
Optimized Multi-Level Monte Carlo Parametrization and Antithetic Sampling for Economic Capital Estimation in Insurance

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Abstract

Estimating Value-At-Risk is crucial in insurance risk management, but it often requires computationally intensive nested Monte Carlo simulations. Multi-Level Monte Carlo (MLMC) methods and their weighted variants are generally more efficient, yet their performance drops when applied to irregular functions like the indicator functions central to Value-At-Risk. In this talk, we introduce a new MLMC parametrization that offers significant performance improvements in practical, non-asymptotic scenarios, while preserving theoretical guarantees. Our approach explicitly accounts for cases where the cost of outer samples in nested simulations is not negligible. Additionally, we show that antithetic sampling of MLMC levels improve efficiency, regardless of the function's regularity. Numerical experiments in a life insurance setting demonstrate the practical advantages of our method, bridging theoretical advances with the real-world needs of insurance risk management.

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