COM-417 **Advanced probability and applications**

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Cursus	Sem.	Type
Computer and Communication Sciences		Obl.
Computer science	MA2	Opt.
Cybersecurity	MA2	Opt.
Data Science	MA2, MA4	Opt.
Data science minor	E	Obl.
Electrical Engineering		Obl.
SC master EPFL	MA2, MA4	Obl.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

In this course, various aspects of probability theory are considered. The first part is devoted to the main theorems in the field (law of large numbers, central limit theorems), while the second part focuses on the theory of martingales in discrete time.

Content

I. Probability
- sigma-fields, probability measures, random variables
- independence, expectation
- convergence of sequences of random variables
- laws of large numbers- central limit theorem
- concentration inequalities
- moments

II. Martingales
- conditional expectation
- definition and properties of a martingale
- stopping times, optional stopping theorem
- maximal inequalities
- convergence theorems

Keywords

probability, measure theory, martingales, convergence theorems

Learning Prerequisites

Required courses

Basic probability course
Calculus courses

Recommended courses

complex analysis

Important concepts to start the course

This course is NOT an introductory course on probability: the students should have a good understanding and practice of basic probability concepts such as: distribution, expectation, variance, independence, conditional probability.
The students should also be at ease with calculus. Complex analyisis is a plus, but is not required.

On the other hand, no prior background on measure theory is needed for this course: we will go through the basic concepts one by one at the beginning.

Learning Outcomes

By the end of the course, the student must be able to:

- Understand the foundations of probability theory
- Acquire a solid knowledge of martingale theory

Teaching methods

Ex cathedra + exercises

Expected student activities

active participation to exercise sessions

Assessment methods

Midterm 20%, homeworks 20%, exam 60%

Resources

Bibliography

Sheldon M. Ross, Erol A. Pekoz, A Second Course in Probability,1st edition, www.ProbabilityBookstore.com, 2007.
Jeffrey S. Rosenthal, A First Look at Rigorous Probability Theory,2nd edition, World Scientific, 2006.
Geoffrey R. Grimmett, David R. Stirzaker, Probability and Random Processes,3rd edition, Oxford University Press, 2001.
Richard Durrett, Probability: Theory and Examples,4th edition, Cambridge University Press, 2010.

Ressources en bibliothèque

- A Second Course in Probability / Ross
- A First Look at Rigorous Probability Theory / Rosenthal
- Probability and Random Processes / Grimmett
- Probability: Theory and Examples / Durrett

Notes/Handbook

available on the course website

Websites

- https://moodle.epfl.ch/course/view.php?id=14557

Prerequisite for

Advanced classes requiring a good knowledge of probability