Academic subject: Mathematical Statistics

Degree Class: LM-40 – Matematica		**Degree Course:** Mathematics	**Academic Year:** 2018/2019
		Kind of class: Optional depending on the Curriculum	**Year:** / **Period:** 2
			ECTS: 7 divided into **ECTS lessons:** 6,5 **ECTS exe/lab/tutor:** 0,5

Time management, hours, in–class study hours, out–of–class study hours
lesson: 52 exe/lab/tutor: 8 in–class study: 60 out–of–class study: 115

Language: Italian	**Compulsory Attendance:** no		
Subject Teacher: Rosa Maria Mininni	**Tel:** +39-080-5442700 **e–mail:** rosamaria.mininni@uniba.it	**Office:** Department of Mathematics Room 5, Floor 4	**Office days and hours:** Tuesday 10–12. Other days and times by appointment.

Prerequisites:
Mathematical knowledge acquired in a basic course of Probability Calculus

Educational objectives:
To acquire a good knowledge of basic topics of mathematical statistics, including through the use of suitable software.

Expected learning outcomes (according to Dublin Descriptors)

Knowledge and understanding:
Acquiring fundamental methodologies and models of mathematical statistics. Going more deeply into all the theoretical aspects closely related to the Theory of Probability.

Applying knowledge and understanding:
Ability to apply the acquired knowledge to the processing of statistical data in all the applied sciences, including through the use of suitable software.

Making judgements:
Ability to build new statistical-probabilistic models, after an "a priori" understanding and gathering of the necessary information to set the problems and interpret the results.

Communication:
Acquiring the mathematical language needed to describe, interpret and explain events and processes in different application fileds using statistical methods and models.

Lifelong learning skills:
Acquiring an appropriate method of analysis, supported by resolution of problems proposed during the course also through specialized software.

Course program

1. Parametric statistical models: sufficiency and completeness of a statistic. Fisher-Neyman factorization theorem. Estimators and their properties. Some criterions to select uniformly minimum-variance unbiased estimators: the Rao-Blackwell and Lehmann-Scheffè theorems, the Cramer-Rao inequality. The exponential family and its properties. Some estimation methods : the method of moments, the method of maximum likelihood. Tests of statistical hypotheses. A criterion to determine most powerful tests for simple or composite hypotheses. The likelihood ratio test. Tests about proportions. Tests about the parameters of a normal distribution. Large samples analysis. Confidence intervals. Connection between confidence intervals and tests of statistical hypotheses. Confidence intervals for proportions. Confidence interval for the parameters of a normal distribution.

2. Non parametric statistical models: Elements of descriptive statistics. The Chi-squared tests: the good-of-fitness test, the test of independence, the test of homogeneity. The sign test. The Wilcoxon rank test. The Wilcoxon-Mann-Whitney two sample rank test. The Wilcoxon signed-rank test. The Kolmogorov-Smirnov good-of-fitness test.

3. The Analyis of Variance (ANOVA): the one-way ANOVA. The two-way ANOVA. The factorial ANOVA. The Tuckey's test for multiple comparisons.

4. Regression linear models: simple linear regression: the mathematical model. The ANOVA for regression. Confidence intervals for model parameters. The use of the regression equation. Connection between correlation and simple linear regression: the correlation coefficient. The multiple linear regression: a matrix approach to the mathematical model. The ANOVA for regression. Confidence intervals for model parameters. The use of the regression equation. Techniques to select the best regression model.

5. Statistical Lab:
The use of the statistical software S-Plus for Windows o LINUX (Re 6.1 available), or of the R software (free available at the link https://www.r-project.org).

Teaching methods:
Lectures and exercise sessions

Auxiliary teaching:
Lecture notes about the statistical lab provided by the teacher

Assessment methods:
Written and Oral exam

Bibliography:
For the whole course:

S.M. Ross, *Probabilità e Statistica per l'ingegneria e le scienze*, seconda edizione, Ed. Apogeo, 2008.

For the theorical results related to the parametric statistical models you can also refer to:

G. Casella - R.L. Berger, *Statistical Inference*, seconda edizione, Duxbury Advanced Series, U.S.A. 2002.

G.G. Roussas, *A First Course in Mathematical Statistics*, Addison-Wesley Publishing Co., Inc., Massachussetts,1973.