Learning to Trade in Financial Time Series through Wavelet Transformation and Deep Reinforcement Learning

Ji Min Lee¹, Hayeong Koh¹, and Hi Jun Choe¹

1) Department of Mathematics, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul, South Korea 03722

Corresponding Author : Ji Min Lee, jmlee524@yonsei.ac.kr

ABSTRACT

Recently, access to finance through deep learning has received a lot of attention from investors and researchers. This study shows how to optimize portfolio, asset allocation and trading systems based on deep reinforcement learning (Deep Q-Network). The framework of deep reinforcement learning consists of three framework, all of which are important for optimizing the trading system. First, the input data is decomposed by wavelet transformation (WT) to remove noise in the stock price time series data. At this time, only mother wavelets (high-frequency) are used for input data among father wavelets (low-frequency) and mother wavelets (high-frequency) that have been disassembled. Second, determining the trading action through the LSTM and the exploration the denoising input value. Third, depending on the action of a given transaction, the deep Q-Network will be conducted to improve the performance of the transaction by changing the state and action according to appropriate rewards. The proposed structure improves transaction performance without the need to build predictive models. To investigate the performance, we apply the S&P 500 stock index to our proposed deep reinforcement learning structure (Wavelet_DeeplSTM Q-network) and other reinforcement learning structures. The daily asset allocation system was then calculated and compared for various test periods (1 year). As the result, the calculation of the sharp ratio (indicative of the fund's excess return by investing in one unit of risky assets) shows that our proposed structure outperforms other similar structures.