Syllabus

Subject

Subject / Group	22355 - Random Probabilities and Processes / 4
Degree	Degree in Telematics Engineering - Second year
Credits	6
Period	1st semester
Language of instruction	English

Professors

Lecturers	**Office hours for students**					
	Starting time	**Finishing time**	**Day**	**Start date**	**End date**	**Office / Building**
Irene María García Mosquera *Responsible* irene.garcia@uib.es	13:00	14:30	Friday	03/03/2020	25/06/2020	AT, D-122

Context

The theory of probability and stochastic processes is playing an important role in all fields of engineering. This is due, in part, to the fact that many natural phenomena can be described by probabilistic methods. In addition, many studies of complex systems has leading to adopt a probabilistic approach.

The goal of this course is to introduce the student to the concepts of probability and stochastic processes that are needed for explain, modeling, analyzing, and designing the technology that telematic engineers develops in the areas of system analysis and communication. The first part of the course covers the basics of probability and both discrete and continuous random variables. The second part has a more specialized coverage, including random vectors, Gaussian random vectors, random processes, Markov Chains, and queuing theory. We will use appropriate software to find solutions of problems tackled over the course with R.

22355 - Probability and Random Processes- is a mandatory course of the second year in Telematics Engineering degree.

Requirements

This subject requires prior knowledge of calculus in one and several variables, as well as linear algebra and discrete mathematics.

Recommended

20301- Mathematics II - Calculus

22350- Linear Algebra and discrete mathematics.

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22352- Calculus II

Skills

Specific

* CB1 Ability to solve mathematical problems that can arise in engineering. Ability to apply knowledge of algebra, geometry, differential geometry, differential and integral calculus, differential and partial differential equations, numerical methods, numerical algorithm, statistics, and optimization.

Generic

* CG1 Critical reasoning: ability to analyze and evaluate different alternatives
* CG2 Problem solving: ability to find optimal solutions to complex problems and projects

Basic

* You may consult the basic competencies students will have to achieve by the end of the degree at the following address: http://www.uib.eu/study/grau/Basic-Competences-In-Bachelors-Degree-Studies/

Content

The subject consists of three blocks. In the first one, we will study the basic of probability and random variables. In the second one, the random processes are studied and we focus on the discrete Markov chains. The third is transversal, the students will be working throughout the course with computer tools and basic statistics.

Range of topics

I. Probability

I.1. Introduction to Probability

Counting techniques. Probability: axioms of probability. Random variables: cumulative distribution function (CDF) and probability density function (PDF). Expected value and variance. Common discrete and continuous random variables: Bernoulli, Geometric, Binomial, Poisson, Uniform, Gaussian, and Exponential. Systems with many random variables. Joint CDF and PDF. Marginal PDF from a given joint PDF. Expected value, correlation, variance, covariance. Transforming random variables. Generating random numbers.

Random Processes and Markov chains. II

II.1. Random Processes

Introduction. Notation. Poisson process. Exponential process. Deterministic and nondeterministic processes. Ensemble average. Time average. Autocorrelation function. Stationary processes. Cross-correlation function. Covariance function. Correlation matrix. Covariance matrix.

II.2. Markov Chain

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Discrete-time Markov Chains. Memoryless property of Markov chains. Markov chain transition matrix. Markov Chains at equilibrium. Reducible Markov chains. Periodic Markov chains. Queuing analysis.

III. Statistics

III.1. Transversal theme: statistical tools

Descriptive statistics. Statistical inference techniques: confidence intervals and hypothesis contrast. Study and management of the statistical package R

Teaching methodology

Some of the activities will be developed in class, but others will have to be studied by the student on her/himself.

For the purpose of making easier the student's personal work, the course will be part of the online platform (Aula Digital) that allows for flexibility in distance teaching and learning. Through this platform, students will have at their disposal online communication with the teacher, a calendar with news of interest, electronic documents, proposed exercises or assignments, as well as a suitable environment for submitting assignments and access to their grades.

Workload

We would like to emphasize that in addition to the in-class work, the student should work independently at least two hours per week.

The workload is described in the following table.

