

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF INFORMATION SCIENCES & TECHNOLOGY		
ACADEMIC UNIT	DEPARTMENT OF STATISTICS		
LEVEL OF STUDIES	1st Cycle (UNDERGRADUATE)		
COURSE CODE	6144	SEMESTER	5 th
COURSE TITLE	Theoretical Statistics		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	7
Workshops			
Labs		2	
COURSE TYPE	Elective - General Background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.dept.aueb.gr/en/stat/content/theoretical-statistics-7-ects		

(2) LEARNING OUTCOMES

Learning outcomes
After completing the course, the students ideally should be able to: Implement the standard methods to derive estimates for unknown parameters of a population with a known distribution. Evaluate and compare estimates with respect to standard criteria. Construct confidence intervals for the unknown parameters. Construct statistical tests for hypothesis testing about unknown parameters.
General Competences
• Search, analysis and synthesis of data and information, using the necessary technologies • Adaptation to new situations • Decision-making • Autonomous work • Teamwork • Project planning and management • Respect for diversity and multiculturalism • Respect for the natural environment • Demonstration of social, professional and ethical responsibility and sensitivity to gender issues • Exercise of criticism and self-criticism

(3) SYLLABUS

Basic Concepts and Terminology

Fundamental concepts and terminology of parametric statistical inference: random sample, sample space, parameter space, sampling distribution, and statistical function.

Point Estimation

Point estimation within the framework of statistical decision theory. Loss and risk functions. Criteria for evaluating estimators: unbiasedness, minimum variance, sufficiency, completeness, maximum likelihood, and efficiency. Methods for constructing uniformly minimum variance unbiased estimators (UMVUEs). Fisher information Cramer-Rao-Frechet inequality. The exponential family of distributions. The Lehmann–Scheffé theorem.

Maximum Likelihood Estimation

Maximum likelihood estimation (MLE). Invariance properties of MLEs. Asymptotic properties of maximum likelihood estimators.

Confidence Interval Estimation

The concept and interpretation of confidence intervals for parameter estimation. Methods for constructing confidence intervals. Pivotal quantities and the general pivotal method. Optimal confidence intervals. Asymptotic confidence intervals.

Parametric Hypothesis Testing

Introduction to the theory of parametric statistical hypothesis testing. Formulation of parametric hypotheses. Types of errors, test functions, and power functions. Evaluation and comparison of statistical tests based on their power functions. The Neyman–Pearson lemma and its applications to the construction of uniformly most powerful tests for simple and one-sided hypotheses. Composite hypothesis testing.

Likelihood Ratio Testing

The likelihood ratio test (LRT). Construction and properties of likelihood ratio tests. Asymptotic likelihood ratio tests and their applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	In Teaching and communicating with the students, eclass.	
TEACHING METHODS	Activity	Semester workload
	Lectures	52
	Tutorial	14
	Assignment	39
	Self Study	70
	Course Total	175
STUDENT PERFORMANCE EVALUATION	Written examination at the end of the semester. The instructor may additionally conduct a supplementary oral examination of a selected sample of students, based on an appropriate sampling procedure, the outcome of which shall be taken into consideration in determining the final grade. Information is available at eclass.	

(5) ATTACHED BIBLIOGRAPHY

- Φερεντίνος Κ. και Παπαϊωάννου Τ. (2000) Μαθηματική Στατιστική, 2η Έκδοση, Εκδόσεις Σταμούλη, Αθήνα.
- Κολυβά-Μαχαίρα Φ., Μαθηματική Στατιστική, Εκδόσεις Ζήτη, 1998.
- Φουσκάκης Δ., Ανάλυση Δεδομένων με τη Χρήση της R., Εκδόσεις Τσότρας, 2013.
- Crawley M.J., Στατιστική Ανάλυση με το R., Broken Hill Publishers, 2013.
- Ρούσσας Γ. (1994) Στατιστική Συμπερασματολογία, Τόμος Ι - Εκτιμητική, 2η Έκδοση, Εκδόσεις Ζήτη, Θεσσαλονίκη.
- Ρούσσας Γ. (1994) Στατιστική Συμπερασματολογία, Τόμος ΙΙ – Έλεγχοι Υποθέσεων, 2η Έκδοση, Εκδόσεις Ζήτη, Θεσσαλονίκη.
- Bickel P.J. and Doksum K.A. (2007): Mathematical Statistics, vol.I, 2nd Edition – Updated Printing, Pearson Prentice Hall.
- Casella G. and Berger R. (2002): Statistical Inference, 2nd Edition, Duxbury.
- Mood A.M., Graybill F.A. and Boes D.C. (1974): Introduction to the Theory of Statistics, 3rd Edition, McGraw-Hill Book Company.