Teaching Plan

1. Descriptive data of the subject

- Name of the subject: Probability and Stochastic Processes
- Code of the subject: 21408, 21719, 21597
- Academic year: 2011/12
- Course: Second Trimester: First and Second
- Degree: Bachelor's degree in Computer Engineering, Bachelor's degree in Audiovisual Systems Engineering and Bachelor's degree in Telecommunications Network Engineering.
- Number of ECTS credits: 8
- Student dedication hours: 200
- Language or teaching languages: Catalan, Spanish
- Teachers : Xavier Binefa, Ralph Andrzejak, Josep Blat, Pol Cirujeda, Karim Lekadir, Toni Urcola, Rosa Mª Figueras.
- Coordination: Xavier Binefa
- Department: Departament de Tecnologies de la Informació i les Comunicacions
- Center: Escola Superior Politècnica (ESUP)
- Campus where the subject is taught: Poblenou

2. Presentation of the subject

The subject of Probability and Stochastic Processes is one of the subjects of mathematical bases for the engineering that is studied in Bachelor's degree in Computer Engineering, Bachelor's degree in Audiovisual Systems Engineering and Bachelor's degree in Telecommunications Network Engineering. It is taught in the first and second trimesters of the second year and requires the use of many mathematical methods acquired in the subjects of the first, in particular, mathematical analysis and linear algebra.

The subject has three distinct parts. In the first part of the course, some of the fundamental elements of the theory of probabilities are introduced: Probability and probability Conditionals Random variables and probability distributions, Moments, expected values and the central limit theorem, among others. All these concepts are the mathematical basis of statistics. The second part of the subject is devoted to statistical inference, including the parametric estimation, the hypothesis test and the analysis of the variance. Finally, the third part is devoted to introducing stochastic processes, essential for the modeling of loads in computing as well as in the transmission and analysis of the signal.

The mathematical knowledge acquired is fundamental for the subjects in which the validity of a model or hypothesis is to be evaluated. In this sense, subjects such as artificial intelligence, signal processing, computational linguistics, audio, computational vision and all those that in one way or another use Pattern Recognition techniques.

3. Skills to reach in the subject[1]

A. General

A1. Scientists
A1.1 Analysis
1. To interpret the results of mathematical problems and to know how to contextualise them within the general framework of a theory.
2. Relate concepts and mathematical results.
A1.2 Understanding
3. Understand mathematical language.
4. Understand the statements of mathematical problems
A2. Technological
5. Know how to apply theoretical knowledge to practical problems.
A3 Communication
6. Exposure of mathematical ideas and the results of mathematical problems in a concise manner.
A4. Development of self-learning
7. Know how to search and analyze the information from different sources.
A5. Interpersonal
8. To be able to discuss and analyze mathematical concepts and concepts as a team, in order to understand them in depth.
A6. Specific competencies
9. Know and understand the concepts of Probability, Statistics and Stochastic Processes

4. Contents, methodology, evaluation and programming of activities

Part 1: Probability and random variables

Contents

1) Introduction to probability
2) Conditional probability
3) Random variables and distributions; discrete, continuous, multiple, conditional
4) Mathematical hope, Variance, Moments, Mijana sample and Law of the great numbers, Covariance and correlation, Conditional hope
5) Special distributions and Theorem of the central boundary

Part 2: Statistical Inference

6) Introduction to statistical inference
7) Parametric inference
8) Test of hypothesis and Significance Test
9) Bayesian estimate

Part Stochastic Processes

10) Introduction to Stochastic Processes
11) Some types of PE (Poisson, Gaussians, Stationary ...)

12) Applications for signal processing
13) Markov processes

Metodology

The theory classes will present the main concepts of the subject illustrated with many examples. In the programming section there is a weekly planning of the contents that will be discussed in each session.

The seminars are aimed at discussing and deepening the concepts introduced into the theory classes through examples and problems. The student will have two hours to work and discuss with the teacher a list of proposed problems. The student will deliver at the end of the seminar a leaflet with the solution of some of the problems worked. These exercises will be delivered corrected and evaluated.

In the problem classes, problems will be solved and discussed, some of which students will have done beforehand and that must be delivered at the beginning of the session. You will be detailed in detail about the problems you need to take prepared and worked every week to take advantage of the class. Most of the blocks are constituted by a theory session and one of seminars or problems.
The subject also includes practice sessions (for example, in the first part there will be two, two hours each, on simulation of statistical distributions and the theorem of the central limit).
The teaching material of the subject will be published weekly during the course. This material consists of class transparencies, a collection of problems and the scripts of the practices.

Evaluation

In the subject, each of the three parts will be evaluated. The grade of the subject will be the average of the notes of the parts if these are all greater or equal to four out of ten. The course is approved if this average grade is greater than or equal to five.

For each part

- There will be the possibility of continuous evaluation based on small exams (15 minutes, approximately every two weeks, in seminar sessions and Practices (to be held in any of the seminars and problems sessions). If the average is approved of controls and practices with a grade equal to greater than 5 means that you have the right to a continuous assessment. This right is maintained until the September call included.
- For each part there will be an examination of the content of the party.

The note of the party may be obtained according to whether or not the continuing assessment is entitled.

- With the right to continuous assessment: they will perform an Examination of the content of the part and if it has a mark equal or superior to 4 in the examination, the note of the part will be:

  $$A = 0.6 * \text{Exam} + 0.3 * \text{Controls} + 0.1 * \text{Practices}.$$

- Without the right to the continuous evaluation: It will consist of an examination of the whole part. It is necessary that this note is equal to five to be able to make average with the notes of the other parts. The note that we will obtain will be the note of the part.

If any party is suspended, together with the third part, one may examine the first and second parts that

are suspended.

If the subject is not approved, it is passed to the September call in which the approved parties are saved and the rights to the continuous evaluation of the suspended parties if they are there.

Competence evaluation

Assessment of general competencies:
Scientists, of communication and of development of the self-learning:
They are evaluated throughout the course by means of the practices the controls and the final examination.
Interpersonal: They are evaluated in seminars by solving group problems.
Evaluation of specific competences:
They are evaluated throughout the course through controls, exams and practices.

5. Bibliography and didactic resources

The basic text of the subject is:
[1] Morris H. DeGroot and Mark J. Schervish: Probability and Statistics. 3rd Edition. Addison-Wesley, 2002
[2] Roy D. Yates and David J Goodman: Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers, 2nd Edition. John Wiley & Sons, 2005

Two more recommended texts are:

[3] S. M. Kay: *Intuitive Probability and Random Processes using Matlab*. Springer 2004.
[4] D.C Montgomery, G. C. Runger Applied Statistics and Probability for Engineers. John wiley & Sons, Inc. Third Edition, 2003.

More the teaching material of the subject available in the global classroom.