Impact of dependence on parameter estimates of autoregressive process with Gumbel distributed innovation

ABSTRACT

Recent studies have shown that independent identical distributed Gaussian random variables is not suitable for modelling extreme values observed during extremal events. However, many real life data on extreme values are dependent and stationary rather than the conventional independent identically distributed data. We propose a stationary autoregressive (AR) process with Gumbel distributed innovation and characterise the short-term dependence among maxima of an (AR) process over a range of sample sizes with varying degrees of dependence. We estimate the maximum likelihood of the parameters of the Gumbel AR process and its residuals, and evaluate the performance of the parameter estimates. The AR process is fitted to the Gumbel-generalised Pareto (GPD) distribution and we evaluate the performance of the parameter estimates fitted to the cluster maxima and the original series. Ignoring the effect of dependence leads to overestimation of the location parameter of the Gumbel-AR (1) process. The estimate of the location parameter of the AR process using the residuals gives a better estimate. Estimate of the scale parameter perform marginally better for the original series than the residual estimate. The degree of clustering increases as dependence is enhance for the AR process. The Gumbel-AR(1) fitted to the Gumbel-GPD shows that the estimates of the scale and shape parameters fitted to the cluster maxima perform better as sample size increases, however, ignoring the effect of dependence lead to an underestimation of the parameter estimates of the scale parameter. The shape parameter of the original series gives a superior estimate compare to the threshold excesses fitted to the Gumbel-GPD.

Keyword: Autoregressive process; Gumbel distribution; Generalised Pareto distribution; Extremal index; Innovation