ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

ΣΧΟΛΗ ΕΠΙΣΤΗΜΩΝ & ΤΕΧΝΟΛΟΓΙΑΣ ΤΗΣ ΠΛΗΡΟΦΟΡΙΑΣ
SCHOOL OF INFORMATION SCIENCES & TECHNOLOGY

ΤΜΗΜΑ ΣΤΑΤΙΣΤΙΚΗΣ
DEPARTMENT OF STATISTICS

ΠΙΣΤΟΠΟΙΗΜΕΝΟ ΠΡΟΓΡΑΜΜΑ ΣΠΟΥΔΩΝ
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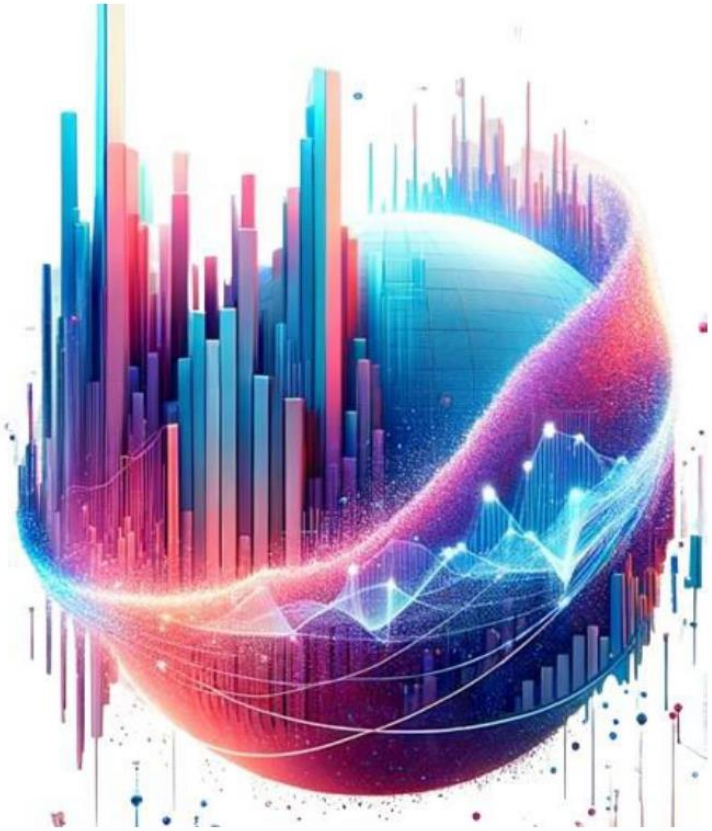
# UNDERGRADUATE PROGRAM
# STUDY GUIDE
# 2023-2024



**ATHENS, SEPTEMBER 2023**

## Athens University of Economics and Business Academic Authorities

**Rector:** Professor Dimitrios Bourantonis
**Vice Rector for Academic Affairs:** Professor Vasileios Vasdekis
**Vice Rector of Research and Lifelong Learning:** Associate Professor Georgios Lekakos
**Vice Rector for Economic Affairs:** Professor Konstantinos Drakos
**Vice Rector for Financial Planning and Development:** Professor Vasileios Papadakis

## School of Information Sciences and Technology

**Dean**: Professor Ioannis Kotidis

## Department of Statistics

**Head of the Department:** Professor Ioannis Ntzoufras

**Vice Chairman:** Professor Dimitrios Karlis

## Communication Information

**Department of Statistics**
**Address:** Athens University of Economics and Business, 76 Patission str, Athens, 10434
**Website:** https://www.dept.aueb.gr/el/stat
**Telephone:** +30-210-820111-113
**Secretary e-mail:** stat@aueb.gr

**University:** Athens University of Economics and Business **(**A.U.E.B)
**Address:** 76 Patission str, Athens, 10434
**Website:** https://www.aueb.gr
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# PART ONE
# ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

## 1. General Description of the University

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

AUEB is, in order of seniority, the third oldest Higher Education Institution of the country and the first in the field of Economics and Business Administration. The scientific fields of Informatics and Statistics were added later. Since its foundation, AUEB has a rich history of significant scientific achievements that characterize its significant presence and set excellent prospects for the future. It was founded in 1920 as the Grand School of Commerce Studies (Ανωτάτη Σχολή Εμπορικών Σπουδών), with the aim of providing university-level education in the fields of economics and business administration. It was renamed to the Grand School of Economic and Commerce Studies (Ανωτάτη Σχολή Οικονομικών και Εμπορικών Επιστημών (Α.Σ.Ο.Ε.Ε.)) in 1926. Until 1955, the school operated under a single-class, three-year curriculum. In 1955 the school converted to a four-year curriculum, with the fourth year's student body being divided in two departments, the Department of Economic Studies, and the Department of Commercial Studies. In 1970 the division of the student body started to take place in the second year. In 1984, the whole school was divided into three Departments, the Department of Economic Studies, the Department of Business Organization and Administration, and the Department of Statistics and Informatics. In 1979 the first graduate program in Economic Studies was inaugurated, while a corresponding program was initiated by the Department of Business Organization and Administration in 1985.

The Athens University of Economics and Business (AUEB) has been historically recognized in the collective consciousness of the academic community - Greek students and society - as a leading University in its core areas of expertise. Its reputation reflects on one side, the high quality of its scientific personnel, the quality of its research and teaching activities, and its modern programs of studies, and, on the other hand, its outstanding graduates that are professionally active in Greece as well as abroad.

## 2. Academic Authorities and Services

The organization and operation of AUEB follows applicable law, notably Law N.4957/2022 (ΦΕΚ 141/21.07.2022 τ. Α΄).

**ADMINISTRATIVE BODIES:**
a) Board of Administration
b) the Senate
c) the Rector
d) the Vice Rectors
e) the Executive Director

**BOARD OF ADMINISTRATION**
The Administration Board is the supreme collective management body of the University and comprises eleven (11) members, of which six (6) are internal and five (5) are external.

**SENATE**
The Senate comprises:

I. The Rector,
II. The School Deans,
III. The School's Presidents,
IV. One representative per staff category (ΕΕΠ, ΕΔΙΠ, ΕΤΕΠ, and administrative staff),
V. Students' representatives, comprising 10% of the total number of Senate members from cases I to III.

**SCHOOLS**

The Athens University of Economics and Business comprises **three Schools**:

1. **SCHOOL OF ECONOMICS:** Oversees and coordinates the operation of the Department of International and European Economic Studies and the Department of Economics.
2. **SCHOOL OF BUSINESS:** Oversees and coordinates the operation of the Department of Management Science and Technology, the Department of Business Administration, the Department of Accounting and Finance and the Department of Marketing and Communication.
3. **SCHOOL OF INFORMATION SCIENCES AND TECHNOLOGY:** Oversees and coordinates the operation of the Department of Informatics and the Department of Statistics.

**DEPARTMENTS**
Departments are the primary educational and academic units of the University. They are tasked with advancing science and technology in their respective fields and administer a curriculum that continuously keeps up with the latest developments. The Departments consists of members of Academic Staff, members of the Special Educational Staff (Ειδικό ΕκπαιδευτικόΠροσωπικό-ΕΕΠ), members of the Laboratory Teaching Staff (Εργαστηριακό Διδακτικό Προσωπικό-Ε.ΔΙ.Π.) and members of the Special Technical Laboratory Staff (Ειδικό Τεχνικό Προσωπικό–ΕΤΕΠ).
The Departments of AUEB are the following:

1. Department of International and European Economic Studies
2. Department of Economics
3. Department of Management Science and Technology
4. Department of Business Administration
5. Department of Accounting and Finance
6. Department of Marketing and Communication
7. Department of Informatics
8. **Department of Statistics**

## 3. List of degree programs offered

Each department at the Athens University of Economics and Business offers a corresponding curriculum, which includes a number of focus areas that provide specialization, as follows:

| A/A | DEPARTMENT CURRICULUM | SPECIALIZATIONS/ CYCLES (*) |
|---|---|---|
| 1. | Department of International and European Economic Studies | 1. International Economics and Finance |

| | | |
|---|---|---|
| | | 2. International and European Political Economy |
| 2. | Economics | 1. Economic Theory and Policy<br>2. Business Economics and Finance<br>3. International and European Economics |
| 3. | Management Science and Technology | 1. Operations Research and Business Analytics<br>2. Operations and Supply Chain Management<br>3. Software and Data Analysis Technologies<br>4. Information Systems and Electronic Business<br>5. Strategy, Entrepreneurship and Human Resources |
| 4. | Business Administration | 1. Business Administration<br>2. Information Systems Administration<br>3. Accounting and Finance Administration<br>4. Marketing |
| 5. | Accounting and Finance | 1. Accounting<br>2. Finance |
| 6. | Marketing and Communication | 1. International Management, Innovation and Entrepreneurship<br>2. Human Resource Management<br>3. Business Analytics<br>4. Digital Marketing |
| 7. | Informatics (*) | 1. Theoretical Computer Science<br>2. Computer Systems and Networks<br>3. Information Systems and Information Security<br>4. Databases and Knowledge Management<br>5. Operational Research and Economics of Information Technology<br>6. Computational Mathematics and Scientific Calculations |
| 8. | Statistics | 1. Data Science<br>2. Operational Research<br>3. Applied Mathematics |

(*) The Department of Statistics does not offer specific directions in studies, but instead, the above-mentioned cycles.

More detailed information on the curriculums is available in the corresponding course guides and on the Departments' websites.

## 4. Studies Structure

Undergraduate studies in AUEB are organized in a system of semester-long courses, according to the Undergraduate Curriculum drawn up by the Department Assembly of each Department. The academic year starts on the 1st of September and ends on the 31st of the following August. Academic activities are organized in two semesters, the winter semester and the spring semester. The duration of undergraduate studies is four years (eight semesters).

Semesters last 13 weeks and are interrupted by the Christmas and Easter breaks. At the end of each semester there is an examination period lasting 4 weeks.

At the completion of the June examination period and until the end of the academic year, no classes take place.

On the last week of August begins the September examination period (repetitive), which lasts 4 weeks, and is followed by the commencement of classes for the winter semester.

Precise dates for the start and end of semesters and examination periods are drafted by the Studies Unit, ratified by the Senate, and announced in the academic calendar of the university.

## 5. Enrollment

Entrance to the Department is achieved primarily through the Panhellenic examinations. The enrollment of the individuals who succeed in these examinations takes place each September, via the electronic enrollment information system of the Ministry of Education, Research, and Religious Affairs.

## 6. Primary Regulations (including procedures of academic recognition)

A small sample of the Institution's Basic Regulations includes:

- ✓ The internal regulation for the operations of AUEB
- ✓ The regulation of administrative services
- ✓ The Postgraduate Programs and PhD Operation Regulation
- ✓ The Internal Regulation for the Conduction of Post-Doc Research
- ✓ The Regulation on the Administration of Examinations

## 7. Personnel

The University staff comprises the following categories:

- **TEACHING STAFF:**
  - Faculty members which are divided in (a) Professors, (b) Associate Professors, (c) Assistant Professors.
  - Special Teaching Staff (Ειδικό Εκπαιδευτικό Προσωπικό-Ε.Ε.Π.).
  - Laboratory Teaching Staff (Εργαστηριακό Διδακτικό Προσωπικό-Ε.ΔΙ.Π.).
  - Special Technical Laboratory Staff (Ειδικό Τεχνικό Προσωπικό–ΕΤΕΠ).
  - Assisting Teaching Staff (Επικουρικό Διδακτικό Προσωπικό-Ε.Δ.Π.)
  - University and Academic Scholars
  - Teachers by secondment

- **ADMINISTRATIVE STAFF**

## 8. Services

The Athens University of Economics and Business staff provides a variety of services, including administrative, catering, housing, library, and sports facilities, to support both its students and the administrative and teaching staff. For more information on the organization and operation of these services, please visit the University's website: www.aueb.gr.

## 9. ECTS Coordinator

The ECTS Coordinator of the University is the Head of the Quality Assurance Unit (Μονάδας Διασφάλισης Ποιότητας-ΜΟΔΙΠ). The Coordinator ensures the compliance of the University with the principles and rules of the European Credit Transfer and Accumulation System (ECTS), oversees the adherence to and application of these principles and rules, and is responsible for ensuring the smooth process of ECTS unit transfer and accumulation.

## 10. Academic Year/ Semester Important Dates *

- Winter Semester: October 2nd, 2023, to January 12th, 2024
- Christmas Holidays: December 23rd, 2023, to January 7th, 2024
- Fall Semester Exams Period: January 15th, 2024, to February 9th, 2024
- Spring Semester: February 12th, 2024, to May 24th, 2024
- Easter Holidays: April 27th, 2024, to May 12th, 2024
- Spring Semester Exams Period: May 27th, 2024, to June 21st, 2024

** According to the 2023-24 Academic Calendar*

## 11. Official Holidays

- ✓ November 17th, 2024 (The Anniversary of Polytechneio)
- ✓ January 30th, 2024 (Three Hierarchs)
- ✓ March 18th, 2024 (Clean Monday)
- ✓ March 25th, 2024 (Greek Independence Day)
- ✓ May 1st, 2024
- ✓ June 14th, 2024 (Pentecost Monday)

# PART TWO
# DEPARTMENT OF STATISTICS

The Hellenic Authority for Higher Education (HAHE) has **certified** that the Undergraduate Study Program of the Department of Statistics of the Athens University of Economics and Business is in full compliance with the HAHE Quality Standards and the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG 2015), at the level of studies 6 of the National and European Qualifications Framework. The accreditation is valid for five years, from May 29, 2020, until May 28, 2025. The accreditation report is available at the following link: https://www.aueb.gr/en/node/20747.

## A. GENERAL DESCRIPTION

### A1. Establishment and Operation

Under PD Presidential Decree 377/1989, ASOEE was renamed to Athens University of Economics and Business (AUEB), coinciding with the founding of the Statistics Department in June 1989. This establishment followed the creation of the joint Department of Statistics and Informatics, as per PD 313/1984. Interestingly, Statistics was part of AUEB's curriculum as early as the 1927-1928 academic year, as noted in the university's first yearbook.

The School of Information Sciences and Technology was established under PD 78/2013, incorporating the Departments of Statistics and Informatics. Emulating trends observed in major US and European universities, this School aims to foster interaction and synergy between these departments, enhancing student benefits and creating a dynamic research environment. The School's activities focus on three areas: education, research, and societal contribution.

In terms of education, the goal is to produce graduates in Statistics and Informatics with comprehensive professional competence, enabling them to keep pace with rapid technological advancements. The undergraduate programs blend foundational knowledge with specialized skills, while the postgraduate offerings provide targeted expertise in high-demand areas. Regular updates every two to three years ensure the curriculum remains updated, and the selection of traditional scientific areas lends enduring value to our degrees. Our graduates quickly find employment both in Greece and abroad, often attaining high-ranking positions in various sectors, with some establishing their own businesses. The Department's educational dynamism is matched by its cutting-edge research, characterized by extensive international collaborations, competitive funding, and notable recognition through awards, and distinctions. The Department strives for multidimensional excellence, contributing significantly to the overall progress of Statistical Science through its active participation in international developments and the achievements of its academic staff, students, and alumni.

The Department of Statistics at AUEB holds the distinction of being the first and only dedicated Statistics department in any Greek university. It is also the only Department in Greece which solely deals with the analysis of data. The degree it offers, conferred by the School of Information Sciences and Technology, proudly bears the department's name.

***Academic Title offered:***
Degree in Statistics

***Admission Requirements***

Students are admitted to the Department through the Pan-Hellenic Exam system adhering to the specific regulations set for various categories of students. Registration is conducted each September via a mandatory electronic registration system, following the guidelines issued by the Ministry of Education. Unique in its focus, the Department of Statistics does not facilitate student transfers from similar departments, as per ΦΕΚ 4002/22.06.2023, τ.Β'.

***Educational and Professional Aims***

The Department's primary objective is to advance and disseminate knowledge in statistical and data science and its associated fields, both theoretical and applied. This is achieved through rigorous research and education, aiming to equip graduates with the skills to apply statistical data science methods across diverse sectors such as economics, social sciences, business, administration, research, and education.

***Access to further studies***

Graduates of the Department have the opportunity to pursue postgraduate studies in various programs, both in Greece and internationally. Their strong foundation in mathematical and statistical principles, quantitative and computational analysis methods, alongside the flexibility to select courses from other departments, provides them with a competitive edge. This diverse academic background opens doors to a wide array of subjects and specializations in their postgraduate studies.

## A2. Facilities

**Department of Statistics Labs**

In order to support the operation of the undergraduate and postgraduate programs of the Department of Statistics as well as to promote research, there are three (3) research labs equipped with computers, with a total capacity of 57 computers and one (1) educational lab of a total capacity of 51 computers.

More specifically, the Department's Laboratories are the following:

Research Labs:

i. **Laboratory of Statistical Methodology**: Located on the 2nd floor of the Evelpidon 47A and Lefkados 33 building, it is available to the Department's postgraduate students. It features a central computer, 27 PCs with Windows OS, internet connection, an instructor's PC, 4 additional workstations, a server (a total of 32 PCs), 1 interactive table, 4 projectors, and 4 laptops.
ii. **Stochastic Modelling and Applications Laboratory**: Situated on the 2nd floor of the Troias 2 and Kimolou str. building, room 208, shared with the Computational and Bayesian Statistical Laboratory.
iii. **Computational and Bayesian Statistical Laboratory**, which is located at the 2nd floor of the Troias 2 and Kimolou str. building, room 208 (co-housed with the Stochastic Modeling and Applications Laboratory), **equipped with 38 computers**.

Educational Lab:

i. **Laboratory of Applied Statistics, Probability and Data Analysis,** is located at the 3rd floor of the Antoniadou wing of the main AUEB building (room A35). Undergraduate students, PhD candidates and temporary teaching staff may work here. The laboratories equipment includes 4 SUN workstations, 2 UPS, 1 DELL server with a local network consisting of 40 PCs, 1 PC for the professor,

2 printers, 1 scanner, 1 overhead projector and a projector connected to the PC. In a separate area of the lab, there are 10 workstations for the PhD candidates (a total of 51 PCs).

**Computer Centre**

AUEB's Computer Center (**CE**) plays a crucial role in providing the necessary computer infrastructure to support both educational and research applications.

Central to the CE's operations is a robust stack of servers, which boast not only sufficient capacity but also one that is continually expanding to meet growing demands. These servers fulfill several key functions. They handle user authentication, ensuring controlled access to the CE's resources. Additionally, they serve as file servers, facilitating the storage and retrieval of data for users. A significant feature of these servers is their role in automating the software reinstallation processes on the CE laboratory computers, which is essential for maintaining software consistency and efficiency across the network. Moreover, these servers are instrumental in safeguarding the computer systems, actively controlling and preventing the intrusion of malicious software, such as viruses. A notable aspect of the CE's infrastructure is the high-speed network to which all servers are connected. This network's design ensures that these servers, and consequently the services they provide, are accessible from anywhere within the University. This accessibility is key to supporting the diverse and dynamic needs of the AUEB community.

The Computer Center (CE) at AUEB features three dedicated teaching and practice rooms, which are available to all students across various departments. The computers in these rooms operate within a Windows environment and are managed centrally, ensuring a uniform and efficient user experience. This centralized management extends to users' accounts and resource allocation, providing seamless access to all applications installed on the CE's central systems.

Access to the CE's resources is open to the entire academic community, encompassing undergraduate and postgraduate students, faculty members, and university staff. Registration for these resources is streamlined through the URegister service, which facilitates access to the CE's e-services as well as other university offerings.

For added convenience, students have the option to request password reminders electronically, obviating the need for physical presence at the CE. Furthermore, the CE's resources, including central systems and email services, are available around the clock. This 24-hour access is not limited to the physical teaching and practice rooms but extends to remote utilization of these services, ensuring that members of the AUEB community have continuous and flexible access to essential computing resources.

**Network Operating Centre**

AUEB's Network Operating Centre (NOC) is responsible for the network infrastructure of the entire institution, both in voice (ie telephony) and in data. NOC monitors, maintains and coordinates all University networks. It also hosts the servers of most of the University's services (websites, e-class, secretariats, etc.), except for the Computer Center, and network protection systems against attacks on the Internet.

A backbone fiber optic network of Gigabit Ethernet technology operates in all University buildings. The main buildings of the University are connected to the backbone through the University's fiber optic ring, while some auxiliary buildings are connected either by wireless laser or microwave link. In all buildings of the University there is a horizontal (in-floor) and vertical (between floors) structured voice and data

wiring that connects offices and workshops with the backbone network at 100 or 1000 Mbps. The University provides wireless broadband access to the network from the classrooms and public areas of all buildings.

The University is connected to the Internet through the Greek Research and Technology Network (GNSS) with a Gigabit Ethernet optical fiber. Therefore, through access networks and the backbone network, all users have access to the Internet at extremely high speeds. Finally, through the Eduroam international system, all University users can connect to the wireless networks of hundreds of educational and research institutions around the world, and vice versa, users of these universities can connect to AUEB's wireless network.

**E-class**

In AUEB operates a complete Course Management System that supports Asynchronous eLearning Services via a simple web browser (https://eclass.aueb.gr). Through e-Class, lecturers may distribute, to their students, material related to their lessons, such as notes, presentations, exercises and announcements, while the latter may submit their work in electronic form. The e-Class is used in all courses of the Department of Statistics, to facilitate communication between students and teachers.

# B. STATISTICS DEPARTMENT PERSONNEL

## B1. Faculty Members (Δ.Ε.Π.)

### Professors

**Vasdekis Vasileios,** holds a degree in Mathematics from the University of Athens (1988), MSc in Applied Statistics from Oxford University (1989) and a Ph.D in Statistics from Oxford University (1993). His research interests are focused on a) repeated and longitudinal measurements, b) models of latent variables, c) statistical inference with the use of composite likelihoods. URL: https://www.aueb.gr/en/faculty_page/vasdekis-vasilios

**Yannakopoulos Athanassios** (University of Athens 1989, Ph.D. Warwick, 1993). His research interests focus on Stochastic Analysis and Applications, Stochastic Differential Equations and Mathematical Modeling with the use of Random and Deterministic Dynamical Systems with applications in Insurance, Finance and Modern Technologies. URL: https://www.aueb.gr/en/faculty_page/yannacopoulos-athanasios

**Dellaportas Petros,** holds a Ph.D. from the University of Plymouth, MSc from the university of Sheffield, and a degree in Mathematics from the University of Athens. His research interests are focused on MCMC theory, Bayesian Model Determination, Inference and Simulation methods for Stochastic Differential Equations, Time Series Forecasting, Financial Statistics, Sparsity. URL: https://www.aueb.gr/en/faculty_page/dellaportas-petros

**Zazanis Michail,** He obtained the Engineering Diploma from the National Technical University of Athens (1982), the M.Sc. in Applied Mathematics from the Division of Applied Sciences, Harvard University (1983), and the Ph.D. in Applied Mathematics from Harvard University (1986). His research interests focus on Applied Probability Theory. URL: https://www.aueb.gr/en/faculty_page/zazanis-michael

**Karlis Dimitrios** BSc. in Statistics from Department of Statistics, AUEB in 1992 and a Ph.D. in Statistics from the same department in 1999. His research interest refers to mixture models, computational statistics and especially stochastic algorithms, multivariate count data analysis, models for statistical analysis for sports data and modeling dependent data via copulas. URL: https://www.aueb.gr/en/faculty_page/karlis-dimitrios

**Kyriakidis Epameinondas, B.Sc.** in Mathematics (1985) University of Athens, M. Sc. in Statistics (1986) Imperial College, Ph.D. in Stochastic Operational Research (1990) Birkbeck College**.** His research interests focus on a) stochastic dynamic programming theory and applications, b) issues of population and epidemic processes control, c) problems of optimal preventive and corrective maintenance of production systems and d) problems of optimal vehicle routing. URL: https://www.aueb.gr/en/faculty_page/kyriakidis-epaminondas

**Livada Alexandra,** graduated from AUEB where she finished M.A studies in Economic Theory and Policy. She holds a Ph.D. degree in Economics from Essex University-UK**.** Her main research interests are in Quantitative Economics and Business Analysis, Applied Econometrics, Applied Time Series Analysis and Forecasting Techniques, Income distribution-Inequality Measurement, Applied Financial Econometrics, Business Cycles Analysis, Index Numbers and Official Statistics URL: https://www.aueb.gr/en/faculty_page/livada-alexandra

**Ntzoufras Ioannis,** Graduate of the Department of Statistics and Insurance Science (1994), University of Piraeus. He received his M.Sc. in Statistics with Application in Medicine (with distinction) from the University of Southampton (1995) and his Ph.D. from the Department of Statistics at Athens University

of Economics and Business (1999). His research interests focus on topics of Bayesian and computational statistics, categorical data analysis, statistical modeling, model and variable selection methodology. He is also highly motivated by applications of sophisticated models in problems related with Medical research, Psychometrics, and sport analytics.URL: https://www.aueb.gr/en/faculty_page/ntzoufras-ioannis

**Psarakis Stylianos,** holds a degree in Mathematics from the University of Crete (1986) and a Ph.D. from the Department of Statistics at AUEB (1993). His research interests focus on: a) Statistical Quality Control, b) Distribution Theory and c) Multivariate Statistical Analysis. URL: https://www.aueb.gr/en/faculty_page/psarakis-stelios :

**Associate Professors**

**Vrontos Ioannis,** He has studied at the Athens University of Economics and Business, from where he obtained his B.Sc. in Statistics (1995), his M.Sc. in Statistics (1997) and his Ph.D. is Statistics (2001). His research interests include Bayesian Methodology, Time Series Modeling, Issues of applied finance, Optimal Asset Portfolio Allocation and alternative forms of investing high risk assets. URL: https://www.aueb.gr/en/faculty_page/vrontos-ioannis

**Ioannidis Evangelos** obtained in 1987 his degree in Mathematics from the University of Heidelberg, Germany, with a diploma-thesis in non-parametric Statistics. In 1993 he obtained his Ph.D. in Mathematics from the same University. His thesis concerned spectral analysis of time series. His current research interests concern co-integration methods, application of bootstrap to Unit-root-testing and Multivariate Spectral Analysis and their application to the analysis of economic data, as well as Official Statistics, and, in particular, survey sampling.URL: https://www.aueb.gr/en/faculty_page/ioannidis-evangelos

**Besbeas Panagiotis,** holds a degree in Mathematics with a specialization in Statistics with honors from University of Kent (1994). He graduated with distinctions from the University of Kent (1995) and obtained Ph.D. in Statistics (1999) from the same university. His research interests include: a) Applied Statistics, b) Statistical Computing and c) Ecological Statistics. URL: https://www.aueb.gr/en/faculty_page/besbeas-panagiotis

