Bachelor in Computer Science Engineering

Course information

Year 2021-22

GENERAL SPECIFICATIONS				
English name				
Mathematics III				
Spanish name				
Matemáticas III				
Code		**Type**		
606010110		Mandatory		
Time distribution				
	Total	**In class**	**Out class**	
Working hours	150	60	90	
ECTS: 6				
Standard group	**Small groups**			
	Classroom	**Lab**	**Practices**	**Computer classroom**
4.44				1.56
Departments		**Knowledge areas**		
Integrated Sciences		Applied Mathematic		
Year		**Semester**		
1º		2º		

TEACHING STAFF			
Name	**E-Mail**	**Telephone**	**Office**
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SPECIFIC INFORMATION OF THE COURSE
1. Contents description
1.1. In English:
Topic 1: Descriptive Statistics Topic 2: Probability Theory Topic 3: Random Variables and Distribution Models Topic 4: Sampling and Estimation Topic 5: Statitiscal Hypothesis Testing Topic 6: Regression Models Topic 7: Linear Programming
1.2. In Spanish
Tema 1: Estadística Descriptiva Tema 2: Teoría de la Probabilidad Tema 3: Variables Aleatorias y Modelos de Distribuciones Tema 4: Muestreo y Estimación Tema 5: Contrastes de Hipótesis Estadísticas Tema 6: Modelos de Regresión Tema 7: Programación Lineal

2. Background

2.1.Situation within the Degree:

Statistics is a vital tool for engineering, since it allows to understand phenomena subject to variations as well as to predict and control them efficiently. Likewise, Mathematical Programming allows to optimally solve problems that arise in the context of task planning and decision making.

The Mathematics III subject, of the Degree in Computer Engineering, aims to give the student a global vision of both disciplines, as well as to introduce students to some of the techniques needed to solve the most common problems. This subject is taught during the second four-month period of the first year of the degree.

2.2. Recommendations:

It is recommended that students acquire from Mathematics I and Mathematics II the following knowledge: real functions of a real variable, limits, continuity, derivative calculus, integral calculus and solving linear equations systems. To successfully study the Mathematics III subject, it is essential to work continuously in order to acquire fluency in the use of the tools and to be able to assimilate the new concepts.

3. Objectives (as result of teaching)

- Know how to discriminate between the objectives of a statistical analysis: descriptive or inferential.

- Be able to summarize and interpret the information contained in a set of observed data.

- Interpret the solutions correctly.

- Recognize and handle the main discrete and continuous probability models.

- Formulate real problems in statistical terms (parameter estimation, hypothesis testing, regression analysis, reliability, etc.), and apply statistical inference to solve them.

- Know basic optimization models and the appropriate techniques for their resolution.

4. Skills to be acquired

4.1. Specific Skills:

CB01: Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge about: linear algebra; differential and integral calculus; numerical methods; numeric algorithmic; statistics and optimization.

4.2. General Skills:

CB2. Students have to be able to know how to apply their knowledge to their work or vocation in a professional way, and possess the competencies that are usually demonstrated through the elaboration and defence of arguments and to the resolution of problems within their study area.

CB4: Ability to transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.

CG0: Capacity for analysis and synthesis: Finding, analyzing, criticizing (critical reasoning), relating, structuring and synthesize information from various sources, as well as integrate ideas and knowledge.

G01: Organizational and planning capacity as well as information management capacity.
G03: Ability to solve problems.
G04: Ability to make decisions based on objective criteria (experimental, scientific or simulation data available) as well as the ability to logically argue and justify said decisions, knowing how to accept others points of view.
G06: Capacity for autonomous learning as well as initiative and entrepreneurial spirit.
CT2: Development of a critical attitude in relation to the capacity for analysis and synthesis.
CT3: Development of an attitude of inquiry that allows the permanent revision and advancement of knowledge.

5. Training Activities and Teaching Methods

5.1. Training Activities:

- Theory sessions on the contents of the Program.
- Problem Solving sessions.
- Practical sessions in specialized laboratories or computer rooms.
- Activities Academically Directed by the Faculty: seminars, conferences, development of works, debates, collective tutorials, evaluation activities and self-evaluation.

