

# A CLOSED-FORM OPTION VALUATION FORMULA IN REGIME-SWITCHING JUMP DIFFUSION MODELS

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## Abstract

To improve the empirical performance of the Black-Scholes model, alternative models have been proposed to address the leptokurtic feature of the asset return distribution, volatility smile, and the effects of the volatility clustering phenomenon. However, the analytical tractability of the option valuation remains problematic for most of the alternative models. In this paper, we propose a regime-switching jump diffusion model that can not only incorporate both the leptokurtic feature and volatility smile but also present the economic features of volatility clustering. In an empirical analysis, the EM algorithm is exploited to estimate the parameters of the model and test if the model is appropriate. To evaluate the price of derivatives, we apply Lucas's general equilibrium framework to provide closed-form formulas for option and futures prices. When the jump size follows a specific distribution, such as a lognormal distribution or a default probability, we devise explicit analytic formulas for the equilibrium prices. Through these formulas, we illustrate the effect of jumps on implied volatility and volatility surface via stochastic intensity as well as sensitivity analysis in stock option prices.

KEY WORDS: contingent claims, equilibrium analysis, European call option, regime-switching jump diffusion model, Markov modulated Poisson process, rational expectations, volatility clustering