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Portfolio optimization using machine learning techniques: An application on Colombo stock exchange

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Stock market price prediction is a challenging task due to the non-linearity and volatility of the financial data. Thereby, forming a portfolio considering accurately predicted future stock prices becomes an even harder task. As a classical approach, most of the researchers apply statistical techniques as analytical tools in financial time-series data analysis and forecasting. However, due to the dominance of the qualitative factors affecting the financial market and their securities, most of the forecasting and other interpretations have less accuracy. Nevertheless, the recent development of computing algorithms, particularly in the field of data science, gives a better opportunity to develop analytical techniques that accurately handle the high uncertainty and the associated volatility of financial data. In this study, classes of Recurrent Neural Network (RNN) algorithms have been used as data science techniques. In particular, the LSTM (Long-Short Term Memory), a special kind of RNN, is utilized to predict the future stock price returns of the Colombo Stock Exchange (CSE), Sri Lanka. Herein, daily assets prices of 20 companies belonging to the S&P SL20 list, and the list of top 100 ranking companies in Sri Lanka in the year 2020, have been analyzed. In the required forecasting, LSTM has been trained using the daily assets closing prices from 1st of January 2010 to 31st of March 2019. The model accuracy measured by Root Mean Square (RMS) averaged 10%. The formation of the portfolio is based on companies that have the highest stock prices and expected stock returns. As a result of this analysis, 7 companies are selected to form different portfolios. To select a portfolio with the highest return with minimum risk, combinations of 5 companies out of 7, i.e., in total 21 combinations of companies, have been analyzed. In portfolio analysis, Markowitz Model (Mean-Variance Optimization Model), Equal-Weighted Model (EQ) and Monte Carlo Simulation (MCS) have been used. Depending on the selection of companies to the portfolio, the model performances are varied. Thus, the best stock allocation resulting the highest expected return with the minimum risk, given by these three models, is selected as the investment plan. Based on the techniques that have been used, the risk could be controlled in the range of 0.3 to 1.1 values.

Keywords: LSTM Model, Portfolio Optimization, Stock Market Returns.