

TREND IDENTIFICATION AND FORECASTING OF S&P CNX NIFTY 50 INDEX VALUES THROUGH FUZZY LOGIC

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Abstract: Fuzzy membership functions are the key elements while creating any fuzzy system [1], [2]. For generating these membership functions usually two sources are used, i.e. expert knowledge and real time data. Expert knowledge may not be available all the time, but the probability of getting real time data is more. Trend identification is a visual process where we can draw and see the trend line, then suggest the trend. But to make the system understand this trend is very tough. Using fuzzy logic first we try to make the system understand the actual trend and verify with what we can see and then we go on for forecasting the future trend. Here we have tried to develop a method by which fuzzification of real time data can be done and then identification of the trend can be done using those fuzzy values after which forecasting of the short term trend can be done [7], [8], [9]. The type of real time data used here is the daily values of S&P CNX NIFTY 50 index used in National Stock Exchange of India for stock futures trading.

Keywords: Fuzzy logic, forecasting, moving averages, correlation, least square criterion, S&P CNX NIFTY 50.

1. INTRODUCTION

There are usually three types of trends found in the stock market. The Bullish trend indicates that next few sessions might show an up trend and values may move up. The Bearish trend indicates that next few sessions might show down trend and values may move down. The Neutral trend indicates that next few sessions might show values that would be in a range bounded around few points above and below the mid distance between highest and lowest values. This information is very useful to the short term traders who purchase and sell with in a time span of one week or so. For our experiments we use S&P CNX NIFTY 50 index used in National Stock Exchange of India for stock futures trading. The real time data is collected from the websites of National Stock Exchange of India (<http://www.nseindia.com>), Bombay Stock Exchange (<http://www.bseindia.com>) and Yahoo finance India (<http://in.finance.yahoo.com>).

We in our proposed model try to use the most recent 5-day real time data and fuzzify them using a modified S-function, using which we can first identify the trend represented the 5-day data, secondly we use correlation, simple linear regression and least square criterion to predict the future trend which we can expect in the 6th day. Here we use a modified fuzzy value manipulation method, which may some time result values which are below zero and some times positive values, but not greater than 1.

This paper is organized as follows: Identification of present trend using fuzzification of the values is explained in section. II, prediction of the immediate future using correlation, simple linear regression and least square criterion is explained in section. III, the practical implementation of the proposed models are shown using examples in section. IV and section V.

2. IDENTIFICATION OF PRESENT TREND

Trend identification is a visual process where we can draw and see the trend line, then suggest the trend. But to make the system understand this trend is very tough. Using fuzzy logic first we try to make the system understand the actual trend and verify with what we can see, then we go on for forecasting.

Here we collect the previous 5-day real time data and convert each value to its equivalent fuzzy membership value. Here the universe of discourse will be the range of values that lie between the lowest and highest values in those 5-days. After fuzzification the 2-day moving averages are found and this process is repeated till two values are left and finally the difference of those values are found.

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2.1. Fuzzy Sets

A fuzzy set A $[x]$ over a universe of discourse X is a set of pairs:

$$A = \{(x, \mu A(x))\} \text{ such that } x \in X, \mu A(x) \in [0, 1]$$

where $\mu A(x)$ is called the membership degree of the element x to the fuzzy set A . This degree ranges between the extremes 0 and 1:

- $\mu A(x) = 0$ indicates that x in no way belongs to the fuzzy set A .
- $\mu A(x) = 1$ indicates that x completely belongs to the fuzzy set A .

2.2. Membership Grade: $M(x)$

We propose the following fuzzy sets:

$M_O(x)$, $M_H(x)$, $M_L(x)$, $M_C(x)$: representing fuzzy values of the Open, High, Low and Close values.

$M_T(x)$: represents the present fuzzy trend value.

Using the following equation we can calculate the membership grade for every value of ' x ', where ' x ' is the daily NIFTY value, which the universe of discourse.

$$M(x) = \begin{cases} 1.0 & \text{if, } x \geq b \\ \frac{x - \alpha}{b - \alpha} & \text{if, } \alpha \leq x \leq b \\ 0 & \text{if, } x \leq a \end{cases}$$

