MEASURING PORTFOLIO VALUE-AT-RISK BY A COPULA-EVT BASED APPROACH

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Abstract

In this work we present a Monte Carlo Simulation (MCS) based procedure to estimate portfolio Value-at-Risk (VaR), assuming for the market risk factors a multivariate log-return distribution different from the conditional Normal one. More precisely, the scenarios for risk factor log-returns are generated from a multivariate distribution with dependence structure represented by a Gaussian copula or a Student's t-copula and with marginal distributions Normal in the centre and Extreme Value Theory (EVT) distributed in the tails. We observe that the tails of the margins (so distributed) fit empirical log-return data better than the conditional Normal distribution, making more accurate the estimate of "tail" risk. We implement this flexible copula-EVT based VaR model to a sample trading portfolio composed of twenty Italian equities. Our final aim is to obtain an accurate estimate of the portfolio VaR calculated at the 99% and 99.9% probability levels and over a one-day holding period. In order to test the effectiveness of this flexible VaR model, we perform a backtest procedure over a time window of four years. We compare the performance of the copula-EVT based model with the ones of one traditional VaR model (MCS model with Normal risk factor distribution) and of two advanced VaR models, precisely a semi-parametric model proposed by Bingham at al. (2003) and a MCS model in which the multivariate distribution of risk factors log-return is modelled by a Student's t-copula and Student's t or Stable margins (Ivanon et al. (2004)). We find (for our sample portfolio) that the copula-EVT based model provides better VaR estimates than the traditional VaR model and produces coherent results with the other two analysed advanced models in correspondence of a 99% confidence level. For a very high probability level, such as 99.9%, the VaR estimates obtained by the copula-EVT model seem slightly better than the ones obtained by the two above cited advanced VaR models. Moreover we find that the choice of the kind of copula (Gaussian or Student's t copula) does not seem to affect the effectiveness of 99% VaR estimates, while it appears to influence it at the 99.9% probability level.

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