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 theorem, concentration inequalities), while the second part focuses on the theory of martingales in discrete time.

Content
- sigma-fields, random variables
- probability measures, distributions
- independence, convolution
- expectation, characteristic function
- random vectors and Gaussian random vectors
- inequalities, convergences of sequences of random variables
- laws of large numbers, applications and extensions
- convergence in distribution, central limit theorem and applications
- moments and Carleman's theorem
- concentration inequalities
- conditional expectation
- martingales, stopping times
- martingale convergence theorems

Keywords
probability theory, 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 analysis 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 main ideas at the heart of probability theory

Teaching methods
Ex cathedra and flipped lectures + exercise sessions

Expected student activities
active participation to exercise sessions

Assessment methods
graded homeworks 20%
midterm 20%
final exam 60%

Resources

Bibliography

Ressources en bibliothèque
- Probability and Random Processes
- Sheldon M. Ross, Erol A. Pekoz, A Second Course in Probability, 1st ed
- Patrick Billingsley, Probability and Measure, 3rd ed
- Richard Durrett, Probability: Theory and Examples, 4th ed
- Jeffrey S. Rosenthal, A First Look at Rigorous Probability Theory, 2nd ed

Notes/Handbook
available on the course website

Websites

Moodle Link
- https://go.epfl.ch/COM-417

Prerequisite for
Advanced classes requiring a good knowledge of probability