A NOVEL FUZZY TIME-SERIES BASED FORECASTING OF STOCK PRICE

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Abstract: Forecasting has an important utility with respect to stock prices. It is the case with all listed companies that facilitates buyers to stocks to take probably well informed decisions. The predication of stock prices is an important research area which has many benefits. There were many techniques in the literature to solve the problem of prediction. Fuzzy time series is one of them that are utilized frequently for making accurate predictions of stock prices. In this paper we improve the prediction performance of fuzzy time-series models a proposing a novel approach which provides better performance. The algorithm we implemented is known as fast Fourier transform algorithm. We built a prototype application to demonstrate the efficiency of our algorithm. The empirical results revealed that our approach is useful in real world applications where forecasting stock prices is essential in order to make investment decisions.

Index Terms – Forecasting, fuzzy time series, fast Fourier transform

I. INTRODUCTION

Stock markets are pertaining to business and there are monetary transactions that go on every day. It is very challenging to take such investment decisions as they have impact on the person's financial freedom or company's financial aspect. Therefore predicting stock price has very important utility in the real world. In other words, forecasting has its role to play in the stock market business. The stock markets of all countries need some sort of prediction for buyers. Moreover investing in stock markets is an exciting challenging and monetary activity that has influence on the economy of individuals and countries. For forecasting stock prices initially traditional statistical methods were used [1], [2], and [3]. Multiple regression models [4], [5] were also used by researchers for forecasting stock prices. These techniques can predict merits and demerits of the stock prices. However, these methods need historical data and with normal distribution of data for accurate prediction. The traditional forecasting methods have drawbacks. They fail in accurate forecasting when the data is very little or linguistic in nature. The conventional time-series forecasting methods also fail as they can't deal with historical data consisting of linguistic values. In order to deal with the problems like this, an alternative forecasting method known as fuzzy time-series is used. They are efficient as they can also work with linguistic values with highest accuracy. Though it works fine, many other models came into existence. They are explored in enrollment applications [6], [7], [8], stock index [9], [10], [11], tourism demand [12], road accidents [13], and temperature [14]. Many researchers provided their fuzzy time series models that can effectively deal with stock market forecasting. For forecasting algorithms, in [8] some arithmetic operators in forecasting solutions instead of using very complex operations [6]. Drawback of the model described above is that it lacks proper weight with respect to fuzzy logic relationships. Some researchers utilized a feature known as length of linguistic intervals [10], [7].These models are good for forecasting. However, theory was linguistic in nature as Millers [15] said. The recent models include hybrid models [16], first order models [17], high order models [18], [17], genetic algorithms [19], bivariate models [9], adaptive expectation models [20], and neural network models [21]. Out of them the first order models are highly useful and suitable for analyzing stock markets. In this paper a model which is based on equal frequency partition is used to improve accuracy in forecasting. The algorithm such as fuzzy time series is used for forecasting stock prices. A new model is implemented in this paper which is known as "Fourier transform model" which can efficiently explore the stock price analysis. The remainder of the paper is structured as follows. Section II provides review of literature. Section III describes the proposed algorithm. Section IV presents experimental results while section V concludes the paper.

II. PROPOSED APPROACH

The proposed methodology is meant for best forecast of stock prices considering various parameters. The stock price forecast has very important real time utilities. The enterprises and shareholders are influenced by the future stock prices. Predicting such stock prices can help them to perform better. The following is the architecture proposed by us to predict stock prices and optimize the results further using Fast Fourier Transform (FFT).

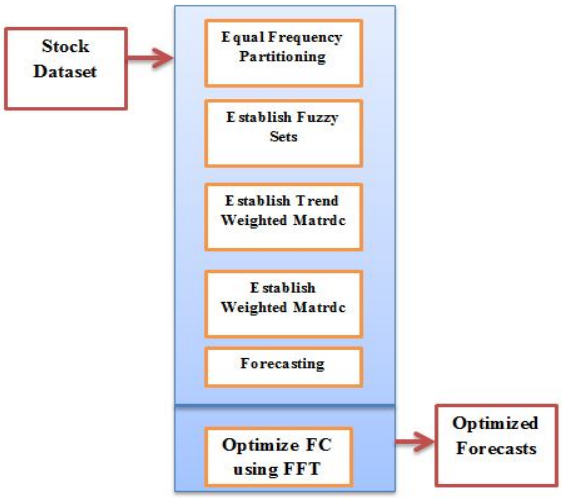

Fig. 1 – Overview of the proposed methodology

As per the methodology, the framework takes stock dataset as input and performs various operations. First of all universe of disclosure is performed. Universe of disclosure is performed as follows.