5.2. Teaching Methods:

- Participatory Master Class.
- Development of Practices in Specialized Laboratories or Computer Classrooms in small groups.
- Problem solving and practical exercises.
- Approach, Realization, Tutoring and Presentation of Works.
- Conferences and Seminars.
- Evaluations and Exams.

5.3. Development and Justification:

Theory and problems academic sessions
The academic sessions of theory and problems will be developed in the classroom alternating theoretical explanations and troubleshooting when deemed appropriate. In them, available resources such as blackboard, projector will be used of transparencies or video cannon. Parallel to the development of the subject, they will be made available to the students some notes with the theoretical content of the same, relations of problems and the necessary tables at all times.

Laboratory practices sessions
The practical sessions will be developed in classrooms equipped with computers and we will use statistical and optimization software packages. The contents of the laboratory practices will deal with the theoretical contents indicated in the syllabus and/or other related contents that are considered of interest for the subject. For a better follow-up of these sessions, scripts with the contents of the sessions will be made available to the students.

Activities Academically Directed
If the development of the course allows it, it may be imparted a seminar dedicated to deepening in aspects that, without appearing specifically in the program, are related to the subject and are of interest to a better understanding of it. Likewise, problem-solving sessions may be held, either in a face-to-face or through moodle, intended for students' self-evaluation.

6. Detailed Contents:

Topic 1: Descriptive Statistics.
1.1 General concepts.
1.2 Distributions of a character: frequency tables.
1.3 Measures of tendency, dispersion and shape.
1.4 Two-character statistical series.
1.5 Graphical representations.

Topic 2: Probability Theory.
2.1 General concepts.
2.2 Set theory: an introduction.
2.3 Probability axioms. Probabilities practical calculation: combinatorics. Laplace's rule.
2.4 Conditional probabilty. Product theorme, total probability and Bayes' teorem.

Topic 3: Random Variables and Distribution Models.
3. 1 General concepts.
3.2 Definition and classification of random variables. Discrete and continuous random variables: main characteristics.
3.3 Moment generator function.
3.4 Discrete models: discrete Uniform, Bernouilli, Binomial, Geometric, Poisson, Negative Biomial, Hypergeometric and Multinomial.
3.5 Continuous models: continuos Uniform, Exponencial, Normal, Beta and Gamma.

Topic 4: Sampling and Estimation.
4.1 General concepts.
4.2 Distributions associated with sampling in normal populations.
4.3 Poin estimation. Statistics and estimators.
4.4 Confidence intervals for the parameters of a normal disrtibutions.
4.5 Confidence intervals for the difference of means and the variance ratio of two normal populations.

Topic 5: Statistical Hypothesis testing.
5.1 General concepts.
5.2 Inferences for the parameters of a normal population.
5.3 Inferences for the difference of means and the variance ratio of two normal populations.
5.4 Non-parametric contrasts: the Runs test, Shapiro-Wilk test, Sign test and Wilcoxon-Mann-Whitney test.

Topic 6: Regression Models.
6.1 General concepts.
6.2 Simple linear regression. Least Squares method. Variabilicálculo práctico de probabilidadesty decomposition. Infenernces for the simple linear modle. Model fit goodness.
6.3 Other regression models. Multiple linear regression. Non-linear regression.

Topic 7: Linear Programming.
7.1 General concepts.
7.2 Linear Programming. Linear Programming problems formulation.
7.3 Graphical method. Simplex method.
7.4 Integer Programming.

7. Bibliography

7.1. Basic Bibliography

- Devore, J.L. PROBABILITY & STATISTICS for Engineering and the Sciences. CENGAGE Learning Custom Publishing, 2015.
- Freund, J.E.; Miller, I.; M. MATHEMATICAL STATISTICS with Applications. Addison-Wesley, 2013.
- Gardener, M.; BEGINNING R: The Statitiscal Programming. John Wiley & Sons, 2012.
- Jarman, Kristin H.; THE ART OF DATA ANALYSIS: How to Answer Almost Any Question Using Basic Statistics. John Wiley & Sons, 2013.
- Taha, H.A., OPERACIONAL RESEARCH: An Introduction. Ed. Pearson, 2007.
- Wilcox, Rand R.; BASIC STATISTICS: Understanding Conventional Methods and Modern Insights. Oxford University Press USA - OSO, 2009.

