Neuro Fuzzy based Techniques for Predicting Stock Trends

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Abstract

In this paper we discuss about Prediction of stock market returns. Artificial neural networks (ANNs) have been popularly applied to finance problems such as stock exchange index prediction, bankruptcy prediction and corporate bond classification. An ANN model essentially mimics the learning capability of the human brain. A Fuzzy system can uniformly approximate any real continuous function on a compact domain to any degree of accuracy. Here Neuro Fuzzy approaches for predicting financial time series are investigated and shown to perform well in the context of various trading strategies involving stocks. The horizon of prediction is typically a few days and trading strategies are examined using historical data. Methodologies are presented wherein neural predictors are used to anticipate the general behavior of financial indexes in the context of stocks and options trading. The methodologies are tested with actual financial data and shown considerable promise as a decision making and planning tool. In this paper methods are designed to predict 10-15 days of stock returns in advance.

Keywords- *Stock, ANFIS, Finance, Trading*

1. Introduction

Stock market prediction is the act of trying to determine the future value of a company stock or other financial instrument traded on a financial exchange. The successful prediction of a stock's future price could yield significant profit. Some believe that stock price movements are governed by the random walk hypothesis and thus are unpredictable. Others disagree and those with this viewpoint possess a myriad of methods and technologies which purportedly allow them to gain future price information[2]. The capital stock (or simply stock) of a business entity represents the original capital paid into or invested in the business by its founders. It serves as a security for the creditors of a business since it cannot be withdrawn to the detriment of the creditors. Stock is different from the property and the assets of a business which may fluctuate in quantity and value.

The stock of a business is divided into multiple shares, the total of which must be stated at the time of business formation. Given the total amount of money invested in the business, a share has a certain declared face value, commonly known as the par value of a share.

A stock derivative is any financial instrument which has a value that is dependent on the price of the underlying stock. Futures and options are the main types of derivatives on stocks. The underlying security may be a stock index or an individual firm's stock, e.g. single-stock futures[1][3][10].

Stock futures are contracts where the buyer is long, i.e., takes on the obligation to buy on the contract maturity date, and the seller is short, i.e., takes on the obligation to sell. Stock index futures are generally not delivered in the usual manner, but by cash settlement.

A stock option is a class of option. Specifically, a call option is the right (not obligation) to buy stock in the future at a fixed price and a put option is the right (not obligation) to sell stock in the future at a fixed price. Thus, the value of a stock option changes in reaction to the underlying stock of which it is a derivative[3].

1.1 Neuro Fuzzy based System

The Neuro Fuzzy based System approach learns the rules and membership functions from data. Neuro Fuzzy is an adaptive network. An adaptive network is network of nodes and directional links. Associated with the network is a learning rule - for example back propagation. It's called adaptive because some, or all, of the nodes have parameters which affect the output of the node. These

networks are learning a relationship between inputs and outputs.

The Neuro Fuzzy architecture is shown below. The circular nodes represent nodes that are fixed whereas the square nodes are nodes that have parameters to be learnt.

One of the Neuro Fuzzy advantages is that it uses a hybrid learning procedure for estimation of the premise and consequent parameters Jang (1992). In this process by keeping fixed the premise parameters, it estimates

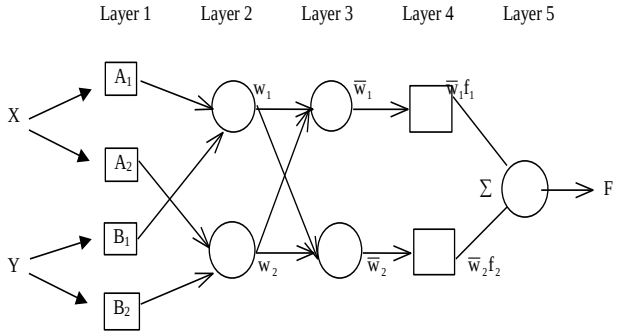

Fig 1. Neuro Fuzzy architecture

them in a forward pass and then in a backward pass by keeping fixed the consequent parameters the process would be continued. In the first path, the input would be forward and propagated and then by applying the least squared method the error would be calculated where is the third layer[8]. Also, in the second path, the error which happens during the first step would be backward to and the premise parameters are updated by a gradient descent method[12]. A basic Neuro Fuzzy architecture is shown in Fig 1.