$$U = [D_{min} - D_1, D_{max} + D_2]$$

Where Dmin and Dmax are the minimum and maximum stock prices respectively. Two propose positive numbers are represented by D1, D2. Afterwards, linguistic intervals with equal frequency partitioning are carried out. The length of linguistic intervals is explored in [19], [8], [22], and [10]. These models have problems with respect to reliable length. To overcome this problem, in this paper we use equal frequency partitioning technique. According to this technique, the linguistic intervals are created in such a way that each linguistic interval frequency is set to constant. When U has range between 4139 and 6109, the result of equal frequency partitioning is as given below.

$$u_1 = [4139, 4378],\ u_2 = [4378, 4550],\ u_3 = [4550, 4832],\ u_4 = [4832, 5078],\ u_5 = [5078, 5413],\ u_6 = [5413, 5691],\ u_7 = [5691, 6108]$$

Then establishing related fuzzy sets is carried out as follows.

$$A_k = \{ \mu_{Ai}(u_j) / u_j \mid \mu_{Ai}(u_j) \in [0,1], u_j \in R, 1 \le i \le k, 1 \le j \le m \}$$

Afterwards the weighted matrix is built as follows.

$$w_i(t) = [\frac{w_1}{\sum_{j=1}^{m} w_j}, \frac{w_2}{\sum_{j=1}^{m} w_j}, \ldots, \frac{w_m}{\sum_{j=1}^{m} w_j}]$$

Finally for forecasting stock prices and defuzzification are carried out as follows.

$$F(t) = M_{df}(t\text{-}1) \circ w_i(t\text{-}1)$$

Afterwards, the forecasts are modified by using fast Fourier Transform. After obtaining forecasts, the results are to be optimized for better performance. This will improve forecasting accuracy.

III. PROTOTYPE DETAILS

We built a prototype application with graphical user interface. The application is built in Java platform. The environment used for the development of application is a PC with 4GB RAM, core 2 dual processor running Windows XP operating system. The prototype has graphical user interface built in Swing API in Java. The main user interface of the application is as follows.

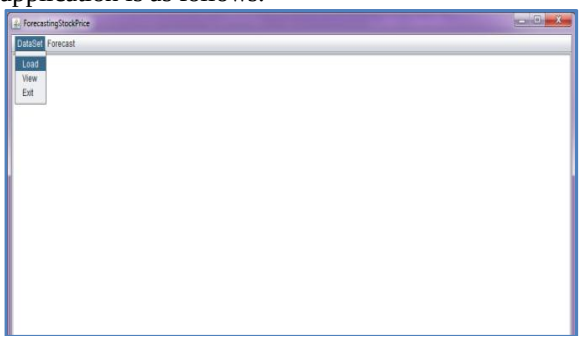

Fig. 2 – Main UI of the prototype

As can be seen in figure 2, the UI has provision for loading dataset and also applying our forecasting methodology in order to obtain accurate forecasts. When data is loaded the data is shown to end user for observation. The dataset is as shown in figure 3.

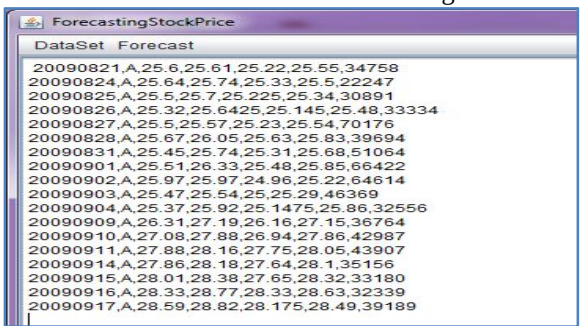

Fig. 3 – Stock dataset used

As seen in figure 3, the dataset is loaded into a window. The dataset is collected from Internet sources. The methodology we built is general which works for any given data set with compatible columns. When forecast operation is carried out as per the proposed methodology, the results appear as follows.

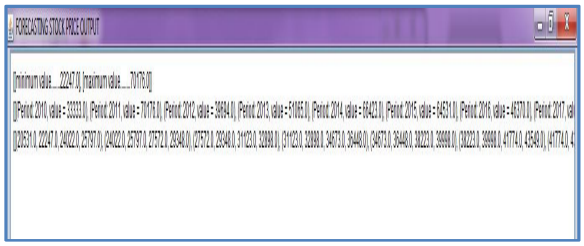

Fig. 4 – Forecasting results

Based on the previous history, the stock prices are analyzed and forecasted as per the methodology

described in this paper. The empirical results revealed that the results are reasonably accurate when compared and analyzed manually for evaluation.

