecasting, density forecasting, forecasting from ARIMA models - Volatility models: ARCH and GARCH models and forecasting - Case studies
Keywords	M1 Relational databases, SQL methods, Data transformation, Econometric preparation, Empirical case studies M2 Stochastic processes, SARIMA models, Volatility models, Forecasting methods, Data analysis
Recommended Prerequisites	M1 Basic knowledge of mathematics and statistics. Familiarity with R software. M2 Basic knowledge of mathematics and statistical inference, and basic familiarity with R software.
Propaedeutic Courses	
Teaching Format	Lectures, pre-recorded videos, and laboratory sessions. The course adopts a blended, student-centred 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 inperson 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.
Mandatory Attendance	Attendance is recommended, but not mandatory.
Specific Educational Objectives and Learning Outcomes	Intended Learning Outcomes (ILO) M1 ILO 1 Knowledge and understanding:

	ILO 1.1 Students acquire programming skills specifically geared towards data analysis and statistical methodologies aimed at implementing models and analysing large datasets. ILO 1.2 Students acquire knowledge of textual data and network analysis and aspects related to the security and privacy of such data. ILO 2 Applying knowledge and understanding: ILO 2.1 Ability to apply and implement, through the development of algorithms, techniques for analysing large datasets and spatial and temporal data, under conditions of uncertainty, in order to ensure the usefulness, quality and effectiveness of the analysis. ILO 2.2 Ability to use IT technologies, techniques and methodologies for the acquisition, management, integration, analysis and visualisation of large datasets, in order to ensure scalability in terms of the volume and speed of dataset acquisition. These skills relate in particular to large database and dataset management systems and related visualisation techniques, models and languages for expressing data semantics, learning techniques, decision-making models, information system organisation, web search techniques and data flow management techniques. ILO 3 Making judgements: ILO 3.1 The student acquires the ability to apply acquired knowledge to interpret data in order to make directional and operational decisions in a business context. ILO 3.2 The student acquires the ability to apply acquired knowledge to support processes related to production, management and risk promotion activities and investment choices through the organisation, analysis and interpretation of complex databases. ILO4 Communication skills: ILO 4.1 The student acquires the ability to communicate effectively in oral and written form the specialised content of the individual disciplines, using different registers, depending on the recipients and the communicative and didactic purposes, and to evaluate the formative effects of his/her communication. ILO 5 Learning skills:

	ILO 5.1 The student acquires knowledge of scientific research tools. He/she will also be able to make autonomous use of information technology to carry out bibliographic research and investigations both for his/her own training and for further education. Furthermore, through the curricular teaching and the activities related to the preparation of the final thesis, she will be able to acquire the ability - to identify thematic connections and to establish relationships between methods of analysis and application contexts; - to frame a new problem in a systematic manner and to implement appropriate analysis solutions; - to formulate general statistical-econometric models from the phenomena studied. M2 ILO 1 Knowledge and understanding: ILO 1.1 The student acquires knowledge of the analytical techniques and tools required to understand and quantitatively analyse economic and business phenomena in order to support decision-making processes. ILO 1.2 The student consolidates knowledge of statistical inference, linear models and their generalisations, linear algebra, and optimisation techniques. ILO 2 Applying knowledge and understanding: ILO 2.1 Ability to apply and implement analysis techniques focusing on different types of datasets such as streaming data, tabular data, documents and images and analysis on joint datasets. ILO 2.2 Ability to apply supervised and unsupervised learning, and knowledge modelling, extraction, integration, analysis and exploitation; these skills are declined in various application domains of interest to companies and public and private organisations. ILO 3 Making judgements: ILO 3.1 The student acquires the ability to apply acquired knowledge to interpret data in order to make directional and operational decisions in a business context. ILO 3.2 The student acquires the ability to apply acquired

	knowledge to support processes related to production, management and risk promotion activities and investment choices through the organisation, analysis and interpretation of complex databases. ILO4 Communication skills: ILO 4.1 The student acquires the ability to communicate effectively in oral and written form the specialised content of the individual disciplines, using different registers, depending on the recipients and the communicative and didactic purposes, and to evaluate the formative effects of his/her communication. ILO 5 Learning skills: ILO 5.1 The student acquires knowledge of scientific research tools. He/she will also be able to make autonomous use of information technology to carry out bibliographic research and investigations both for his/her own training and for further education. Furthermore, through the curricular teaching and the activities related to the preparation of the final thesis, she will be able to acquire the ability - to identify thematic connections and to establish relationships between methods of analysis and application contexts; - to frame a new problem in a systematic manner and to implement appropriate analysis solutions; - to formulate general statistical-econometric models from the phenomena studied.
Specific Educational Objectives and Learning Outcomes (additional info.)	M1 1) Knowledge and understanding Students gain knowledge of: - Principles of database systems and relational data models. - Data cleaning and data quality concepts. - Techniques for reshaping and integrating economic data. 2) Applying knowledge and understanding Students learn to: - Construct datasets suitable for econometric workflows. - Extract, transform, and integrate data using SQL and R. - Prepare datasets for regression, panel data, time series, and volatility models. 3) Making judgements Students develop the ability to select appropriate data

