UNIVERSITY OF PIRAEUS
DEPT. OF STATISTICS AND INSURANCE SCIENCE
MSc In APPLIED STATISTICS

COURSE OUTLINES

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M1 DATA ANALYSIS USING STATISTICAL PACKAGES

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΑΔΕ02	**SEMESTER**	1st
COURSE TITLE	DATA ANALYSIS USING STATISTICAL PACKAGES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA107/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The skill of using statistical software packages for data analysis is a necessary tool for a statistician. This course aims to familiarize students with the use of the widely used statistical packages SPSS and R. After successful completion of the course, students will be able:

• to import, organize and generally handle data using statistical packages,

• to identify when the application of a specific methodology is the appropriate method of analysis for the problem under investigation,

• to apply this specific analysis methodology to available data using statistical packages,

• to evaluate the validity of the results of the analysis,

• to correctly present the results of the analysis, and

• to make the final decisions on the problem they are considering.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Project planning and management

Respect for difference and multiculturalism

Adapting to new situations *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Decision-making.
- Working independently.
- Team work.
- Working in an interdisciplinary environment.
- Production of new research ideas.
- Production of free, creative and inductive thinking.

SYLLABUS

Part I: SPSS

Data entry, variables, data selection. SPSS tools. Descriptive statistics, graphs. Hypothesis tests: Parametric and non -parametric tests. Goodness of fit tests. Regression analysis and analysis of variance. SPSS's Syntax Editor and how it is used.

Part II: R

Introduction to R, data objects, graphs, descriptive statistics, distributions and random numbers, estimation, hypothesis tests, non -parametric tests, linear regression, programming in R.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lab)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Eclass, email, statistical packages in PC
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (laboratory) at the end of the semester. The final written examination consists of a combination of multiple-choice questions, short-answer questions

Activity	***Semester workload***
Lectures	30
Laboratory practice	9
Homework (assignment preparation)	40
Non guided study	48
Exam preparation	20
Exams participation	3
Course total	**150**

presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	and problem-solving questions. Conducted in the lab and is made using a PC. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture Notes
- Gnardelis, C. (2013), Data Analysis with IBM SPSS STATISTICS 21, Papazisis Pub. (in Greek).
- Field, A. (2000). Discovering statistics, using SPSS: Advanced Techniques for the beginners, Ism, London.
- Crawley, M. J. (2007), The R Book, Wiley.
- Ekstrom, C. T. (2017). The R Primer, 2nd edition, Chapman & Hall/CRC Press.
- Hothorn, T. and Everitt, B. S. (2014). A Handbook of Statistical Analyses Using R, 3rd edition, Chapman & Hall/CRC Press.
- Verzani, J. (2005). Using R for Introductory Statistics, Chapman & Hall.

M2 REGRESSION ANALYSIS AND ANALYSIS OF VARIANCE

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΑΠΔ01	**SEMESTER**	1st
COURSE TITLE	Regression Analysis and Analysis of Variance		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA103/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to familiarize students with the techniques of simple and multiple Linear Regression as well as with the basic techniques of Analysis of Variance so that they can apply them using appropriate Statistical Packages in the analysis of data derived from real-life problems. Students must participate in person to the theoretical and laboratory classes held during the semester (3 hours each).

After successful completion of the course, the student should be able:

- to explain even to non-specialists how the techniques of Regression Analysis and Analysis of Variance are expected to provide valuable information in various scientific areas and in applied problems of practical interest where there is a need to make predictions under conditions of uncertainty.
- to recognize when the Regression Analysis or Analysis of Variance techniques are applicable, based on the description of a real problem and choose the appropriate model for its Statistical study,
- to analyze the problem using the available data,
- to be familiar with and capable of taking advantage of the properties of the model he/she has chosen,

- to apply appropriately the selected Regression Analysis or Analysis of Variance techniques and check the conditions that are necessary so that the results obtained using the selected statistical methodology be valid,
- to assess the validity of the analysis results and revise them, if deemed necessary;
- to interpret the data he processed and present the conclusions derived by the Statistical Analysis of the data (written and verbal), correctly, with clarity and rationality,
- make the final decisions on the problem under consideration or give all the necessary information to the decision centers that have the authority to make the final decisions on the problem under consideration.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision making
- Working independently
- Teamwork
- Production of new research ideas and research results
- Work in an interdisciplinary environment
- Working in an international environment
- Project design and administration
- Production of free, creative, and inductive thinking

SYLLABUS

The course provides a comprehensive presentation of linear regression techniques and an introduction to analysis of variance techniques, with particular emphasis on how to apply them using a statistical package.

A thorough analysis is presented for the simple linear model as well as for the diagnostic tests that should be carried out to ensure that its application is valid. The basic techniques of multiple regression and the methods of selecting the best set of independent (predictor) variables are presented. In the framework of the analysis of variance, the classical techniques of multiple comparisons and their application to practical problems are elucidated.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class, email, Statistical software (packages), PowerPoint presentations
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography,*	

Activity	***Semester workload***
Lectures	30
Laboratory practice	9

tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Homework (assignment preparation): 36 Non guided study: 42 Exam preparation: 30 Exams participation: 3 **Course total: 150**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The final written exam, for both theory and lab, consists of a combination of multiple-choice questions and problem-solving exercises. It also includes examination of students' ability to make decisions on specific practical questions by "reading" the outputs of Statistical Packages as they arise from the analysis of experimental data. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester. It is based on the score of the final exam and the average scores of the assignments submitted by the students during the Semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture Notes
- Koutras, M. and Evangelaras, H. (2019). *Regression Analysis: Theory and Practice*, Tsotras Publ. (in Greek).
- Koutras, M. and Evangelaras, H. (2010). *Regression Analysis: Exercises with the aid of Statistical Packages*, Stamoulis Publ. (in Greek).
- Atkinson, A. C. (1985). *Plots, Transformations and Regression*, Clarendon press, Oxford.
- Draper, N. R. and Smith, H (1998). *Applied Regression Analysis*, Wiley & Sons, NY.
- Keppel Geoffrey,. Sheldon Zedeck (1989). *Data Analysis for Research Designs: Analysis of Variance and Multiple Regression/Correlation Approaches*, W.H. Freeman, N.Y.
- Kleinbaum D. G., Kupper L.L., Muller K.E. and Nizam A. (1998). *Applied Regression Analysis and other Multivariate Methods*. 3rd Edition, Duxbury Press.
- Miles, J. (2001). *Applying Regression & Correlation: a guide for students and researchers*, Sage Publications, London.
- Mendenhall, W. (1996). *A Second Course in Statistics: Regression Analysis*, Prentice Hall, New Jersey.
- Kutner, M. H., Nachtscheim, C. J., Neter, J. and I, W. (2004). *Applied Linear Statistical Models* (5th ed.) Mc Graw-Hill.
- Rechner, A. (2000). *Linear Models in Statistics*, John Wiley, N.Y.

