COURSE: Probability and Matematical Statistics			
ACADEMIC YEAR: 2017/2018			
TYPE OF EDUCATIONAL ACTIVITY: Characterizing			
TEACHER: Iuliano Antonella			
e-mail: aiuliano19@gmail.com		website:	
phone:		mobile (optional):	
Language: Italian/english			
ECTS: (lessons e tutorials/practice)	n. of hours: 48	Campus: Matera Dept.: Mathematics Program:	Semester: I

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The aim of the course is to offer students a good understanding of the basic elements of Probability Theory and Statistics through precise definitions, theorems and proofs. The student will be able to describe, connect and compare the main statements and results obtained and to demonstrate the theorems illustrated during the course. He will solve problems relating the theoretical expertise with the selection and building of models following the guidelines given during practice lessons. In addition, the student will be able to extend these methodologies to different scientific areas. The student will improve his/her knowledge and expertise in order to identify new results. He will be able to explain the basic concepts of Probability Theory and Statistics easily to non-skilled people and to summarize the results achieved by using a correct statistical language. Finally, students will encourage to attend seminars, conferences and specific courses and to follow the course constantly.

PRE-REQUIREMENTS

Good knowledge of mathematical logic and mathematical analysis (combinatorial calculation, study of a function, derivative, integral, convergence, and series of functions).

SYLLABUS

Module 1: *Probability Theory*

• Axiomatic definition of probability space: events, sigma-algebra, definition of probability, first calculation rules and continuity of the probability measure.

• Conditioning and Indipendence: the total probability and Bayes theorem. Borel-Cantelli lemma.

• Random variables: distribution function and its properties. Discrete random variables (Bernoulli, Binomial, Geometric, Negative Binomial, Ipergeometric) and continuous random variables (Normal, Uniform, Cauchy, Exponential, Gamma, Chi-Square, Student T, and Fisher). Multidimensional random variables, indipendence.

• Moments: Moment generating function and characteristic function.

• Limit theorems: convergence in law, convergence in probability, Chebyshev's inequality and weak law of large numbers, central limit theorem, strong law of large numbers, approximation of discrete random variables.

Module 2: *Introduction to Statistics*

• Random sampling with replacement: construction of the sampling space and definition of the random sample from a population, definition of statistics and sample moments, mean and variance of the sample moments., sample mean and sample variance, distribution of the sample moments.

• Point estimation: definition of an estimator, Cramer-Rao Theorem, symptotic properties of the estimator, sufficient estimators.

• Interval estimation: definition of confidence interval. Pivotal quantity method.

• Hypothesis testing: definition of statistical hypothesis, critical region, first and second kind errors, power and

level of significance of the test, Neyman-Pearson Lemma, composite hypothesis and generalized likelihood ratio.

- General linear model: analysis of variance, regression, estimation in the general linear models (Gaussian and uncorrelated cases), Gauss-Markov theorem.

Module 3: *Introduction to R*

- What is "R"?
- The random world: Probability Theory and random variables
- From sample to population: sample mean and sample variance, confidence intervals, hypothesis testing, ANOVA and regression analysis (simple and multivariate).

TEACHING METHODS
Theoretical lessons, Laboratory tutorials, Project works.

EVALUATION METHODS
Discussion of a project work and Oral examination.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

- Notes provided by the teacher available upon request

- Ross S.M. (2007). Calcolo delle probabilità. II Edizione. Apogeo.
- Crescenzo, A., and Luigi M. Ricciardi (2000). Elementi di statistica. Liguori.
- Iacus S.M., e Masarotto G., Laboratorio di Statistica con R. McGraw-Hill.

- Buonocore, A. Di Crescenzo, L.M. Ricciardi (2011). Appunti di Probabilità, Liguori.
- P. Baldi (2011). Calcolo delle Probabilità, McGraw-Hill.
- Ricciardi L.M. e Rinaldi S. (1994). Esercizi del calcolo delle probabilità. Liguori.
- G. Casella, R.L. Berger (2001). Statistical Inference, Duxbury Press.
- D. Piccolo (2010). Statistica, Il Mulino.

INTERACTION WITH STUDENTS
At the beginning of the course, after the description of the main goals, program and evaluation methods, the teacher will share the didactic materials.
Office Hours: Tuesday 2:00 PM-4:00 PM at the Department of Mathematics.
In addition, the teacher will provide own email address to all students.

EXAMINATION SESSIONS (FORECAST)
30/01/2018, 27/02/2018, 27/03/2018, 29/05/2018, 26/06/2018, 24/07/2018, 25/09/2018, 30/10/2018, 27/11/2018

SEMINARS BY EXTERNAL EXPERTS YES x NO □

FURTHER INFORMATION