



IDENTIFYING DATA

Mathematics: Probability and Statistics

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|---------------------|--|-----------------|------|------------|
| 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 Fernández Bernárdez, José Ramón Mojón Ojea, Artemio Oya Díez, Simón 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 | <p>Concept of random variable (RV). Classification.</p> <p>Cumulative distribution function (CDF) and properties.</p> <p>Discrete random variables: probability mass function.</p> <p>Continuous random variables: density function.</p> <p>Functions of RV. CDF and discrete RV.</p> <p>Transformation of continuous RV: fundamental theorem.</p> <p>Mean and variance.</p> |
| Random vectors | <p>CFD and continuous RV.</p> <p>Marginals. Point and line masses.</p> <p>Conditional density. Continuous versions of Bayes and total probability theorems.</p> <p>Two-dimensional transformations: fundamental theorem.</p> <p>Changes of dimension.</p> <p>Correlation and regression.</p> |
| Estimation and limit theorems | <p>Sample and population.</p> <p>Estimators.</p> <p>Estimation of mean and variance.</p> <p>Sequences of RV. Laws of the large numbers.</p> <p>Central limit theorem.</p> |
| Stochastic processes | <p>Description of a stochastic process.</p> <p>Statistics of a stochastic process.</p> <p>Stationarity.</p> <p>Examples.</p> |

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 | 1.5 | 6 | 7.5 |
| Multiple choice tests | 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 | <p>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.</p> <p>The students will be required to perform a previous reading of the contents.</p> <p>Through this methodology the competencies CG3, CE1 and CT3 are developed.</p> |
| Troubleshooting and / or exercises | <p>Each topic will be complemented with problem resolution.</p> <p>The problems could be developed and solved in big or small group.</p> <p>The students will be required to work previously on these problems.</p> <p>Through this methodology the competencies CG3, CG4, CE1, CT2 and CT3 are developed.</p> |
| Practice in computer rooms | <p>Each topic will be completed with one or several sessions of computer practices.</p> <p>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.</p> <p>Through this methodology the competencies CG3, CG4, CE1, CT2 and CT3 are developed.</p> |

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, two occasions along the course | 25 | B3 B4 | C1 |
| Multiple choice tests | The students must answer a test. | 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: Individual resolution of a problem. 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

Basic Bibliography

JR Fernández, I. Alonso y A. Mojón, **Apuntes de Probabilidad y Estadística**, 8 ed, 2018

A Mojón, I. Alonso y JR Fernández, **Videos 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