- Rawlings S. O. (1988). *Applied Regression Analysis: a Research Tool*, John Wiley, N.Y.
- Sprent, P. (1969). *Models in Regression and Related topics*, Methuen & Co LTD, London.
- Westfall, P. H. and Arisa, A. L. (2022). *Understanding Regression Analysis: A Conditional Distribution Approach*, Chapman & Hall.

M3 RESEARCH METHODOLOGY AND SURVEY TECHNIQUES

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΕΜΤΔ-20	**SEMESTER**	1st /3rd
COURSE TITLE	RESEARCH METHODOLOGY AND SURVEY TECHNIQUES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA163/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to familiarize students with the basic components that comprise the implementation of a large sample survey – stages of preparation, challenges likely to be met and the ways these are addressed. The course covers types of surveys (cross-sectional, longitudinal) as well as their properties. Specific European comparative surveys are examined in detail, with special emphasis on the Survey of Health Ageing and Retirement in Europe (SHARE). The subjects covered include sampling techniques, questionnaire design, field implementation (e.g. interviewers), post-collection processing and ways of delivering data to users. During the course students practice accessing data of surveys and assessing information contained in survey meta-data.

After successful completion of the course, the student should be able:

- to judge how far practical and technical issues in conducting a survey affect the quality and reliability of statistical information.
- To appreciate how technical and administrative practices in the design and implementation of surveys affect the accuracy and quality of data and of estimated parameters

- To judge how far the survey modes selected may affect the final product.
- To form opinions on what type of research choices (types of survey, interviewer selection and training, design and calibration of questionnaires) are appropriate depending on special features of the research subject tackled.
- To see how analytical subjects covered in other parts of the course are reflected in the concrete choices embodied in a well-known large European panel survey (SHARE).
- To form opinions on quality issues of surveys by making use of published meta data
- To be able to access, interpret and use data from large international surveys which are available in the internet.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

- Facility in using and assessing available large statistical data bases
- Ability to participate in survey design and implementation of sample surveys.
- Ability to evaluate how technical issues affect the reliability of a survey and the quality of data

SYLLABUS

The course consists of five units corresponding to different stages in conducting a survey

1st Introduction to the survey methodology and survey background. Types of surveys. How special features of a research topic pose specific needs and constraints in how a survey is designed and conducted. Technical characteristics and data. An application in population ageing – SHARE.

2nd Sampling Theory and special issues in surveys. Probabilistic sampling methods.

3rd The Preparation Stage: From design to the field. Survey modes (CATI, CAPI, Internet, mixed modes), questionnaire design and question calibration, special subjects (scales – psychometric scales and reliability)

4th Surveys in the Field. Conducting a survey, non-response and non-response bias, the role of interviewers, post-collection processing, strategies for reducing sample selection bias, quality checks.

5th Post Collection Processing. Coding, editing, imputations, anonymization and GDPR, Meta data and the data user.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class, email, PowerPoint presentations
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art*	

Activity	*Semester workload*
Lectures	30
Laboratory practice	9

workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Homework (assignment preparation)	70 (Indicative)
	Non guided study	70 (Indicative)
	Exam preparation	38
	Exams participation	3
	Course total	**150**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Written exam (theory) at the end of the semester, including both essays questions and exercises. The final written exam is conducted using 'open book take-home' model, employing case studies. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester and is proportional to the hours taught.	

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture Notes uploaded to e-class
- Groves, R.M., Fowler, F. J., Couper, M.P., Lepkowski, J.M., Singer, E., and Tourangeau, R. (2009). *Survey Methodology*, Second Edition. New Jersey: John Wiley & Sons
- Börsch-Supan, A. and Jürges, H. (Eds.). (2005). The Survey of Health, Ageing and Retirement in Europe – Methodology. Mannheim: MEA. http://www.share-project.org/data-documentation/methodology-volumes.html
- David Spiegelhalter, 2020, *The Art of Statistics: Learning from Data* (Pelican Books)

M4 CLINICAL TRIALS

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΚΔΚ23	**SEMESTER**	1st
COURSE TITLE	CLINICAL TRIALS		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/ EFA102/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Clinical trial is a scientific investigation that examines and evaluates safety and efficacy of drug therapies or new surgical interventions in human subjects.

The aim of the course is to present the concepts of design and analysis of clinical trials and to provide the students with the basic tools for the statistical analysis of data from a clinical trial, so that they can undertake, design and analyze a clinical trial in cooperation with a medical team. Students should participate in the 13 lectures held during the semester (3 hours each).

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

- Design a clinal trial
- Write the protocol of a clinical trial
- Supervise a clinical trial and intervene when process deviates from the protocol.
- Analyze the data collected from a clinical trial.
- Present the results of the analysis with clarity, in a structured and correct manner.

