Mathematics

ECTS credits
4 credits

Semester
Spring

In brief

Course langage: French

Presentation

Prerequisites

- Analysis and Algebra corresponding to the first and second years of Bachelor of Science with major mathematics.
- An introduction to discrete probability is recommended

Learning objectives

- Know how to mobilize and use basic mathematical approaches in other scientific disciplines
- Know how to implement numerical methods adapted to a problem
- Know how to recognize a situation involving randomness and be able to model it, be able to estimate the underlying parameters in simple cases

Description of the programme

The cours is divided into three distinct parts.The first part addresses the bases of theoretical mathematical analysis, the second part concerns scientific calculus and the last part aims to introduce the bases of probability and basic statistics.

1. **Theoretical Mathematical Analysis**
    1. Differential calculus
    2. Optimisation,
    3. Lebesgue Integration
    4. Fourier transforms
    5. Hilbert Space
1. **Numerical Analysis**

1. Iterative Methods
2. Polynomial Approximation
3. Numerical Integration,
4. Numerical approximation of ordinary differential equations
5. Finite difference method for partial derivative equations

1. **Probability and Statistics**

1. Basis of probability theory,
2. Real random variables and their distributions (caracteristic function, moment generating function, generating function), moments,
3. Random variable pair and random vectors, independence
4. Random variable sequence and types of convergence, Law of Large Numbers, Centrale Limit Theorem,
5. Statistics : point estimation, estimation by intervals.

Generic central skills and knowledge targeted in the discipline

- Basics of analysis and numerical analysis, probability theory, parametric statistics.
- Know and know how to apply the main tools of Theoretical Analysis to Numerical Analysis, Probability, Statistics and in other scientific fields.
- Know how to approximate a function by numerical methods
- Know how to approach numerically the solution of ordinary differential equations and partial differential equations.
- Know the basics of Probability and know the main probability distributions
- Know the main types of convergence for sequences of random variables and know how to apply the main theorems of Probability: Law of Large Numbers, Central Limit Theorem (CLT)

How knowledge is tested

Continuous assessment

There are 3 writtent evaluations during the semester:

1. DS1 : Theoretical Mathematical Analysis,
2. DS2 : Numerical Analysis,
3. DS3 : Probability and Statistics.

The overall grade is the average:

course unit grade = (DS1 + DS2 + DS3) / 3.

Bibliography

Course handouts.

1. Theoretical Mathematical Analysis
2. Numerical Analysis
    1. Allaire, Grégoire. "Approximation numérique et optimisation." (2019),

2. Quarteroni, Alfio, et al. "Méthodes Numériques." (2007).
3. Probability and Statistics

Teaching team

- **Theoretical Mathematical Analysis**: Thibaut Le Gouic (head for S5-Autumn semester and S6-Spring semester), Jean-Marie Rossi, Magali Tournus, Frédéric Schwander, Marie Billaud-Friess
- **Numerical Analysis**; Marie Billaud-Friess (head for S5-Autumn semester and S6-Spring semester), Jean-Marie Rossi, Frédéric Schwander, Magali Tournus,
- **Probability and Statistics**: Mitra Fouladirad (head for S5-Autumn semester), Christophe Pouet (head for S6-Spring semester), Magali Tournus, Frédéric Schwander, Thibaut Le Gouic.

Other instructors may interact with students during the exercise lessons such as PhD students, Post-Doc, instructors not belonging to Centrale Méditerranée,...

Total des heures		**96h**
CM	Master class	36h
TD	Directed work	36h
AA		24h

Useful info

Name responsible for EU

Lead Instructor

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