

**ΟΙΚΟΝΟΜΙΚΟ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΑΘΗΝΩΝ**



ATHENS UNIVERSITY
OF ECONOMICS
AND BUSINESS

SCHOOL OF INFORMATION SCIENCES AND TECHNOLOGY

DEPARTMENT OF STATISTICS

MSc. in APPLIED STATISTICS

**STUDY GUIDE
ATHENS, ACADEMIC YEAR 2021-22**

PART I: INFORMATION ABOUT THE INSTITUTION

CONTACT DETAILS (Name & Address)

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS (AUEB)

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

Telephone number: +30-210-8203911

Website: <https://www.aueb.gr> e-mail: webmaster@aub.gr

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

Twitter: <https://twitter.com/aueb>

Linkedin: <https://www.linkedin.com/school/athens-university-of-economics-and-business/mycompany/>

Youtube: <https://www.youtube.com/channel/UCPncunqp3bMuAHHeCikhalg>

Instagram: <https://www.instagram.com/aueb.gr/>

ACADEMIC AUTHORITIES

The rectorate authorities consist of the Rector and the Vice Rectors, as per below:

Rector:

Professor Dimitris Bourantonis

Vice Rectors:

Vice Rector of Academic Affairs and Personnel

Professor Vasilios Vasdekis

Vice Rector of Research and Lifelong Learning

Associate Professor Georgios Lekakos

Vice Rector of Financial Planning and Infrastructure

Professor Konstantinos Drakos

Vice Rector of International Cooperation and Development

Professor Vasilios Papadakis

School of Information Sciences and Technology

Dean Professor Georgios Stamoulis

Department of Statistics

Chair Professor Ioannis Ntzoufras

Master's Program

Director Professor Stylianos Psarakis

Contact details

Address: 47A Evelpidon & 33 Lefkados Street, Athens, 113 62, Greece

Telephone number: +30 210 82 03 681

Email: masterst@aub.gr

Website: <https://aub-analytics.wixsite.com/msc-stats/>

ACADEMIC CALENDAR

FALL SEMESTER

| | |
|----------------------------------|-------------------|
| Classes begin: | October 4, 2021 |
| Break before Christmas Holidays: | December 23, 2021 |
| Classes restart: | January 10, 2022 |
| Classes end: | January 25, 2022 |

Exam period January-February 2021

| | |
|-----------------|-------------------|
| Start of Exams: | January 31, 2022 |
| End of Exams: | February 25, 2022 |

Holidays

October 28, 2022: Holiday - The Anniversary of the “No”
November 17, 2022: The Anniversary of Polytechnio, Tuesday
January 6, 2022: Epiphany

SPRING SEMESTER

| | |
|-------------------------------|-------------------|
| Classes begin: | February 28, 2022 |
| Break before Easter Holidays: | April 18, 2022 |
| Classes restart: | May 2, 2022 |
| Classes end: | June 10, 2022 |

Exam period June 2021

| | |
|-----------------|---------------|
| Start of Exams: | June 13, 2022 |
| End of Exams: | July 8, 2022 |

Holidays

March 7, 2022: Clean Monday
March 25, 2022: Greek Independence Day
June 13, 2022: Pentecost Monday

UNIVERSITY LEADERSHIP & STRUCTURE

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

THE SENATE

The **Senate** consists of:

- the Rector,
- the Vice-Rectors,
- the Deans of the Schools
- the Heads of the Departments
- one representative of undergraduate students, postgraduate students and doctoral candidates each

- one representative per category of staff: Special Educational Staff (EEP), Laboratory Teaching Staff (EDIP), Special Technical Laboratory Staff (ETEP) and administrative staff.

The **Senate** is the highest collective decision-making body of the University. It is comprised of the Rector, the Vice-Rectors, the Deans of the Schools, the Chairmen/Chairwomen of the Departments, students, teaching staff and administrative staff delegates.

SCHOOLS

The Athens University of Economics and Business consists of three Schools:

- 1. SCHOOL OF ECONOMIC SCIENCES**, which supervises and coordinates the operation of the Department of International and European Economic Studies and the Department of Economics.
- 2. SCHOOL OF BUSINESS**, which supervises 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 SCIENCE AND TECHNOLOGY**, which supervises and coordinates the operation of the Departments of Informatics and the Department of Statistics.

According to Law 4485/2017 (Government Gazette 114 / 4-8-2017), each School is governed by the Dean of the School, the Dean's Council and the School's General Assembly, while each Department is governed by the Department's Chairman and General Assembly.

DEPARTMENTS

The Department is the University's main educational and academic unit, which promotes science and knowledge development in the relevant academic field, organizes and delivers teaching and ensures continuous improvement in research and education. The Department consists of the Professors, Associate Professors, Assistant Professors, Lecturers, members of the Special Educational Staff (EEP), members of the Laboratory Teaching Staff (EDIP) and members of the Special Technical Laboratory Staff (ETEP).

The Departments of the Athens University of Economics and Business are:

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

According to Law 4485/2017 (Government Gazette 114 / 4-8-2017), each Department is governed by the Department's Chairman and the General Assembly.

UNIVERSITY STAFF

The University staff consists of the following categories:

- TEACHING STAFF:

- The Faculty consisting of (a) Professors, (b) Associate Professors (c) Assistant Professors.
- Special Educational Staff (E.E.P.).
- Laboratory Teaching Staff (E.DI.P.).
- Special Technical Laboratory Staff (E.T.E.P.).
- Auxiliary Teaching Staff (E.D.P.).
- Research Assistants.
- University Scholars.
- Special Assignment Teachers.