**Papageorgiou Ioulia,** has a B.Sc. in Mathematics (2.1) from the University of Ioannina, Department of Mathematics with major in Statistics and Ph.D. in Statistics, University of Ioannina, and Department of Mathematics. Her research interests are in the field of Sampling Theory, Model Based Clustering, Mixture Models, Applications to Archaeometry. URL: https://www.aueb.gr/en/faculty_page/papageorgiou-ioulia

**Pavlopoulos Charalampos, r**eceived his B.Sc. degree in Mathematics from the University of Patras, Greece (1985), and subsequently his M.A. (1988) and Ph.D. (1991) degrees in Statistics from the University of Maryland, College Park, Maryland, USA. His research interests focus on stochastic modeling of rainfall processes, scaling statistical properties of spatio-temporal rainfall fields, time series models, spatial and environmental statistics. URL: https://www.aueb.gr/en/faculty_page/pavlopoulos-charalampos-harry

**Tsiamyrtzis Panagiotis,** holds a degree in Mathematics from the Aristotle University of Thessaloniki (1994), an M.Sc (1997) and a Ph.D. (2000) in Statistics from the Statistics department of the University of Minnesota, USA. His research interests focus on a) Bayesian statistical process and quality control and b) statistical problems in computational physiology. URL: https://www.aueb.gr/en/faculty_page/tsiamyrtzis-panagiotis

**Assistant Professors**

**Stavros Vakeroudis** obtained his degree in Applied Mathematics from the School of Applied Mathematical and Physical Sciences of the National Technical University of Athens (2004). He continued his postgraduate studies in Paris, where he obtained an M.Sc. in Probabilities and Applications from the Pierre et Marie Curie-Paris VI University (2006). He got his PhD from the same university in the Science of Mathematics (2011). His research interests focus on stochastic analysis, stochastic processes, stochastic modeling, actuarial mathematics, risk theory, financial mathematics and the actuarial science and his Ph.D. in Nottingham. His research interests mainly concern Bayesian Statistics and its applications in Biostatistics, health economics and epidemic patterns. URL: https://www.aueb.gr/en/faculty_page/vakeroudis-stavros

**Demiris Nikolaos** studied Mathematics at the University of Patras and received his M.Sc. from AUEB and his PhD from Nottingham. His research interests mainly concern Bayesian Statistics and its applications in Biostatistics, health economics and epidemic patterns. URL: https://www.aueb.gr/en/faculty_page/demiris-nikolaos

**Zympidis Alexandros,** received a first-class honors degree in Mathematics from the University of Athens, Master of Science (M.Sc.) with distinction and Doctor of Philosophy (Ph.D.) in Actuarial Science from the City University of London. His basic research interests include a) stochastic modeling of insurance and pension systems and b) applications of the fractional brownian motion and H∞ optimal control. URL: https://www.aueb.gr/en/faculty_page/zimbidis-alexandros

**Papastamoulis Panagiotis,** is a Graduate of the Department of Mathematics, University of Patras (2003), holding a M.Sc. in Applied Statistics from the University of Piraeus (2005) and a Ph.D. in Statistics from the University of Piraeus (2010). His research interests focus on estimating distribution mixes, cluster analysis, Bayesian and Computational Statistics and inference in big Bioinformatics data. URL: https://www.aueb.gr/en/faculty_page/papastamoulis-panagiotis

**Penteli Xanthi-Xanthipi**, is a Graduate of the Department of Statistics, ~~at~~ Athens University of Economics and Business (2003). She received her M.Sc. in Biostatistics from the University of Athens (2006) and her Ph.D. from the Department of Statistics at Athens University of Economics and Business (2011). Her research interests are focused on statistical modeling and inference for time series, discrete data and biostatistics. URL: https://www.aueb.gr/en/faculty_page/penteli-xanthi-xanthipi

| FACULTY MEMBER | OFFICE | TELEPHONE NUMBER | email |
|---|---|---|---|
| **PROFESSORS** | | | |
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| Michalis Zazanis | 12 Kodrigtonos str, 2nd floor | 210-8203**523** | zazanis@aueb.gr |

| FACULTY MEMBER | OFFICE | TELEPHONE NUMBER | email |
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| Alexandra Leivada | 12 Kodrigtonos str, 2nd floor | 210-8203**521** | livada@aueb.gr |
| Stylianos Psarakis | 12 Kodrigtonos str, 1st floor | 210-8203541 | spsa@aueb.gr |
| **ASSOCIATE PROFESSORS** | | | |
| Ioannis Vrontos | Troias & Kimolou str., 4th floor, office 410 | 210-8203**927** | vrontos@aueb.gr |
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| Panagiotis Besbeas | 12 Kodrigtonos str, 3rd floor | 210-8203**502** | besbeas@aueb.gr |
| Ioulia Papageorgiou | 12 Kodrigtonos str, 5th floor | 210-8203**583** | ioulia@aueb.gr |
| Haralambos Pavlopoulos (*on leave during the winter semester of the academic year 2023-24*) | 12 Kodrigtonos str, 2nd floor | 210-8203**527** | hgp@aueb.gr |
| Panagiotis Tsiamyrtzis (*on leave during the spring semester of the academic year 2023-24*) | Troias & Kimolou str., 4th floor, office 411 | 210-8203**926** | pt@aueb.gr |
| **ASSISTANT PROFESSORS** | | | |
| Vakeroudis Stavros | 12 Kodrigtonos str, 2nd floor | 210-8203**225** | svak@aueb.gr |
| Nikolaos Demiris | 12 Derigni str, 2nd floor | 210-8203**569** | nikos@aueb.gr |
| Alexandros Zymbidis | 12 Derigni str, 6th floor | 210-8203**418** | aaz@aueb.gr |
| Papastamoulis Panagiotis | 12 Kodrigtonos str, 5th floor | 210-8203**591** | papastamoulis@aueb.gr |
| Xanthi Penteli | 12 Kodrigtonos str, 1st floor | 210-8203**454** | xpedeli@aueb.gr |

## B2. Special Teaching Laboratorial Staff of the School of Information Sciences and Technology employed in the Department of Statistics

**Mamaloukas Christos,** holds a degree in Applied Mathematics (1984) from the Aristotle University of Thessaloniki and a PhD (2000) from the Polytechnic School of the Aristotle University of Thessaloniki. His

research interests focus on a) Applied Mathematics, b) Computational Mathematics, c) Differential Equations and d) PC Programming and Mathematical Software.

URL1: https://www.aueb.gr/en/faculty_page/mamaloukas-christos and URL2:*http://scholar.google.co.in/citations?user=fZuGhmQAAAAJ&hl=en&cstart=0&pagesize=20*

**Tsompanaki Evgenia**, holds a BSc in Mathematics majoring in Statistics and Operational Research, Department of Mathematics, University of Patras, an M.Sc. in Statistics, Department of Statistics, Athens University of Economics and Business and a PhD in Statistics, Department of Statistics, Athens University of Economics and Business**.** Her main research interests are in the areas of Multivariate Analysis, Latent Variable Models, Categorical Data, Missing and Influential Data, Applications to health and social sciences. URL: https://www.aueb.gr/en/faculty_page/tsompanaki-evgenia

## B3. Special Technical Laboratorial Staff (Ε.Τ.Ε.Π.)

**Mihou Tatiana** holds a degree in Statistics, Department of Statistics, Athens University of Economics and Business (2001).

## B4. Administrative Staff

**Laboratorial Infrastructure Support Staff** (Antoniadou Building, 3rd floor)

- **Moraitis Nikolaos**

**Secretariat Personnel** (Derigni Building, Ground Floor))

- **Chatzipanagiotou Kyriaki,** Deputy Head, holds a B.Sc. in Statistics, Department of Statistics, Athens University of Economics and Business (1995), and a M.Sc. in Statistics, Department of Statistics, Athens University of Economics and Business (2011).
- **Anastasiou Sofia,** Graduate of the School of Physical Education and Sport Science (2000), Democritus University of Thrace and postgraduate degree in Public Policy and Management from the Department of Management Science and Technology and the Department of Economics and Department of International and European Economic Studies, Athens University of Economics & Business (2021).
- **Spyropoulou Aliki,** graduate of ATEI of Halkida in Business Management (2000), postgraduate degree from the Greek Open University in Business Management (2010).

**Support Staff for Postgraduate Studies** (Evelpidon Building, 47A Evelpidon & 33 Lefkados str., 7th floor)

- **Smyrnaki Argyro**, holds a degree in Statistics, Department of Statistics, Athens University of Economics and Business (1996), a M.Sc. in Human Resources Management (2016), Department of Marketing & Communication and Management of Science and Technology, Athens University of Economics & Business.
- **Chrysanthopoulou Maro,** holds a degree in Statistics, Department of Statistics, Athens University of Economics and Business (2004), and a M.Sc. in Statistics, Department of Statistics, Athens University of Economics and Business (2006).

# C. DEPARTMENT OF STATISTICS STUDY PROGRAM

## C1. Learning Outcomes

Upon successful completion of their studies at the Department of Statistics, the graduates will be able:

- To understand the basics of probability theory and the mathematical foundations of statistics, statistical reasoning and inference.
- To understand the notion of uncertainty and how statistics, probability and modern data science can improve decision making in an uncertain environment.
- To design, collect and analyze statistical data and draw appropriate conclusions, knowing the limitations that exist in every step of this process.
- To interpret and communicate the results of a statistical analysis.
- To analyze data using statistical packages and other computational tools.
- To demonstrate knowledge of ways to avoid misuse of statistical methods and prevent incorrect interpretations of statistical results.
- To comprehend and articulate the process of transforming research assumptions into hypotheses or queries that can be effectively addressed using statistical methods.
- To critically examine publications employing statistical methods, and to assess the validity and soundness of the statistical arguments presented.

## C2. Studies Regulation

Basic **principles** and rules of the program are as follows:

1. The program is in accordance with the philosophy of the curricula of European Universities with which the Department cooperates, since it is based on the European Credit Transfer System (ECTS). The basis of this system is the Credit Unit (ECTS). Each course corresponds to a number of ECTS referred to the program.
2. To ascertain the ECTS credit allocation for each course, a comprehensive evaluation is conducted that encompasses all aspects of the course, including lectures, assignments, required preparation, and other relevant educational activities.
3. The student completes his/ her studies and is awarded a degree when he/ she has successfully attended courses corresponding to, at least, 240 ECTS credits. Courses can be passed either by examination, or by exemption, or by equivalence under the Erasmus program.
4. According to the Department's indicative curriculum, each academic year includes educational activities corresponding to 60 academic ECTS credits.
5. The program offers 14 compulsory courses.

Starting from the academic year 2021-22, the Department of Statistics, in partnership with the Department of Informatics, has implemented specialized course cycles. These cycles comprise select courses from both departments, each aligning with specific thematic areas. The subjects of these course cycles include:

- Data Science

- Operational Research
- Applied Mathematics

While participation in these cycles is not mandatory, they provide students with the opportunity to gain additional knowledge and expertise in their areas of interest, thereby enhancing their academic and professional skill set.

## C3. Courses Categories

1. The program's courses are divided into two primary categories:
    1. **14 compulsory courses** which must be attended by all students
    2. **Elective courses** which are further subdivided into:
        1. Courses offered by the Department of Statistics.
        2. Courses offered by other Departments.
2. Compulsory courses are offered during the first 6 semesters (8 in the first year, 4 in the second year and 2 in the third year), This structure ensures that students acquire the necessary foundational knowledge in their initial semesters.
3. In the last two semesters, no compulsory courses are offered. This approach allows students to tailor their study program, combining essential statistics knowledge from compulsory courses with elective courses that align with their individual interests.
4. During the **first two semesters** the student may enroll in courses with a **maximum of 30 ECTS credits**.
5. From the 3rd to the 4thsemester, the student may enroll in courses with a **maximum of 40 ECTS credits per semester.**
6. From the 5th to the 6thsemester, the student may enroll in courses with a **maximum of 40 ECTS credits per semester.**
7. In the 7th and 8thsemesters the student may enroll in courses with a **maximum of 48 ECTS credits per semester.** An exception for exceeding this limit applies only to the "Practical Training" course.
8. After the 4th year of study, the student may enroll in courses with a **maximum of 48 ECTS credits per semester**. An exception for exceeding this limit applies only to the "Practical Training" course.

In particular, the maximum ECTS credits per semesters are displayed in the table below:

| | **Maximum ECTS's** | |
|---|---|---|
| **Year** | **Winter Semester** | **Spring Semester** |
| 1st | 30 ECTS | 30 ECTS |
| 2nd | 40 ECTS | 40 ECTS |
| 3rd | 40 ECTS | 40 ECTS |
| 4th | 48 ECTS + Practical Training | 48 ECTS + Practical Training |
| 5thand above | 48 ECTS + Practical Training | 48 ECTS + Practical Training |

9. **When selecting courses for each semester, students must prioritize compulsory courses from previous semesters that they have not yet passed and are available in the current semester. These courses should be chosen before enrolling in any other courses.**
10. There are **prerequisite courses.** "Estimation and Hypothesis Testing" of the 3rd semester is a prerequisite course for "Linear Models" of the 4th Semester. "Linear Models" is a prerequisite course for "Generalized Linear Models" of the 5th Semester as well as "Data Analysis" of the 6th Semester. It should be noted that the courses "Estimation – Hypothesis Testing" and "Linear Models" are repeated in the 4th and 5th semester respectively.

11. Apart from the 14 compulsory courses that amount to 108 ECTS, the student must accumulate **at least** 72 ECTS from elective courses offered by the Department of Statistics. The remaining 60 ECTS credits, necessary for the degree, can be obtained either from elective courses offered by the Department of Statistics, or by courses offered by other University Departments.
12. "Practical Training" is an elective course. This means, its credits are not counted to the total 72 ECTS credits from elective courses offered by the Department.
13. The list of the offered courses is announced each year and depends on the availability of the teaching personnel. Some elective courses may not be offered if there is no available instructor.
14. Upon obtaining their degree, students are eligible to receive a computer certificate equivalent to the European Computer Driving License (ECDL) recognized in the public sector. This certification is contingent upon the successful completion of four of the following courses during their studies:

**INFORMATICS KNOWLEDGE COURSES**

| Course Title | Department |
|---|---|
| INTRODUCTION TO PROGRAMMING USING R | STAT |
| INTRODUCTION TO PROBABILITY AND STATISTICS USING R | STAT |
| DATA ANALYSIS | STAT |
| SIMULATION | STAT |
| DATABASES | DET OR INF |
| COMMUNICATION NETWORKS | INF |
| COMPUTER NETWORKS | INF |
| DATA MANAGEMENT & ANALYSIS SYSTEMS<br>(old title: DATABASE DESIGN) | INF |
| ARTIFICIAL INTELLIGENCE | INF |
| MACHINE LEARNING | INF |
| DATA MINING | INF |
| INFORMATION RETRIEVAL SYSTEMS | INF |

15. Students can enroll in the Teacher Education Program. More information can be found here: https://www.dept.aueb.gr/en/tep.
16. Lastly, students are afforded the opportunity to spend one semester in a comparable department at a university abroad through the ERASMUS+ program. The courses successfully completed abroad will be matched to equivalent courses in the Department. These courses will then be included in the student's official transcript of records. For more information about student mobility, you may visit the link: https://www.aueb.gr/en/erasmus.

## C4. General Structure of the Studies Program

The general structure of the studies program is depicted in the table below.

| 1st Semester | 2nd Semester |
|---|---|
| • Probabilities I (C)<br>• Calculus I (C)<br>• Linear Algebra I (C)<br>• Introduction to Programming using R (C)<br>• Statistics I: Probabilities and Estimation* | • Probabilities II (C)<br>• Calculus II (C)<br>• Linear Algebra II (C)<br>• Introduction to Probabilities and Statistics using R (C)<br>• Statistics II: Inference and Regression * |
| **3rd Semester** | **4th Semester** |
| • Estimation and Hypothesis Testing (C) | • Linear Models (C) |

| | |
|---|---|
| • Stochastic Procedures I (C)<br>• Introduction to Mathematical Analysis<br>• Bayesian Statistics<br>• Introduction to Economics<br>• Introduction to Accounting Information Systems<br>• ERASMUS BIP: Mixed Mobility for Studies** | • Time Series Analysis (C)<br>• Demographic Statistics<br>• Sampling<br>• Mathematical Methods<br>• Actuarial Science I |
| **5th Semester** | **6th Semester** |
| • Generalized Linear Models (C)<br>• Experimental Design and Analysis<br>• Statistical Quality Control<br>• Theoretical Statistics<br>• Introduction to Operations Research<br>• Introduction to Database Management | • Data Analysis (C)<br>• Simulation<br>• Multivariate Statistical Analysis<br>• Biostatistics I<br>• Probability Theory<br>• Official Statistics<br>• Numerical Methods in Statistics |
| **7th Semester** | **8th Semester** |
| • Methods of Statistical and Machine Learning<br>• Biostatistics II<br>• Econometrics<br>• Stochastic Procedures II<br>• Actuarial Science II<br>• Bayesian Inference Methods<br>• Special Topics in Probability and Statistics<br>• Bachelor Thesis<br>• Practical Training | • Categorical Data Analysis<br>• Advanced Sampling Methods<br>• Statistical Methods for the Environment and Ecology<br>• Non-Parametric Statistics<br>• Research Methodology<br>• Special Topics in Probability and Statistics<br>• Bachelor Thesis<br>• Practical Training |

*(C): compulsory courses*

**Notes:**

- Courses noted with an asterisk (*) "Statistics I: Probabilities and Estimation" and "Statistics II: Inference and Regression" will be offered only to Erasmus students, during the academic year 2023-24.
- Course noted with two asterisks (**) "ERASMUS BIP: Mixed Mobility for Studies" **is exclusively offered under the conditions of a Multilateral Inter-Institutional Agreement between universities. This agreement specifies the selection criteria and limits the course to a certain number of students, with funding provided by IKY (State Scholarships Foundation). It is important to note that each student is eligible to enroll in this program only once during their academic studies.**
- Elective courses are offered only if there is an available professor.
- Tutoring courses are provided for all compulsory courses. Tutoring is also be done, depending on availability, in elective courses.
- Each course involves 4 hours of weekly instruction, supplemented by 2 hours of tutorials where applicable.
- Each course examination method is determined by the instructor and may involve assignments, exercises, intermediate exams, etc.
- The student can also choose from a list of elective courses offered by other Departments.

Starting with the academic year 2021-22, the Department of Statistics has initiated a seminar series aimed at first-year students. This series is designed to bridge theoretical concepts with practical

applications of statistical methods. The primary objective of these seminars is to cultivate interest among first-year students in the field of statistical science, highlighting its various applications and the career opportunities it offers. More specifically:

- Each seminar lasts for 45 to 60 minutes and takes place once a month, or more frequently, depending on lecturer's availability.
- There will be no final exams and attendance is optional.
- The seminar is open to all undergraduate students of the Department, not only freshmen.
- The following are presented at a level comprehensible to first year students (not as if it was intended to be a research seminar):
  - ✓ Statistical applications with a significant social impact (COVID pandemic, clinical trials, sports, economics, Enigma, market research, psychometry etc.)
  - ✓ Interesting statistical problems from publications on relevant topics in international journals (i.e. Significance)
  - ✓ Areas of current state-of-the-art statistical research and applications (i.e. Statistical learning, Big data)
  - ✓ Statistical applications in business (insurance, banks, pharmaceutical companies etc.)

Furthermore, starting from the academic year 2021-22, the Department of Statistics has implemented lab seminars focusing on Microsoft Excel for first-year students. These seminars are dedicated to teaching specialized tools and techniques for creating databases, statistical tables, and graphical representations of statistical results.

- The Microsoft Excel lab is **optional.**
- The lab has a short duration (eg 2 hours/ week for 6 weeks) and can be done twice a year.
- Successful attendance, proven via exams or exemption exercise, will not yield credit units and will not be accounted for the degree acquisition.
- Successful attendance is listed only on the diploma's annex received during the Graduation Ceremony
- At the request of the interested party, a "Certificate of Successful Attendance" is given (without grade indication), which is signed by the Head of the Department.
- There is a limit to the number of participants, depending on the workstations available in the Lab used for the seminar. Selection criteria are defined by the faculty member in charge.

### C.12 Elective Courses offered by other Departments for the academic year 2023-24

**Winter Semester**

| Semester | Code | ECTS | Course Cat. | COURSE TITLE | DEPARTMENT |
|---|---|---|---|---|---|
| A | 1131 | 6 | E.E. | GENERAL ECONOMIC HISTORY | SCHOOL OF ECONOMIC SCIENCES |
| C | 1193 | 6 | E.E. | PRINCIPALS OF SOCIOLOGY | SCHOOL OF ECONOMIC SCIENCES |

| | | | | | |
|---|---|---|---|---|---|
| C | 1311 | 6 | E.E. | MACROECONOMIC THEORY I | SCHOOL OF ECONOMIC SCIENCES |
| C | 1313 | 6 | E.E. | MICROECONOMIC THEORY I | SCHOOL OF ECONOMIC SCIENCES |
| E | 1550 | 6 | E.E. | PUBLIC FINANCE I | SCHOOL OF ECONOMIC SCIENCES |
| Z | 2612 | 6 | E.E. | COST ACCOUNTING | BUSINESS ADMINISTRATION |
| Z | 3070 | 6 | E.E. | TEACHER TRAINING INTERNSHIP I | INFORMATICS |
| Z | 3074 | 6 | E.E. | INTRODUCTION TO PEDAGOGY | INFORMATICS |
| Z | 3075 | 6 | E.E. | ORGANIZATION AND MANAGEMENT OF EDUCATION AN D EDUCATIONAL INSTITUTIONS | INFORMATICS |
| Z | 3076 | 6 | E.E. | INTRODUCTION TO METHODOLOGY OF TEACHING - ANALYTICAL PROGRAMS | INFORMATICS |
| Z | 3078 | 6 | E.E. | EDUCATIONAL EVALUATION | INFORMATICS |
| A | 3117 | 6 | E.E. | DISCRETE MATHEMATICS | INFORMATICS |
| A | 3125 | 6 | E.E. | INTRODUCTION TO PROGRAMMING | INFORMATICS |
| C | 3230 | 8 | E.E. | COMPUTATIONAL MATHEMATICS (2 classes) | INFORMATICS |
| C | 3321 | 8 | E.E. | COMPUTER PROGRAMMING WITH C++ | INFORMATICS |
| C | 3335 | 7 | E.E. | DATA STRUCTURES | INFORMATICS |
| E | 3515 | 7 | E.E. | LOGIC | INFORMATICS |
| E | 3531 | 7 | E.E. | ARTIFICIAL INTELLIGENCE* | INFORMATICS |
| E | 3541 | 8 | E.E. | SOFTWARE ANALYSIS AND DESIGN | INFORMATICS |
| E | 3571 | 8 | E.E. | COMMUNICATION NETWORKS | INFORMATICS |
| Z | 3632 | 6 | E.E. | TOPICS IN ALGORITHMS* | INFORMATICS |
| Z | 3745 | 6 | E.E. | MACHINE LEARNING* | INFORMATICS |
| A | 4107 | 6 | E.E. | FINANCIAL LAW | INTERNATIONAL & EUROPEAN ECONOMIC STUDIES |
| Z | 4137 | 6 | E.E. | PORTFOLIO MANAGEMENT | INTERNATIONAL & EUROPEAN ECONOMIC STUDIES |
| A | 4110 | 6 | E.E. | INTRODUCTION TO POLITICS AND INTERNATIONAL RELATIONS | INTERNATIONAL & EUROPEAN ECONOMIC STUDIES |
| C | 5634 | 6 | E.E. | MARKETING RESEARCH | MARKETING |
| C | 5636 | 6 | E.E. | MARKETING | MARKETING |
| A | 5411 | 6 | E.E. | INTRODUCTION TO BUSINESS ADMINISTRATION | MARKETING |
| A | 5622 | 6 | E.E. | INTRODUCTION TO MARKETING | MARKETING |
| Γ | 8117 | 6 | E.E. | DATABASES* | MANAGEMENT SCIENCE AND TECHNOLOGY |
| E | 8123 | 6 | E.E. | OPTIMIZATION METHODS IN MANAGEMENT SCIENCE | MANAGEMENT SCIENCE AND TECHNOLOGY |
| Z | 8137 | 6 | E.E. | BUSINESS INTELLIGENCE AND BIG DATA ANALYSIS (prerequisite is 8117 – Databases) | MANAGEMENT SCIENCE AND TECHNOLOGY |
| Z | 8143 | 6 | E.E. | COMBINATIONAL OPTIMIZATION | MANAGEMENT SCIENCE AND TECHNOLOGY |
| Z | 8154 | 6 | E.E. | ENTREPRENEURSHIP | MANAGEMENT SCIENCE AND TECHNOLOGY |

** Has prerequisites, as already mentioned*

**Spring Semester**

| Semester | Code | ECTS | Course Cat. | COURSE TITLE | DEPARTMENT |
|---|---|---|---|---|---|
| D | 1402 | 6 | E.E. | MICROECONOMIC THEORY II | SCHOOL OF ECONOMIC SCIENCES |
| D | 1412 | 6 | E.E. | MACROECONOMIC THEORY II | SCHOOL OF ECONOMIC SCIENCES |
| D | 2410 | 6 | E.E. | ADVANCED FINANCIAL ACCOUNTING (LOGISTICS II) | BUSINESS ADMINISTRATION |
| D | 2416 | 6 | E.E. | FINANCIAL MANAGEMENT I | BUSINESS ADMINISTRATION |
| E | 2610 | 6 | E.E. | OPERATIONAL POLICY AND STRATEGY | BUSINESS ADMINISTRATION |
| E | 2622 | 6 | E.E. | INVESTMENT MANAGEMENT | BUSINESS ADMINISTRATION |
| F | 3080 | 6 | E.E. | TEACHER TRAINING INTERNSHIP II | INFORMATICS |
| F | 3084 | 6 | E.E. | GENERAL AND EVOLUTIONARY PSYCHOLOGY | INFORMATICS |
| F | 3085 | 6 | E.E. | QUALITY IN EDUCATION AND TEACHING | INFORMATICS |
| F | 3086 | 6 | E.E. | INTRODUCTION TO COMPUTERS - EDUCATIONAL APPLICATIONS | INFORMATICS |
| F | 3087 | 6 | E.E. | SPECIAL EDUCATION METHODOLOGY - TEACHING ECONOMIC COURSES | INFORMATICS |
| B | 3222 | 6 | E.E. | COMPUTER PROGRAMMING USING JAVA (2 classes) | INFORMATICS |
| D | 3432 | 7 | E.E. | ALGORITHMS* | INFORMATICS |
| D | 3436 | 8 | E.E. | DATABASES* (2 classes) | INFORMATICS |
| H | 3513 | 6 | E.E. | APPLIED NUMERICAL ANALYSIS * *(old tile: APPLIED NUMERICAL ANALYSIS)* | INFORMATICS |
| E | 3543 | 7 | E.E. | DATABASES SYSTEMS DESIGN *(old title: DATABASES)* | INFORMATICS |
| E | 3672 | 7 | E.E. | COMPUTER NETWORKS | INFORMATICS |
| H | 3584 | 6 | E.E. | TECHNOLOGICAL INNOVATION AND ENTREPRENEURSHI | INFORMATICS |
| H | 3612 | 6 | E.E. | SPECIAL TOPICS OF DISCRETE MATHEMATICS* | INFORMATICS |
| H | 3713 | 6 | E.E. | GAME AND DECISION THEORY* | INFORMATICS |
| H | 3814 | 6 | E.E. | INFORMATION THEORY* *(is not offered during the 2023-24 academic year)* | INFORMATICS |
| H | 3644 | 6 | E.E. | INFORMATION RETRIEVAL SYSTEMS* | INFORMATICS |
| H | 3743 | 6 | E.E. | DATA MINING* *(old title: DATA MINING FROM LARGE DATABASES AND THE WEB)* *(is not offered during the academic year 2023-24)* | INFORMATICS |
| D | 5414 | 6 | E.E. | HUMAN RESOURCES MANAGEMENT | MARKETING |
| ΣΤ | 5626 | 6 | E.E. | DIGITAL MARKETING | MARKETING |
| H | 7138 | 6 | E.E. | RISK MANAGEMENT | ACCOUNTING & FINANCE |
| B | 8106 | 6 | E.E. | PROGRAMMING I | MANAGEMENT SCIENCE AND TECHNOLOGY |
| D | 8116 | 6 | E.E. | MATHEMATICAL PROGRAMMING | MANAGEMENT SCIENCE AND TECHNOLOGY |
| E | 8132 | 6 | E.E. | FOOD SUPPLY CHAIN MANAGEMENT | MANAGEMENT SCIENCE AND TECHNOLOGY |
| E | 8134 | 6 | E.E. | PRODUCTION AND OPERATIONS MANAGEMENT | MANAGEMENT SCIENCE AND TECHNOLOGY |
| E | 8146 | 6 | E.E. | ELECTRONIC COMMERCE | MANAGEMENT SCIENCE AND TECHNOLOGY |

** Has prerequisites, as already mentioned*

Note: Only students accepted to the "Teacher Education Program" are eligible to enroll to the Informatics course: "Digital educational content creation & usage, in contemporary learning methodologies", 6 ECTS.

