

Academic Year: (2022 / 2023)

Review date: 19-05-2022

Department assigned to the subject: Statistics Department

Coordinating teacher: MEILAN VILA, ANDREA

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Probability, Programming in R

OBJECTIVES

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

DESCRIPTION OF CONTENTS: PROGRAMME

- Introduction to stochastic processes
 - 1.1. Definition and basic concepts.
 - 1.2. Types of processes.
- Discrete-time Markov chains.
 - 2.1. Definition and basic computations.
 - 2.2. Classification of states.
 - 2.3. Limiting and stationary distributions.
 - 2.4. Limit theorems.
 - 2.5. ML estimation of transition probabilities.
- Markov chain Monte Carlo.
 - 3.1. The Metropolis-Hastings algorithm.
 - 3.2. The Gibbs sampler.
 - 3.3. MCMC diagnosis.
- Poisson processes.
 - 4.1. Introduction.
 - 4.2. The Poisson process.
 - 4.2.1. Inter-arrival times.
 - 4.2.2. Infinitesimal probabilities.
 - 4.2.3. The connection with the uniform distribution.
 - 4.2.4. Thinning and superposition
 - 4.3. Non-homogeneous Poisson processes.
- Continuous-time Markov chains
 - 5.1. Introduction
 - 5.2. Transition function and transition rates
 - 5.3. Long-term behaviour
 - 5.4. Time-reversibility
- Brownian motion and Gaussian processes
 - 6.1. Brownian Motion
 - 6.2. Transformations and Properties
 - 6.3. Extensions of the Brownian Motion
 - 6.4. Gaussian processes

LEARNING ACTIVITIES AND METHODOLOGY

In each class, theoretical concepts are introduced. Numerical and simulated exercises are shown for better understanding. Applications are also made with real data.

ASSESSMENT SYSTEM

Continuous evaluation through two tests (50%) and final exam (50%).

% end-of-term-examination:	50
% of continuous assessment (assignments, laboratory, practicals...):	50

BASIC BIBLIOGRAPHY

- Dobrow, R. P. Introduction to stochastic processes with R, Wiley, 2016
- Durrett, R. Essentials of stochastic processes, Springer, 2012
- S.M. Ross Introduction to probability models, Academic Press, 2007

ADDITIONAL BIBLIOGRAPHY

- Norris, J.R. Markov Chains, Cambridge University Press, 1997
- Ross, S.M. Stochastic Processes, Wiley, 1996