UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze Economiche, Aziendali e Statistiche
ACADEMIC YEAR	2019/2020
BACHELOR'S DEGREE (BSC)	STATISTICS FOR DATA ANALYSIS
SUBJECT	STATISTICAL INFERENCE
TYPE OF EDUCATIONAL ACTIVITY	A
AMBIT	50244-Statistico - probabilistico
CODE	19596
SCIENTIFIC SECTOR(S)	SECS-S/01
HEAD PROFESSOR(S)	MUGGEO VITO Professore Ordinario Univ. di PALERMO MICHELE ROSARIO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	147
COURSE ACTIVITY (Hrs)	78
PROPAEDEUTICAL SUBJECTS	19597 - "R" LABORATORY 01736 - PROBABILITY THEORY 20581 - EXPLORATORY STATISTICS 16127 - MATHEMATICS
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MUGGEO VITO MICHELE ROSARIO** Tuesday 10:00 12:00 stanza 217 2° piano

DOCENTE: Prof. VITO MICHELE ROSARIO MUGGEO

PREREQUISITES	The student should be familiar with the basic statistical methods (such as mean, variances, and distributions) and the key issues of probability and mathematics. Some basic notion about the R language would be very useful.
LEARNING OUTCOMES	Knowledge and ability to understand 1. Knowledge of the basic methods underlying the statistical inference. 2. Acquisition of appropriate language and terminology of the discipline. 3. Ability to understand theoretical properties and connections among the different topics Ability to use knowledge and understanding 1. Ability to specify the statistical model and the inferential procedures to use 2. Ability to deal with practical problems by means of the methods gathered in the lessons. 3. Ability to use the statistical environmental R to apply the methods gathered in the lessons and to `check' the theory via simulations. Making judgments 1. To be able to understand critically features, and potentialities and limits of the inferential procedures discussed in class. 2. To be able to frame a typical inferential problem in a wider context Communication abilities 1. To be able to discuss with other people (also non statisticians) the features and key issues of a given problem in inferential terms. 2. To be able to setting up an inferential problem and to use appropriate statistical language Learning ability To be able to use the inference basics in the next courses of applied and methodological statistics.
ASSESSMENT METHODS	Written and oral exam. The written exam aims at assessing the student abilities in setting up a statistical inferential problem with appropriate notation. The coherence of the reported text represents the essential requirement to pass the written test. The oral test aims to study in deep the topics discussed in the written test, and to assess if the student is able to recognize links among different subjects. Using appropriate terms represents one of the most important points to be evaluated. Understanding the rationale of the inferential tools is essential to pass the exam (score 18-20); full grasp of the subjects along with appropriate language leads to a quite good assessment. Finally details and proofs allow the student to get a pretty satisfactory vote. An excellent final vote is granted if the student exhibits full understanding and brilliant performance both in the written and in the oral test.
EDUCATIONAL OBJECTIVES	The course aims to guide the student to the knowledge of basic methodologies of statistical inference and the acquisition of skills to apply the methodologies the statistical analysis problems. To this end, the course provides basic theoretical concepts and basic statistical inference tools, necessary both to differentiate a statistical problem by a mathematical and probabilistic one, and to address concrete problems. The student is addressed to the study and use of parametric statistical inference tools of classic likelihood approach. The student must be able to: i) to use appropriately the language with their discipline terminology, such as parameter, estimator, estimation, sampling distribution; ii) to build a middle-level statistical model, by identifying the probability density function appropriate for modeling various phenomena in question; iii) to derive the estimators with particular emphasis to those of maximum likelihood; iv) to build confidence intervals for the parameters of interest; v) to carry out hypothesis testing through the likelihood-based statistic tests (the likelihoods ratio, Wald, Score and Gradient). All the theoretical arguments developed in the lectures and exercises will be revisited in application terms via computer-statistical laboratory with the use of the R environment. In this context, the student must be able to write code for the development of elementary simulations.
TEACHING METHODS	The course is composed by lectures and exercises delivered both at the blackboard and on the computers.
SUGGESTED BIBLIOGRAPHY	Testi di utile consultazione: • Mood A. M., Graybill F. (1988) Introduzione alla Statistica. McGraw&Hill. [distribuzioni campionarie, stimatori e loro proprieta. Verica di ipotesi] • Azzalini A. (1992) Inferenza statistica : Un'introduzione basata sul concetto di verosimiglianza. Springer&Verlag, Berlin-Heidelberg. [concetto di verosimiglianza e corrispondenti quantita, score e informazione. Il modello

	lineare] Testi suggeriti per approfondimenti • Muggeo V., Ferrara G. “Il linguaggio R: concetti introduttivi ed esempi”, http://cran.r-project.org/doc/contrib/nozioniR.pdf [introduzione al linguaggio R] • Casella G, Berger R.L., (1990) Statistical Inference, Wadsworth. [approfondimenti]

SYLLABUS

Hrs	Frontal teaching
8	Introduction to statistical inference. Basic concepts and definitions. The Model Probabilistic-Statistical parametric. Likelihood and amount 'connected. Main parametric inferential procedures: model specification, point and interval estimation, hypothesis testing.
8	Sample statistics. Statistics and their sampling distribution. Sufficency
8	Point estimate. Property 'of the estimators: unbiasedness, consistency, efficiency; Exact and asymptotic distribution. Construction methods of point estimators: The maximum likelihood method, the minimum distance methods; the method of moments
8	Interval estimation. Definition of nominal confidence level and interval estimator; property. methods of building confidence intervals; exact and approximate pivot quantities. Comparisons between interval estimators.
8	Testing hypotheses. Introductory concepts: simple and composite hypothesis, statistical test, acceptance and rejection regions, the first and second type errors, the test size, power function. Methods of building of statistical tests: the likelihoods ratio test, Wald test, the Rao score tests and the gradient test.
8	The classical linear regression model. Specification, the weak and stronger assumptions. Least square and maximum likelihood estimation, confidence intervals and hypothesis testing

Hrs	Practice
6	Statistical sampling distributions, expected value and variance. Exact and asymptotic distributions. The simulations to obtain a Monte Carlo estimate of the sampling distributions.
6	Jensen's inequality and linearization of random variables. The linearization method for the approximate calculation of bias and variance (Delta method); basics of numerical iterative methods of Fisher and Newton-Raphson.
6	Interval estimation and verification of coverage of confidence intervals through simulations
6	Hypothesis testing and computation of size and power of the test through simulations.
6	Inference on the classical linear regression model and outline on the correlation coefficient. Implementation in R.