PhD offer in Statistics

Inference for extreme data in a univariate dependent setting

Laboratory IMAG, Université de Montpellier, and Lemon Inria, Montpellier, France

Supervision team Gwladys Toulemonde (IMAG, Université de Montpellier and Inria LEMON) and Nicolas Meyer (IMAG, Université de Montpellier and Inria LEMON) with Klaus Herrmann and Eric Marchand (Equipe de statistique, Université de Sherbrooke)

Skills required Strong background in statistics and probability theory, proficiency in R and/or Python programming

Keywords extreme value theory, copula, dependence modeling, frequentist and Bayesian estimation

Period This is a three-year position, starting in late 2025. The exact starting date is flexible and can be agreed upon with the supervisors and the selected candidate.

How to apply ? To express your interest, please contact
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Applications should include :
- A cover letter
- A curriculum vitae (CV)
- Transcripts of Bachelor's and Master's grades (or equivalent qualifications, such as from engineering schools)

Scientific context

Univariate extreme value theory (EVT) states that the maximum of a sequence of independent, identically distributed random variables converges to a Generalized Extreme Value (GEV) distribution. However, the assumption of independence is often unrealistic in real-world applications, where data are typically temporally or spatially correlated - e.g., wave heights, temperature records, pollution levels, or financial returns.

Pioneering work by Leadbetter (1974, 1983) relaxed the independence assumption by introducing asymptotic dependence conditions, allowing a form of "quasi-independence" between extreme events. More recently, copula-based approaches

have enabled the separate modeling of marginal behavior and dependence structure (Sklar, 1959), significantly advancing the field, especially in multivariate settings. We refer to Nelsen (2006), Joe (2015), or Durante and Sempi (2015) for textbook introductions.

A different point-of-view was proposed by Herrmann, Hofert, and Nešlehová (2024), who established convergence conditions for the maximum in a dependent univariate setting using copulas. This generalizes the Fisher-Tippett-Gnedenko theorem to sequences of dependent variables.

Objectives

The aim of this thesis project is to develop frequentist and Bayesian inference techniques for estimating the limit distribution of the maximum under dependency assumptions. Bayesian methods are particularly suited to situations where information is scarce or uncertain - which is typically the case in the analysis of extremes, see Beirlant et al. (2004, Chapter 11) or Bousquet & Bernardara (2021, Chapter 11). By introducing flexible prior distributions on the parameters, we can obtain :

— credibility intervals (rather than simple confidence intervals),
— density prediction for extreme observations,
— better consideration of dependency structure, particularly in exchangeable models, such as those discussed in Herrmann, Hofert & Nešlehová (2024).

The thesis will thus aim to develop and study estimators and evaluate their performance on simulated and real data, for example meteorological or financial data.

Context of the PhD offer

This PhD position is part of the "Thèses Tandem" program, a joint initiative between the Université de Montpellier (France) and the Université de Sherbrooke (Canada).

Two complementary PhD projects are offered through this collaboration, each focusing on a different yet interconnected aspect of univariate extreme value modeling under dependence. The selected candidates will benefit from shared supervision, close collaboration between the two universities, and regular research exchanges.

The program includes funding for a work computer, travel to national and international conferences, and several research stays at Université de Sherbrooke, in Québec, Canada.