- ADMINISTRATIVE STAFF

STUDENT SERVICES & FACILITIES

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

GENERAL DESCRIPTION OF THE UNIVERSITY

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

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

The University as a center of excellence, in academic research and teaching, is rated as one of the leading universities in its subject areas in Greece and one of the best internationally. The high level of its scientific staff, the quality in teaching and research, the modern curriculum/courses, but also the high demand of its graduates enhance significantly the University's brand name and reputation, in Greece and abroad.

LIST OF DEGREE PROGRAMMES

Athens University of Economics and Business offers the following Degrees and streams:

| A/A | DEPARTMENTS | SPECIALIZATIONS |
|------------|---|---|
| 1. | International and European Economic Studies | 1. International Economics and Finance 2. International and European Political Economy |
| 2. | Economics | 1. Economic Theory and Policy 2. Business Economics and Finance 3. International and European Economics |
| 3. | Management Science and Technology | 1. Operations Research and Business Analytics 2. Operations and Supply Chain Management 3. Software and Data Analysis Technologies 4. Information Systems and Electronic Business 5. Strategy, Entrepreneurship and Human Resources |

| | | |
|----|-----------------------------|--|
| 4. | Business Administration | <ol style="list-style-type: none"> 1. Business Administration 2. Information Systems Management 3. Accounting and Financial Management 4. Marketing |
| 5. | Accounting and Finance | <ol style="list-style-type: none"> 1. Accounting 2. Finance |
| 6. | Marketing and Communication | <ol style="list-style-type: none"> 1. International Management, Innovation and Entrepreneurship 2. Human Resource Management 3. Business Analytics 4. Digital Marketing |
| 7. | Informatics | <ol style="list-style-type: none"> 1. Theoretical Computer Science 2. Computer Systems and Networks 3. Information Systems and Information Security 4. Databases and Knowledge Management 5. Operational Research and Economics of Information Technology 6. Computational Mathematics and Scientific Calculations |
| 8. | Statistics | No specializations are offered |

Detailed information about programs and curriculum is provided in each department's study guide and website.

MAIN UNIVERSITY REGULATIONS

The regulations include:

- The Internal Regulations for the Operation of the Institution
- The Organization of Administrative Services
- The Regulations for the Operation of Postgraduate and PhD Programs
- The Internal Regulation for postdoctoral research
- The Exam Guide

ECTS COORDINATOR OF THE UNIVERSITY

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

PART II: INFORMATION ON DEGREE PROGRAMS

(A) General Description

Qualification awarded

The Postgraduate Program awards a **Master Degree in Applied Statistics**.

Admission requirements

The program accepts university graduates, from Greek or non-Greek higher education institutions that have been recognized from the Hellenic NARIC organization (DOATAP), according to the law 4485/2017 (article 34). Applicants that have not yet graduated from their universities' must submit a solemn statement of Law No. 1599/86 that if selected for the MSc program, they will have completed their undergraduate studies until the forthcoming September.

Admission criteria/Registration Procedure

The program accepts university graduates, from Greek or non-Greek higher education institutions that have been recognized from the Hellenic NARIC organization (DOATAP), according to the law 4485/2017 (article 34).

Foreign students must have proficient knowledge of the Greek language (they must either have graduated from the Hellenic high school (lyceum) or have a GAT Greek language certificate).

The program accepts up to forty (40) students per year.

Applicants selection is made according to the provisions of the Law No. 4485/2017 and the program's Academic Regulations as published in the Governmental Gazette No.

The Following documents must be submitted with the application, as indicated in the official call for applications:

1. Online application form <http://e-graduate.applications.aueb.gr>
2. Curriculum Vitae
3. Copies of all University Degrees / Diplomas and Official Transcripts of marks received. Applicants that have not yet graduated from their universities' must submit a solemn statement of Law No. 1599/86 that if selected for the MSc program, they will have completed their undergraduate studies until the forthcoming September.
4. Certified copy of the English language certification verifying good command of the language (at least level B1).
5. Two confidential recommendation letters (for FT applicants only academic references are accepted, while for PT applicants employer's references are also accepted)

6. For non-Greek university degrees recognition by the Hellenic National Academic Recognition Information Centre (DOATAP) is required according to the Law No. 4485/2017 art. 34.

The applicant's evaluation process has as follows:

The Admissions Committee

- a) Compiles a table of all applicants
- b) Rejects all applicants that do not meet the minimum prerequisites that have been set by the Departmental Assembly.
- c) Calls all eligible applicants for a personal interview with at least two members of the Admissions Committee.
- d) Ranks all applicants according to the above mentioned quantitative and qualitative criteria and selects the ones that will be accepted.
- e) The final list of accepted applicants is validated by the Departmental Assembly.

Educational and professional goals

The Postgraduate Program in Applied Statistics has as its object the provision of specialized postgraduate knowledge to graduates of Greek and recognized foreign universities in the main fields of Statistics and Probability. In particular, the object of the Program is the education of postgraduate students in the following areas: a) Data analysis, b) Biostatistics, c) Computational Statistics of Big Data, d) Applied Probability.

The program aims to:

1. The creation of specialized scientists in areas that are compatible with the research activity, the corresponding specializations of the undergraduate study program and with the scientific staff of the department.
2. The training of senior executives for companies and organizations in the private and public sector that may cover their needs in for specific applications in data analysis.
3. To promote the University globally, to develop networks of cooperation with the international scientific community and the greatest possible activity within the framework of the opportunities offered in Europe and in the wider world.
4. In the interconnection of the educational process with the needs of the market and the economy in general.

Access to further studies

Access to the PhD Program – 3rd Cycle.

