

ABSTRACT

INTEGRATING MACHINE LEARNING AND PARTICLE SWARM OPTIMIZATION FOR STOCK PRICE PREDICTION AND OPTIMAL PORTFOLIO ALLOCATION

by

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This study aims to enhance stock market predictions by integrating machine learning models to support investment strategies, maximize portfolio returns, and manage risks. Building on Modern Portfolio Theory and risk-adjusted metrics like the Sharpe ratio, the study explores the potential of machine learning to improve stock predictions by leveraging Long Short-Term Memory (LSTM) networks for time-series forecasting, Random Forest (RF) with Particle Swarm Optimization (PSO) for regression, and Support Vector Machines (SVM) enhanced with Binary Gravitational Search Algorithm (BGSA) for classification. These models are trained on a 10-year dataset of major stock tickers.

The research addresses the limitations of traditional single-model approaches by combining these diverse techniques to capture complex patterns and trends in stock market behavior. Performance is assessed through metrics such as Root Mean Square Error (RMSE), accuracy, precision, and recall, with the goal of achieving higher predictive accuracy and model robustness under various market conditions. The study further employs PSO to optimize portfolio allocations based on the Sharpe ratio, balancing risk and returns.

The results highlight the effectiveness of the proposed multi-model approach in stock prediction and portfolio optimization. The optimized portfolio strongly favors CAT_Returns and AAPL_Returns, which together account for over 80% of the allocation, reflecting their superior balance of expected returns and risk. This allocation results in an impressive Sharpe Ratio of 10.26, demonstrating exceptional risk-adjusted returns. Additionally, the model effectively minimizes risk, achieving a low standard deviation of 3.73%. However, the high concentration in a few assets indicates limited diversification, exposing the portfolio to sector-specific risks. The exclusion of assets like TSLA_Returns, JPM_Returns, and V_Returns suggests their higher volatility or weaker correlation with the optimized portfolio.

Keywords: Stock market prediction, Machine learning, Particle Swarm Optimization (PSO), Portfolio optimization, Financial forecasting.