COURSE OUTLINE

(1) GENERAL

SCHOOLS	NATURAL SCIENCES		
ACADEMIC UNIT/UNITS	MATHEMATICS		
TITLE OF MASTER'S DEGREE	COMPUTATIONAL AND STATISTICAL DATA ANALYTICS (MCDA)		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MCDA103	**SEMESTER**	B
COURSE TITLE	DATA-DRIVEN PROBABILISTIC MODELS IN DECISION MAKING PROCESS		

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:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/MATH1071/ https://eclass.math.upatras.gr/courses/MATHDEP241/

(2) 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 goal of this course is to present and apply a set of mathematical techniques to be used for the design, performance and reliability of systems operating under probabilistic rules. For the optimal design of these systems, it is first necessary to identify their structural elements, such as arrival and service processes, by using data-based methods. On the other hand, their optimal performance is closely relying by their reliability, i.e., the probability that the system will perform its intended function during a specified time period under stated conditions. In such a scenario, we aim to study and estimate the reliability of components and systems using lifetime and other data. The course consists of two parts. In the first part, we present data-based techniques to optimize the performance of service systems, while in Part B, we focus on probabilistic models and methods for the study of failure data in the reliability of engineering systems. In the following, we present the detailed course schedule.

Upon completing the course, students are expected to be able to:

- understand the basic concepts of operation and the structure of the problems faced by service systems,

- develop solutions that provide optimal performance measures according to the desires of the decision-maker,
- compare alternative scenarios based on these measures and systematically approach the exploration of the structure of these solutions by thoroughly analyzing how a system works.
- develop and implement mathematical / analytical models to solve these problems,
- understand strategic and operational decision levels and be able to choose the appropriate method of solution to support any type of decision,
- use appropriate software to help make decisions about underlying operating systems that exploit the data provided by their operation,
- be familiar with methods of collecting data from reliability and develop and implement statistical methods of analyzing and interpreting these data to provide engineering information,
- understanding how the design of a system, such as a telecommunications system or an energy distribution system in a large city can lead to improved system performance,
- identify proper system models that appear in modern bibliography and study their attributes related to their reliability by using probability and statistical methods.

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…*

- Decision making.
- Ability to work in an interdisciplinary environment.
- Autonomous work.
- Team work.
- Ability to promote free, productive and inductive thinking.

(3) SYLLABUS

PART A: Service Engineering

Service sector is central in the life of post-industrial societies - more than 70% of the Gross National Product in most developed countries is due to this sector. Important examples are healthcare systems (hospitals), financial services (banks) and telephone and internet services. In concert with this state of affairs, there exists a growing demand for high-quality multi-disciplinary research in the field of services, as well as for a significant number of Service Engineers, namely scientifically-educated specialists that are capable of designing service systems, as well as solving multi-faceted problems that arise in their practice. The course will provide a framework for modeling service systems and techniques that are used to design, analyze, and operate service systems. Our teaching approach is data oriented: examples from various service sectors are presented at lectures and homework assignments, with the call center industry being the central application area. In this course, a service system is viewed as a stochastic network. Thus, the main theoretical framework is queuing theory, which primarily involves a large class of stochastic models. However, the subject matter is highly multi-disciplinary; hence alternative frameworks are useful as well, including ones from Statistics, Psychology, and Marketing.

PART B: Engineering Reliability

The mathematical theory of reliability has grown out of the continually increasing demands of technology. Reliability is the probability of a system performing its purpose adequately for a period of time intended under operating conditions encountered. The teaching of this part of the course concentrates on coherent

system reliability, failure data analysis and maintenance policies. It will be developed the use of probability theory for the study of reliability and life time of the systems, via appropriate probabilistic models and statistical methods for studying reliability data.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures (face to face)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Support of the course via the online platform *eClass* of University of Patras. • Use of specific software (Excel, 4CallCenters etc.)
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*	(see table below)

Activity	*Semester workload*
Lectures	39
Study (no driven)	100
Solving suggested exercises	45
Final examination	3.5
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***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.

Assessment Language: Greek
Assessment Language for Erasmus students: English

Assessment methods:
for Part A:

1. Homework (**30%**): Theoretical, empirical and practical. Empirical analysis will include actual data from a bank's helpdesk (http://ie.technion.ac.il/serveng2013S/callcenterdata/index.html). Practical analysis will be based on two tools: SEEStat and 4CallCenters. The first tool, developed at SEECenter, provides an online graphical environment with transaction data (call centers, hospitals). The second tool supports manpower management (staffing).
2. Presentation and development of topics from international bibliography / articles (**20%**).
3. Written examination (**50%**).

For Part B:

1. Presentation and development of topics from international bibliography / articles (**20%**).
2. Written examination (**80%**).
3. Exercises will be given during the lectures.

Minimum passing grade: 5
Maximum passing grade: 10

(5) ATTACHED BIBLIOGRAPHY

- Barlow, R. (1998). *Engineering Reliability*. SIAM.
- Barlow, R. and Proschan, F. (1981). *Statistical Theory of Reliability and Life Testing.* To Begin With. Reprint edition.
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- Brown, L., Gans, N., Mandelbaum A., Sakov,A., Zeltyn, S., Zhao, L. and Haipeng, S. (2005). *Statistical Analysis of a Telephone Call Center: A Queueing-Science Perspective*. JASA.
- Fitzsimmons, J. and Fitzsimmons, M. (2004). *Service Management: Operations, Strategy, Information Technology.* 4th ed. McGraw Hill.
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- Kuo, W. and Zuo, M. (2003). *Optimal Reliability Modeling*. John Wiley & Sons.
- Leemis, L.M. (2009). *Reliability, Probabilistic Models and Statistical Methods*. 2nd ed. Lightning Source.
- Meeker, W.Q. and Escobar, L.A. (2014). *Statistical Methods for Reliability Data*. John Wiley & Sons.
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- Samaniego, F.J. (2007). *System Signatures and Their Applications in Engineering Reliability*. Springer.
- Whitt, W. (2002). *Stochastic-Process Limits*. Springer.
- Whitt, W. (2017). *Time-varying queues. Queueing Models and Service Management.* (forthcoming).
- Whitt, W. and Zhang, X. (2017). *A data-driven model of an emergency department*. Operations Research for Health Care 12, 1–15.