New efficient hybrid candlestick technical analysis model for stock market timing on the basis of the Support Vector Machine and Heuristic Algorithms of Imperialist Competition and Genetic

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ABSTRACT

In this paper, two hybrid models are used for timing of the stock markets on the basis of the technical analysis of Japanese Candlestick by Support Vector Machine (SVM) and Heuristic Algorithms of Imperialist Competition and Genetic. In the first model, SVM and Imperialist Competition Algorithm (ICA) are developed for stock market timing in which ICA is used to optimize the SVM parameters. In the second model, SVM is used with Genetic Algorithm (GA) where GA is used for feature selection in addition to SVM parameters optimization. Here the two approaches, Raw-based and Signal-based are devised on the basis of the literature to generate the input data of the model. For a comparison, the Hit Rate is considered as the percentage of correct predictions for periods of 1–6 day. The results show that SVM-ICA performance is better than SVM-GA and most importantly the feed-forward static neural network of the literature as the standard one.

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1. Introduction

Predicting the behavior of the stock market prices is an issue that all the financial scientists and investments are always interested. The main reason of investing in the stock market is to gain profit, which needs the right information from the stock market, stock changes and trend forecasting. That is why investment needs powerful and reliable tools to predict stock prices.

Researches show that so many factors are affecting the stock market's performance, so fluctuations in the stock market are non-linear (Jasemi, Kimiagari, & Memariani, 2011a). That's why the stock market is a non-linear dynamic system and predicting the stock prices path is a difficult task. However, a suitable non-linear modeling approach such as artificial intelligence systems can discover the complex non-linear relations and handle the prevailing uncertainty and inaccuracy in the stock market.

With recent advances in artificial intelligence, new methods for predicting have been provided which are more accurate than the traditional methods. However, each of these methods has its own advantages and disadvantages. The most common method among all is the neural network. Considering the technical analysis of Japanese Candlestick as the investment technique applied for stock market timing, Jasemi, Kimiagari, and Memariani (2011b) applies a supervised feed-forward neural network; Barak, Heidary, and Dahooie (2015) uses a Wrapper ANFIS-ICA as a fuzzy neural network; and Ahmadi, Abooie, Jasemi, and Zare Mehrjardi (2016) applies a NARX as a non-dynamic neural network as an analyst.

Recently Support Vector Machine (SVM), which is a supervised learning methods, has gained popularity. This method uses its ability to learn any changes in the rules lying in the time series and uses it to predict the future. Setting-up the parameters of SVM has a major role in the accuracy of backup vectors. Studies use meta-heuristic algorithms to find the proper number of variables. According to the current lack of literature in the field, in this study, SVM along with two meta-heuristic algorithms, are used to predict the movement of the stock prices. The two meta-heuristic algorithms are Genetic Algorithm (GA) and the Imperialist Competition Algorithm (ICA) that are used to optimize the parameters of the
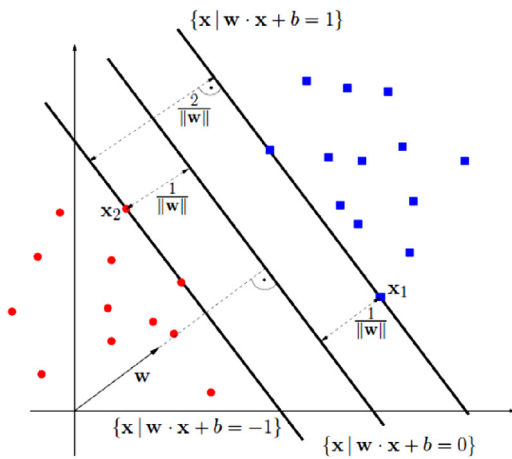

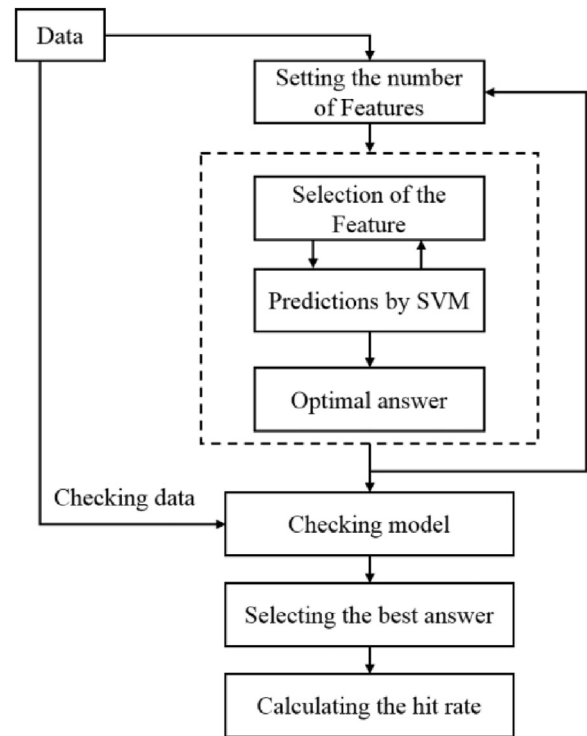**Fig. 1.** Support Vector Machine classifier.

