MA2814
Introduction to Random Modeling

Professor: Fabrice Borel-Mathurin

Language of instruction: English – **Number of hours**: 36 – **ECTS**: 3

Prerequisites: MA1200 and MA1300 or equivalent. Axioms: probability spaces, events, probability measures. Random variables and expectations. Probability on R and characteristic functions. Gaussian vectors. Sequences of random variables. Statistic tests. Regression. Note: this course is not open to students having already taken MA2300.

Period: S8 Elective 12 March to June IN28IE5, SEP8IE5

Course Objectives

This course is a continuation of the basic course of probability theory M1200. In a pedagogical format "from examples to theory", it introduces the representation of high variability or uncertain phenomena, which are present in various fields of industry.

An important part of the course is devoted to the review of basic probability. The focus on the study of concrete examples is particularly important.

This course is an introduction to the theory of stochastic processes that appears in physical and financial modeling, and signal/image processing. Students will study the most important family of discrete-time stochastic process: random walks, martingales, and Markov chains. They are basic concepts to define strategies and simulation algorithm. All the mandatory concepts (basic probability, conditional expectation, stopping times,...) will be recalled at the beginning of the course.

Contrary to MA2300 course, the study of concrete examples taken from different areas of engineering (networks, internet, gambling, meteorology, ...) is more important here than the definition of rigorous theoretical foundations. A large quantity of exercises will be adressed within the course in order the students to master practically all the usual techniques. Regarding the time remaining, some very concrete case (exemple: Google PageRank) might be studied and implemented in class.

On completion of the course, students should be able to

implement basic and classical discrete-time probabilistic models to describe random or uncertain phenomena.

Course Contents

Course:

- ✧ Refresher on probabilistic formalism (9 hrs)
- ✧ Discrete-time martingales (12 hrs)
- ✧ Markov chains (12 hrs)

Homework:

- ✧ Implementation/practical situations (10 to 15hrs)

Course Organization

Lectures: 21 hrs, Tutorials: 12 hrs, Homework : 10 to 15 hrs, Final exam: 3 hrs

Teaching Material and Textbooks

Course notes and a self contained bibliography

Evaluation

Midterms:

- a mandatory one (1 hr work in class or a homework)
- an optional one (project consisting in a model implementation and a small report)

Final exam: 3-hr written exam.