Inference on the Tail Process with Application to Financial Time Series Modelling

Richard A. Davis

Department of Statistics, Columbia University, USA

Email: davis.richarda@gmail.com

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Abstract: In this talk, we use the spectral tail process, as formulated by Basrak and Segers (2009) for heavy-tailed time series, to assess and measure extremal dependence. The spectral tail process provides an in-depth description of the structure of extremal dependence. Limit theory is given for nonparametric estimates of the distribution of the spectral tail process for a class of heavy-tailed stationary time series. This builds on earlier work of Drees et al. (2015) for heavy-tailed Markov chains. The nonparametric estimates provide quantitative information about extremal dependence within a time series and as such can be used in both exploratory and confirmatory phases of modelling. As an example, it provides estimates of the probability that an extreme observation will occur at time t, given one has occurred at time 0, and that its absolute value will be even larger. These estimates can also be used for model confirmation, in much the same way that the ACF is used for assessing quality of fit for second-order models of time series. For example, one can compute a pre-asymptotic version of the distribution of the spectral tail process from a GARCH process, which in most cases can be easily calculated via simulation. Then the estimated distribution of the spectral tail process can be compared with the pre-asymptotic version as a check of model compatibility. A good fit would indicate the plausibility of using a GARCH model for capturing serial extremal dependence. Resampling methods are employed for assessing the compatibility of the model fit. This estimation procedure is illustrated on a couple financial time series. (This is joint work with Holger Drees, Johan Segers, and Michal Warchol.)