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A Nonlinear Autoregressive Model with Exogenous Variables Neural Network for Stock Market Timing: The Candlestick Technical Analysis

Elham Ahmadi, M.S. Student
Department of Industrial Engineering, Yazd University
Yazd, Iran
E.ahmadi@yazd.ac.ir

Mohammad HosseinAbooie, Ph.D
Assistant Professor of Industrial Engineering,YazdUni
Yazd, Iran
mhabooie@yazd.ac.ir

***Abstract*—In this paper, the nonlinear autoregressive model with exogenous variables as a new neural network is used for timing of the stock markets on the basis of the technical analysis of Japanese Candlestick. In the model the "nonlinear autoregressive model with exogenous variables" is an analyzer. For a more reliable comparison, here (like the litrature) two approaches of Raw-based and Signal-based are devised to generate the input data of the model. The correct predictions percentages for periods of 1- 6 days with the total number of buy and sell signals are considered. The result prove that to some extent the approaches have similar performances while apparently they are superior to a feed-forward static neural network. The created network is evaluated by the measure of Mean of Squared Error and the proposed model accuracy is calculated to be extremely high.**

Keywords- Finance; Stock Market Forecasting; Technical Analysis; NARX recurrent neural network; Levenberg–Marquardt algorithm

I. INTRODUCTION

Developing a model for predicting returns in order to make investment decisions is an important goal for academics and practitioners. Typically, the financial services industry relies on three main approaches to make investment decisions: the fundamental approach that uses fundamental economic principles to form portfolios, the Technical Analysis approach, and the mathematical approach that is based on the mathematical model. The first two approaches dominate practice because of their applicability; however, our paper focuses on TA approach[1].

In recent years, technical analysis has proven to be powerful for evaluating stock prices and is widely accepted among financial economists and brokerage firms. This is due to the fact that technical analysis appears to be a compromising tool since it offers a relative mixture of human, political, and economical events[2].

This paper focuses on candlestick technical trading strategies. Candlestick technical analysis is a short-term timing technique that generates signals based upon the relationship between open, high, low, and close prices[3]. The Japanese candlestick chart was originally developed by Munehisa Honma in the 1700s[4].Many studies have analyzed the applications and advantages of candlestick charts for predicting the stock market; such as Lee and Jo[5], Kamo[4], Lana and et al.[6], Chen and et al.[7]. Hence, we can conclude that candlestick charts can be used as a powerful tool in TA.

Nevertheless, mining stock market trend is a challenging task due to its high volatility and noisy environment. Many factors influence the performance of a stock market including political events, general economic conditions, and traders' expectations[8]. Therefore, predicting stock price movement is a very difficult task. However, an appropriate nonlinear model approach, such as an intelligent system technique, may be able to discover complex nonlinear relationships and handle the uncertainty and imprecision common in the stock market[2].Artificial neural network, as a main approach in the Artificial Intelligent field, has attracted a lot of interest over the past decade for its ability to forecast financial performance[7].

Much research has used ANNs in modelling and prediction of time series data[8-12]. Most of the reported research has focused on using feed forward neural network[13]. These networks do not have any feedback connections in their architectures. Therefore, they do not take into account the temporal dependencies between the data. Recurrent neural networks (RNNs) are widely used to deal with many dynamical and non-linear problems, including time series prediction[14-16]. RNNs are computationally more powerful than feed forward networks and valuable approximation result have been obtainedfor prediction problems[13].

One of the most convenient model forms among RNNs for prediction purposes is the nonlinear autoregressive