Universitat de les Illes Balears

Syllabus

Academic year	2017-18
Subject	22355 - Random Probabilities and Processes
Group	Group 4, 1S
Syllabus	R
Language	English

Subject

Name	22355 - Random Probabilities and Processes
Credits	2.4 in-class (60 hours) 3.6 distance (90 hours) 6 total (150 hours).
Group	Group 4, 1S (Campus Extens)
Period	First semester
Language	Catalan

Lecturers

Lecturers	Office hours for students					
	Starting time	Finishing time	Day	Start date	End date	Office
Irene María García Mosquera irene.garcia@uib.es	15:30	16:30	Monday	01/09/2017	31/01/2018	Anselm Turmeda D-122

Context

The complexity of the systems found in engineering practices call for an understanding on how to use the probability as a tool. The course 22355 - Probability and Random Processes- is a basic course of the Telematics Engineering degree. Our goal is to provide both the basic theoretical concepts of probability, statistics and stochastic processes and techniques for solving problems that arise in practice.

Requirements

The probability theory and stochastic processes are playing an ever more important role in all fields of engineering. This is due, in part, to the growing realization that many natural phenomena can be accurately described by probabilistic means. In addition, many studies of complex systems have to lead to the use of the probabilistic concept as a method of description.

The purpose of this course is to introduce the student to the concepts of probability and stochastic processes that are needed for the areas of system analysis and communication. To do this, we will teach the students to apply these techniques to solve practical problems that engineers have to face in their professional everyday activity, and for which a probabilistic-statistical type of model may give a more suitable practical solution than a deterministic model. We will use appropriate software to find solutions to problems tackled over the course with R and Matlab.

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Recommended

This subject requires prior knowledge of Calculus in one and several variables, as well as Linear Algebra and Discrete Mathematics.

Skills

The skills are described on page 57 of the Telematics Engineering Study Plan at UIB.

Regarding the specific CB1 competence, special attention will be paid to the descriptors of statistics and probability.

Generic skills will focus on the application of computer tools for both problem solving and reporting (corresponding to generic competence CG3)

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 contents of probability and random variables. In the second one, the random processes are studied and we focus in the Markov chains. The third is transversal, the students will be working throughout the course with computer tools and basic statistics

Theme content

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: Gaussian, exponential, uniform, Bernoulli, geometric, binomial and Poisson. Systems with many random variables. Joint CDF and PDF. Individual 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

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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

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

We will describe some of the activities in the classroom, but others won't be in order for the student to reach the corresponding skills.

To favor the autonomous work of the student, this subject will be part of Campus Extems. This platform will be used in order for the student to have all the material of the course (class notes, examples, problems, forums, etc) in it. In addition, Campus Estems will promote communication between the student, her/his classmates, and the teacher

Workload

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

The workload of the subject is described in the following table.

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Theorical class	Large group (G)	Master lecture with examples of the contents of the subject. Classes of problems proposed. We working the skills CB1 and CG1	40
Practical classes	Solving problems	Large group (G)	Resolution collection of problems to be solved during the course. We working the skills CB1, CG1 and CG2 are worked	16
Assessment	Partial examination I	Large group (G)	Partial exam of the subject to evaluate the acquisition of specific skills and some general. Skills CB1, CG1 and CG2 are worked	2
Assessment	Partial examination II	Large group (G)	Partial exam of the subject to evaluate the acquisition of specific skills and some general. Skills CB1, CG1 and CG2 are worked	2

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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 Campus Extens platform.

Distance education work activities

Modality	Name	Description	Hours
Individual self-study	Autonomous work	To study and to practice the contents of the subject. Skills CB1, CG1 and CG2 are worked.	30
Individual self-study	Questionnaires	Questionnaires that will have to be solved throughout the course individually. Skills CB1 and CG1 are worked	30
Group self-study	Delivery of solved problems	Resolution and memory delivery of proposed problems.Skills CB1, CG1 and CG2 are worked.	30

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 in each partial test.

Partial examination I

Modality	Assessment
Technique	Extended-response, discursive examinations **(retrievable)**
Description	Partial exam of the subject to evaluate the acquisition of specific skills and some general. 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 to be able to average with the other activities. Skills CB1, CG1 and CG2 are worked.

Final grade percentage: 25% with minimum grade 3

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Partial examination II

Modality	Assessment
Technique	Extended-response, discursive examinations **(retrievable)**
Description	Partial exam of the subject to evaluate the acquisition of specific skills and some general. 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 to be able to average with the other activities. Skills CB1, CG1 and CG2 are worked.

Final grade percentage: 25% with minimum grade 3

Questionnaires

Modality	Individual self-study
Technique	Papers and projects **(non-retrievable)**
Description	Questionnaires that will have to be solved throughout the course individually. Skills CB1 and CG1 are worked
Assessment criteria	Questionnaires to be carried out throughout the course individually. Skills CB1 and CG1 are worked.

Final grade percentage: 25%

Delivery of solved problems

Modality	Group self-study
Technique	Papers and projects **(non-retrievable)**
Description	Resolution and memory delivery of proposed problems.Skills CB1, CG1 and CG2 are worked.
Assessment criteria	Delivery of proposed problems weekly. Skills CB1, CG1 and CG2 are worked.

Final grade percentage: 25%

Resources, bibliography and additional documentation

Throughout the course, we will be publishing the notes of the subject in Campus Extems.

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 Rosello Francesc. "ActivaR. Introducció a R". Col·lecció Materials Didactics UIB 161. Segona edició revisada. 2008.

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

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* 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