

ABSTRACT

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COMPARATIVE PERFORMANCE ANALYSIS OF MONTE CARLO SIMULATION VARIANCE REDUCTION TECHNIQUES IN THE CONTEXT OF ORDINARY AND EXOTIC OPTIONS PRICING

Thesis, Faculty of Science and Technology (2023)

(xiii + 83 pages, 10 figures, 26 tables)

Options, as crucial derivative assets, enable the diversification of investment strategies. The pricing of exotic options, particularly those with novel features, relies heavily on Monte Carlo simulation (MCS), an ostensibly simplistic yet central method even amidst advanced methodologies. The focus of this thesis is variance reduction techniques (VRT), a class of strategies aimed at enhancing MCS performance through diminishing the variance of simulation outcomes. A comprehensive comparative analysis of several VRT models, including the traditional antithetic and control variates, an innovative non-parametric importance sampling, and combined models fusing antithetic variates and importance sampling, is undertaken. This investigation spans diverse option styles, from conventional European options and American puts, to more specialized exotic options like rebate deferred and knock-in barrier options, employing bespoke techniques like the Longstaff-Schwarz algorithm for American put continuation value computation, and continuity correction for Barrier options. Performance evaluation of each VRT models is based on three critical metrics: accuracy, precision, and time efficiency. Moreover, the analysis is broadened to incorporate sensitivity to volatility parameters, convergence analysis, and control variate optimization methods. The determination of the superior model is complex, considering varying researcher preferences. Thus, a decision framework integrating Von Neumann-Morgenstern (VNM) utility theory and logistic transformation is implemented to accommodate researcher preferences across the three metrics, thereby aiding in the selection of the most effective VRT model.

Keywords: Monte Carlo simulation (MCS), variance reduction techniques (VRT), options, antithetic variates, control variates, importance sampling, VNM utility, decision framework.

Reference: 21 (1973-2022)