Course structure diagram with credits:

The course structure diagram with credits for the Academic Year 2020-21 is defined as follows:

| 1st Semester <i>(each student selects all three (3) courses)</i> | ECTS |
|--|-------------|
| (Applied Probability -Estimation | 5 |
| Hypothesis Testing – Linear Models | 5 |
| Statistical Applications using R | 5 |
| | |
| 2nd Semester <i>(each student selects all three (3) courses)</i> | |
| Optimization Techniques | 5 |
| Generalized Linear Models | 5 |
| Time Series Analysis and Forecasting using R | 5 |
| | |
| 3rd Semester <i>(each student selects all two (2) courses) and courses from the “elective courses” list)</i> | |
| Medical Statistics | 5 |
| Computational Statistics using R | 5 |
| <i>Elective Courses (from the list below)</i> | |
| | |
| 4th Semester <i>(each student selects courses from the “elective courses” list)</i> | |
| <i>Elective Courses (from the list below)</i> | |
| | |
| Elective Courses <i>(each student selects four (4) courses from the “elective courses” list below)</i> | |
| Applied Bayesian Statistics | 5 |
| Statistical Learning | 5 |
| Survival Analysis | 5 |
| Quality Control and Reliability | 5 |
| Clinical Trials | 5 |
| High dimensional Statistics | 5 |
| Financial Mathematics with Applications in MATLAB and PYTHON | 5 |
| | |
| 5th Semester | |
| MSc Thesis | 30 |

Examination and assessment regulations

The final grade of each course is determined by the respective teachers. The degree may involve individual and group work of students. Participation in the exams on the specific date announced according to the exam schedule is mandatory.

The examinations grading scale is set from zero (0) to ten (10), half grades are also awarded. The passing grade is five (5) or higher.

A student who fails a course is re-examined in the following examinations' period. If a student fails in the following examinations' period then he is entitled to be examined in the next exam of the course and in case of failure he is dropped from the program and is only entitled to a certificate for courses successfully attended.

In order to be awarded the Master's degree, students must achieve passing grades in all courses as well as the Master's dissertation in the designated time period. If not, then students are dropped from the program, and are only entitled to a certificate for courses successfully attended.

ECTS Coordinator

The ECTS Coordinator of the University is, ex officio, the chair of the Quality Assurance Unit. 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.

(B) Description of individual course units

Applied Probability - Estimation (62101)

Instructors: E.KYRIAKIDIS

Core Course, 1st semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Random Experiment. Sample Space. Axioms of Kolmogorov. Properties of Probabilities. Law of total probability. Bayes's Rule. Discrete and Continuous random variables. Expected value and variance of random variables. Binomial distribution. Geometrical Distribution. Poisson Distribution. Hypergeometrical Distribution. Uniform Distribution. Exponential Distribution. Normal Distribution. Central Limit Theorem. Law of Large Numbers. Estimator of unknown parameter. Unbiased Estimator. Consistent Estimator. Sufficient Estimator. Rao-Blackwell Estimator. Cramer-Rao lower bound. Method of maximum likelihood. Methods of moments.

Prerequisites

Knowledge of Calculus.

Target Learning Outcomes

- The students will be able to compute probabilities of events, expected values and variances of discrete and continuous random variables. They will also be able to apply the central limit theorem and find estimates of unknown parameters.
- The students will be able to solve realistic problems that are related with random experiments.

Recommended Bibliography

- S. M. Ross, "A first course in Probability"
- Γ. Ρούσσα, "Στατιστική Συμπερασματολογία"

Teaching and Learning Activities

In Class, distant learning.

Assessment and Grading Methods

Written final exam, Assignments.

Hypothesis Testing – Linear Models (62102)

Instructors: I.VRONTOS – ST.PSARAKIS

Core Course, 1st semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

In this course we present the confidence intervals, the statistical hypothesis theory, the principles of linear regression (simple and multivariate), the Analysis of Variance and their applications.

Prerequisites

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Applied Probability – Estimation.

Target Learning Outcomes

The students after attending successfully the course will be able, using the appropriate methodology, to construct confidence intervals that will contain the unknown parameters with the desirable probability and to perform hypothesis testing in various problems. They will be able to apply the basic tools of regression analysis, to various problems of economics and business administration. More specifically, they will be able to analyze, construct and estimate an appropriate model (simple or multivariate) and make inference on the results of the estimation procedure.

Recommended Bibliography

- Draper N, Smith H (1998) Applied Regression Analysis 3rd Edition Wiley
- Montgomery D (2012) Introduction to Linear regression Analysis, 5th Edition Wiley.
- Montgomery D. and Runger GC (2018) Applied Statistics and Probability for Engineers 7th Edition Wiley

Teaching and Learning Activities

One three-hour lecture per week and study exercises as homework (some to be submitted).

Assessment and Grading Methods

90% Written examination. 10% project/assignment based on simulated data applying the methodologies and techniques described during the course accompanied with short scientific report.

Statistical Applications using R (62103)

Instructors: P.BESBEAS

Core Course, 1st semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

The course provides an introduction to modern applied statistics and elementary programming via the statistical programming language R. The course provides an inclusive guide to R, developing a skill set to efficiently perform technical computations, whilst at the same time covering a variety of statistical techniques to analyse data, ranging from standard material like descriptive statistics, estimation, and hypothesis testing to intermediate methods like linear regression, model selection and diagnostics.

Prerequisites

Applied Probability – Estimation. Hypothesis Testing – Linear Models.

Target Learning Outcomes

On successfully completing the module students will be able to

- demonstrate proficiency in the use of computing utilities and the statistical package R;
- show judgement in the application of R;
- make effective and well-considered use of R
- use suitable statistical methods to analyse data
- use information technology effectively for introductory data analysis including data retrieval.

