

Title: Fast calculation of portfolio credit losses and the sensitivities on GPU.

Description:

The research thesis aims to investigate the high performance computing on GPU of the Value-at-Risk of portfolio credit losses and the risk sensitivities in factor copula models. It is the industrial standard to solve the loss distribution of copula models by Monte Carlo simulation. In [1], the authors replaced the Monte Carlo simulation by a semi-analytical method to compute the distribution of the portfolio credit losses, the VaR, and the VaR sensitivities. In essence, it directly recovers the cumulative distribution function of the portfolio loss via the COS method, a method based on the Fourier-cosine series expansion. Fourier coefficients are extracted from the characteristic function (ch.f.) of the portfolio loss and the ch.f. can be pre-calculated by means of numerical integration. They have demonstrated that both the computational speed and the accuracy of this method are much superior to Monte Carlo simulation on CPU, using the examples of a multifactor Gaussian and a Gaussian-t hybrid model.

To further improve the computing efficiency, it is worthy of investigating the extension of the work in [1] in two directions, parallelizing the numerical calculation of ch.f. and reducing the dimensionality of the factor copula models. Parallel computing on GPU has been widely used in industry. An exercise of practical value is to design an efficient parallel algorithm and compare the performances of the COS method and Monte Carlo simulation on GPU. Besides of parallel computing, another interesting exercise is to consider approximating the factor copula models, which are in practice of high dimensionality, by a low dimensional model via dimension reduction techniques such as PCA.

[1] Using the COS Method to Calculate Risk Measures and Risk Contributions in Multifactor Copula Models. Xiaoyu Shen, Fang Fang and Chujun Qiu.