	management strategies, identify data problems, and evaluate dataset suitability. 4) Communication skills Students learn to communicate analytical workflows and empirical findings clearly using statistical tools. 5) Learning skills The course provides foundational and practical skills for effective data preparation in econometric modelling and business applications. M2 The course will provide students with the ability to analyze and interpret data using econometric models. 1) Knowledge and understanding The course will equip students with the ability to organize and combine economic and business data starting from structured databases. It will also enable students to acquire knowledge about state-of-the-art of models to represent time series data. 2) Applying knowledge and understanding Students will be able to implement data management techniques and econometric models in order to extract proper information from data, useful to analyse real phenomena in several fields of economics and management, and to understand their most important aspects. 3) Making judgements Students who successfully complete this course will be able to select the most appropriate data management approaches and apply proficiently statistical model to obtain inferences and predictions using statistical software, and organize results in order to draw conclusions and decide in uncertain situations, like in specific economic and business situations. 4) Communication skills Students who successfully complete this course will be able to communicate, to experts and non-experts the results of their analyses using specific software. 5) Learning skills The course is aimed to provide the methodological and applied knowledge of data management for subsequent econometric modeling, and necessary to address subsequent analyses.
Assessment	The overall exam mark will be determined by the assessment of

	the two modules (M1+M2) M1 Attending students: Written exam (60% of the final grade) – (ILOs 2.1, 2.2, 3.1, 5.1). Project assignment (20% of the final grade) – (ILOs 1.1, 1.2, 2.2, 3.2, 4.1, 5.1). Project presentation (20% of the final grade) – (ILO 4.1). Non-attending students: Written exam (60% of the final grade) – (ILOs 2.1, 2.2, 3.1, 5.1). Project assignment (40% of the final grade) – (ILOs 1.1, 1.2, 2.2, 3.2, 4.1, 5.1). M2 Attending students: Written exam composed of exercises and theoretical questions (50% of the final grade) - (ILOs 1, 2.2, 3-5), group project and presentation (50% of the final grade) - (ILOs 1-5). Non-attending students: Written exam composed of exercises, theoretical questions, tasks related to data analysis (100% of the final grade). (ILOs 1-5)
Evaluation Criteria	M1 Evaluation criteria for both the written exam and the project include: clarity and structure in exposition; knowledge and understanding of core concepts in data management and applied econometrics; ability to select and apply appropriate methods for data extraction, cleaning, transformation, integration, and modelling; correctness of the interpretation of results; originality and critical engagement with the material; quality of analysis and discussion; and adherence to reproducible practices, including well documented code and transparent data workflows. M2 Attending students: 50% written exam (consisting of theoretical questions and exercises), 50% group project report (consisting of analysis tasks on data sets assigned during the semester to be carried out through the use of statistical software) and presentation of the

	project. Non-attending students: 100% written exam consisting of theoretical questions, exercises, and data analysis tasks. Evaluation criteria for both written exams and projects: clarity in exposition, knowledge and understanding of statistical methods, ability to apply appropriate statistical procedures, correctness of results.
Required Readings	M1 All compulsory materials (lecture notes, slides, datasets, tutorials) will be provided by the lecturer. M2 • Peter J. Brockwell and Richard A. Davis, Introduction to Time Series and Forecasting, 2016, 3rd ed., Springer, ISBN: 978-3-319-29852-8. Chapters: 1-3, 5-7, 10. • Christopher Chatfield and Haipeng Xing, The Analysis of Time Series - An introduction with R, 2019, 7th ed., Chapman & Hall,ISBN: 978-1-498-79563-0. Chapters: 1-5, 12. • Selection of papers provided by the lecturers. • Lecture notes, exercises and datasets will be provided.
Supplementary Readings	M1 • Shan, J., Goldwasser, M., Malik, U., and Johnston, B., SQL for Data Analytics: Harness the Power of SQL to Extract Insights from Data, Packt Publishing Ltd, 2022. • Soheil Bakhshi, Expert Data Modeling with Power BI: Get the Best Out of Power BI by Building Optimized Data Models for Reporting and Business Needs, Packt Publishing Ltd, 2021. • Additional readings on data preparation and applied econometrics will be announced during the course M2 • George E.P. Box, Gwilym M. Jenkins, Gregory C. Reinsel andGreta M. Ljung, Time series analysis, Forecasting and

