Advanced statistical inference

Academic Year: (2020 / 2021) **Review date: 30/06/2020 13:23:27**

Department assigned to the subject:

Coordinating teacher: LILLO RODRIGUEZ, ROSA ELVIRA

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

OBJECTIVES

* To use the model of random variable and different types of convergence of sequences of random variables.
* To know the methods for obtaining estimators and their statistical properties.
* To understand the concept of confidence interval and its correct application.
* To know how to formulate and solve hypothesis testing, including the idea of ¿¿p-value.
* To learn the basic ideas of non-parametric inference and resampling, including the ideas of bootstrap and jackknife.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction.
1.1 Distributions of random variables.
1.2 Independence.
1.3 Conditional distributions.
1.4 Transformation of random variables.
1.5 Expectation and conditional expectation.
1.6 Moment generating function and characteristic function.
1.7 Markov, Chebichev and Hoeffding inequalities.

2 Convergence of random variables.
2.1 Almost sure convergence.
2.2 Convergence in probability.
2.3 Convergence in distribution.
2.4 The law of large numbers.
2.5 The central limit theorem.
2.6 The delta method.

3. Point and interval estimation.
3.1 The estimation problem.
3.1.1 Examples.
3.2 Constructing estimators.
3.2.1 The method of moments. Properties.
3.2.2 The maximum likelihood method. Properties: consistency, equivariance, asymptotic normality, optimality .
3.3 Confidence intervals.
3.3.1 The normal case.

4 Test of hypothesis.
4.1 Hypothesis, error rates and power function.
4.2 The Neyman-Pearson lemma.
4.3 The Wald test.
4.4. The chi-square test.
4.5 Significance testing of Fisher: p- values.
4.6 The likelihood ratio test.

4.7 Goodness-of-fit tests.

5. Nonparametric Inference.
5.1 The empirical distribution function.
5.2 The Glivenko - Cantelli theorem.
5.3 Resampling methods: the bootstrap and jackknife

LEARNING ACTIVITIES AND METHODOLOGY

Class hours (1.4 ECTS) will be devoted to the following training activities :
* Lectures: The aim is to achieve specific cognitive skills. In these classes the knowledge that students must acquire will be presented. To facilitate its development students receive class notes and have basic reference texts that allow them to complete and to deep those subjects in which they are most interested .
* Practical lessons: Problem solving classes, computer practices or presentation by the students. These classes help develop specific skills.
Additionally, 1.4 ECTS will be devoted to tutored training activities. These oversight activities include theoretical and practical teaching-learning activities, but may develop independently, requiring monitoring of a teacher. These activities may include, among others: scheduled tutorials, review papers and tracking tutorials.
The remaining credits, 3.2 ECTS, are devoted to the study of student independently or in group without teacher supervision. During this time the student performs exercises and readings proposed by the teacher. It also performs additional readings from the teacher's recommended material.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

Exam (30%). Exercises proposed in class (25%) An empiric project in groups (25%). A take- home work with real data (20%).

BASIC BIBLIOGRAPHY

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- Casella, G. and Berger, R. L Statistical Inference, 2001, Duxbury. San Francisco.

- Gibbons, J. D. Nonparametric Statistical lnference, Marcel Dekker. New York., 1985

- Rice, J. Mathematical Statistics and Data Analysis. , Brooks and Cole. San Francisco., 2007

- Vélez, R. y García, A. Principios de Inferencia Estadística., UNED. Madrid, 1994

- Wasserman, L. All of Statistics, Springer- Verlag. New York., 2004

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- van der Vaart, A. W Asymptotic Statistics, Cambridge University Press. Cambridge., 1998