Using a fuzzy inference system in the framework of an adaptive neural network, it provide a tool which make the grade estimation more accurate because by using both neural network and fuzzy logic, it would be possible to estimate the fuzzy inference system parameters. This method could be applied extensively to solve the mining problems in which most of them are in some specify fuzzy conditions[12]. The performance of the model with respect to the predictions made on the test data set would able the network to perform more accurate that both the other methods. Neural network trained input data is shown in Fig 4.

1.2 Fuzzy systems

Common sense, human thinking and judgment are the lures of fuzzy logic. What after all does fuzzy logic bring to the party is a question that has been hotly debated upon during the past several years, and probably will continue to remain controversial in the near future.

The primary reason for this is that the ultimate universal proof of why a fuzzy logic solution is ‘better’ than a conventional one, for whatever reason, does not exist. First of all, this is because fuzzy logic does not replace conventional control techniques. Instead, it renders possible new solutions that were not feasible to implement earlier. Hence a direct comparison between a fuzzy logic solution and a conventional one rarely exists. Even when a conventional solution for comparison exists, the advantages of the fuzzy logic solution depend very much on the type of the application. Thus it is impossible to quantify the ‘benefits in general’ of using fuzzy logic.

Many fuzzy logic applications have benefited from either exploiting information from additional sensors, better exploited information from existing sensors, or simply the ease of integrating engineering experience. Therefore, in a sense, some benefits of successful fuzzy logic applications have not stemmed from the use of fuzzy logic. However, almost invariably, fuzzy logic applications could not have been solved, as well as they have been, without using fuzzy logic. Combining conventional techniques and artificial neural networks with fuzzy logic, more powerful solutions may be offered.

2. Data Description

The stock market closing data was taken from BSE Sensex through Yahoo Finance from 17th September 2007 to 9th March 2012. A period of 3 years and 6 months data, the closing prices data set was comprised of day closing prices we extracted 2542 records. The closing price data behavior is plotted in fig.1. BSE Limited is the oldest stock exchange in Asia it is now popularly known as the BSE was established as "The Native Share & Stock Brokers' Association" in 1875. Over the past 135 years, BSE has facilitated the growth of the Indian corporate sector by providing it with an efficient capital raising platform. Today, BSE is the world's number 1 exchange in the world in terms of the number of listed companies (over 4900). It is the world's 5th most active in terms of number of transactions handled through its electronic trading system. And it is in the top ten of global exchanges in terms of the market capitalization of its listed companies. BSE is the first exchange in India and the second in the world to obtain an ISO 9001:2000 certification. It is also the first Exchange in the country and second in the world to receive Information Security Management System Standard BS 7799-2-2002 certification for its BSE On-Line trading System (BOLT). Presently, we are ISO 27001:2005 certified, which is a ISO version of BS 7799 for Information Security.

3. Data Processing

In neural network learning, stock data with different scales often lead to the instability of neural networks. Neural network algorithms generally use a numeric method to normalized input and output data, with all input and output values ranging from zero to one. Furthermore, financial time series is a non-linear series and often changes sharply in some points. We can recognize these points as noise, and noise point is harmful to neural network's learning. Therefore we smooth these noise points to generate better outcome. Here we apply an stock data preprocessing method which can handle the task of normalization and smoothing in one process. The input data is plotted in Fig 2.

