European Option Pricing Method for Stocks with Stochastic Volatility and Interest Rate

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Abstract: European option prices may be calculated using the Black-Scholes formula when the parameters are assumed constant with time. A formula using transformations derived by Rodrigo and Mamon extends the Black-Scholes method by allowing interest rate and volatility to vary with time. In this paper, the Rodrigo-Mamon formula is proved using Itos Lemma. Extensions of the method are used to obtain corresponding put option values and the Put-Call Parity for European options. Numerical results are shown in the case when volatility and interest rate are modeled as stochastic processes, in particular when they follow the Cox-Ingersoll-Ross model. Comparisons with results obtained using standard Monte Carlo methods show that the Rodrigo-Mamon method is not merely an adequate alternative for pricing options, but actually improves on Monte Carlo methods in terms of accuracy and convergence.

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