***Final Exams***

Examinations are scheduled at the end of each semester. Additionally, a supplementary examination period is provided in September for retakes.

***Exams and Evaluation/ Grading Rules***

As defined by the University regulations.

***Department's ECTS Coordinator***

The Department's ECTS Coordinators is Professor D. Karlis, and deputy coordinator is Professor A. Livada.

**MODULE COURSES**

Commencing from the academic year 2021-22, the Department of Statistics, in partnership with the Department of Informatics, has launched specialized course modules. These modules comprise a curated selection of courses from both departments, each focusing on a distinct thematic area. The available modules are:

- Data Science Module
- Operational Research Module
- Applied Mathematics Module

These modules are designed to provide students with the flexibility to gain additional knowledge in specific subject areas.

Module Completion: In order for a student to complete a module, he/ she has to succeed in **at least 5 module courses** (these courses must not have been taken in any other modules) and **at least 2 of those** have to be either from the Department of Informatics, or, from the Department of Management of Science and Technology.

Participation in these modules is optional. Students have the freedom to select courses from any or all of the modules. Completion of a module will be officially recognized and noted in the **Annex** of the student's **Diploma.**

The courses titles and the way they are distributed in modules is displayed in the table below:

| Cod. | Course | Data Science | Operational Research | Applied Mathematics | Semester | ECTS |
|---|---|---|---|---|---|---|
| 6023 | Linear Models (STAT) | ✓ | | | 4th | 8 |
| 6005 | Data Analysis (STAT) | ✓ | | | 6th | 8 |
| 6136 | Multivariate Statistical Analysis (STAT) | ✓ | | | 6th | 8 |
| 3531 | Artificial Intelligence (INF) | ✓ | | | 5th | 7 |
| 3745 | Machine Learning (INF) | ✓ | | | 7th | 6 |
| 3743 | Data Mining (INF) *(old title: Data Mining g from Large Databases and the Web)* | ✓ | | | 8th | 6 |
| 3436 | Databases (INF or DET) | ✓ | | | 4th | 8 |

| Cod. | Course | Data Science | Operational Research | Applied Mathematics | Semester | ECTS |
|---|---|---|---|---|---|---|
| 6127 | Methods of Statistical and Machine Learning (STAT) | ✓ | | | 7th | 8 |
| 3644 | Information Retrieval Systems (INF) | ✓ | | | 8th | 6 |
| 6126 | Stochastic Processes I (STAT) | | ✓ | ✓ | 3rd | 8 |
| 6153 | Introduction to Operations Research (STAT) | | ✓ | ✓ | 6th | 7 |
| 6057 | Stochastic Processes II (STAT) | | ✓ | ✓ | 7th | 8 |
| 6123 | Statistical Quality Control (STAT) | | ✓ | | 4th | 7 |
| 6145 | Time Series Analysis (STAT) | | ✓ | | 4th | 8 |
| 6125 | Simulation (STAT) | | ✓ | | 6th | 7 |
| 3432 | Algorithms (INF) | | ✓ | | 4th | 7 |
| 3713 | Decision and Game Theory (INF) | | ✓ | | 8th | 6 |
| 3632 | Special Topics in Algorithms (INF) | | ✓ | | 7th | 6 |
| 8116 | Mathematical Programming (DET) | | ✓ | | 4th | 6 |
| 8143 | Combinatorial Optimization (DET) | | ✓ | ✓ | 7th | 6 |
| 6124 | Probabilities II (STAT) | | | ✓ | 2nd | 7,5 |
| 6082 | Linear Algebra II (STAT) | | | ✓ | 2nd | 7,5 |
| 6133 | Introduction to Mathematical Analysis (STAT) | | | ✓ | 3rd | 7 |
| 6143 | Mathematical Methods (STAT) | | | ✓ | 4th | 7 |
| 6116 | Probability Theory (STAT) | | | ✓ | 6th | 8 |
| 6115 | Numerical Methods in Statistics (STAT) | | | ✓ | 6th | 7 |
| 6256 | Special Topics in Statistics and Probability (STAP): Introduction to Measurement Theory with regard to Probability and Statistics (STAT) | | | ✓ | 8th | 7 |

| Cod. | Course | Data Science | Operational Research | Applied Mathematics | Semester | ECTS |
|---|---|---|---|---|---|---|
| 3117 | Discrete Mathematics (INF) | | | ✓ | 1st | 6 |
| 3513 | Numerical Linear Algebra *(old title: Applied Numerical Analysis)* (INF) | | | ✓ | 8th | 6 |
| 3612 | Special Topics in Discrete Mathematics (INF) | | | ✓ | 8th | 6 |
| 3814 | Information Theory (INF) | | | ✓ | 8th | 6 |

The teaching semester and the ECTS's for courses provided either by the Department of Statistics, or other Departments could be modified.

**COMMON MODULES INFORMATICS – STATISTICS - <u>PREREQUISITES</u>**

**DATA SCIENCE MODULES**

| TITLE | PREREQUISITES |
|---|---|
| Artificial Intelligence (INF) | Calculus II (STAT) or Algorithms (INF) |
| Machine Learning (INF) | Calculus II (STAT) or Artificial Intelligence (INF) |
| Data Mining (INF) *(old title: Data Mining g from Large Databases and the Web)* *(not offered during the academic year 2023-24)* | Databases (INF) or Artificial Intelligence (INF) |
| Databases (INF or DET) | Introduction to Programming using R (STAT) or Programming with JAVA(INF) |
| Methods of Statistical and Machine Learning (STAT) | -------- |
| Multivariate Statistical Analysis (STAT) | -------- |
| Information Retrieval Systems (INF) | Introduction to Programming using R (STAT) or Computer Programming in Java (INF) |
| Linear Models (STAT) | Estimation – Hypothesis Testing (STAT) |
| Data Analysis (STAT) | Linear Models (STAT) |

**OPERATIONAL RESEARCH MODULE**

| TITLE | PREREQUISITES |
|---|---|
| Algorithms (INF) | Introduction to Programming using R (STAT) |
| Introduction to Operations Research (STAT) | ----- |
| Decision and Game Theory (INF) | Calculus I (STAT), **and** Probabilities I (STAT) **or** Probabilities II (STAT) |
| Stochastic Procedures II (STAT) | ----- |
| Simulation (STAT) | ----- |
| Topics in Algorithms (INF) | Databases (INF) **Or** Algorithms (INF) |
| Mathematical Programming (DET ) | ----- |
| Statistical Quality Control (STAT) | ----- |
| Combinatorial Optimization (DET) | ----- |
| Time Series Analysis (STAT) | ----- |

**APPLIED MATHEMATICS MODULE**

| TITLE | PREREQUISITES |
|---|---|
| Discrete Mathematics (INF) | ----- |
| Numerical Methods in Statistics (STAT) | ----- |
| Introduction to Operations Research (STAT) | ----- |
| Introduction to Mathematical Analysis (STAT) | ------ |
| Mathematical Methods (STAT) | ----- |
| Stochastic Procedures II (STAT) | ----- |
| Introduction to Measurement Theory with regard to Probability and Statistics (STAT) | ----- |
| Probability Theory (STAT) | ----- |
| Topics in Discrete Mathematics (INF) | Discrete Mathematics (INF) |
| Information Theory (INF) | Probabilities I (STAT) **or** Probabilities II (STAT) |
| Combinatorial Optimization (DET) | ----- |
| Applied Numerical Algebra *(old title: Applied Numerical Analysis)* (INF) | Calculus II (STAT) **and** Computational Mathematics (INF) **or** Numerical Methods in Statistics |

## C4. Educational Support

1. In the courses offered by the Department of Statistics, particularly in the compulsory ones, a portion of the time is allocated for students to gain hands-on experience with statistical software relevant to the course material. This practice is apart from the theoretical aspects of the courses. The department houses a laboratory dedicated to undergraduate students. This lab is a resource for completing assignments, conducting research, and gathering data and bibliographic materials. It is well-equipped with a variety of statistical packages and other essential software, including word processors, graphic design tools, databases, etc. Additionally, the lab provides access to copies of Practical Training reports authored by students, as well as pre-publications from the Department. The laboratory also hosts seminars on topics related to the Department's curriculum and occasionally is used for conducting undergraduate courses, subject to coordination with the lab supervisor.
2. When deemed necessary, tutoring is offered. Tutoring hours and the room in which they are held are announced in the University's website (https://www.aueb.gr/en). During tutoring hours, students can ask for help to solve exercises, ask questions or help to understand concepts.

## C5. General Rules

**Maximum study duration and part time study**

1. The maximum duration of first cycle studies of minimum duration of eight (8) academic semesters for graduation, is this duration, augmented by four (4) academic semesters. After completing the maximum period of study, notwithstanding the next paragraphs, an act of deletion is issued by the responsible body.
2. The procedural details and supporting documents for the exceptional exceedance of the maximum study duration, as stated in paragraph 1, for serious health reasons of the student himself or first-degree blood relatives or person with whom the student has issued a civil partnership agreement, will be determined according to the University's internal regulation.
3. The following groups are eligible to submit applications for part-time study:
   a) Students who are proven to work at least twenty (20) hours a week
   b) Student with disabilities and special educational needs.
   c) Students that are also athletes and during their studies belong to sports clubs registered to the electronic record of sports clubs of article 142 of the law v. 4714/2020 (A' 148) that is held at the General Secretariat for Sports, under the following conditions:
      1. For the years in which they occupy the 1st to 8th place in Panhellenic individual sports championships, with the participation of at least twelve (12) athletes and eight (8)

sports clubs, or are competing in clubs of the two (2) upper categories in group sports, or participate as members of national teams, or

2. Participate, even once during their studies, in Olympics, special Olympics or Olympics for the deaf.

For part – time students each semester counts as half. These students cannot take courses that are more than half the number of semester courses described in the study guide.

4. Students that have not exceeded the maximum duration of studies, as described in paragraph 1, can apply to interrupt their studies, for no more than 2 years. This interruption can be done either at once or for the duration of one (1) semester, however this interruption cannot exceed the maximum period of two years. The student status is suspended during the interruption and participation in any educational process is not allowed.

**Other Rules**

1. The program does not have fixed tracks or directions in the strict sense. However, each student has the opportunity to shape their own academic path and desired area of specialization by selecting specific Course Modules.
2. Each student can also expand his or her knowledge in other academic fields of the University (i.e. Economics, Administration, Marketing, Informatics etc) by choosing appropriate elective courses. This selection happens in collaboration with their Studies Advisor. This way of designing one's studies provides them with freedom of choices.
3. For the elective courses, the semesters are only indicative. Students of greater semesters can also enroll in these courses.
4. The elective courses of the Department of Statistics are offered in accordance to the program's needs, faculty availability and the student's interest in attending them.
5. Minimum number of students necessary in order for a course to be taught is 8. It is possible, in exceptional cases, for a course to be taught with fewer students, only following a decision from the Department's Assembly.
6. Other than the courses offered in the Department's curriculum, the students can also choose other courses offered by other Departments from a list of offered courses.
7. The Internal Mobility Program aims to enable students enrolled in a first cycle study program, who have not exceeded the minimum duration of their studies, to transfer to another School or Department at a different University. This transfer, which can be to a similar or a different field of study, is for the duration of one academic semester. During this period, students are expected to engage in academic activities and undergo evaluations at the host institution.
   The number of students eligible to participate in this mobility program is capped at 10% of the total admissions of first-year students in the Department of Statistics each year.
   Applications for the mobility program must be submitted electronically via a specialized digital platform provided by the Ministry of Education. The application period occurs twice each academic year, aligning with the start of each academic semester.
   Information regarding eligible participants, prerequisites for participation, the application submission and evaluation process, and other relevant details about the program are outlined in the Official Gazette 2904/02.05.2023, vol. B'.
8. The degree's grade is the weighted average of the grades of the individual courses, and the weighting coefficients are each course's ECTS.
9. All the Department's announcements are uploaded at the Department's website (https://www.dept.aueb.gr/en/stat-0).
10. Faculty members must keep an updated page of the courses they teach in the University's eclass.

11. Optionally, grades can be announced in the Department's website and/ or in the courses eclass. **Official announcement of the grades is in e-Γραμματεία (https://aueb.gr/el/content/e-grammateia-0).**

12. The studies program contains the titles of the compulsory and elective courses, their content, their weekly teaching hours, which include the type of teaching work that is carried out, and the time sequence or interdependence of the courses.

13. The above provisions are part of the Department's internal regulation. These provisions are communicated to the students through the Undergraduate Studies Guide, which is released at the beginning of each academic year. In the guide there are listed the courses of the program, the semesters in which these courses are offered, their characterization and the corresponding ECTS's. This information is advisory in nature.

14. **Bachelor Dissertation**: The Dissertation can take place only on the 4th year (or later). For a student to be able to write it, he/ she must have passed all compulsory courses and hold an average grade to these courses, of 7 or larger. The duration of the dissertation is set for one academic semester. A supervisor is appointed, plus two other professors as examiners. The dissertation is presented at a specific date and time set for all dissertations, during or a little before the respective exams period. More information is available at the studies guide.

15. **Practical Training**: Students may participate only once in it, and it refers to applying statistical methods in a working environment, either of the public or the private sector. For the training to begin, the student interested must obtain the consent of the Supervisor and the approval of the Practical Training Coordinator appointed by the Department and then fill in the relevant forms available on the Department's website. The training can begin after the completion of the 6th semester, after the summer. The student must have collected at least 80 ECTS and must have passed at least 8 compulsory courses. Depending on its subject and duration, it can yield from 6 to 14 ECTS. The number of ECTS is determined by the Practical Training Coordinator, after a proposal made from the student's supervisor. Preparatory seminars are held before each period. URL: https://www.aueb.gr/en/internship. More info can be found at the relevant section of the Studies Guide.

16. **ERASMUS**

17. BIP: Mixed Mobility for Studies: Starting from the academic year 2022-23, the Department of Statistics has incorporated the "ERASMUS BIP: Mixed Mobility for Studies" course into its Undergraduate Curriculum. The course has the following characteristics:

- ECTS Credits: Students can earn between 3 and 6 ECTS credits, depending on the duration of their stay at the Host University.
- Course Type: This is an elective course.
- Academic Coordinators: The program is overseen by Professor A. Leivada and Assistant Professor P. Papastamoulis.
- **Participation Limit: Students are allowed to participate in the program only once during their academic studies.**
- Evaluation Method: The course is assessed on a pass/fail basis, following a 10-15 minute presentation. This assessment also involves communication between the Department's and the Host University's Academics in charge.
- Eligibility Criteria: To be eligible for this program, students must:
    1. Be in their second year of studies or higher.
    2. Have accumulated at least 60 ECTS credits at the time of application, including courses from the 1st year of studies.
    3. Possess a good command of the language used at the Host Institution (minimum level B2).

**Criteria of Choice and Placement at Host Universities:**

In selecting students for participation in the program and their subsequent placement at Host Universities, the following factors will be taken into consideration:

1. **Student's Academic Performance:** The student's average score at the time of submitting the application will be evaluated.
2. **Credit Accumulation:** The total number of earned credits in relation to the expected number of credits for the student's current semester will be assessed.
3. **Host University Requirements:** Any specific conditions set by the Host University, such as language proficiency level, minimum number of earned credits, prerequisite courses, etc., must be fulfilled by the student.

Additionally, as per the decision of the Department's Assembly, should a student fail to fulfill their academic obligations, they will be required to return the funding received or will be ineligible to receive the remaining 20% of the funding provided by IKY.

According to the applicable law, the guide's review occurs every April.

## C6. Courses Attendance, Selection and Examination

- **Course Selection**: To be able to participate in the courses' exams, the students must complete an electronic course statement, which they submit to the Electronic Secretariat of the University (**e-Γραμματεία)** (https://aueb.gr/el/content/e-grammateia-0). The submission takes place at dates announced by the University at the beginning of each semester and is **compulsory**. If the student fails to submit the form, even if he/ she successfully passes the courses exams, it is canceled.
- For the definite submission of the form to the electronic secretariat, the form must be **saved**.
- **Text Book Selection**: In a similar way, the students must submit electronically their textbook selection via the EUDOXUS platform (https://eudoxus.gr/). **It must be noted that Course Selection and Textbook Selection do not substitute each other.** There are penalties in the case that a student chooses and receives a textbook from a course he has not selected.
- It is ensured that teaching hours from courses of the same semester do not overlap.
- Each course is taught for 13 weeks, in 4 lecture hours per week. Most courses also include labs, that are for exercises and answering student's questions.
- Course grades range from 0 to 10, with half grades (e.g., 0.5) included. Five (5) is the lowest passing grade. The degree grade is the weighted average of the grades from each course. The weights are the ECTS credits of each course. Here are the details:

  Excellent: 8,51 – 10

  Very Good: 6,51 - 8,5

  Good: 5 - 6,5

  Passing grade is 5 and more.

- For courses taught in the winter semester the exams take place from the end of January to the beginning of February. For courses taught in the spring semester, the exams take place in June and July. Finally, courses from both semesters are re-examined in September. If a student fails at the exams of the course he/ she has taken during the Winter or Spring Semester, he/ she can retake the exams in September.
- **Course Re-examination**: If students want to retake a course they have already passed, they can apply to the Department's Secretariat. They should do this after the Directorate of Education makes the announcement. The following restrictions apply:
  - Each student has the right to use this feature 4 times (for 4 courses), during his studies.

- The application must be submitted in the period between the interval between the examination period that the student passed the course, and the exams period in which the course will be examined. Obviously, the student can be examined in this course at any time in the future.

## C7. Scholarships and Awards

The Department of Statistics and the University's Career Office, in order to support undergraduate students, but also to acknowledge and encourage excellence, would like to inform interested parties for scholarships derived from collaborations with other organizations, institutions and businesses. These scholarships are announced at the university's website (https://www.aueb.gr/el/news_archive/23) and at the Department's website (https://www.dept.aueb.gr/en/stat/content/scholarships).

Also, the AUEB Property Management & Development S.A. manages the bequests from the foundations "Georgia Nikolakopoulou" and "Faidonas G. Chatzigeorgiou", through which scholarships are granted to students with limited financial resources, based on their academic performance.

The **State Scholarships Foundation (IKY)** also grants performance scholarships to diligent students and aims to ensure equal participation in education of those with low income and those that belong to vulnerable social groups. This action is cofounded by Greece and the European Union (European Social Fund) through the Operational Program "Human Resources Development, Education and Lifelong Learning 2014 – 2020".

In the academic year 2021-22, the Department of Statistics introduced a Rewards Program for Undergraduate Students with EXCELLENT PERFORMANCE, as well as a Rewards Program for Undergraduate Students with a GOOD PERFORMANCE. In particular:

**A. REWARDS PROGRAM FOR EXCELLENT PERFORMANCE OF UNDERGRADUATE STUDENTS of the Department of Statistics**

- Beneficiary for the scholarship/ reward are the **best three (3) undergraduate students** with and excellent performance per year of study – unless there is a private funding to reward more students – that achieved the highest average grade, in combination with the aggregation of specific ECTS's, as specified below.
- The average grade for the undergraduate student's reward is at **least seven (7).**
- It must be pointed out that the undergraduate students eligible for the reward in the 1$^{st}$, 2$^{nd}$, 3$^{rd}$ and 4$^{th}$ year must have accumulated specific ECTS. More specifically, for the 1st year, students must acquire 60 ECTS, for the 2nd year, the total ECTS requirement is at least 120, for the 3rd year, students must have accumulated at least 180 ECTS in total, for the 4th year, the requirement is at least 240 ECTS in total.
- In calculating the average grade and the number of ECTS's, all courses (and their respective ECTS's) in which students received a passing grade in all three exams periods, are taken into account.
- From the 2021-22 academic year and beyond, the **three (3) best graduates** will be rewarded - unless there is a private funding to reward more students. **7,50 (seven and a half)** is set as the minimum grade for the reward.
- For graduating students, the length of the studies is not taken into account, but only the average grade is. If a graduating student is also entitled to the reward as a 4$^{th}$ year student with excellent performance, then he will receive the reward twice, as it is for different reasons (excellent performance during the 4$^{th}$ year of studies and best degree grade).
- The reward amounts to **150 euros for the 1$^{st}$, 100 euros for the 2$^{nd}$ and 50 euros for the 3$^{rd}$.** These amounts are a contribution of the Department and may be modified depending on the

Department's financial availability or may be replaced or modified depending on possible sponsorships available.

- With the REWARD there is also a AWARD OF ACADEMIC PERFORMANCE, which is signed only from the Head of the Department and contains details of the award.
- In the case of a tie, all tying students receive the REWARD and the AWARD OF ACADEMIC PERFORMANCE.
- Students who already hold a Higher Education Degree or are exempted from some courses, are not eligible for the EXCELLENT PERFORMANCE AWARD and can only receive an ACADEMIC PERFORMANCE AWARD.
- Academic Performance Awards are granted in the period from March to April of the next academic year. Following a reasoned decision of the Department's Assembly, this period can be modified.
- The students REWARD will be mentioned in the section "6.1 Additional Information" of the Diploma (both in its Greek and ~~the~~ English version).

**B. REWARDS PROGRAM FOR GOOD PERFORMANCE OF UNDERGRADUATE STUDENTS of the Department of Statistics**

- Beneficiary for the scholarship/ reward are the **undergraduate students** that achieve a good performance in the curriculum courses, in combination with the aggregation of specific ECTS's, as specified below.
- The average grade for the undergraduate students' reward is at **least seven (7).**
- It must be pointed out that the undergraduate students eligible for the reward in the $1^{st}$, $2^{nd}$, $3^{rd}$ and $4^{th}$ year must have accumulated specific ECTS. More specifically, for the 1st year, students must acquire 60 ECTS, for the 2nd year, the total ECTS requirement is at least 120, for the 3rd year, students must have accumulated at least 180 ECTS in total, for the 4th year, the requirement is at least 240 ECTS in total.
- In calculating the average grade and the number of ECTS's, all courses (and their respective ECTS's) in which students received a passing grade in all three exams periods, are taken into account.
- The REWARD amounts to the symbolic amount of 15 euros and will be accompanied by an "ACADEMIC PERFORMANCE AWARD" which will be signed by the Head of the Department of Statistics and will contain the details of the award. The rewards amount is a contribution of the Department and can be modified in relation to the Department's financial availability or can be replaced or modified depending on possible private sponsorships/ donations. The possibility not to give a sum of money as a scholarship/ reward, but to give, for example, a book or a USB or other, similar, symbolic reward gift, will be explored.
- In the case of a tie, all tying students receive the REWARD and the AWARD OF ACADEMIC PERFORMANCE.
- Students who already hold a Higher Education Degree or are exempted from some courses, are only eligible for the GOOD PERFORMANCE AWARD.
- Academic Performance Awards are granted in the period from March to April of the next academic year. Following a reasoned decision of the Department's Assembly, this period can be modified.
- The students' REWARD will be mentioned in the section "6.1 Additional Information" of the Diploma (both in the Greek and the English version).

With the commencement of the above programs, the "Performance Award" program is terminated. The program was about the two (2) best students of the Department that had successfully attended all courses of the previous academic year (at least eight (8)), as described in the Studies Guide, and held an average grade of at least eight (8). In the case of a tie, the reward was given to all tying students, while those already holding a Higher Education degree were exempted from this process.

Finally, since the academic year 2018-19, the Department of Statistics began the **process of awarding scholarships and performance rewards to undergraduate students** based on purely academic criteria, founded from the Department's resources. More specifically:

Each graduate student of the Department that completes his/ her undergraduate studies in four (4) years with an average of at least eight point fifty-one (8.51), can be eligible to a full scholarship (in the form of 100% exemption from tuition fees) for attending a Postgraduate Program of the Department of Statistics within the next three (3) years from the year he/ she graduated, following the request of the interested party (after he/ she is selected for the program).

## C8. Complaint Management Procedure

In the context of strengthening the student-centered educational process, **a complaints management procedure** has been adopted for both students and other members of the Department, such as teaching, laboratory, administrative staff, etc.).