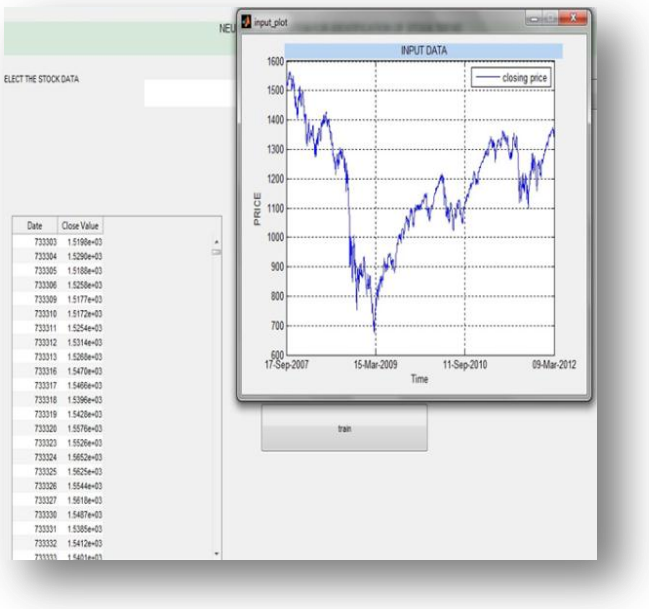

Fig 2. Input stock data plot

4. System Design

The prediction model consists of two parts. One is training part, in which stock data is trained using Neural Network technique and with trained data set the stock is predicted using Fuzzy system. The combination of Neural network and Fuzzy system combined and called ANFIS technique. The design of system is represented using the block diagram. From the Stock market data base the user can plot the stock values, later train them and applying Fuzzy methods for forecasts. The system design for prediction of stock is given in Fig 3.

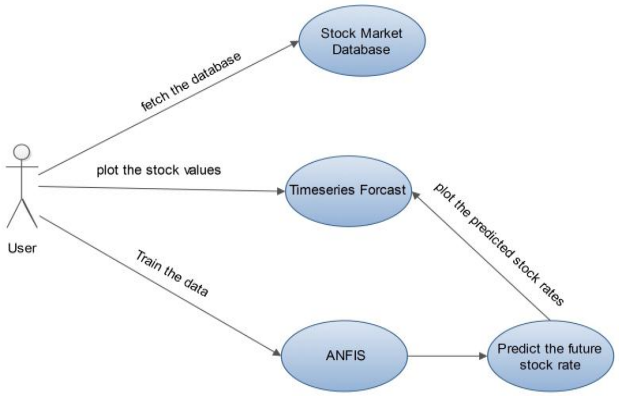

Fig 3. System Design for prediction of Stock

5. Methodology

Data acquisition is the first step, the stock market closing data is extracted from the BSE stock market, then data is preprocessed by normalizing it is done to prepare the data for training, the training is carried out by applying Adaptive Neural Network based techniques, that we can call it has trained data. The plot of trained data is shown. The flow diagram of the proposed method is shown in Fig 4. Finally by using the trained data prediction of future data is done by Fuzzy technique.

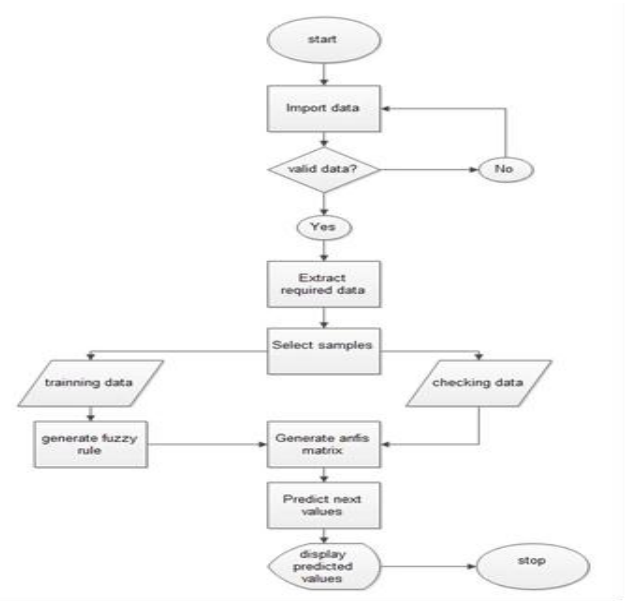

Fig 4. Flow chart of Stock Prediction system.

5.1 Algorithm of Predictive Model

Step 1: Import the stock data.

[~,~,raw,dateNums]= xlsread(filename,'table','','',@convertSpreadsheetDates);

Step 2: Extract the stock data into a variable.

Table_values = cell2mat(raw);

Step 3: Select the samples for training and for checking data

trn_data(:, n) = x_t(i:j);

chk_data(:, m) = x_t(a:b);

Step 4: Generate the fuzzy rule using the training data.

