Universidade Vigo

IDENTIFYING DATA
Mathematics: Probability and Statistics

Subject	Mathematics: Probability and Statistics
Code	V05G300V01204
Study programme	Degree in Telecommunications Technologies Engineering

Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd

Teaching language	Spanish
Department	Signal Theory and Communications
Coordinator	Fernández Bernárdez, José Ramón
Lecturers	Alonso Alonso, Ignacio Fernández Bernárdez, José Ramón Mojón Ojea, Artemio Prol Rodríguez, Miguel
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General description	The aim of this subject is to study some basic concepts of statistics, probability and random processes. These concepts are necessary in order to easily follow other subsequent subjects.

Competencies

Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
C1	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial differential equations; numerical methods, numerical algorithms, statistics and optimization
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Learn how to distinguish between deterministic or random models	B4	C1	D2
Identify a probabilistic model that fits with the needs of a specific problem	B3 B4	C1	D2 D3
Propose solutions to simplify statistical models by using deterministic parameters	B3 B4	C1	D2 D3

Contents

Topic	
Probability theory	Concept of probability. Axiomatic definition. Conditional probability, total probability and Bayes theorems. Independence.

One-dimensional random variables	Concept of random variable (RV). Classification.
	Cumulative distribution function (CDF) and properties.
	Discrete random variables: probability mass function.
	Continuous random varriables: density function.
	Functions of RV. CDF and discrete RV.
	Transformation of continuous RV: fundamental theorem.
	Mean and variance.
Random vectors	CFD and continuous RV.
	Marginals. Point and line masses.
	Conditional density. Continuous versions of Bayes and total probability theorems.
	Two-dimensional transformations: fundamental theorem.
	Changes of dimension.
	Correlation and regression.
Estimation and limit theorems	Sample and population.
	Estimators.
	Estimation of mean and variance.
	Sequences of RV. Laws of large numbers.
	Central limit theorem.
Stochastic processes	Description of a stochastic process.
	Statistics of a stochastic process.
	Stationarity.
	Examples.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Problem solving	13.5	28	41.5
Computer practices	14	7	21
Problem solving	1.5	6	7.5
Objective questions exam	0.5	2	2.5
Other	0.5	1	1.5
Essay questions exam	2	26	28

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The course is divided in five main topics. Each topic will have a theoretical part that will be exposed by the teacher in big group. The students will be required to perform a previous reading of the contents. Through this methodology the competencies CG3, CE1 and CT3 are developed.
Problem solving	Each topic will be complemented with problem resolution. The problems could be developed and solved in big or small group. The students will be required to work previously on these problems. Through this methodology the competencies CG3, CG4, CE1, CT2 and CT3 are developed.
Computer practices	Each topic will be completed with one or several sessions of computer practices. For this, a software developed by the teachers and specific questionnaires for each topic will be used. The students will be required to perform a previous reading of the contents. Through this methodology the competencies CG3, CG4, CE1, CT2 and CT3 are developed.

Personalized attention

Methodologies	Description
Lecturing	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. These timetables will be published on the subject website.
Problem solving	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. These timetables will be published on the subject website.
Computer practices	Students will have the chance to attend tutorial sessions at the teacher´s office. Teachers will establish timetables for this purpose at the beginning of the course. These timetables will be published on the subject website.

Assessment

	Description	Qualification	Training and Learning Results	
Problem solving	Students must solve a problem individually, two occasions along the course	25	B3 B4	C1
Objective questions exam	Students must answer a multiple choice test individually.	12.5	B3 B4	C1
Other	Students must solve a problem individually. (part 1) In a later class, each student will correct individually a solution to the same problem made by somebody else (part 2).	12.5	B3 B4	C1
Essay questions exam	Individual final exam.	50	B3 B4	C1

Other comments on the Evaluation

Following the guidelines of the degree, two evaluation systems will be offered to the students: continuous evaluation or unique evaluation.

Continuous evaluation is based on several assessed tasks.

It is assumed that a student follows the continuous evaluation system if she/he participates in task 2 (approximately in the seventh week of the semester) or any later task. Task 1 (both, part 1 and part 2) may be performed without engaging the student with the continuous evaluation system.

Students who choose continuous evaluation:

Several tasks are evaluated with a grade between 0 and 10. The planning for the different intermediate evaluation tasks will be approved by the Degree Academic Board (CAG) and it will be available at the beginning of the semester. A brief description of the tasks and the weight of each one in the final grade is listed below.

Task 1: Weight 12.5%. Two parts, both with the same weight:

  Part 1: Individual resolution of a problem

  Part 2: Correction of the task 1(part 1) from somebody else

Task 2: Individual resolution of a multiple choice test. Weight 12.5%

Task 3: Individual resolution of a problem. Weight 12.5%

Task 4: Individual resolution of a problem. Weight 12.5%

Last Task: Final exam. A reduced version of the exam to be carried out by the students who chose unique evaluation. Weight 50%

Before the completion or delivery of each task, the date and procedure for its review will be indicated. Students will have the option to know the grade of each task and review its correction within a reasonable period of time (usually a week).

These tasks are not recoverable, what means that if a student cannot fulfill them in the stipulated period, teachers will not be committed to repeat them.

The obtained grades will be valid only for the current academic course.

If a student has participated in continuous evaluation and does not pass the course he/she will receive a grade of fail, regardless of he/she carries out the final exam or not.

The final grade for students who opt for continuous evaluation will be calculated as the mean between the final exam and the average of the previous tasks marks. To minimize the impact of a possible miss on a task, the average of these will be computed excluding the worst obtained grade.

Students who choose for unique evaluation or extraordinary call:

For this evaluation system the students will carry out a unique final exam. This exam will be rated between 0 and 10, and this will be the final grade obtained.

Second chance

Previously to the exam (or at its beginning), all students will be asked to choose to be evaluated by continuous evaluation

system or unique evaluation system as they have been described before.

The subject is considered passed if the final grade obtained is equal to or greater than 5.

Sources of information

Basic Bibliography

JR Fernández, I. Alonso y A. Mojón, **Apuntes de Probabilidad y Estadística**, 9 ed, 2019

A Mojón, I. Alonso y JR Fernández, **Vídeos de la asignatura de Probabilidad y Estadística**, 1 ed, 2014

X. Rong Li, **Probability, Random Signals and Statistics**, 1 ed, 1999

R. Cao y otros, **Introducción a la estadística y sus aplicaciones**, 1 ed, 2001

Complementary Bibliography

H. Stark y J.W. Woods, **Probability, Random Processes, and estimation theory for engineers**, 2 ed, 1994

D. Peña, **Estadística, modelos y métodos. Tomo 1: Fundamentos**, 2 ed, 1991

P. Peebles, **Principios de probabilidad, variables aleatorias y señales aleatorias**, 4 ed, 2006

A. Papoulis, **Probability, random variables and stochastic processes**, 4 ed, 2002

A. Blanco y S. Pérez-Díaz, **Modelos aleatorios en ingeniería**, 1 ed, 2015

Recommendations

Subjects that continue the syllabus

Data Communication/V05G300V01301

Computer Networks/V05G300V01403

Signal Transmission and Reception Techniques/V05G300V01404

Basics of bioengineering/V05G300V01915

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus 2/V05G300V01203

Subjects that it is recommended to have taken before

Mathematics: Linear algebra/V05G300V01104

Mathematics: Calculus 1/V05G300V01105