UNIVERSIDAD DE MURCIA

FACULTY OF MATHEMATICS

Statistical Inference

Syllabus

Course code:	1598
Number of ECTS credits:	6
Semester:	1st (September-January)
Prerequisites:	None
Recommended components:	Funciones de una variable real I y II (1568 and 1575), Linear Algebra (1569), Elementos de Probabilidad y Estadística (1576), Introducción al Software Científico y a la Programación (1572), Teoría de la Probabilidad (1590) and Ampliación de Probabilidad y Procesos Estocásticos (1595)
Language of instruction:	Spanish (students are allowed to ask questions and write homeworks and exams in English)

Course description

This course is intended as an introduction to the main aspects of Statistical Inference. The course is devoted to the study of sampling distribution, the theory of point and confidence estimation, hypothesis testing and the general linear model.

Learning outcomes and competences

After completion of this course you will:

1. be able to to derive the sampling distribution and the main properties of some of well known statistics, as the sample mean and the sample variance.
2. know and apply Fisher's Theorem.
3. know how to obtain the minimum variance unbiased estimator of an unknown parameter.
4. know how to construct the uniformly most powerful test for an unknown parameter.
5. know how to estimate and provide tests for the unknown parameters in the general linear model.
6. able to solve statistical inference problems with `R`.

Course contents

I. Sampling Distribution

1. Preliminaries.
   Introduction. Multivariate characteristic function and properties. Covariance matrix and properties. Multivariate normal distribution and properties.
2. Introduction to Statistical Inference. Sampling distribution.
   Introduction. Random sample. Ordered samples. Empirical distribution function and properties. Sample moments. Asymptotic distributions of sample moments. Fisher's theorem and consequences.

II. Parametric Estimation

1. Point estimation. Lower bound for the variance of an estimate.
   Introduction. Properties of an estimate. Uniformly minimum varaince unbiased estimate. Cramer-Rao's bound. Maximum likelihood estimate.
2. Estimates based on sufficient statistics.
   Sufficient statistics. Factorization theorem. Rao-Blackwell's theorem. Complete statistic. Lehmann-Scheffé's theorem.
3. Confidence estimation.
   Introduction. Confidence interval. Methods for constructing confidence intervals. Pivotal quantity method and Neyman's method.

III. Hypothesis Testing

1. Parametric hypothesis testing.
   Introduction. Elements of hypothesis testing. Simple alternative and null hypothesis testing: Neyman-Pearson theory.
2. Composite parametric hypothesis testing.
   One tail hypothesis testing. Families with monotone likelihood ratio. Two tails hypothesis testing. The likelihood ratio tests. Hypothesis testing for the normal distribution.

IV. General linear model

1. General linear model. Full rank case.
   Introduction. Statistical inference under linear and uncorrelated assumptions. Gauss-Markov's theorem. Statistical inference under the normality assumption. Aplications to the linear regression model and the analysis of variaince.

References

Main texts

1. Cristobal Cristobal J.A. *Inferencia Estadística*, PUZ, 1995.
2. Rohatgi V.K. *An Introduction to Probability Theory and Mathematical Statistics*, Wiley, 1976.
3. Rohatgi V.K. and Ehsanes A.K. *An Introduction to Probability and Statistics*, Wiley, 2000.

Supplementary references

1. Gómez Villegas M.A. *Inferencia Estadística*, Díaz de Santos, 2005.

2. Vélez Ibarrola R. and García Pérez A. *Principios de Inferencia Estadística*, UNED, 1993.