Fismat = genfis1(trn_data);

Step 5: Generate the anfis matrix using fuzzy rule.

[trn_fismat,trn_error] = anfis(trn_data, fismat,[],[],chk_data);

Step 6: Predict the next possible share values using anfis rule.

Anfis_output = evalfis(input, trn_fismat);

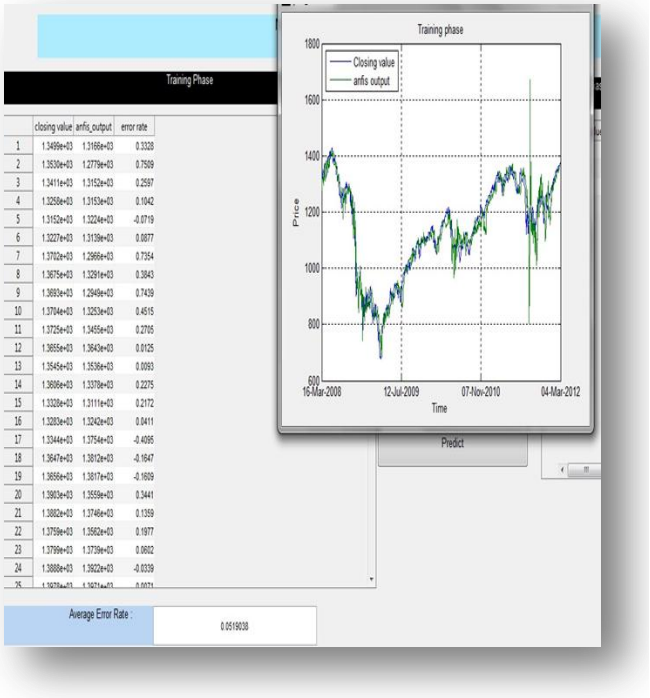

Fig 5. Neural Network Trained input data

6. Results & Discussions

The stock market closing price data which is collected from 17th September 2007 to 12 march 2012. The results obtained after applying our methods, we can predict next 10-15 days data in advance from the previous available data base. The number days of predicting results is depend on the algorithm by just altering and increasing the number of 'for loops' in the algorithm we can increase the prediction of data(days).the training of input data is shown in Fig 5. The results of 10-15 days prediction is shown in Fig 6. & Fig 7.

The results comparison can be done with statistical techniques like moving average, regression and by simple analysis stock market trends.

7. Conclusion

Prediction of stock market returns is an important issue in finance. Artificial neural networks have been used in stock market prediction during the last decade. Studies were performed for the prediction of stock index values as well as daily direction of change in the index. In some applications it has been specified that artificial neural networks have limitations for learning the data patterns or that they may perform inconsistently and unpredictable because of the complex financial data used.

Taking the low level of errors in the long and short – term modelling into account, it could be concluded that the "ANFIS" is capable of forecasting stock price behaviour.

The most significant outcome is that the stock price behaviour is non-linear model and forecasting stockerror estimation of the stock price. price with non-linear methods could decrease the stock price.