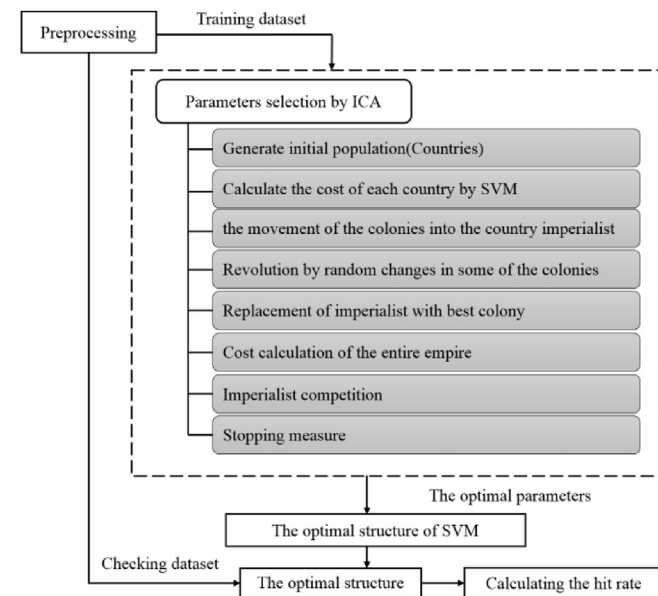**Fig. 2.** Structure of the SVM-ICA model.

Fig. 3. Structure of the SVM-GA model.

model and features. The aim of this study is evaluating the SVM using the mentioned algorithms, which influence the combination of input variables on the overall result, and specifying the accuracy of its predictions.

The article is structured as follows: Section 2 covers the literature review. In Section 3 the background in which the new insights that are brought with the proposed methods to overcome the limitations of previous studies, are discussed and knowing the basics explained in this section is necessary to understand the nature of work deeply. Section 4 presents the applied methodology along with the base conceptual model to come to the two main new models of the study. Section 5 runs the models with real data and discusses them in details and a variety of aspects. Section 6 presents the final discussions of the study.

2. Literature review

Predicting the stock market and determining trends are very interesting to the finance and stock market's researchers and anyone who wants to choose the correct stock and/or the right time to buy or sell the stocks (Sahin & Ozbayoglu, 2014).

However, the accurate prediction is very challenging due to the noisy nature and non-static stock prices. Many macro-economic factors such as political events, company's policy, General economic conditions, product price indexes, interest rates and stocks, expectation of investors and psychological factors, affect the stock prices (Majhi, Rout, & Baghel, 2014). Also, government policy and legislative measures have a significant impact on the movement of the stock market overall.

Traders use different methods for decision making in stock market which can be divided into two groups of technical analysis and fundamental analysis (Sankar, Vidyaraj, & Kumar, 2015). Fundamental analysis studies economy and industry conditions, financial conditions, company management and other qualitative and quantitative factors for secure investigation and Technical analysis uses previous prices to predict the future prices of the stock (Anbalagan & Maheswari, 2015). Jasemi et al. (2011a), the base paper of this study, offered a new model for stock market timing based on a neural network monitoring and technical analysis of Japanese candlesticks. In this research, analysis of the Japanese charts and their patterns are used as technical information. Many studies have analyzed the use and advantages of candlestick in predicting the stock market (Lan, Zhang, & Xiong, 2011; Lee & Jo, 1999; Xie, Zhao, & Wang, 2012).

According to a nonlinear system of stock market, Soft Computing methods are widely used for stock market issues (Barak, Arjmand, & Ortobelli, 2017). They are useful tools for predicting such turbulent areas which suggest finding their nonlinear behavior. The use of intelligent systems like neural networks, fuzzy systems and GA or hybrid models to predict the financial implications are vast. Recently, artificial neural network and SVM have been used to solve problems of forecasting financial time series prediction of stock market funds (Anbalagan & Maheswari, 2015). There are many studies that combine the evolutionary techniques with classification mechanisms (Dahal, Almejalli, Hossain, & Chen, 2015; de Campos, de Oliveira, & Roisenberg, 2016; Kuo, Lin, & Liao, 2011). However, even after developing many efficient models, Artificial