PhD proposal:

Nonparametric estimation of conditional extreme quantiles

Research topics: Extreme-value and nonparametric statistics.

Environment: This position is offered at the Rhône-Alpes Research Unit of INRIA, team Mistis, located near Grenoble and Lyon. The Unit counts more than 500 people, within 25 research teams and 10 support services. The starting date will be between september 2007 and december 15, 2007.

Duration: 3-years position.

Salary and benefits: 1529 euros net / month + full health insurance and social benefits included - salary will be upgraded to 1611 euros net / month the 3rd year.

Description: 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 extreme-value statistics, the main problems are the estimation of the tail index and extreme quantiles associated to a random variable of interest Y. The tail index drives the distribution tail heaviness of the considered random variable distribution. We refer to [3] for a general account on extreme-value statistics. More details on the expertise of the Mistis team on extreme-value analysis is available at `http://mistis.inrialpes.fr/people/girard/extremes.`

The goal of this PhD work is to contribute to the development of theoretical and algorithmic models to tackle the conditional case, ie the situation where some covariate information X is recorded simultaneously with the quantity of interest. In such a case, the tail heaviness of Y depends on X, and thus the tail index as well as the extreme quantiles are also functions of the covariate.

We propose in this PhD work to investigate how to combine nonparametric smoothing techniques [4] with extreme-value methods in order to obtain efficient estimators of the conditional tail index and conditional extreme quantiles. In case of one-dimensional covariates, existing methods involve local polynomial [1] and spline fitting [2] of the extreme-value distribution to the largest observations. The PhD work could be based on some multidimensional extensions [5] developed in the Mistis team. Conditional extremes are studied in climatology where one is interested in how climate change over years might affect extreme temperatures or rainfalls. In this case, the covariate is univariate (the time). Bivariate examples include the study of extreme rainfalls as a function of the geographical location. Further details on the interaction between extreme-value statistics and environmental sciences are available on the website of the Statistical Extremes and Environmental Risk Workshop (`http://seer2007.fc.ul.pt`).

The application part of the study could be joint work with the LTHE (Laboratoire d'étude des Transferts en Hydrologie et Environnement, `http://www.lthe.hmg.inpg.fr`) located in Grenoble.

1. Chavez-Demoulin, V., Davison, A. (2005). "Generalized additive modelling of sample extremes" *Journal of the Royal Statistical Society, series C*, **54**, 207–222.
2. Davison, A., Ramesh, N. (2000). "Local likelihood smoothing of sample extremes", *Journal of the Royal Statistical Society, series B,* **62**, 191-208.
3. Embrechts, P., Klüppelberg, C., Mikosch, T. (1997). "*Modelling extremal events*", Springer.
4. Ferraty, F. and Vieu, P. (2006). "*Nonparametric Functional Data Analysis: Theory and Practice*", Springer Series in Statistics, Springer.
5. Gardes, L. and Girard, S. (2007). "A moving window approach for nonparametric estimation of the conditional tail index", `http://hal.inria.fr/inria-00124637`.

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