UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	
ACADEMIC YEAR	
ANNO ACCADEMICO EROGAZIONE	
SUBJECT	
CODE	
SCIENTIFIC SECTOR(S)	
HEAD PROFESSOR(S)	MUGGEO VITO MICHELE ROSARIO — Professore Ordinario — Univ. di PALERMO
OTHER PROFESSOR(S)	ABBRUZZO ANTONINO — Professore Associato — Univ. di PALERMO MUGGEO VITO MICHELE ROSARIO — Professore Ordinario — Univ. di PALERMO
CREDITS	
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	
TERM (SEMESTER)	
ATTENDANCE	
EVALUATION	
TEACHER OFFICE HOURS	**ABBRUZZO ANTONINO** Monday 15:00 17:00 DSEAS secondo piano stanza 222 **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.
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.

MODULE
BAYESIAN STATISTICS

Prof. ANTONINO ABBRUZZO

SUGGESTED BIBLIOGRAPHY

A first course in Bayesian statistical methods, Hoff, Peter D, 2009, Springer Science & Business Media. Capitoli 2, 3, 5, 6, 9, 10 e 11.

Bayesian Data Analysis, Gelman et. al, Capitoli 2, 3, 10, 11, 12, 14, 16

Stan Reference Manual e Stan User's Guide

Appunti del docente

AMBIT	84542-Discipline Statistiche
INDIVIDUAL STUDY (Hrs)	108
COURSE ACTIVITY (Hrs)	42

EDUCATIONAL OBJECTIVES OF THE MODULE

The course guides the student to the knowledge of the primary methods of Bayesian statistics and the acquisition of the ability to apply these methodologies to real datasets. Students should be able: to understand both the positive and negative aspects of Bayesian statistics with respect to the classical ones, and to use these techniques to investigate real datasets.

SYLLABUS

Hrs	Frontal teaching
3	Bayesian statistical modelling and Inference; Prior, Posterior distribution, and Predictive distributions
3	Conjugate Bayesian Models: Poisson-Gamma, Normal-Normal
3	Monte Carlo Markov Chain for non-conjugate models: The Gibbs sampling and the Metropolis-Hastings
3	Inference and prediction in generalized linear models

Hrs	Practice
2	Beta-Binomial Model: an Application
2	Conjugate Multinomial-Dirichlet model: An application
2	Apllication of MCMC through STAN
3	Generalized linear model: some applications

MODULE
NON PARAMETRIC MODELS

Prof. VITO MICHELE ROSARIO MUGGEO

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

AMBIT	84542-Discipline Statistiche
INDIVIDUAL STUDY (Hrs)	108
COURSE ACTIVITY (Hrs)	42

EDUCATIONAL OBJECTIVES OF THE MODULE

The course guides the student toward knowledge of the methodologies of Bayesian statistics and theacquisition 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

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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