Expert Systems with Applications
Volume 36, Issue 3, Part 2, April 2009, Pages 5932-5941

Surveying stock market forecasting techniques – Part II: Soft computing methods

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https://doi.org/10.1016/j.eswa.2008.07.006
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Abstract

The key to successful stock market forecasting is achieving best results with minimum required input data. Given stock market model uncertainty, soft computing techniques are viable candidates to capture stock market nonlinear relations returning significant forecasting results with not necessarily prior knowledge of input data statistical distributions. This paper surveys more than 100 related published articles that focus on neural and neuro-fuzzy techniques derived and applied to forecast stock markets. Classifications are made in terms of input data, forecasting methodology, performance evaluation and performance measures used. Through the surveyed papers, it is shown that soft computing techniques are widely accepted to studying and evaluating stock market behavior.

Introduction

Stock market forecasters focus on developing approaches to successfully forecast/predict index values or stock prices, aiming at high profits using well defined trading strategies. The central idea to successful stock market prediction is achieving best results using minimum required input data and the least complex stock market model.

Undoubtedly, forecasting stock returns is difficult because of market volatility that needs be captured in used and implemented models. Accurate modeling requires, among other factors, consideration of phenomena characterized, for instance, by recession or expansion periods, and high- or low-volatility periods. Observed volatility in stock market returns/prices arises from the fact that desirable (required) rates of return are themselves highly volatile, driven by cyclical and other short-term fluctuations in aggregate demand. Recent advances in soft computing techniques offer useful tools in forecasting noisy environments like stock markets, capturing their nonlinear behavior.

This research focuses on applications of currently available intelligent techniques to forecast stock market indexes and stock prices. A stock market index represents the movement average of many individual stocks; an index reflects mainly market movement rather than movement of a stock. Firm characteristics are not taken into consideration in the forecasting process. To overcome this limitation, researchers have developed models to forecast individual stock prices. As such, soft computing techniques may be and they have been applied to diverse markets to forecast either indexes or stocks, regardless of their daily trading volume.

Therefore, the purpose of this research is to review and classify derived and applied soft computing techniques to stock market problems; in particular, over 100 related scientific articles applied to stock market forecasting have been reviewed. Results are presented in terms of five summary tables. The first table lists the respective stock markets authors have modeled. The second table lists input variables (independent variables) to the stock market model. The third table summarizes specific methodologies and model parameters used in each paper to forecast stock markets. The fourth table demonstrates modeling benchmarks of each author's specific approach, as well as any comparisons/discussions made against other techniques; such techniques include artificial neural networks (ANNs), linear and multi-linear regression (LR, MLR), ARMA and ARIMA models, genetic algorithms (GAs), random walk (RW), buy and hold (B & H) strategy, and/or other models. The last table summarizes performance measures used to evaluate each surveyed model.

The contribution of this research is a cohesive presentation and classification of soft computing techniques applied to different stock markets that may be used for further analysis and evaluation, as well as comparative studies. An obvious benefit of this study is that if one applies the specifically derived models to the same stock market, stock(s) and/or portfolio(s), valuable results will be obtained, which, when analyzed, may offer additional information to market behavior, correlation among factors influencing performance, input data sensitivity, among other things.

Section snippets

Surveyed stock markets and related data sets

The list of stock markets authors have obtained their data for training and testing of their perspective models is shown in Table 1. Surveyed articles focus on forecasting returns of a single stock market index or of multiple stock market indexes. However, several studies concentrate in forecasting returns of a single stock or multiple stocks (Ajith et al., 2003a, Atsalakis and Valavanis, 2006a, Atsalakis and Valavanis, 2006b).

Articles in Table 1 may be classified in three categories. The first …

Input variables

The number of input variables used in each model differs. In general, the average number of input variables is between four and ten; however, there are cases where only two input variables are used (Constantinou et al., 2006, Ettes, 2000). On the contrary, Olson and Mossman, 2003, Zorin and Borisov, 2002 use 59 and 61input variables, respectively.

Specific techniques are also utilized to choose the most important input variables for the forecasting process among a large number of candidate ones, …

Forecasting methodology

Each surveyed paper is classified with respect to data preprocessing, sample size, type of implemented technique and its characteristics (number of ANN layers or fuzzy set membership functions), validation data sets and training method.

Input data preprocessing and proper sampling may impact forecasting performance. Choice of indicators as inputs through sensitivity analysis may help eliminate redundant inputs. In many cases input data has a large range of values reducing effectiveness of…

Performance measures

Table 5 presents the list of performance measures used to evaluate each author's approach. Utilized performance measures may be classified as statistical measures and as non-statistical measures.

Statistical measures include the root mean square error (RMSE), the mean absolute error (MAE) and the mean squared prediction error (MSPE), statistical indicators like the autocorrelation, the correlation coefficient, the mean absolute deviation, the squared correlation and the standard deviation. …

Conclusions

This study has surveyed articles that have applied neural networks and neuro-fuzzy models to predict stock market values. The study has focused on input data, forecasting methodology, model comparisons and measures used for performance evaluation.

The observation is that neural networks and neuro-fuzzy models are suitable for stock market forecasting. Experiments demonstrate that soft computing techniques outperform conventional models in most cases. They return better results as trading systems …

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European Journal of Operational Research (2000)

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Using percentage accuracy to measure neural network predictions in stock market movements

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Q. Cao *et al.*

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Computers and Operations Research (2005)

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