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Comparative Study and Parallel Implementation of Stochastic Models for Pricing of European Options Portfolios using Monte Carlo Methods

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Abstract : Over the years, with the emergence of sophisticated computers and algorithms, finance has been quantified using computational prowess. Asset valuation has been one of the key components of quantitative finance. In fact, it has become one of the embryonic steps in determining risk related to a portfolio, the main goal of quantitative finance. This study comprises a drawing comparison between valuation output generated by two stochastic dynamic models, namely Black-Scholes and Dupire's bi-dimensionality model. Both of these models are formulated for computing the valuation function for a portfolio of European options using Monte Carlo simulation methods. Although Monte Carlo algorithms have a slower convergence rate than calculus-based simulation techniques (like FDM), they work quite effectively over high-dimensional dynamic models. A fidelity gap is analyzed between the static (historical) and stochastic inputs for a sample portfolio of underlying assets. In order to enhance the performance efficiency of the model, the study emphasized the use of variable reduction methods and customizing random number generators to implement parallelization. An attempt has been made to further implement the Dupire's model on a GPU to achieve higher computational performance. Furthermore, ideas have been discussed around the performance enhancement and bottleneck identification related to the implementation of options-pricing models on GPUs.

Keywords : monte carlo, stochastic models, computational finance, parallel programming, scientific computing
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