

# Efficient importance sampling for rare event simulation with applications

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## Abstract

Importance sampling has been known as a powerful tool to reduce the variance of Monte Carlo estimator for rare event simulation. Based on the criterion of minimizing the variance of Monte Carlo estimator within a parametric family, we propose a general account for finding the optimal tilting measure. To this end, when the moment generating function of the underlying distribution exists, we obtain a simple and explicit expression of the optimal alternative distribution. The proposed algorithm is quite general to cover many interesting examples, such as normal distribution, noncentral  $\chi^2$  distribution, and compound Poisson processes. To illustrate the broad applicability of our method, we study value-at-risk (VaR) computation in financial risk management and bootstrap confidence regions in statistical inferences.

Keywords: bootstrap, confidence region, exponential tilting, moderate deviation, VaR