SOFT COMPUTING APPROACH IN PREDICTION OF A TIME SERIES DATA

Satyendra Nath Mandal[1], J.Pal Choudhury [2],S.R.Bhadra Chaudhuri[3],Dilip De [4]
[1]Dept. of I.T, Kalyani Govt. Engg College, Kalyani ,Nadia(W.B),India,
[2] Dept. of I.T, Kalyani Govt. Engg College, Kalyani, Nadia(W.B),India,
[3]Dept. of ETE,Bengal Engineering & Science University,Howrah(W.B),India,
[4]Bidhan Chandra Krishi Viswavidayalay , Kalyani, Nadia(W.B),India
E-mail: satyen_kgec@rediffmail.com, jnpc193@yahoo.com, prof_srbc@yahoo.com , dilipde.bckv@gmail.com

ABSTRACT

Soft Computing Model always composed of Fuzzy logic, Neural Network, Genetic algorithm etc. Most of the time, these three components are combine in different ways to form model. Fuzzy- Neuro Model, Neuro- GA model, Fuzzy- Neuro- GA model etc. All this combination is widely used in prediction of time series data. If in a time series data, initial change are observed during some time interval, the final value of this data must be predicted. In this paper, an effort has been made to use soft computing approaches for predicting a final product of a time series data. The data is taken from a statistical survey has been conducted by a group of certain agricultural personnel on different mustard plant under the supervision of Prof. Dilip dey, Bidhan Chandra Krishi Viswavidayalay West Bengal, India. In this paper, the models of soft computing using neural network based on fuzzy input and genetic algorithm have been tested on same data and based on error analysis (calculation of average error) a suitable model is predicted for this data.

Keywords-*Soft Computing, Forecasting, Artificial Neural Network, Genetic Algorithm, Average Error, Forecasting Error*.

1. INTRODUCTION

The principal components of soft computing[24] are as follows:-
(1) Neuro Computing + Fuzzy Logic(Neurofuzzy: NP)
(2) Fuzzy Logic + Genetic Algorithm (Fuzzygenetic: FG)
(3) Fuzzy logic + Chaos theory(fuzzychaos: FCh)
(4) Neural Networks + Genetic Algorithm(Neurogenetic: NG)
(5) Neural Networks + Chaos theory(Neurochaos: NCh)
(6) Fuzzy Logic + Neural Networks + Genetic Algorithm(Fuzzyneurogenetic: FNG)
(7) Neural Networks + Fuzzy Logic + Genetic Algorithm(Neurofuzzygenetic: NFG)
(8) Fuzzy Logic + Probabilistic reasoning(Fuzzyprobabilistic: FP)

Q. Song and Chissom [3] explained the definition of fuzzy time series and discussed the models using Fuzzy Relational equations. Song and Chisson [1] used a time invariant fuzzy time series model. J. Sullivien and W. H. Woodall [2] made a comparative study of Fuzzy Forecasting and Markov Model and suggested that Markov Model would give better prospects. They illustrated the methodology by forecasting the enrollment at the University of Alambama from 20 years of data. H. Bintley [4] applied fuzzy logic and approximate reasoning to a practical case of forecasting. Q. Song and B. S. Chissom[5] used first order time variant models and utilized 3 layer back propagation neural network for defuzzification. G. A. Tagliarini, J. F. Christ and E. W. Page [6] demonstrated that artificial neural networks could achieve high computation rates by employing massive number of simple processing elements of high degree of

