Hlawka-Mück techniques for option pricing[1]

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For the numerical simulation of various applications in finance using Monte Carlo and Quasi-Monte Carlo algorithms, one has to create non-uniform variates (e.g. of the normal inverse Gaussian, the variance-gamma or the hyperbolic distribution) of sufficient accuracy. While the inversion method for sampling such points does not produce acceptable results, with Quasi-Monte Carlo methods Acceptance-Rejection sampling is not advisable, as it induces an integration over a discontinuous function.

To solve this problem, we present a Hlawka-Mück [4, 3] type scheme to generate low-discrepancy sequences with a given density f and analyze their properties and quality. The results obtained by Quasi-Monte Carlo simulation are also compared with a method that combines the ratio-of-uniforms idea and importance sampling to avoid the generation of variates of heavy-tailed distributions.

Since the calculation of large low-discrepancy sequences using Hlawka-Mück methods is computationally expensive for many distributions, we will finally present variation-reduction techniques to increase the efficiency of our algorithms.

In this talk we consider as an example the valuation of path-dependent derivates in Lévy-models (see e.g. [1]) using Monte Carlo and Quasi-Monte Carlo simulation methods. In particular we will be concerned with the efficient valuation of discrete sampled Asian options in variance-gamma and NIG models.

References

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