Figure 1: Membership Grade $M(x)$

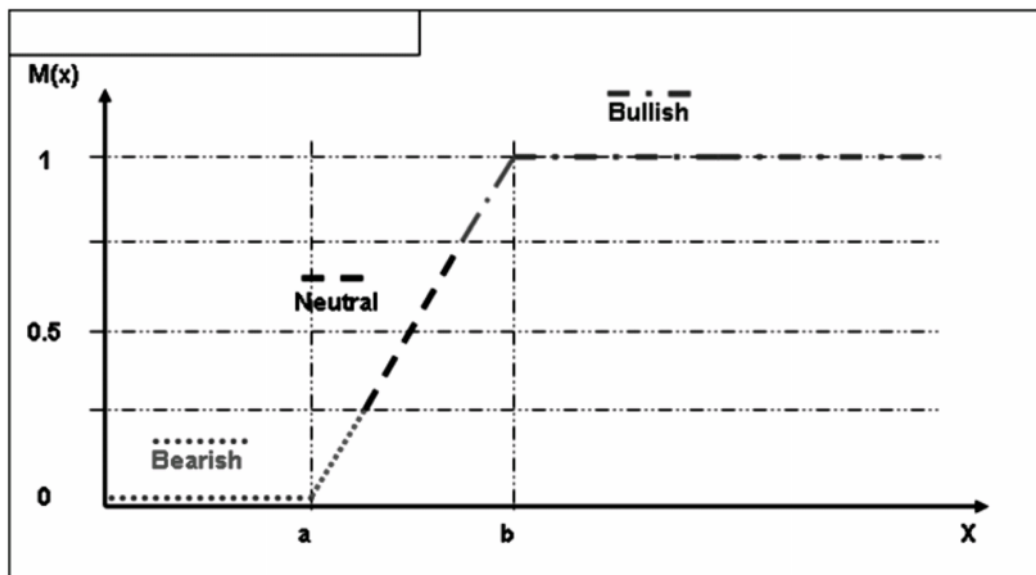


Image 1: Membership Function

The value of **a** is the lowest value and **b** is the highest value in the universe of discourse.

Following table (Table 1) gives an interpretation of the $M_T(x)$ values

Table 1
Trend Interpretation

$M_T(x)$	Interpretation of Trend
Less than 0	Bearish
0 to 0.01	Neutral
Above 0.01	Bullish

2.3. Steps in Trend Identification

Step 1: We accumulate the five day Open, High, Low and Close values.

Step 2: Considering the values of a,b and c given in the Table-3a we now calculate the fuzzy values $MO(x)$, $MH(x)$, $ML(x)$ and $MC(x)$ representing fuzzy equivalent for Open, High, Low and Close values for every day separately.

Step 3: Then using the fuzzy values we find the 2-day moving averages progressively till we are left with two values.

Step 4: Now we obtain the difference between the last two values i.e. last_value – second_last_value. This is our $MD(x)$. This $MD(x)$ value is obtained for Open, High, Low and Close values, so $MDO(x)$, $MDH(x)$, $MDL(x)$ and $MDC(x)$ are obtained respectively.

Step 5: To get the final trend value we obtain the average of $MDO(x)$, $MDH(x)$, $MDL(x)$ and $MDC(x)$ and achieve the current trend value, $MT(x)$.

Step 6: Using the value obtained for $MT(x)$ and guidelines given in Table 2 we can interpret the current trend.

3. FORECASTING OF THE TREND

With the help of the fuzzified values of previous 5-days we use Correlation, Simple Linear Regression and use the Least Square Criterion to predict the fuzzy value that may be achieved on the 6th day. The idea is to achieve an equation of line that can indicate the next move of the market.

3.1. Steps in Trend Forecasting

Step 1: We find the coefficient of correlation ' r ' using the formula:

$$r = \frac{n \sum XY - \sum X \sum Y}{\sqrt{n \sum X^2 - (\sum X)^2} * \sqrt{n \sum Y^2 - (\sum Y)^2}}$$

Step 2: For prediction we try to fit a line that passes through the values

$$Y_{pred} = B_0 + B_1 * X$$

Here Y_{pred} is the predicted value of Y w.r.t. X .

B_0 is the Y intercept and B_1 is the slope.

$$\begin{aligned} Y' &= \frac{\sum Y}{n} \\ X' &= \frac{\sum X}{n} \\ B_0 &= Y' - B_1 * X' \\ B_1 &= \frac{\sqrt{\sum (Y - Y')^2}}{\sqrt{\sum (X - X')^2}} * r \end{aligned}$$

Step 3 : Using the following table (Table 2) we specify the trend which the results indicate:

Table 2
Trend Interpretation of Forecasted Fuzzy Value

$M_T(x)$	Interpretation of Trend
0 to 0.125	Very Bearish
0.126 to 0.25	Bearish
0.251 to 0.49	Bearish Neutral
0.491 to 0.5	Neutral
0.51 to 0.74	Bullish Neutral
0.741 to 0.875	Bullish
0.876 to 1	Very Bullish

4. REPRESENTATION THROUGH EXAMPLE FOR TREND IDENTIFICATION

Following is a table representing the historical values of S&P CNX NIFTY 50 index, that will be used for this experiment.

