Abstract:
A fundamental deficiency of classical multivariate extreme value theory is the inability to distinguish between asymptotic independence and exact independence. In this work, we examine multivariate threshold exceedance modeling in the framework of regular variation on cones. Under this framework, dependence in the tail of a distribution is described by a limiting measure, which in some cases is degenerate on joint tail regions despite possible dependence in such regions at finite levels. Hidden regular variation, a higher-order tail decay on these regions, offers a refinement of the classical theory. We develop a representation of random vectors possessing hidden regular variation as the sum of independent regular varying components. The representation is shown to be asymptotically valid via a multivariate tail equivalence result. We develop a likelihood-based estimation procedure from this representation via a Monte Carlo expectation-maximization algorithm which has been modified for tail estimation. The methodology is demonstrated on simulated data and applied to air pollution measurements.