

Risks aggregation in multivariate dependent Pareto distributions

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Abstract

In this paper we obtain closed expressions for the probabilistic distribution and several risk measures, when we consider aggregated risks with multivariate dependent Pareto distributions. We work with the dependent multivariate Pareto type II proposed by Arnold (1983, 2015), which is widely used in insurance and risk analysis. We begin with the individual risk model, where we obtain the probability density function (PDF), which corresponds to a second kind beta distribution (see Guillén, Sarabia, Prieto, 2013). We obtain several risk measures including the VaR, TVaR and other tail measures. Then, we consider collective risk model based on dependence, where several general properties are studied. We study in detail some relevant collective models with Poisson, negative binomial and logarithmic distributions as primary distributions. In the collective Pareto-Poisson model, the PDF is a function of the Kummer confluent hypergeometric function, and in the Pareto-negative binomial is a function of the Gauss hypergeometric function. We also obtain explicit expressions for the moments and some risk measures. Using the data set based on one-year vehicle insurance policies taken out in 2004-2005 (Jong and Heller, 2008), we conclude that our collective dependent models outperform the classical collective models Poisson-exponential and geometric-exponential in terms of the AIC and CAIC statistics. Finally, some possible extensions are discussed.

Key Words: Aggregation, multivariate dependent random variables, collective and individual risk models, hypergeometric functions, tail value at risk

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