

# Introduction to stochastic process

#### In brief

> Course langage: French

# Presentation

#### Prerequisites

Undergraduate level probability course (3rd year of Bachelor's degree, MAT-1A). Matrix calculus.

### Learning objectives

- 1. The student will know how to use conditional expectation in different branches of probability.
  - 2. The student will be able to model a number of phenomena by appropriate stochastic processes.
  - 3. The student will be able to recognize the main stochastic processes in discrete time and exploit their properties to give qualitative or quantitative evidence about their behavior in long time.

# Description of the programme

The goal of this course is to prepare students for advanced courses in probability such as a course in stochastic calculus which is the foundation of financial mathematics or a course in stochastic algorithms which are very present in Statistics, Data Science and Machine Learning.

This 30-hour course is broken down into

- 7 CM (2h each) = 14h
- 5 TD (2h each) = 10h
- 3 practical sessions (2h each) under Python = 6h
- The program treated in this course is the following
- 1. Conditional expectation, conditional law
- 2. Filtering, stopping time, player's ruin, Wald identity
- 3. Martingales in discrete time, stopping theorems, convergence theorems for martingales (Lp, almost surely)
- 4. Markov chains on countable state spaces, strong Markov property, recurrence, positive recurrence, ergodicity

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### Introduction to stochastic process

5. Poisson process: construction, strong Markov property, characterization

6. Markovian processes of jumps: definitions

# Generic central skills and knowledge targeted in the discipline

1. Calculate the conditional expectation of a random variable using its conditional distribution or using the properties of conditional expectation (linearity, measurability, independence)

2. Verify that a stochastic process is a martingale and determine if the process converges.

3. Recognize a situation that can be modeled by a Markov chain, understand the strong Markov property, know how to classify Markov chains according to their behavior.

4. Recognize a situation that can be modeled by a Poisson process and more generally by a Markov process of jumps.

# How knowledge is tested

CC1 = written 100%.

# Bibliography

The bibliography will be given at the beginning of the course.

### Teaching team

Charles Bordenave DR CNRS, I2M équipe Probabilités

Total des heures		30h
CM	Master class	14h
TD	Directed work	10h
TP	Practical work	6h

# Useful info

### Name responsible for EU

#### Lead Instructor

Charles Bordenave