Recommended Bibliography

- J. Verzani. Using R for Introductory Statistics (2nd edition, CRC Press, 2014)
- Crawley M. J. The R Book, Wiley 2009
- Chatfield, C. Problem–solving: a statistician’s guide. London, Chapman and Hall. 1995
- Cox, D.R. and Snell E.J. Applied Statistics: Principles and Examples (Chapman Hall statistics text series) 1987.

Teaching and Learning Activities

24 hours of lectures and terminal classes. 75 hours independent study.

Assessment and Grading Methods

Assessment: The unit is assessed by a combination of examination and continuous assessment.

Continuous Assessment: Open book written assessment completed in independent study hours.

Examination: A final written examination in the examination period.

Optimization Techniques (62104)

Instructors: A.YANNACOPOULOS

Core Course, 2nd semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

The course introduces the basic concepts and techniques of Optimization theory with an emphasis on applications in various fields such as e.g. statistics, machine learning, finance etc.

Techniques are covered from convex optimization, duality methods, stochastic optimization, non smooth programming as well as computational algorithms such as e.g. gradient methods, stochastic gradient schemes, Newton and quasi Newton schemes etc.

Prerequisites

None.

Target Learning Outcomes

Upon successful completion of the course, students will learn the fundamental concepts and techniques of the theory of Optimization and they will be able to apply these techniques in the context of problems in Statistics.

Recommended Bibliography

- S. Boyd and Vanderberghe, Convex optimization, Cambridge University Press
- J. Nocedal, Numerical Optimization, Springer.
- D. Kravvaritis and A. N. Yannacopoulos, Variational Methods in Nonlinear Analysis with applications in Optimization and PDEs. De Gruyter, Chapters 4 and 5.
- A. N. Γιαννακόπουλος, Βελτιστοποίηση και εφαρμογές, Σημειώσεις μαθήματος

Teaching and Learning Activities

In vivo or by distance teaching, computational applications.

Assessment and Grading Methods

Essays and mini projects within the term.

Generalized Linear Models (62105)

Instructors: V.VASDEKIS

Core Course, 2nd semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Introduction to statistical modeling, exponential family of distributions, parts of a GLM, analysis of binomial data, logit models, Poisson models, log-linear models for analysis of categorical data, analysis of overdispersion, normal data, multinomial and ordinal data. All applications include the use of the R language.

Prerequisites

Students should have basic knowledge of mathematical calculus and probability theory.

Target Learning Outcomes

Upon successful completion of the course, students are expected to understand if the nature of their data allows application of a generalized linear model (knowledge and understanding). They should also be able to define the appropriate generalized linear model to the data at hand (application). They should be able to fit this model and interpret the results of analysis (skill). Finally, they should be able to explain to scientists of other disciplines the results of their analysis (synthesis).

Recommended Bibliography

- Agresti (2013). Categorical data analysis, Wiley
- Atkinson (1985). Plots, transformations and regression, Oxford university Press
- Carroll and Ruppert (1988). Transformation and weighting in regression, Chapman and Hall
- Chatterjee and Price (1977). Regression analysis by example, Wiley.
- Christensen R. (1998). Analysis of variance, design and regression. Chapman and Hall.
- Collett, D. (1991) Modelling Binary data, Chapman and Hall
- Cook and Weisberg, S. (1982). Residuals and Influence in regression, Chapman and Hall
- Dobson, A., Barnett, A.G (2008). An introduction to generalized linear models, Chapman and Hall.
- Draper and Smith (1981). Applied regression analysis, Wiley.
- McCullagh, P and Nelder, J.A. (1989) Generalized Linear Models, Chapman and Hall.
- Montgomery, D.C. (1989) Design and Analysis of Experiments, Wiley
- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2001). Introduction to linear regression analysis. Wiley.
- Ryan (1997). Modern regression methods, Wiley.
- Weisberg, S. (1985) Applied Linear Regression, Wiley
- Venables W.N. and Ripley B.D (1999) Modern Applied Statistics with S-Plus, Springer

Teaching and Learning Activities

One three-hour lecture per week, study exercises as homework (some to be submitted).

Assessment and Grading Methods

The final grade is the weighted average of the final examination grade (70%) and the grade of the study exercises to be submitted (30%).

Time Series Analysis and Forecasting με R (62106)

Instructors: I.VRONTOS

Core Course, 2nd semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

This course provides the theory and practice of time series analysis. It introduces the deterministic type of models and the decomposition of a given time series into its components: a trend, a seasonal and an irregular component. The course presents and describes different models for estimating trend and seasonal effects. It introduces linear filters and exponential smoothing techniques. It also introduces the basic theory of stationary processes (characteristics of stationary and non-stationary time series and unit root testing), it describes and presents analytically stochastic time series models, ARMA models in particular, and the Box-Jenkins methodology for ARIMA models. The course introduces the class of conditional heteroscedastic models (ARCH/GARCH), and presents practical time series forecasting techniques. Illustrative examples applying time series models/techniques to actual economic and financial data are also presented using R package and the econometric package Eviews. The empirical analysis consists of (a) unit root testing to exchange rate series and financial series, e.g. stocks and indices, and (b) modeling and forecasting economic/financial time series..

Prerequisites

Students should have basic knowledge of statistics and linear models.

