

Outlier detection and Extreme values theory

| | |
|--|---|
| Course title - Intitulé du cours | Outlier detection and Extreme values theory |
| Level / Semester - Niveau /semestre | M2 / S1 |
| School - Composante | Ecole d'Economie de Toulouse |
| Teacher - Enseignant responsable | RIBATET Mathieu |
| Other teacher(s) - Autre(s) enseignant(s) | ARCHIMBAUD Aurore |
| Other teacher(s) - Autre(s) enseignant(s) | |
| Lecture Hours - Volume Horaire CM | 21 |
| TA Hours - Volume horaire TD | |
| TP Hours - Volume horaire TP | 0 |
| Course Language - Langue du cours | English |
| TA and/or TP Language - Langue des TD et/ou TP | English |

Teaching staff contacts - Coordonnées de l'équipe pédagogique :

Extreme Value Theory:

Mathieu RIBATET: + email: mathieu.ribatet@umontpellier.fr + interaction: email, after the classes (since based in Montpellier)

Outlier detection:

Aurore ARCHIMBAUD: Aurore.Archimbaud@ut-capitole.fr + interaction: email, after the classes.

Course Objectives - Objectifs du cours :

Extreme Value Theory: The aim of this course is to introduce the basic notions to the statistical modeling of extreme events. Extreme events by nature are rare and thus the main difficulty from a statistical point of view is that we focus on the tail of the distribution. Consequently, specific methods should be apply and those form what is known as the extreme value theory. During the lecture you will learn the essential notion of Value at Risk, return levels and return period and will see how one can model block maxima/exceedances using the Generalized Extreme Value / Generalized Pareto distributions. You will apply these concepts use the R software and will learn how to perform a whole extreme value analysis on a data set of your choice.

Outlier detection: The aim of this course is to introduce the basic concepts and usefulness of outlier analysis. Indeed, outliers may be a nuisance for a given statistical method, in the sense that outliers influence too much the results of the method. Such a method is said not robust to outliers. Contrary to extreme value theory, the goal of outlier detection is either defining statistical methods not too sensitive to outliers or only focusing on identifying them like in fraud detection for example. During the lecture you will learn how to measure the robustness of a method using some mathematical tools (influence function and breakdown point) and to derive robust methods. In addition, you will discover

some methods to detect outlying observations in a univariate and a multivariate context. You will apply these concepts using the R software and will learn how to perform a whole outlier detection analysis on a data set of your choice.

Prerequisites - Pré requis :

Students should be familiar with the basic notions of likelihood theory (MLE, delta method, Fisher information, ...) and should have a little knowledge of the R language.

Practical information about the sessions - Modalités pratiques de gestion du cours :

Laptops are accepted (and even highly recommended)

Grading system - Modalités d'évaluation :

Final exams + homework

Bibliography/references - Bibliographie/références :

Extreme Value Theory:

[Coles, 2001] Coles, S. (2001). An Introduction to Statistical Modelling of Extreme Values. Springer Series in Statistics. Springer Series in Statistics, London.

[Embrechts et al., 1997] Embrechts, P., Klüppelberg, C., and Mikosch, T. (1997). Modelling Extremal Events for Insurance and Finance. Springer, New York.

Outlier detection:

Aggarwal, C. C. (2017). Outlier Analysis, 2nd edition. Springer Publishing Company, Incorporated.

Barnett, V. and Lewis, T. (1994). Outliers in Statistical Data. Wiley.

Hampel, F., Ronchetti, E., Rousseeuw, P., and Stahel, W. (1986). Robust statistics: the approach based on influence functions. Wiley & Sons, New York.

Hawkins, D. M. (1980). Identification of outliers, volume 11. Springer.

Additional information – Informations additionnelles :

Extreme Value Theory: Course materials will be posted on my personal webpage.

Distance learning – Enseignement à distance :

If necessary: - Interactive virtual classrooms - MCQ tests and other online exercises and assignments - Remote (online) tutorials (classes) - Chatrooms