Probability and Statistics

Academic Year: (2024 / 2025) **Review date: 21-04-2024**

Department assigned to the subject: Statistics Department

Coordinating teacher: GARCIA PORTUGUES, EDUARDO

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.
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CE1. Solve mathematical problems that may arise in engineering and apply knowledge of linear algebra, differential and integral calculus, numerical methods, numerical algorithms, statistics, differential equations and in partial derivatives, complex and transformed variables.
CE2. Understand and manage fundamental concepts of probability and statistics and be able to represent and manipulate data to extract meaningful information from them, as well as process, analyze and graphically present experimental data.
CE22. Design, plan and estimate the costs of an engineering project.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.

RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them.
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking.
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study.
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be

able to plan and organize their own training with a high degree of independence.

OBJECTIVES

CB1. Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study.
CB2. Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues.
CB4. Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CE1. Solve mathematical problems that may arise in engineering and apply knowledge of linear algebra, differential and integral calculus, numerical methods, numerical algorithms, statistics, differential equations and in partial derivatives, complex and transformed variables.
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CE22. Design, plan and estimate the costs of an engineering project.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.
RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them.
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking.
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study.
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to statistics
   1.1. General concepts
   1.2. Sampling methods
   1.3. Introduction to visualization tools

2. Probability space
   2.1. Basic properties
   2.2. Independence and conditional probability
   2.3. Total probability
   2.4. Bayes theorem

3. Univariate statistics
  3.1. Visualization techniques
  3.2. Characteristic measures
  3.3. Transformations

4. Random variables
  4.1. Distributions
  4.2. Characteristic measures
  4.3. Transformations
  4.4. Examples

5. Introduction to statistical inference
  5.1. Population and sample
  5.2. Sampling distribution of a statistic
  5.3. The sample mean distribution
  5.4. Estimation and estimators
  5.5. Method of moments
  5.6. Maximum likelihood

6. Confidence intervals
  6.1. For the mean
  6.2. For the proportion
  6.3. For the variance

7. Hypothesis testing
  7.1. Introduction to hypothesis testing
  7.2. Type I and Type II errors
  7.3. Power of a Statistical Test
  7.4. p-value

8. Nonparametric goodness-of-fit tests
  8.1. Chi-square tests
  8.2. Kolmogorov-Smirnov tests

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

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students must acquire. Receive course notes and will have basic reference texts. Students partake in exercises to resolve practical problems.
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher. Subjects with 6 credits have 4 hours of tutoring with 100% on-site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK. Subjects with 6 credits have 98 hours with 0% on-site.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours with 100% on-site.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject's main concepts are developed, while providing material and bibliography to complement student learning.
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group.
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with a teacher as tutor. Subjects with 6 credits have 4 hours of tutoring with 100% on-site.

ASSESSMENT SYSTEM

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

There will be continuous evaluation by means of two partial examinations. There will be some questions about the computer sessions for those exams.

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

If the grade obtained at the continuous evaluation is 6 or higher, the student should not attend the final exam and his/her final grade will be the grade of the continuous evaluation. If the grade obtained at the continuous evaluation is lower than 6, the student will have to attend the final exam.

For those students that attend the final exam, 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.

The grade for the students attending the extraordinary examination will be the grade obtained at such an exam.

BASIC BIBLIOGRAPHY

- Montgomery, D. C. and Runger, G. C. Applied Statistics and Probability for Engineers, John Wiley & Sons, 2013

- Navidi, W. Statistics for Engineers and Scientists, McGraw-Hill, 2010

- Song, T. T. 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

- Peña, D. Fundamentos de Estadística, Alianza Editorial, 2001

- Peña, D. Regresión y Diseño de Experimentos, Alianza Editorial, 2002