A new measure of extreme risk

Context

- MSIAM2 MSc thesis project proposal, research oriented, may continue with a PhD thesis.
- Laboratory/location: Team Mistis/Inria Grenoble Rhône-Alpes (Montbonnot).
- Supervisor: Stéphane Girard (Mistis), `Stephane.Girard@inria.fr`, tel 04.76.61.53.25.
- Length: 5 months.
- Gross salary: about 500 euros a month.

Objectives

A measure of the variability associated with a random quantity Y has been introduced Gini and is defined by $Gini(F) = \mathbb{E}(|Y_1 - Y_2|)$ where Y, Y_1 and Y_2 are three random variables sharing the same cumulative distribution function F. This measure extends the notion of variance to heavy-tailed distributions for which the second order moment may be infinite. The aim of this project is to study an extension of this risk measure in the situation where:

- The variable of interest Y is recorded simultaneously with a covariate X that may drive its behavior.
- One focuses on the extreme values of Y, *i.e.* the values over a quantile of order α.

There are two aspects to this work. From a theoretical point of view, we shall investigate the behavior of the new risk measure for extreme risks, *i.e.* when $\alpha \to 1$, and for heavy-tailed distributions. Then, an estimator of the new risk measure from a sample of random variables will be constructed, and we shall study its convergence properties when the sample size tends to infinity. The numerical side of the work will consist in implementing the estimator in `Matlab` or `R` and to study its behavior in practice on simulated data. Finally, the estimator will be applied to farm income data collected in an annual database of 7000 farms of commercial size.

Competences required

The candidate should come from the Statistics (STAT) track and have strong a knowledge on mathematical statistics (extreme-value theory and/or nonparametric statistics would be a plus). Good programming skills in `Matlab` or `R` are also required.

Bibliography

J. El Methni, L. Gardes & S. Girard. Nonparametric estimation of extreme risk measures from conditional heavy-tailed distributions, *Scandinavian Journal of Statistics*, **41**, 988–1012, 2014. `http://hal.archives-ouvertes.fr/hal-00830647`