ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

SCHOOL OF BUSINESS

DEPARTMENT OF MANAGEMENT SCIENCE AND TECHNOLOGY

MSc in
Business Analytics

ATHENS UNIVERSITY OF ECONOMICS & BUSINESS

STUDY GUIDE
ATHENS, JULY 2023

PART I: INFORMATION ABOUT THE INSTITUTION

CONTACT DETAILS (Name & Address)

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS (AUEB)

Address:76, Patission Str. GR-10434, Athens

Telephone number: +30-210-8203911

Website: https://www.aueb.gr

e-mail: webmaster@aueb.gr

Facebook: https://www.facebook.com/auebgreece

Twitter: https://twitter.com/aueb

ACADEMIC AUTHORITIES

The rectorate authorities consist of the Rector and the Vice Rectors:

Rector:

Professor Dimitris Bourantonis

Vice Rectors:

Vice Rector of Academic Affairs and Personnel
Professor Vasilios Vasdekis

Vice Rector of Research and Lifelong Learning
Professor Georgios Lekakos

Vice Rector of Financial Planning and Infrastructure
Professor Konstantinos Drakos

Vice Rector of International Cooperation and Development
Professor Vasilios Papadakis

School of Business
Dean: Professor Angeliki Poulymenakou
Department of Management Science and Technology
Chair: Professor Irini Voudouri
Master's Program in Business Analytics
Director: Professor Damianos Chatziantoniou
Contact details
Address: 47A Evelpidon & 33 Lefkados Str., GR-11362 Athens, Greece
Telephone number: (+30) 210 8203 676
Email: ms-ba@aueb.gr
Website: http://analytics.aueb.gr/

ACADEMIC CALENDAR

FALL SEMESTER

Classes begin (1st period):	Monday, September 25, 2023
Classes end (1st period):	Saturday, December 16, 2023
Christmas Recess:	Saturday, December 23, 2023

Fall Semester Examination Period

Start of Exams:	Monday, December 18, 2023
End of Exams:	Monday, January 8, 2024

National/Bank Holidays
October 28 Holiday - The Anniversary of the "No", Saturday, October 28, 2023
The Anniversary of Polytechneio, Friday, November 17, 2023
Epiphany, Saturday, January 6, 2024

SPRING SEMESTER

Classes begin (2nd period):	Tuesday, January 9, 2024
Classes end (2nd period):	Saturday, March 30, 2024
Classes begin (3rd period):	Monday, April 8, 2024
Easter Recess:	Wednesday, May 1, 2024
Classes restart (3rd period):	Wednesday, May 8, 2024
Classes end:	Saturday, July 6, 2024

Spring Semester Examination Period

Start of Exams (2nd period):	Monday, April 1, 2024
End of Exams (2nd period):	Saturday, April 6, 2024
Start of Exams (3rd period):	Monday, July 8, 2024
End of Exams (3rd period):	Saturday, July 13, 2024

National/Bank Holidays

The Three Holy Hierarchs, Tuesday, January 30, 2024
Clean Monday, Monday, March 18, 2024
Greek Independence Day, Monday, March 25, 2024
Pentecost Monday, Monday, June 24, 2024

AUEB's OPERATIONAL STRUCTURE

The structure and operation of the Institution is defined by current legislation as in force. The Athens University of Economics and Business is under the supervision of the Ministry of Education, Research and Religious Affairs. Its governing bodies include:

The Governing Council
The Senate
The Rector
The Vice-Rectors

The Executive Director

Until the Governing Council assumes its duties, administration is exercised by the University's Rector's Council

AUEB's ACADEMIC STRUCTURE

The Athens University of Economics and Business is structured by academic units of two (2) levels: a) the Schools, and b) the Departments

Each School is structured by at least two (2) Departments, covers a domain of related scientific areas, and ensures the interdisciplinary approach to teaching and research between its departments. The School is responsible for supervising and coordinating the operation of the Departments and the educational and research work produced, in accordance with the Internal Operating Regulations.
The bodies of the School, according to Law 4957/2022 (A 141) as applicable are: a) the Dean and b) the Dean's Council

The Department is the University's fundamental academic unit and aims to advance a specific field of science, technology, letters and arts through education and research. The Department consists of all the members of the Teaching & Research Staff (DEP), the members of the Special Education Staff (EEP), the members of the Laboratory Teaching Staff (EDIP) and the members of the Special Technical Laboratory Staff (ETEP).

Bodies of the Department according to Law 4957/2022 (A 141) as applicable are: a) the Assembly, b) the Board of Directors, c) the Head/Chair and d) the Deputy Head/Chair.

The Athens University of Economics and Business consists of three Schools & eight Departments:

1. **SCHOOL OF ECONOMIC SCIENCES**

   Department of International and European Economic Studies

   Department of Economics.

2. **SCHOOL OF BUSINESS**

   Department of Management Science and Technology

   Department of Business Administration

   Department of Accounting and Finance

   Department of Marketing and Communication**.**

3. **SCHOOL OF INFORMATION SCIENCE AND TECHNOLOGY**

   Department of Informatics
   Department of Statistics

ADMINISTRATIVE BODIES OF POSTGRADUATE STUDY PROGRAMS

Competent bodies for the organization and operation of the Postgraduate Study Programs are:

a) the Senate,
b) the Assembly of the Department,
c) the Coordinating Committee (CC), and
d) the Director of the Postgraduate Program.

Especially for inter-departmental, inter-institutional and joint programs, the responsibilities of the Department's Assembly are exercised by the Curriculum Committee

UNIVERSITY STAFF

The University staff consists of the following categories:

- TEACHING STAFF:

- Teaching & Research Staff (DEP)
- Emeritus Professors
- Visiting Professors
- Special Education Staff (E.E.P.)
- Laboratory Teaching Staff (E.DI.P.)
- Special Technical Laboratory Staff (E.T.E.P.)
- Auxiliary Teaching Staff
- Teaching Fellows
- Scientific Faculty Members
- Adjunct Instructors
- Secondet Teachers

- **ADMINISTRATIVE STAFF**

SERVICES

The Athens University of Economics and Business provides both administrative and other services (meals, housing, library, sport facilities etc.) aiming at serving both its students and staff. More information on the organization and operation of the University's services can be found on the University's website (http://www.aueb.gr/en).

GENERAL DESCRIPTION OF THE UNIVERSITY

The Athens University of Economics and Business (AUEB), as a Higher Educational Institution, is a legal entity governed by public law and supervised by the Ministry of Education, Research and Religious Affairs.

AUEB is, in order of seniority, the third Higher Education Institution of the country and the first in the fields of Economics and Business Administration. Later, the scientific fields of Informatics and Statistics were added. Since its founding, in 1920, AUEB has a rich and noteworthy tradition of significant academic achievements that define the present and create excellent prospects for the future.

The University as a center of excellence, in academic research and teaching, is rated as one of the leading universities in its subject areas in Greece and one of the best internationally. The high level of its staff, the quality in teaching and research, the modern curriculum/courses, but also the high

demand of its graduates significantly enhance the University's brand name and reputation, in Greece and abroad.
Detailed information on the study programs is provided in the study guides and departmental websites.

