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A multivariate piecing-together approach with an application to operational loss data

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The univariate piecing-together approach (PT) fits a univariate generalized Pareto distribution (GPD) to the upper tail of a given distribution function in a continuous manner. We propose a multivariate extension. First it is shown that an arbitrary copula is in the domain of attraction of a multivariate extreme value distribution if and only if its upper tail can be approximated by the upper tail of a multivariate GPD with uniform margins. The multivariate PT then consists of two steps: The upper tail of a given copula C is cut off and substituted by a multivariate GPD copula in a continuous manner. The result is again a copula. The other step consists of the transformation of each margin of this new copula by a given univariate distribution function. This provides, altogether, a multivariate distribution function with prescribed margins whose copula coincides in its central part with C and in its upper tail with a GPD copula. When applied to data, this approach also enables the evaluation of a wide range of rational scenarios for the upper tail of the underlying distribution function in the multivariate case. We apply this approach to operational loss data in order to evaluate the range of operational risk.

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