

Comparative and Generative Analysis of Monte Carlo, EWMA, and LSTM Models for Financial Value-at-Risk Forecasting

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Abstract:
Forecasting risk accurately is an important contributor to financial stability and strategic investment. Existing volatility models, such as the Exponentially Weighed Moving Average (EWMA), which assumes that returns are normally distributed, have difficulty capturing large or extreme losses during volatile periods, or they underestimate them. Deep learning, such as Long Short-Term Memory (LSTM) networks, can model nonlinear dependencies but struggle with short-term forecasting and interpretability. This research presents the Hybrid Monte Carlo-EWMA stimulator (HME-Stimulator) and integrates the sequential stochastic precision of Monte Carlo simulation with the rollover adaptive volatility method using EWMA and validates the methodology through the performance metric Mean Squared Area Error Function (MSAEF). Using Tesla (TSLA) daily stock data from 2010 to 2017, the study compares each of the Monte Carlo, EWMA, and LSTM models for forecasting 1-day 99 %, value-at-risk (VaR). The results show that the HME-Stimulator provides the best short-term accuracy and interpretability compared to the standalone statistical (MWMA or MCS) and deep learning methodology (LSTM).

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