# . – Mathematical Statistics II

## Prof. Alfredo Marzocchi

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The main aim of the course is to introduce students to inferential statistics, an essential tool for obtaining accurate information from variously distributed data. At the end of the course, students should know the main concepts of multivariate statistics and their application to estimate parameters, hypothesis tests and nonparametric methods. From the ability to apply knowledge and understanding perspective, students will be able to develop a statistical test suitable for a certain situation, motivating the choice with respect to any alternatives, and interpreting the possible results by drawing appropriate conclusions. Furthermore, given that the *forma mentis* of statistical knowledge, though hypothetical-deductive, differs slightly from the mathematical one by virtue of the variety of application situations, the course may also stimulate the student's ability to learn in situations other than pure mathematics.

***COURSE CONTENT***

- Recalls on multivariate random variables.

- Functions of random variables: the general case and special examples.

- Parametric families of distributions: exponential family.

- Sampling and sample variables. Sample space. Simple random sampling. Likelihood function.

- Statistics. Sample mean and sample variance. Exact and approximate distributions of the sample moments. Rao-Cramèr inequality. Sufficiency. Subordinate statistics and equivalent statistics. Minimal sufficiency. Complete statistics. Sufficient estimators and exponential family. Rao-Blackwell theorem.

Comparison of estimators.

- Estimation methods research of estimators. Method of moments. Maximum likelihood method. Maximum likelihood and exponential family. Asymptotic Optimality of the Maximum-Likelihood

- Confidence intervals. Pivotal method. Exact confidence intervals for the mean and the variance of a normal distributions. Asymptotic confidence intervals: the discrete and continuous cases. Examples.

- Theory of statistical hypothesis testing. Neyman-Pearson lemma. Exact parametric tests for the mean and variance in the normal case. Chi Square test.

- Introduction to linear models.

- Introduction to non-parametric estimation methods.

***READING LIST***

- A.M.Mood, F.A.Graybill, D.C.Boes, *Introduzione alla Statistica,* Mc Graw-Hill, 2003.

Additional notes will be provided during thec.

***TEACHING METHOD***

Frontal lectures with ample opportunity for interaction with students, accompanied by tutorials with examples of the topics covered.

***ASSESSMENT METHOD AND CRITERIA***

A written and an oral exam. The written exam aims to assess students' knowledge of the course syllabus, and usually consists of two exercises plus a short demonstration. The answers to the questions will be assessed in terms of their completeness, the procedure used to reach the result, and their consistency, rather than the specific calculations which, in reality, can be entrusted to the calculator. The mark obtained in the written exam is taken as a basis for the oral exam assessment.

The oral exam consists of a short interview at the blackboard in which the written exam is critically examined and the main concepts contained in it reviewed. The final assessment will focus not only on the written exam, but also on relevance of students' answers, their appropriate use of specific terminology, well-argued and coherent structuring of their argumentation, and their ability to identify conceptual links and respond to open questions.

***NOTES AND PREREQUISITES***

Apart from the subjects covered in Mathematical Statistics I, which are preparatory to the course, no other prerequisites are required.

*Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.*