Chapter VI
Higher Order Neural Networks for Stock Index Modeling

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ABSTRACT

Artificial Neural Networks (ANNs) have become very important in making stock market predictions. Much research on the applications of ANNs has proven their advantages over statistical and other methods. In order to identify the main benefits and limitations of previous methods in ANNs applications, a comparative analysis of selected applications is conducted. It can be concluded from analysis that ANNs and HONNs are most implemented in forecasting stock prices and stock modeling. The aim of this chapter is to study higher order artificial neural networks for stock index modeling problems. New network architectures and their corresponding training algorithms are discussed. These structures demonstrate their processing capabilities over traditional ANNs architectures with a reduction in the number of processing elements. In this chapter, the performance of classical neural networks and higher order neural networks for stock index forecasting is evaluated. We will highlight a novel slide-window method for data forecasting. With each slide of the observed data, the model can adjusts the variable dynamically. Simulation results show the feasibility and effectiveness of the proposed methods.

INTRODUCTION

Stock index forecasting is an integral part of everyday life. Current methods of forecasting require some elements of human judgment and are subject to error. Stock indices are a sequence of data points, measured typically at uniform time intervals. The analysis of *time series* may include many statistical methods that aim to understand such data by constructing a model. Such as:

1. Exponential smoothing methods
2. Regression methods
3. Autoregressive moving average (ARMA) methods
4. Threshold methods
5. Generalized autoregressive conditionally heteroskedastic (GARCH) methods

ARMA processing has shown to be the most effective tool to model a wide range of *time series*. The models of order (n, m) can be viewed as linear filters from the point of view of digital signal processing. The time structure of these filters is shown in Equation (1), where *y(k)* is the variable to be predicted using previous samples of the *time series*, *e(i)* is a sequence of independent and identically distributed terms which have zero mean, and *C* is a constant.

However, these models do not work properly when there are elements of the *time series* that show a nonlinear behavior. In this case, other models, such as time processing *neural networks*, must be applied.

Several *Evolutionary Computation* (EC) studies have a full insight of the dynamic system to describe (Back T, 1996; Robert R. & Trippi, 1993). For instance, some have used Artificial *Neural networks* (ANNs) (Davide & Francesco, 1993; Edward Gately, 1996), Genetic Programming (GP) (Edward Gately, 1996; Santini & Tattamanzi 2001) and Flexible Neural Tree (FNT) (Yuehui Chen & Bo Yang, 2005) for stock index prediction, among others, recently have used a hybrid algorithm such as Gene Expression Programming (GEP) (Ferreira.C., 2002; Heitor S.Lopes & Wagner R.Weinert, 2004) and Immune Programming (IP) Algorithm (Musilek & Adriel, 2006) for predicting stock index.

Artificial *neural networks* (ANNs) represent one widely technique for stock market forecasting. Apparently, White (1988) first used *Neural Networks* for market forecasting. In other work, Chiang, Urban, and Baldridge (1996) have used ANNs to forecast the end-of-year net asset value of mutual funds. Trafalis (1999) used feed-forward ANNs to forecast the change in the S&P (500) index. Typically the predicted variable is continuous, so that stock market prediction is usually a specialized form of regression. Any type of neural network can be used for stock index prediction (the network type must, however, be appropriate for regression or classification, depending on the problem type). The network can also have any number of input and output variables (Hecht-Nielsen R, 1987). In addition to stock index prediction, *neural networks* have been trained to perform a variety of financial related tasks. There are experimental and commercial systems used for tracking commodity markets and futures, foreign exchange trading, financial planning, company stability, and bankruptcy prediction. Banks use *neural networks* to scan credit and loan applications to estimate bankruptcy probabilities, while money managers can use *neural networks* to plan and construct profitable portfolios in real-time. As the application of *neural networks* in the

Equation (1).

$$y(k) = a_1 * y(k-1) + \cdots + a_n * y(k-n) + e(k) + b_1 * e(k-1) + \cdots + b_{m-1} * e(k-m+1) + C$$