The procedure concerns all complaints that have to do with the quality of the educational and administrative services offered by the Department, and is as follows:

- To record complaints made by members of the academic community directly associated with the Department (students, graduates, faculty members, EDIP and ETEP members, administrative staff etc) a "complaint form" is available at the Department's website (https://www.dept.aueb.gr/sites/default/files/stat/entypa/Aitisi_paraponon.pdf).
- Once the complaint is recorded, it is submitted to the Department's secretariat.
- The Secretariat (either undergraduate or postgraduate) issues a report, which is sent to the Head of the Department and the student's Faculty Advisor.
- The Head of the Department looks into the problem and informs the concerning body. For example, if the complaint concerns the structure of the Undergraduate Studies Program, the relevant Committee is informed, etc.).
- It is then evaluated whether the problem should be discussed in the Department's Assembly for any necessary corrective actions.
- The student is informed of the actions taken and of any decision of the Department's Assembly.
- It is important to note that all complaints are regarded as valuable data. They are systematically processed and considered carefully during any revisions or reforms of the study program.

## C9. Bachelor Dissertation

Within the framework of the educational process, students, on their 4th year (or more) of study, are able to conduct a Bachelor Dissertation on a wide range of cognitive areas covered by the Department of Statistics. This guide aims to define the process of assignment, execution and evaluation of the Bachelor Dissertation, thus ensuring the studies' standards and the Department's reliability.

**General Rules for Applying**

- In order for a student to be able to apply for the dissertation, he/she must have successfully attended all compulsory courses and hold an average on these courses, of (at least) 7 (seven).

- Successful fulfillment of dissertation is awarded with 8 ECTS.
- The dissertation is conducted under the supervision of a faculty member.
- Students are eligible to enroll in the Bachelor Dissertation upon the successful completion of their 6th semester.
- The student must complete and submit to the Department's Secretariat the form labeled "Submission of Proposal for Bachelor Dissertation", in which the dissertation's subject, the supervisor and the subject's summary are declared.

Specialized Teaching Staff (E.DI.P) who either hold a Ph.D. or are in the conclusive rank are eligible to supervise dissertations, provided they have the support of a faculty member.

**Assignment**

The faculty members announce the Dissertation's subject that they are willing to supervise, either through the Department's website and the laboratories or through the Department's secretariat. The students can contact the professor for further information. The Department's Assembly then is informed about the assignment of the dissertation and appoints a three-member Evaluation Committee, after taking into consideration the supervisor's proposal. The supervisor is appointed as Chair of the Committee.

**Conducting the dissertation**

Conducting the Thesis is based on the approved proposal. Work progress is regularly monitored in cooperation with the supervisor.

**Writing Procedure**

The dissertation must contain the following:

- Full bibliography review
- Description of the computational procedure and methodology used
- Presentation and discussion of the outcomes
- Conclusions and suggestions for future work
- Data that document the conclusions, in the form of appendices, such as tables, charts etc.
- Abstract in Greek and English, for documentation purposes.

Detailed information on how to write the dissertation can be found at the following link: https://www.dept.aueb.gr/en/stat/content/bachelor-dissertation

**Presentation Procedure**

The student delivers an electronic copy of his/her dissertation to the members of the Evaluation Committee and to the Department's Secretariat, at least 7 days prior to the dissertation's presentation.

The presentation takes place at a specific date, time and place, during or just before the exam period.

For the date to be set, the student must come to an agreement with the supervisor and the Department's secretariat. Members of the academic community can attend the presentation. At the conclusion of the presentation, the student engages in a question-and-answer session with the Evaluation Committee and the audience. The presentation itself should not exceed 20 minutes in duration, followed by a 15-minute period allocated for addressing questions.

**Evaluation Procedure**

After completing the presentation procedure and after the student has answered all questions, the Committee meets, in order to evaluate the dissertation and grant the final grade. The Committee then fills out the relevant proceedings which are submitted to the secretariat. The final grade is recorded to the Department's Electronic Secretariat ("e-Grammateia"), for the current examination period.

**Dissertation Submission**

The student is required to submit the dissertation both electronically and as a hard copy to the Department's secretariat. This submission should be made after incorporating any necessary corrections or observations that may have arisen following the presentation.

## C10. Practical Training

The Department of Statistics, since its foundation in 1989, has established **"Practical Training"** in its curriculum. It was the first department in the University that offered this service.

The "AUEB STUDENTS PRACTICAL TRAINING" program is conducted under the auspices of the 'Human Resources Development, Education and Lifelong Learning' and 'Competitiveness, Entrepreneurship and Innovation 2014 - 2020' operational programs. This initiative is co-financed by the European Union (European Social Fund) and national resources.

This program is fully funded by the Company, which is responsible for depositing the funds required for student compensation and insurance coverage in the event of an accident. These funds should be transferred to a designated bank account managed by the Special Account for Research and Development at the conclusion of the internship term.

Students are eligible to participate in the Practical Training program only once, whether it is funded through NSRF (National Strategic Reference Framework) or other resources. Practical Training is categorized as an elective course with the code 6801 and grants between 6 to 14 ECTS credits. Students must apply for Practical Training during the semester in which it is offered and implemented.

**Program's Aims**

The main scope of the Practical Training program is for students to obtain professional experience and for the participating organizations and companies to understand the need to use Statistics in decision making. It refers to applying statistical methods in the private or public sector workplaces. This way, students can utilize their academic knowledge and practically apply them in their workplace.

Exposing students to real-world working conditions significantly aids in their effective integration into the productive system, applicable to both Greek and international markets. The objective is to establish a reciprocal channel of communication between the Department of Statistics and the industry. This channel facilitates the exchange of information regarding the industry's needs in the field of statistics and data science and the Department's capacity to meet these needs. It also aims to highlight the potential contributions and perspectives that the discipline of statistics can offer to the industry.

Through this channel, the Department of Statistics draws significant information and is thus able to continuously adapt the Department's curriculum to the needs of the market.

Statistical science is by default an applied one. Its development came through practical problems and is essential for our students to witness the use of statistics in the workplace. It is also vital for business executives to observe how the use of statistics can assist them in more rational decision making. This way, the market stays informed of the potential benefits from utilizing statistically trained scientists. It is noteworthy that a significant number of students secure employment with participating companies following the completion of their practical training period.

For more detailed information on Practical Training, including relevant university regulations, please visit the AUEB Career Office website: https://www.aueb.gr/en/internship.

Briefly, the following are mentioned:

**Terms and Conditions**

The Practical Training Program is addressed to students that have completed the **6$^{th}$ semester (3$^{rd}$ year)**, have compiled at least 80 ECTS, have been successfully tested at, at least, 8 compulsory courses until the

exams period prior to their application date, and have participated in a relevant informative meeting/ seminar organized by the Practical Training Office [the minimum academic requirements are an on-off exclusion criterion from the selection process].

In the case that the offered Internship Positions are less than the students' applications, in the context of sound financial management of the co-financed operations and to ensure transparency and equal treatment and non-discrimination of applicants in the program, the following evaluation criteria are additionally applied. These criteria are common to all Departments.

Once the minimum academic requirements are verified and submissions not meeting the standards are excluded, the evaluation process commences. Each of the following criteria is scored from 0 to 100 points:

a) The average grade up to the exam period preceding the application is considered. This average is multiplied by 20. This criterion carries a weight of 80% in the overall evaluation.
b) The total ECTS credits earned by the student from successfully completed courses, in relation to the minimum credits required for obtaining the degree. This criterion is assigned a weight of 10%.
c) Year of Studies: Students in their 3rd or 4th year receive the full 100 points. For each year beyond the 4th, the student loses 10 points. The weight of this criterion is 10%.

If two or more students received the same number of points, the one with the highest average score in the exams period prior to the application will be selected.

In the case that some application is cancelled, the corresponding NSRF funding is attributed to the first runner up based on the announced ranking. In the case of a delayed cancellation of a student's application, and if the first runner-up has already been placed through the self-financed project, the next runner-up will be selected. If there is no runner-up, the funding amount is carried over to the next semester.

Especially for students belonging to the disabled category (according to relevant certification by the disability certification center) applies the paragraph 12 of the Internal Regulation for Practical Training.

**Students Applications – Objections**

a) The announcement inviting students to submit applications for the internship program is published on specific dates for each period. This is done in coordination with the Institutional Director and is available on the Internship and Career Office's website.
b) The students' applications can only be submitted online through the AUEB Internship Information System, in specified dates announced at the Internship's Office website, as well as at the individual Department's websites. The minimum duration for submitting applications is 10 calendar days.
c) The applications are evaluated by the Department's Internship Committee (based on the decision taken by the Department's Assembly) and the temporary and finite results are announced at the Internship Office website and the Department's website.
d) After the provisional results are announced, the interested students can submit a written objection to the Department's Secretariat within five (5) working days since the results were announced. Objections are reviewed by the Objection Committee set by the Department.
e) Upon completion of the application evaluations, including any objections, and the validation of the official results, the responsible Committee publishes a table of results on the Internship Office's website. This table includes each candidate's ranking. Subsequently, the online applications that have been accepted are being integrated into the AUEB Internship Information System by the Internship Office.
f) The Department of Statistics Assembly validates the final table of results.
g) The students are informed via email about whether their application has been accepted or declined.

**Choice of Host**

a) Via the Practical Training Informative System, which is connected to the "Atlas" Central Support System of the Student Practical training of the Ministry of Education, students chosen to participate in the Program can electronically express their interest in the available positions.
b) Upon completion of the interview process, students must select the institution where they will undertake their internship. They are then required to inform the designated staff member at the Practical Training Office. This step is crucial for arranging formal procedures and preparing the necessary documentation to commence the internship.
c) Each internship position offered to undergraduate students is officially published and recorded in the ATLAS information system, in accordance with current legislation.
d) Students are prohibited from conducting their Practical Training at an institution where a relative (3rd degree or closer, whether by blood, marriage, or legal recognition) is the legal representative. Additionally, in any case where there is a kinship (3rd degree or closer) or a marital relationship between the student and any employee at the host institution, that employee cannot be assigned as the student's supervisor.

**Practical Training Duration**

The training duration is set at three (3) months of full-time employment or six (6) months of part-time employment (full time employment corresponds to 40 hours of work, per week and part-time employment corresponds to 20 hours of work, per week). If the host institution's full-time schedule differs from the 8-hour schedule, this can be arranged. The Practical Training can be implemented during the two academic semesters (winter and spring semester), and also, during the summer period.

The duration of the Internship must be declared in the ERGANI System by the Host Institution, based on the signed Private Internship Agreement. The Host is obliged to send the submitted form E3.5 to the Practical Training Office, both at the start and at the end of the Internship period.

*Internal Regulation of the Implementation of Internship of the Department of Statistics link: https://www.aueb.gr/el/internship/content/proypotheseis-kai-oroi-symmetohis*

**Communication - Information**

**Eleftheria Nifli, Maria Kanella and Antonis Roussos**

Central Practical Training Office

Athens University of Economics and Business

13 Elpidos str, 104 34 (3rd floor), tel: 210 8203815, 813 and 806

E-mail: apan@aueb.gr

*The Department of Statistics Practical Training Office is accepting students Monday to Friday, 11:00 – 15:00.*

# D. COURSE DESCRIPTION

## 1st YEAR

### A' Semester

**Probabilities I (code: 6001)**

Course Type: Compulsory

Course level: First cycle

Instructor: E. Kyriakidis, Professor (1° Class) and St. Vakeroudis, Assistant Professor, (2° Class), Department of Statistics

E.C.T.S.: 7,5

**Desired Learning Outcomes:** Upon successful completion of the course, the students should be able to: Understand the way probabilities correspond to events, solve problems using probabilities laws, review probabilities using the Bayes rule, choose the correct probabilistic model for their problem.

**Prerequisites:** none

**Syllabus:** Discrete probability spaces, elementary combinational analysis. Probabilities properties. Conditional Probabilities, Law of Total Probability. Bayes theorem. Discrete random variables, Joint distribution of random variables. Independence. Mean value, Variance, Covariance, correlation coefficient. Cauchy-Schwarz inequality, Markov and Chebyshev inequalities. Uniform, binomial, geometric and hypergeometric distributions, Poisson distribution. Uniform, binomial, geometric and hypergeometric distributions, Poisson distribution. Conditional mean value. The Weak Law of Large Numbers. Probability generating function. Multinomial and Multivariate hypergeometric distribution.

Continuous distributions. Distribution function and probability density function. Mean, variance. Uniform, exponential and normal distribution. Gamma and Beta distributions. Moment generating functions. Joint continuous variable distribution. independency. Random variables simulation using the method of inverse transformation.

**Recommended Reading**


- Κούτρας Μ., Εισαγωγή στη Θεωρία Πιθανοτήτων και Εφαρμογές, Εκδόσεις ΤΣΟΤΡΑΣ ΑΝ ΑΘΑΝΑΣΙΟΣ, 2016.
- Feller, W. (1968). An Introduction to Probability Theory and its Applications. Wiley, N.Y.
- Hoel P., Port S., Stone C., Εισαγωγή στη Θεωρία Πιθανοτήτων, ΙΤΕ Παν/κές Εκδόσεις Κρήτης, 2009.
- Hogg, R. and Graig, A. (1970). Introduction to Mathematical Statistics, Third Ed., The Macmillan Co., New York.
- Hogg,R.V. and Tanis,E.A. (2000). Probability and Statistical Inference. Prentice Hall.
- Mendenhall, W., Beavec R.J. & Beaver, B.M. (1999): Introduction to Probability & Statistics (10th edition), Duxbury Press.
- Mood, A., Graybill, F. and Boes, D. (1974). Introduction of the Theory of Statistics. McGraw-Hill.
- Ross, S. (1976). A First Course in Probability. Collier, Macmillan, New York.
- Ross, S. (1983). Introduction to Probability Models. 2nd Ed. Academic Press, New York.
- Roussas, G.G. (2003). An introduction to Probability and Statistical Inference. Academic Press.
- Ε.Ξεκαλάκη, Ι.Πανάρετος (1998) Πιθανότητες και Στοιχεία Στοχαστικών Ανελίξεων.


Teaching Method: Face to Face

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek

**Calculus I (code: 6041)**

Course Type: Compulsory

Course level: First cycle

Instructor: H. Pavlopoulos, Assistant Professor, Department of Statistics (1st class, A – L) and Al. Zymbidis, Assistant Professor, Department of Statistics (2nd class, M – Omega)

E.C.T.S.: 7,5

**Desired Learning Outcomes:** After the successful completion of the course, the students will have adequately understood elementary concepts and techniques of Infinite Calculus and will be able to use them in solving Probability and Statistics problems.

**Prerequisites:** none

**Syllabus:** Axiomatic foundation of the system of real numbers. Axioms of domain and order, axiom of the least upper bound and the Archimedean property. Monotonic and bounded functions, continuity of a function, Bolzano's theorem, Mean-value theorem, extreme value theorem and uniform continuity. Elements of set theory. Derivative of a function, calculus of derivatives and derivatives of higher order, theorems of Rolle, Mean-Value and L'Hospital, local extremes. Riemann' s integral, properties of the integral (additivity, triangular inequality, linearity), continuity and differentiability of the integral function, integrability of continuous functions, Mean-value theorem for integrals, indefinite integral of a function, Fundamental theorem of Infinitesimal Calculus. Techniques of integration (change of variable, integration by parts, etc.), logarithm and the exponential function, generalized integrals, examples and applications. Subsets of R, points of accumulation, sequences of real numbers, monotonic sequences, subsequences and the Cauchy criterion of convergence, Bolzano-Weierstrass theorem, theorems of sequence convergence. Series of real numbers, series with positive terms, criteria of convergence and absolute convergence of series. Taylor's theorem and Taylor series.

**Recommended Reading**


- Αθανασιάδης Χ.Ε, Γιαννακούλιας Ε., Γιωτόπουλος Σ.Χ. (2009). Γενικά Μαθηματικά, Απειροστικός Λογισμός, Τόμος 1, Εκδόσεις Συμμετρία.
- Spivak, M. (2010). Διαφορικός και Ολοκληρωτικός Λογισμός, 2η έκδοση, ΙΤΕ Πανεπιστημιακές Εκδόσεις Κρήτης.
- Finney R.L., Weir M.D., and Giordano F.R. (2004). Απειροστικός Λογισμός, τόμος Ι, Πανεπιστημιακές Εκδόσεις Κρήτης.
- Apostol, T. M. (1967). Calculus, Vol.1, 2nd edition, Wiley.


Teaching Method: Face to Face.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Linear Algebra I (code: 6051)**

Course Type: Compulsory

Course level: First cycle

Instructor: E. Melas, Appointed Instructor

E.C.T.S.: 7,5

**Desired Learning Outcomes:** In depth understanding of the concepts introduced in the course, so that students can answer questions demonstrating this understanding, obtaining a geometric insight in concepts such as projection, and finally, applying this knowledge to solving exercises such as: obtaining the LDU factorization of a matrix, inverting a matrix and calculating a projection matrix.

**Prerequisites:** none

**Syllabus:** Elements and calculus in Rn, lines and planes in Rn. Matrices and matrix multiplication, Elementary matrices. Linear systems: The Gauss algorithm and the factorization PA=LDU. Inverse and transposed matrices, the algorithm Gauss-Jordan. Symmetric matrices and the Cholesky factorization. Vector spaces and subspaces. Linear systems: the solution of m equations with n unknowns and the rank of a matrix. Linear independence, bases and dimension. The four fundamental subspaces of a matrix. The fundamental theorem of Linear Algebra. Linear transformations of Rn and matrices. Orthogonal subspaces, and orthogonal complement of a subspace. Projections and least squares approximations. Projections.

**Recommended Reading**


- Gilbert Strang (1999), Γραμμική Άλγεβρα και Εφαρμογές, Πανεπιστημιακές Εκδόσεις Κρήτης.
- Lipschutz, S., LipsonMarcLars, Γραμμική Άλγεβρα, $5_η$ Έκδοση, Εκδόσεις Τζιόλα, 2013.
- Ε. Ξεκαλάκη & Ι. Πανάρετος (1993), Γραμμική Άλγεβρα για Στατιστικές Εφαρμογές, Αθήνα.
- Η. Φλυτζάνης (1999), Γραμμική Άλγεβρα & Εφαρμογές, Τεύχος Α: Γραμμική Άλγεβρα, Το Οικονομικό.
- Γ.Δονάτος-Μ.Αδάμ (2008), Γραμμική Άλγεβρα Θεωρία και Εφαρμογές, Gutenberg.
- Graybill, F. A. (1969), Introduction to Matrices with Applications in Statistics, Wadsworth, Belmont, CA.
- Harville, D. A. (1997), Matrix Algebra from a Statistician's perspective, Springer.
- Healy, M.J.R. (1995), Matrices for Statistics, Oxford University Press.
- Searle, S. R. (1982), Matrix Algebra Useful for Statistics, Wiley.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Home Assignment.

Teaching Language: Greek.

**Introduction to Programming using R (code: 6122)**

Course Type: Compulsory

Course level: First cycle

Instructor: P. Besbeas, Associate Professor, E. Tsompanaki, EDIP, holding a PhD from the Department of Statistics

E.C.T.S.: 7,5

**Desired Learning Outcomes:** Upon successful completion of the course students should be able to manage and import data to R, perform basic R operations, create and analyze simple functions in R.

**Prerequisites:** none

**Syllabus:** Introduction to computers. Basic principles of programming. Introduction to R: basic elements of R; command and window environment. Arithmetic operations. Graphs. Objects and object types. Composite commands: for, while, repeat. Creating programs. Results Lists. Special commands. Graphs in R, creating multiple graphs. Functions, Functions with multiple outputs.

**Recommended Reading**

- Ντζούφρας Ι., Καρλής Δ., Εισαγωγή στον Προγραμματισμό και στη Στατιστική Ανάλυση με R, Εκδόσεις Ελληνικά Ακαδημαϊκά Συγγράμματα και Βοηθήματα-Αποθετήριο "Κάλλιπος", 2016.
- Δ. Φουσκάκης (2013). Ανάλυση Δεδομένων με Χρήση της R . Εκδόσεις Τσότρας. Αθήνα.
- Crawley, M. (2014) Εισαγωγή στη στατιστική ανάλυση με την R (ελληνική μετάφραση). Εκδόσεις BrokenHill.
- Field, A., Miles, J and Field, Z. (2012). Discovering Statistics Using R. Sage publications Ltd.

Teaching Method: Face to Face

Teaching includes: Class lectures. Lab Exercise. Tutorial.

Written exam at the end of the semester (80%). Written assignments (20%). Lab exercises (extra small bonus).

Student Assessment Method: Written exam at the end of the semester (80%). Written Assignment (20%). Lab exercises (small extra bonus).

Teaching Language: Greek.

**Statistics I: Probabilities and Estimation (code: 9079)**

Course Type: Elective

Course level: First cycle

Instructor: H. Thomadakis, Contract instructor

E.C.T.S.: 6

**Desired Learning Outcomes**: Upon completing the course, students will gain a thorough understanding of the basic principles, theorems, and applications of statistics and probabilities. Specifically, they will be able to:

- Clearly articulate the concepts of sample space, random experiment, and random variable.
- Differentiate between various discrete and continuous distributions and solve related problems.
- Assess whether an estimator is unbiased, consistent, and sufficient.
- Employ various methods of parameter estimation effectively, including the maximum likelihood method and the method of moments.
- Accurately construct confidence intervals for different parameters of interest.

**Prerequisites:** Calculus

**Syllabus:** Random Experiment. Sampe Space. Kolmogorov axiom, Probabilities Properties. Law of total Probability. Bayes formula. Discrete and continuous random variables. Mean and variance of random variables. Binomial Distribution. Geometrical Distribution. Poisson Distribution. Hypergeometric Distribution. Uniform Distribution. Exponential Distribution. Normal Distribution. Central Limit Theorem. Law of the large numbers. Estimating an unknown parameter. Unbiased estimator. Consistent estimator. Adequate Estimator. Rao-Blackwell Theorem. Cramer-Rao lower bound. Maximum Likelihood Method. Moments Method. Confidence intervals for a normal population with known and unknown variance. Confidence intervals for the difference of normal populations means. Confidence intervals for ratios. Confidence intervals for a normal population's variance.

**Recommended Reading**

- Basic Business Statistics, 14th edition. Mark L. Berenson, David M. Levine, Kathryn A. Szabat & David F. Stephan (2019). Pearson, NY.
- An Introduction to Probability and Statistics. Rohatgi, K. Vijay & Ehsanes Saleh, A. K. MD. Wiley (2015).
- Probability and Statistics, 3rd edition. DeGroot, Morris H., & Mark J. Schervish. Boston, MA: Addison-Wesley, 2002. ISBN: 0201524880.
- Introduction to probability and statistics. Mendenhall W., Beaver R. & Beaver B. (2013). Brooks/Cole: Boston.
- https://www.openintro.org/book/os/
- https://openstax.org/details/books/introductory-business-statistics

Teaching Method: Face to Face
Teaching includes: Class lectures. Lab Exercise. Written assignments. Self Study.
Student Assessment Method: Written exam at the end of the semester. Written assignments.
Teaching Language: English

## B' Semester

**Probabilities II (code: 6142)**

Course Type: Compulsory

Course level: First cycle

Instructors: P. Dellaportas, Professor – St. Vakeroudis, Assistant Professor, Department of Statistics

E.C.T.S.: 7,5

**Desired Learning Outcomes:** Upon successful completion of the course, students will have a deeper understanding of the concepts learned in the introductory probability course. In addition, they will have the prerequisite knowledge for courses based on multi-dimensional distributions and joint studies, such as multivariate analysis, multivariate techniques and modeling.

**Prerequisites:** Introduction to Probability

**Syllabus:** Joint random variables distribution, Conditional probability density, conditional mean value. Random variable functions, density transformations, distribution of sums of independent random variables, density convolution. Ordered samples. χ2, t, and F distributions. Multivariate distributions. The Multivariate Normal Distribution. Convergence in distribution. The Central Limit Theorem.

**Recommended Reading**

- Ross, S., Βασικές Αρχές θεωρίας πιθανοτήτων, Εκδόσεις Κλειδαριθμός ΕΠΕ, 2011.
- Κούτρας Μ., Εισαγωγή στη θεωρία Πιθανοτήτων και Εφαρμογές, Εκδόσεις Τσότρας, 2016.
- Παπαϊωάννου Τ., Θεωρία Πιθανοτήτων και Στατιστικής, Εκδόσεις Σταμούλης Α.Ε., 1997.
- Feller, W. (1968). An Introduction to Probability Theory and its Applications. Wiley, N.Y.
- Hoel P., Port S., Stone C., «Εισαγωγή στη Θεωρία Πιθανοτήτων», ΙΤΕ Παν/κές Εκδόσεις Κρήτης, 2009.
- Hogg, R. and Graig, A. (1970). Introduction to Mathematical Statistics, Third Ed., The Macmillan Co., New York.
- Hogg,R.V. and Tanis,E.A. (2000). Probability and Statistical Inference. Prentice Hall.
- Mendenhall, W., Beavec R.J. & Beaver, B.M. (1999): Introduction to Probability & Statistics (10th edition), Duxbury Press.

- Mood, A., Graybill, F. and Boes, D. (1974). Introduction of the Theory of Statistics. McGraw-Hill.
- Ross, S. (1976). "A First Course in Probability". Collier, Macmillan, New York.
- Ross, S. (1983). "Introduction to Probability Models". 2nd Ed. Academic Press, New York.
- Gut, Alan. (2009). A Second Course in Probability, 2nd ed. Springer Verlag.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Calculus II (code: 6042)**

Course Type: Compulsory

Course level: First cycle

Instructor: A. Yannacopoulos, Professor, Department of Statistics

E.C.T.S.: 7,5

**Desired Learning Outcomes:** Upon successful completion of the course, students will be able to understand and use basic concepts related to (a) series of functions and (b) function of more than one variables (partial derivatives, optimization with or without constraints, including techniques such as Lagrange multipliers or the Kuhn-Tucker conditions, multiple integrals, etc.). The course emphasizes on future application of these concepts to statistics, probability, computer science and various fields of study related to economic or management sciences.

**Prerequisites:** none

**Syllabus:** Series of functions (power series, Taylor series, Fourier series) and applications. Pointwise and uniform convergence and applications. Geometry of $R^n$. Functions of more than one variable. Limits and continuity. Derivatives of functions on $R^n$. Integration of functions on $R^n$. Transformations and Jacobian. Optimization, Lagrange multipliers and applications.

