Stochastic Processes

Academic Year: (2020 / 2021) **Review date: 07-07-2020**

Department assigned to the subject: Statistics Department

Coordinating teacher: JIMENEZ RECAREDO, RAUL JOSE

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

OBJECTIVES

Competences and skills that will be acquired and learning results.

SPECIFIC SKILLS
Students will acquire knowledge and skills necessary to:
1. Knowing the theoretical foundations and the basic properties of stochastic processes
2. Stochastic Modelling of real cases.
3. Resolution of problems of Stochastic Nature.

GENERAL SKILLS
Students will be able to:
1. Develop their ability to think analytically
1. Become familiar with a statistical software
2. Establish a framework to solve problems
3. Develop their interactive skills
4. Enhance their critical thinking
5. Improve their learning skills and communication

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Stochastic Processes.
1.1. Basic Definitions and Notations.
1.2. Examples: branching processes and queues.
1.3. Review of Conditional Expectation.
1.4. Review of Characteristic Functions and applications.

2. Discrete time Markov Chains.
2.1. Basic Definitions and Notations.
2.2 Chapman-Kolmogorov Equations and classification of states.
2.3. Asymptotic results.
2.4. First Step Analysis.
2.5. Random Walks and Success Runs.
2.6 The Geo/Geo/1 queue.

3. Renewal Theory and Poisson process.
3.1 Definition and basic notions.
3.2 The Elementary Renewal Theorem.¿
3.3 The Key Renewal Theorem.
3.4 The Delayed Renewal Theorem.
3.5 Compound Poisson Process.

4. Continuous time Markov Chains.
4.1 Definition and basic notions¿
4.2 Chapman-Kolmogorov Equations and Limit Theorems
4.3 Birth and Death Processes (M/M/m queues).

5. Continuous time Markov Processes: Brownian Motion.
5.1 Brownian Motion and Gaussian Processes.
5.2 Variations and Extensions.
5.3 Hitting times.¿

5.4 Relation with Martingales.

LEARNING ACTIVITIES AND METHODOLOGY

- Clases magistrales: Presentación de conceptos, desarrollo de la teoría y ejemplos, 2.2 ECTS
- Clases de resolución de problemas: 2.2 ECTS
- Prácticas de ordenador: 0.6 ECTS
- Sesiones de evaluación (exámenes de evaluación continua y examen final): 1 ECTS

ASSESSMENT SYSTEM

40% of the final qualification is obtained in a final exam. The remaining 60% is the result of continuous evaluation based on the acquired abilities of the student by two midterm exams (40%), carry out practical data analyses, computer labs and explain the results they have obtained (20%).
In the extraordinary examination, the final grade will be the maximum between the previous system and 100% of the final exam.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- 1. Moshe Haviv. A Course in Queueing Theory. , Springer, 2013
- Sheldon M. Ross. Stochastic Processes. , Wiley, 1995