connectivity between the elements. This paper presented a systematic approach to design neural networks for optimizing applications. T. K. Bhattacharya and T. K. Basu[7] described that a time series model of multiplicative SARIMA(seasonal autoregressive integrated moving average) type suffered from a divergent error level in the multistep ahead forecast of all the specific features of the different days of the week. The authors proposed that the data had to be grouped into various subgroups known as Walsch transform, the components of which were then processed by fading memory Kalman filter algorithm and forecasts were made by taking the inverse transform of the predicted value of the component. F. G. Donaldson and M. Kamstra[8] investigated the use of artificial neural network(ANN) to combine time series forecasts of stock market volatility from USA, Canada, Japan and UK. The authors presented combining procedures to a particular class of nonlinear combining procedure based on artificial neural network. J. V. Hansen and R. D. Nelson[9] presented the neural network techniques which provided valuable insights for forecasting tax revenues. The pattern finding ability of neural networks gave insightful and alternate views of the seasonal and cyclical components found in economic time series data. It was found that neural networks were stronger than exponential smoothing and ARIMA(autoregressive integrated moving average). S. F. Brown, A. Branford and W. Moran[10] proposed that artificial neural networks were powerful tool for analyzing data sets where there were complicated nonlinear interactions between the measured inputs and the quantity to be predicted. M. Sugeno and K. Tanaka[11] proposed successive identification method of a fuzzy model. The structure and initial parameters were determined to identify a model called 'initial model', which was identified by the off-line fuzzy modeling method using some pairs of input-output data. L. Zuoyong, C. Zhenpei and L. Jitao[12] proposed a method of classification of weather forecasts by applying fuzzy grade statistics. The rainfall in a certain region could be forecasted as one of three grades. The range of rainfall was chosen depending on the historical data. The membership functions of the fuzzy sets were also designed. L. Feng and X. x. Gaung[13] described the model of fuzzy self-regression. The main steps were the making of the form of self-related sequence number according to the observed number, the calculation of self-related coefficient and the ascertaining of the forecasting model of fuzzy self-regression. M. Ishikawa and T. Moriyama [14] presented various methods of learning and the process of predicting time series analysis, which were ranged from traditional time series analysis to recent approaches using neural networks. It described that back propagation learning had a difficulty in interpreting hidden inputs. In order to solve these problems, a structural learning method was proposed which was based on an information criterion.

A comparative study was made among gaussian, triangular and trapezoidal functions for using the function for fuzzification[16] and it was observed that gaussian function was the most suitable function for fuzzification. A Rule Base was constructed for a Personnel Selection System using Fuzzy Expert methodology[17]. A comparison was made among the fuzzy time series and markov model [18] for the purpose of manpower prediction and it was found that fuzzy time series method was more preferable than markov model.

G. P. Bansal, A. Jain, A. K. Tiwari and P. K. Chande[19] proposed a novel methodology called genetic programming which they considered as a variant of genetic algorithms(GAs) and that evolved on a dynamic length tree representation the basis of fitness function. The methodology presented was to provide assistance to the attendant indicating that plant's behavior, which was drifting away from normal operation with the strategy to minimize error and optimize the operation.

K. K. Shukla[20] presented a novel genetically trained neural network(NN) predictor trained historical data. Substantial improvement in prediction accuracy by the neuro-genetic approach had been demonstrated as compared to a regression-tree-based conventional approach and back propagation neural network(NN) approach.

S. Bandyopadhaya and U. Maulik[21] proposed an efficient evolutionary search algorithm, which could exploit the enhanced searching capability of parallel genetic algorithms. The performance of this algorithm with and without migration of chromosomes had been studied. In GAs(Genetic Algorithms), all chromosomes were performing similar operations. This made GAs(Genetic

Algorithms) parallelizable relatively easily. There were advantages in parallel GAs(Genetic Algorithms): when several GAs(genetic algorithms) were run on multiple processors simultaneously, higher speed up might result; after some period of evolution, the majority of chromosomes in a single population became very similar. Depending on the parallelism, the level of interactions, pGAs(parallel Genetic Algorithms) might be classified into two groups: (1) Fine-grain pGAs(parallel Genetic Algorithms): Numerous small populations evolved parallely, with large amount of interaction among them. The next generation was evolved by first replacing each individual by an individual selected from its neighborhood on the grid. Then the crossover of each individual was performed with a mate randomly selected from its neighborhood with a certain probability. (2) Coarse-grain pGAs(parallel Genetic Algorithms): Here small number of relatively large populations was evolved parallely with little amount of interaction among them.
B. Banerjee, A. Konar and S. Mukhopadhaya[22] proposed a new technology for efficient obstacle avoidance and path planning of a mobile robot by exploiting the techniques of neural network(Hopefield network) and genetic algorithms.

After literature survey it has been observed that most of authors([6], [8], [10], [14]) preferred the neural network techniques for the purpose of forecasting in various applications. In fuzzy environment, linguistic variables are generated from crisp or real data. The states of each linguistic variable are expressed by linguistic terms interpreted as specific fuzzy numbers as defined in terms of a base variable, the values of which are real numbers within a specific range. In genetic algorithm[15], certain new strings are generated and certain old strings are lost based on the fitness function. Certain research work has been developed using neuro-GA approach of software development effort[20] and for navigational planning of a mobile robot [22] .

Shyi-Ming and Jeng-Ren Hwang[28] proposed two algorithms for temperature prediction using two – factors time variant fuzzy time series. The first factor was the daily average temperature and the second factor was the daily cloud density. They considered the historical data of the daily average temperature from June 1996 to September 1996 in Taipei as main factor and historical data of daily cloud density as second factor to predict the temperature in future.

