uc3m | Universidad **Carlos III** de Madrid

Statistics

Academic Year: (2023 / 2024)   **Review date: 07-06-2023**

Department assigned to the subject: Statistics Department

Coordinating teacher: CASCOS FERNANDEZ, IGNACIO

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Social Sciences and Law

SKILLS AND LEARNING OUTCOMES

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.

CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.

CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.

CG10. Being able to work in a multi-lingual and multidisciplinary environment

CE1 Módulo FB. Ability to solve the mathematic problems arising in engineering. Aptitude for applying knowledge on: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives in differential equations; numerical methods; numerical algorithms; statistics and optimization.

CE4 Módulo FB. Ability to understand and apply the principles of basic knowledge of general chemistry, organic and inorganic chemistry and their applications in engineering.

CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.

CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.

CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.

CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:

RA1.1   knowledge and understanding of the statistic principles underlying their branch of engineering;

RA2.1   the ability to apply their knowledge and understanding to identify, formulate and solve statistic problems using established methods;

RA2.2   the ability to apply their knowledge and understanding to analyse engineering products, processes and methods;

RA3.2   an understanding of statistics methodologies, and an ability to use them.

RA5.1   the ability to select and use appropriate statistic tools and methods;

RA5.2   the ability to combine theory and practice to solve engineering problems;

RA5.3   an understanding of applicable statistic techniques and methods, and of their limitations;

OBJECTIVES

By the end of this course, students will be able to have:

1.   knowledge and understanding of the statistic principles underlying their branch of engineering;

2.   the ability to apply their knowledge and understanding to identify, formulate and solve statistic problems using established methods;

3.   the ability to apply their knowledge and understanding to analyse engineering products, processes and methods;

4.   an understanding of statistics methodologies, and an ability to use them.

5.   the ability to select and use appropriate statistic tools and methods;
6.   the ability to combine theory and practice to solve engineering problems;
7.   an understanding of applicable statistic techniques and methods, and of their limitations;

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 Assessment of probabilities in practice
1.5 Conditional probability
1.6 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 Independence of random variables
BLOCK II: PARAMETRIC MODELS AND INFERENCE
3. Distribution models
3.1 Binomial distribution
3.2 Geometric distribution
3.3 Poisson distribution
3.4 Uniform distribution (continuous)
3.5 Exponential distribution
3.6 Normal distribution (with CLT)
4. Statistical Inference
4.1 Introduction
4.2 Estimators and their distributions
4.3 Confidence Intervals
4.4 Hypothesis testing
4.5 Particualr tests on a single sample
4.6 Comparison of two populations
BLOCK III: APPLICATIONS
5. Quality control
5.1 Introduction, control charts
5.2 Variables control charts, the X-bar chart
5.3 Attributes control charts, the p and np charts
6. Linear regression
6.1 Introduction
6.2 Simple linear regression
6.3 Multiple linear regression

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
The evaluation of the course will be based on continuous evaluation and a final exam with the weighting given below:
  50% - final exam,
  50% - continuous evaluation.
There is no requirement for a minimum score at any of these parts.

Continuous evaluation
There will be continuous evaluation by means of two midterm exams (40%+50%) and computer lab assignments (10%). At the partial examinations there will be some questions about the computer sessions at those exams.

Final exam - regular session

- The final exam will consist of solving problems using all the tools learnt during the course.
- The final grade will be 50% continuous evaluation + 50% final exam
(20% first midterm exam + 25% second midterm exam + 5% computer labs + 50% final exam)

Final exam - extraordinary session
- The final exam will consist of solving problems using 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) 50% continuous evaluation + 50% final exam

% end-of-term-examination: 50

% of continuous assessment (assigments, laboratory, practicals…): 50

BASIC BIBLIOGRAPHY
 - MONTGOMERY, D.C., RUNGER, G.C. Applied Statistics and Probability for Engineers, John Wiley & Sons, 2003

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

 - SONG, TT Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons, 2004

ADDITIONAL BIBLIOGRAPHY
 - GUTTMAN, L., WILKS, S.S., HUNTER, J.S. Introductory Engineering Statistics, Wiley, 1992