Target Learning Outcomes

The aim of this course is to provide students with the learning of using appropriate time series models and techniques required for the analysis of time series data. After successfully completing the course, students will be able to:

- know deterministic time series modeling
- know the basic concepts of stationary processes
- have learned the ARMA stochastic time series models
- have learned about the time-varying ARCH/GARCH volatility models
- be able to apply the Box-Jenkins methodology in empirical applications
- be able to model and forecast time series data
- know how to implement time series analysis using R and Eviews

Recommended Bibliography

- Hamilton, James D. Time Series Analysis. Princeton, New Jersey: Princeton University Press, 1994.
- Enders, Walter. Applied Econometric Time Series. New York: Wiley, 2010.

- Cowpertwait, Paul S.P., and Metcalfe V. Andrew. *Introductory Time Series with R*. New York: Springer Texts in Statistics, 2009.
- Cryer, Jonathan D., and Chan Kung-Sik. *Time Series Analysis with Applications in R*. Springer Texts in Statistics, 2010.
- Gujarati, Damodar N. *Basic Econometrics*. New York: McGraw-Hill, 2008.
- Pindyck, R.S. and D.L. Rubinfeld. *Econometric Models and Economic Forecasts*. New York: McGraw-Hill, 1991.
- Shumway, Robert H. and David S. Stoffer. *Time Series Analysis and Its Applications with R Examples*. New York: Springer Texts in Statistics, 2011.
- Tsay, Ruey S. *Analysis of Financial Time Series*. New York: Wiley, 2010.
- Wooldridge, Jeffrey. *Introductory Econometrics: A Modern Approach*. South-Western College Publishing, 2009.
- Granger, C.W.J. and Paul Newbold. *Forecasting Economic Time Series*. San Diego, CA: Academic Press, 1986.

Teaching and Learning Activities

One three-hour lecture per week, study exercises, and programming exercises as homework (some to be submitted).

Assessment and Grading Methods

The final grade is the average of the final examination grade (weight 80%) and the grade of the study and programming exercises to be submitted (weight 20%), provided that the final examination grade is at least 5/10. Otherwise, the final grade equals the final examination grade.

Medical Statistics (61216)

Instructors: N.DEMIRIS

Core Course, 3rd semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Medical/Epidemiological studies and a comparative approach to their advantages and disadvantages. Risk measures: suitability by study type and statistical theory with real data applications. Deconfounding, stratification and effect modification. The last part of the course is concerned with Epidemic models, the basic SIR model, its behaviour, the reproduction rate R_0 and disease control.

Prerequisites

Probability, Statistics and computational methods.

Target Learning Outcomes

At the end of the course each student will become familiar with the basic types of medical study and the appropriate method of statistical analysis by study, including their practical application. They will also become aware of the main techniques for correcting for confounders. Finally they will understand the basic principles of disease transmission and the calculations involved in disease control.

Recommended Bibliography

Lecture notes and Rosner's book "Fundamentals of Biostatistics".

Teaching and Learning Activities

Weekly lectures and assignments.

Assessment and Grading Methods

Written exam.

Computational Statistics using R (62107)

Instructors: P.BESBEAS

Core Course, 3rd semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

The course aims to develop a broad and thorough knowledge of modern statistical computing techniques, to enable use of advanced statistical modelling and inference methods in practice.

In more complex situations this will mean using numerical optimisation routines to obtain maximum likelihood estimates for the model parameters, and modern computational power to simulate distributional properties of estimators and test statistics. The course also considers how to evaluate such stochastic models. Outline syllabus includes: Numerical function optimisation. Numerical maximum likelihood and likelihood tools for inference.

Simulation techniques. Inferences using Monte-Carlo and resampling methods. The methods are implemented in the statistical programming language R, and illustrated using detailed real examples.

Prerequisites

- Applied Probability – Estimation.
- Hypothesis Testing – Linear Models.
- Statistical Applications using R.

Target Learning Outcomes

On successfully completing the module students will be able to:

- demonstrate systematic understanding of computational statistics
- demonstrate the capability to deploy established approaches accurately to analyze and solve problems in the following areas: function optimization, numerical aspects of maximum likelihood estimation, simulation methods and Monte Carlo, resampling
- apply a range of computational statistics methods, showing good judgment in the selection and application of tools and techniques
- write R programs for complex applications, making effective and well-considered use of R

Recommended Bibliography

- Rizzo, Maria. 2014. Statistical Computing with R. Chapman and Hall.
- Voss, Jochen. 2013. An introduction to statistical computing: A simulation-based approach. Wiley.
- Eubank, R. and A. Kupresanin. 2011. Statistical Computing in C++ and R. Chapman and Hall.
- Givens, Geof and Hoeting, Jennifer. 2012. Computational Statistics. Wiley.
- Gentle, James. 2009. Computational Statistics. Springer.
- Martinez, Wendy and Martinez, Angel. 2015. Computational Statistics Handbook with Matlab. Chapman and Hall.

- Gentle, James. 2013. Elements of Computational Statistics. Springer.

Teaching and Learning Activities

24 hours of lectures and terminal classes. 75 hours independent study.

Assessment and Grading Methods

Assessment: The unit is assessed by a combination of examination and continuous assessment.

Continuous Assessment: Open book written assessment completed in independent study hours.

Examination: A final written examination in the examination period.

Applied Bayesian Statistics (61219)

Instructors: I.NTZOUFRAS

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

This course will provide the introduction to the Bayesian approach in statistics both from the theoretic and the computational perspective using R and WinBUGS. The course syllabus includes: Bayesian inference. Conjugate Analysis. Simulation and random number generation. Markov models and hidden Markov (MCMC) methods. Metropolis-Hastings algorithm, Gibbs sampling. Introduction to WinBUGS. Bayesian inference for Regression and GLMs. Hierarchical models. Bayesian model and variable selection.

