



255 | 9 | 0
Views | CrossRef citations to date | Altmetric

Original Articles

Some contributions to sequential Monte Carlo methods for option pricing

Deborshee Sen , Ajay Jasra & Yan Zhou

Pages 733-752 | Received 16 Aug 2015, Accepted 10 Aug 2016, Published online: 29 Aug 2016

Cite this article <https://doi.org/10.1080/00949655.2016.1224238>



Full Article

Figures & data

References

Citations

Metrics

Reprints & Permissions

Read this article

Share

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 1970s. It has been seen in Del Moral P, Shevchenko PV. [Valuation of barrier options using sequential Monte Carlo. 2014. arXiv preprint] and Jasra A, Del Moral P. [Sequential Monte Carlo methods for option pricing. Stoch Anal Appl. 2011;29:292–316] that Sequential Monte Carlo (SMC) methods are a natural tool to apply in this context and can vastly improve over standard MC. In this article, in a similar spirit to Del Moral and Shevchenko (2014) and Jasra and Del Moral (2011), we show that one can achieve significant gains by using SMC methods by constructing a sequence of artificial target

densities over time. In particular, we approximate the optimal importance sampling distribution in the SMC algorithm by using a sequence of weighting functions. This is demonstrated on two examples, barrier options and target accrual redemption notes (TARNs). We also provide a proof of unbiasedness of our SMC estimate.

KEYWORDS:

Diffusions sequential Monte Carlo option pricing

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.

Additional information

Funding

AJ was supported by a Singapore Ministry of Education Academic Research Fund Tier 1 grant [R-155-000-156-112] and is affiliated with the RMI and CQF at NUS. YZ was supported by a Singapore Ministry of Education Academic Research Fund Tier 2 grant [R-155-000-143-112].

Related research

People also read	Recommended articles	Cited by 9
------------------	----------------------	---------------

Information for

[Authors](#)

[R&D professionals](#)

[Editors](#)

[Librarians](#)

[Societies](#)

Opportunities

[Reprints and e-prints](#)

[Advertising solutions](#)

[Accelerated publication](#)

[Corporate access solutions](#)

Open access

[Overview](#)

[Open journals](#)

[Open Select](#)

[Dove Medical Press](#)

[F1000Research](#)

Help and information

[Help and contact](#)

[Newsroom](#)

[All journals](#)

[Books](#)

Keep up to date

Register to receive personalised research and resources by email



Sign me up



Copyright © 2025 Informa UK Limited [Privacy policy](#) [Cookies](#) [Terms & conditions](#)

[Accessibility](#)

 Taylor and Francis Group

Registered in England & Wales No. 01072954
5 Howick Place | London | SW1P 1WG