

Academic Year: (2020 / 2021)

Review date: 09/07/2020 11:38:44

Department assigned to the subject:

Coordinating teacher: D AURIA , BERNARDO

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

An elementary course of Probability and Statistics

OBJECTIVES

To acquire basic rudiments of the theory of stochastic processes.
Modeling real problems through Markov processes and Martingales.
To solve problems using the appropriate stochastic methodologies and techniques.

DESCRIPTION OF CONTENTS: PROGRAMME

Introduction and basic notions.

- Measurable spaces, sigma-algebras, Probability spaces, Semi-algebras, Extension Theorem.
- Continuity of probabilities
- Random variables
- Independence

Discrete time Stochastic Processes.

- Existence of the coin tossing probability space
- Elementary existence theorem

Discrete-time Markov chains.

- Definitions and basic properties
- Class structure
- Hitting times and absorption probabilities
- Strong Markov property
- Recurrence and transience
- Invariant distributions
- Convergence to equilibrium

Continuous-time Markov chains.

- Q-matrices and their exponentials
- Continuous-time random processes
- Some properties of the exponential distribution
- Poisson processes
- Jump chain and holding times
- Stopping times and strong Markov property
- Explosion
- Forward and backward differential equations
- Class structure
- Hitting times and absorption probabilities
- Recurrence and transience
- Invariant distributions
- Convergence to equilibrium

Discrete-time Martingales.

- Definition and properties
- Basic inequalities
- Martingale convergence theorem
- Uniform integrability
- Optional Stopping Theorem

Brownian Motion.

- Definition and basic properties
- Markov properties
- Construction

LEARNING ACTIVITIES AND METHODOLOGY

Class hours (1.4 ECTS) will be devoted to the following training activities target:

- "Lecture / exhibition: They will target specific cognitive skills matter. They present the knowledge that students should acquire. To facilitate their development students will receive class notes and key reference texts will allow them to complete and further on those issues which they are most interested in.
- "Practical Classes: These classes are problem solving. These classes help to develop specific skills.

Additionally, 1.4 ECTS will be devoted to training activities tutored. These oversight activities consist of teaching-learning both theoretical and practical training content, although it can develop independently, require the supervision and monitoring, more or less specific, by a teacher. These activities may include, among others, the following: scheduled tutorials, review of follow-up work and tutorials.

The remaining credits, 3.2 ECTS are devoted to the study of students independently or in groups without teacher supervision. During this time the student performs exercises and readings proposed by the teacher. It also performs additional readings obtained through literature search between the material recommended by the teacher.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	40
% of continuous assessment (assignments, laboratory, practicals...):	60

Continuous assessment by two partial assessments (60%) and the delivery of a final project (40%).

BASIC BIBLIOGRAPHY

- Norris, J.R. Markov Chains, Cambridge University Press, 1997
- Bass, R.F. Stochastic Processes, Cambridge University Press, 2001
- Rosenthal, J.S. A First Look at Rigorous Probability Theory, World Scientific Publishing Co., 2006

ADDITIONAL BIBLIOGRAPHY

- Evans, L.C. An Introduction to Stochastic Differential Equations, American Mathematical Society, 2013
- Steele, J.M. Stochastic Calculus and Financial Applications, Springer, 2000
- S.M. Ross Introduction to probability models., Academic Press, 2007