Prerequisites

The students should have a good quantitative and computational background. Specifically, knowledge in the fields of calculus, probability/distribution theory, statistical modelling and R programming will be necessary for this course.

Target Learning Outcomes

Upon completion of the course, students will be able to:

- Understand the basic theory and philosophy of Bayesian Statistics
- Understand the basic notions of Bayesian computation
- Analyze data using WinBUGS
- Build models (glm and hierarchical) in WinBUGS
- Perform Bayesian variable selection using WinBUGS and BAS package in R.

Recommended Bibliography

- 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.
- P. Dellaportas and P. Tsiamyrtzis, "Introduction to Bayesian Statistics" (in Greek)

Teaching and Learning Activities

- Live teaching in a lecture room or computer labs
- Informal labs for using R and WinBUGS/OpenBUGS/JAGS
- Evaluation of current knowledge using Kahoot web game
- Interim optional exercises

- Personalized assignment/project

Assessment and Grading Methods

The course is examined by a big project/assignment that contributes 100% of the final grade. The students can break the final outcome/assignment in smaller landmark exercises (optional) that will help him to construct the final project report.

Statistical Learning (61220)

Instructors: I.PAPAGEORGIOY

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

A range of statistical learning methods is studied. For supervised learning: (i) Classification problems and methods such as LDA, QDA, k-nn, decision trees (ii) data reduction problem, principal components analysis, factor analysis. For unsupervised learning: clustering (hierarchical, optimization clustering, model-based). Model Assessment and Selection.

Prerequisites

Multivariate analysis. Statistical inference.

Target Learning Outcomes

Upon completion of the course, students will have the knowledge and the skills to implement statistical methods aiming to deal with the problem of classification, data dimension reduction, factor analysis and clustering. They will be able to interpret the results and assess the methodologies' performance.

Recommended Bibliography

- 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 and Learning Activities

Face to face teaching covering theory and practice. The practicals are implemented with R.

Assessment and Grading Methods

Written exam and projects.

Decision Analysis and Game Theory (61217)

Instructors: E.KYRIAKIDIS – M.ZAZANIS

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Decision processes, decision criteria, a priori criterion, a posteriori criterion, decision trees, utility, Von Neumann utilities, games, strategies, stable games, unstable games solution by linear programming, dominance.

Prerequisites

Probabilities, Linear Algebra.

Target Learning Outcomes

The students will be taught decision processes, decision criteria, a priori criterion, a posteriori criterion, utility. They will be able to construct decision trees. They will also be able to solve find the optimal solution of a game using linear programming.

Recommended Bibliography

- E. Μαγείρου, Παιγνία και Αποφάσεις, Εκδόσεις Κριτική, 2012.
- Κ. Μηλολιδάκης, Θεωρία Παιγνίων: Μαθηματικά Μοντέλα Σύγκρουσης και Συνεργασίας, Εκδόσεις Σοφία, 2009.
- P. Morris, Introduction to Game Theory, Springer-Verlag, 1994.
- F. S. Hillier and G. J. Lieberman, Introduction to Operations Research, 11th Edition, Mc Graw-Hill, 2021.

Teaching and Learning Activities

Lectures in classroom. Theory and Exercises.

Assessment and Grading Methods

Written Exams.

Quality Control and Reliability (61222)

Instructors: ST.PSARAKIS

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Definition of quality. Basics on statistical quality control and reliability. An introduction to Acceptance sampling and Design of Experiments. Metrology and reliable measurements. Cause and effect chart and Pareto chart. The philosophy of statistical process control. Control charts for variables and attributes. Individual control charts. EWMA and CUSUM charts Capability indices. Control charts for autocorrelated data. Introduction to multivariate control charts. Basics of six sigma methodology.

Prerequisites

Students should have good knowledge of estimation and statistical inference. It is also useful to have basic knowledge of the statistical language R.

Target Learning Outcomes

The student after the course will acquire the skills needed to deal with problems of controlling and improving the quality and the reliability of products or services using statistical methods.

Recommended Bibliography

- Montgomery D (2019) Introduction to Statistical Quality Control, 8th Edition Wiley.
- Qiu P. (2013) Introduction to Statistical Process Control, CRC Press.
- Ταγαράς Γ.(2001) Στατιστικός Έλεγχος Ποιότητας, εκδόσεις ΖΗΤΗ.

Teaching and Learning Activities

One three-hour lecture per week and study exercises as homework (some to be submitted).

Assessment and Grading Methods

85% Written examination.

15% project/assignment based on simulated data applying the methodologies and techniques described during the course accompanied with short scientific report.

Clinical Trials (61226)

Instructors: V.VASDEKIS

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Principles of Clinical Trials (CT), trials types, CT protocol, blinding, randomization methods, sample size, ITT, PP, TR populations, covariate adjustment, cross-over trials, analysis of repeated measures data, linear mixed models, GEE models, introduction to meta-analysis.

Prerequisites

Students should have basic knowledge of mathematical calculus, probability theory and generalized linear models.

Target Learning Outcomes

After successfully completing the course, students will be able to:

- write the statistical parts of a CT protocol,
- find the appropriate size of a CT,
- randomize patients into experimental groups,
- analyze clinical trials data,
- perform a basic meta-analysis using statistical techniques.

Recommended Bibliography

- Everitt, B.S. and Pickles, A. (1999). Statistical Aspects of the Design and Analysis of Clinical Trials, Imperial College Press.
- Chow, S-C. and Liu, J-P. (2013). Design and Analysis of Clinical Trials, Wiley.
- Fitzmaurice, G.M., Laird, N. and Ware, J. (2004). Applied longitudinal data analysis, Wiley.
- Whitehead, A. (2002). Meta-Analysis of Controlled Clinical Trials. Wiley.

