UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze Economiche, Aziendali e Statistiche
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	STATISTICS AND DATA SCIENCE
SUBJECT	STATISTICAL MODELS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50606-Statistico
CODE	07979
SCIENTIFIC SECTOR(S)	SECS-S/01
HEAD PROFESSOR(S)	CHIODI MARCELLO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	162
COURSE ACTIVITY (Hrs)	63
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**CHIODI MARCELLO** Tuesday 15:00 17:00 stanza del docente (edificio 13); eccezionalmente su teams Friday 12:00 13:00 stanza del docente (edificio 13); eccezionalmente su teams

DOCENTE: Prof. MARCELLO CHIODI

PREREQUISITES	Knowledge of the foundations and methods of classical statistical inference (at the level of Statistical Inference STAD) and of inference on Linear Models (at the level of Linear Models STAD); ability to use the statistical programming environment R at intermediate level, or other scientific opensource languages (e.g. Python)
LEARNING OUTCOMES	Knowledge and understanding 1. Knowledge of advanced methods of classical statistical inference (based on the likelihood approach). 2. Knowledge of basic methods of Bayesian inference. 3. Understanding of the theoretical justifications of methods and techniques learnt in previous courses. Applying knowledge and understanding 1. Ability to specify the statistical model with a critical approach, starting from the study objectives. 2. Ability to use in an integrated way the knowledge acquired in previous courses to deal with real application problems, including non-standard ones. 3. Ability to derive theoretical results in a formal way. Making judgements 1. Critical understanding of features, potentials and limitations of statistical models already known, and ability to enrich them with extensions and new features when needed. Communication 1. Ability to discuss the characteristics of a given inferential problem, both with other statisticians and with non statisticians. 2. Ability to write a scientific-technical report, focussed on the statistical model chosen to cope with a real problem and on the subject-matter interpretation of the results. Lifelong learning skills 1. Ability to use the advanced notions acquired in successive Statistics and Applied statistics courses and for the final thesis. 2. Ability to consult and understand the international statistical literature, in order to update knowledge and technical skills.
ASSESSMENT METHODS	Final written and oral exams. The written exam consists in the analysis of a real dataset at the computing lab, using the statistical programming environment R. The candidate usually has three hours available, at the end of which (s)he must hand in a technical report. The written exam has only two possible outcomes: "Admitted to the oral exam" vs. "Not admitted to the oral exam". The necessary requirement for passing this written exam is that the candidate shows a sufficient ability: (i) to use in an autonomous and critical way the statistical methods learnt in class for analysing the specific problems characterising the proposed dataset; (ii) to interpret the statistical results found; (iii) to write a technical report. The oral exam, which can only be taken by the students who have passed the written test, consists of two phases: (i) discussion of the final technical report handed in by the candidate at the end of the written test; (ii) assessment of the knowledge and ability of the candidate to illustrate and discuss the main theoretical results taught in the front classes. In case of success, the final grade (expressed in the 18/30 - 30/30 range, plus the possible "laude") will mirror: (i) the global level of achievement, in the written exam, of the "Learning outcomes", with particular reference to those listed in the previous section under the entries sub. 2 and 4.2 (up to a max of 15/30); (ii) the global level of achievement, in the oral exam, of the "Learning outcomes", with particular reference to those listed in the previous section under the entries 1.1, 1.2, 1.3, 2.3, 4.1 (up to a max of 15/30). The final grade will be obtained by summing the two components. To pass the exam, i.e. to obtain a grade not below 18/30, the student must show a SUFFICIENT level of achievement of the "Learning outcomes" in both the written and oral exam. To achieve the maximum grade of 30/30, the student must show an OPTIMAL level of achievement of the "Learning outcomes" in both the written and oral exam. The "laude" is reserved to the students who show an excellent mastering of the course contents and a remarkable level of critical approach in their use.
EDUCATIONAL OBJECTIVES	This course aims at enriching the theoretical and applicative know-how of the student in the area of statistical modelling, discussing: 1) developments in the field of non linear regression-type models (GLM and extensions); 2) some critical aspects of classical parametric inference; 3) the basics of Bayesian inference. The theoretical part, taught in the front classes, will be complemented from the applications point of view in laboratory tutorials, carried out in the R environment. After successfully attending this course, proficient students should

	be able: (i) to specify an appropriate GLM or another model for the data at hand, making inference on it and interpreting the results; (ii) to recognise situations where an extension of standard GLMs is needed, specify an appropriate model and make inference on it; (iii) to have a critical approach to the modelling process; (iv) to build up on the introductory notions on Bayesian inference.
TEACHING METHODS	Front class teaching, computing lab tutorials, analysis of real case studies.
SUGGESTED BIBLIOGRAPHY	a)appunti di lezione (lecture notes); b)Agresti, A., (2015) Foundations of Linear and Generalized Linear Models-Wiley eds. c) Mc Cullagh, Nelder, (1989) Generalized Linear Models-Chapman and Hall eds. d) Wood, S. (2006) , Generalized Additive Models_ An Introduction with R-Chapman and Hall e) Pawitan, Y. (2001) In All Likelihood. Oxford Science Publications, Oxford

SYLLABUS

Hrs	Frontal teaching
14	(a) recall on linear models, ordinary and general, linear predictors and design matrix configuration. Multivariate Normal Distribution. Asymptotic theory of multiparametric inference in regular cases.
6	General approaches to inference. A brief Introduction to Bayesian inference. Prior and posterior distributions; the role of likelihood. Bayesian point and interval estimation. Assessment of hypotheses: Bayes factor. Bayesian prediction. Classical inference and basic concepts on penalization techniques
16	Generalized linear models. Model components and their different roles: linear predictor, link function, exponential family distributions. Numerical methods for parameters estimation (IWLS). Asymptotic properties. Residuals, diagnostic. Model comparison and selection. Computational issues.

Hrs	Workshops
23	Advancements in regression-type models: laboratory tutorials with R. GLM: examples on different distributions, case studies, R software and specific packages. Parameter estimation, interpretation of results, model comparison, diagnostic. Some application of simulation techniques
4	(b) Advancements in classical statistical modelling: laboratory tutorials with R.