GIMAS8AA MONTE CARLO RANDOM PROCESSES

GIMAS8AA **Monte Carlo Method & Application to Random Processes**	**ECTS Credits:** 2 **Duration:** 21 hours	**Semester:** S8

Person(s) in charge:

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Keywords: Monte Carlo methods; Random processes; Simulation

Prerequisites: Probabiliy theory (M1 level); basics in MATLAB

Objective:

Mastering the Monte Carlo method and being able to simulate random processes

Program and contents:

The first part of this course introduces the Monte Carlo method, which consists in estimating a probabilistic expectation using simulations; this way, a *deterministic* quantity is computed by the means of a *random* device.

In this part we will explain how to compute the desired value ; and also how to assess the confidence interval for the estimator we get—which is quite important too. Then, improving that confidence interval is worth: to do that, we will introduce the so-called *variance reduction* techniques. We will introduce four of these techniques: importance sampling, conditioning, control variable, and common random numbers.

The second part of this course is an introduction to the study of random processes indexed by time: these processes are an important field in mathematical engineering; moreover it is a context where applying the Monte Carlo method is frequently needed.

In this second part, our goal will be to understand in a concrete way what Markovian random processes are, and how one can simulate them numerically. So, we will deal with stochastic differential equations, as well as with jump processes. We will focus on the general ideas and the practical devices, rather than bothering with the underlying technicalities.

A wide part of this course will be devoted to implementing the concepts into computers. The software used for that will be MATLAB.

Abilities:

Levels	Description and operational verbs
Know	Knowing how to compute the confidence interval for a Monte Carlo method Knowing the main variance reduction techniques
Understand	Understanding the principle of the Monte Carlo method Understanding the meaning of a Brownian stochastic differential equation, possibly with jumps
Apply	Implement numerically the Monte Carlo method on a computer Simulating a Brownian stochastic differential equation, possibly with jumps
Analyze	Being able to choose a relevant reduction variance technique for a given problem
Summarize	
Assess	

Evaluation:

☑ Written test	☐ Continuous assessment	☑ Oral presentation	☐ Project	☐ Written report