Teaching and Learning Activities

One three-hour lecture per week, study exercises as homework (some to be submitted).

Assessment and Grading Methods

The final grade is the weighted average of the final examination grade (60%) and the grade of the study exercises to be submitted (40%).

High Dimensional Statistics (61227)

Instructors: P.PAPASTAMOULIS

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Modern statistical applications deal with the analysis of high-dimensional datasets. However, inference is extremely challenging due to the curse of dimensionality: as the number of variables increases, the data may become quite noisy and it is difficult to separate the actual underlying information. The course will present modern statistical techniques particularly suited to problems with high dimensionality, such as:

- large scale hypothesis testing
- statistical applications in bioinformatics
- applications of (generalized) linear models in big data problems
- Regularization techniques (LASSO, Ridge regression)
- Classification and model-based clustering for multivariate data with dimensionality reduction techniques

Prerequisites

- Prerequisites
 - Hypothesis Testing - Linear Models
 - Generalized Linear Models
- Some basic knowledge on
 - Computational Statistics
 - R programming
- Students will also benefit from the following courses (not required)
 - Applied Bayesian Statistics
 - Statistical Learning

Target Learning Outcomes

After completing the course, the students will:

- know the challenges that big data impose to the statistician
- properly deal with large scale hypothesis testing
- put their hands on many different types of data from cutting edge research areas such as bioinformatics
- learn many novel statistical ideas and methods developed in the last 20 years
- know how to apply the relevant methods using R and Bioconductor.

Recommended Bibliography

- Christophe Giraud (2015). Introduction to High-Dimensional Statistics. Philadelphia: Chapman and Hall/CRC
- Tony Cai, Xiaotong Shen, eds. 2011. High-dimensional data analysis. Frontiers of Statistics. Singapore: World Scientific
- Hastie, R. Tibshirani and R. Friedman (2009). Elements of Statistical Learning. Springer
- Efron, Bradley. Large scale inference: Empirical Bayes Methods for Estimation, Testing and Prediction. Cambridge University Press, 2010
- McLachlan, G. and Peel, D (2000). Finite Mixture Models. Cambridge University Press, 2010

Teaching and Learning Activities

One three-hour lecture per week, study exercises and programming exercises as homework (some to be submitted).

Assessment and Grading Methods

The final grade will be a weighted average of 2 or 3 homework assignments.

Financial Mathematics with Applications in MATLAB and PYTHON (61224)

Instructors: A.YANNACOPOULOS

Elective Course, 3rd or 4th semester, 5 ECTS units

Course level: Graduate (MSc)

Language: Greek

Course Description

Introduction to fundamental concepts of financial mathematics and presentation of quantitative theoretical and computational tools for financial market analytics. Decision theory under uncertainty, introduction to the structure of financial markets and the nature of financial assets, asset pricing models, derivative products, bonds, portfolio theory and introduction to risk management techniques. Computational methods and techniques for the above using Python and Matlab (Octave) environments.

Prerequisites

None.

Target Learning Outcomes

To familiarize students with quantitative and computational techniques for financial market analytics as well as with the Python and Matlab (Octave) environment.

Recommended Bibliography

- Hull, J. C. (2015) Options, Futures, and Other Derivatives, 9th edition, Pearson
- McDonald, R. L. (2013), Derivatives Markets, 9th edition, Prentice Hall
- Shreve, S. (2005), Stochastic calculus for finance Vols. I and II, Springer
- Γιαννακόπουλος Α. (2014) Στοχαστικά Χρηματοοικονομικά (σημειώσεις)

Teaching and Learning Activities

In vivo or by distance teaching, computational applications.

Assessment and Grading Methods

Essays and mini projects within the term.

PART III: INFORMATION FOR THE STUDENTS

GENERAL INFORMATION FOR THE STUDENTS

Athens University of Economics and Business provides not only high-quality education but also high quality student services. The adoption of the Presidential Decree 387/83 and Law 1404/83 defines the operation, organization and administration of Student Clubs at Universities, which aim at improving the living conditions of the students and enhance their social and intellectual wellbeing through engagement and socialization initiatives.

To fulfill this objective the University ensures the required infrastructure for housing, meals and sports activities through the operation of a student restaurant, reading rooms, library, organization of lectures, concerts, theatrical performances and excursions in Greece and abroad. Further in this context, the University supports the development of international student relations, organizes foreign language classes, computer/software literacy classes, and courses in modern Greek as a foreign language for foreign students and expatriated Greek students.

Meals

In the main building of the University there is a restaurant where all members of the university community can enjoy meals for free or by paying a minimum fee. Free meals are granted to those who meet special conditions (by contacting the Student Club).

Medical Services, Insurance / Healthcare

Undergraduate, postgraduate and PhD students of the University who have no other medical and hospital care are entitled to full medical and hospital care in the National Health System with coverage of the relevant costs by the National Health Service Provider. The doctor's office is located in the main building and operates on some working days as announced. A psychiatric counseling service also operates at the University, staffed with a physician specializing in the treatment of mental health issues. More information can be found here <https://www.aueb.gr/en/content/health-care> .

Services/Facilities to Students with Special Needs

Athens University of Economics and Business ensures the facilitation of students with special needs for access to the university buildings through ramps, lifts and other equipment. There are also specific exam regulations for students with special needs.