Chief Regulations of the University (including academic recognition procedures)
The regulations include, for example:

- The University's Internal Operating Regulations
- The Organization of Administrative Services
- The Regulations for the Operation of Postgraduate and Doctoral Study Programs
- The Internal Regulation for conducting postdoctoral research

AUEB'S ECTS COORDINATOR

The University's ECTS Coordinator is the Quality Assurance Chairperson, who ensures the University's compliance with the principles and rules of the European credit accumulation and transfer systems, supervises compliance and implementation and is responsible for the full recognition and transfer of credit units.

PARTII: INFORMATION ON DEGREE PROGRAMMES

A. GENERAL DESCRIPTION

QUALIFICATION AWARDED
The Postgraduate Program awards the MSc in Business Analytics.

ADMISSION REQUIREMENTS
The selection criteria for candidates are defined in the notice and include in particular:

I. Degree/s grade,
II. Grades on the undergraduate courses, which are relevant to the courses of the MSc,
III. Dissertation Performance, where this is provided for the undergraduate studies,
IV. Duration and type of employment, if available,
V. Other skills (grade in GMAT / GRE exams, IT skills, relevant seminars, etc.).

as well as the following quality criteria:

VI. University and originating Department,
VII. Type of research experience,
VIII. C1 level of English language knowledge,
IX. Knowledge of other foreign language,
X. Interview,
XI. Recommendation letters from faculty members or employers,
XII. Any distinction/awards.

ADMISSION/REGISTRATION PROCEDURE
The registration of the each year's admitted postgraduate students takes place from June to October of each year, within deadlines set by the CC of the MSc.
The candidate, before registering, acquaints himself/herself of the Operation Regulation and the establishment act of the MSc and declares in writing that he/she accepts the Operation Regulation of the program. For reasons of exceptional necessity, the Assembly may decide, upon a reasoned request by the person concerned, that registration may take place within one month of the expiry of the deadline.

EDUCATIONAL AND PROFESSIONAL GOALS
The Postgraduate Studies Program (MSc) entitled "MSc in Business Analytics" aims at providing specialized postgraduate studies in the key areas of Business Analytics and focuses on the following subject areas:

a) business performance and innovation management,
b) quantitative methods in decision making,
c) data analysis and management, and
d) operational applications and analytics tools.

Purpose of the MSc is to prepare executives who will best combine knowledge in business management, data analysis and management techniques, and analytics tools based on statistical and operational research, with a view to making optimal business decisions. That is, to be able to handle the information of a fast and constantly changing world, full of data, in a way that is flexible, efficient and effective for their working environment.

ACCESS TO FURTHER STUDIES

It is possible to continue studies at the Doctoral level.

COURSE STRUCTURE DIAGRAM WITH CREDITS

1st Semester	П.М.
Information Systems & Business Process Management	5
Large Scale Optimization)	5
Data Management and Business Intelligence	5
Statistics for Business Analytics I	5
Business and Privacy Issues in Data Analysis	5
Business Analytics Practicum 1	2,5
Innovation and Entrepreneurship	2,5
Total of 1st Semester	30
2nd Semester	
Big Data Systems and Architectures	5
Statistics for Business Analytics II	5
Mining Big Datasets	5
Social Network Analysis	2,5
Machine Learning and Content Analytics	2,5
Business Analytics Practicum II	2,5
Business Analytics Use Cases	5
Elective courses	
Advanced Topics in Statistics	2,5
Advanced Topics in Data Engineering	2,5
Total of 2nd Semester	30
3rd Semester	
Thesis/Field Study Project/Internship	30
Total of 3rd Semester	30
TOTAL	90

The full-time program consists of one year of coursework, followed by a semester-long diploma thesis or field-study project or internship. The part-time program consists of two years of coursework, followed by a semester-long thesis or field-study project or internship.

FINAL EXAMINATION

The two semesters in the full-time program are divided into three teaching periods and the four semesters in the part-time program are divided into six teaching periods. In both programs - full and part-time – examinations take place three times each academic year, in the following months: December/January, March/April and June/July. The courses/exercises and exams curriculum of each period shall be drawn up and communicated at least ten days before the beginning of the semester.

EXAMINATION AND ASSESSMENT REGULATIONS

1. The final evaluation of each course is done either through written or oral examinations and/or assignments.
2. The final grade for each course is determined by the respective teachers. The individual and group assignments of the students can be included. Participation in the examination on the specific date announced in accordance with the Program is compulsory.
3. The grading scale is set from zero (0) to ten (10) with grades of the whole or half unit. Passing grades are considered the total grade of 5 and higher.
4. In the event that a student does not come unjustifiably on the specific examination date of a course, s/he loses the examination period and the course is considered as failed.
5. In case of exceeding the limit of absences, the postgraduate student is obliged to repeat the courses attendance. In case of failure in a course, a re-examination may be carried out twice, in accordance with the professor's instructions as regards the type of examination, but not a third time. The re-examination does not require a re-registering. Specific arrangements and cases are examined by the CC.
6. For the award of the MSc, a promotional grade is required in all postgraduate courses and in the dissertation or field study project or internship. If this condition is not met within the expected period, the postgraduate student is only entitled to a simple certificate of successful attendance of the courses, wherever s/he has received a promotional grade and the postgraduate student's attendance of the Program is completed.
7. The Administrative Science and Technology Department’s Assembly upon the recommendation of the CC, may decide to delete postgraduate students if the failed courses exceed two per academic term.
8. In any case of deletion of the postgraduate student, any tuition fees paid shall not be reimbursed, unless there are special reasons and the Assembly shall justifiably decide otherwise upon the proposal of the CC of the MSc.

DISSERTATION OR FIELD STUDY PROJECT OR INTERSHIP

The dissertation or field study project or internship is compulsory and performed both for full-time and part-time students upon completion of the course, i.e. the semester from August 1st to January 31st of the next year.

The students of the program may choose to pursue a field study project instead of a dissertation, with a few hours of weekly meetings of the student in the company, or b) Internship, lasting at least 3 months and working up to 40 hours per week, in a company-provider with the scope of solving real-life problems related to the subject of the dissertation, field study project or internship. The above options will have the same impact and the same Credit Units as the dissertation, as mentioned in the studies regulation.

B. DESCRIPTION OF INDIVIDUAL COURSE UNITS

CORE COURSES

Course title	**Data Management and Business Intelligence**
Course code	Full Time Program: m82103f Part Time Program: m82103p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 1st trimester Part Time Program: 1st trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Damianos Chatziantoniou, Professor
Objective of the course (preferably expressed in terms of learning outcomes and competences)	This course is designed to introduce students to modern data management concepts, as evolved in the last few years in the context of big data applications. After taking this course, students should be able to: • Develop an application in relational systems: design relational schemas, write SQL, use APIs to connect to a relational database within a programming language. • Distinguish between different data models and use them appropriately. Understand (and apply) concepts such as database federation, integration, data exchange, connectivity, interoperability. • Compare in-memory and column-oriented vs. traditional query processing. • Develop data warehousing applications: defining business goals, identifying data sources, using tools/methods to extract and transform data, designing star schemas and cubes and perform multi-dimensional analysis. • Understand and apply the additional technologies to bring business intelligence to the big data era.
Prerequisites	No Prerequisites.