Surajit Chattopadhyay and Monojit Chattopadhyay [29] used ANN as soft computing technique to anticipate the average monsoon rainfall over India. They have taken data during months of June ,July and August from 1891-1999 and predicted the average rainfail over India during summer monsoon season. They have studied only few parameters. If more input parameters are available then the prediction of higher accuracy would be possible.The different type of research work ([30]-[35],[37]) has been carried out using fuzzy logic and artificial neural network to forecasting rainfall, temperature and thunderstrorms. They compared the proposed method with existing fuzzy time series time-invariant model based on forecasting accuracy. S.Kotsiantis, E. Koumanakos, D. Tzelepis and V. Tampakas[35] explored the effectiveness of machine learning techniques in detecting firms that issue fraudulent financial statements(FFS) and deals with the identification of factors associated to FFS. Tahseen Ahmed Jilani, syed Muhammad, Agil Burney and Cemal Ardil[36] proposed a method is based on frequency density based partitioning of the historical enrollment data . They proved that the proposed method is the based method of forecasting accuracy rate for forecasting enrollments than the existing methods.

Now the data used in this paper from a statistical survey on the mustard plant. The same types of data are taken from different mustard plant. The entire component which are observed during data collection such as shoot length, number of leaf, root length etc are changes on time. But among all these parameters, the growth of shoot length can be observed during its life time until yield will produce. The shoot length is growing continuously and finally produce yield. So, soft computing approach to observe the growth of shoot length and can be predicted the yield. In this paper, a effort can be made to predict the yield applying fuzzy logic, neural network and genetic algorithm on the same data and finally based on the error analysis one method has been selected to predict the yields.

2. METHODOLOGY

2.1. Fuzzy Systems

The characteristic function of a crisp set assigns a value of either 1 or 0 to each individual in the universal set, thereby discriminating members and nonmembers of the crisp set under consideration. This function can be generalized such that the value assigned to the elements of the universal set fall within a specific range and indicate the membership grade of these elements in the set in question. Larger values denote higher degrees of set membership. Such a function is called a membership function and the set defined by it a fuzzy set.
The range of values of membership functions is the unit interval [0, 1]. Here each membership function maps elements of a given universal set X, which is always a crisp set, into real numbers in [0, 1].
The membership function of a fuzzy set A is defined by A, A : X ------> [0, 1].

2.2 Artificial Neural Network(ANN)```

An ANN(Artificial Neural Network) is composed of basic units called artificial neurons on neurodes that are processing elements(PEs) in a network. Each neurode receives input data, processes it and delivers a single output. The input data can be raw data or output of other processing elements(PEs). The output can be the final product or it can be an input to another neurode.
An ANN(Artificial Neural Network) is composed of collection of interconnected neurons that are often grouped in layers; however in general no specific architecture should be assumed. In terms of layered architecture, two basic structures are considered. In one type, two layers are seen: input and output. In other type there are three layers: input, intermediate (called hidden) and output. An input layer receives data from the outside world and sends signals to subsequent layers. The outside layer interprets signals from the previous layer to produce a result that is transmitted to the outside world. In three layer ANN((Artificial Neural Network) architecture, the concept of hidden layer is assumed in order to control the weights between input to hidden layer and hidden layer to output layer.

Feed Forward Back Propagation Neural Network

The feed forward back propagation neural network (FFBP NN) does not have feedback connections, but errors are back propagated during training. Errors in the output determine measures of hidden layer output errors, which are used as a basis for adjustment of connection weights between the input and hidden layers. Adjusting the two sets of weights between the pairs of layers and recalculating the outputs is an iterative process that is carried on until the errors fall below a tolerance level. Learning rate parameters scale the adjustments to weights. A momentum parameter can be used in scaling the adjustments from a previous iteration and adding to the adjustments in the current iteration. The layout of feed forward back propagation neural network is furnished in figure 1.

2.3. Genetic Algorithm

A genetic algorithm is composed of three operators:-
(1) Reproduction / Selection (2) Cross Over (3) Mutation
The balance, which critically controls the performance of GAs(Genetic Algorithm): the cross over and mutation probabilities and population sizes.

2.3.1. Reproduction

Reproduction is a process in which individual strings are copied according to their objective function values f.(the function is called as fitness function). The strings are copied according to their fitness value which means that the strings with a higher value have a higher probability of contributing one or more offspring in the next generation and the strings with a lower value(less than average) have a probability of not contributing any offspring in the next generation.