	Control,2016, 5th Ed., Wiley, ISBN: 978-1-118-67502-1. • Robert H. Shumway and David S. Stoffer, Time Series Analysisand Its Applications: With R Examples, 2017, 4th ed., Springer,ISBN: 978-3-319-52451-1. Chapters: 1-3, 5. • James D. Hamilton, Time series analysis, Princeton UniversityPress, 1994, ISBN: 978-0-691-04289-3. • Further readings will be announced during the course.
Further Information	
Sustainable Development Goals (SDGs)	Partnerships fot the goals, Quality education

Course Module

Course Constituent Title	M1 - Management of Economic and Business Data
Course Code	27522A
Scientific-Disciplinary Sector	INFO-01/A
Language	English
Lecturers	dr. Aldo Paolillo, Aldo.Paolillo@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/48246
Teaching Assistant	
Semester	First semester
CP	6
Responsible Lecturer	
Teaching Hours	- 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for re-watching)
Lab Hours	18
Individual Study Hours	-
Planned Office Hours	18
Contents Summary	This module equips students with practical skills to manage, clean, integrate, and use economic and business data for empirical analysis. It introduces database management, data quality, and relational modelling, using SQL and R for data extraction and transformation. Students build reproducible workflows and prepare well-structured datasets for econometric applications using real

	world data.
Course Topics	- Concepts of data and information in economic and organizational settings. Relational databases, design principles, integrity, and SQL for data extraction and transformation. - Data cleaning and transformation: missing values, inconsistencies, outliers, validation, reshaping, and reproducible documentation. - Integration of cross sectional, time series, panel, and financial data across sources, frequencies, and aggregation levels. - Preparing model ready datasets for regression, panel data, forecasting, and volatility applications. - End to end case studies, from raw data to applied empirical analysis, using real world economic and business data.
Teaching Format	Lectures, pre-recorded videos, and laboratory sessions. The module adopts a blended, student-centred 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.
Required Readings	All compulsory materials (lecture notes, slides, datasets, tutorials) will be provided by the lecturer.
Supplementary Readings	• Shan, J., Goldwasser, M., Malik, U., and Johnston, B., SQL for Data Analytics: Harness the Power of SQL to Extract Insights from Data, Packt Publishing Ltd, 2022. • Soheil Bakhshi, Expert Data Modeling with Power BI: Get the Best Out of Power BI by Building Optimized Data Models for Reporting and Business Needs, Packt Publishing Ltd, 2021. • Additional readings on data preparation and applied econometricswill be announced during the course

Course Constituent Title	M2 - Time Series Analysis and Forecasting
Course Code	27522B
Scientific-Disciplinary Sector	ECON-05/A
Language	English
Lecturers	Prof. Francesca Marta Lilja Di Lascio, Marta.DiLascio@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/32845 Prof. Francesco Ravazzolo, Francesco.Ravazzolo@unibz.it https://www.unibz.it/en/faculties/economics-management/academic-staff/person/36066
Teaching Assistant	
Semester	Second semester
CP	6
Responsible Lecturer	
Teaching Hours	- 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for re-watching)
Lab Hours	18
Individual Study Hours	-
Planned Office Hours	
Contents Summary	This module introduces the fundamentals of stochastic process theory, stationary and heteroskedastic models, and the principles of forecasting. It covers the core workflow of time-series analysis - from exploratory visualization and summarization to decomposition, model building, and forecasting. The theoretical aspects are complemented by modern data analysis with R.
Course Topics	- Basics of stochastic processes theory and characteristics of time series data - Smoothing, filtering and decomposing a time series - Introduction to AR, MA, ARIMA and SARIMA models - Maximum likelihood estimation - Box & Jenkins procedure to analyse a time series - Forecasting methods: time series forecasting, density forecasting, forecasting from ARIMA models

	- Volatility models: ARCH and GARCH models and forecasting - Case studies
Teaching Format	Lectures, pre-recorded videos, and laboratory sessions. The module adopts a blended, student-centred 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.
Required Readings	• Peter J. Brockwell and Richard A. Davis, Introduction to Time Required Readings Series and Forecasting, 2016, 3rd ed., Springer, ISBN: 978-3-319-29852-8. Chapters: 1-3, 5-7, 10. • Christopher Chatfield and Haipeng Xing, The Analysis of Time Series – An introduction with R, 2019, 7th ed., Chapman & Hall, ISBN: 978-1-498-79563-0. Chapters: 1-5, 12. • Selection of papers provided by the lecturers. • Lecture notes and exercises will be provided.
Supplementary Readings	• George E.P. Box, Gwilym M. Jenkins, Gregory C. Reinsel andGreta M. Ljung, Time series analysis, Forecasting and Control,2016, 5th Ed., Wiley, ISBN: 978-1-118-67502-1. • Robert H. Shumway and David S. Stoffer, Time Series Analysis and Its Applications: With R Examples, 2017, 4th ed., Springer, ISBN: 978-3-319-52451-1. Chapters: 1-3, 5. • James D. Hamilton, Time series analysis, Princeton University Press, 1994, ISBN: 978-0-691-04289-3. • Further readings will be announced during the course.