Course contents	• Introduction to Data Management. An introduction to the fundamental aspects of data management systems. An overview of data principles from late 60s to the big data era. • Fundamentals of Data Management and Relational Systems. Data Modeling: Entity-Relationship and Relational. SQL, database updates, nested queries, ODBC/APIs. Storage models, indexing. Query processing, transactions, parallel and distributed databases. • Business Intelligence: Fundamentals, Architecture and Performance. Architecture, design and modeling of data warehouses, ETL, data cubes, OLAP, indexing, applications, tools and systems. Introduction to data mining: architecture, concepts, classification, clustering, association rules. Special topics: data provenance, governance. • Non-relational Data Management & Big Data Era. Hadoop, No SQL systems (viewed from the data modeling perspective) data stream engines and complex event processing. • Presentation of the BI Assignment.
Recommended reading	[1] *Multidimensional Databases & Data Warehousing*, by Christian S. Jensen, Torben Bach Pedersen, and Christian Thomsen. [2] *Database Systems: The Complete Book,* by Hector Garcia-Molina, Jeff Ullman, Jeniffer Widom
Teaching methods	Twelve 3-hour lectures, one SQL lab.
Assessment methods	There will be three assignments, evenly distributed throughout the semester. The first and third assignments account for 40% of your grade, 20% each. The second assignment (business intelligence) accounts for 40%. The final exam will contribute 20% towards your grade.
Language of instruction	English

Course title	**Information Systems and Business Process Management**
Course code	Full Time Program: m82101f Part Time Program: m82101p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Semester/trimester	Full Time Program: 1st trimester Part Time Program: 4th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Angeliki Poulymenakou, Professor

Objective of the course (preferably expressed in terms of learning outcomes and competences)	This course introduces the notion of information systems (IS) used in enterprises, explains how technology supports business operations and strategy through the concept of enterprise architecture, and analyses business processes (BPs) as the fundamental element of modern enterprises and the management of their performance. The course provides practical knowledge and skills for business process modelling using the Archimate modelling language. The course also develops skills for the definition of KPIs business and process performance management, based on the Balanced Scorecard method. Students apply the knowledge acquired in an analysis and design project in a real-life organization. Upon completion of the course the students will be able to • Understand and apply concepts of Information Systems Analysis Design and Management in the context of an Enterprise (Enterprise Architecture) • Understand how business processes connect human resources, information systems and technologies and enterprise strategy • Apply techniques of business process analysis and modelling (Enterprise Architecture modelling) to extract requirements and to formulate specifications for business support through digital technologies • Understand and apply techniques for the definition of Key Performance Indicators (KPIs) in the context of Business Process Management • Understand and apply Business Analytics technologies for the management of KPIs • Understand and apply the Archimate modelling language to define business and technology enterprise architecture
Prerequisites	none
Course contents	• Foundations of Information Systems for Enterprises: Business strategy, organizational structure, work roles, information technologies, business, and management processes. practical case examples of enterprise and inter-organizational systems • Information systems and business value creation – the concept of the value chain. • IT enabled work systems and the Work Centered Analysis methodology. • Embedding technology in business processes for operational support, managerial decision making and strategic management. • Analyzing organizations and their information technologies using the Work-centered analysis method • Evaluating organizational and IT architecture and performance • Developing performance measurement frameworks based on KPIs using the Balance Score Card method

	• Modelling processes using the Archimate modelling language • Hands-on ERP lab (SAP HANA or Microsoft) (optional)
Recommended reading	• P. Weill and J. Ross (2004) Information Technology Governance, Harvard Business School Press • J. Ross, P. Weill and D.C. Robertson, (2006) Enterprise Architecture Strategy, Harvard Business School Press • David Parmenter, (2019) Key Performance Indicators – developing, implementing and using winning KPIs (4th Edition), John Wiley & Sons, Inc. • ArchiMate® 3.1 Specification, a Standard of The Open Group (Web link) • Archi - Archimate Modelling Tool - User Guide (Web link) Papers from selected journals including • Management Information Systems Quarterly • Decision Support Systems • Organisation Science • Harvard Business Review • Journal of the Association of Information Systems
Teaching methods	Lectures, Labs, Assignment feedback sessions, Optional labs
Assessment methods	The course is evaluated through a team project assignment which pertains the analysis of a real-life organizational work system based on information technologies arranged in three sections. The project is submitted in written form and presented orally. The structure of the study project is as follows 1. AS IS analysis: Strategy, Organisational Structure and roles, Information Systems and Technologies, Business and Management processes. Modelling of a core process using the Archimate modelling language 2. Architectural and performance management evaluation of the work system under study. Proposal for a Performance Management Framework (KPIs) using the Balanced Scorecard Method 3. Proposals for organisational interventions with IT to improve work system architecture and performance with emphasis on analytics technologies for business and process performance management Evaluation criteria • Understanding of the AS-IS (analysis and modelling) -50%

	• Evaluation of the AS-IS and recommendations for intervention – 30% • Quality of presentation -15%
Language of instruction	English
Course title	**SAP Labs (in the context of the course "Information Systems and Business Process Management)**
Course code	Full Time Program: m82101f Part Time Program: m82101p
Type of course	Optional
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Semester/trimester	Full Time Program: 1st trimester Part Time Program: 1st trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	
Name of lecturer	George Papanikolaou, MEng
Objective of the course (preferably expressed in terms of learning outcomes and competences)	This 30-hour hands-on lab intents to introduce to Business Analytics students the use of ERP platforms in Enterprise Architectures to manage key transactions, processes and data in order to provide business with valuable intelligence from this data. The lab makes use of a live SAP service offered by TUM Germany in the context of the SAP Global University Alliances and University Competence Centers where AUEB is a member (Academic coordinator Prof. Angeliki Poulymenakou). The 30-hour SAP lab is an important element of the Information Systems and Business Process Management course. The lab performance counts towards 25% of the total IS&BPM course for the students that opt to attend it. Upon completion of the course the students will be able to • Define the SAP Platform architecture in terms of the technology tiers and the SAP Modules • Understand how to use SAP functionality across modules to generate and implement critical business scenaria: (1) Requisitioning Process (2) Production (3) MRP i, MRP ii

	(4) Warehouse Management (5) Lead-to-cash (6) Financial Accounting • Map, create Process maps of key business scenaria and define: (1) Master Data and Business Reporting & Analytics Requirements (2) Identify key SAP transactions & documents involved in each scenario execution • Understand and apply in a test-project the full ERP implementation project lifecycle • Prepare (with extra study) to attend SAP certification exams.
Prerequisites	none
Course contents	• Intercompany module mapping • Source to pay definition • Main business processes Design-to-Operate • Master Data • Lead-to-Cash • Record-to-Report • Transactional data for internal reports • SAP Implementation Stages and methodology
Recommended reading	Students attending the lab must register in the SAP UA/UCC student learning portal where all relevant lab material can be found https://learning.sap.com/student-zone
Teaching methods	3-hour interactive lab sessions per week
Assessment methods	Individual and group projects, students' presentations
Language of instruction	English

Course title	**Large Scale Optimization**
Course code	Full Time Program: m82102f Part Time Program: m82102p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Trimester	Full Time Program: 1st trimester Part Time Program: 4th trimester

Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Zachariadis Emmanouil Asst. Professor
Objective of the course (preferably expressed in terms of learning outcomes and competences)	• Understand the relation between Prescriptive Analytics and Combinatorial Optimization • Differentiate between solution shape and solution objective • Familiarize with three main types of Combinatorial Optimization problems • Understand the insufficiency of using mathematical programming methods for dealing with large-scale combinatorial optimization problems • Use a modern programming language to develop algorithms for dealing with optimization problems • Describe and apply local search-based optimization methodologies • Incorporate efficient guiding mechanisms into local search optimization frameworks
Prerequisites	No prerequisites.
Course contents	• Combinatorial Optimization Problem Types • Sequencing Problems • Assignment Problems • Selection Problems • Greedy Algorithms • Python Basics • Development of Greedy Algorithms for Optimization Problems • Local Search • Local Search based metaheuristics
Recommended reading	• Instructor Notes • Handbook of Metaheuristics, Michel Gendreau & Jean-Yves Potvin, International Series in Operations Research & Management Science, 2019. • Introduction to Computation and Programming Using Python, John V. Guttag, With Application to Understanding Data, 2021
Teaching methods	Lectures Solving Combinatorial Problem Examples Optimization methodology development using Python
Assessment methods	Final examination 70% • Written exam in Greek • Problem Solving • Comments on the obtained results Project 30% • Problem Solving
Language of instruction	English

Course title	**Statistics for Business Analytics I**
Course code	Full Time Program: m82104f Part Time Program: m82104p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 1st trimester Part Time Program: 1st trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Associate Professor Panagiotis Tsiamyrtzis Professor Ioannis Ntzoufras
Objective of the course (preferably expressed in terms of learning outcomes and competences)	Primary aim of this course is the understanding and the application of statistical methods in real life business problems. Emphasis is given in the implementation of all methods using R and in problem solving. Interesting real-life datasets and problems are analyzed during this course with aim to provoke their attention and motivate them. Finally, the students are introduced to the basic principles of scientific report writing and storytelling by writing an assignment accompanied with a written scientific report.
Prerequisites	No prerequisites
Course contents	1. Introduction to probability and distribution theory 2. Statistical inference via point and interval estimation 3. Hypothesis testing (t-tests, ANOVA, chi-square tests) 4. Simple and Multiple Regression 5. Lasso for multiple regression
Recommended reading	1. Diez, D., Barr, C., & Cetinkaya-Rundel, M. (2019). *OpenIntro statistics* (Fourth Edition). Free Open Book; available at https://www.openintro.org/book/os/ 2. Fox J. & Weisberg H.S. (2011). *An R Companion to Applied Regression.* 2nd edition. SAGE Publications Inc. 3. Faraway, J. (2002). *Practical regression and ANOVA using R;* available at http://cran.r-project.org/doc/contrib/Faraway-PRA.pdf 4. Ντζούφρας Ι. & Καρλής Δ. (2015). *Εισαγωγή στον προγραμματισμό και στη στατιστική ανάλυση με R*. Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. http://hdl.handle.net/11419/2601, ISBN: 978-960-603-449-7

	5. Φουσκάκης Δ. (2013). *Ανάλυση Δεδομένων με Χρήση της R*. Εκδόσεις Τσότρας. Αθήνα. (Κωδικός Βιβλίου στον Εύδοξο: 33134029). 6. Field A, Miles J and Field Z. (2012). Discovering Statistics Using R. Sage Publications. Μεταφρασμένη στα Ελληνικά έκδοση (2021): Ανακαλύπτοντας την Στατιστική με τη Χρήση της R. Εκδόσεις Προπομπός.
Teaching methods	• Introductory motivational talk about the value and the fun part of Statistics. • Teaching in a classroom and computer labs. • Three lab sessions in R (3 hrs each) • Two lab sessions on Hypothesis testing and regression (3 hrs each) • Laboratory exercises in R and Statistical Analysis (one for each lab) • Online Quizizz game (all together in the room - online version and asynchronously - offline). https://quizizz.com/ • Guess the correlation game. http://guessthecorrelation.com/
Assessment methods	• 10% R lab exercises (2) • 10% Data Analysis Lab exercises (2) • 30% Main assignment/project • 50% written examination • In order to account the lab exercises and the assignment in the final grade, the student needs to be successful in the written examination.
Language of instruction	English

Course title	**Big Data Systems and Architectures**
Course code	Full Time Program: m82108f Part Time Program: m82108p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 2nd trimester Part Time Program: 2nd trimester

Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Diomidis Spinellis, Professor Damianos Chatziantoniou, Professor Thanasis Vergoulis, Dr Spyros Safras
Objective of the course (preferably expressed in terms of learning outcomes and competences)	Successful students: 1. leverage in-memory databases to deal with high request loads 2. can perform exploratory business analytics tasks by applying Unix command-line tools to extract, transform, filter, process, load, and summarize data 3. utilize programming models and leverage software systems to parallelize their code over a distributed compute infrastructure 4. can store big volumes of (un)structured data to distributed file systems or databases and analyse them using Spark 5. can work with data & stream processing workflows
Prerequisites	-
Course contents	- Introduction to big data systems and architectures - Data engineering with Unix tools - Redis and MongoDB - Hadoop and its ecosystem - Data processing with Spark - Machine Learning with Spark MLlib - Apache Airflow - Kafka
Recommended reading	Data science at the command line The art of Unix programming
Teaching methods	Lectures
Assessment methods	Assignments, class participation bonus system, and oral exam
Language of instruction	English

Course title	**Business Analytics Practicum I**
Course code	Full Time Program: m82106f Part Time Program: m82106p
Type of course	Core

Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Semester/trimester	Full Time Program: 2nd trimester Part Time Program: 5th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Panagiotis Louridas, Associate Professor Andreas Zaras, SAS
Objective of the course (preferably expressed in terms of learning outcomes and competences)	First part • Learn and understand the fundamentals of Data Analysis, Statistical Learning, and Machine learning. Apply the fundamentals using production-quality tools in the Python programming language. Second part • Learn and understand concepts related to Machine Learning so as students can formulate and solve data mining related business problems with applications in market basket analysis, customer segmentation, campaign management and optimization etc. • Lear how to use the following software: SAS Visual Analytics, SAS Visual Data Mining and Machine Learning on SAS Viya
Prerequisites	Statistics
Course contents	First Part • Data Analysis • Data Crawling and Scraping • Data Visualisation • Statistical Analysis • Machine Learning methods Second part Introduction to Data Driven Decision Making, Data Mining/ Machine Learning Techniques (Market basket Analysis through Association Rules, Customer Segmentation through Clustering, Campaign Management through Predictive Analytics, Decision Trees, Model Assessment, Scoring New Data, Decision Support System: SAS Visual Analytics, SAS Visual Data Mining and Machine Learning on SAS Viya)
Recommended reading	• Course notes provided by the instructors. • Carlos Pinheiro et al. 2019. *Machine Lerarning Using SAS Viya*. Cary: SAS Institute Inc. • Nicole Ball 2019. SAS Visual Analytics 1: Basics. Cary: SAS Institute Inc. • Peter Christie et al, 2011. *Applied Analytics Using SAS Enterprise Miner Course Notes*. Cary: SAS Institute Inc. • Kattamuri S. Sarma, 2017. *Predictive Modeling with SAS Enterprise*

	Miner: Practical Solutions for Business Applications, SAS Publishing. • Olivia Parr – Rud 2014. *Business Analytics Using SAS Enterprise Guide and SAS Enterprise Miner: A Beginner's Guide*. SAS Publishing.
Teaching methods	• Lectures using interactive Python notebooks. All course content is with practical examples that the students can follow and execute on their own computers. • Power point presentations. • Demonstrations of producing business analytics results using relevant software. • Analysis and interpretation of the software output for business decision making. • Hands on case studies related to the production and analysis-interpretation of business analytics output for business decision making.
Assessment methods	**First Part (1/2 of the final grade)** • Two assignments, each contributing 1/2 of the final grade. **Second part (1/2 of the final grade)** • Class participation: 5% • Final individual exam about data mining/ machine learning: 30% • Final group project about data mining/ machine learning: 65%
Language of instruction	English