**Recommended Reading**

- MarsdenandTromba (2007) Διανυσματικός Λογισμός (ελληνική μετάφραση). Παν. Εκδ. Κρήτης.
- Thomas and Finney, Weir and Giordano (2001) ΑπειροστικόςΛογισμός, Παν. Εκδ. Κρήτης.
- Αθανασιάδης Χ.Ε, Γιαννακούλιας Ε., Γιωτόπουλος Α. (2010) Γενικά Μαθηματικά, Απειροστικός Λογισμός, Τόμος 1, Εκδόσεις Συμμετρία.
- Κατερίνης, Φλυτζάνης, (2010) Ανώτερα Μαθηματικά, Εκδ. Μπένου

Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Midterms. Home assignment.

Teaching Language: Greek.

**Linear Algebra II (code: 6082)**

Course Type: Compulsory

Course level: First cycle

Instructor: Appointed Instructor

E.C.T.S.: 7,5

**Desired Learning Outcomes:** In-depth understanding of the concepts of the course so that students are able to answer questions demonstrating this understanding. The acquisition of a geometric oversight of concepts such as projection, determinant, eigenvalues and eigenvectors. Finally, applying this knowledge to solving exercises, such as calculating a projection matrix, solving a function interpolation problem with least squares, matrix diagonalization, calculating the square type contour lines.

**Prerequisites:** none

**Syllabus:** Least Squares approach, Rectangular matrices, the Gramm-Schmidt rectangularization and A = QR factorization. Determinants. Eigenvalues and characteristic polynomial, eigenvectors and eigen spaces. Matrix diagonization. Matrix powers and spectral theorem for symmetric matrices. Basis coordinates and similar matrices. Quadratic forms in symmetrical matrices: positive, Raleygh quotient, ellipsoids in n – dimensions. Examples from the multivariate normal distribution. Singular values decomposition. Complex matrices, hermitian, unitary.

**Recommended Reading**


- Gilbert Strang (1999), Γραμμική Άλγεβρα και Εφαρμογές, Πανεπιστημιακές Εκδόσεις Κρήτης.
- Ε. Ξεκαλάκη & Ι. Πανάρετος (1993), Γραμμική Άλγεβρα για Στατιστικές Εφαρμογές, Αθήνα.
- Η. Φλυτζάνης (1999), Γραμμική Άλγεβρα & Εφαρμογές, Τεύχος Α: Γραμμική Άλγεβρα, Το Οικονομικό.
- Γ. Δονάτος-Μ. Αδάμ (2008), Γραμμική Άλγεβρα Θεωρία και Εφαρμογές, Gutenberg.
- Graybill, F. A. (1969), Introduction to Matrices with Applications in Statistics, Wadsworth, Belmont, CA.
- Harville, D. A. (1997), Matrix Algebra from a Statistician's perspective, Springer.
- Healy, M.J.R. (1995), Matrices for Statistics, Oxford University Press.
- Searle, S. R. (1982), Matrix Algebra Useful for Statistics, Wiley.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Introduction to Probability and Statistics using R (code: 6031)**

Course Type: Compulsory

Course level: First cycle

Instructors: Professor D. Karlis, Department of Statistics – V. Hasiotis, Contact Instructor

E.C.T.S.: 7,5

**Desired Learning Outcomes:** Upon completion of the course, students will: gain knowledge and understanding of fundamental concepts in Statistics, comprehend basic principles of Probability Theory, become familiar with the core characteristics of Statistics and Probability through simulations, acquire sufficient proficiency in R programming to implement basic programs for solving standard statistical methodologies, develop the ability to create and interpret basic descriptive graphs, achieve competence in managing and analyzing large volumes of data to extract relevant and useful information and understand the fundamental characteristics of real-world data.

**Prerequisites:** none

**Syllabus:** This course aims to introduce students to basic principles of statistics and probability using R. These tasks include: Data collection. Reading and organizing data. Data management. The basic idea of simulation. Probability games using computer and R. Law of large numbers and other probability results. Introduction and comparison of distributions. Basic principles of descriptive statistics. Describing data using the appropriate graphs and measures. Tabulating and presenting the data. Introduction to linear regression. Statistical terminology and the media, probabilities, inference. Case studies. Examples from everyday life.

**Recommended Reading**


- Αγγελής Β., Δημάκη Α., Στατιστική Τόμος Α, Εκδόσεις "σοφία", 2010.
- Δαμιανού Χ., Κούτρας Μ., Εισαγωγή στη Στατιστική Μέρος Ι, Εκδόσεις Συμμετρία, 2003.
- VerzaniJ., Εισαγωγή στη Στατιστική με την R, Εκδόσεις Κλειδάριθμος ΕΠΕ, 2016.
- Gelman, A. Nolan, D. (2002) Teaching Statistics: A bag of tricks. Oxford University Press
- Dalgaard, P. (2008) Introductory Statistics with R. Springer
- Kerns, J. (2011) Introduction to Probability and Statistics Using R. Available at http://cran.r-project.org/web/packages/IPSUR/vignettes/IPSUR.pdf
- Horgan, J. (2008) Probability with R: An Introduction with Computer Science Applications. Wiley
- Crawley, M.J. (2014) Statistics: An Introduction Using R, 2nd Edition, Wiley
- Δ. Φουσκάκης (2013). Ανάλυση Δεδομένων με Χρήση της R . Εκδόσεις Τσότρας. Αθήνα.
- Crawley, M. J. (2014) Εισαγωγή στη στατιστική ανάλυση με την R (ελληνική μετάφραση). Εκδόσεις Broken Hill.
- Πετράκος, Γ. (2016) Εφαρμογές της Θεωρίας Πιθανοτήτων με τη χρήση της R. Εκδόσεις Τσότρας.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Bibliography study and analysis. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Home Assignment. Written Project.

Teaching Language: Greek.

**Statistics II: Inference and Regression (code: 9068)**

Course Type: Elective

Course level: First cycle

Instructors: H. Thomadakis, Contact instructor

E.C.T.S.: 6

**Desired Learning Outcomes:** Through the instruction of this course, students will become proficient in several key areas:

- Understanding the basic principles of statistical inference, encompassing both theoretical and practical aspects.
- Gaining knowledge about the concept of statistical correlation, including its theoretical background and practical applications.
- Developing a solid grasp of linear models, focusing on both their theoretical framework and practical implementation.

**Prerequisites:** Probability theory and Point/ Interval Estimation

**Syllabus:** Hypothesis Testing, statistical hypotheses, control function, hypothesis testing for population parameters such as mean values, ratios, variances, comparing parameters in two populations, statistical significance level, p-value, power of a test, determining the sample size. Pearson & Spearman statistical correlation. Introduction to regression, simple linear model, statistical linear model, normal linear model, inference in the normal linear model (confidence/ prediction intervals and hypothesis testing), transformations, residuals and deviation diagnostics for the linear model hypotheses. Multiple linear model, choosing the optimal model, choosing a model with information criteria, AIC, BIC, Mallows Cp. One factor Analysis of Variance (ANOVA). Applications in R.

**Recommended Reading**


- Draper, Norman R. & Smith, Harry. Applied Regression Analysis, 3rd edition. NY: Wiley, 1998.
- Fox, John & Weisberg, Sanford. An R Companion to Applied Regression. LA: SAGE, 2019.
- Hastie ,Trevor; Tibshirani, Robert; Friedman, Jerome. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. NY: Springer,2017.
- Lehmann, E.L & Romano, P. Joseph. Testing Statistical Hypotheses. NY: Springer-Verlag, 2008.
- Montgomery, C. Douglas; Peck, Elisabeth; Vining, G. Geoffrey. Introduction to Linear Regression Analysis, 5th Edition. NY: Wiley, 2012.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab Exercise. Interactive teaching. Written assignments.
Student Assessment Method: Written exam at the end of the semester. Written assignments.
Teaching Language: English

## 2nd YEAR

### C' Semester

**Estimation and Hypothesis Testing (code: 6012)**

Course Type: Compulsory

Course level: First cycle

Instructor: Professor St. Psarakis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After successfully completing the course, students will be able to estimate unknown parameters using the appropriate methodology, to build confidence intervals that contain the unknown parameters with the desired probability and to carry out statistical tests regarding the specific problems.

**Prerequisites:** none

**Syllabus:** Point estimation, properties of point estimators (consistency, unbiasedness, efficiency, sufficiency), point estimation methods (moment method, least squares, maximum likelihood). Sampling and sampling. Confidence intervals for means, rates, variances and their differences for normal and non-normal populations.

Hypothesis testing, statistical hypotheses, hypothesis testing for parameters such as mean values, variations, comparing parameters in two different samples, statistical significance level, p-value, power of a test, sample size calculation.

**Recommended Reading**


- Αγγελής Β., Δημάκη Α., Στατιστική Τόμος Α, Εκδόσεις "σοφία", 2012.

- Δαμιανού Χ., Κούτρας Μ., Εισαγωγή στη Στατιστική ΜΕΡΟΣ Ι, Εκδόσεις Συμμετρία, 2003.
- Πανάρετου Ι, Ξεκαλάκη Ε. Εισαγωγή στη Στατιστική Σκέψη Τόμος ΙΙ.
- Newbold, P., Carlson, W. and Thorne, B. 'Statistics for Business and Economics'.
- Berry, D. and Lindgren, B. 'Statistics Theory and Methods'.
- Freund, J. 'Mathematical Statistics with applications'.
- Walpole, R., Myers, R. and Myers, S. 'Probability and Statistics'.
- Wonnacott, T. H. and Wonnacott, R. J. Introductory Statistics. 4th edition, J. Wiley & Sons.
- Alder, H. L. and Roessler, E. B. Introduction to Probability and Statistics. 6th edition, W. H. Freeman & Company.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Bibliography study and analysis. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Stochastic Processes I (code: 6126)**

Course Type: Compulsory

Course level: First cycle

Instructor: Professor M. Zazanis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** Upon successful completion of the course, students should be able to: classify stochastic processes according to the state space and the parameterization set, determine whether a stochastic process is stationary or non-stationary, know the basic properties of a simple random walk process on the integers, Poisson and Wiener processes in continuous time, Markov chains in discrete time, renewal and branching processes.

**Prerequisites:** Probability I, Probability II, Linear Algebra I, Calculus I.

**Syllabus:** Discrete probability spaces, probability generating functions, binomial models and Poisson limit theorems. Simple random walk, gambler's ruin, game length, ballot theorems, arc-sine law. Markov chains, matrix of transition probabilities, classification of states. Asymptotic behavior, stationary distribution, stability equations. Time reversibility, Kolmogorov's criterion, random walks on graphs. Speed of convergence to stationary distribution, potential matrices. Perfect simulation and the Propp-Wilson algorithm. Branching processes and probability of extinction. Poisson process, Markov chains in continuous time, Kolomogorov's differential equations, birth - death - migration process.

**Recommended Reading**

- Χρυσαφίνου Ουρανία (2008) Εισαγωγή στις Στοχαστικές Ανελίξεις. Εκδόσεις Σοφία.
- Καλπαζίδου Σ., Στοιχεία θεωρίας στοχαστικών ανελίξεων, Εκδόσεις Ζήτη, 1991.
- Cox, D.R. and Miller, H.D. (1965). Theory of Stochastic Process, Methuen, London.
- Ross, S. M. (2002). Introduction to Probability Models, 8th edition, Academic Press.
- Karlin S. and H. Taylor (1975). A First Course in Stochastic Processes, Academic Press.
- Grimmett, G.R. and D.R. Stirzaker (2001). Probability and Random Processes. Oxford University Press.
- Norris, J.R. (1998). Markov Chains, Cambridge University Press.

Teaching Method: Face to Face.

Teaching includes Class lectures. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Problem Solving.

Teaching Language: Greek.

**Introduction to Mathematical Analysis (code: 6133)**

Course Type: Elective

Course level: First cycle

Instructor: Professor A. Yannacopoulos, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** Upon successful completion of the course, students will have developed a comprehensive understanding and practical ability in applying the fundamental concepts of mathematical analysis. This proficiency is aimed at preparing them for future applications of these concepts in the fields of statistics, probability, and computer science. Additionally, students will be equipped to apply these mathematical principles in various domains related to economic sciences, enhancing their analytical capabilities in these areas.

**Prerequisites:** none

**Syllabus:** Introduction to Real Analysis. Fundamental concepts from set theory. The set of real numbers. Sequences and series of real numbers.

Real functions, continuous, uniformly continuous, monotone and convex functions. Stieltjes integral and functions of bounded variation. Metric spaces and continuous functions in metric spaces. Uniform convergence of sequences and series of functions. Linear spaces with norm and inner product spaces (Banach and Hilbert spaces). Short introduction to Lebesgue measure and integration. Applications of these concepts in probability, statistics and scientific computation.

**Recommended Reading**


- K. Saxe, Beginning Functional Analysis, Springer Series on Undergraduate Mathematics, 2002
- A.N. Yannacopoulos, Introduction to Mathematical Analysis, Lecture Notes (2016)
- Johnsonbaugh, R. and W. Pfaffenberger (1981). Foundations of mathematical analysis. M. Dekker (New York, NY).
- Labarre, A. E. (2008). Intermediate mathematical analysis. Dover Publications
- Bobrowski, A. (2005). Functional analysis for probability and stochastic processes: an introduction. Cambridge University Press.
- Rudin, W. (1964). Principles of mathematical analysis, Volume 3. McGraw-Hill New York.
- Severini, T. A. (2005). Elements of distribution theory, Volume 17. Cambridge University Press.
- Jacod, J. and P. E. Protter (2003). Probability essentials. Springer.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Home assignment.

Teaching Language: Greek.

**Bayesian Statistics (code: 6106)**

Course Type: Elective

Course level: First cycle

Instructor: Assistant Professor N. Demiris, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** After successful completion of the course, students will be able to handle issues regarding: objective and subjective probability, features in the Bayes approach, the likelihood principle, a-priori distribution and how to choose one (conjugate, non-informative, improper, Jeffreys, a-priori mixtures), Sufficiency and sequential updating, Multivariate Bayesian statistics, Statistical inference: (decision theory, Bayes risk, Bayes rule, MINIMAX rule, point estimate, interval estimation, hypothesis testing), predictive distribution.

**Prerequisites:** none

**Syllabus:** The aim of this course is to introduce students to the Bayesian approach to statistics and to compare the Bayesian with the classic (frequentist) approach to statistics. During this course are taught: objective and subjective probability, features in the Bayes approach, the likelihood principle. A-priori distribution and how to choose one (conjugate, non-informative, improper, Jeffreys, a-priori mixtures). Sufficiency and sequential updating. Multivariate Bayesian statistics. Statistical inference: decision theory, Bayes risk, Bayes rule and MINIMAX. Point estimate, interval estimation, hypothesis testing. Predictive Distribution. Asymptotic theory.

**Recommended Reading**

- Δελλαπόρτας Π & Τσιαμυρτζής Π (2012) "Στατιστική κατά Bayes". Πανεπιστημιακές Σημειώσεις:
- Bernardo J. M. & Smith A. F. M., (1994). Bayesian Theory, Wiley, London.
- Carlin B.P. & Louis T.A. (2000). Bayes and Empirical Bayes Methods for Data Analysis, Chapman and Hall/CRC.
- O' Hagan A. and Forster J. (2004). Kendall's advanced Theory of Statistics, Volume 2b: Bayesian Inference, Edward Arnold, London.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Studying and analyzing bibliography. Tutorial. Assignments.

Student Assessment Method: Written exam at the end of the semester. Home assignment. Optional quizzes.

Teaching Language: Greek.

**Introduction to Economics (code: 6112)**

Course Type: Elective

Course level: First cycle

Instructor: Academic Scholar

E.C.T.S.: 7

**Desired Learning Outcomes:** After successfully completing the course, students will be able to understand the basic concepts of economic science focused on micro and macro analysis, as well as economic policy tools.

**Prerequisites:** none

**Syllabus:** Introductory knowledge regarding the way microeconomics and macroeconomics operate, as well as the main problems they face. Also, introductory knowledge regarding basic concepts and scales of the economy and how to measure and define them. Introduction: The Circular flow of income. The Scarcity problem. Institutional Framework.

Microeconomics theory: Supply and Demand, Balance and elasticity. Consumer behavior theory. Utility method and Indifference curves. Production and cost theory. Market structures forms: Perfect competition, Monopoly, Monopolistic competition, Oligopoly, other forms. General Economic Balance and Economics of Prosperity.

Macroeconomics theory: National product and National income. Consumption. Saving. Investment. Multiplier. Production. Employment, Salaries. Defining income and employment. Money markets. Fiscal and Monetary policy. International trade and macroeconomics. About inflation and unemployment. Economic growth. The State's role in solving macroeconomic problems.

**Recommended Reading**

- Mankiw N., Taylor P. Mark, Οικονομική 3η Έκδοση, Εκδόσεις Τζιόλα, 2016.
- McConell C., Flynn S., Brue S., Εισαγωγή στην Οικονομική Επιστήμη, Εκδοτικός Οίκος Rosili, 2016.
- G. Mankiw, M. Taylor (2011) «Αρχές Οικονομικής Θεωρίας» - Gutenberg Γιώργος & Κώστας Δαρδανός
- D. Begg, S. Fischer, R. Dornbusch (2006) "Εισαγωγή στην Οικονομική" Εκδόσεις Κριτική
- Δημέλη Σ. (2010) «Μακροοικονομικά Μεγέθη και ανάπτυξη της Ελληνικής Οικονομίας»

Teaching Method: Face to Face

Teaching includes: Class lectures. Seminars. Field exercises. Studying and analyzing bibliography. Interactive teaching. Educational visits. Assignments. Devising a study. Self-Study. Scientists' lectures.

Student Assessment Method: Written exam at the end of the semester. Elaboration questions. Problem solving. Home assignment. Written exam (Project). Presentation. Practical exercises.

Teaching Language: Greek

**Introduction to Accounting Information Systems (code: 6163)**

Course Type: Elective

Course level: First cycle

Instructor: Halevas Konstantinos, Assistant Professor Department of Accounting and Finance

E.C.T.S.: 7

**Desired Learning Outcomes:** Recognizes and records Accounting events and prepares Electronic Accounting Statements.

**Prerequisites:** none

**Syllabus:** Introducing the basic theoretical framework of Financial Accounting and Reporting. Presentation and preparation of Financial Statements in accordance with International Financial Reporting Standards (Statement of Financial Position, Income Statement, Comprehensive Income Statement, Statement of Changes in Equity, disclosures). Presenting accounting cycle steps and basic accounting records (general ledger), analyzing economic events and their impact in the logistic equation, recording calendar entries, adjusting entries, closing entries, trial balance instruction. Introduction to amortization logistics. Introduction to the operation of an accounting information system, registering

economic events and documents to the system, issuing a balance sheet using an accounting information system.

**Recommended Reading**

- Γκίκας, Δ. και Παπαδάκη Α. (2012) Χρηματοοικονομική Λογιστική, 4η έκδοση, Εκδόσεις Μπένου.
- Μπάλλας Α. και Χέβας Δ. (2010) Εφαρμοσμένες Χρηματοοικονομικής Λογιστικής, Εκδόσεις Μπένου.
- Jerry J. Weygandt, Donald E. Kieso, Paul D. Kimmel (2013) Financial Accounting, 7th edition, Wiley publications
- An Accounting Information System (AIS)

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Tutorial. Assignments.

Student Assessment Method: Written exam at the end of the semester. Home assignment.

Teaching Language: Greek.

**ERASMUS BIP: Mixed Mobility for Studies (code.: 6110-45)**

Course Type: Elective

Course level: First cycle

Instructors: Professor A. Livada, Department of Statistics and Assistant Professor P. Papastamouis, Department of Statistics

E.C.T.S.: 3-6, depending on the length of stay to the Host University

**Desired Learning Outcomes:** Students will be able to:

- Understand basic concepts of Statistical Inference and its practical applications.
- Analyze data using statistical techniques.
- Develop and evaluate statistical models.
- Apply statistical techniques to solve real problems.
- Use statistical packages and software.
- Communicate their results in a clear and understandable manner.

**Syllabus:** Statistical models, Inference and Statistical Learning, Estimating the cumulative distribution function, Bootstrap, Parametric Statistical Inference, Hypothesis testing and p-values, Linear and Logistic Regression, Choosing and evaluating the optimal model, Time Series analysis

**Prerequisites:** The student has the right to participate in the program only once (1) during their studies, after applying for participation, following the invitation for expressing an interest in the Blended Mobility for Studies Program.

**Criteria of Choice and Placement at Host Universities**

The selection of students for the program and their placement at host universities will depend on the following criteria:

1. Academic Performance: The student's average score at the time of application submission.
2. Credit Accumulation: The total number of credits earned by the student, in comparison to the expected number of credits for their current semester.
3. Host University Requirements: Compliance with any specific conditions set by the host university, such as the required level of language proficiency, a minimum number of earned credits, completion of prerequisite courses, etc.

**Recommended Reading**

- Larry Wasserman (2003). All of Statistics - A Concise Course in Statistical Inference. Springer New

York, NY

- Trevor Hastie, Robert Tibshirani, Jerome Friedman (2009) - The Elements of Statistical Learning - Data Mining, Inference, and Prediction, Second Edition. Springer New York, NY

Teaching Method: Online meetings, short visits in person in the Host University, as described in the signed Multilateral Inter-Institutional Agreement between the Universities involved.
Student Assessment Method: pass/fail after a a 10 – 15 min presentation and communication between Academic Officers of the Department and the Host University.

## D΄ Semester

**Linear Models (code: 6023)**

Course Type: Compulsory

Course level: First cycle

Instructor: Assistant Professor P. Papastamoulis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After successfully completing this course, students will be able to handle topics concerning: correlation coefficient, simple and multiple linear regression, statistical inference in linear regression, hypothesis testing and diagnostic tests, transformations, general linear model, algorithmic methods for choosing the optimal (sub)model, multicollinearity and dummy variables.

**Prerequisites:** Estimation and hypothesis testing (code: 6012)

**Syllabus:** Introduction to simple linear regression, model coefficients estimates. Properties of estimated coefficients, mean value, variance, confidence intervals, hypothesis testing, estimation of conditional variance. Predicted values, simple linear regression ANOVA, R^2, F-test.

Introduction to multivariate normal distribution. Multiple regression, design matrix, introduction to pseudo variables, general form of linear model, LS estimates and properties. Unbiased estimate of data variance. Maximum likelihood estimation. Multiple correlation coefficient, model ANOVA, partial F-tests. Simple residuals, standardized and studentized residuals, normality test, Q-Q plots, residual plots, added variable plots. Transformations, influence statistics and diagnostic tests, multicollinearity. Model choice, forward, backward, stepwise methods, all possible regressions, model choice using AIC, BIC, Mallows Cp.

**Recommended Reading**

- Draper N.R. and Smith, H. (1997). Εφαρμοσμένη Ανάλυση Παλινδρόμησης, Παπαζήσης
- Κούτρας, Μ. Και Ευαγγελάρας, Χ. (2010). Ανάλυση Παλινδρόμησης: Θεωρία και Εφαρμογές, Σταμούλης
- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2012). Introduction to Linear Regression Analysis, Wiley.
- Weisberg, S. (2014). Applied Linear Regression, Wiley

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Tutorial. Assignments.

Student Assessment Method: Written exam at the end of the semester. Home assignment.

Teaching Language: Greek.

**Time Series Analysis (code: 6145)**

Course Type: Compulsory

Course level: First cycle

Instructor: Associate Professor I.Vrontos, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After the successful completion of the course, students should be able to:

- Determine mathematical time series models.
- Estimate numerical parameters of time series models.
- Predict values of modeled time series.
- Test model fit based on residuals od observed and predicted values.

**Prerequisites:** none

**Syllabus:** Introduction with examples of time series data. Concepts of stationarity. Autocorrelation function of stationary time series. The additive model with deterministic components (trend, seasonality). Parametric and nonparametric methods of estimating and eliminating deterministic components. Box Cox transformations for eliminating heteroscedasticity. Classical tests for randomness and normality of the stochastic component. Linear filters of stationary time series. Stationary series representation as linear filters of uncorrelated noise and Wold's theorem. Autoregressive moving average model (ARMA), conditions for the existence of causality - reversibility of stationary linear solutions. Calculating the auto-covariance function of causal stationary solutions in the general ARMA (p,q) model. Bartlett's theorem and asymptotic statistical inference for autocorrelations. Predicting the minimum mean squared error. Algorithms for calculating optimal linear predictions functions (Durbin-Levinson, innovations) and its applications in predicting causal stationary ARMA models solutions. Partial autocorrelation function and its estimation.

Fitting causal stationary ARMA models:

a) preliminary estimators for autoregressive AR(p) models (Yule-Walker, least squares), moving average MA(q) models (innovations algorithm), mixed ARMA(p,q) models, (generalized Yule-Walker method), innovations algorithm).

b) maximum likelihood estimation and asymptotic inference. Diagnostic tests and criteria for choosing ARMA models rank (AIC, BIC).

Introduction to ARIMA and SARIMA models for non-stationary time series with a unit root, Dickey - Fuller test.

**Recommended Reading**


- Μπόρα-Σέντα Ε., Μωυσιάδης Χ.Θ., Εφαρμοσμένη Στατιστική, Εκδόσεις Ζήτη, 1990.
- Zivot, Eric.Wang, Jiahui, Modeling Financial Time Series with S-PLUS, Springer Science and Business Media Inc., 2006.
- Shumway, Robert H., Stoffer, David S., Time Series Analysis and its Applications, Springer Science and Business Media LLC, 2006.
- Gilgen, Hans, Univariate Time Series in Geosciences, Springer-Verlag Berlin Heidelberg, 2006.
- Kirchgassner, Gebhard, Wolters, Jurgen, Introduction to Modern time Series Analysis, Springer-Verlag Berlin Heidelberg, 2007.
- Δαμιανού Χαράλαμπος Χ., ΜΕΘΟΔΟΛΟΓΙΑ ΔΕΙΓΜΑΤΟΛΗΨΙΑΣ, Εκδόσεις “σοφία”, 2007.
- Brockwell, P.J. and R.A. Davis (2002, 2nd Edition): Introduction to Time Series and Forecasting, Springer Verlag.
- Brockwell, P.J. and R.A. Davis (1991, 2nd Edition): Time Series: Theory and Methods, Springer Verlag.

- Cryer, J.D. and K.S. Chan (2008): Time Series Analysis With Applications in R, Springer-Verlag.
- Δημέλη Σ. (2003, 3η Έκδοση): Σύγχρονες Μέθοδοι Ανάλυσης Χρονολογικών Σειρών, Εκδόσεις ΚΡΙΤΙΚΗ, Αθήνα.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Studying and analyzing bibliography. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Estimation and Hypothesis Testing (code: 6012) - recursive**

Course Type: Compulsory

Course level: First cycle

Instructor: Academic Scholar, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After successfully completing the course, students will be able to estimate unknown parameters using the appropriate methodology, to build confidence intervals that contain the unknown parameters with the desired probability and to carry out statistical tests regarding the specific problems.

