Statistics

Academic Year: (2022 / 2023) **Review date: 18-05-2022**

Department assigned to the subject: Department of Statistics

Coordinating teacher: MINGUEZ SOLANA, ROBERTO

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 2

Branch of knowledge: Social Sciences and Law

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear algebra
Calculus
Programming

OBJECTIVES

By the end of this subject, students will be able to have:
1. Knowledge and understanding of the statistic principles underlying the branch of robotics engineering
2. The ability to apply their knowledge and understanding to identify, formulate and solve statistical problems using well-known methods
3. The ability to gather and interpret relevant data to make judgments that include a reflection on relevant issues of a social, scientific, professional or ethical nature
4. The ability to apply their knowledge and understanding to robotics engineering analysis
5. An understanding of the different statistical methods and applicable statistical techniques, as well as their limitations, and the ability to use them appropriately
6. The ability to select and use appropriate statistical tools and methods
7. The ability to combine theory and practice to solve engineering problems

DESCRIPTION OF CONTENTS: PROGRAMME

1.Descriptive statistics
1.1. Qualitative and quantitative data
1.2. Univariate descriptive statistics. Frequency tables
1.2.1. Graphical representation for qualitative data: Bar chart, pie chart, Pareto diagram
1.2.2. Graphical representation for quantitative data: Histograms, frequency polygons, boxplots
1.2.3. Analytical measures for data summary
1.2.3.1. Measures of central tendency: Average, median and mode
1.2.3.2. Measures of variability: Variance, coefficient of variation, quartiles and percentiles
1.2.3.3. Other Measures: Skewness and kurtosis
1.3. Descriptive statistics for two variables. Scatter plots, covariance and correlation.
2. Probability
2.1. Introduction to the concept of probability: Equiprobability and Laplace rule. Frequentist approach and law of large numbers
2.2. Events and operations with events. Event definition. Venn diagrams. Union, Intersection and complementary events
2.3. Definition and properties of probability
2.4. Independence and conditional probability
2.5. Law of total probability
2.6. Bayes theorem
3. Introduction to random variables
3.1. Definition of random variable (discrete/continuous) and properties. Probability function, density function
3.2. Expectation and variance of discrete and continuous random variables
3.3. Distribution function
4. Univariate distribution models
4.1. Probability models for discrete random variables. Bernoulli, Binomial, geometric and Poisson
4.2. Probability models for continuous random variables. Uniform, exponential and normal distributions. The central limit theorem
5. Introduction to statistical inference

5.1. Population and sample. Distribution of the sample mean
5.2. Confidence intervals for the sample mean
5.3. Distributional inference of a population using a sample
6. Hypothesis Testing
6.1 Population and sample (review)
6.2 Null hypothesis and alternative hypothesis
6.3 Hypothesis testing for one population
6.4. Hypothesis testing for the mean, proportion and variance of one population
6.5. Hypothesis testing for two populations: Difference of means and proportions
7. Quality control
7.1. Introduction to quality control. Assignable and non-assignnable causes
7.2. Control charts for variables. Control charts for the mean and range. Process capability.
7.2.1. Control charts for the mean
7.2.2. Control charts for the range
7.2.3. Control charts for the mean for the standard deviation
7.2.4. Process capability. Probability of defective products
7.3. Control charts for attributes
7.3.1. p control chart
7.3.2. np control chart
8. Regression
8.1 Introduction to linear regression
8.2 Simple linear regression
8.2.1. Hypothesis
8.2.2. Parameter estimation
8.2.3. Parameter significance and interpretation
8.2.4. Model diagnosis
8.3. Multiple linear regression
8.3.1. Hypothesis
8.3.2. Parameter estimation
8.3.3. Parameter significance and interpretation
8.3.4. Model diagnosis
8.3.5. Multicollinearity
8.3.6. Regression with qualitative variables (dichotomous / polytomous).

LEARNING ACTIVITIES AND METHODOLOGY

THEORETICAL PRACTICAL CLASSES.
Knowledge and concepts students must acquire. Students will receive course notes and will have basic reference texts. Students partake in exercises to resolve practical problems.

TUTORING SESSIONS.
Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher. There will be 4 hours of tutoring/ 100% on- site attendance.

STUDENT INDIVIDUAL WORK OR GROUP WORK.
Students will dedicate 98 hours/0% on-site of individual work.

WORKSHOPS AND LABORATORY SESSIONS.
There will be 8 hours/100% on-site instruction.

ASSESSMENT SYSTEM

FINAL EXAM.
Assessment of knowledge, skills and abilities acquired throughout the second half of the course will be assessed globally. The valuation percentage will be 40%.

MIDTERM EXAM.
This exam is the equivalent of the final exam for the first half of the subject matter, it will have a weight of 40% of the grade and will allow students to study uniformly during the whole semester.

CONTINUOUS EVALUATION.
Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course. The percentage of the evaluation corresponds to 20% of the final grade.

FINAL EXAM
Those students who do not follow the continuous assessment process may take the final exam and examine the entire content of the subject. The weight of this exam will be 60% of the total grade.

EXTRAORDINARY EXAM
The extraordinary exam will assess globally all the knowledge of the subject. The grade of the extraordinary call will be the final grade of the subject.

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

BASIC BIBLIOGRAPHY

- PEÑA, D. Y ROMO, J. Introducción a la Estadística para las Ciencias Sociales, McGraw-Hill, 1997
- Wasserman, L All of Statistics, Springer-Verlag. New York, 2004
- Wasserman, L. All of Statistics, Springer-Verlag. New York, 2004

ADDITIONAL BIBLIOGRAPHY

- Luceño, A. y González, F. J. Métodos estadísticos para medir, describir y controlar la variabilidad, Editorial Universidad de Cantabria, 2015
- MONTGOMERY, D.C., RUNGER, G.C. Probabilidad y Estadística aplicadas a las ingenierías., Limusa Wiley, 2002
- Navidi, W. Estadística para ingenieros y científicos., McGraw-Hill, 2006
- PEÑA, D. Regresión y Diseño de Experimentos., Alianza Editorial, 2002
- PEÑA, D. Fundamentos de Estadística., Alianza Editorial., 2001