

## *Extreme value theory*

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Course : 18 hours - TP : 0 hours

### *Objectives*

This course introduces the fundamental concepts of the Theory of Extreme Values (laws of maximum random variables, joint laws of largest values, laws of exceeding thresholds, laws of arrivals exceeding thresholds, etc.) and presents the statistical tools to apply this theory using data from insurance and finance. It presents this theory in static (i.i.d. random variables) and dynamic (time series) frameworks, in univariate and multivariate frames. He pays particular attention to the applications of this theory in insurance and finance.

Main learning outcomes: At the end of this course, students will know how to

- state the fundamental results of extreme value theory and explain the practical uses of these results;
- understand the limitations of extreme value theory and its scope of application;
- use appropriate statistical techniques to estimate the distributions of extremes (recognize the domain of attraction of a distribution from suitable graphs, choose the right estimator of the parameters of the distributions of extremes, be able to evaluate extreme quantiles after defining the right class of extreme distributions to be used).

### *Outline*

- General introduction.
- Analysis of univariate extremes in a static framework. Limit laws for the maximum, threshold exceedances, estimation of the parameters of the laws of extremes.
- Analysis of univariate extremes in a dynamic framework. Limit laws for the maximum, threshold exceedances, estimation of the parameters of the laws of extremes.
- Analysis of multivariate extremes in a static framework. Limit laws for the maxima of the components of a vector, multivariate factor models and extremes, characterization of the extreme dependence.

### *Bibliography*

- Beirlant J., Goegebeur Y., Segers J. and Teugels, J. (2004) *Statistics of Extremes: Theory and Applications*, Wiley Series in Probability and Statistics, John Wiley & Sons Ltd., Chichester. [177 BEI]
- Coles S. (2001) *An Introduction to Statistical Modeling of Extreme Values*. Springer, London. [177 COL]
- Embrechts P., Klüppelberg C. and Mikosch T. (1997) *Modelling extremal events for insurance and finance*. Berlin: Springer Verlag [177 EMB]