

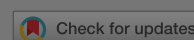
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Original Articles

Some contributions to sequential Monte Carlo methods for option pricing

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ABSTRACT

Pricing options is an important problem in financial engineering. In many scenarios of practical interest, financial option prices associated with an underlying asset reduces to computing an expectation w.r.t. a diffusion process. In general, these expectations cannot be calculated analytically, and one way to approximate these quantities is via the Monte Carlo (MC) method; MC methods have been used to price options since at least the 1950s. However, the computational cost of MC methods can be very high, especially for barrier options. In this paper, we propose a new method for pricing barrier options. Our method is based on the Sequential Monte Carlo (SMC) method. We use a sequence of weighting functions to approximate the distribution in the SMC algorithm by using a sequence of weighting functions. This is

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demonstrated on two examples, barrier options and target accrual redemption notes (TARNs). We also provide a proof of unbiasedness of our SMC estimate.

Q KEYWORDS:

Diffusions

sequential Monte Carlo

option pricing

Q AMS SUBJECT CLASSIFICATION:

91G60 (primary)

65C05 (secondary)

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. We have a slight abuse of notation in the above, wherein we have used $\mu(n, S_n)$ and $\sigma(n, s_n)$ to denote $\mu(t_n, R_{t_n})$ and $\sigma(t_n, R_{t_n})$ respectively.
2. If μ is a constant other than 0, then it is trivial to extend the methods we propose. If it is a function of the asset value, we could do things similar to what we do in the local volatility model considered later.
3. We have assumed here that the interest rate is 0. If the interest rate was r , then there would be a factor of $e^{\int_0^T r(t) dt}$ multiplied with QD. This is a constant and affects the variance of the estimate only up to a (known) scale factor.
4. Path degeneracy is when repeated resampling steps lead to many multiple copies of the same particle $X_{1:N}$. This causes estimates based on the entire paths being unreliable.

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