UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	
ACADEMIC YEAR	
ANNO ACCADEMICO EROGAZIONE	
SUBJECT	
CODE	
SCIENTIFIC SECTOR(S)	
HEAD PROFESSOR(S)	MUGGEO VITO Professore Ordinario Univ. di PALERMO MICHELE ROSARIO
OTHER PROFESSOR(S)	
CREDITS	
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	
TERM (SEMESTER)	
ATTENDANCE	
EVALUATION	
TEACHER OFFICE HOURS	**MUGGEO VITO MICHELE ROSARIO** Tuesday 10:00 12:00 stanza 217 2° piano

DOCENTE: Prof. VITO MICHELE ROSARIO MUGGEO

PREREQUISITES	Elements of statistical inference. Fundamentals of multiple regression models and generalized linear models
LEARNING OUTCOMES	Knowledge and understanding skills. Knowledge of the methodologies of Bayesian and nonparametric statistics. Acquisition of the language and terminology proper to the discipline. Ability to understand the derivations, theoretical properties and internal connections of the methods presented. Ability to apply knowledge and understanding Ability to deal with concrete problems with the methods acquired during the lectures. Ability to use the R statistical environment to apply the methods acquired during the frontal lectures and to verify theoretical results by simulation. Autonomy of judgment Be able to critically understand characteristics, potentials and limitations of Bayesian and nonparametric methods. Be able to frame a specific problem in Bayesian and nonparametric terms. Communication skills. Be able to discuss the characteristics of a given problem. Be able to use statistical terminology and problem formalization in a written exposition. Learning skills Be able to consult scientific literature on the subject; ability to learn extensions of models studied in lecture; ability to learn specialized statistical software even different from that used in the classroom.
ASSESSMENT METHODS	The examination will consist of a written test and an oral discussion (contingent on passing the written test). The written test will consist of an analysis of a dummy dataset and its implementation in R.
EDUCATIONAL OBJECTIVES	The course guides the student toward knowledge of the methodologies of Bayesian statistics and the acquisition of the ability to apply these methodologies to real practical cases. By the end of the course, the student should be able to recognize the merits and demerits of Bayesian techniques compared to classical ones, and describe complex real-world data sets by exploiting the techniques learned.
TEACHING METHODS	The course will be taught in English and will be divided into lectures and exercises. All theoretical topics developed in the lectures will be approached in applied terms through computer-statistical laboratory activities using the R programming environment. During the "Bayesian Statistics" module, group work and analysis reports will be organized with students' independent presentations and conducting activities in homework mode for discussion in the classroom. R software will be used for dataset analysis.
SUGGESTED BIBLIOGRAPHY	* Eilers, P. G. and Marx, B. D. (2021). Practical Smoothing: the joys of P-splines. Cambridge University Press. * Wood S. (2006) Generalized Additive Models: an introduction with R, CRC

SYLLABUS

Hrs	Frontal teaching
2	Introduction to nonparametric modeling. From linear regression model to "flexible" regression model using "smoothing". Polynomials for modeling nonlinear relationships and their limits. The first smoother: the B-splines.
4	Characteristics and properties of B-splines: nodes and degree of the polynomial. The derivatives of B-splines.
4	The risk of under- and over-fitting of B-splines. The use of penalization. The penalized splines (P-splines).
6	The estimation of a model with penalized splines. Penalized least squares through ordinary least squares. The role of the order of differences in the penalty.
8	Smoothing parameter selection: CV, AIC, BIC, and through random effects models.Additive models. Introduction to tensor products of B-splines for surface modeling.

Hrs	Practice
6	Implementation in R of the methods described in lecture
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