

Academic Year: ( 2021 / 2022 )

Review date: 09-06-2021

Department assigned to the subject: Department of Statistics

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

[Link to document](#)

**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.  $\zeta$
  - 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  $\zeta$
  - 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.

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

#### BASIC BIBLIOGRAPHY

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