

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF INFORMATION SCIENCES & TECHNOLOGY		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS		
LEVEL OF STUDIES	1st Cycle (UNDERGRADUATE)		
COURSE CODE	6115	SEMESTER	6 th
COURSE TITLE	Numerical Methods and Optimization in Statistics and Machine Learning		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
Lectures		2	7
Workshops			
Labs		2	
COURSE TYPE	Elective – Scientific Field		
PREREQUISITE COURSES:	Knowledge of topics related to statistical inference, are very useful.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.dept.aueb.gr/en/stat/content/numerical-methods-and-optimization-statistics-and-machine-learning-7-ects		

(2) LEARNING OUTCOMES

Learning outcomes
At the end of the course the student will be able to understand the methodology, usage and limitations and will also be able to implement from first principles advanced numerical methods and numerical optimization methods required for statistical science and machine learning. Among others, the student will be able to identify and fully understand and implement the appropriate statistical method for the concrete problem at hand, program it from first principles in a high level programming environment (e.g. Python or R) and use it for understanding the particular concrete problem or model.
General Competences

(3) SYLLABUS

1. Numerical linear algebra (Matrix decompositions and applications in statistics and machine learning)
2. Iterative methods (Basic concepts in iterative schemes and their convergence, Jacobi, Gauss Seidel, relaxations schemes, iterative methods for eigenvalue problems, applications in statistics and machine learning).
3. Optimization without constraints (First order schemes – Gradient descent, Stochastic Gradient Descent and extensions, Second order schemes – Newton and Quasi Newton schemes, applications in statistics and machine learning)
4. Constrained optimization (Projection schemes, Duality based schemes)
Large scale problems (Subspace iteration methods – Krylov methods, Nonconvex optimization, Heuristic and Evolutionary algorithms, Scalability)

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face			
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	YES			
TEACHING METHODS	Activity	Semester workload		
	Lectures			
	Project			
	Course Total	175		
STUDENT PERFORMANCE EVALUATION	<table><tr><td>Project</td><td></td></tr></table>		Project	
	Project			
Information is available at eclass				

(5) ATTACHED BIBLIOGRAPHY

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