- Take the final decisions for the correctness of the results and the termination or the interruption of a clinical trial.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

- *Working in an interdisciplinary environment*
- *Team work*
- *Decision-making*
- *Search for, analysis and synthesis of data and information, with the use of the necessary technology*
- *Working independently*
- *Production of new research ideas*
- *Production of free, creative and inductive thinking*

SYLLABUS

The course provides an integrated picture on how to design , follow and implement a clinical trial. More specifically the next topics are presented

- Introduction to clinical trials- the basic concepts
- The Phases of a clinical trial
- The protocol
- Single-blind and double-blinded clinical trial, ethical issues
- Randomization
- Parallel designs of one and two groups
- Cross over design
- Bioequivalence
- Group sequential designs.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Eclass email**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	***Semester workload***
Lectures	30
Laboratory practice	9
Homework (assignment preparation)	18
Non guided study	50
Exam preparation	40

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	Exams participation: 3 **Course total: 150**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam at the end of the semester. The final written exam includes both essays questions and exercises **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester. It is based on 70% on the final written exam and 30% on the homework assignments.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture Notes
- Freidman LM, Funberg CD, DeMets DL (2010). Fundamendals of Clinical Trials, Springer 4th Ed.
- Meinert, C.L. (1986). Clinical Trials — Design, Conduct and Analysis, Oxford University Press, New York.
- Peto, R., Pike, M.C., Armitage, P. et al. (1976). Design and analysis of randomized clinical trials requiring prolonged observation of each patient: I Introduction and Design, Br. J. Cancer 34: 585–612.
- Pocock, S.J. (1983). Clinical Trials, John Wiley and Sons, Chichester.
- Pocock, S.J., Geller, N.L. and Tsiatis, A.A. (1987). The analysis of multipleend-points in clinical trials, Biometrics 43: 487–498.
- Whitehead, J. (1986). Sample sizes for phase II and phase III clinical trials, in ikatantegrated approach, Statist. Med. 5: 459–464.

M5 STATISTICAL METHODS IN DATA MINING

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΘΕΔ39	**SEMESTER**	1st
COURSE TITLE	STATISTICAL METHODS IN DATA MINING		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA139/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aims of the course are (a) to understand the organization of information in data warehouses from a data mining perspective, (b) to study core data mining techniques (knowledge discovery in data - KDD), such as classification, clustering, and association rules techniques, (c) the presentation of applications and case studies of mining results, focusing on mining from large databases, and (d) the introduction to advanced KDD techniques (mining temporal / spatial knowledge, extracting knowledge from text, etc.), as well as to topics that are interesting from a research point of view. Finally, the course includes laboratory lectures for hands-on experience on Postgresql and Python.

After successful completion of the course, the student should be able:

- Understand the role of and benefits from data mining
- Understand the main categories of problems and representative solution methods
- Know the issues that arise in databases and ways to address them
- Use well-known software packages to solve data mining problems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Project planning and management
- Production of free, creative and inductive thinking

SYLLABUS

The course provides an introduction to data mining. Indicative data mining problems and representative solution methods that are covered include: classification (k-nearest neighbor (k-NN), decision trees, neural networks), clustering (hierarchical and partitioning algorithms, density-based algorithms, online / incremental algorithms, algorithms for large databases, algorithms for categorical data), association rules (algorithms for finding frequent item-sets), deep learning (design, training, and application of deep neural networks). Lectures are accompanied by laboratory lessons using tools such as Postgresql and Python.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class, email, software
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work,*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: Essay/report and oral examination.

Activity	***Semester workload***
Lectures	30
Laboratory practice	9
Study and analysis of bibliography	54
Project	34
Essay writing	20
Exams	3
Course total	**150**

essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester. The knowledge and skills acquired by the students are evaluated as a whole. Emphasis is given on the degree of understanding the concepts and methods.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture Notes
- G. Joel (2021). Επιστήμη Δεδομένων: Βασικές Αρχές και Εφαρμογές με Python, 2η έκδοση, Παπασωτηρίου.
- M. J. Zaki, W. Meira, Jr. (2017). Εξόρυξη και Ανάλυση Δεδομένων: Βασικές Έννοιες και Αλγόριθμοι, Κλειδάριθμος.
- M. H. Dunham (2004). "Data Mining – Εισαγωγικά και Προηγμένα Θέματα Εξόρυξης Γνώσης από Δεδομένα". Εκδόσεις Νέων Τεχνολογιών.
- P.-N. Tan, M. Steinbach, V. Kumar (2010). "Εισαγωγή στην Εξόρυξη Δεδομένων". Εκδόσεις Τζιόλα.
- Jiawei Han, Micheline Kamber, Jian Pei (2011). "Data Mining: Concepts and Techniques", Third Edition, The Morgan Kaufmann Series in Data Management Systems.
- S. Theodoridis (2015). "Machine learning: a Bayesian and optimization perspective", Academic Press.
- C.M. Bishop (2006). "Pattern recognition and machine learning", Springer.
- Κ. Διαμαντάρας, Δ. Μπότσης (2019). "Μηχανική Μάθηση", Εκδόσεις Κλειδάριθμος ΕΠΕ.
- S. Haykin (2010). Νευρωνικά Δίκτυα και Μηχανές Μάθησης, Εκδόσεις Παπασωτηρίου.
- Κ. Διαμανταράς (2007). Τεχνητά Νευρωνικά Δίκτυα, Εκδόσεις Κλειδάριθμος.

M6 STATISTICAL QUALITY CONTROL

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΣΕΠ37	**SEMESTER**	1st
COURSE TITLE	STATISTICAL QUALITY CONTROL		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA113/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is course is to acquaint the students with the main techniques of Statistical Process Control and Acceptance Sampling, so that they can use or develop them to deal with real problems. Students should participate in the 13 lectures held during the semester (3 hours each).

After successful completion of the course, the student should be able:

- to use effectively tools of statistical process control
- to design, use, and interpret control charts for variables
- to design, use, and interpret control charts for attributes
- to perform analysis of process capability and measurement system capability.
- to design, use, and interpret EWMA, CUSUM and Moving Average control charts.
- to design acceptance sampling plans for attributes and to apply proper standards (MIL-STD-105E, ANSI/ASQC Z4).
- to design acceptance sampling plans for variables and to apply the standard MIL-STD-414 (ANSI/ASQC Z9)

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision making
- Working independently
- Teamwork
- Production of new research ideas
- Project planning and management
- Production of free, creative, and inductive thinking

SYLLABUS

The course presents the main methods of Statistical Process Control and Acceptance Sampling. Emphasis is given on how to apply them and analyze the corresponding data using the statistical package Statgraphics.

The content of the course is as follows.

Basic concepts of statistical process control: Histogram, check sheet, cause and effect diagram, defect concentration diagram, Pareto chart and analysis, control charts, sigma limit model and probability limit model, control limits, center line, warning limits, natural tolerance limits of a process, rational subgrouping, in and out of control average run length, OC curve, Phase I and Phase II control charts.

