



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				
Coordinator	Fernández Bernárdez, José Ramón			
Lecturers	Alonso Alonso, Ignacio Comesaña Alfaro, Pedro Curty Alonso, Marcos Fernández Bernárdez, José Ramón Mojón Ojea, Artemio Prol Rodríguez, Miguel			
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General description	In this subject we review 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	C1	D2
	B4		D3
Propose solutions to simplify statistical models by using deterministic parameters	B3	C1	D2
	B4		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 variables: 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 the 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
Master Session	24	24	48
Troubleshooting and / or exercises	13.5	28	41.5
Practice in computer rooms	14	7	21
Troubleshooting and / or exercises	1	4	5
Multiple choice tests	0.5	2	2.5
Practical tests, real task execution and / or simulated.	0.5	2	2.5
Other	0.5	1	1.5
Long answer tests and development	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
Master Session	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.
Troubleshooting and / or exercises	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.
Practice in computer rooms	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
Master Session	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. This schedule will be published on the subject website.

Troubleshooting and / or exercises	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. This schedule will be published on the subject website.
Practice in computer rooms	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. This schedule will be published on the subject website.

Assessment				
	Description	Qualification	Training and Learning Results	
Troubleshooting and / or exercises	Students must solve a problem.	12.5	B3 B4	C1
Multiple choice tests	The students must answer a test.	12.5	B3 B4	C1
Practical tests, real task execution and / or simulated.	In group B class, students must solve an exercise. Students can be distributed in pairs. In this case each couple provides an unique exercise and both students obtain the same mark.	12.5	B3 B4	C1
Other	Students must solve a problem. (part 1)	12.5	B3 B4	C1
	In a later class, each student will correct a problem made by somebody else (part 2).			
Long answer tests and development	Final exam.	50	B3 B4	C1

Other comments on the Evaluation

Following the guidelines of the studies, two evaluation systems will be offered to the students inscribed on this subject: continuous evaluation and evaluation at the end of the semester.

The continuous evaluation consists of several tasks.

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 opting for the continuous evaluation.

Students who choose continuous evaluation:

Several tasks are evaluated. The approximate task calendar and the weight of each task in the final grade are listed below.

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

Part 1: Individual resolution of a problem. Week 4

Part 2: Correction of the task 1(part 1) from somebody else. Week 5

Task 2: Individual resolution of a test. Weight 12.5%. Week 10

Task 3: Individual resolution of a problem. Weight 12.5%. Week 12

Task 4: Resolution of a problem by couples. Weight 12.5%. Week 14

The last task of the continuous evaluation will be a final exam. This will be a smaller version of the exam to be carried out by students who do not opt for continuous evaluation. The weight of the examination in the final grade will be 50 %

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

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 grade 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 takes the final exam or not.

The final grade for students who opt for continuous evaluation will be calculated as the average between the final exam and 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 evaluation at the end of the semester:

The possibility of a final examination will be provided to students who do not opt for the continuous evaluation. 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), students will be asked to choose to be evaluated by continuous evaluation system (described before) or only by the final exam.

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

Sources of information

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

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

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

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

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

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

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

- Notes of the course

- Questionnaires for laboratory

- They include the theoretical contents of the course.

- At the end of each chapter there is a set of problems belonging to any of the books listed in the bibliography and recommended readings. In general these problems are somewhat easier than those from bulletins.

Questionnaires for the laboratory include the statements and each practice problems and also some theoretical content. It is very important to read them in advance to carry out the practice.

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