In-class work activities (2.4 credits, 60 hours)

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Lecture class	Large group (G)	The lecture will introduce the fundamental concepts and procedures relevant to the content of each unit. We working the skills CB1 and CG1	40
Practical classes	Practical class	Large group (G)	During these sessions, students will complete activities to acquire the course's skills. We working the skills CB1, CG1, and CG2.	16
Assessment	Partial Assessment II	Large group (G)	Students will be expected to complete an individual test for the second part of the course in order to evaluate the acquisition of specific and general skills.	2
Assessment	Partial Assessment I	Large group (G)	Students will be expected to complete an individual test for the first part of the course. Skills CB1, CG1 and CG2 are worked	2

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Aula Digital platform.

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Distance education tasks (3.6 credits, 90 hours)

Modality	Name	Description	Hours
Individual self-study	Questionnaires	Questionnaires should be solved through the platform Aula Digital individually. The questionnaires content is about the themes worked in class and the individual self-study of the descriptive statistic with R.	30
Individual self-study	Individual and group self-study	Students are expected to study and practice the concepts introduced in class, as well as solve proposed exercises individually and also in a group.	60

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

The evaluation consists of 4 parts (specified in the table below).

The final grade of the subject will be the weighted average of the 4 parts provided that the student has obtained a minimum of 3.5 in each partial test.

Frau en elements d'avaluació

In accordance with article 33 of Regulation of academic studies, "regardless of the disciplinary procedure that may be followed against the offending student, the demonstrably fraudulent performance of any of the evaluation elements included in the teaching guides of the subjects will lead, at the discretion of the teacher, a undervaluation in the qualification that may involve the qualification of "suspense 0" in the annual evaluation of the subject".

Practical class

Modality	Practical classes
Technique	Student internship dissertation **(non-recoverable)**
Description	During these sessions, students will complete activities to acquire the course's skills. We working the skills CB1, CG1, and CG2.
Assessment criteria	During these sessions, students will complete practical activities in a group.

Final grade percentage: 25%

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Partial Assessment II

Modality	Assessment
Technique	Extended-response, discursive examinations **(recoverable)**
Description	Students will be expected to complete an individual test for the second part of the course in order to evaluate the acquisition of specific and general skills.
Assessment criteria	Students will be expected to complete an individual test at the end of the course.

Final grade percentage: 30%with a minimum grade of 3.5

Partial Assessment I

Modality	Assessment
Technique	Extended-response, discursive examinations **(recoverable)**
Description	Students will be expected to complete an individual test for the first part of the course. Skills CB1, CG1 and CG2 are worked
Assessment criteria	Test of development to assess the acquisition of specific skills and some generic. It requires a minimum of 3.5 to be able to average with the other activities. Skills CB1, CG1 and CG2 are worked.

Final grade percentage: 25%with a minimum grade of 3.5

Questionnaires

Modality	Individual self-study
Technique	Real or simulated task performance tests **(non-recoverable)**
Description	Questionnaires should be solved through the platform Aula Digital individually. The questionnaires content is about the themes worked in class and the individual self-study of the descriptive statistic with R.
Assessment criteria	Questionnaires should be solved through the platform Aula Digital individually.

Final grade percentage: 20%

Resources, bibliography and additional documentation

Throughout the course, we will be publishing the notes of the subject in Aula Digital.

The following is the recommended bibliography:

Basic bibliography

* Gebali, Fayez. "Analysis of Computer and Communication Networks". Second edition. Springer. 2015.
* Leon-Garcia. "Probability, Statistics, and Random Processes for Electrical Engineering".Third Edition. Pearson-Prentice Hall. 2008.
* Alberich Ricardo, Mir Arnau and Roselló Francesc. "AprendeR: Parte I". Col·lecció Materials Didactics UIB 161. Segona edició revisada. 2018.

Complementary bibliography

* Free Introduction to R Programming Online Course - DataCamp: https://www.datacamp.com/courses/free-introduction-to-r
* R Introduction | R Tutorial: www.r-tutor.com/r-introduction

* Larson, L. Problem-Solving Through Problems. Springer-Verlag. 1993

Other resources

* https://www.class-central.com/mooc/7944/nptel-stochastic-processes
* A Free and Fun-to-Read Book: "Introduction to Probability" by Charles Grinstead and J. Laurie Snell. http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/amsbook.mac.pdf

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