Shewhart type control charts for variables: X-bar, R, S, S^2, X and MR control charts.

Shewhart type control charts for attributes: p, np, c, and u control charts.

Capability analysis: Capability indices C_p, C_{pk}, C_{pm} and C_{pmk}, confidence intervals, capability analysis of a process through control diagrams. Evaluation of the measurement system.

Acceptance Sampling: Simple sampling plans, characteristic curve, producer and consumer risk, design of simple sampling plans, average outgoing quality and its limit, average number of inspected units and their average percentage, rectifying inspection and average sample size, double, multiple, sequential and Dodge-Roming sampling plans, sampling system MIL STD 105E, method K and M, the sampling system MIL STD 414.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Eclass, email, statistical packages in PC	
TEACHING METHODS	***Activity***	***Semester workload***

The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Lectures	30
Laboratory practice	9
Homework (assignment preparation)	36
Non guided study	42
Exam preparation	30
Exams participation	3
Course total	**150**

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

LANGUAGE OF EVALUATION: Greek

EVALUATION METHODS:

• Assignment evaluation during the semester

• Written exam (theory and laboratory) at the end of the semester.

The theory exam consists of a combination of multiple-choice questions, short-answer questions, and problem-solving questions. The laboratory examination is done using a computer and is based on the analysis of experimental data and the answer to specific research questions.

EVALUATION CRITERIA:

The assessment method for the final grade is announced to the students during the semester. It is based on the score of the final exam and the average scores of the assignments submitted by the students during the semester.

ATTACHED BIBLIOGRAPHY

- Προτεινόμενη Βιβλιογραφία:

1. Lecture Notes
2. Bersimis, S., Rakitzis, A. & Sachlas, A. (2021). Statistical Process Control, Tziolas Press, Thessaloniki (in Greek).
3. Chandra, M. J. (2001). Statistical Quality Control, CRC Press.
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9. Ryan, T. P. (2000). Statistical Methods for Quality Improvement, Second Edition, John Wiley & Sons, Inc.
10. Tagaras, G. (2001). Statistical Process Control, Ziti Press, Thessaloniki (in Greek).
11. Wheeler, D. J. & Chambers, D. S. (1992). Understanding Statistical Process Control, Second Edition, SPC Press.

SPRING CEMESTER COURSES

M7 GENERALIZED LINEAR MODELS

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΓΓΜ10	**SEMESTER**	2nd
COURSE TITLE	GENERALIZED LINEAR MODELS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA123/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to familiarize students with the techniques of Generalised Linear Models (GLM) so that they can apply them using appropriate statistical packages in the analysis of data derived from real-life problems. Students must participate in person to the theoretical and laboratory classes held during the semester (3 hours each).

After successful completion of the course, the student should be able:

- To explain, even to non-specialists, how the techniques of Generalised Linear Models are expected to provide information in various scientific areas and in applied problems of practical interest, where there is a need to make predictions under conditions of uncertainty;
- to recognize when GLM techniques are applicable, based on the description of a real problem and choose the appropriate model for statistical analysis;
- to analyse the problem using the available data;
- to be familiar with, and capable of, taking advantage of the properties of the model that the student has chosen;

- to apply appropriately the selected GLM techniques and check the conditions that are necessary so that the results obtained using the selected statistical methodology be valid;
- to assess comparatively the results and the performance of different models and select the most suitable model for the problem under consideration;
- to assess the validity of the results from the analysis and revise them, if needed;
- to interpret the main findings of the model fitting and present the conclusions derived by the statistical analysis of the data (both written and verbally), correctly, with clarity and coherence;
- to make the final decisions on the problem under consideration or give all the necessary information to the decision makers to make appropriate decisions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision making
- Working independently
- Teamwork
- Production of new research ideas and research results
- Work in an interdisciplinary environment
- Working in an international environment
- Project design and administration
- Production of free, creative, and inductive thinking

SYLLABUS

The course provides a comprehensive description of generalised linear models, presenting the main types of such models and the techniques used, with special emphasis on how to apply them in analysing data using a statistical package (R).

First, the need to use generalized linear models is explained, in cases where the assumptions of the classical regression model are not satisfied, and the exponential family of distributions is presented. Logistic regression and loglinear models with or without overdispersion are studied in detail, outlining the common features and the differences between these types of models. Further, the concepts of odds and odds ratios, along with their use withing a GLM context, are discussed.

The use of generalized linear models to analyze data in contingency tables, as well as models with multinomial responses, is also presented. Finally, the main diagnostic and model selection methods are given.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Email, eclass, MS Teams**
TEACHING METHODS	

Activity	*Semester workload*
Lectures	30

The manner and methods of teaching are described in detail. *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Laboratory practice: 9 Homework (assignment preparation): 48 Non guided study: 57 Exam preparation: 40,5 Exams participation: 3 **Course total: 187,5**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The final written exam consists of a combination of various types of questions; True/False questions, answers to questions based on output from the R package, while the students are also assessed in the lab, carrying out data analysis and answering questions related to the given data. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students at the beginning of the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Couse Notes, provided by the lecturers
- Agresti, A. *Categorical Data Analysis*. Wiley, 3rd edition, 2012.
- Agresti, A. *An Introduction to categorical data analysis*. Wiley, 3rd edition, 2018.
- Aitkin, M. Anderson, D., Francis, B. and Hinde, J. *Statistical Modelling in GLIM*. Oxford Statistical Science Series, 1989.
- Collett, D. Modelling binary data. Chapman & Hall, 2003.
- Dobson, A. *An introduction to generalized linear models* (2nd edition). Chapman & Hall, 4th edition, 2018.
- Dunn, P. and Smyth, J.K. *Generalized Linear Models with Examples in R.* Springer Texts in Statistics, 2018.
- Fahrmeir, L. and Tutz, G. *Multivariate statistical modelling based on generalized linear models.* Springer, 2001.
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- Kleinbaum, D.G., Kupper, L.L. Muller, K.E. and Nizam, A. *Applied Regression Analysis and other multivariate methods* (3rd edition). Duxbury Press, 1998.
- Liao, T.F. *Interpreting probability models: logit, probit and other generalized linear models*. Sage publications, 1994.
- McCullagh, P. and Nelder, J.A. *Generalised Linear Models* (2nd edition). Chapman & Hall, 1989.
- Myers, R. Montgomery, D. and Vining, G. G. *Generalized Linear Models: with applications in engineering and the sciences.* Wiley, 2002.