**Prerequisites:** none

**Syllabus:** Point estimation, properties of point estimators (consistency, unbiasedness, efficiency, sufficiency), point estimation methods (moment method, least squares, maximum likelihood). Sampling and sampling distributions. Confidence intervals for means, rates, variances and their differences in the case of normal and non-normal populations.

Hypothesis testing, statistical hypotheses, hypothesis testing for parameters such as mean values, variations, comparing parameters in two different samples, statistical significance level, p-value, power of a test, sample size calculation.

**Recommended Reading**

- Αγγελής Β., Δημάκη Α., Στατιστική Τόμος Α, Εκδόσεις "σοφία", 2012.
- Δαμιανού Χ., Κούτρας Μ., Εισαγωγή στη Στατιστική ΜΕΡΟΣ Ι, Εκδόσεις Συμμετρία, 2003.
- Πανάρετου Ι, Ξεκαλάκη Ε. Εισαγωγή στη Στατιστική Σκέψη Τόμος ΙΙ.
- Newbold, P., Carlson, W. and Thorne, B. 'Statistics for Business and Economics'.
- Berry, D. and Lindgren, B. 'Statistics Theory and Methods'.
- Freund, J. 'Mathematical Statistics with applications'.
- Walpole, R., Myers, R. and Myers, S. 'Probability and Statistics'.
- Wonnacott, T. H. and Wonnacott, R. J. Introductory Statistics. 4th edition, J. Wiley & Sons.
- Alder, H. L. and Roessler, E. B. Introduction to Probability and Statistics. 6th edition, W. H. Freeman & Company.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Studying and analyzing bibliography. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Demographic Statistics (code: 6134)**

Course Type: Elective

Course level: First cycle

Instructor: Appointed Instructor

E.C.T.S.: 7

*Is not offered during the academic year 2023-24*

**Desired Learning Outcomes:** Knowledge of statistical techniques for analyzing demographic data and their applications.

**Prerequisites:** none

**Syllabus:** Basic concepts: Demographic events, types of demographic data, sources of demographic data, demographic data publications, demographic measures, population evolution – basic equation. Mortality, mortality per cause of death, mortality measures, mortality probability, mortality comparisons – standardization methods, direct and indirect standardization. Life tables: building a life table, the life table as a stationary population, mortality rate, stochastic approach to life table functions. Parametric and non-parametric mortality models, Mortality age, Multiple decrement tables, Fertility measures, reproduction factors, Parametric and non-parametric fertility models. Estimations, projections and population projections: projection techniques, probabilistic population projection.

**Recommended Reading**

- Παπαδάκης Μ., Τσίμπος Κ., Δημογραφική Ανάλυση-Αρχές, μέθοδοι, υποδείγματα, Εκδόσεις Σταμούλη Α.Ε., 2004.
- Keyfitz, Nathan, Caswell, Hal (2010). Applied Mathematical Demography (Statistics for Biology and Health). Springer.
- Preston, S., Heuveline, P., Guillot, M. (2000). "Demography: Measuring and Modeling Population processes" Blackwell publishing.
- Colin Newell, (1990). Methods and Models in Demography. Guilford Press.
- Shiva S. Halli, K. Vaninadha Rao (1992). Advanced Techniques of Population Analysis, Plenum Pub Corp.
- Κωστάκη, Α. "Δημομετρία". Σημειώσεις διδασκαλίας.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Self-Study and assignment.

Student Assessment Method: Written exams (70% of the final grade) and an assignment using the techniques presented during the course (30% of the final grade).

Teaching Language: Greek.

**Sampling (code: 6033)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor I. Papageorgiou, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** The students who attend and successfully pass the course will be ideally able to apply basic methods of sample selection and to combine these methods to collect a sample from a finite population. To choose the most effective and appropriate plan, depending on the population, among alternatives. To find estimators, their typical errors, confidence intervals and in general, statistical inference based on the sampling method used to collect the data. To be aware of sampling and non-sampling errors entering a survey and how to minimize them, and finally to compile an effective questionnaire.

**Prerequisites:** none

**Syllabus:** Introductory concepts and definitions. Finite populations, subpopulations, variables. Census survey, sampling survey. Random and non-random sampling. Probability of selecting population units. Finite population parameters, parameter estimation, properties. Sampling frame. Sampling techniques. Simple random sampling. Mean, ratio and proportion estimation. Confidence intervals. Estimating required sample size. Stratified sampling. Parameter estimation. Distributing a sample in strata. Comparing simple random to stratified sampling. Quota sampling. Systematic sampling. Estimating parameters and comparison to other sampling techniques. Probability proportional to size ('PPS') sampling. Cluster sampling. Single stage cluster sampling. Equal and non-equal probability sampling. Two stage cluster sampling. Conducting a sampling research. Sampling frame, questionnaire and methods of data collection. Sampling research errors. Methods of avoiding or minimizing errors and correction methods. Non response errors, adjustment and imputation techniques.

**Recommended Reading**


- Παπαγεωργίου Ι., Θεωρία Δειγματοληψίας, 2016.
- Sarndal, C-E., Swensson, B., Wretman, J. (1992) Model assisted survey sampling. Springer.
- Lohr, S. (2010) Sampling: Design and Analysis. 2nd Edition. Brooks/Cole. Sengage learning.
- Kish, L. (1965). Sampling Surveys. John Wiley & Sons. New York.
- Barnett, V. (1974). Elements of Sampling Theory. The English Universities Press Ltd.
- Pascal Ardilly, Yves Tillé. Sampling Methods: Exercises and Solutions.
- Δαμιανού, Χ. (2006) Μεθοδολογία της Δειγματοληψίας. Τεχνικές και εφαρμογές. Εκδόσεις Σοφία.
- Ξεκαλάκη Ε. (1995) Τεχνικές Δειγματοληψίας. Σημειώσεις, Οικονομικό Πανεπιστήμιο Αθηνών.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Mathematical Methods (code: 6143)**

Course Type: Elective

Course level: First cycle

Instructor: M. Zazanis, Professor, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** Upon successful completion of the course, students will have a good working understanding of the mathematical techniques described in the syllabus.

**Prerequisites:** Calculus I and II, Linear Algebra I and II.

**Syllabus:** Linear recursive relations. Linear differential equations with constant coefficients. Matrix differential equations, the exponential matrix. Orthogonal polynomials. Combinatorial Analysis. Permutations, orders, combinations. Enumeration techniques, binomial coefficients, probability generating functions, partitions. Elements of the graph theory. Optimization under Constraints, Introduction to Convex Analysis.

**Recommended Reading**


- LipschutzS., LipsonMarcLars, Γραμμική Άλγεβρα, 5η έκδοση, Εκδόσεις Τζιόλα, 2013.
- Slomson A. (1991). An introduction to combinatorics, Chapman and Hall.
- Arrowsmith D. K. and Place C. M. Ordinary differential equations. Chapman and Hall.
- Τσουμπελής, Δ. (2008). Συνήθεις Διαφορικές Εξισώσεις, Πανεπιστήμιο Πατρών.
- Χαραλαμπίδης, Χ. (2010). Συνδυαστική Ανάλυση. Εκδόσεις Συμμετρία.
- Bellman, R. (1987). Matrix Analysis. Classics in Applied Mathematics, SIAM Publishing.
- Liu, C.L. (1968). Introduction to Combinatorial Mathematics. McGraw-Hill.
- Strang, G. (1986). Introduction to Applied Mathematics. Wellesley-Cambdridge Press.
- Logan, D.J. (2010). Εφαρμοσμένα Μαθηματικά. Πανεπιστημιακές Εκδόσεις Κρήτης.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Actuarial Science I (code: 6135)**

Course Type: Elective

Course level: First cycle

Instructor: A. Zymbidis, Assistant Professor, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** At the end of the lectures, the students are able to deal with the basic problems of pricing, reserving and reinsurance in a general insurance company.

**Prerequisites:** none

**Syllabus:** Damage models: Individual and group standard, damage or loss distributions and compensation distributions and their estimation. Application in non-analog risk coverage, asymptotic estimations in the distributions right end, estimating upper limits of stop loss premiums, stop loss and inflation, positive experience clauses. Bankruptcy theory. The surplus procedure, the adjustment factor and its approaches, bankruptcy possibility, discrete surplus procedure, random variables relevant to the surplus procedure. Credibility theory, partial and full credibility, Buhlmann and Buhlmann – Straub models, other models, loss functions, Bayes credibility, time series methods, Kalman filters, application in persons group insurance. Pricing. Models of insurance against damage: evolution of one use payments or one insurance year use, Reserve for outstanding losses and allocated and non allocated settlement expenses, loss reserving methods, total and structural, triangular methods of compensation progress (chain ladder etc.), expected loss ratio, the Reid method, the Bornhuetter-Ferguson method, separate frequency and severity modeling, parametric methods (use of damage functions).

**Recommended Reading**


- Ζυμπίδης, Α. (2008) Αναλογιστικά Μαθηματικά Γενικών ασφαλίσεων. Εκδόσεις ΟΠΑ.

- Ζυμπίδης, Α. (2008) Θεωρία Κινδύνων,, Εκδόσεις ΟΠΑ.
- Robert L. Brown, Leon R. Gottlieb (2007) Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance, ACTEX Publications.
- Kaas, R., Goovaerts, M., Dhaene, J., Denuit, M. (2008) Modern Actuarial Risk Theory, Springer, 2nd ed.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

## 3rd YEAR

### E' Semester

**Experimental Design and Analyis (code: 6225)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor P. Tsiamyrtzis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** Students are expected to know the basic principles of experimental design and the ANOVA methodology. In particular, they are expected to be able to propose the appropriate statistical design of an experiment, to answer some research questions, as well as to implement the appropriate statistical analysis to the experimental data, allowing for statistical inference and decision-making.

**Prerequisites:** Linear Algebra, Linear Models.

**Syllabus:** Introduction to Experimental Design and Analysis. One factor ANOVA experiment. Multiple Comparisons. Random effects model. Non parametric ANOVA. Randomized Complete Block Design. Latin Squares. Balanced Incomplete Block Design. Factorial Experiments/ ANOVA: two factors with/ without interaction. General factorial experiments/ ANOVA: more than two factors with interactions. $2^k$ factorial designs. Fractional factorial designs. Nested and Split-plot designs. Examples and case studies using R.

**Recommended Reading**

- D. C. Montgomery (2020). "Design and analysis of experiments", Wiley.
- A. Dean, D. Voss and D. Draguljic (2017). "Design and Analysis of Experiments", Springer.
- C. F. J. Wu and M. S. Hamada (2021). "Experiments: Planning, Analysis, and Optimization", Wiley.
- J. Lawson (2014). "Design and Analysis of Experiments with R", Chapman & Hall.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab Exercise. Writing assignment/assignments.

Student Assessment Method: Written exam at the end of the semester. Project.

Teaching Language: Greek.

**Introduction to Database Management (code: 6245)**

Course Type: Elective

Course level: First cycle

Instructor: Under Contract

E.C.T.S.: 7

*Not offered during the winter semester of the academic year 2023-24.*

**Desired Learning Outcomes:** The aim of this course is for the students to be able to correctly design and implement a database application, to know how to set simple and complex questions in the database and to define those structures that lead to optimal system performance.

After completing the course, the student will be able to:

- Model a business or institution's data using Entity Relationship Models or the relational model.
- Write simple or complex questions in SQL, through which they manage a relational database or retrieve data in various ways.
- Use a relational database trading system for all the above.

**Prerequisites:** Linear Algebra, Linear Models.

**Syllabus:** Databases began as a simple application in early 70s and grew to one of the most important fields in computer industry, touching hundreds of IT applications. This outcome was somehow expected, since the focus of database research is the description, storage and usage of data. To describe a database application, we need a data model, such as the entity-relationship or the relational model. To retrieve and make use of the stored data, we need a generic query language, such as SQL. Finally, there are numerous ways to store data, depending on how this will be used. The goal of this course is to educate students on how to design properly, build efficiently and use intelligently a database. Furthermore, it should make apparent the various trade-offs that exist in designing, building and using such an application. The aim of this course is for the students to be able to correctly design and implement a database application, to know how to set simple and complex questions in the database and to define those structures that lead to optimal system performance.

The course contents include:

- Introduction: Purpose, data models, database languages, users, transactions, architecture.
- Entity-Relationship Model: Entities, relationships, attributes, keys, mapping cardinalities, weak entities, E-R diagrams, mapping to tables, examples.
- Relational Model: Relations, relational schema, relational algebra.
- The SQL Language: Basic structure, nested subqueries, aggregation, views, update, procedural and embedded SQL, triggers.
- Relational Design: Integrity constraints, functional dependencies, decomposition, normalization.
- Storing and Indexing: File organization, indexing, hashing, trees.
- Special Topics (if there is time): Data warehousing, OLAP, data mining, data streams, OO DBs.

**Recommended Reading**

- «Συστήματα Διαχείρισης Βάσεων Δεδομένων», Τόμος Α΄ & Β΄, R. Ramakrishnan & J. Gehrke, Εκδόσεις Τζιόλα, 2002.
- «Θεμελιώδεις Αρχές Συστημάτων Βάσεων Δεδομένων», Τόμος A' & B', R. Elmasri S. B. Navathe (μεταφραστική επιμέλεια Μ. Χατζόπουλος), Εκδόσεις Δίαυλος, 2001.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab Exercise. Writing assignment/assignments.

Student Assessment Method: Written exam at the end of the semester. Project.

Teaching Language: Greek.

**Generalized Linear Models (code: 6176)**

Course Type: Compulsory

Course level: First cycle

Instructors: Associate Professor I. Vrontos – Assistant Professor E. Ioannidis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** Understanding generalized linear models, the statistical analysis techniques implied and their properties, as well as the ability to apply these methods in data analysis and interpret the results, and in some depth, the understanding of the theoretical issues that arise.

**Prerequisites:** Linear Algebra, Estimation – Hypothesis Testing, Linear models.

**Syllabus:** GLM Theory: Covariance matrix and the Wald test. Maximum likelihood estimation: scores and their distribution, asymptotic distribution of the maximum likelihood estimators and the likelihood ratio. The exponential distributions family. Generalized linear model likelihood analysis, maximum likelihood estimation in the generalized linear model: the scores, the Fisher information and the Newton-Raphson algorithm. Relation to weighted least squares. Inference for coefficients. Deviance from the saturated model. Models with an unknown scale parameter. Residuals.

Applications, examples: binomial data: Link functions, coefficients interpretation, inference, overdispersion. One factor analysis (categorical or continuous), two or more factors analysis, with or without interactions: parameterizations, design matrices, coefficients interpretation. Probit and clog-log models examples.

Poisson and log-linear models. Contingency tables, odds ratio and log-linear parameters. Multinomial and multinomial product, equivalency with log-linear, log-linear and logistic regression. Independence, group independence, conditional independence, uniform dependence. Overdispersion, overdispersion test and dispersion index, the negative binomial model and other alternatives.

**Recommended Reading**

- Agresti, A. (2015), Foundations of Linear and Generalized Linear Models, Wiley Series in Probability and Statistics
- Agresti, A. (2012), Categorical Data Analysis, 3rd edition, Wiley Series in Probability and Statistics
- Dobson & Barnett (2008), An Introduction to Generalized Linear Models, Taylor & Francis.
- Fox (2008), Applied Regression Analysis and Generalized Linear Models, Kindle
- Hosmer, D.W. and Lemeshow, S. (1989, 2000), Applied Logistic Regression. New York: Wiley.
- McGullagh, P and Nelder, J.A. (1989), Generalized Linear Models, London: Chapman and Hall.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Written exam (Project). Exams on computers at the end of the semester.

Teaching Language: Greek.

**Linear Models (code: 6023) - recursive**

Course Type: Compulsory

Course level: First cycle

Instructors: Assistant Professor P. Papastamoulis and Assistant Professor X. Pendeli, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After successfully completing this course, students will be able to handle topics concerning: correlation coefficient, simple and multiple linear regression, statistical inference in linear regression, hypothesis testing and diagnostic tests, transformations, general linear model, algorithmic methods for choosing the optimal (sub)model, multicollinearity and dummy variables.

**Prerequisites:** Estimation and hypothesis testing (code: 6012)

**Syllabus:** Introduction to regression, straight line fitting, model coefficients estimates. Properties of estimated coefficients, mean value, variance, confidence intervals, hypothesis testing, estimation of conditional variance. Predicted values, simple linear regression ANOVA, $R^2$, F-test (note: definition through SS_Regr and SS_error).

Introduction to multivariate normal distribution. Multiple regression definition, examples. Design matrix, introduction to pseudo variables, general form of linear model, LS estimates and properties (through matrices). Unbiased variance estimate. Maximum likelihood estimation. Multiple correlation coefficient, model ANOVA, partial F-tests, recursive f-tests. Examples. Simple residuals, standardized and studentized residuals, normality test, Q-Q plots, simple hypothesis testing plots, added variable plots, other plots and hypothesis testing for the model. Simple transformations, influence statistics and diagnostic tests, multicollinearity. Model choice, forward, backward, stepwise methods, all possible regressions, model choice using AIC, BIC, Mallows Cp.

**Recommended Reading**


- Draper N.R. and Smith, H. (1997). Εφαρμοσμένη Ανάλυση Παλινδρόμησης, Παπαζήσης
- Κούτρας, Μ. Και Ευαγγελάρας, Χ. (2010). Ανάλυση Παλινδρόμησης: Θεωρία και Εφαρμογές, Σταμούλης
- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2012). Introduction to Linear Regression Analysis, Wiley.
- Weisberg, S. (2014). Applied Linear Regression, Wiley


Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab Exercise. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Statistical Quality Control (code: 6123)**

Course Type: Elective

Course level: First cycle

Instructor: Professor St. Psarakis, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** Upon completion of the course, students will be equipped with the necessary skills to enhance the quality of products or services through the application of statistical methods.

**Prerequisites:** Estimation – Hypothesis Testing

**Syllabus:** Basic concepts of quality control and statistical quality control. Cause and effect charts. Pareto charts. Control charts for variables (R, S). Attributes control charts (p, np, c, u). CUSUM and EWMA control

charts. Capability indices. Introduction to multivariate control charts. The six-sigma methodology. Acceptance sampling. Basic experimental design using principals of repetition and blocking.

**Recommended Reading**

- Montgomery D (2012) Introduction to Statistical Quality Control, 7th Edition Wiley.
- Ταγαράς Γιώργος (2001) Στατιστικός Έλεγχος Ποιότητας. Εκδόσεις ΖΗΤΗ.

Teaching Method: Face to Face.

Teaching includes: Class lectures, Lab exercise, Studying and analyzing bibliography, Tutorial Assignments: Self Study.

Student Assessment Method: Written exam at the end of the semester +

Project.

Teaching Language: Greek.

**Theoretical Statistics (code: 6144)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor I. Papageorgiou, Department of Statistics and St. Vakeroudis, Assistant Professor, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After completing the course the students ideally should be able to: Implement the standard methods to derive estimates for unknown parameters of a population with a known distribution. Evaluate and compare estimates with respect to standard criteria. Construct confidence intervals for the unknown parameters. Construct statistical tests for hypothesis testing about unknown parameters.

**Prerequisites:** none

**Syllabus:** Terminology and definition of basic introductory concepts of parametric statistical inference (random sample, sampling space, parametric space, sample distribution, estimating statistical function). Point estimation in decision making theory (loss function, risk function). Criteria for estimator evaluation: Unbiasedness, Minimum Variance, Sufficiency, completeness, maximum Likelihood, efficiency. Methods of finding unbiased estimators of uniformly minimum variance. Fisher information, Cramer-Rao-Frechet inequality. The exponential family of distributions. Lehmann-Scheffe theorem. Maximum Likelihood Estimators (MLE). Invariance and asymptotic properties of the MLE. The concept of estimating parameters with confidence intervals. Methods of constructing confidence intervals. Pivotal quantity and the general method. Optimal confidence intervals. Asymptotic confidence intervals. Introduction to theory of parametric statistical hypothesis testing (defining the parametric hypothesis, types of errors, control function, power function). Evaluating statistical tests based on the power function. The Neyman-Pearson lemma and its applications in finding a uniformly powerful statistical test of simple hypotheses. Composite hypothesis testing. Likelihood Ratio test (LRT) and asymptotic LRT.

**Recommended Reading**

- Φερεντίνος Κ. και Παπαϊωάννου Τ. (2000) Μαθηματική Στατιστική, 2η Έκδοση, Εκδόσεις Σταμούλη, Αθήνα.
- Κολυβά-Μαχαίρα Φ., Μαθηματική Στατιστική, Εκδόσεις Ζήτη, 1998.

- Φουσκάκης Δ., Ανάλυση Δεδομένων με τη Χρήση της R., Εκδόσεις Τσότρας, 2013.
- CrawleyM.J., Στατιστική Ανάλυση με το R., BrokenHillPublishers, 2013.
- Ρούσσας Γ. (1994) Στατιστική Συμπερασματολογία, Τόμος Ι - Εκτιμητική, 2η Έκδοση, Εκδόσεις Ζήτη, Θεσσαλονίκη.
- Ρούσσας Γ. (1994) Στατιστική Συμπερασματολογία, Τόμος ΙΙ – Έλεγχοι Υποθέσεων, 2η Έκδοση, Εκδόσεις Ζήτη, Θεσσαλονίκη.
- Bickel P.J. and Doksum K.A. (2007): Mathematical Statistics, vol.I, 2nd Edition – Updated Printing, Pearson Prentice Hall.
- Casella G. and Berger R. (2002): Statistical Inference, 2nd Edition, Duxbury.
- Mood A.M., Graybill F.A. and Boes D.C. (1974): Introduction to the Theory of Statistics, 3rd Edition, McGraw-Hill Book Company.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Home Assignment.

Teaching Language: Greek.

**Introduction to Operational Research (code: 6153)**

Course Type: Elective

Course level: First cycle

Instructor: Professor E. Kyriakidis, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:**

After successfully attending the course, the students will be able to solve linear programming problems graphically, with algebraic methods, with the Simplex method and with Excel. They will also be able to find the optimal policy that minimizes the total expected cost for finite-time horizon problems using the method of dynamic programming. They will also be able to find optimal replenishment policies for inventory problems.

**Prerequisites:** none

**Syllabus:** The linear programming problem, examples, solution by graphical method, canonical form, properties of solutions, The Simplex algorithm, the M-method, the dual problem of linear programming, sensitivity analysis, the transition problem, the integer programming problem, the dynamic programming problem, the machine maintenance problem, the replacement problem, the Secretary problem. Dynamic Programming, Game theory.

**Recommended Reading**

- Δ. Φακίνος, Α. Οικονόμου, «Εισαγωγή στην Επιχειρησιακή Έρευνα», Εκδόσεις Συμμετρία, 2003.
- HillierF., S., LiebermanG.J., Εισαγωγή στην Επιχειρησιακή Έρευνα, Τόμος Α΄, Τεύχος Α΄, Εκδόσεις Παπαζήσης, 1985.
- F. S. Hillier, G. J. Lieberman, “Introduction to Operations Research”, McGraw-Hill, 2005.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Studying and analyzing bibliography. Assignments.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

## F' Semester

**Data Analysis (code: 6005)**

Course Type: Compulsory

Course level: First cycle

Instructor: Professor I. Ntzoufras, Assistant Professor – K. Pateras, Contact Instructor

E.C.T.S.: 8

**Desired Learning Outcomes:** After successful completion of the course, the students should be able to:

- Manage real life problems and analyze data in R,
- Perform basic hypothesis testing,
- Construct and interpret regression models, and
- Write statistical reports in a professional manner.

**Prerequisites:** Linear Models (code: 6023)

**Syllabus:** Statistical methods in simple problems using statistical packages (emphasis on R and secondary on other statistical packages): Descriptive statistics, visualization, simulating random numbers from theoretical distributions, confidence intervals, hypothesis testing for one and two independent samples, hypothesis testing for two dependent samples, contingency tables, simple and multiple regression analysis, AnCoVa models and analysis for one and two factors (and one continuous explanatory). Case studies and analysis real data sets from various scientific fields (economics, marketing, social sciences, sports, medicine, psychology etc.). Basic principles for writing professional and scientific reports and presenting data analysis.

**Recommended Reading**


- Ντζούφρας Ι., Καρλής Δ., Εισαγωγή στον Προγραμματισμό και στη Στατιστική Ανάλυση με R, Εκδόσεις Ελληνικά Ακαδημαϊκά Ηλεκτρονικά Συγγράμματα και Βοηθήματα-Αποθετήριο "Κάλλιπος'', 2016.
- Φουσκάκης Δ. (2013). Ανάλυση Δεδομένων με Χρήση της R. Εκδόσεις Τσότρας. Αθήνα.
- Marques de Sa, Joaquim P., Applied Statistics Using SPSS, STATISTICA, MATLAB and R, Editions Springer-Verlag, 2008.
- Chatterjee S., Handcock M.S., Simonoff J.S. (1995). A Casebook for a First Course in Statistics and Data Analysis. John Wiley & Sons.
- Faraway J.J. (2002). Practical Regression and Anova using R. Free electronic book available at http://cran.r-project.org/doc/contrib/Faraway-PRA.pdf.
- Fox J. & Weisberg H.S. (2011). An R Companion to Applied Regression. 2nd edition. SAGE Publications Inc.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercises. Studying and analyzing bibliography. Tutorial. Assignments.

Student Assessment Method: Written exam at the end of the semester (50%). Assignment and oral examination/ presentation (50%). Lab exercises (small extra bonus).

Teaching Language: Greek.

**Simulation (code: 6125)**

Course Type: Elective

Course level: First cycle

Instructor: Professor P. Dellaportas, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** After successfully completing the course, the students will be able to understand elements of stochastic simulation and implement it on PC.

**Prerequisites:** none

**Syllabus:** Generating uniform random variables, reductive generators, random number tests, methods of generating random numbers. The inversion method, the rejection method, component method, other methods. Methods for specific distributions. Dispersion reduction techniques and the Monte Carlo integration: Monte Carlo simulation, significance sampling, opposite random variables, control random variables. Generating dependent random variables: ranked sample, exponential spaces, multivariate normal distribution, Poisson process, Markov chains, random Markov fields, Gibbs sampler, Particle filtering.

