Non-parametric Estimation

Academic Year: (2022 / 2023) **Review date: 16-05-2022**

Department assigned to the subject: Statistics Department

Coordinating teacher: GARCIA PORTUGUES, EDUARDO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I and II
Probability I and II
Statistical Inference Methods I and II
Programming I and II
Linear Algebra
Advanced Mathematics
Regression Methods
Advanced Regression Methods
Multivariate Analysis

OBJECTIVES

* General competences

- Description and data synthesis: Description of a set of data based on numeric and graphic measurements both at univariate and multivariate levels demonstrating possible relations between variables of interest.
- Modelling Ability to identify or create the appropriate model for a specific problem arising from each business activity (finance, marketing, production planning and control etc.).
- Model Analysis and Validation: Capacity to computationally manipulate established models, making the most of the power of statistical, optimisation methods etc. and analysing the results obtained.
- Drawing conclusions: Ability to perceive the nature of problems and interpret solutions provided by the corresponding models in a useful way, in order to improve performance in the various areas of a business (finance, production, quality, marketing, etc.).
- Presentation and communication of results: Ability to communicate results, conclusions of models and solutions proposed in a manner which is intelligible to the rest of the company, in order to ensure that they are accepted and implemented by decision makers.

* Specific competences

- Data description and synthesis.
- Modelling and statistical analysis of both static and dynamic data.
- Correct and rational use of software.
- Ability to devise and construct models and validate them.
- Graphic representation of data.
- Interpretation of results based on statistical models.

* Learning outcomes

Acquisition of knowledge on: 1) nonparametric estimation of the distribution function; 2) kernel density estimators and their applications; 3) nonparametric regression methods based on smoothing.

DESCRIPTION OF CONTENTS: PROGRAMME

ATTENTION: all the teaching materials are given in ENGLISH. Lessons are in Spanish.

This course is designed to give a panoramic view of several tools available for nonparametric estimation, at an intermediate level. This view covers in-depth the main concepts in the estimation of the distribution, density and regression function. The focus is placed on providing the main insights on the statistical/mathematical foundations of nonparametric estimation and on showing its effective implementation with the use of the statistical software R.

1. Introduction and review
   1.1. Why nonparametric statistics?
   1.2. Review on statistical inference
   1.3. Review on probability
   1.4. Useful inequalities
   1.5. Landau's notation

2. Nonparametric estimation of the distribution function
   2.1. The empirical distribution function
   2.2. Properties of the empirical distribution function
   2.3. Applications

3. Nonparametric estimation of the density function
   3.1. The histogram
   3.2. The Parzen-Rosenblatt's estimator
   3.3. Properties of the estimator
   3.4. Selection of the smoothing parameter
   3.5. Modifications
   3.6. Multivariate density estimation

4. Nonparametric estimation of the regression function
   4.1. The regressogram
   4.2. The Nadaraya-Watson's estimator
   4.3. The local polynomial estimator
   4.4. Properties of the local polynomial estimator
   4.5. Selection of the smoothing parameter

The program is subject to minor modifications due to the course development and/or academic calendar.

LEARNING ACTIVITIES AND METHODOLOGY

The lessons combine theory sessions (description of methods) and practical sessions (exercises, computational implementation, and practical usage of methods). The implementation of the methods is done with the statistical language R.

* Training activities

THEORETICAL AND PRACTICAL CLASSES. In them the knowledge to be acquired by the students will be presented. They will receive the class notes and will have basic reference texts to facilitate the follow-up of the classes and the development of the subsequent work. Exercises and practical problems will be solved by the student and workshops will be held to acquire the necessary skills. For subjects of 6 ECTS, 48 hours will be dedicated as a general rule with 100% attendance.
TUTORIALS. Individualized assistance (individual tutorials) or in group (collective tutorials) to the students by the professor. For subjects of 6 credits, 4 hours will be dedicated with 100% attendance.
INDIVIDUAL OR GROUP WORK OF THE STUDENT. For subjects of 6 credits, 98 hours will be dedicated with 0% attendance.

* Teaching methodologies

THEORY CLASS. Lectures in class by the professor with the support of computer and audiovisual media, in which the main concepts of the subject are developed and the materials and bibliography are provided to complement the students' learning.
PRACTICALS. Resolution of practical cases, problems, etc. posed by the teacher individually or in groups.
TUTORIALS. Individualized assistance (individual tutorials) or group (group tutorials) to students by the professor. For subjects of 6 credits, 4 hours will be dedicated with 100% attendance.

ASSESSMENT SYSTEM

The evaluation in the ordinary call is done exclusively by continuous evaluation. This consists of:

(a) two sets of group problems;
(b) the presentation of the problem sets;
(c) active participation in the lessons.

The final grade (on the scale 0-10) in the ordinary exam is

min(0.70 * A + 0.30 * B + 0.10 * C, 10),

where:

- A (on the 0-10 scale) is the mean of the two sets of group problems;
- B (on the 0-10 scale) is the mean of the individual grades of the problem presentations;
- C (on the 0-10 scale) is the degree of participation in lessons.

Students who have not followed the continuous evaluation may take a final exam in the ordinary call with a value of 60% of the final grade.

The grade for the extraordinary convocation is established by an exam.

Further details are provided in Aula Global. The evaluation is subject to modifications due to the course development and/or academic calendar.

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

BASIC BIBLIOGRAPHY

- Chacón, J. E. and Duong, T. Multivariate Kernel Smoothing and Its Applications, Chapman and Hall/CRC, 2018
- Wand, M. P. and Jones, M. C. Kernel Smoothing, Chapman & Hall, 1995
- Wasserman, L. All of Nonparametric Statistics, Springer-Verlag, 2006
- Wasserman, L. All of Statistics, Springer-Verlag, 2004