

MATH-431

**Theory of stochastic calculus**

Duch Pawel

Cursus	Sem.	Type
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.
Statistics	MA2, MA4	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

Introduction to the mathematical theory of stochastic calculus: construction of stochastic Ito integral, proof of Ito formula, introduction to stochastic differential equations, Girsanov theorem and Feynman-Kac formula, martingale representation theorem.

**Content**

- Construction of Brownian motion
- Continuous time martingales
- Ito's theory of integration
- Ito's formula with proof
- Existence and uniqueness theorem for solutions of stochastic differential equations
- Girsanov theorem and Feynman-Kac formula
- Martingale representation theorem

**Keywords**

stochastic calculus, Ito's integral, stochastic differential equations, Girsanov theorem, Feynman-Kac formula, martingale representation

**Learning Prerequisites****Required courses**

- Bachelor programme of the Mathematics section
- Swiss school programme up to "Maturité"

**Recommended courses**

Advanced Probability

**Important concepts to start the course**

Advanced Probability, Probability and analysis course in the Bachelor programme of the Mathematics section

**Learning Outcomes**

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

- Demonstrate mastery of the course material
- Demonstrate mastery of the problems related to the exercises sessions
- Demonstrate mastery of the prerequisites
- Demonstrate the capability of using these notions in other contexts

### Transversal skills

- Use a work methodology appropriate to the task.

### Teaching methods

Ex cathedra lecture and exercises

### Expected student activities

Attend lecture regularly, solve the exercises and write down the solutions, study the previous course material before the next course, go over the material before the exam.

### Assessment methods

Written exam

In the case of Article 3 paragraph 5 of the Section Regulations, the teacher decides on the form of the examination he communicates to the students concerned.

### Resources

#### Virtual desktop infrastructure (VDI)

No

### Bibliography

- J. Michael Steele, Stochastic Calculus and Financial Applications. Springer (2001)
- B. Oksendal, Stochastic Differential Equations (6th edition). Springer (2003)
- J.-F. LeGall, Brownian Motion, Martingales, and Stochastic Calculus. Springer (2016)

### Ressources en bibliothèque

- [Stochastic Differential Equations / Øksendal](#)
- [Stochastic calculus and financial applications / Steele](#)
- [Brownian Motion, Martingales, and Stochastic Calculus](#)

### Moodle Link

- <https://go.epfl.ch/MATH-431>

### Prerequisite for

- martingales in financial mathematics
- stochastic control