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

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

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