Course title	**Innovation and Entrepreneurship**
Course code	Full Time Program: m82107f Part Time Program: m82107p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Trimester	Full Time Program: 2nd trimester Part Time Program: 5th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Prof. Katerina Pramatari Dr. Stratos Baloutsos
Objective of the course (preferably expressed in terms of learning outcomes and competences)	a. Understand the skills, mindset, and drive necessary to be a successful entrepreneur. b. Identify personal strengths and weaknesses in terms of entrepreneurial competences.

	c. Understand the lean startup methodology and entrepreneurial process through a hands-on approach focusing on the business analytics and technology space. d. Develop initial concept, sales pitch, business model and mock-up of an innovative business venture to be used for business validation g. Identify the drivers and barriers behind a successful business venture and the power of the team.
Prerequisites	None
Course contents	1. Entrepreneurship and Entrepreneurial Competences a. Evolution of entrepreneurship in today's economy b. Entrepreneurial attributes, traits, competences c. Personal assessment d. Team formation 2. Ideas to Opportunities a. Generating innovative business ideas b. Business model canvas c. Mock-up design d. Pitching presentation 3. Validating the opportunity a. Feasibility analysis b. Customer identification c. Environmental scan d. Competitive assessment e. Financial model 4. Final Pitching Presentations
Recommended reading	Steve Blanc, Why the Lean Start-Up Changes Everything, Harvard Business Review, May 2013
Teaching methods	a. Guest speakers b. Internet instruction c. Collaborative group work d. Web-based presentations e. Outside research f. Small group or directed class discussions g. Student-instructor conferences h. Study groups i. Audio-visual presentations
Assessment methods	a. Grading scale specified in the course syllabus b.Groupwork c. Application of knowledge/skill d. Class presentations e. Completion of homework assignments f. Creative-innovation projects g. Demonstrated ability h. Written project description

Course title	**Statistics for Business Analytics II**
Course code	Full Time Program: m82109f Part Time Program: m82109p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 2nd trimester Part Time Program: 2nd trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Dimitris Karlis, Professor Panagiotis Papastamoulis, Assistant Professor
Objective of the course (preferably expressed in terms of learning outcomes and competences)	After completion of the course the student will be able • To fit and understand regression models and their extensions. • Understand the classification problem and apply a wide range of methods, comparing them and being able to understand whether it is suitable for the problem or not. • Understand the clustering problem and apply several methods, together with diagnostics to understand the success of them • Use R for the models taught.
Prerequisites	Students need to have completed Statistics for Business Analytics I. Knowledge on topics of Linear Algebra is welcome
Course contents	Topics in Regression modelling. Generalizing the Regression, smoothing regression, generalized Linear model. Logistic regression, Poisson regression, multinomial logistic regression, regression trees. Classification: basic principles, discriminant analysis, k-nn method, decision trees, naïve Bayes approach, Support Vector Machines. Diagnostics and measures for goodness of prediction. Variable selection problems. Clustering, distances, hierarchical clustering, K-means and variants, Model Based Clustering, DBSCAN algorithm. Measures for clustering success, clustering for big datasets. Real Data applications with R
Recommended reading	Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani (2014) An Introduction to Statistical Learning with Applications in R, 4th edition Springer text in statistics. http://www-bcf.usc.edu/~gareth/ISL/ISLR%20Fourth%20Printing.pdf

	Trevor Hastie and Robert Tibshirani, Jerome Friedman (2009) The Elements of Statistical Learning: Data Mining, Inference, and Prediction. 2nd Edition, Springer text in statistics. http://statweb.stanford.edu/~tibs/ElemStatLearn/ Rui Miguel Forte (2015) Master predictive modeling and build your own data analysis toolbox with R. Packt Publishing https://www.packtpub.com/application-development/mastering-predictive-analytics-r
Teaching methods	12 lectures, including laboratories
Assessment methods	2 projects and final exam
Language of instruction	English

Course title	**Business and Privacy Issues in Data Analysis**
Course code	Full Time Program: m82100f Part Time Program: m82100p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Semester/trimester	Full Time Program: 2nd trimester Part Time Program: 5th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Mitrou Lilian, Professor Terrovitis Emmanouil, Researcher, Athina Research Center Vafopoulos Michail, Dr. Nousias Alexandros
Objective of the course (preferably expressed in terms of learning outcomes and competences)	Upon completion of this course, students will be able to: o Identify the key regulatory, legal and ethical issues related to privacy and (personal) data protection o Understand the adequacy and relevance of the existing law and the regulatory frameworks in privacy and data protection and identify possible weaknesses and deficiencies

	○ To understand and integrate their studies and professional background into a general social, economic and institutional context.
Prerequisites	None
Course contents	Introduction into basic terms/notions: privacy, data protection, confidentiality, security. Information: regulation and governance. Theoretical and regulatory approaches in Greece, EU and abroad. The notion of personal data. Regulation of the use of personal data in EU/ Greece. Analysis of the main concepts, approaches and requirements of General Data Protection Regulation (legal grounds, principles, rights of data subjects). Data Protection by Design and Data Protection Impact Assessment and BA. Big Data Analytics: characteristics of big data analytics and techno-economical context and impact on personal data governance. Big Data Analytics and Data protection principles (purpose limitation, data minimization). Profiling and Decision making. Artificial Intelligence/ Machine learning and processing of personal data. Accountability, transparency and explainability of AI (applications). The issues concerning discrimination and impact of predicting/decision making. Ethics and Business/ Data Analytics.
Recommended reading	Fundamental Rights Agency – Council of Europe – Handbook on European Data Protection Law, 2018 Douwe Korff and Marie Georges,The DPO Handbook Guidance for data protection officers in the public and quasi-public sectorson how to ensure compliancewith the European Union General Data Protection Regulation, 2019 European Parliament, The Impact of the General Data Protection Regulation on Artificial Intelligence, 2021 Council of Europe, GUIDELINES ON THE PROTECTION OF INDIVIDUALS WITH REGARD TO THE PROCESSING OF PERSONAL DATA IN A WORLD OF BIG DAT, 2017
Teaching methods	a) lectures, b) case studies
Assessment methods	Assignment
Language of instruction	English

Course title	**Mining Big Datasets**
Course code	Full Time Program: m82110f Part Time Program: m82110p

Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 3rd trimester Part Time Program: 3rd trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Yannis Kotidis, Professor
Objective of the course (preferably expressed in terms of learning outcomes and competences)	Upon completion of the course, students will be able to 1) describe and use data mining techniques on complex datasets. 2) understand the benefits and shortcomings of different data representations (such as points, vectors, sets, graphs) in data modelling and analysis. 3) select appropriate data mining techniques for emerging big data applications. 4) apply data mining techniques on datasets of realistic sizes using modern data analysis frameworks.
Prerequisites	Students should have basic knowledge of computer algorithms, linear algebra, and statistics. For the programming assignments of the course, programming experience is recommended (e.g., in R, Python or Java).
Course contents	• Introduction to Big Data. • Similarity Metrics for different data representations. Nearest Neighbour Queries. • Advanced techniques for extracting patterns from data. Association rules, discovery and usage. • Rule mining using Singular Value Decomposition (SVD). Dimensionality reduction techniques, data clustering and classification. • Link analysis, pageRank, HITS, centrality metrics. Locality Sensitive Hashing.
Recommended reading	Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeff Ullman, http://www.mmds.org/
Teaching methods	One three-hour lecture per week, programming exercises as homework.
Assessment methods	The final grade is the weighted average of the final examination grade (60%) and the grade of the programming exercises (40%).
Language of instruction	English