- Selvin, S. *Modern Applied Biostatistical Methods Using Splus*. Oxford University Press, 1998.
- Venables, W.N. and Ripley, B.D. *Modern Applied Statistics with S* (3rd edition). Springer, 2002.

M8 SURVIVAL ANALYSIS

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΑΕΠ05	**SEMESTER**	2nd
COURSE TITLE	SURVIVAL ANALYSIS		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA131/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is course is to acquaint the students with the main techniques of Survival Analysis for analyzing censored data, so that they can use or develop them to deal with real problems. Students should participate in the 13 lectures held during the semester (3 hours each).

After successful completion of the course, the student should be able:

• to understand the basic theory of survival analysis and identify characteristics of censored data.

• to understand the relationship between the survival function, distribution function, hazard function, relative hazard, and cumulative hazard function.

• to perform univariate analyses of survival data using the Kaplan-Meier and Nelson-Aalen estimators.

• to perform and interpret two-sample analyses of survival data using common statistical procedures such as the log-rank, Breslow and Tarone-Ware test.

• to fit parametric regression model and the proportional hazards model to survival data and to interpret the regression coefficients

• to incorporate time-dependent covariates in the proportional hazards model

• to use graphical methods and other methods to assess the adequacy of fitted models

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision making
- Working independently
- Teamwork
- Production of new research ideas
- Production of free, creative, and inductive thinking

SYLLABUS

The course presents the main statistical methods used in Survival Analysis. Emphasis is given on how to apply them and analyze the corresponding censored data using statistical packages (SPSS, R).
The content of the course is as follows.

Introduction: Survival function, hazard function and cumulative hazard function for discrete and continuous random variables. Censored data and types of censoring. Likelihood theory review. Delta method.

Non-parametric estimation of the survival function: Life tables for censored data, actuarial assumption, Greenwood's formula. Kaplan-Meier (MS) estimator of the survival function, KM estimator as maximum likelihood estimator. Confidence Intervals and bands for the survival function. Estimation of the cumulative hazard function, Nelson-Aalen estimator, Fleming-Harrington estimator. Estimation and confidence intervals for quantiles.

Comparing survival functions: Logrank, Breslow, Tarone-Ware, Peto-Peto, modified Peto-Peto and Flemming-Harrington test to compare survival functions of two or more groups. Stratified and trend tests.

Semi-parametric estimation of the survival function: The Cox proportional hazard model, partial likelihood, estimation and confidence intervals for the model parameters. Model selection. Estimation of the survival function and the cumulative hazard function.

Assessment of the proportional hazard assumtion: Time-dependent covariates, stratified Cox model, graphical methods. Residuals Analysis (Cox-Snell, modified Cox-Snell, martingale, deviance, Schoenfeld, scaled Schoenfeld, rescaled Schoenfeld, score and scaled score (or Delta-Beta) residuals).

Parametric estimation of the survival function: Exponential, Weibull, log-logistic and log-normal regression model and the equivalent log-linear models. Accelerated failure time models. Diagnostic methods for parametric models.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Eclass, email, statistical packages in PC
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	30
Laboratory practice	9
Homework (assignment preparation)	48
Non guided study	60
Exam preparation	37.5
Exams participation	3
Course total	**187,5**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The theory exam consists of a combination of multiple-choice questions, short-answer questions, and problem-solving questions. The laboratory examination is done using a computer and is based on the analysis of experimental data and the answer to specific research questions. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester. It is based on the score of the final exam and the average scores of the assignments submitted by the students during the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Lecture Notes
2. Andersen, P. K., Borgan, Ø., Gill, R.D. and Keiding, N. (1995). *Statistical Models Based on Counting Processes*, Springer Verlag, New York.
3. Collett, D. (2003). *Modelling survival data in medical research*, Chapman & Hall/CRC.
4. Cox, D. R. and Oakes, D. (1984). *Analysis of survival data*, Chapman & Hall/CRC.
5. Hosmer, D. W. and Lemshow, S. (2008). *Applied survival analysis*, John Wiley, New York.
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8. Klein, J. P. and Moeschberger, M. L. (2003). *Survival analysis: Techniques for censored and truncated data*, Springer Verlag.

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12. Therneau, T. and Grambsch P. (2000). Modeling Survival Data: Extending the Cox Model, Springer-Verlag.

M9 APPLIED MULTIVARIATE ANALYSIS

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΕΠΑ21	**SEMESTER**	2nd
COURSE TITLE	APPLIED MULTIVARIATE ANALYSIS		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA126/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to familiarize students with the techniques of Multivariate Analysis so that they can apply them using appropriate Statistical Packages or/and other programming languages in the analysis of data derived from real-life problems. Students must participate in person to the theoretical and laboratory classes held during the semester (3 hours each).

After successful completion of the course, the student should be able:

- to explain even to non-specialists how the techniques of Multivariate Analysis are expected to provide valuable information in various scientific areas and in applied problems of practical interest where there is a need to analyze data calling for the simultaneous study of many characteristics.
- to recognize when the Multivariate Analysis techniques are applicable, based on the description of a real problem and choose the appropriate model for its Statistical study,
- to analyze the problem using the available data,
- to be familiar with and capable of taking advantage of the properties of the model he/she has chosen,
- to apply appropriately the selected Multivariate Analysis techniques and check the conditions that are necessary so that the results obtained using the selected statistical methodology be valid,

- to assess the validity of the analysis results and revise them, if deemed necessary;
- to interpret the data he processed and present (written and verbal) the conclusions derived by the Statistical Analysis of the data, correctly, with clarity and rationality,
- make the final decisions on the problem under consideration or give all the necessary information to the decision centers that have the authority to make the final decisions on the problem under consideration.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision making
- Working independently
- Teamwork
- Production of new research ideas and research results
- Work in an interdisciplinary environment
- Working in an international environment
- Project design and administration
- Production of free, creative, and inductive thinking

