Statistics

Academic Year: (2024 / 2025) **Review date: 15-05-2024**

Department assigned to the subject: Statistics Department

Coordinating teacher: CASCOS FERNANDEZ, IGNACIO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

Branch of knowledge: Engineering and Architecture

LEARNING OUTCOMES

RA1: Acquire knowledge and understanding of the basic general fundamentals of engineering and biomedical sciences.
RA2: Be able to solve basic engineering and biomedical science problems through a process of analysis, identifying the problem, establishing different methods of resolution, selecting the most appropriate one and its correct implementation.
CB1: Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2: Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1: Adequate knowledge and skills to analyse and synthesise basic problems related to engineering and biomedical sciences, solve them and communicate them efficiently.
CG3: Knowledge of basic scientific and technical subjects that enables them to learn new methods and technologies, as well as providing them with great versatility to adapt to new situations.
CG4: Ability to solve problems with initiative, decision-making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the biomedical engineer's activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG8: Ability to solve mathematical, physical, chemical and biochemical problems that may arise in biomedical engineering.
CG12: Ability to solve mathematically formulated problems applied to biology, physics and chemistry, using numerical algorithms and computational techniques.
ECRT1: Ability to solve mathematical problems that may arise in engineering and biomedicine. Ability to apply knowledge of: linear algebra; geometry; differential and integral calculus; differential and partial derivative equations; numerical methods; numerical algorithms; statistics and optimisation.
CT1: Ability to communicate knowledge orally and in writing to both specialised and non-specialised audiences.

OBJECTIVES

Once successfully having studied this subject, the students should be able to:
- Analize problems involving random phenomena
- Define populations for a statistical study
- Build Hypothesis about a distribution
- Estimate and test hypothesis about the paramters of the chosen model
- Evaluate how well does the model fit to reality
- Understand the limitations of the methods that have been studied and the conditions under which they lead to wrong conclusions

DESCRIPTION OF CONTENTS: PROGRAMME

BLOCK 0: DESCRIPTIVE STATISTICS
0. Descriptive Statistics

BLOCK I: PROBABILITY
1. Introduction to Probability
1.1 Introduction
1.2 Random phenomena
1.3 Definition of probability and properties
1.4 Conditional probability
1.5 Bayes Theorem
2. Random variables
2.1 Definition of random variable
2.2 Discrete random variables
2.3 Continuous random variables
2.4 Characteristic features of a random variable
2.5 Transformations of random variables
2.6 Random vectors
3. Distribution models
3.1 Binomial distribution
3.2 Poisson distribution
3.3 Geometric distribution
3.4 Uniform distribution (continuous)
3.5 Exponential distribution
3.6 Normal distribution (with CLT)
BLOCK II: ESTIMATION AND INFERENCE
4. Parameter estimation
4.1 Introduction and basic concepts
4.2 Sampling distributions
4.3 Maximum Likelihood Estimation
4.4 Properties of Maximum Likelihood Estimators
4.5 Inference based on MLEs
5. Statistical Inference
5.1 Introduction
5.2 Confidence Intervals
5.3 Hypothesis testing
5.4 Particualr tests on a single sample
5.5 Comparison of two populations
5.6 Statistical quality control
BLOCK III: APPLICATIONS
6. Statistical quality control
6.1 Introduction to statistical process control
6.2 Variables charts, the Xbar chart
6.3 Attributes charts, p and np charts
7. Linear regression
7.1 Introduction
7.2 Simple linear regression
7.3 Multiple linear regression
7.4 Comparison of three or more population means (ANOVA)

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures: introducing the theoretical concepts and developments with examples, 2.2 ECTS
- Problem solving sessions: 2.2 ECTS
- Computer (practical) sessions: 0.6 ECTS --- 4 SESSIONS
- Evaluation sessions (continuous evaluation and final exam): 1 ECTS

ASSESSMENT SYSTEM

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

There will be continuous evaluation by means of two partial examinations (40%+55%) and computer lab assignments (5%). At the partial examinations there will be some questions about the computer sessions at those exams.

If the grade obtained at the continuous evaluation is 6 or higher (has followed the continuous evaluation satisfactorily), the student should not attend the final exam and his/her final grade will be the grade of the cotinuous evaluation.

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

If the grade obtained at the continuous evaluation is lower than 6, the student will have to attend the final exam. For those students, the final grade will be computed giving a 40% weight to the partial examinations, and a 60% weight to the grade at the final exam.

BASIC BIBLIOGRAPHY

- Douglas C. Montgomery and George C. Runger Applied Statistics and Probability for Engineers (3rd ed), Johan Wiley & Sons, 2003

- Navidi, W. Statistics for Engineers and Scientists, McGraw-Hill, 2006

ADDITIONAL BIBLIOGRAPHY

- John D. Enderle, David D. Farden, Daniel J. Krause Basic Probability Theory for Biomedical Engineers, Morgan & Claypool, 2006

- John D. Enderle, David D. Farden, Daniel J. Krause Advanced Probability Theory for Biomedical Engineers, Morgan & Claypool, 2006

- Kristina M. Ropella Introduction to Statistics for Biomedical Engineers, Morgan & Claypool Publishers, 2007