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An analytical approximation formula for European option pricing under a new stochastic volatility model with regime-switching

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Abstract

In this paper, an analytical approximation formula for pricing European options is obtained under a newly proposed hybrid model with the volatility of volatility in the Heston model following a Markov chain, the adoption of which is motivated by the empirical evidence of the existence of regime-switching in real markets. We first derive the coupled PDE (partial differential equation) system that governs the European option price, which is solved with the perturbation method. It should be noted that the newly derived formula is fast and easy to implement with only normal distribution function involved, and numerical experiments confirm that our formula could provide quite accurate option prices, especially for relatively short-tenor ones. Finally, empirical studies are carried out to show the superiority of our model based on S&P 500 returns and options with the time to expiry less than one month.

AMS(MOS) subject classification.

Keywords. European option, Regime-switching Heston model, Perturbation method, Empirical studies.

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