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**	**6th**
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, students will be familiar with the methodology, use and implementation of fundamental computational methods and computational optimization methods used in statistics, data analysis, statistical learning and machine learning. Among other things, students will be able to identify the numerical methods required to address specific theoretical and practical problems in statistics, understand their limitations, and implement them from scratch in computational environments (e.g. Python or R) for data analysis, machine learning and other applications.
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)
5. Large scale problems (Subspace iteration methods – Krylov methods, Nonconvex optimization, Heuristic and Evolutionary algorithms, Scalability)

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	**YES**
TEACHING METHODS	

Activity	***Semester workload***
Lectures	
Project	
Course Total	**175**

STUDENT PERFORMANCE EVALUATION	

Project	

Information is available at eclass

(5) ATTACHED BIBLIOGRAPHY

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