Chapter 15

An Adaptive Second Order Neural Network with Genetic-Algorithm-based Training (ASONN-GA) to Forecast the Closing Prices of the Stock Market

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ABSTRACT

Successful prediction of stock indices could yield significant profit and hence require an efficient prediction system. Higher order neural networks (HONN) have several advantages over traditional neural networks such as stronger approximation, higher fault tolerance capacity and faster convergence characteristics. This paper proposes an adaptive single layer second order neural network with genetic algorithm based training (ASONN-GA) applied to forecast daily closing prices of the stock market. For comparative study of performance, two conventional neural based models such as a recurrent neural network (RNN) and a multilayer perceptron (MLP) have been developed. The optimal network parameters for all the three models are tuned by genetic algorithm (GA). The efficiencies of the models have been evaluated by forecasting the one-day-ahead closing prices of real stock markets. From simulation studies, it is revealed that the ASONN-GA model achieve better forecasting accuracy over other two models.

1. INTRODUCTION

Stock market behaves very much like a random walk process and the stock market index prediction has been considered as an important and challenging task for the researchers. Due to the influence of uncertainties involved in the movement of the market, the stock market forecasting is regarded as a difficult task. Stock movement prediction is also difficult due to its nonlinearities, highly volatile in nature, discontinuities, movement of other stock markets, political influences and other many macro-economical factors and even individual psychology. Various economic factors such as oil prices, exchange rates, interest rates, stock price indices in other countries, domestic as well as global economic situations, etc. have been influencing the market behavior. As more and more money is being invested in the stock market by common investors, brokers and speculators, they get anxious about the future trend of the stock prices in the market. Hence, an effective and accurate forecasting model is necessary in order to predict the stock market behavior. If the direction of the market is successfully predicted, the investors may be better guided and also monetary rewards will be substantial. In recent years, many new methods for the modeling and forecasting the stock market have been developed including linear as well as nonlinear models.

For many decades linear models have been the basis of traditional statistical forecasting models in financial engineering. The Box-Jenkins method using autoregressive moving average (ARMA) linear models have extensively been used in many areas of time series forecasting (Box & Jenkins, 1976). Several statistical techniques such as moving averages (MA), auto-regressive integrated moving average (ARIMA), auto-regressive heteroscedastic (ARCH), generalized ARCH (GARCH) have been used extensively for stock market prediction. They have been successfully applied to different engineering, economic and social applications. Nonlinear dynamics proposes that in financial time series, past prices help to determine future prices, but not in a straightforward way. The relationship between past prices and future prices is nonlinear, and this nonlinearity implies that past price change can have wide ranging effects on future prices. Due to the presence of noise and nonlinearity in the financial time series, such traditional methods have seldom proved to be effective. These models were lacking in capturing the nonlinearity of other types of time series, since they have developed to model certain types of problems. This paves the path toward adopting nonlinear models. The popular nonlinear models used for financial forecasting include artificial neural networks, support vector machine, Bayesian networks, fuzzy system models etc. Amongst these frequently adopted methods, artificial neural networks have drawn significant interests from several researchers in the stock market behavior forecasting.

Artificial neural network (ANN) is one of the important approaches in machine learning methods. ANNs are software constructs designed to mimic the way the human brain learns. The neural network can imitate the process of human's behavior and solve nonlinear problems, which have made it widely used in calculating and predicting complicated systems. The quality of non linearity mapped achieved in ANN is difficult with the conventional calculating approaches. It has the capability of dealing with complex problems of structural instability. They are analogous to nonparametric, nonlinear regression models. Their novelty lies in their ability to model nonlinear processes with few a priori assumptions about the nature of the generating process. Neural networks extensively used in medical applications such as image/signal processing (Miller, 1992), pattern and statistical classifiers (Maglaveras, 1998) and for modeling the dynamic nature of biological systems. ANNs are relatively recent method for business forecasting and has been successfully applied to wide range of forecasting problems such as exchange rate, credit scoring, business failure, bankruptcy, interest rate, stock return, stock market index, portfolio management and option & future prices. ANNs have been successfully applied in financial engineering

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