Modelling extremes by Markov-switching structures

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Abstract

In this talk I investigate the extremal clustering behaviour of stationary time series that possess two regimes, where the switch is governed by a hidden two-state Markov chain and the generating noise is light-tailed. We focus on the models, which behave like a random walk in one (called dominant) regime and as a stationary autoregression in the other (dominated) regime.

Under additional technical conditions we prove that the stationary solution has asymptotically exponential tail and the extremal index is smaller than one. The extremal index and the limiting cluster size distribution of the process are calculated explicitly for some noise distributions, and simulated for others.

The practical relevance of the results is illustrated by examining extremal properties of a regime switching autoregressive process with Gamma-distributed noise. The limiting aggregate excess distribution is shown to possess Weibull-like tail in this special case.

An estimation and simulation scheme is proposed, taking into account only observations above high thresholds. The properties of this estimation method are also investigated. Finally, as an application, the model is used to fit high-level exceedances of water discharge data.

This is joint work with Péter Elek (Eötvös Loránd University and Ministry of Finance, Budapest)

References

[1] Elek, P. and Zemplni, A., 2008. Tail behaviour and extremes of two-state Markov-switching autoregressive models. Computers Math. Appl. 55, 2839-2855.

[2] Smith, R. L., Tawn, J. A. and Coles, S. G., 1997. Markov chain models for threshold exceedances. Biometrika 84, 249–268.