**Recommended Reading**

- Δελλαπόρτας, Π. (1994). Στοχαστικά Μοντέλα και Προσομοίωση. Σημειώσεις παραδόσεων, τμήμα Στατιστικής, Οικονομικό Πανεπιστήμιο Αθηνών. Διαθέσιμες στη διεύθυνση http://www.stat-athens.aueb.gr/~ptd/simulation.ps.
- Devroye, L. (1986). Non-Uniform Random Variable Generation, Springer-Verlag, New York.
- Ripley, Brian D. (1987). Stochastic Simulation, John Wiley, New York.
- Robinson, S. (2004). Simulation: The Practice of Model Development and Use, Wiley, Chichest, UK.
- Robert, C., Casella, G. (2010). Introducing Monte Carlo Methods with R. Springer

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Tutorial. Research assignment. Assignments.

Student Assessment Method: Home assignment. Written exam (Project).

Teaching Language: Greek.

**Multivariate Statistical Analysis (code: 6136)**

Course Type: Elective

Course level: First cycle

Instructor: Professor D. Karlis, Department of Statistics – V. Hasiotis, Contact Instructor

E.C.T.S.: 8

**Desired Learning Outcomes:** Upon completion of the course, the students will be able to: produce graphs and comprehend relations in data, apply basic methods of multivariate data analysis, infer on multivariate data, use methods of dimension reduction.

**Prerequisites:** none

**Syllabus:** Multivariate data, multivariate descriptive measures, covariance matrix, generalized variance. Plots for multivariate data. Multivariate distributions, basic properties and handling. Multivariate normal distribution. Properties. Estimation. Distributions resulting from the multivariate normal distribution. Principal components analysis, choosing principal components, principal components interpretation. Principal components analysis in sampling data. Factor analysis, the orthogonal factor model. Estimation. Model rotation, results interpretation, applications. The multivariate linear model, multivariate regression, multivariate analysis of variance. The concept of distance and its use for grouping. Structural Equation Modeling.

**Recommended Reading**


- Σιάρδος Γ., Μέθοδοι Πολυμεταβλητής Στατιστικής Ανάλυσης, Εκδόσεις Σταμούλη Α.Ε., 2005.
- Everitt, Sidney B., Casella, Fienberg G., Olkin S., Ingram, An R and S-PLUS Companion to Multivariate Analysis, Springer-Verlag London Limited, 2005.
- Anderson, T. W. (1984). An Introduction to Multivariate Statistical Analysis, John Wiley & Sons, New York, 2nd edition.
- Bartholomew, D.J., Steele, F., Moustaki, I., Galbraith, J. (2011) Ανάλυση πολυμεταβλητών τεχνικών στις κοινωνικές επιστήμες, Εκδόσεις ΚΛΕΙΔΑΡΙΘΜΟΣ
- Basilevski, A. (1994). Statistical Factor Analysis and Related Methods. Theory and Applications. John Wiley & Sons.
- Chatfield, C. and Collins, A.J. (1992). Introduction to Multivariate Analysis.
- Jackson, J. (1991). A User's Guide to Principal Components, John Wiley & Sons, Inc., New York, NY.
- Krzanowski, W. J. (1988). Principles of Multivariate Analysis. Oxford University Press.
- Mardia, K. V., Kent, J. T. & Bibby, J. M. (1979). Multivariate Analysis. London: Academic Press.
- Καρλής, Δ. (2005). Πολυμεταβλητή Στατιστική Ανάλυση. Εκδόσεις Σταμούλη.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Research Assignment. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Written exam (Project).

Teaching Language: Greek.

**Probability theory (code: 6116)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor Ch. Pavlopoulos, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** Upon successful completion of the course, students should be able to: determine the probability space of a random experiment with uncountable sample space according to the Lebesgue - Caratheodory extension theorem, to apply advanced probability calculus according to Kolmogorov's axioms, manage random variables as measurable mappings of a given probability space to the Borel line, determine the type of a random variable according to its probability distribution induced on the Borel line (discrete, continuous, mixed), calculate its expected (or mean) value as a Lebesgue integral on the Borel line, to distinguish and verify modes of stochastic convergence of a given sequence of random variables, to apply the laws of large numbers and the central limit theorem.

**Prerequisites:** Probability I, Probability II, Calculus I, Calculus II, Introduction to Mathematical Analysis.

**Syllabus:** Uncountable sets and the necessity for axiomatic foundation of probability spaces (σ-algebra of events, Kolmogorov's axioms, properties of probability measure). The Lebesgue-Caratheodory extension theorem for construction of probability spaces (summary, applications). Definition of random variables and Borel measurability. Stochastic independence, Borel-Cantelli lemmas, tail events and Kolmogorov's 0-1 law. Expectation of random variables with respect to a probability measure as Lebesgue integral with respect to their probability distributions induced on the Borel line, properties of expected values. Modes of convergence for sequences of random variables (almost certain, in p-th order mean, in probability, in distribution). Limit theorems (monotone convergence, Fatou's lemma, dominated/bounded convergence theorem, uniform integrability, weak and strong laws of large numbers, central limit theorem). Lebesgue's decomposition of a probability distribution on the Borel line to its components (discrete, absolutely continuous, singular continuous), characterization of absolute continuity by the Radon-Nikodym theorem. Conditional expectation, conditional probability and their properties.

**Recommended Reading:**


- Athreya, Krishna B., Lahiri, Soumendra N., Measure Thery and Probability Thery, Springer Science and Business Media, LLC, 2006.
- Billingsley, P. (1995): Probability and Measure, 3rd Edition, John Wiley & Sons.
- Bhattacharya, Rabi. Waymire, Edward C., A Basic Course on Probability Theory, Springer Science and Business Media, Inc., 2007.
- Rosenthal, J. S. (2006): A First Look at Rigorous Probability Theory, Second Edition, World Scientific.
- Roussas, G.G. (2005): An Introduction to Measure-Theoretic Probability, Elsevier Academic Press.
- Skorokhond, A.V., Prokhorov, Yu.V., Basic Principles and Applications of Probability Theory, Springer-Verlag Berlin Heidelberg, 2005.
- SpringerLink (Online service), Gut A., Probability: A graduate Course, Springer Science and Business Media, Inc., 2005.
- Ρούσσας, Γ. Γ. (1992): Θεωρία Πιθανοτήτων, Εκδόσεις ΖΗΤΗ, Θεσσαλονίκη.
- Καλπαζίδου, Σ. (2002): Στοιχεία Μετροθεωρίας Πιθανοτήτων, Εκδόσεις ΖΗΤΗ, Θεσσαλονίκη.


Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Biostatistics I (code: 6246)**

Course Type: Elective

Course level: First cycle

Instructor: Assistant Professor N. Demiris, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** At the end of the course students will: Be familiar with the basic types of medical research. Be able to read a medical study and the corresponding scientific publication. Be able to perform basic analysis of medical data. The course motivates students to continue their studies in Biostatistics and to engage in the field.

**Prerequisites:** none

**Syllabus:** Basic principles of epidemiology, morbidity and risk measures, odds ratio, diagnostic tests (Mantel-Hanzel, ROC curves, sensitivity – specificity), case control studies, introduction to clinical trials, sample size estimation, principles of epidemic models, Infectious disease control.

**Recommended Reading**

- Pagano M. και Gauvreau, K. (2000). Αρχές Βιοστατιστικής. (μτφ. Ρ.Δαφνή) Εκδόσεις ΕΛΛΗΝ Περιστέρι.
- Ιωαννίδης, Ι (2000) Αρχές Αποδεικτικής Ιατρικής: Επιδημιολογία, Δημόσια Υγιεινή, Μέθοδοι Έρευνας, Εκδόσεις Λίτσας, Αθήνα.
- Ντζούφρας Ι. (2010). Εισαγωγή στη Βιοστατιστική και την Επιδημιολογία. Διδακτικές Σημειώσεις. Τμήμα Στατιστικής, Οικονομικό Πανεπιστήμιο Αθηνών [διαθέσιμες μέσω http://eclass.aueb.gr ]
- Δεμίρης Ν. (2012). Εισαγωγή στα Επιδημικά Μοντέλα. Διδακτικές Σημειώσεις. Τμήμα Στατιστικής, Οικονομικό Πανεπιστήμιο Αθηνών [διαθέσιμες μέσω http://eclass.aueb.gr]
- Rosner, B. (2010). Fundamentals of Biostatistics. 7th International edition, Brooks/Cole – Νέαέκδοσηπροσεχώς.
- DiekmannO., Heesterbeek, J.A.P. and Britton, T. (2012). Mathematical tools for understanding infectious disease dynamics. First edition, Princeton University Press.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Tutorial. Assignments. Self-Study. Screenings of films relative to the course and exercises/ tasks based on them. Sometimes we also have guest graduates to talk about their career and about problems and methodologies they face in their work.

Student Assessment Method: Written exam at the end of the semester. Open questions. Problem Solving. Home assignment. Lab exercises. Practical exercises.

Teaching Language: Greek.

**Official Statistics (code: 6114**)

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor A. Livada, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** After successfully completing the course, students will be able to understand the basic concepts and principles of international and National official statistics. They will also be able to know the basic concepts and principles of constructing, estimating and using index numbers.

**Prerequisites:** none

**Syllabus:** Introduction, indices, simple and complex numbers, simple size indices, individual indices behavior, base, base change, unifying indices time series, errors, heterogeneity, sampled indices in Greece, indices as random variables.

Family budget surveys, Metadata. Describing and using data and surveys by EUROSTS, OECD, UN, etc.

**Recommended Reading**

- Τζωρτζόπουλος Π., Α Λειβαδά (2011) «Αριθμοδείκτες Και Επίσημες Στατιστικές», Οικονομικό Πανεπιστήμιο Αθηνών, Αθήνα.
- OECD (2008) "Handbook on Constructing Composite Indicators – Methodology and User Guide".

Teaching Method: Face to Face.

Teaching includes: Class lectures. Seminars. Field exercise. Bibliography study and analysis. Interactive teaching. Scientists' lectures. Educational Visits. Conducting a study. Assignments. Self-study.

Student Assessment Method: Written exam with open notes at the end of the semester. Open questions. Problem solving. Project and project presentation. Practical exercises.

Teaching Language: Greek.

**Numerical Methods in Statistics (code: 6115)**

Course Type: Elective

Course level: First cycle

Instructor: Professor A. Yannacopoulos, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** At the end of the course the student should be able to: use a pc to perform statistical inference. Write basic programs in R to apply statistical inference. Analyze data using computational methods and approaches.

**Prerequisites:** None

**Syllabus:** General principles of arithmetic calculations and basic tools in estimating accuracy of said calculations. Arithmetical solving of one variable functions. Bisection methods. Point method. Newton method. Secant method, False position method. Function approximation. Function approximation using least squares. Interpolation and multinomial function approach. Orthogonal polynomials and applications. Curve fit. Spline functions. Approximation using kernels. Arithmetical linear algebra. Direct methods. Linear systems stability. Matrices factorization, special matrices. LU decomposition, the Cholesky decomposition. Iterative methods of solving linear systems. The Jacobi method, the Gauss-Seidel method and its variants, general iterative method. Special linear systems. Numerical solving of nonlinear systems. Point method for multiple variable functions, Newton method in the multidimensional case. Numerical integration and differentiation methods. Taylor series approach. Monte Carlo integration. Numerical differentiation. Calculating derivatives using interpolation polynomials. Numerical optimization methods. Typical optimization problems, using LaGrange method of multipliers in optimization theory and the Karush–Kuhn–Tucker conditions (KKT). The Steepest Descent method, the Newton method for solving optimization problems with or without equality constraints. Interior point methods – central path method and using bounded functions for solving optimization problems with mixed constraints. Principles of simulation and random search algorithms. Basic idea of global optimization methods. Simulated Annealing algorithmic method. The EM algorithm and its variations.

**Recommended Reading**

- Burden, R., Faires, J., (2010). Numerical Analysis. Cencage Learning.
- Chapra, S., Canale, R. (2016). Αριθμητικές Μέθοδοι για Μηχανικούς. Εκδόσεις Τζιόλα.
- Gentle, J. (2009). Στοιχεία Υπολογιστικής Στατιστικής. Εκδόσεις Παν. Μακεδονίας.
- Lange, K. (2010). Numerical Analysis for Statisticians. Springer.
- Monahan, J. F. (2011). Numerical methods of statistics. Cambridge University Press.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutoring.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

## 4th YEAR

### Z' Semester

**Econometrics (code: 6175)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor I. Vrontos, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** Upon successful completion of the course students will be able to: know, identify, control and suggest ways to deal with violations of classical hypotheses of the classic linear multivariate regression model: autocorrelation - heteroscedasticity and multilinearity using linear algebra. Also, they will be able to assess what is, when they are used, under which conditions and how they are estimated: the simultaneously determined regressions – Systems of interdependent variables, the structural and reduced models and the Seemingly Unrelated Regression Equation Systems. Applications using Eviews (educational version).

**Prerequisites:** Regression and Introduction to economic analysis

**Syllabus:** Introduction to econometrics. Hypotheses and variable stability tests – Hypotheses violations (using linear algebra). Systems of Codependent Variables, Structural – Reduced, Financial systems: Concept – Interpretation – Estimation. Consequences of ignoring explanatory variables endogeny. Identifying the parameters of structural equations/ regressions of a system: Identification conditions. The case of under-identification and over-identification.

Estimating structural parameters with Indirect Least Squares Method (ILS) – Instrumental Variables Method (IV) – 2SLS – 3SLS.

Seemingly Unrelated Regression Equation Systems (SURE): Estimation, Parameter Heterogeneity Test, models PANEL. Applications with economic data using Eviews.

**Recommended Reading**

- Τζαβαλής Η., (2008). «Οικονομετρία», Εκδόσεις Οικονομικού Πανεπιστημίου Αθηνών.
- JohnstonJ., DinardoJ., Οικονομετρικές Μέθοδοι, Εκδόσεις Κλειδάριθμος ΕΠΕ, 2005.
- Δριτσάκη Ν. Χάιδω, Δριτσάκη Ν. Μελίνα (2013) "Εισαγωγή στην Οικονομετρία με τη Χρήση του Λογισμικού EViews" Εκδ. Κλειδάριθμος.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Seminars. Field exercise. Studying and analyzing Bibliography. Interactive teaching. Scientists' lectures. Educational visits. Assignment. Self-study.

Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Open questions. Problem solving. Project and public presentation. Practical exercises.

Teaching Language: Greek.

**Stochastic Processes II (code: 6057)**

Course Type: Elective

Course level: First cycle

Instructors: Professors E. Kyriakidis, - M. Zazanis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After successfully completing the course, students will be able to identify basic concepts of Stochastic Processes theory (martingale, Markov processes in continuous time and discrete and continuous state spaces, birth – death processes, infusion processes), to model and solve problems that require these techniques. They will be able to apply fundamental techniques from this theory focused on future applications in statistics and various cognitive objects related to economic sciences, finances, the environment and contemporary technologies.

**Prerequisites:** none

**Syllabus:** Markovian processes in continuous time and discrete state space. Generators, forward and backward Kolmogorov functions. Calculating transition probabilities. Birth – death processes and applications. Markjovian processes in discrete time with continuous state spaces.

Martingales in discrete time, stopping times, filtrations (intuitive). Optional Stopping Theorem. Stochastic procedures in continuous time. Brownian motion and its properties. Geometric Brown motion and the Ornstein-Uhlenbeck process. Gaussian processes. Introduction to the stochastic integral. Simulating stochastic processes. Applications in economics, finance, environment and contemporary technologies.

**Recommended Reading**

- Κουμουλλής Γ. Χ., Νεγρεπόντης Σ., Θεωρία Μέτρου, Εκδόσεις Συμμετρία, 2005.
- Karlin S., Taylor H. M. (1981). A second course in stochastic processes, Academic Press.
- Rogers L. C., Williams D. (2000). Diffusions, Markov processes and Martingales:Volume I, Foundations. Cambridge University press.
- Revuz D., Yor M. (2004). Στοιχηματικές στοχαστικές διαδικασίες συνεχούς χρόνου και κίνηση Brown (ελληνική μετάφραση), Leaders Books.
- Χρυσαφίνου Ουρανία (2008) Εισαγωγή στις Στοχαστικές Ανελίξεις. Εκδόσεις Σοφία.
- Karlin S. and H. Taylor (1975). A First Course in Stochastic Processes, Academic Press.
- Grimmett, G.R. and D.R. Stirzaker (2001). Probability and Random Processes. Oxford University Press.
- Steele, M.J. (2001). Stochastic Calculus and Financial Applications. Springer.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Studying and analyzing bibliography. Self-Study. Simulation lab session.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Methods of Statistical and Machine Learning (code: 6127)**

Course Type: Elective

Course level: First cycle

Instructor: Assistant Professor X. Penteli, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** Upon completion of the course students will be able to: apply contemporary statistical methods using the R software to analyze large volumes of data, chart and understand relationships in the data, find groups of observations, create classification rules, apply methods and work with large data sets. At the end of the course, students will be able to construct graphs and understand relationships between data, identify observation clusters in the data, be able to build classification rules.

**Prerequisites:** Understanding subjects related to Statistical Inference, Distribution Theory and Linear Algebra will be useful.

**Syllabus:** Distinguishing statistical learning methods as supervised and unsupervised and determining the type of statistical problems they treat, the concept of distance in Statistics, Clustering (K-means, Hierarchical clustering, Model-based clustering), Classification (LDA, QDA, K-nearest neighbors, Fisher's discriminant analysis). Resampling methods (cross-validation, bootstrap), linear model selection and regularization (subset selection, shrinkage, dimension reduction), multinomial regression, step functions, regression splines, tree methods, support vector machines, neural networks.

**Recommended Reading**

- Bartholomew D.J., Steele F., Moustaki I., Galbraithe J.I., Ανάλυση Πολυμεταβλητών Τεχνικών στις Κοινωνικές Επιστήμες, Εκδόσεις Κλειδάριθμος ΕΠΕ, 2011.
- Ιωαννίδης Δ., Αθανασιάδης Ι., Στατιστική και Μηχανική Μάθηση με την R, Εκδόσεις Τζιόλα, 2017.
- Rajaraman A., Ullman D.J., Εξόρυξη από Μεγάλα Σύνολα Δεδομένων, Εκδόσεις Νέων Τεχνολογιών, 2014.
- Sidney B., Everitt, Casella G., Fienberg, S., Ingram O., An R and S-PLUS Companion to Multivariate Analysis, Springer-Verlag London Limited, 2005.
- Hastie, Tibshirani and Friedman (2009) Elements of Statistical Learning, 2nd edition Springer
- James, Witten, Hastie and Tibshirani (2011) Introduction to Statistical Learning with applications in R, Springer
- B. S. Everitt, S. Landau, M. Leese, and D. Stahl (2011) Cluster Analysis, Fifth Edition, Wiley

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Studying and analyzing bibliography. Tutorial. Assignments.

Student Assessment Method: Written exam at the end of the semester. Oral exam. Written exam (Project).

Teaching Language: Greek.

**Biostatistics II (code: 6118)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor P. Besbeas, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** Upon successful completion of the course, students will: Know and understand Survival Analysis. Have acquired knowledge about theory and methods. Practical skills for survival data analysis. Basic and transferable skills for Medical Statistics and Biostatistics.

**Prerequisites:** none

**Syllabus:** Survival data and their properties. Survival time functions (survival function, risk function, average residual life) and their interrelationships. Survival time parametric models examples: Exponential, Weibull, Log-logistic etc.). Nonparametric survival analysis, estimating functions methods: Product-Limit (Kaplan-Meier) and Nelson-Aalen estimators. Standard errors, types of confidence intervals (plain, log, cloglog) and inference. Methods of comparing survival function: Logrank test and generalizations. Extension to more than two samples.

Parametric survival analysis: Distribution fitting with the maximum likelihood method. Hypothesis testing, asymptotic theory, types of confidence intervals and inference. Generalization for two samples. Survival analysis with instrumental variables: Cox's model of analog risks, partial likelihood and inference. Accelerated Failure Time model. Model interpretation through Bayesian examples. Survival analysis and frailty. Introduction to clinical trials. Designs (parallel, crossover, cross-sectional, etc.). Sample size and power. Treatment allocation randomization, adjustable designs. Meta-analysis.

**Recommended Reading**


- Μπερσίμης Σ., Σαχλάς Α., Εφαρμοσμένη Στατιστική με έμφαση στις Επιστήμες Υγείας, Εκδόσεις Τζιόλα, 2016.
- Μπερσίμης Σ., Σαχλάς Α., Εφαρμοσμένη Στατιστική με χρήση του IBM SPSSStatistics 23, Εκδόσεις Τζιόλα, 2016.
- PetrieA., SabinC., Ιατρική Στατιστική με μια ματιά, Εκδόσεις Παρισιάνου Α.Ε., 2015.
- PaganoM., GauvreauK., Αρχές Βιοστατιστικής, Εκδόσεις Έλλην, 2002.
- Ιωαννίδης Ι., Αρχές Αποδεικτικής Ιατρικής, Ιατρικές Εκδόσεις Λίτσας, 2000.
- Μπεσμπέας (2015) Ανάλυση Επιβίωσης. Σύγγραμμα (150 σελ.).
- Rosner, B. (2010). Fundamentals of Biostatistics. 7th International edition, Brooks/Cole – Νέα έκδοση θα βγει σύντομα.
- Armitage, P., Berry, G. and Mathews JNS (2002). Statistical Methods in Medical Research. 4th Edition. Blackwell Science.
- Hosmer, D. W., Lemeshow, S. and May S. (2008). Applied Survival Analysis: Regression Modeling of Time to Event Data, Second Edition, Wiley-Blackwell.
- Friedman L.M., Furberg C.D. and DeMets, D.L. (2010). Fundamentals of Clinical Trials. 4th edition, Springer.
- Collett D. (2003). Modelling survival data in medical research, Second edition. Chapman and Hall.
- J.F. Lawless (2002). Statistical Models and Methods for Lifetime Data, Second Edition. Wiley.
- D.R. Cox and D. Oakes (1984). Analysis of survival data. Chapman and Hall.
- S. Piantadosi (2005). Clinical Trials: A Methodological Perspective Second Edition. Wiley.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Tutorial. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Actuarial Science II (code: 6124)**

Course Type: Elective

Course level: First cycle

Instructor: Assistant Professor A. Zympidis, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** At the end of the course, students can deal with the main problems of pricing and storage of life insurance policies.

**Prerequisites:** none

**Syllabus:** Simple mortality matrix and relative functions. Force of mortality, classic mortality laws, actuarial tables and commutation functions, stochastic approach to life insurance. Types of personal insurance, actuarial present values, present values variances and covariances. Types of annuities, actuarial present values and annuities variances, relations between annuities and insurance policies. Insurance (annual, united, payable in installments), approximate relationships between different types of insurance. Recursive and differential relationships for insurances and annuities. Mathematical stocks of all types, differential equations and approximate relations, alternative reserving methods (stochastic and non-stochastic), Joint life and death probability, "multiple head" insurance and annuities, common insurance for Gompertz and Makeham cases, as well as under the assumption for uniform distribution of deaths (UDD). Matrices with multiple output causes, multiple situations standards, disability standards and Markov methods. Retirement models.

**Recommended Reading**

- Ζυμπίδης Α.(2009), Αναλογιστικά Μαθηματικά Ασφαλίσεων Ζωής
- Ζυμπίδης Α. (2008) Συνταξιοδοτικά Ταμεία & Αναλογιστικές Μελέτες
- Neil A. (1986), «Life Contingencies» Heinemann Professional Publishing
- Etienne De Vylder (1997), "Life insurance: Actuarial Perspectives", Kluwer Academic Print
- David C. M. Dickson, Mary Hardy, Mary R. Hardy, Howard R. Water. (2013) Actuarial Mathematics for Life Contingent Risks. Cambridge University Press, 2013
- Arthur W. Anderson (2006) Pension Mathematics for Actuaries, ACTEX Publications

Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Methods of Bayesian Inference (code: 6168)**

Course Type: Elective

Course level: First cycle

Instructor: Assistant Professor P. Papastamoulis, Department of Statistics

E.C.T.S.: 7

**Desired Learning Outcomes:** After successful completion of the course the students should be able to:

- Understand the differences between classic and Bayesian approach
- Know the basic principles of the Bayesian approach
- Apply contemporary Bayesian analysis methods to real problems
- Know the tools that will assist them in implementing these analyses

**Prerequisites:** none

**Syllabus:** Repetition of the basic principles of Bayesian inference. Markov chain, Monte Carlo and its use in Bayesian Statistics. Variations of this method and extensions. Building algorithms MCMC in R. Bayesian regression. Bayesian models using R and WinBUGS. Deviance information criterion and model

complexity. Hierarchical models. Basic principles of Bayesian hypothesis testing, comparing and weighing models.

**Recommended Reading**

- Ntzoufras, I. (2009). Bayesian Modeling Using WinBUGS. Wiley. Hoboken. USA.
- Carlin B. and Louis T. (2008), Bayes and Empirical Bayes Methods for Data Analysis. 3rd Edition, London: Chapman and Hall.
- Gelman A., Carlin J.B., Stern H.S., Dunson, D.B., Vehtari, A. and Rubin D.B. (2013). Bayesian Data Analysis. Third Edition. Chapman and Hall/CRC.

Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

## H' Semester

**Categorical Data Analysis (code: 6108)**

Course Type: Elective

Course level: First cycle

Instructor: 6178

E.C.T.S.: 8

**Desired Learning Outcomes:** At the end of the course, students are expected to know how to quantify different dependency forms between two or more categorical data (knowledge), to control which form of dependency appears to apply to a particular set of data (aptitude), to fit logistic regression models and to interpret the results of their data fit (capability).

**Prerequisites:** none

**Syllabus:** Types of categorical data. Contingency tables, joint, marginal and conditional probabilities, independence, comparison of proportions in 2x2 contingency tables (difference of proportions, relative risk, odds ratio), types of observational studies (retrospective, cross-sectional, prospective), odds ratio and other measures of correlation in LxJ tables. $\chi^{2\ test}$ of independence, exact tests, partition of the statistical function $\chi^2$, test of independence for ordinal data, tests of linear trend for 2xL tables. Correlated data pairs, comparison of correlated proportions, Mc Nemar test for comparison of marginal proportions, measures of raters' agreement, odds ratio for agreement, kappa measure of agreement. Correlation in multidimensional contingency tables, conditional and marginal odds ratios, Simpson's paradox, partial-conditional independence, homogeneity, collapsibility, Cochran-Mantel-Haenszel tests. Logistic regression, interpretation of model parameters, inference in logistic regression, the case of categorical predictive variables, multiple logistic regression, model selection, test of goodness of fit. Models of logistic regression for polytomous variables.

**Recommended Reading**

- Agresti A., (2013). Categorical data analysis, Wiley
- Agresti A., (2007). An Introduction to Categorical Data Analysis, Wiley.
- Hosmer, D., Lemeshow, S. and Sturdivant, R. (2013) Applied Logistic Regression, Wiley
- Kateri, M. (2014). Contingency Table Analysis, Springer.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Studying and analyzing bibliography. Assignments. Self-Study.