Course title	**Social Network Analysis**
Course code	Full Time Program: m82111f Part Time Program: m82111p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 3rd trimester Part Time Program: 3rd trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Aikaterini Papakonstantinopoulou, Lecturer
Objective of the course (preferably expressed in terms of learning outcomes and competences)	The aim of the course is to introduce students to Social Network Analysis (SNA) and its instrumental value for businesses and the society. SNA encompasses techniques and methods for analyzing the constant flow of information over online social networks (e.g. Facebook posts, Twitter feeds, Foursquare check-ins) aiming to identify, sometimes even in real-time, patterns of information propagation that are of interest to the analyst. The course will provide students with an in-depth understanding of the structural properties and behavioral characteristics of social networks, as well as the opportunities, challenges and threats arising by online social networks as far as businesses and the society at large are concerned. It will also introduce students to the social and ethical issues that often arise by mining the publicly available information across online social networks for business purposes and/or other types of analyses. By the end of the course, the students will be able to: ● Formalize different types of entities and relationships as nodes and edges and represent this information as relational data. ● Design and execute network analytical computations. ● Use advanced network analysis software to generate visualizations and perform empirical investigations of network data. ● Interpret and synthesize the meaning of the results with respect to a question, goal, or task. ● Evaluate several approaches for performing a SNA task, and make justified decisions on which to choose. ● Apply their knowledge on realistic and real datasets. ● Process the collected raw data to highlight the connections among them and decide the appropriate formalization as a graph.

	● Investigate the conditions under which various phenomena, like information diffusion, opinion convergence (asymptotic learning) or herding may occur in online social networks. ● Write academic/professional social network analysis reports.
Prerequisites	Mathematical maturity (introductory course in probability, statistics or discrete math), Programming maturity, Experience in programming with R
Course contents	● Modeling a network as a graph (Elements of Graph Theory) ● Network models: Random Networks and Small Worlds ● Structural properties of social networks ● Behavioral characteristics of social networks ● Processes in social networks, e.g., Diffusion, Influence maximization, Learning and Herding ● Study of SNA Use Cases
Recommended reading	● "Networks, Crowds and Markets: Reasoning about a Highly Connected World", David Easley and Jon Kleinberg, Cambridge University Press, 2010. ● "Networks: An Introduction", Mark Newman, Oxford University Press, 2009. ● "Social and Economic Networks", Matthew O. Jackson, Princeton University Press, 2008.
Teaching methods	● Lectures that include presentation and discussion of concepts and use-cases. ● Tutorial on relevant analytical and software tools. ● in-class hands-on experimentation using appropriate examples and use-cases. ● further practice via projects on social network data analysis and visualization using R and igraph.
Assessment methods	● Two projects (contributing 25% and 35% respectively, in the final grade). Each project includes writing code in R to analyze a given dataset, and creating a report that presents the methodology followed and results derived, along with proper visualization. ● A final written exam (contributing 40% in the final grade) ● Participation in the discussions held in class is also taken into account in the students' final assessment.
Language of instruction	English

Course title	**Machine Learning & Content Analytics**
Course code	Full Time Program: m82112f Part Time Program: m82112p
Type of course	Core
Level of course	Master

Year of study	Full Time Program: 1st Part Time Program: 1st
Trimester	Full Time Program: 3rd trimester Part Time Program: 3rd trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Haris Papageorgiou, Research Director, Athina Research Center
Objective of the course (preferably expressed in terms of learning outcomes and competences)	The course provides a pathway for you to gain the knowledge and skills to apply content analytics and deep learning to your work and level up your technical career. Concretely, you will: -Understand the capabilities and basic concepts of deep learning, -Apply deep learning methodologies for a wide range of problems and projects, -Build content analytics workflows using TensorFlow/Pytorch, -Handle real-world cases and explore strategies to analyse content.
Prerequisites	• Proficiency in Python • Familiarity with the basic probability theory and statistics • Familiarity with the basic linear algebra
Course contents	The course focuses on the content analysis of vast amounts of data streams. We will study the basic concepts and methodologies and get familiar with effective deep learning techniques and best practices of how to set up, organize and perform content analytics tasks. We take a deep dive in deep learning techniques used by practitioners in industry, including deep feedforward networks, regularization, optimization algorithms, embedding representations, convolutional networks, sequence modeling and graph neural networks. You learn the practical methodologies and tools (TensorFlow/Pytorch) to build scalable content analysis workflows for a wide range of problems and projects.
Recommended reading	[1] Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning" (Adaptive Computation and Machine Learning series), MIT Press, 2016 [2] François Chollet, "Deep Learning with Python", Manning Publications, 2017, 2021 [3] Ian Pointer, "Programming PyTorch for Deep Learning: Creating and Deploying Deep Learning Applications", Oreilly Media, 2019
Teaching methods	5-6 Units/lectures, 5-6 hands-on Labs and Lab challenges
Assessment methods	Course Micro-Projects
Language of instruction	English

Course title	**Business Analytics Practicum II**

Course code	Full Time Program: m82113f Part Time Program: m82113p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Trimester	Full Time Program: 3rd trimester Part Time Program: 6th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Dimitris Karlis, Professor Panagiotis Papanikolaou
Objective of the course (preferably expressed in terms of learning outcomes and competences)	After completion of the course the student will be able • understand how data visualization works, in terms of human visual perception and cognition • to understand about good and bad practices when plotting data • learn about practical data visualization, including methods to plot various types of data, interaction techniques, the grammar of graphics concept etc. • create data visualizations using R • To build a Qlik Sense Application by designing a star scheme data model and creating various visualizations • To know the basic functionalities of cloud computing. • to create a fully integrated cloud-based pipeline that produces predictive analytics on the fly
Prerequisites	Basic understanding in coding and data associations. Machine Learning Fundamentals Familiar with the concept of Cloud Computing
Course contents	The course has two modules. **Visual Analytics:** Basic ideas on visualization and story telling. Good and bad practices. Galeeries of plots and their interpretation. Trellis plots. Grammar of graphics. R-shiny. Introduction and basic functionalities of Qlik Sense. How to import, manage and visualize data with Qlik Sense. **Cloud Analytics:** Basics of Cloud Computing. How to deploy a complete ML Model to an API and incorporate it into a production dataflow pipeline. Tips, Best Practices, and resources that you will find useful to continue your ML journey
Recommended reading	• Chen, C., Hardle, W. K., & Unwin, A. (2007). Handbook of data visualization. Springer Science & Business Media.

