Module Description, available in: EN

Stochastic Modeling

General Information

Number of ECTS Credits

3

Module code

FTP_StochMod

Valid for academic year

2025-26

Last modification

2020-04-01

Coordinator of the module

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Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%		
Documentation					**X** E 100%		
Examination					**X** E 100%		

Module Category

FTP Fundamental theoretical principles

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

1. Basis calculus (integration, differentiation, ordinary differential equations, complex numbers, Fourier transform)
2. Basic probability theory (probability, conditional probability, Bayes' theorem, expectation, variance, random variables)
3. Linear algebra (matrix algebra, system of linear equations, eigenvectors, eigenvalues)

Brief course description of module objectives and content

The ubiquitous presence of uncertainty and noise in the engineering sciences and the importance of randomized algorithms in computer and data science make it mandatory to understand and quantify random phenomena. To achieve this goal the course will provide a solid review of probability theory and an introduction to the theory of stochastic processes. Special attention is given to applications, including examples from various fields such as communications and vision, signal processing and control, queuing theory or physics of small systems (Brownian motion).

Aims, content, methods

Learning objectives and competencies to be acquired

The student is familiar with the main working tools and concepts of stochastic modeling (expectation, variance, covariance, autocorrelation, power spectral density). He/She is able to explain properties and limitations of stochastic processes as a modeling tool for noisy systems. He/She will be able to model and analyze simple random phenomena through adaptation of proposed stochastic models.

Module content with weighting of different components

- Probability review: random variables, conditional probabilities, theorem of large numbers, central limit theorem.
- General introduction to discrete and continuous stochastic processes. Applications, e.g., communications, Kalman filtering.
- Discrete, continuous and hidden Markov chains. Applications, e.g., page rank algorithm, queuing systems, pattern recognition, speech recognition.
- Bernoulli, Poisson, Gaussian processes, Brownian motion, white and colored noise.

Teaching and learning methods

Ex cathedra teaching
Presentation of simulation results and case studies

Literature

The script is, in principle, sufficient. Further readings are:

1. Sheldon M. Ross, Probability Models, Elsevier.
2. John A. Gubner, Probability and Random Processes for Electrical and Computer Engineers, Cambridge University Press.
3. Mario Lefebvre, Applied Stochastic Processes, Springer.
4. Bassel Solaiman, Processus stochastiques pour l'ingénieur, PPUR.

Assessment

Additional performance assessment during the semester

The module does not contain an additional performance assessment during the semester

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

No electronic aids permitted

Other permissible aids

Handwritten summary of five A4 sheets (=ten pages in total), compiled by the student.

Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

No aids permitted