Student Assessment Method: Assignment. Written exam at the end of the semester.

Teaching Language: Greek.

**Advanced Sampling Methods (code: 6128)**

Course Type: Elective

Course level: First cycle

Instructor: Contract Instructor

E.C.T.S.: 7

*Not offered during the winter semester of the academic year 2023-24.*

**Desired Learning Outcomes:** Upon successful completion of the course, students will be able to recognize the type of statistical problems in real-time sample surveys as well as to select and apply the appropriate, by case, methodology. They will also have the ability to evaluate the quality of the results of the selected method.

**Prerequisites:** Basic knowledge of Statistics

**Syllabus:** Statistical theory of finite populations: populations, sub-populations, variables, parameters. Random sampling, probabilities of selection of units. Sampling with unequal probabilities, sampling weights, selfweighting and nonselfweighiting sampling. Randomization in finite populations, estimation of finite population parameters and calculation of estimators' variances. Design effect. Estimation for sub-populations. Estimation of the distribution function. Graphics for survey data. Estimation for population size and rare populations.

Use of auxiliary information in estimation: Method of generalized regression (ratio estimator, regression estimator, poststratified estimator). Optimal regression estimator. Calibration.

Variance estimation in complex surveys. Resampling methods (random groups, jackknife, bootstrap).

Treatment of non-sampling errors. Methods of adjustment for non-response. Imputation.

**Recommended Reading**

- Lohr, S. (2010) Sampling: Design and Analysis. 2nd Edition. Brooks/Cole. Sengage learning.
- Sarndal, C-E., Swensson , B., Wretman , J. (1992) Model assisted survey sampling. Springer.

Teaching Method: Face to Face.

Teaching includes: Class lectures. Lab exercise. Self-Study.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Statistical Methods for the Environment and Ecology (code: 6058)**

Course Type: Elective

Course level: First cycle

Instructor: Associate Professor P. Besbeas, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** After successfully completing the course, students should be able to: distinguish between deterministic and statistical criteria for weighing/ evaluating environmental contamination, apply contamination weighing criteria in stochastic models of enumerating violations of contamination threshold, compare the compatibility between keeping the statistical criterion and probability of violating the corresponding contamination threshold, determine the (spatial and temporal) distribution of pollutants concentration (produced at a constant rate at a constant source) based on a stochastic model of molecular diffusion – transmission of the pollutant to the environmental medium, determine probability distribution for pollutant concentration in a fixed point in space based on the theory of consecutive stochastic diffusions, apply stochastic models of population dynamics in estimating the population size based on sampling data with various methods (inventory, survival, distance, retrieval).

**Prerequisites:** Probability I, Probability II, Stochastic Procedures I

**Syllabus:** General overview of topics and problems of interest in environmental statistics and ecology. Criteria of weighing environmental pollutants. Applications of stochastic models in checking the keeping or violation of weighing criteria. Statistical analysis and modeling of extreme values (for example, exceeding the pollutant concentration threshold). Natural process of pollutant diffusion and dilution, and the Plume model of spatial and time distribution of pollutant concentration. The theory of stochastic dilution and asymptotic lognormal diffusion processes for modeling point concentration of pollutants. Introduction to spatial statistics methods, models and estimating the function of spatial scatter (variogram) and the Kringing regression.

Data types from studies of biological organizations and examples. Preliminary analysis of characteristic data sets. Special characteristics of sample distributions and the appropriate models, such as truncated, inflated, mixed. Overdispersion, underdispersion and appropriate models. Individual heterogeneity models. Model fit using maximum likelihood through arithmetic methods and the use of statistical packages (R). Estimating population size and variance. Methods of census and distance sampling. Capture – Recapture methodologies for closed and open populations. Ecological time series and their characteristics. Stochastic models of population dynamics: state – space models and models for simultaneous analyses of survival and census. Examples and applications.

**Recommended Reading**


- Ott, W. R. (1995): Environmental Statistics and Data Analysis, CRC Press, Inc.
- Barnett, V. (2004): Environmental Statistics: Methods and Applications, Wiley.
- Le, N.D. and Zidek, J.V. (2006): Statistical Analysis of Environmental Space-Time Processes, Springer.
- Williams, K., Nichols, J. and Conroy, M. J. (2002): Analysis and Management of Animal Populations. Academic Press, San Diego, California.
- Μπεσμπέας, Π. (2010): Στατιστικές Μέθοδοι στην Οικολογία, Πανεπιστημιακές Σημειώσεις
- Καρανδεινός Γ. Μ. (2007): Ποσοτικές Οικολογικές Μέθοδοι, Πανεπιστημιακές Εκδόσεις Κρήτης
- Σαϊτάνης Κ., Καρανδεινός Γ.Κ. (2010): Πληθυσμιακή οικολογία - δυναμική πληθυσμών. Έμβρυο.


Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Non-Parametric Statistics (code: 6113)**

Course Type: Elective

Course level: First cycle

Instructor: Contract Instructor

E.C.T.S.: 8

*Not offered during the winter semester of the academic year 2023-24.*

**Desired Learning Outcomes:** At the end of the course students will be able to: Understand the non-parametric methods described and their properties. Apply these methods in real data analysis and correctly interpret the results.

**Prerequisites:** none

**Syllabus:** Nonparametric density estimation, histograms, Nadaraya-Watson estimator: bias, variance, tradeoff between them and bandwidth choice: plug in and cross-validation methods. Nonparametric regression: smoothing techniques. Estimator based on kernels (Nadaraya-Watson), asymptotic development of bias and variance, bandwidth choice, local polynomial regression and splines, variance estimation and confidence intervals. Generalized additive models (and regression trees). Empirical distribution function, empirical process, Kolmogorov –Smirnoff and similar tests. Statistics based on functional of the empirical distribution. Jacknife and Bootstrap: general principles, examples, parametric bootstrap, estimating parameter variance and bootstrap confidence intervals. Nonparametric tests based on ranks and concepts of robustness and asymptotic relative efficiency.

**Recommended Reading**


- Efron and Tibshirani (1998), An Introduction to the Bootstrap. Chapman & Hall.
- Fan, J. and Gijbels, I. (1996). Local polynomial modelling and its applications. Chapman & Hall.
- Fox, J. (2000). Nonparametric Simple Regression: Smoothing Scatterplots. Sage Publications.
- Hajek, J. (1969). A Course in Nonparametric Statistics. Holden Day.
- Hastie, T. J. and Tibshirani, R. J. (1990). Generalized Additive Models. Chapman and Hall.
- Hettmansperger, T. and McKean, J. (2011). Robust nonparametric Statistical Methods. Boca Raton: CRC/Taylor & Francis.
- Higgins, J. J. (2004). Introduction to Modern Nonparametric Statistics. Thomson/Brooks/Cole, New York.
- Hollander, M. and Wolfe, D. A., (1999). Nonparametric Statistical Method. Wiley.
- Shao and Tu (1995), The Jackknife and the Bootstrap, Springer.
- Sidak, Z., Sen, P. K. and Hajek, J. (1999). Theory of Rank Tests. Academic Press.
- Silverman, B.W. (1986). Density Estimation for Statistics and Data Analysis. Chapman and Hall.
- Wand, M. P. and Jones, M. C. (1994). Kernel Smoothing. Chapman and Hall.
- Wasserman, L. (2006). All of Nonparametric Statistics. Springer.
- Wood, Generalized Additive Models.Chapman and Hall.
- Ξεκαλάκη , Ε. (2001). Μη παραμετρική στατιστική.


Teaching Method: Face to Face.

Teaching includes: Class lectures. Tutorial. Assignments. Self-Study.

Student Assessment Method: Written exam at the end of the semester. Written Project.

Teaching Language: Greek.

**Special Topics in Statistics and Probability (STSP): Introduction to Measurement Theory with reference to Probability and Statistics (code: 6256)**

Course Type: Elective

Course level: First cycle

Instructor: St. Vakeroudis, Assistant Professor, Department of Statistics.

E.C.T.S.: 7

**Desired Learning Outcomes:** After successfully attending the course students will become familiar with the basic concepts of measure theory and integration and will be able to use some of its basic tools. Thus, they will be able to approach the techniques used in probability and statistics from a point of view of measurement theory, as well as the techniques of statistical/ mechanical learning.

**Prerequisites:** none

**Syllabus:** Sets and functions. Algebra and S-algebra of sets. Open, closed and solid subsets of the real numbers. Constructing the Lebesgue measure in real numbers. Measurable sets according to Borel and Lebesgue. The Cantor set and the Cantor function. Non-measurable sets according to Lebesgue.

Measurable functions according to Lebesgue. Borel Functions. Random variables. Sequences of functions and random variables and convergence concepts (almost certain, in measure).

The Lebesgue integral, construction and properties. Basic convergence theorems, (the Fatou Lemma, monotonous convergence theorem, dominated convergence theorem). Expected price. Convergence in distribution and applications in statistics (estimation, simulation, etc).

Lebesgue spaces of integrable functions and random variables and their structure as metric spaces. Holder and Minkowski inequities, the Beppo-Levi theorem and completeness. Convergence in Lebesgue spaces and applications. The case of L^2, its structure as a Hilbert space, the projection theorem and its relation to conditional mean value, bases and expansions (eg Karhunen-Loeve transform, etc.).

Product measure, construction and properties and relation to independence. Integration and product measure, Fubini theorem.

Absolute continuity and measure singularity. Hahn-Jordan decomposition. Radon-Nikodym derivation. Measure space as an extension of the functions. Applications in statistics (the conditional average value under a new prism, likelihood, extreme event simulation, consistency) in finance.

Measure space as a metric space and applications. Total change distance, Helinger distance, Kuhlback-Leibler distance (entropy), transportation distance. Applications in model selection statistical and machine learning, etc.

**Recommended Reading**


- Athreya, Krishna B., and Soumendra N. Lahiri. Measure theory and probability theory. Springer Science & Business Media, 2006.
- Billingsley, P. 2008. Probability and measure. John Wiley & Sons.
- Capinski, M., & Kopp, E., (2003). Measure, Integral and Probability. Springer-Verlag.
- Jacod, J., & Protter, P. E. (2003). Probability essentials. Springer Science & Business Media.
- Καλπαζίδου, Σ. (2002). Στοιχεία μετροθεωρίας πιθανοτήτων. Εκδόσεις ΖΗΤΗ.


Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Assignments. Written exam at the end of the semester and/ or assignment.

Teaching Language: Greek.

**Research Methodology (code: 6117)**

Course Type: Elective

Course level: First cycle

Instructor: E. Tsompanaki, Laboratorial Teaching Staff

E.C.T.S.: 7

**Desired Learning Outcomes:** Upon completion of the course, students should be able to:

- Read scientific announcements and understand the results as well as their validity.
- Be able to find information about data and methodologies needed for their analyses.
- Accurately designing surveys and all their individual features.
- Gain an understanding of a survey's validity and reliability.
- Be able to distinguish problematic from accurately designed surveys.
- Be able to correctly choose and apply statistical methodologies to address a research problem.
- Be aware of morality issues in research.

**Prerequisites:** none

**Syllabus:** Data collecting methods: contemporary methods, advantages and disadvantages. Error types. Questionnaire design. Building scales, scale types. Reliability indices. Examples of misuse of statistics, discussions on specific publications, building a questionnaire, research issues (introducing bias, etc.), report writing and presenting.

**Recommended Reading**

- Norman M. Bradburn, Seymour Sudman, Brian Wansink (2004) Asking Questions: The Definitive Guide to Questionnaire Design.
- Paul P. Biemer (2004) Measurement Errors in Surveys. Wiley.

Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Written exam at the end of the semester.

Teaching Language: Greek.

**Special Topics in Statistics and Probability (STSP): Decision Theory (code: 6178)**

Course Type: Elective

Course level: First cycle

Instructor: K. Bourazas, Contract Instructor

E.C.T.S.: 7

**Desired Learning Outcomes:** Upon successful completion of the course, student will be able to:

- Construct a table of financial outcomes in a decision problem with a finite number of different possibilities and decisions.
- Find the optimal decision based on the criterion of (i) maximize the minimum financial gain, (ii) maximize the maximum financial gain, (iii) the prevailing possibility, (iv) the Hurwicz index and (v) Bayes.
- Construct the table of loss of the chance of financial gain.
- Find the optimal decision based on the criterion of minimizing the expected loss of the chance of financial gain.
- Construct the table of financial outcomes with added information and find the optimal decision.
- Construct the decision tree.
- Locate the points of balance in a game, if there are any.

**Prerequisites**: none

**Syllabus:** Decision making under conditions of uncertainty. Calculating the financial outcomes for every combination of an act and a possible event. Decision criteria (criteria based exclusively on the possible financial outcomes). A priori decision-making analysis (Hurwicz alpha index, the Bayes criterion, expected value of complete information. Graphical analysis of decision-making problems. Point and possibility of indifference. The normal distribution in a priori decision making. The Bayes criterion and sensitivity analysis). Decision making and the theory of money utility. Constructing the money utility curve. Expected utility value as a decision criterion. Posterior analysis of decision making (utilization of additional information to improve decisions, creating the tree diagram). Pre-posterior analysis of decision making. Bayesian decision making and classic statistical induction. Introduction to game theory (complete and incomplete information games, two player zero sum games).

**Recommended Reading**

- Ευάγγελος Μαγείρου, Παίγνια και Αποφάσεις, Εκδόσεις Κριτική, 2012.
- Κ. Μηλολιδάκης, Θεωρία Παιγνίων, Εκδόσεις Σοφία, 2009.
- J. Q. Smith, Decision Analysis: A Bayesian Approach, Chapman and Hall, 1988.
- F. S. Hillier and G. J. Lieberman: Introduction to Operations Research, Mc GrawHill, 2005.

Teaching Method: Face to Face.

Teaching includes: Class lectures.

Student Assessment Method: Written exam at the end of the semester and/ or assignment.

Teaching Language: Greek.

**Bachelor Dissertation (code: 6907)**

Course Type: Elective

Course level: First cycle

Υπεύθυνος: Assistant Professor E. Ioannidis, Department of Statistics

E.C.T.S.: 8

**Desired Learning Outcomes:** At the end of the dissertation students will have extensive experience in using interdisciplinary knowledge in a particular area and will have improved his/her understanding of a research question or problem, the analysis and processing of the relevant evidence and other problem-solving techniques as appropriate.

**Prerequisites:**

**Syllabus** The opportunity to undertake a dissertation is available only in the 4th year of studies or later. To be eligible for this, students must have successfully completed all compulsory courses and must have achieved a minimum average grade of seven (7).

The work lasts one semester. A supervising Professor is assigned, as well as two other faculty members as examiners. The dissertation is presented on a specific day and time specified for all these within (or shortly before) the corresponding exam. The dissertation corresponds to 8 PM. (URL: https://www.dept.aueb.gr/en/stat/content/bachelor-dissertation).

**Practical Training (code: 6801)**

Course Type: Elective

Course level: First cycle

Coordinator: Professor D. Karlis, Department of Statistics

E.C.T.S.: 6-14

**Desired Learning Outcomes:** Upon completion of the practical training students will be able to:

- Know how they can deal with a statistical problem with real data.
- Be able to understand, explore and formulate a real problem of statistical content in the sense of statistical analysis.
- Know the role of a statistician in a company and the way of interacting with colleagues and function within a group.
- Understand time allocation when working on a project.
- Learn to handle various types of data, coming from different sources.
- Learn how to compile reports on the results of statistical analyses.
- Transfer theoretical knowledge to practical aspects.
- Acquire work experience and work skills while discovering the working environment.
- Learn how to write a CV and choose prospective employers/ work environment

**Prerequisites:**

Student must have

- Completed the $5^{th}$ semester
- Not have participated again in practical training
- Accumulated at least 80 ECTS's
- Successfully completed at least 8 compulsory courses
- Participated in a relevant informative session/seminar of the Practical Training office.

# PART 3
# GENERAL INFORMATION FOR THE STUDENTS

Athens University of Economics and Business provides not only high-quality education but also high-quality services. With the publication of the Presidential Decree 387/83 and the Law 1404/83, the operation, organization, administration of Student Clubs at Universities is designed to improve the living conditions of the students, to entertain them and promote their social and intellectual wellbeing with initiatives to engage in socialization.

To fulfill this objective the University ensures the required infrastructure funds for housing, procurement, sports, the operation of a restaurant, canteen, reading room, library, organizes lectures, concerts, theatrical performances and excursions inland and abroad, develops international student relations, holds classes for the teaching of foreign languages, computer science and Modern Greek as a foreign language for foreign students and provides any other means needed.

## 1. Cost of Living

The cost of living is determined by the current housing and feeding prices. This cost is reduced if students qualify for free accommodation and meals.

## 2. Housing

The Student Club of the Athens University of Economics and Business provides free accommodation to students, provided that they satisfy the necessary conditions, available in the Student Club's website. At the same time, the Student Club also has a Housing Finding Office, which collects ads for renting apartments.

## 3. Food Services

Located inside the main building of the University is a student refectory of the AUEB University Student Club, where all members of the University Community can eat meals, either free of charge or for a fee. Free meals are granted to those that meet the necessary conditions. For more information one can contact the Student Club office.

## 4. Medical Services, Insurance/ Healthcare

Undergraduate, postgraduate and PhD students of the University that have no other medical and hospital care are entitled to full care in the National Health System (ESY), with expenses covered by the National Health Services Provider (EOPYY). The infirmary is housed in the main building and operates on certain weekdays. The Psychiatric Counseling Service also operates at the University, where a physician specializing in the psychodynamic treatment of mental health issues is employed.

## 5. Services for students with special needs

The University ensures the facilitation of students with special needs through the design, implementation and application of adaptations to the university's environment for access to university buildings. In the main building there are specially designed lifts, ramps and elevators. There are also specific exam regulations for students with special needs.

Furthermore, the Library provides to students with vision impairments the possibility of electronic access to the suggested bibliography for their courses. In this context, the Link of Greek Academic Libraries (Σ. Ε. Α. Β.) has developed a multimodal electronic library named **AMELib**. To access this service, users must be authenticated and use a code and password. For more information visit the Library's webpage https://www.aueb.gr/en/library.

## 6. Financial Support

Undergraduate students of Higher Education Institutions and Higher Ecclesiastical Academies, Greek nationals or nationals of other European Union countries, are entitled to annual housing allowance in accordance with the terms and conditions set out in Joint Ministerial Decision 140832 / G1 / 25-8-2017 (FEK 2993 B / 31-8-2017).

Also, the State Scholarship Foundation (IKY) annually grants scholarships to students who exhibit excellent academic performance in their six-month courses and for achieving high entrance admission scores at the University. The Secretariats of the respective Departments shall notify the names of the Candidate Scholars and will set the deadlines for submitting their supporting documents.

In addition, the "George Halkiopoulos Foundation" operates at the University. It grants scholarships depending on the educational performance and the financial status of the candidates. In October of each academic year, the Foundation (Public Relations Department, ground floor building) announces the scholarship amount, as well as the manner and date of application for the interested parties.

Finally, other awards are granted occasionally by various Institutions, Organizations and Businesses. Information is provided by the Department of Education Department of Student Welfare (ground floor of the main building) and by the Secretariats of the Departments, as well as on the central AUEB website.

## 7. Office of Student Affairs – Faculty Advisors

At each department a faculty advisor is designated for each student, appointed by the Head of the Department, with the responsibility to guide and consult the student regarding their studies. If one of the advisors is on a leave, then a substitute is appointed by him/ her. In the case that a professor leaves the Department, the distribution of his students is the department's Head responsibility.

## 8. Study Centers – Reading Rooms – Libraries

The Library & Information Center (BCC) of the Athens University of Economics and Business was established in 1920 and operates on the first and second floor of the University's central building. It is part of the Hellenic Academic Libraries Association (Heal-LINK), the European Documentation Centers Europe Direct and the Economic Libraries Cooperation Network (DIOB).

Three (3) Documentation Centers operate within the library:

- The European Documentation Center (KET) since 1992,
- The Organization for Economic Cooperation and Development (OECD) Documentation Center since 1997,
- The Delegation Center of the World Tourism Organization (WHO) hosting publications since 2004.

The Library contributes decisively both to meeting the needs for scientific information of the academic community and to supporting teaching and research work. This is achieved through the unified organization of collections and the coordination of the provided services. The Library provides access to:

- the printed collection of books and scientific journals,

- courses textbooks,
- collection of electronic scientific journals,
- e-books collection,
- the postgraduate theses and doctoral theses produced in AUEB 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),
- Collection of official governmental publications of the European Union, the OECD and the WCO
- databases on the issues cultivated by the University,
- printed collections of other academic libraries.

The Library lends to its members all its printed collections, except for magazines and statistical series, in accordance to its internal rule of operation. The Library has a reading room, computer workstations for visitors, photocopiers and printing machines, and provides the opportunity to interlibrary loan books and magazine articles from other academic libraries that are members of its network.

## 9. International programs and practical information on international student mobility

AUEB is actively involved in the Erasmus+ Program by promoting cooperation with universities, businesses and international organizations of the European Union (EU) as well as the mobility of students, teaching and administrative staff. Within the framework of this Program, the University collaborates with more than 220 European Institutions on subjects relative to its Departments. More than 7000 students have participated so far in the Erasmus Program.

Of these, approximately 4,000 AUEB students have attended courses at Associate Universities in Europe and about 3,000 foreign students who have completed a period of study at AUEB ensure accreditation through the Credit Transfer and Accumulation System (ECTS).

In addition, the Foundation co-ordinates the Erasmus+ Practical Training Group with partners from the National Technical University of Athens and the Universities of Crete, Ioannina and Macedonia, offering the possibility of practical training for students and the ability of teaching/education to faculty members.

Finally, AUEB, adopting the internationalization and extroversion strategy, has been successfully participating in the International Credit Mobility Program with the aim of developing international collaborations in education and research with partner Universities in countries outside the EU via: a) student mobility; b) short-term teaching staff mobility and c) teaching and administrative staff training mobility. The Program was first implemented in the academic year 2015-2016 and to date there have been 52 students and staff members moving from and to 8 Partner Institutions in countries outside the EU. (USA, Canada, Singapore, Russia, South Korea, Armenia). More information can be found on the Foundation's homepage (https://www.aueb.gr/en/erasmus).

## 10. Language lessons

Knowledge of foreign languages, as a universally accepted educational value, is a necessary resource for effective individual involvement in the sophisticated social reality. The Student Club, understanding this modern educational necessity, offers the opportunity to every university and technical university student, as well as to all those who are interested, to attend relevant seminars. Seminars are held in English, French, German, Spanish, Italian and Russian, and new language seminars are available if there is a similar interest.

## 11. Practical Training

The mission of the Central Office of Practical Training is to promote, in the best possible way, the linking of theory to practice and the smooth transition of the students from academic to professional life. Practical Training is an integral component of education at the Athens University of Economics and Business, as all its Departments have instituted and included it in their curriculum. The duration is 2 to 4 months and is mainly implemented in three periods (winter semester, spring semester and summer season). Preparatory seminars are conducted prior to each internship period. Information: 13 Elpidos street, 3rd floor.

## 12. Sports Facilities

The Athens University of Economics and Business organizes a variety of sports activities. It has a long history in sports accompanied with a multitude of distinctions, medals, trophies and prizes in national and international competitions. In order to continue to provide complete education to its students, the Athens University of Economics and Business collaborates with the City of Athens' Cultural, Sports and Youth Organization and uses its sports facilities, located at 10 Pasov Street, Grava, Ano Patissia (indoor swimming pool, indoor basketball and volleyball court), open athletics course at the Ermonassis & Pityountos - Thermis junction (5x5 open soccer field) and at the Mitsakis & Polyla junction - Ano Patissia (open air tennis court).

The teaching of Physical Education courses at the Physical Education Department of AUEB follows the curriculum for the teaching of academic subjects. It begins in winter semester and ends at the end of the spring semester. It is worth noting that students have the right to attend Physical Education courses up to six months after receiving their Diploma. The Department of Physical Education of the Athens University of Economics and Business is staffed by well-trained Physical Education Teachers and by specialized temporary teaching staff.

## 13. Student Clubs

Various Student Organizations and Clubs operate in the academic community of the Athens University of Economics and Business. More information can be found on AUEB's website (https://www.aueb.gr/en/content/student-clubs).

## 14. Career Office

The Office's main task is to assist University students and graduates to join the labor market and guide them for postgraduate studies. The Career Office assists students and graduates in their first steps to find work by: (a) communicating available positions and promoting CV's to collaborating businesses and organizations, (b) organizing Occupational Orientation Days where students and graduates get the chance to meet and discuss with businesses and other organizations representatives, (c) organizing seminars concerning the job interview procedure, as well as presentations of the current trends in the job market, (d) providing printed and electronic material with directions on how to write the cv and the cover letter, as well as advises for job interviews, (e) giving the chance to students and graduates to talk with consultants for career or educational issues and to use the special psychometric tests .

The office also provides extended information for AUEB's undergraduate and postgraduate programs, other Greek and international postgraduate programs, scholarships and Greek businesses.

The Office publishes informational brochures and organizes informative events. It also runs regular visits of high school students to the University's premises. In addition, the Office maintains a database of graduate employment data and job positions to provide an insight into the labor market's supply and demand. The Office also cooperates with The Athens Center for Entrepreneurship and Innovation.

## 15. Unit of Innovation and Entrepreneurship

The Unit of Innovation and Entrepreneurship's task is to encourage innovative thinking and foster entrepreneurship in the AUEB community, to support the students and the wider public interested in entrepreneurship, to understand requirements and organize new innovative business endeavors. For that reason:

- The Unit's website provides direct and continuous access to relevant information, knowledge and practical tools to encourage creativity and to provide the means for managing innovation and organizing successful business efforts.
- The Unit's helpdesk is available for direct personal communication, information and problem solving.
- The Professors and collaborating Partners of the Unit actively create and provide educational materials. These materials include detailed instructions and information that reflect the latest developments across various scientific fields.
- The Unit supports teaching of entrepreneurship courses by providing teachers with contemporary material and relevant tools.
- The Unit organizes open events, seminars and visits to courses, thus providing the opportunity of direct contact with successful entrepreneurs and prominent executives, in order to improve students' understanding by reducing the distance between theoretical training and the practical application of their ideas.
- The Unit closely cooperates with the Advisory Steering Committee, providing the opportunity to enhance educational activities and provide practical knowledge to students, with the assistance of specialized teachers and executives.

The Unit also provides support for the start-up of new business groups through the services of the ACEin Center (Athens Center for Entrepreneurship (https://acein.aueb.gr/en/).