A tail-sensitive generalization of Spearman's coefficient for upper-tail dependence analysis

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Quantifying dependence during extreme events is of paramount importance in fields such as finance, insurance, and environmental sciences. Classical correlation measures often fail to capture co-movements in the tails of distributions. Tail dependence measures — particularly those derived from copula theory — provide a natural framework for modeling such behavior. In this paper, we introduce two classes of copula-based dependence measures designed to assess tail dependence at sub-asymptotic levels. The first class includes, as special cases, Spearman's coefficient and Blest's index, while the second arises as a limiting case of the first. Our approach generalizes Spearman's coefficient to focus explicitly on tail behavior, offering a flexible and interpretable tool for evaluating co-movements in extreme, yet non-asymptotic, regions of the distribution. For both classes, we establish theoretical properties, propose rank-based estimators, derive their asymptotic distributions, and demonstrate their performance through simulation studies and an empirical application.