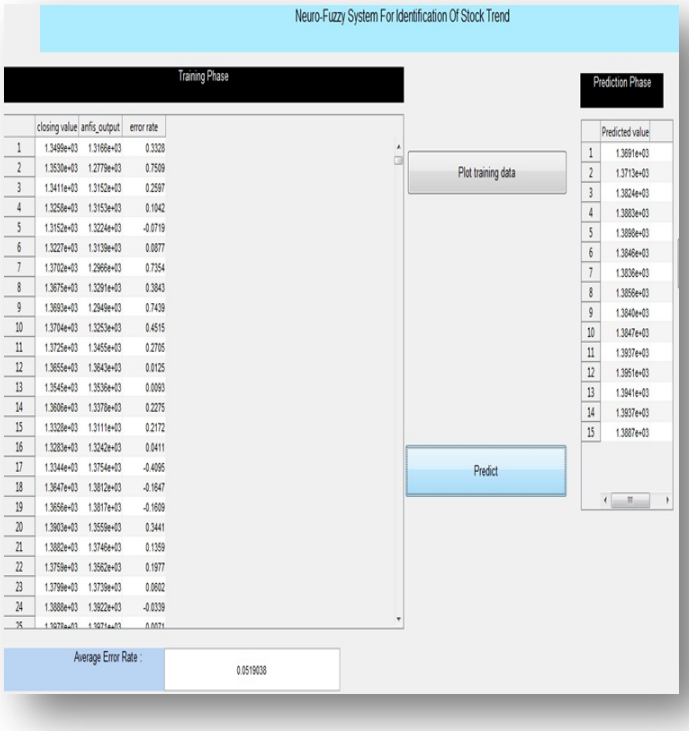

Fig 6. Neuro Fuzzy system for predicting stock trend

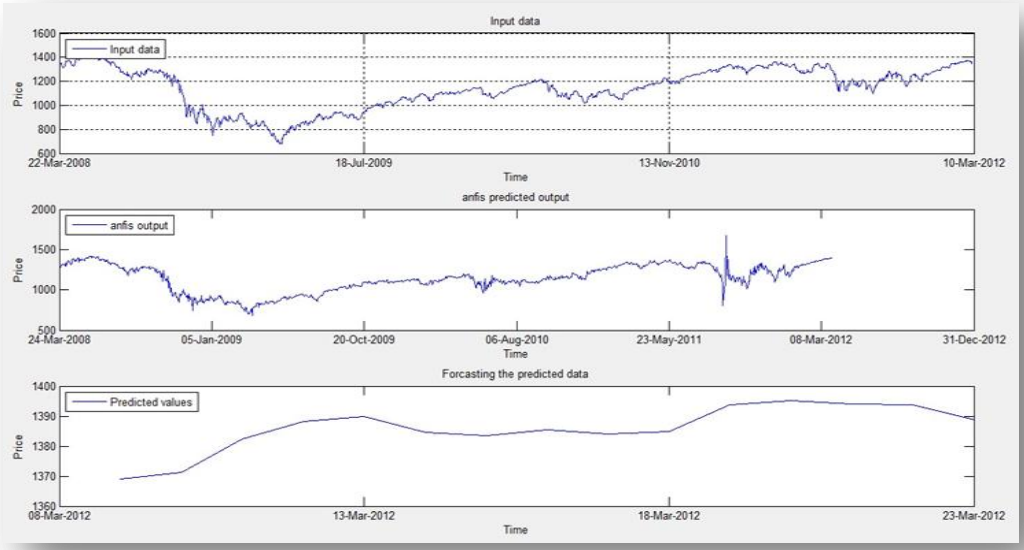

Fig 7. Predicted output for 10 days in advance

References

[1] ALBERT, P. [1978], "The algebra of fuzzy logic." Fuzzy Sets Syst. 1:203-230. ARCHER, N. P., AND S. WANG [1991]. "Fuzzy set representation of neural network classification boundaries." IEEE Trans. Syst. Man Cybern. 21(4):735-742.

[2] Jang, J.-S. R., "ANFIS: Adaptive-Network-based Fuzzy Inference Systems," IEEE Transactions on Systems, Man, and Cybernetics, Vol. 23, No. 3, pp. 665-685, May 1993

[3] M. Chen, G. Wang, G. Wu and X. Jiang, "The ACD-GARCH Modeland its Application in China Stock Market," Statistical Research, vol. 20, no. 11, pp. 60–62, 2003.

[4] G. Xu and D. Jin, "A Test on Nonparametric Specification with Extensive ACD Model Based on the High Frequency Data of Financial Market," Statistical Research, vol. 24, no. 4, pp. 15–18, 2007.

[5] Emerson E.A., "Temporal and Modal Logic" in J.V. Leeuwen (ed.), Handbook of Theoretical Computer Science - volume B, Elsevier Science, 1992.

[6] Faloutos C., Ranganathan M., Manolopoulous Y., "Fast Subsequence Matching in Time Series Database", Proc. 1994 ACM SIGMOD, 1994

[7] Fu K.S. Syntactic Pattern Recognition and Applications, Prentice-Hall, 1982.

[8] Inmon W.H. and Osterfelt S., Understanding Data Pattern Processing, QED Technical Publishing Group, 1991.

