Extremal serial dependence of time series

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Modeling the dependence between consecutive observations in a time series plays a crucial role in risk management. For example, the risk of large losses from a financial investment is increased if extreme negative returns tend to occur in clusters, and heavy rainfall on several consecutive days could trigger a catastrophic flooding.

We will recall the so-called *coefficient of tail dependence* (introduced by Ledford and Tawn, 1996) as an important measure of the strength of serial dependence between extremes which allows for a refined characterization of dependence structures, especially in the case of asymptotic independence. A general class of empirical processes introduced by Drees and Rootzén (2010) enables us to analyze the asymptotic behavior of estimators of the coefficient of tail dependence in a unified framework. Bootstrap versions of these empirical processes yield asymptotic confidence intervals.

In an application it is shown how to use these results to discriminate between time series of GARCH-type and time series from common stochastic volatility models. An analysis of a time series of returns of the German blue stocks index however reveals that probably none of these time series models describe the extremal dependence structure accurately.

As a suggestion for time series models which allow for a more flexible modeling of the extremal dependence structure we will introduce a new specification of stochastic volatility models with a heavy-tailed volatility sequence and light-tailed innovations. For a finer description of the extremal behavior of those models we show that they feature so-called hidden regular variation (cf. Resnick, 2002) and derive some useful general results.

(The last part of the talk is based on a joint project with Anja Janßen, University of Hamburg.)

References

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