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A hybrid stock trading framework integrating technical analysis with machine learning techniques

Rajashree Dash [a,*,1], Pradipta Kishore Dash [b,2]

[a] *Computer Science & Engineering Department, ITER, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha, 751030, India*
[b] *Siksha 'O' Anusandhan University, Bhubaneswar, Odisha, 751030, India*

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Abstract

In this paper, a novel decision support system using a computational efficient functional link artificial neural network (CEFLANN) and a set of rules is proposed to generate the trading decisions more effectively. Here the problem of stock trading decision prediction is articulated as a classification problem with three class values representing the buy, hold and sell signals. The CEFLANN network used in the decision support system produces a set of continuous trading signals within the range 0−1 by analyzing the nonlinear relationship exists between few popular technical indicators. Further the output trading signals are used to track the trend and to produce the trading decision based on that trend using some trading rules. The novelty of the approach is to engender the profitable stock trading decision points through integration of the learning ability of CEFLANN neural network with the technical analysis rules. For assessing the potential use of the proposed method, the model performance is also compared with some other machine learning techniques such as Support Vector Machine (SVM), Naive Bayesian model, K nearest neighbor model (KNN) and Decision Tree (DT) model.

Keywords: Stock trading; Stock trend analysis; Technical indicators; CEFLANN

* Corresponding author.
E-mail addresses: rajashree_dash@yahoo.co.in (R. Dash), pkdash.india@gmail.com (P.K. Dash).
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[1] Rajashree Dash is working as an Asst. Professor in ITER, Siksha 'O' Anusandhan University. She has completed her M.Tech in Computer Science and Engineering. Now she is pursuing her P.H.D. Her research topics include data mining, time series prediction, evolutionary computation etc.

[2] Professor P.K.Dash holds D.SC.,Ph.D. degrees in Electrical Engineering and currently is the director of research at the Siksha O Anusandhan University, Bhubaneswar, India. He had several visiting appointments at the Universities in USA, Canada, Singapore, and Malaysia. He has published more than 450 papers in reputed International journals and conferences. His research interests include Power Engineering, Renewable Energy, Signal Processing, Computational intelligence, Evolutionary Computing, and Information Technology.

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1. Introduction

With the era of economic globalization and the facility of digital technology, generation and accumulation of financial data has reached at an unprecedented rate. The rapidly growing volume of data has far exceeded the ability of a human being to analyze them manually. Again financial time series data are more complicated than other statistical data due to the long term trends, cyclical variations, seasonal variations and irregular movements. These are highly affected by many external factors, such as many highly interrelated economic, political, social and even if the psychological behavior of the investor. The continuous growth of such highly fluctuating and irregular data has put forth the critical need for developing more automated approaches for efficient analysis of such massive financial data to extract meaningful statistics from that. Being a process of exploring useful hidden knowledge, Data mining has carved its own niche in financial time series analysis. It provides pathways for investors to take proactive and knowledge-driven decisions in order to achieve successful gain with less investment risk.

Gaining high profit is the ultimate goal of an investor participating in financial market. There are so many investment opportunities like trading (i.e. buying and selling) bonds, shares, foreign exchanges and precious metals etc. present in a financial market. Trading in stock market is one of the popular channels of financial investment. Investors in the stock Market can maximize their profit by buying or selling their investment at proper time. The key to realize high profits in stock trading is to find out the suitable trading time with the minimum risk of trading. But it is always hard to decide the best time to buy or sell due to the highly fluctuating and dynamic behavior of stock market. Technical indicators are the primary interest for most of the researchers to monitor the stock prices and to assist investors in setting up trading rules for buy−sell−hold decisions. Technical indicators are produced based on historical stock data. So trading decision taken based on particular technical indicators may not always be more profitable. In literature various data mining and artificial intelligence tools has been applied to analyze technical indicators in an attempt to find the best trading signals.[1−4] Gaining profit or loss from stock trading ultimately depends on analysis of future movement of highly fluctuating and irregular stock price values. Successful classification of up and down movements in stock price index values may not only helpful for the investors to make effective trading strategies, but also for policy maker to monitor stock market. Keeping track of upswings and downswings over the history of individual stocks will reduce the uncertainty associated to investment decision making. Investors can choose the best times to buy and sell the stock through proper analysis of the stock trends. In literature a number of models combining technical analysis with computational intelligent techniques are available for prediction of stock price index movements[5−7]; Patra, Thanh, & Meher, 2009).

In this study, the problem of stock trading decision prediction is articulated as a classification problem with three class values representing the buy, hold and sell signals. The foremost objective of this study is to develop a novel decision support system using a computational efficient functional link artificial neural network (CEFLANN) and a set of rules based on technical analysis, to generate the trading decisions more effectively. Instead of training the CEFLANN network using traditional back propagation algorithm, the ELM learning is proposed for the network. Six popular technical indicators calculated from the historical stock index price values are used as the input features for the proposed model. The CEFLANN network is applied to capture the nonlinear relationship exists between the technical indicators and trading signals. Instead of using discrete class values during training of the network, a continuous trading signal within range 0−1 are fed to the network. The new trading signals in the range 0−1 can provide more detailed information regarding stock trading related to the original price variations. Further the outputs from the CEFLANN model is transformed in to a simple trading strategy with buy, hold and sell signals using suitable rules. The model performance is evaluated based on profit percentage obtained during test period. The CEFLANN model is also compared with some other known machine learning techniques like support vector machine (SVM),[5,6,8,9] Naive Bayesian model, K nearest neighbor model (KNN)[2,9] and decision tree (DT)[10] model.

The remainder of the paper is organized in to following sections; Section 2 highlights relevant reviews on different machine learning techniques used in stock trading. Section 3 specifies the details of CEFLANN network followed by the details of ELM Learning in Section 4. Section 5 describes the detailed steps of the decision support system for generating stock trading decision points. Section 6 shows experimental results obtained from the comparative analysis. Finally Section 7 contains the concluding remarks.