EPFL

MATH-447	**Risk, rare events and extremes**

Cursus	Sem.	Type
Data Science	MA1	Opt.
Financial engineering	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathematics for teaching	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Remark

pas donné en 2017-18

Summary

Modelling of rare events, such as stock market crashes, storms and catastrophic structural failures, is important. This course will describe the special models and methods that are relevant to such modelling, including the mathematical bases, statistical tools and applications.

Content

• **Mathematical bases**: behaviour of maxima and threshold exceedances in large samples, both for independent and dependent data. Poisson process modelling.

• **Statistical methods**: modelling using the GEV and GP distributions, for independent and dependent data. Likelihood and Bayesian inference. Non-stationarity. Extremal coefficients. Multivariate extreme-value distributions. Max-stable processes.

• **Applications**: Environmental, financial, and engineering applications. Use of R for extremal modelling.

Learning Prerequisites

Important concepts to start the course

Probability and statistics at the level of second-year bachelor (mathematics), plus further knowledge of statistics and stochastic processes.

Learning Outcomes

By the end of the course, the student must be able to:
• Recognize situations where statistical analysis of extrema is appropriate
• Manipulate mathematical objects related to the study of extrema
• Analyze empirical data on extremes using appropriate statistical methods
• Construct appropriate statistical models for extremal data
• Interpret such models in terms of underlying phenomena
• Infer properties of real systems in terms of probability models for extremes

Teaching methods

Lectures, theoretical and computational exercises in class and at home.

Assessment methods

Mini-project, final exam.

Resources

Bibliography

Coles, S. G. (2001) An Introduction to the Statistical Modelling of Extreme Values. Springer.
Beirlant, J, Goegebeur. Y., Teugels. J. and Segers. J. (2004) Statistics of Extremes: Theory and
Applications. Wiley.