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Construction of positivity preserving numerical method for jump-diffusion option pricing models

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Abstract

Using the Euler scheme to simulate the stochastic differential equations (SDEs) models in finance often gives rise to the problem that the exact solution is positive while the numerical solution is not. Recently, we find that this problem existed in the jump-diffusion models as well. Hence, this paper aims to construct a numerical method preserving positivity for jump-diffusion option pricing models. We generalize the balanced implicit method (BIM) to the jump-diffusion models, which already turned out to be efficient for preserving positivity in SDE models. Then the positivity of BIM for jump-diffusion models is proved under some conditions. Finally, a numerical example is simulated to verify the positivity and efficiency of the proposed method.

Keywords: Jump-diffusion; numerical solution; balanced implicit method; positivity preserving.
2000 MSC: 60H35; 60H30; 60H10; 65C30

1. Introduction

In this paper, we will consider the following scalar jump-diffusion models for option pricing

$$\mathrm{d}S(t) = \mu S\left(t^{-}\right)\mathrm{d}t + \sigma S\left(t^{-}\right)\mathrm{d}W\left(t\right) + \gamma S\left(t^{-}\right)\mathrm{d}N\left(t\right) \tag{1.1}$$

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