SYLLABUS

The course provides a comprehensive presentation of Multivariate Analysis techniques, with particular emphasis on how to apply them using a statistical package. The theoretical background of these techniques is taught as well so that the students gain a better understanding of them and also develop the potential to modify them if the nature of the problem they are studying requires it.
In particular, the course covers the following topics:

- Random vectors and matrices
- Multivariate normal distribution,
- Principal component analysis,
- Analysis of factors,
- Separative analysis,
- Cluster analysis.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class, email, Statistical software (packages), programming languages (Mathematica), PowerPoint presentations
TEACHING METHODS *The manner and methods of teaching are described in detail.*	

Activity	*Semester workload*
Lectures	30
Laboratory practice	9

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Homework (assignment preparation): 40 Non guided study: 55,5 Exam preparation: 50 Exams participation: 3 **Course total: 187,5**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The final written exam, for both theory and lab, consists of a combination of multiple-choice questions and problem-solving exercises. It also includes examination of students' ability to make decisions on specific practical questions by "reading" the outputs of Statistical Packages as they arise from the analysis of experimental data or/and the results obtained by setting up programs in specific programming languages (Mathematica or R). **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students during the semester. It is based on the score of the final exam and the average scores of the assignments submitted by the students during the Semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecture Notes
- Aldenderfer, M. S., Blashfield, R. K. (1984). *Cluster Analysis*, Sage Publ., Beverly Hills and London.
- Anderberg, M. R. (1973). *Cluster analysis for applications*, Academic press, New York.
- Everitt, B. S. and Dunn, G. (1991). *Applied Multivariate Data Analysis*, Arnold, New York.
- Everitt, B.(1981). *Cluster Analysis*, Heinemann Educational Books, London.
- Fan, J., R. Li, C.-H. Zhang, and Zou, H. (2020). Statistical Foundations of Data Science. Chapman; Hall / CRC.
- Flury, B. and Riedwyl, H. (1988). *Multivariate Statistics : A practical approach*, Prentice Hall, New York.
- Gordon, A. D. (1999). *Classification*, (2nd ed.), Chapman and Hall, London.
- James, G., D. Witten, T. Hastie, and Tibshirani, R. (2021). An Introduction to Statistical Learning with Applications in R. 2nd ed. Springer.
- Johnson, R. A. and Wichern, D. W. (1998). *Applied Multivariate Statistical Analysis*, Prentice Hall, New Jersey.
- Kaufman, L. and Rousseeuw, P. J. (1990). *Finding Groups in Data: An Introduction to Cluster Analysis*, Wiley, New York.
- Krzanowski, W. J. (1988). *Principles of Multivariate Analysis : A user's perspective*, Oxford University Press, U.K.
- Manly, B. F. J. (1986). *Multivariate Statistical Methods*: *A primer*, Chapman and Hall, London.
- Tinsley, H. and Brown, S. (2000). *Handbook of Applied Multivariate Statistics and Mathematical Modeling*. Academic Press.

- Toit, S. H. C., Steyn, A. G. W. and Stumpf, R. H. (1986). *Graphical Exploratory Data Analysis*, Springer-Verlag, New York.

M10 SIMULATION METHODS

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΜΠΡ24	**SEMESTER**	2nd
COURSE TITLE	SIMULATION METHODS		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA130/		

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The purpose of this course is the introduction to the theory of simulation methods (Monte Carlo estimation, process simulation) and mainly the practical application of these methods in various scientific areas (option pricing, hypothesis testing, neural networks, queueing systems, inventory control systems, reliability systems, risk management, biostatistics) to solve complex problems that are very difficult to handle with analytical methods. The course is taught entirely in the computer labs using appropriate software (mainly Wolfram Mathematica).

After successful completion of the course, the students should be able to:

• understand the basic concepts of stochastic simulation methods in connection with applications in various research areas.

• select and develop appropriate techniques for the empirical study of complex stochastic models in various scientific areas (mainly related to the directions of the postgraduate program).

• build appropriate simulation algorithms of stochastic models and implement them using appropriate computational software for the empirical assessment of various characteristics of the stochastic models of interest.

• interpret, evaluate, and present the results and conclusions of the empirical study conducted.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision making
- Working independently
- Teamwork
- Work in an interdisciplinary environment
- Production of new research ideas
- Production of free, creative, and inductive thinking

SYLLABUS

• Introduction to the computational software Wolfram Mathematica

• Pseudorandom Numbers, Monte Carlo Integration

• Generating Random Numbers from Discrete and Continuous Distributions. The methods of inversion, rejection. Generation of random numbers from various distributions (Geometric, Poisson, Binomial, Uniform, Exponential, Beta, Gamma, etc.)

• Generating random numbers from the Normal distribution. The polar (Box-Muller) method. Generating random numbers from a multivariate normal distribution.

• Simulation of homogeneous and non-homogeneous Poisson Process

• Simulation of Brownian Motion and Geometric Brownian Motion

Applications in:

• Finance: Simulating prices of financial products. Profit estimation of investment strategies. Valuation of the fair value of derivatives. The Black and Scholes formula. Exotic options. Simulation of stochastic differential equations.

• Operations Research: Queueing systems simulation. Optimization of inventory control systems via simulation.

• Quality Control: Simulation and empirical comparison of alarm signaling rules in Shewhart-type control charts.

• Estimation theory and Hypothesis Testing: Efficiency comparison of estimators via simulation. Estimation of critical points, p-value, power by simulating Hypothesis Tests.

• Credit Risk: Simulation of Credit Default Swaps (CDS), estimation of the present value of the premiums leg and the protection leg, CDS spread estimation.

• Artificial Neural Networks (ANNs): layers, weights, thresholds and neuron activation function, supervised ANN training, back-propagation algorithm, test data. Application to image recognition problems. • Epidemiological models: Simulating the spread process of an infectious disease in a population, study of SIR, SIRD models and their variants (varying reproduction rate, immunity loss, vaccination).

TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face (lectures and lab practice)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>e-class, email, MS Teams. PowerPoint presentations. Wolfram Mathematica.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>30</td></tr>
<tr><td>Laboratory practice</td><td>9</td></tr>
<tr><td>Homework (assignment preparation)</td><td>45</td></tr>
<tr><td>Non guided study</td><td>60</td></tr>
<tr><td>Exam preparation</td><td>40,5</td></tr>
<tr><td>Exams participation</td><td>3</td></tr>
<tr><td>Course total</td><td>187,5</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>LANGUAGE OF EVALUATION: Greek

EVALUATION METHODS:
• Assignment evaluation during the semester
• Written exam (theory and laboratory) at the end of the semester.

The final test consists of problem-solving questions. The laboratory examination is done using Wolfram Mathematica software and is based on the construction and implementation of specific algorithms.

EVALUATION CRITERIA:
The assessment method for the final grade is announced to the students during the semester.</td></tr>
</table>

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

(1) BOUTSIKAS M. (2005) Simulation methods, Lecture Notes (in Greek).

- *Monte Carlo Simulation – Computational Statistics*

(2) ROSS S. (1997) *Simulation* (2nd edition), Academic Press.
(3) GENTLE J.E. (2002) *Elements of Computational Statistics*. Springer – Verlag
(4) RUBINSTEIN R. Y., MELAMED B. (1998) *Modern simulation and modeling*, Wiley.
(5) ROBERT C. P., CASELLA G. (1999) *Monte Carlo statistical methods*, Springer Verlag.
(6) FISHMAN S. G. (1996) *Monte Carlo: Concepts, Algorithms, and Applications*. Springer Verlag.
(7) BREMAUD P. (2002) *Markov Chains: Gibbs Fields, Monte Carlo Simulation, and Queues*. Springer

- *Monte Carlo methods in Finance*

(8) JAECKEL P. (2002) *Monte Carlo Methods in Finance*. John Wiley & Sons.
(9) ROSS S. (1999) *An Introduction to Mathematical Finance*. Cambridge.
(10) GLASSERMAN P. (2004) *Monte Carlo Mehtods in Financial Engineering*. Springer – Verlag

- *Neural Networks*

(11) NIELSEN, M. (2015) *Neural Networks and Deep Learning*. Determination Press
(12) CHARU C. AGGARWAL(2018) *Neural Networks and Deep Learning*. Springer
(13) GOODFELLOW et al. (2016) *Deep Learning Adaptive Computation and Machine Learning*. MIT

M11 EXPERIMENTAL DESIGN

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΠΣΧ28	**SEMESTER**	2nd
COURSE TITLE	Experimental Design		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA129/		

LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The aim of the course is to acquaint the students with the main types of experimental designs and with the analysis of experimental data, so that they can use or develop them to deal with real problems. Students should participate in the 13 lectures held during the semester (3 hours each). Upon successful completion of the course, students will be able to: • analyze a problem under study and choose an appropriate experimental design to use, • know and evaluate the properties of the design they have chosen, • correctly use the design they chose for the collection of experimental data, • choose an appropriate statistical methodology for the analysis of the experimental data, • assess the validity of the results of the analysis and revise it, if necessary • present the results of the analysis with clarity, in a structured and correct manner, • make the final decisions about the problem they examine.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision making
- Working independently
- Teamwork
- Work in an interdisciplinary environment
- Production of new research ideas
- Production of free, creative, and inductive thinking

SYLLABUS

The course presents the main methods of designing experiments in Statistics. Emphasis is given on how to apply them and analyze the corresponding data using a statistical package (R).

The first part consists of an overview of analysis of variance methods. Then, block designs (BIB, Latin and Graeco-Latin squares) are studied. In the next part of the course, 2^k factorial designs (full and fractional) and orthogonal arrays are examined in detail, and in the last part of the course an introduction to Taguchi methodology is presented.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class, email, Statistical software (packages), PowerPoint presentations
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION	Language of evaluation: Greek EVALUATION METHODS:

Activity	***Φόρτος Εργασίας Εξαμήνου***
Lectures	30
Laboratory practice	09
Homework (assignment preparation)	48
Non guided study	60
Exam preparation	37,5
Exams participation	03
Course total	**187,5**

Description of the evaluation procedure *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The theory exam consists of a combination of multiple-choice questions, short-answer questions, and problem-solving questions. The laboratory examination is done using a computer and is based on the analysis of experimental data and the answer to specific research questions. EVALUATION CRITERIA: The assessment method for the final grade is announced to the students during the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

(1) Lecture notes

(2) D.C. Montgomery (2004). Design and Analysis of Experiments, 5th edition, Wiley, New York.

(3) C.F.J. Wu and M. Hamada (2009). Experiments: Planning, Analysis and Parameter Design Optimization, 2nd ed., Wiley, New York.

(4) T.P. Ryan (2007). Modern Experimental Design, Wiley, New York.

(5) G.E.P. Box, W.G. Hunter and J.S. Hunter (1978). Statistics for experimenters, Wiley, New York.

(6) J. Neter, M.H. Kutner, C.J. Natscheim, and W.Wasserman (1996). Applied linear statistical models, 4th ed., Chicago: Irwin.

(7) D.R. Cox and N. Reid (2000). The theory of the design of experiments, Chapman and Hall.

(8) P.G. Mathews (2005). Design of experiments with Minitab, ASQ Quality Press.

M12 TIME SERIES AND FORECASTING

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΜΠΧΠ31	**SEMESTER**	2nd
COURSE TITLE	TIME SERIES AND FORECASTING		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA104/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The current course will provide a thorough presentation of Time Series Econometrics, the branch of Economics that deals with estimation and evaluation of theoretical results based on time series data. The goal of the course is to help students understand how Time Series Analysis works alone and/or in collaboration with Econometric Analysis using real data, rather than forcing students to memorize proofs of several theorems. The tools used in this course allow analyzing time series data and deriving policy conclusions.