IV. EXPERIMENTAL RESULTS

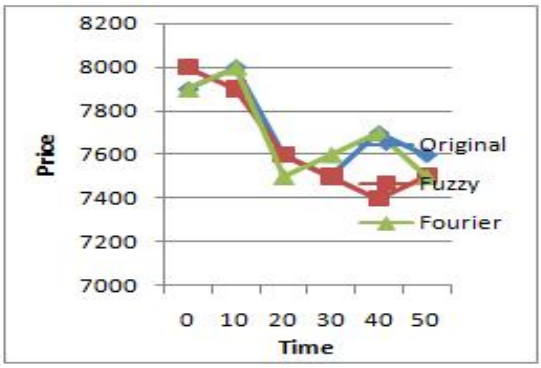

Figure 5. The stock price fluctuation for testing dataset in 1997

As shown in the above figure represents the horizontal axis represents time while vertical axis represents Price.

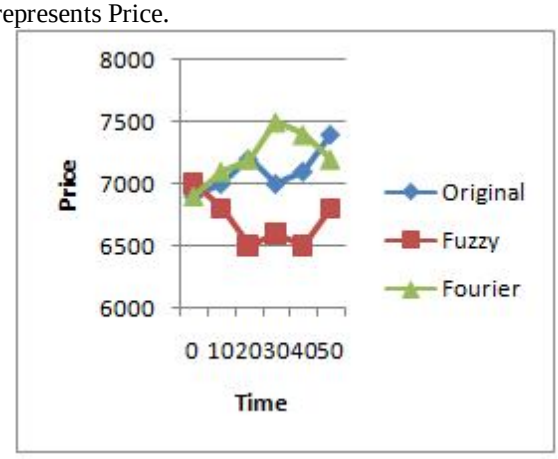

Figure 6. The stock price fluctuation for testing dataset in 1998

As shown in the above figure represents the horizontal axis represents time while vertical axis represents Price.

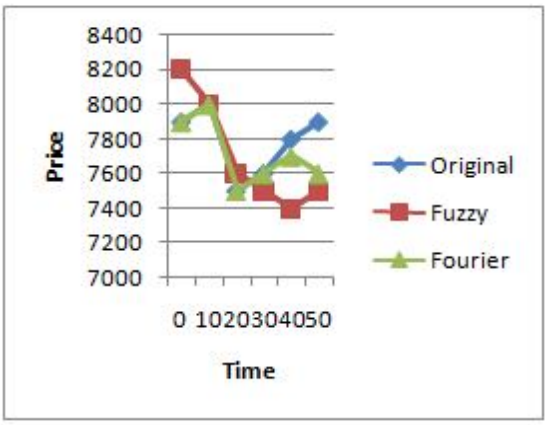

Figure 7. The stock price fluctuation for testing dataset in 2000

As shown in the above figure represents the horizontal axis represents time while vertical axis represents Price.

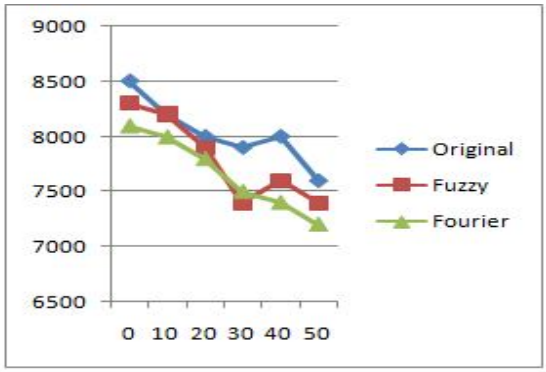

Figure 8. The stock price fluctuation for testing dataset in 2002

As shown in the above figure represents the horizontal axis represents time while vertical axis represents Price.

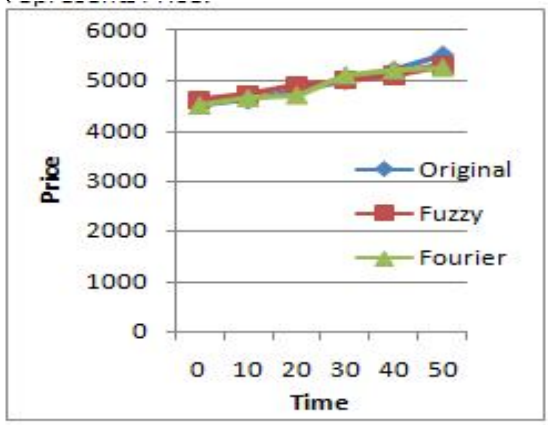

Figure 9. The stock price fluctuation for testing dataset in 2003

As shown in the above figure represents the horizontal axis represents time while vertical axis represents Price.

CONCLUSIONS

In this paper we studied the problem of forecasting stock prices. As this has very important utility in real world, we implemented a novel algorithm to improve the prediction performance of the forecasting application. The concept implemented by the algorithm is equal frequency partitioning. The name of algorithm is fast Fourier transform algorithm which makes use of fuzzy time series in order to improve the accurate prediction of stock prices. We built a prototype application using Java platform which demonstrates the proof of concept. The empirical results revealed that the application is very useful in the real world scenarios.

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