	• Ward, M.O., Grinstein, G. & Keim, D., 2010. Interactive Data Visualization: Foundations, Techniques, and Applications, A K Peters Ltd. • Cleveland, W.S., 1993. Visualizing Data 1st ed., Summit, NJ, USA: Hobart Press. • Johnson, J., 2010. Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules, Morgan Kaufmann Publishers Inc. • Tufte, E.R., 2001. The Visual Display of Quantitative Information 2nd ed., Graphics Press. • Cleveland, W.S., 1994. The Elements of Graphing Data 2nd ed., Summit, NJ, USA: Hobart Press • https://help.qlik.com/en-US/sense/February2021/Content/Sense_Helpsites/Tutorials.htm • Azure Machine Learning technology stack documentation
Teaching methods	Lectures and laboratories
Assessment methods	Assignments
Language of instruction	English

Course title	**Business Analytics Use Cases**
Course code	Full Time Program: m82115f Part Time Program: m82115p
Type of course	Core
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Trimester	Full Time Program: 3rd trimester Part Time Program: 6th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	5 ECTS
Name of lecturer	Damianos Chatziantoniou, Professor
Objective of the course (preferably expressed in terms of learning outcomes and competences)	Upon completion of the course, students will be able to: - Understand the end-to-end process in analytics applications (business goals, data collection, data integration, analysis, interpretation, delivery), - Understand the requirements and types of analysis in analytics applications in different domains (e.g. healthcare, banking, finance, energy, insurance, etc.)

	- Design architectures for analytics applications
Prerequisites	No Prerequisites.
Course contents	The course is organized into six workshop-style lectures (six hours) – each lecture has the form of a workshop. Each lecture (workshop) presents an end-to-end analytics application in a specific domain, a vertical sector of the economy – usually banking, insurance, finance, health, energy, etc. End-to-end means: description of business goals to be achieved through data analysis, available data sources, data extraction and integration, building the data warehouse or any other model, presentation of the statistical or machine learning algorithms used, visualizations and interpretation and business actions. These lectures are co-organized with leading companies/organizations of the private and public sector, which they present real-world implementations.
Recommended reading	Selected business and research articles
Teaching methods	Face-to-face, 6 workshops of 6 hours each
Assessment methods	A short multiple-choice/questionnaire quiz after each workshop
Language of instruction	English

ELECTIVE COURSES

Course title	**Advanced Topics in Statistics**
Course code	Full Time Program: m82200f Part Time Program: m82200p
Type of course	Elective
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Trimester	Full Time Program: 3rd trimester Part Time Program: 6th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Dimitris Karlis, Professor
Objective of the course (preferably expressed in terms of learning outcomes and competences)	After completion of the course the student will be able • Understand the basic concepts of time series.

	• To work with data that are time series and apply them to a wide range of problems. • Be able to apply statistical modelling in networks. • Understand the challenges of big data era in applying statistical models. • Understand how simulation can help statistical inference. • Apply R to solve such problems.
Prerequisites	Students need to have completed Statistics for Business Analytics I. Knowledge on topics of Linear Algebra is welcome
Course contents	Time Series models. Autocorrelation and Partial Autocorrelation Functions. Basic models, Holt-Winters method, exponential smoothing, trend and seasonality. Box and Jenkins approach. ARIMA models. Forecasting principles. More advanced models, ARCH and GARCH. Models for Statistical networks, basic descriptives, how to visualize a network. Exponential Random Graph models, with covariates, Stochastic block model. Methods to fit models, model based clustering in networks. Statistics for Big Data, what are the challenges and new methodologies. Dimension Reduction methodologies and computer based statistical inference. Monte Carlo approaches in Statistics and Machine Learning.
Recommended reading	1. Hamilton, James D. Time Series Analysis. Princeton, New Jersey: Princeton University Press, 1994. 2. Enders, Walter. Applied Econometric Time Series. New York: Wiley, 2010. 3. Cryer, Jonathan D., and Chan Kung-Sik. Time Series Analysis with Applications in R. Springer Texts in Statistics, 2010. 4. Christophe Giraud. Introduction to High-Dimensional Statistics. Philadelphia: Chapman and Hall/CRC. 2015 5. Peter Bhlmann and Sara van de Geer. Statistics for high-dimensional data: methods, theory and applications. Heidelberg; New York: Springer. 2011 6. Hastie, R. Tibshirani and R. Friedman. Elements of Statistical Learning. Springer. 2009 7. D. Kolaczyk. Statistical Analysis of Network Data with R . Springer. 2014
Teaching methods	6 lectures, including laboratories
Assessment methods	1-2 projects and final exam
Language of instruction	English

Course title	**Advanced Topics in Data Engineering**
Course code	Full Time Program: m82201f Part Time Program: m82201p

Type of course	Elective
Level of course	Master
Year of study	Full Time Program: 1st Part Time Program: 2nd
Semester/trimester	Full Time Program: 2nd semester, 3rd trimester Part Time Program: 4th semester, 6th trimester
Number of credits allocated (based on the student workload required to achieve the objectives or learning outcomes)	2,5 ECTS
Name of lecturer	Professor Dimitris Karlis, Dr. George Papastefanatos, Giorgos Alexiou
Objective of the course (preferably expressed in terms of learning outcomes and competences)	Data science activities, such as statistical analysis and machine learning require processing, cleaning, and transformation of the input data before these can be exploited for knowledge extraction. However, data exists in various systems, models, and formats. Systems vary from state-of-the-art (e.g. Hadoop) to legacy (e.g. IBM mainframes and Cobol). Data can be stored in raw files (csv, json, xml), compressed formats (parquet, avro), or various database formats (relational, document, graphs). Finally, data can be structured or unstructured, such as text and images. Topics in this course will cover the full pipeline which is necessary in most data science activities, including data extraction, data transformation, data integration, data virtualization, entity resolution, and proper indexing for data visualization. After completion of this course, the student will be able to: - Understand the different types of missing data - Impute missing data choosing appropriate technique - Understand the impact of missing data in data analysis - Understand different technologies to support SQL querying on big data - Understand the concept of data virtualization - Be familiar with Apache Impala and Apache Drill - Be aware of the processes of data integration pipeline - Understand the ETL components of data warehouses and commercial tools used in practice. - Be aware of common tasks used in data integration of heterogenous sources, like entity resolution.
Prerequisites	None
Course contents	Examples of missing data, the impact of missingness, types of missingness. Methods for handling missing data, different imputation methods starting from simple ones. Illustrations. Data virtualization, Apache Impala, Apache Drill, ETL, Data integration, Entity resolution
Recommended reading	• Stephan van Buren (2013) Flexible imputation of Missing values Stephan van Buren. Available at https://stefvanbuuren.name/fimd/

	• Rubin, DB. (1987). Multiple imputation for survey nonresponse. New York: Wiley. • Little, RL & Rubin, DB. (1st ed. 1990, 2nd ed. 2002). Statistical analysis with missing data. New York: Wiley. • https://impala.apache.org/ • https://drill.apache.org/ • AnHai Doan, Alon Halevy, and Zachary Ives: Principles of Data Integration. Morgan Kaufmann.
Teaching methods	6 Lectures
Assessment methods	Project Based: 2 project assignments for • Data virtualization with Apache Impala and Apache Drill • Data integration and entity resolution
Language of instruction	English

PART III: STUDENT INFORMATION

GENERAL STUDENT INFORMATION

The Athens University of Economics and Business provides not only high-quality education but also high-quality student services. The adoption of the Presidential Decree 387/83 and Law 1404/83 defines the operation, organization, and administration of Student Clubs at Universities, which aim at improving the living conditions of the students and enhance their social and intellectual wellbeing through engagement and socialization initiatives.
To fulfill this objective the University ensures the required infrastructure for housing, meals, and sports activities through the operation of a student restaurant, reading rooms, library, organization of lectures, concerts, theatrical performances, and excursions in Greece and abroad. Further in this context, the University supports the development of international student relations, organizes foreign language classes, computer/software literacy classes, and courses in modern Greek as a foreign language for foreign students and expatriated Greek students.
Detailed information on meals, housing, fitness, foreign languages, cultural activities, scholarships, financial aid, is provided on the website of AUEB's Student Club at https://lesxi.aueb.gr/

Electronic Services

A significant number of procedures related to both attendance and student care are carried out electronically through applications of the University or the Ministry of Education and Religious Affairs. All applications are accessible with the same codes (username & password).

