MATH-426 **Gaussian processes**

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

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

Remark

(pas donné en 2021-2022)

Summary

This is an introductory course on Gaussian fields and processes - or more shortly, on Gaussian magic. By discussing both the general theory and concrete examples, we will try to understand where and how Gaussian processes appear, and how to study them.

Content

This course serves as an introduction to the world of Gaussian processes. Gaussian processes are omnipresent in modelling random phenomena. There are at least two reasons for it:
1) Gaussian processes appear naturally through the Central Limit Theorem and its relatives;
2) Gaussian models have many special properties that make their mathematical study interesting...and possible.

The aim of this course is to better understand these two reasons by both looking into general properties of Gaussian measures, and by studying in detail some concrete Gaussian models.

Here is a tentative list of topics:

- Different characterisations of standard Gaussians (via stable laws, entropy etc) and revisiting the Central Limit Theorem;
- Basic properties of finite-dimensional Gaussian measures (including marginal laws, conditional laws);
- Existence and constructions of infinite-dimensional Gaussian processes, Reproducing Kernel Hilbert Spaces and their basic properties;
- Suprema and continuity of Gaussian processes;
- Some of the models potentially discussed: Gaussian random matrices, the Random Energy Model, the Discrete Gaussian free field; Gaussian process regression; Brownian motion/bridge.
With high motivation, the course can be followed already at BA6 level too.

Learning Prerequisites

Required courses

Mathematics Bachelor's level knowledge of analysis, linear algebra and probability (for example, the Bloc "Science de Base" in EPFL Mathematics Bachelor's program).

Recommended courses

From the Bachelor's program: Martingales and applications; Stochastic processes;
From the Master's program: Probability theory, Theory of Stochastic calculus.

Learning Outcomes

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

- Recognize Gaussian processes
- Characterize Gaussian processes
- Analyze Gaussian processes

Teaching methods

Lectures and exercise classes.

Assessment methods

Oral exam
Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Bibliography

Will be discussed in class.