Applications of Machine Learning in High-Frequency Financial Time Series Prediction

Rino R. Beeli

February 18, 2021

Abstract

Interest in the use of machine learning methods continues unabated, notably in empirical finance and financial time series prediction. The recent advent of powerful machine learning methods combined with the availability of vast amounts of computational resources form an attractive basis for researchers and practitioners. This thesis applies four methods for stock price movement prediction and algorithmic trading, with the fourth method belonging to the field of deep learning. Concretely, a simple momentum model, an autoregressive $AR(1)$ model combined with prediction smoothing, a linear ℓ_1 trend filter based model with adaptive hyperparameter optimization, and a Long Short-Term Memory neural network are employed on 1 min high-frequency price data. The objective is to attain high accuracies for price movement predictions and to find profitable trading strategies net of transaction costs. The LSTM-based prediction model utilizes 1 min price data and extracts features based on handcrafted basis functions fitted to tick price data using the least-squares method, which are then further processed using a LSTM neural network for prediction. The model delivered the best performance with a prediction accuracy of 72% based on average prices for the considered stocks and period, and outperformed the other approaches net of transactions costs, although the performance was still negative overall. These findings are encouraging and support further research using modern machine learning methods for high-frequency financial time series prediction and algorithmic trading applications. It is expected that a bet sizing mechanism on top of price movement predictions would significantly improve strategy performance net of transaction costs.