Sl. No.	Date	Open	High	Low	Close
1.	06/13/2011	5,469.85	5511.45	5437.55	5,498.50
2.	06/14/2011	5,485.60	5,520.15	5,484.20	5,500.50
3.	06/15/2011	5,494.45	5,499.35	5,438.95	5,447.50
4.	06/16/2011	5,419.65	5,447.50	5,389.80	5,396.75
5.	06/17/2011	5,412.50	5421.15	5355.85	5,366.40

Source: <http://in.finance.yahoo.com/q/!hp?s=%5ENSEI>

a b
5355.85 5520.15

For Open values

$M_O(x)$	$Ma1(x)$	$Ma2(x)$	$Ma3(x)$	$MD_O(x)$	TREND
0.693852708					
0.789713938	0.97				
0.843578819	0.94	0.96			
0.38831406	0.72	0.83	0.89		
0.344796105	0.48	0.60	0.71	-0.18	BEARISH

For High values

$M_H(x)$	$Ma1(x)$	$Ma2(x)$	$Ma3(x)$	$MD_H(x)$	TREND
0.947048083					
1	0.97				
0.873402313	0.94	0.96			
0.557821059	0.72	0.83	0.89		
0.397443701	0.48	0.60	0.71	-0.18	BEARISH

For Low values

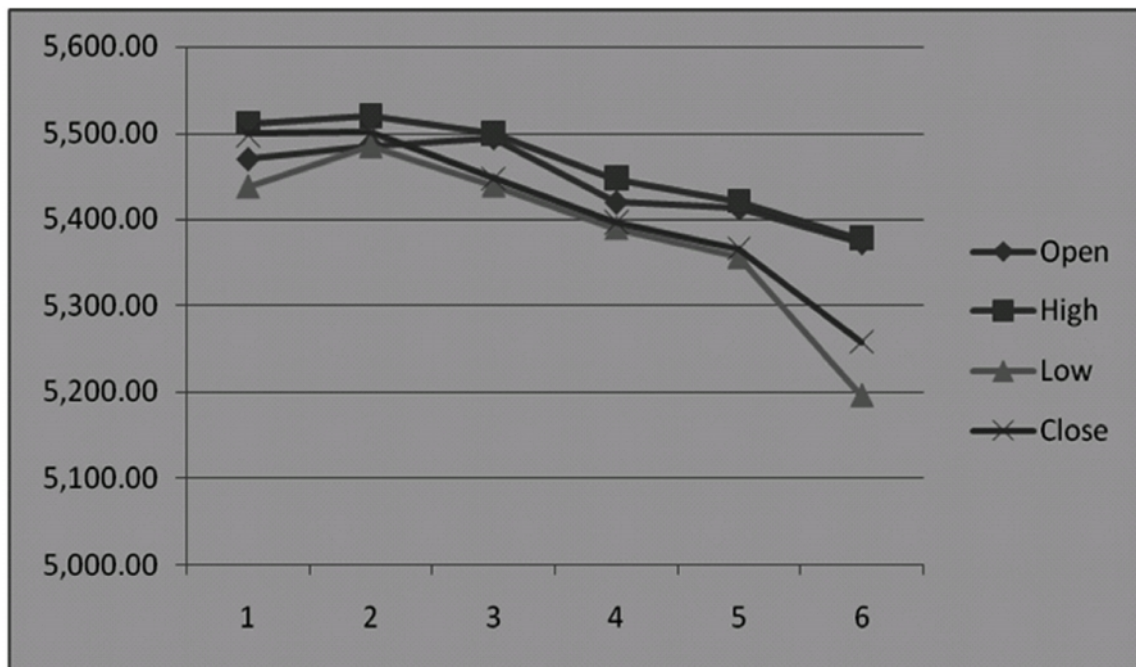
$M_L(x)$	$Ma1(x)$	$Ma2(x)$	$Ma3(x)$	$MD_L(x)$	TREND
0.497261108					
0.78119294	0.64				
0.505782106	0.64	0.64			
0.206634206	0.36	0.50	0.57		
0	0.10	0.23	0.36	-0.21	BEARISH

For Close values

$M_C(x)$	$Ma1(x)$	$Ma2(x)$	$Ma3(x)$	$MD_C(x)$	TREND
0.86822885					
0.880401704	0.87				
0.557821059	0.72	0.80			
0.248934875	0.40	0.56	0.68		
0.064211808	0.16	0.28	0.42	-0.26	BEARISH

$$M_T(x) = \text{Average}(MD_O(x), MD_H(x), MD_L(x), MD_C(x))$$

$M_T(x) = -0.21$ which implies a **Bearish Trend**



Graph 1: Graph Representing the Trend

From the above graph (Graph 1) it can be observed that the slopes of the Open, High, Low and Close values are down indicating a down trend hence it can be concluded that the trend is bearish.