- **E-mail account:**

Detailed instructions for using the Webmail Service are provided at https://www.aueb.gr/el/content/webmail-manual

- **Electronic Secretariat (Student Register)**

The Electronic Secretariat application is the information system through which students can be served by the Department's Secretariat via the web.

- **Wireless network**

Using their personal codes, students have access to a wireless network in all areas of the Athens University of Economics and Business buildings/campus.

- **E-Learning Platform – ECLASS**

The Open eClass platform is an integrated Electronic Course Management System and is the proposal of the Academic Internet (GUnet) to support Asynchronous Distance Education Services.
Instructions are provided at https://eclass.aueb.gr/info/manual.php

Medical Services, Insurance / Healthcare

Undergraduate, postgraduate and PhD students at the University who have no other medical and hospital care are entitled to full medical and hospital care in the National Health System with coverage of the relevant costs by the National Health Service Provider. A psychiatric counseling service also operates at the University, staffed with a physician specializing in the treatment of mental health issues.
More information at https://www.aueb.gr/en/content/health-care .

Services/Facilities to Students with Special Needs

The Athens University of Economics and Business ensures the facilitation of students with special needs, through the design, implementation, and environmental adaptations, for access to the university building facilities. In the main building there are specially configured lifting machines, ramps, and elevators. There are also special regulations for conducting exams for students with special needs.
The Athens University of Economics and Business has established a Committee for Equal Access for people with disabilities and people with special educational needs. The Commission is an advisory body and submits recommendations to the competent bodies for the formulation and implementation of the policy of equal access for persons with disabilities and persons with special educational needs.

Through the Library services, students with physical disabilities are granted electronic access to the recommended Greek bibliography of the courses taught at the University. In this context, the Association of Greek Academic Libraries (SEAB) has developed a multimodal electronic library called AMELib.
More information is available at https://www.aueb.gr/el/lib/content/amea-atoma-me-idiateires-anages.

Studies Advisor

The Study Advisor informs and provides advice to the Postgraduate Students both on their studies and on wider academic matters. The MSc in Business Analytics has appointed Professors-Advisors according to their subject to guide and inform students in the context of their studies.

Library and Study Rooms

The Library & Information Center of the University operates at the University's main building. The AUEB Library is a member of the Hellenic Academic Libraries Association (Heal-LINK), the European Documentation Centers Europe Direct and the Economic Libraries Cooperation Network (DIOBI).
Three Documentation Centers operate within the library:

- The European Documentation Center
- The Organization for Economic Cooperation and Development (OECD) Documentation Center
- The Delegation Center of the World Tourism Organization (WHO)

The library contributes substantially both to meeting the needs for scientific information of the academic community and to supporting studying and research. The library provides access to:

- printed collection of books and scientific journals,
- course books used in modules,
- collection of electronic scientific journals& books
- postgraduate theses and doctoral theses that are produced in Athens University of Economics and Business and deposited in digital form at the PYXIDA institutional repository
- sectoral studies
- statistical series by national and international organizations
- audiovisual material
- information material (encyclopedias, dictionaries)
- databases on the topics used by the University

- printed collections of other academic libraries

The library lends all its printed collections, except for magazines and statistical series, in accordance with its internal rules of operation. The Library and Information Center offers reading rooms, computer workstations for visitors, photocopiers and printing machines, and interlibrary loan of books and journal articles from other academic libraries that are members of its network. More information at https://www.aueb.gr/en/library .

International Programs and Information on International Student Mobility

Athens University of Economics and Business is actively involved in the Erasmus+ Program since 1987 promoting cooperation with universities, businesses, and international organizations of the European Union (EU) as well as in the mobility of students, teaching, and administrative staff.
In addition, strengthening its internationalization objectives, it creates new opportunities through the Erasmus+ International Mobility Program. Within this framework, mobility scholarships are granted through the State Scholarships Foundation (SSF) to incoming and outgoing students of the three study cycles, according to the funding approved each year by the State Scholarship Foundation for the University. Outgoing students have the possibility to spend a period of study at a Partner Institution outside the EU with full academic recognition through the application of the ECTS credits system https://www.aueb.gr/en/content/erasmus-programme

Connecting with the Job Market and Entrepreneurship

D.A.STA.O.P.A. (https://www.aueb.gr/el/dasta) is the administrative unit of the University that plans, coordinates and implements the actions of the Athens University of Economics and Business in the following areas:

a) development of entrepreneurship and innovation

b) connecting students and graduates with the labor market

c) connecting the academic community with businesses

d) student internship programs and,

e) supporting research utilization actions

Student Associations

Various student clubs and associations are active within the community of the Athens University of Economics and Business

(https://www.aueb.gr/el/content/student-associations).

Alumni Network

Adhering to a long tradition of educating future top executives in the economic, social, and political life of the country, AUEB is proud that thousands of its graduates hold leading positions in companies, organizations, research institutes and universities in Greece and abroad. Understanding the importance of developing and strengthening the bond with its graduates, AUEB created its Alumni network including a platform https://alumni.aueb.gr where all graduates of the University can register. The main objectives of the Network are the connection of the graduates with their colleagues and former fellow students, and diffusion of information about activities, services, and events in and around the University that concern them.

Additional information on Clubs and Alumni Associations is available on the website https://www.aueb.gr/el/content/organizations-and-associations-of-students-and-alumni.

Volunteer Program

Within the framework of its strategies, the "AUEB Volunteers" Volunteering Program was launched in September 2017. The aim of the Program is to highlight important social issues and the value of participation and practical contribution, but also to raise community awareness regarding the 17 UN Sustainable Development Goals. Actions are developed around two pillars: (a) actions addressed to AUEB's Community, which have as their main objective the maintenance of the quality of the University's infrastructure based on their aesthetics and functionality, and (b) actions addressed to Greek society. (https://auebvolunteers.gr/).

Quality Assurance

The Athens University of Economics & Business implements a quality assurance policy to continuously improve the quality of its study programs, research activities and administrative services, and upgrade the academic and administrative processes and the University's operations. The Quality Assurance Unit (MODIP) operating at AUEB coordinates and supports evaluation processes. Particularly the quality assurance of the educational process is achieved using the module/teaching evaluation questionnaire completed by AUEB students. (https://aueb.gr/modip).

Training and Lifelong Learning Center

The Center for Training and Lifelong Learning **(KEDIVIM)** is an AUEB unit which ensures the coordination and interdisciplinary cooperation in the development of training programs, continuing education, training and in general lifelong learning, which complement, modernize and/or upgrade knowledge, competences, and skills, acquired from formal education, vocational education and initial vocational training systems or from work experience, facilitating integration or reintegration in the labor market, job security and professional and personal development.

(https://www.aueb.gr/el/content/dia-vioy-mathisi-kedivim-opa).