Statistics

Academic Year: (2021 / 2022) **Review date: 28-06-2021**

Department assigned to the subject: Statistics Department

Coordinating teacher: ALONSO FERNANDEZ, ANDRES MODESTO

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Social Sciences and Law

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus (Course 1 - Semester 1) and Linear Algebra (Course 1 - Semester 1)

OBJECTIVES

The objective of this course is for the student to acquire a set of tools or skills related to Statistics both at a theoretical and applied level.

-Proficiency to analyze and synthetize the main information content in a set of univariate and multivariate data.
-Proficiency to compute probabilities and statistical moments at different dimensions
-Proficiency to use random variables as a statistical device to model real phenomena.
-Proficiency to identify the appropriate probability model for specific real situations.
-Knowledge of the properties of point and interval estimation methods, with the aim of doing statistical inference.
-An Proficiency to use statistical models as well as the Proficiency to perform an optimal estimation of the parameters by maximizing the likelihood and minimizing the prediction errors.
-Proficiency to formulate and testing hypothesis about a population.
-Proficiency to design lineal models that help to understand and predict real phenomena.
-Proficiency to use statistical software.

DESCRIPTION OF CONTENTS: PROGRAMME

Chapter I: Univariate Descriptive Statistics
1.1 Introduction. The purpose of Statistics.
1.2 Description of data by tables
1.3 Description of data by graphs
1.4 Characteristics measures of a variable

Chapter II: Bivariate Descriptive Statistics
2.1 Introduction.
2.2 Bivariate Frequency Tables
2.3 Scatterplots
2.4 Measures of linear dependence
2.5 The regression line

Chapter III: Probability
3.1 Introduction
3.2 Probability: definition and properties
3.3 Conditional and total probability
3.4 Independence of events
3.5 Bayes Theorem

Chapter IV: Introduction to Random Variables
4.1 Introduction
4.2 Univariate discrete random variables
4.3 Univariate continuous random variables
4.4 Characteristics measures of a random variables

Chapter V: Probability models
5.1 Introduction

5.2 Bernoulli process
5.3 Poisson process
5.4 Normal distribution
5.5 Relationship between Normal, Binomial and Poisson distributions
5.6 Simple regression model

Chapter VI: Introduction to statistical inference
6.1 Statistical inference. Population and sample
6.2 Sampling distribution of a statistic
6.3 The sample mean distribution
6.4 Estimation and estimators
6.5 Method of moments
6.6 Diagnosis of the model
6.7 Transformations that improve normality

Chapter VII: Large-Sample Inference
7.1 Confidence intervals for the mean with large samples
7.2 Determining the sample size
7.3 Other confidence intervals
7.4 Introduction to the Hypothesis Testing
7.5 Hypothesis test for the mean with large samples
7.6 Interpreting the test using the p-value
7.7 Relation between the hypothesis test and the confidence intervals

Chapter VIII: Comparison of Populations
8.1 Introduction
8.2 Comparing two populations means: Independent samples
8.3 Comparing two populations means: Paired data
8.4 Comparing two population proportions
8.5 Comparing two populations variances (normal populations)

Chapter IX: Introduction to Multiple Regression
9.1 Statistical model for Simple Regression.
9.2 Statistical model for Multiple Regression.
9.3 Estimation of the Multiple Regression parameters.
9.4 Inference for Multiple Regression.
9.5 Test for the Multiple Regression model.
9.6 Regression with binary variables.

LEARNING ACTIVITIES AND METHODOLOGY

The learning methodology consists on the following elements:
-Lecture class will be taught in face-to-face mode (0.8 ECTS): Presentation of the main statistical concepts, with their justification and examples. The instructor will illustrate the methodologies with the computer and real or simulated data. Discussion of the concepts with the students. Discussion of the questions and doubts aroused during the self learning process.
-Exercises class (0.8 ECTS): Classes devoted to solving exercises in small groups.
-Lab class (0.2 ECTS): The students solve data analysis problems by using a statistical package. They are asked to solve exercises and conceptual problems by using the statistical software. After each class and organized in small groups, they are asked to make a case study that will be evaluated.
-Tutorials (1.1 ECTS): Individualized or group assistance to students by the teaching staff with 25% attendance.
-Individual or group work (2.9 ECTS).
-Final exam (0,2 ECTS).

ASSESSMENT SYSTEM

The evaluation of the course will be based on continuous evaluation and a final exam. The final score will be a weighted average of both types of evaluation:
40% - final exam,
60% - continuous evaluation.
There is no requirement for a minimum score in each of these parts.

Continuous evaluation
The continuous evaluation consists of the realization of a case study (20%), as well as two theoretical-practical midterm exams (40% each).

Final exam - regular session

- The final exam will consist of solving theoretical questions as well as doing data analysis. Students will need to use all the tools learned during the course.
- The final grade will be 60% continuous evaluation + 40% final exam

Final exam exemption:
Students who obtain good grades on continuous assessment will be exempted from the final exam. In this case, the continuous assessment grade will weigh 100% in the grade for the course. To qualify for this exemption, the following requirement must be met:
- In none of the partial exams you should have a grade lower than 4.5.

Final exam - extraordinary session
- The final exam will consist of solving theoretical questions as well as doing data analysis and interpreting results obtained by the statistical software. Students will need to use all the tools learnt during the course.
- The evaluation system in the extraordinary session will be the maximum between the following criteria:
    a) 100% final exam
    b) 60% continuous evaluation + 40% final exam

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- MONTGOMERY, D.C; RUNGER, G.C Applied Statistics and Probability for Engineers, Wiley.
- MOORE, D.S; MCCABE, G.P. "Introduction to the practice of statistics, Duxbury Press.
- OSTLE, B.; TURNER, K.V; CHARLES R. HICKS, C.R. "Engineering Statistics: The industrial experience", Duxbury Press.

ADDITIONAL BIBLIOGRAPHY

- DEGROOT, M.H. "Probability and stadistics", Adison-Wesley.
- GUTTMAN, I.; WILKS, S.S; HUNTER, J.S. "Introductory Engineering Statistics", Wiley.