2EL1710 – Advanced probabilities

Instructors: Erick Herbin
Department: DÉPARTEMENT MATHÉMATIQUES
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Fundamental Sciences
Advanced level : Yes

Description

This theoretical course is a follow-up to the 1st year Mathematics course, which includes the basic concepts of probability theory. It introduces the foundations of the general theory of stochastic processes, taking into account the temporal evolution of random concepts.

These probabilistic models constitute the basic mathematical objects for modelling phenomena with high variability, uncertainty or complexity that make it impossible to describe them in detail. Among them, Brownian motion is widely used to describe phenomena (natural, physical, biological or financial) based on stochastic differential equations. It is at the crossroads of important classes such as martingales, Markov processes or Gaussian processes, from which it inherits properties.

The objective of this course is the theoretical study of the first two families of stochastic processes, in the particular case where the parameters are in a discrete space, and then to introduce Gaussian processes indexed by the real ones. The course is in the classic format of a mathematics course in which the fundamental theorems are demonstrated on the board.

Quarter number

SG6

Prerequisites (in terms of CS courses)

CIP course of the CentraleSupelec curriculum or last year courses of a Mathematics Licence: Integration, Measure Theory, Probability.

Syllabus

Discrete time martingales (15h): study of discrete time martingales; martingales and game strategy; convergence results

Markov chains (12h): transition operators, Markov ownership and canonical Markov chain; state classification, recurrence/transience; asymptotic results
Gaussian processes and introduction to Brownian motion (6h): law of a stochastic process; Gaussian processes, white noise and introduction to Brownian motion

Class components (lecture, labs, etc.)
Lectures entirely on the board (results, proofs and examples): 22 hrs
Tutorial: 9 hrs

Grading
Home Works, Compulsory partial exam: 1 hrs 30 (without document, calculator or computer) at the halfway point of the course, Final written exam: 2 hrs (without document, calculator or computer).

Resources
Teaching team (names of the lecturers): Erick Herbin
One TD group (full complement): Philippe Bouafia

Learning outcomes covered on the course
The objective of this course is the theoretical study of the first two families of stochastic processes, in the particular case where the parameters are in a discrete space, and then to introduce Gaussian processes indexed by the real ones.

Description of the skills acquired at the end of the course
Theoretical foundations for the study of stochastic discrete-time processes and Gaussian random processes. At the end of this course, students will be ready to take a 2nd year Stochastic Calculus course in Mathematics.
C1: Analyze, design and build complex systems with scientific, technological, human and economic components
C2.1 : Deepen a field of engineering sciences or a scientific discipline
C2.2 : Import knowledge from other fields or disciplines
C2.3 : Identify and acquire independently the new knowledge and skills required
C7 : Know how to convince
C7.1 : Structure ideas and arguments