

DELIVERABLE OF RESEARCH PROJECT 13: REPORT ON MC METHODS PDES AND OPTIMISATION IN HPC PLATFORMS

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The deliverable comprises one published paper and one working paper as follows:

1. Hu J, Kannianen J. Asymptotic expansion of European options with mean-reverting stochastic volatility dynamics. *Finance Research Letters*, 2015, 14: 1-10.

In this paper, we develop methods for pricing European options under general mean-reverting stochastic volatility dynamics, which can be used with both affine and non-affine volatility models. In our methods, the option price under stochastic volatility is expanded as a power series of parameters or variables by transferring the original partial differential equation to a set of solvable inhomogeneous Black-Scholes equations. The analytic approximation is more generally applicable than the fast Fourier transform, because it does not rely on the existence of a characteristic function. Finally, we numerically demonstrate our approach with the Heston, 3/2, and continuous-time GARCH models.

2. Hu J. Limit order book models and market phenomenology, Working paper.

In this paper, we propose a dynamical model of the limit order book. After postulating the behavior of order placement, execution and cancellation, Monte-Carlo simulation reconstruct the evolution of the limit order book. Many important aspects of market phenomenology, such as diffusion, jumps, spread and return, emerge from the simple model with less than ten parameters.