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Legendre Wavelet Collocation Method for Pricing European Options governed by Jump-Diffusion Models

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Abstract:
Improving numerical methods used for pricing options in derivative markets becomes essential, especially where asset returns often exhibit characteristics (such as jumps, heavy tails, and asymmetry) that aren't well-suited to traditional Gaussian models. To account for these features, the research explores jump-diffusion processes governed by an integro-differential equation (IDE), where the integral term represents the jumps in asset prices. Since closed-form solutions for these equations are generally unavailable, numerical methods are used, but they often involve complex matrices and slow computations. The study proposes using the Legendre wavelet collocation method (LWCM) as a more efficient and simple alternative to approximate Merton's jump diffusion model. It specifically models jump magnitudes with a log-logistic distribution.
The key findings highlight that the LWCM is a simple yet robust method that closely approximates Merton's analytical solution. This approximation is achieved with high convergence rates in both L_2 and L_infty norms, showcasing the method's efficiency. This makes it a promising numerical tool for option traders looking to integrate jump-diffusion models into their pricing strategies.

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