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Intelligent Stochastic Approaches for Valuating European Options

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Abstract. The pricing of multi-dimensional options presents significant challenges, as it is a fundamental issue in modern large-scale financial analysis. A European call option grants its holder the right, but not the obligation, to acquire a specified quantity of an underlying asset S at a predetermined strike price K on a fixed maturity date T. In financial modeling under uncertainty, Monte Carlo and quasi-Monte Carlo techniques have emerged as powerful tools for tackling complex valuation problems. This paper investigates the intelligent optimization of simulation-based approaches to accurately determine the fair value of multi-dimensional European options. Monte Carlo methods, particularly in higher-dimensional settings, are well-suited for such pricing tasks due to their flexibility and effectiveness. In this study, we introduce intelligent optimization strategies that leverage low-discrepancy sequences and variance reduction techniques, significantly enhancing the precision of conventional Monte Carlo simulations. These refinements lead to more reliable pricing outcomes, which are critical for informed financial decision-making under uncertainty. Furthermore, the proposed methodology demonstrates robust performance in scenarios where traditional