

LP-based identification of true & misspecified tail-dependence/Bernoulli matrices in large dimensions

In the context of market-, credit-, and operational risk, stochastic models allowing for tail dependence are considered indispensable in modern risk-management. Being difficult to estimate, it is often a matter of expert judgment to define a matrix of pairwise tail-dependence coefficients. Given a $d \times d$ matrix, however, it is rather difficult to decide if (i) this matrix is indeed a possible tail-dependence matrix, and (ii) how a stochastic model can be constructed representing it. These problems, and the one-to-one connection to Bernoulli matrices, has been thoroughly studied on a theoretical level, but efficient numerical tests beyond $d = 15$ were so far deemed impossible. We add to the existing literature by exploiting the polyhedral geometry of the set of Bernoulli matrices. This allows to translate the above questions into a linear optimization problem with exponentially many variables. We demonstrate that the curse of dimensionality can be partially evaded by a specific column generation approach. For this purpose the additional structure in the constraints of the dual problem is exploited. Finally, we introduce a new stopping criterion for general column generation approaches by a suitable shrinkage of dual iterates to a dual Slater point. In essence, we can thus solve problems up to $d = 40$ in reasonable time.

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