
Level of qualifications required: Graduate degree or equivalent
Function: PhD Position

About the research centre or Inria department
Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 35 research teams and 9 research support departments. Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas. Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Context
Environment:
- Team Mistis, LJL, Inria Grenoble Rhône-Alpes & CERAG, Univ. Grenoble Alpes.
- Research topics: extreme-value analysis, nonparametric statistics, Bayesian statistics, graphical models, insurance, natural disasters.
- PhD advisors:
  - Stéphane Girard (DR) Mistis, Inria Grenoble, Rhone-Alpes.
  - Geoffrey Enjolras (PR) CERAG, Univ. Grenoble-Alpes.
  - http://mistis.inrialpes.fr/people/girard/
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Assignment
Thesis subject:
Natural disasters are increasing in terms of numbers, intensity and related damages. Facing these extreme events, several financial instruments (public funds, catastrophe bonds, insurance policies) may help to hedge risk provided they supply emergency funding, compensation to the victims and support to reconstruction [6]. They could be a critical asset aiming at reinforcing proactivity and resilience when facing disasters risks. However, they face some limitations related to risk modeling [9].

Facing this critical issue, extreme-value theory is a branch of statistics dealing with the extreme deviations from the bulk of probability distributions. More specifically, it focuses on the limiting distributions for the minimum or the maximum of a large collection of random observations from the same arbitrary (unknown) distribution.

In extrem-value statistics, the main problems are the estimation of the tail index and extreme quantiles associated to a random variable of interest X. The tail index drives the distribution tail heaviness of the considered random variable distribution. We refer to [1,2] for a general account on extreme-value statistics.

In a risk analysis perspective, the extreme quantile associated with X is referred to as the Value at Risk and has been extensively studied [3]. Recently, many efforts have been done to define alternative extreme risk measures based either on expectiles, Lp quantiles, or extensions of the Expected Shortfall, see for instance [4,5]. However, since these methods are extreme-value based, their applicability is restricted to large sample sizes.

While some databases exist on natural disasters, the relative scarcity of these events restrict available data [7]. We then propose in this PhD work to investigate how introducing prior information on the distribution of X can improve the estimation of extreme risk measures on small samples.

Keywords:
extreme risk measures, extreme value theory, Bayesian statistic, nonparametric statistic, insurance, natural disasters

References:
Main activities

The goal of this PhD work is to contribute to the development of Bayesian methods for the estimation of extreme risk measures. Then, financial risk management instruments may be adapted to a better hedging of large risks in France and abroad, and in various contexts [8].

This topic is intrinsically transdisciplinary in its definitions, its methodology and its implications.

Skills

Conditions for applicants:

We look for candidates strongly motivated by challenging research with application to real world data. The applicant should have strong background in mathematics and probability/statistics. The required knowledge includes ideally Bayesian methods and extreme-value analysis. Programming skills with C/C++, Matlab, Python or R are desired.

Benefits package

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Remuneration

1982 - 2085 euros bruts