[9] Kacprzyk J. and Zadrozny S., "Fuzzy Queries in Microsoft Access V.2", in Fuzzy Information Engg., D. Dubois, H. Prade, R.R. Yager (eds), John Wiley, 1997, pp. 223-232.

[10] Kartalopoulos S.V., Understanding Neural Networks and Fuzzy Logic, Prentice-Hall, 2000.

[11]Kennedy R.L., Lee Y., Roy B.V., Reed C.P., Lippman R.P., Solving Data Mining Problems Through Pattern Recognition, Prentice-Hall PTR, 1998.

[12] J. Wang, Multivariate Statistical Analysis, Science publishing Company, 2008.

[13] J. Sun, J. Liu and L. Zhao, "Clustering Algorithms Research,". Journal of Software, vol. 19, no. 1, pp. 48–61, 2008.

[14] S. Li and S. Zhang, "Comparative Study of Two Volatility Estimation Methods of High Frequency Financial Data," Journal of Systems & Management, vol. 16, no. 4, pp. 723–729, 2007.

[15] Jang, J.-S. R., "Fuzzy Modeling Using Generalized Neural Networks and Kalman Filter Algorithm," Proc. of the Ninth National Conf. on Artificial Intelligence (AAAI-91), pp. 762-767, 1991

[16] P. Tan, M. Steinbach and V. Kumar, Introduction to Data Mining, The People's Posts and Telecommunications Press, 2006.

Biography

Hemanth Kumar P. currently pursuing Ph.D. in the stream of Computer Science Engineering from Visvesvaraya Technological University Resource Research Centre, Belgaum, Karnataka had received his Master's degree in branch Digital Communication from National Institute of Technology (MANIT) Bhopal, Madhya Pradesh, India in the year 2010 and Bachelor's Degree from Global Academy of Technology, Bangalore in 2008. Currently working as Assistant Professor in AMC Engineering College, Bangalore in Department of Electronics & Communication Engineering. My area of interest include Neural Network, Data Mining, Image Processing, Communication etc. He has have two years of Teaching Experience and guided four M.Tech projects successfully.

Prashanth K. B. is currently working as Project Lead at HCL Technologies in Aerospace domain as Lead Engineer at HCL Technologies and Member Technical Staff at HCL Technologies, Bangalore India. He has 8 years of Industrial experience. He is currently Pursuing his M.Sc in Computer Science and Engineering in Visvesvaraya Technological University Resource Research Centre, Belgaum, India and has obtained his Bachelor's from UBDT College of Engineering, Davangere in 2004. His subject of interest include Neural Network, Data Mining, Patteren Recognition, Fuzzy system and Hybrid models etc.

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Dr. S.BASAVARAJ PATIL is Professor & Head, CSE Deptt., BTL Institute of Technology and he is also Principal Consultant & Founder, Predictive Research. Started career as Faculty Member in Vijayanagar Engineering College, Bellary (1995-1997). Then carried out Ph.D. Research work on Neural Network based Techniques for Pattern Recognition in the area Computer Science & Engineering. Along with that took initiatives to bring several central government projects (AICTE sponsored) and executed successfully. Also consulted many software companies (Aris Global, Manthan Systems, etc.,) in the area of data mining and pattern recognition. Later joined Industry(2003-2004) and worked in diversified domains in the Pharma, Retail and Finance in the predictive analytics space in different capacities such as Technical Architect, Technology Consultant, Manager and Assistant Vice President (2004-2010). The last one was Assistant Vice President, Equity Quantitative Research with HSBC for around five years. He was responsible for building the revenue generating global quantitative research team at HSBC, Bangalore, that spread across different geographical locations such as London, Hongkong and Bangalore from scratch. For smaller stints he also worked at Canary wharf, HSBC Headquarters, London. His areas of research interests are Neural Networks and Genetic Algorithms. He founded Predictive Research in 2011. Now the Company has domestic and international client base and staff strength of 12 people. He is presently mentoring two PhD and one MSc (Engg by Research) Students. He has published around 12 International, 8 National (in referred journals and conferences) and 14 Commercial Research Papers (with HSBC Global Research). His total experience is 19 years in Teaching and Research (10 years in Teaching and 9 years in Industry).