After successful completion of the course, the student should be able:

• to study the behavior of time series and generate forecasts
• to make decisions
• to analyze econometric causal relationships
• to determine short-term and long-term changes
• to construct distributed lag models

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Time series analysis and forecasting
- Analysis and prediction of phenomena relative to other variables using time series data
- Working independently
- Decision making
- Construct Forecasts

SYLLABUS

I. INTRODUCTION
Economic Theory and Decision Analysis
II. STATISTICS
A review in Statistics and Estimation and Forecasting
III. ECONOMETRICS
A review in Econometrics with Problems in Estimation and Special Issues. i.e., Lagged Values, Expectations, Proxy Variables. Partial Correlation Coefficients, Trends, Unit Root Test
Lagged Dependent Variables and Difference Equations
IV. TIME SERIES ANALYSIS
A. SMOOTHING TECNIIQUES: Simple Moving Average. Simple Exponential Smoothing, Double Moving Average, Double exponential smoothing – Brown's Method, Holt's Method and Winters' Method
B. TIME SERIES DECOMPOSITION: Seasonal – Trend – Cyclical and Irregular components
C. BOX & JENKINS OR ARIMA (p, d, q) ANALYSIS: Stationarity, Autocovariances -Autocorrelations, Autoregressive Processes, Moving Average Processes, ARMA(p, q) Processes, Extensions of ARMA Processes, Integrated Processes, Seasonal Models, Fractionally Integrated Processes, Model Building, Identification Stage, Parameter Estimation Stage, Model Checking Stage and Forecasts
V. ISSUES IN TIME SERIES ANALYSIS: Testing for a unit aurotegressive root, Difference versus Trend Stationary Processes, Co-integration and Error Correction Model

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	eclass, Labs, Statistical software (packages)

TEACHING METHODS

The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-

Activity	***Semester workload***
Lectures	30
Laboratory practice	9
Homework (assignment preparation)	48
Non guided study	60
Exam preparation	37,5
Exams participation	3
Course total	**187,5**

directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The final written exam focuses on questions related to the course material. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students at the end of the semester and it is based 40% of the homework assignments and 60% on their final exam.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Box, G. E. P. and G. M. Jenkins, Time Series Analysis Forecasting and Control, Holden-Day, Oakland, 1976.

Enders, W., Applied Econometric Time Series, John Wiley & Sons, Inc., New York, 1995.

Fuller, W. A., Introduction to Statistical Time Series, Second Edition, John Wiley & Sons, Inc., New York, 1996.

Granger, C. W. J. and Newbold, P., Forecasting Economic Time Series, Second Edition, Academic Press, Inc., San Diego, 1986.

Hamilton, J. D., Time Series Analysis, Princeton University Press, Princeton, 1994.

Maddala, G. S. and In-Moo Kim, Unit Roots, Cointegration, and Structural Change, Cambridge University Press, Cambridge, 1998.

Mills, T., The Econometric Modeling of Financial Time Series, Second Edition, Cambridge University Press, Cambridge, 1999.

M13 COMPUTATIONAL STATISTICAL TECHNIQUES

COURSE OUTLINE

GENERAL

SCHOOL	FINANCE AND STATISTICS		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	ΣΥΣΤΕ-20	**SEMESTER**	2nd
COURSE TITLE	COMPUTATIONAL STATISTICAL TECHNIQUES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	7,5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://stat.unipi.gr/eclass/courses/EFA162/

LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to introduce modern computational techniques with broad applications in Statistics to students like bootstrap and Markov chain Monte Carlo. Students must participate in person to the theoretical and laboratory classes held during the semester (3 hours each).

After successful completion of the course, the student should be able:

- To apply the basic bootstrap methods in order to estimate standard errors of estimators, compute confidence intervals for quantities of interest and perform simple statistical tests;
- to use bootstrap methods to evaluate candidate regression models based on their predictive ability;
- to program Metropolis-Hastings algorithms and Gibbs samplers in order to simulate from univariate and multivariate distributions and estimate aspects of them;
- to understand the basics of Bayesian Statistics;
- to choose appropriate conjugate prior distributions and find the corresponding posterior distributions;
- to understand the structure of a hierarchical Bayesian model;

• to select variables in Bayesian linear regression with normal errors and to approximate the predictive distribution of new observations as well as to calculate respective point and interval predictions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision making
- Working independently
- Teamwork
- Production of new research ideas and research results
- Work in an interdisciplinary environment
- Working in an international environment
- Project design and administration
- Production of free, creative, and inductive thinking

SYLLABUS

The course consists of two parts. Part I is about bootstrap techniques while part II discusses Markov chain Monte Carlo (MCMC) methods.

Part I: The jackknife. From jackknife to bootstrap. Parametric and nonparametric bootstrap. Estimation of statistics standard errors using bootstrap. Bootstrap confidence intervals (standard, percentile, t, BC_a). Hypothesis testing via bootstrap. Bootstrapping in regression analysis.

Part II: Markov chains in general state space. The Ergodic Theorem. The idea of MCMC methods. Gibbs sampler. Metropolis-Hastings algorithm. Metropolis-within-Gibbs. The basics of Bayesian inference. Hierarchical Bayesian models. Approximate simulation from the posterior distribution using MCMC methods. Bayesian linear regression.

TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face (lectures and lab practice)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Email, eclass, MS Teams

TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-

Activity	*Semester workload*
Lectures	30
Laboratory practice	9
Homework (assignment preparation)	48
Non guided study	57
Exam preparation	40,5
Exams participation	3
Course total	**187,5**

directed study according to the principles of the ECTS	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**LANGUAGE OF EVALUATION**: Greek **EVALUATION METHODS**: • Assignment evaluation during the semester • Written exam (theory and laboratory) at the end of the semester. The final written exam consists of problems which must be solved by writing short R programs in order to answer statistical questions and make corresponding decisions. **EVALUATION CRITERIA**: The assessment method for the final grade is announced to the students at the beginning of the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Couse Notes, provided by the lecturers
- Davison, A.C. and Hinkley, D.V. (1997). Bootstrap methods and their application. Cambridge University Press.
- Efron, B. (1987). The jackknife, the bootstrap, and other resampling plans.
- Efron, B. and Tibshirani, R.J. (1993). An introduction to the bootstrap. Chapman & Hall.
- Gilks, W.R. and Richardson, S. (1998). Markov chain Monte Carlo in practice. Chapman & Hall.
- Good, P. (2005). Permutation, parametric and bootstrap tests of hypotheses. 3rd edition. Springer.
- Marin, J.-M. and Robert, C. (2014). Bayesian essentials with R. Springer.
- Robert, C.P. and Casella, G. (2004). Monte Carlo statistical methods. Springer.