In addition, the Library provides students with visual impairment with aids to access online the proposed reading lists of the courses taught at the University. In this context, the Association of Greek Academic Libraries has developed a multimodal electronic library called AMELIB. Entry to this service requires user authentication as well as username and password. More information can be found on the Library website <https://www.aueb.gr/en/lib/content/users-additional-needs> .

Student Financial Aid – Scholarships and Awards

Athens University of Economics and Business offers scholarships to undergraduate and graduate students in order to support them and to award and encourage excellence. The resources for these scholarships come from the Institution itself or from partnering organizations. More information about scholarships, according to the level of studies, can be found here <https://www.aueb.gr/en/content/scholarships> .

Studies Advisor (fill accordingly)

Library and Study Rooms

The Library & Information Center of the University was established in 1920 and operates on the first and second floor of the University's main building. The AUEB Library is a member of the Hellenic Academic Libraries Association (Heal-LINK), the European Documentation Centers Europe Direct and the Economic Libraries Cooperation Network (DIOB).

Three 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 (WTO) hosting publications since 2004.

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

- Its printed collection of books and scientific journals,
- Course books used in classes,
- Its collection of electronic scientific journals
- Its collection of e-books
- Postgraduate theses and doctoral theses that are produced in Athens University of Economics and Business and deposited in digital form at the PYXIDA institutional repository
- Sectoral studies
- Statistical series by national and international organizations
- Audiovisual material
- Information material (encyclopedias, dictionaries)
- Collection of official government publications of the European Union, the OECD and the WCO
- Databases on the issues adopted by the University
- Printed collections of other academic libraries

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

International Programmes and Information on International Student Mobility

Athens University of Economics and Business is actively involved in the Erasmus+ Program by promoting cooperation with universities, businesses and international organizations of the European Union (EU) as well as in the mobility of students, teaching and administrative staff. Within the framework of this Program, the University collaborates with more than 220 European Institutions on the subjects that its Departments encompass. It is worth mentioning that more than 7,000 students have participated in the "Erasmus" Program to date. 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).

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 / administrative staff training mobility. The Program was first implemented in the academic year 2015-2016, and since then a total of 52 students and staff members moved from and to 8 Partner Institutions in countries outside the EU (USA, Canada, Singapore, Russia, South Korea, Armenia). More information can be found in the here <https://www.aueb.gr/en/content/erasmus-programme>

Foreign Language Courses

Knowledge of foreign languages is a necessity in today's educational and professional context. The Student Club offers opportunities of attending foreign language classes. Classes are held in English, French, German, Spanish, Italian and Russian, and new language seminars are available upon request. More information can be found here <https://www.aueb.gr/en/content/foreign-languages-university-student-club>.

Connections with the Job Market and Entrepreneurship

DASTA AUEB is the University's Employment and Career Unit that plans, coordinates and implements actions related to:

- a) Entrepreneurship and innovation
- b) Connecting students and graduates with the labor market
- c) Connecting the academic community with businesses
- d) Offering internships, and
- e) Supporting dissemination of research output.

DASTA is structured in three units:

- a) the Internship and Career Unit, that focuses on supporting our students and graduates in their professional development. The Unit also offers consulting services to students and graduates regarding work and educational future.
- b) the ACEin Unit (Athens Center for Entrepreneurship and Innovation). Its goal is to support business ventures focused on implementing an innovative idea, develop a sustainable business effort or exploit the results of their research. At the same time, the Unit organizes actions that are part of a wider network between the Unit and the market in specific productive sectors.

More information can be found here <https://www.aueb.gr/en/dasta>

Athletic Activities

Students can participate in individual and team sports activities through the Department of Physical Education, which is staffed by University personnel, as well as a number of part-time instructors specialized in various sports. The University cooperates with the City of Athens Culture, Sports and Youth Organization and uses public and private sports facilities. More information can be found here <https://www.aueb.gr/en/content/athletic-activities>

Cultural Activities

To fulfill its purpose of providing a multidimensional study experience at AUEB, the Student Club organizes various cultural activities, such as theater, traditional dance, choir, photography, cinema,

rhetorical club and Model Of United Nations (MUN). More information can be found here <https://www.aueb.gr/en/content/cultural-activities>

Student Organizations and Clubs

Various student organizations and clubs are active within the AUEB community, including AIESEC, Erasmus Club, Investment Club, Entrepreneurship Club ThinkBiz, and other. More information can be found here <https://www.aueb.gr/en/content/student-clubs>

Alumni Network

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

Volunteer Program

AUEB's Volunteer Program was launched in September 2017 and since then has brought more than 450 volunteers to for-impact organizations around Athens, implementing more than 50 volunteer activities. The aim of "AUEB Volunteers" is to give the chance to the members of university's community, i.e. students, faculty and administrative staff, to experience volunteering so as to highlight the value of participation and contribution to society and the university, as well as to sensitize more citizens about crucial social issues. More information can be found here <https://auebvolunteers.gr/english-intro/>

Quality Assurance

Athens University of Economics & Business implements a quality assurance policy in order to continuously improve the quality of its educational programs, research activities and administrative services, and upgrade the academic and administrative processes and the University's overall operations. The Quality Assurance Unit (MODIP) coordinates and supports all related activities including the administration of the University-wide teaching and course evaluation process by students across all programs. More information can be found here <https://aueb.gr/modip> .

Education and Lifelong Learning Center

The Center for Education and Lifelong Learning (KEDIVIM / AUEB) ensures the coordination and interdisciplinary cooperation among all University entities in the development of continuous education programs, which complement and upgrade the skills and competences of the program participants. These programs build on participants earlier formal education, vocational training and professional experience. The aim is to facilitate job market integration, career and personal development. More information can be found here <https://www.aueb.gr/en/content/kedivim-opa>