Bivariate generalized Pareto distribution in practice: models and estimation

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Abstract

Extreme values are of substantial interest in fields of environmental science, engineering or finance, because they are associated with rare but hazardous events (such as flooding, mechanical failure or severe financial loss). There is often interest in understanding how the extremes of two different processes are related to each other. One possible way to tackle this problem is an asymptotic approach which involves fitting multivariate generalised Pareto distribution (MGPD) to data that exceed a suitably high threshold. As exceedances can be defined different ways, there are a few non-equivalent definitions of MGPD in use. A rather classical way is the first type definition which is based on exceedances being over the threshold in all components and a second type definition considers those exceedances, which are over a threshold in at least one of the components regardless of the rest. The first type definition is widely investigated in the recent literature but the second type definition attracted less attention. One aim of this paper is to investigate the applicability of classical parametric dependence models within the second type definition of MGPD. Due to continuity problems the set of available dependence models narrows, especially if asymmetry property is also required. As an alternative solution, a general transformation is proposed for creating asymmetric models from the well-known symmetric ones. We apply the proposed approach to the exceedances of wind speed data and outline methods for calculating prediction regions as well as evaluating the goodness-of-fit.

Key words: Multivariate threshold exceedances, asymmetric dependence models, wind speed data, prediction region, goodness of-fit.