

MATH-330

Martingales and Brownian motion

Duch Pawel

Cursus	Sem.	Type
Mathematics	BA6	Opt.

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

Summary

Introduction to the theory of discrete-time martingales including, in particular, the convergence and stopping time theorems. Application to branching processes. Introduction to Brownian motion and study of its properties.

Content

Martingales play a fundamental role in probability theory. Originally introduced to model betting strategies, they represent sequences of random variables where the expectation of the next value, given all past values, is equal to the current value. Martingales have wide range of practical applications across various fields: finance, statistic, machine learning, population modeling, epidemiology, etc.

The course will cover the following topics:

- introduction to the theory of martingales,
- stopping time and stopping time theorem,
- convergence of martingales,
- application to branching processes,
- introduction to Brownian motion,
- basic properties of Brownian motion.

Keywords

martingales, stopping time theorem, convergence theorem, branching processes, Brownian motion

Learning Prerequisites**Required courses**

First and second year courses of the mathematics bachelor program

Recommended courses

Familiarity with the material covered in the courses 'Probability theory' (MATH-432) and 'Measure and integration' (MATH-303) will be helpful.

Teaching methods

Blackboard lectures and exercise sessions

Expected student activities

Attending the lectures and solving the exercises

Assessment methods

Written exam

In the case of Art. 3 para. 5 of the Section Regulations, the teacher decides on the format of the exam and communicates it to the concerned students.

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Bibliography

S. Karlin, H.M. Taylor, 'A First Course in Stochastic Processes', Academic Press (1975)

D. Williams, 'Probability with martingales', Cambridge University Press (1991)

P. Mörters, Y. Peres, 'Brownian motion', Cambridge University Press (2010)

Moodle Link

- <https://go.epfl.ch/MATH-330>

Prerequisite for