7.2. Additional Bibliography:

- Notes provided by teachers through Moodle platform .

8. Systems and Assessment Criteria

8.1. System for Assessment:

- Theory/problem exam.
- Practical exam

8.2. Assessment Criteria and Marks:

The subject assesement and grading, in each session, will be carried out according to the following rules:

- **Call I**: two practical laboratory exams will be held in the computer room. The first one will take place approximately halfway through the term, once the practical block on Descriptive Statistics and Linear Programming has been finalized. The second exam will take place during the last week of he course, once the block dedicated on Distribution Models, Statistical Infenrence a Linear Regression has been completed. The practical mark of each student will be the average of the marks obtained in both exams. There will also be a theory-problem exam on the date set by the Engineering School.

- **Calls II and III**: in both sessions, a practical exam and a thery-problem exam will be held on the sate set by the Engineeering School.

Those studens who request their assessement in a single sitting, in accordance to the rules established in the Assessment Regulations of the University of Huelva, will take a single practical exam on the same date as the theory exam. Those students who, for any of the exceptional and unforeeseen reasons describe in the Assessment Regulations , wish make use of the single assessment method will have to submit a sined request to the subject teacher.

- **Extraordinary call for the completion of the degree**: a practical exam and a theory-problem exam will be held on the date set up by the Engineering School.

In each practical exam, students will be asked to solve, by means of the software packages used in the practical laboratory classes, a collection of exercises related to the contents explained in the practical classes. In each theory-problem exam, students will be asked to

solve a set of problems, exercises and/or questions of a theoretical and/or practical nature related to the theoretical/practical contents of the subject. Each practical exam will have a duration of no more than 2 hours and each theory-problem exam will have a duration of no more than 4 hours.

In practice exams, students will be allowed to use a summary sheet of R procedures. In the theory-problems exams, the use of a summary form will be allowed. Both the summary sheet of R procedures, such as the form, will be available in Moodle at least three days before the completion of the corresponding exam. These materials must be used as it is available in Moodle, without amendments or additional strike throughs. Likewise, it will be the responsibility of each student to take said material to the exam, not being allowed to share it with other students while the exam.

The grade obtained in the theory-problems exam will have a weight of 70% in the final grade and the grade of the practical exam weighing 30%. In this way the weighted global rating will be calculated as:

global_grade = 0.7 * theory_grade-problems + 0.3 * practice_grade.

In each call, to pass the subject, it will be necessary to obtain a minimum grade of at least 4 points out of 10 in the theory-problems exam, a score of at least 3.5 points out of 10 in the practical exam carried out in the computer room and an overall weighted grade of at least 5 out of 10. The overall grade of a student whose grades, in the theory-problems and / or practical exams, do not reach the minimum stated above will be calculated as the It will be valued, as appropiate, the mastery of the theoretical concepts, the interpretation of the results, the brevity and clarity of the presentation, the skill in the application of the various practical methods and the precision in calculationsminimum between 4.5 and the overall weighted grade.

Provided that the student does not express himself in the opposite direction, the passing (qualification equal to or greater than 5 points) of any of the parties (theory-problems / laboratory) in call I, will also be effective in call II and with the same calification. Parts approved in calls I and / or II will not be saved for call III and neither will be save from one academic year to another.

For the mention of Enrollment of Honor it will be a necessary, not sufficient condition to obtain a weighted overall grade equal to or greater than 9.5 points. For its concession, the global note will be attended first to weighted score obtained by the candidate students and, in the event of a tie between two or more students, such qualification will be given to students who have obtained the highest qualification in the theory-problems exam.

It will be valued, as appropiate, the mastery of the theoretical concepts, the interpretation of the results, the brevity and clarity of the presentation, the skill in the application of the various practical methods and the precision in calculations.