The experiment was conducted for various sets of real time values and it was found that our system can identify the trend to a very large extent.

5. REPRESENTATION THROUGH EXAMPLE FOR TREND FORECASTING

Following is a table representing the historical values of S&P CNX NIFTY 50 index, which will be used for this experiment.

Sl.No.	Date	Open	High	Low	Close
1.	06/14/2011	5,485.60	5,520.15	5,484.20	5,500.50
2.	06/15/2011	5,494.45	5,499.35	5,438.95	5,447.50
3.	06/16/2011	5,419.65	5,447.50	5,389.80	5,396.75
4.	06/17/2011	5,412.50	5,421.15	5,355.85	5,366.40
5.	06/20/2011	5,372.20	5,377.40	5,195.90	5,257.90
6.	06/21/2011	5,280.80	5,322.45	5,257.00	5,275.85

Source: <http://in.finance.yahoo.com/q/!hp?s=%5ENSEI>.

We would try to estimate trend that may emerge on the 6th observation by using the previous 5 observations. On the basis of Open values we estimate High, Low and Close values.

Following are the fuzzy values of the above observations:

Sl. No.	$M_O(x)$	$M_H(x)$	$M_L(x)$	$M_C(x)$
1.	0.893446415	1	0.889128759	0.939398612
2.	0.92074017	0.935851966	0.749575944	0.775944487
3.	0.690053971	0.775944487	0.597995374	0.619429453
4.	0.668003084	0.694680031	0.493292213	0.525828836
5.	0.543716268	0.559753277	0	0.191210486
6.	0.261835004	0.390285274	0.18843485	0.246569005

Using the steps 1 and 2 we found the following fuzzy values:

	Actual	Predicted	Error (Actual – Predicted)
$M_H(x)$	0.390285274	0.431423155	-0.041137881
$M_L(x)$	0.18843485	0.193792457	-0.00536
$M_C(x)$	0.246569005	0.272831093	-0.02626
Average $M(x)$	0.275096376	0.2993489	-0.024252525

From the above table it can be observed that the error value is quite less, so the approximation of predicted values is more or less closer to actual values.

The actual average comes to 0.275 which depicts a Bearish Neutral trend and we predicted it to be 0.299 which depicts a Bearish Neutral trend. So our prediction closely represents the actual trend for the next day (6th day).

The experiment was conducted for various sets of real time values and it was found that our system can predict the trend for the immediately next trading day to a very large extent.

6. CONCLUSION

The Standard & Poor's CRISIL NSE Index 50 or S&P CNX Nifty nicknamed Nifty 50 or simply Nifty, is the leading index for large companies on the National Stock Exchange of India. The Nifty is a well diversified 50 stock index accounting for 23 sectors of the economy.

The attractive feature of the stock market is that every investor has the image to make millions in return from buying and selling stocks (cash and futures). Unfortunately, the reality of the nature of the market poses a less optimistic picture. Although, researchers have proposed many methods to somehow predict the market movements and also it is observed that the best market players have been the investors who use their professional knowledge of the markets to predict the next trend of the stock price. Here the need of an automated trustworthy forecasting tool is extremely desired, so that the investors don't have to rely on some one else to do forecasting for them. And also, the more accurately the forecasting tool performs, the more profitable it would be for the investor.

In our approach we use fuzzy logic as it does not need tones of data as in the case of ANN, and also the results are achieved fast. From the above suggested method, the fuzzification of the NIFTY values is done in an easy way using S-function to assess the short term trend.

We took the actual 5-day data and fuzzified it, we successfully made the system understand the current trend and then we successfully made the system predict the future trend for the 6th day. The approximations presented by both the methods are good.

The methodology can be enhanced to predict the long term future trends. The proposed model is simple and easy to develop which can effectively identify the present trend and also help in predicting the immediate future trend. There is ample scope of improvement and researchers can creatively use this model for trend identification and further enhance it for further trend prediction.

The proposed future work is to de-fuzzify the trend values and achieve a crisp value of how much points the market is going to rise or fall in the short term.

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