

# New Acceleration Schemes with the Asymptotic Expansion in Monte Carlo Simulation

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In the present paper, we propose a new computational technique with the Asymptotic Expansion (AE) approach to achieve variance reduction of the Monte-Carlo integration appearing especially in finance. In order to compute control variables, we utilize the analytic approximation based on AE in Takahashi (1999) and Kunitomo and Takahashi (2003a). We extend the algorithm developed by Takahashi and Yoshida (2003) to the second order asymptotics. Moreover, we apply AE to approximate time dependent differentials of the target value in two kinds of Newton (1994)'s schemes.

Through numerical experiments, we observe remarkable acceleration of convergence, which implies broad applications of our techniques. Our numerical examples include pricing of average, basket and swap options and their risk parameters (delta, gamma) when the underlying state variables follow Constant Elasticity of Variance (CEV) processes.

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