2.3.2. Cross over

Crossover (simple) may proceed in two steps. First, member of newly reproduced string in the mating pool are mated in random. Second, each pair of strings undergoes crossing over.

2.3.3. Mutation

Mutation decides the probability of changing the bits from 1 to 0 and vice versa. With a low probability rate, if the expected mutation is very less, no mutation are carried out.

2.3.4. Fitness function

The fitness function measures the performance of the system. The fitness function to be evolved is problem dependent. For prediction and estimation problem, the function will be the inverse of mean square error or absolute distance error.

The mean square error $E = 1/N \Sigma (O_i - t_i)^2$. The absolute distance error $A = 1/ N \Sigma | O_i - t_i |$

Where N is the number of training data, and O_i and t_i are the ith obtained and target outputs.

The fitness function = 1/ E or, 1/ A as the case may be depending on the type of particular application.

2.4 Error Analysis

Forecasting error = | Forecasted Value - Actual Value | / (Actual Value) * 100 %

Average Forecasting error = (Sum of Forecasting errors) / (Total no of Errors).

2.5 Data Used in This Paper (Time Instances vs. Shoot length of Different Mustard Plant)

A statistical survey has been conducted by a group of certain agricultural personnel on different mustard plant under the supervision of Prof. Dilip de, Bidhan Chandra Krishi Viswavidayalay West Bengal, India. The data for shoot length of the initial stage(growing stage) of the plant are also available, which are measured at different time instances(after an interval of 7 days, 14 days, 21 days, 28 days). The ultimate aim is to develop a model that estimated which plant is growing as per desire standard. It is observed that irrespective of rain fall, humidity and temperature, the amount of pod yields of mature plant dependent on its number of leaves, number of roots, roots length and shoot length. At the time of the plant is growing, only shoot length can measure during course of time. As leaves may come and fall down and roots goes deeper to deeper inside the land, both can not be measure all time. By observing the initial growth of shoot length, it can be predicted the shoot length at the maturity. If the growth of shoot length is not at per desired standard, the said plant can be destroyed otherwise the said plant can be survived and protected as it has maximum probability to produce expected yields.

The objective of the survey is to find out the production of a particular type plant using certain initial parameters(root length, root number, leaf number, shoot length, branch number etc.). In this paper, the value of shoot length measured at initial stage after plantation has been taken and it increases as time series data is used as input data of a particular type of mustard plant. The value of shoot length (measured with equal time intervals within 28 days after plantation) and final shoot length and pod yield after 95 days for mustard plant (B-59) have been taken and furnished in table 1(a) and 1(b)

Table 1(a): Mustard Type and Shoot Length

Time Instances	B-59
1	19
2	24
3	28
4	33
5	37
6	41
7	45
8	49
9	54
10	57
11	59
12	63
13	66

Table 1(b) :Type B-59 (Pod Yield and Shoot Length)

Shoot Length(Height)	Pod yield
122.6	3.991
134	2.679
140.8	7.281
141.8	7.47
144.6	7.401
146	7.5
149.5	7.64

3.1. METHOD

Under artificial neural network system, a feed forward back propagation neural network is used

which comprises of a 6 noded input layer, 6 noded output layer and 2 noded hidden layer.

Step 1.

The universe of discourse U is defined within which the available data are and upon which the fuzzy sets will be defined. The minimum data (D_{min} say,) is 19 and the maximum data (D_{max} say,) is 66. The universe U is defined as [D_{min} - D_1, D_{max} + D_2] where D_1 and D_2 are two proper positive numbers. Let us choose D_1 = 9 and D_2 = 4. Thus the universe is the interval of U [10, 70].

Step 2.

The universe U is partitioned into five equal length(10) intervals. The intervals are chosen as u_1 = [10, 20], u_2 = [21, 30], u_3 = [31, 40], u_4 = [41, 50],u_5 = [51, 60], u_6=[61,70]

Step 3.

Fuzzy sets are defined on the universe. First some linguistic values are determined. Second the fuzzy sets on U are defined. All the fuzzy sets will be labeled by the possible linguistic values. Let u_1, u_2, ...and u_6 are chosen as the elements of each fuzzy set. How well each u_k (k = 1, 2, ..., 6) belonging to A_i determines the memberships of u_1, u_2, ...u_6 to each A_i (i = 1, 2, ..., 6). If u_k completely belongs to A_i, the membership will be 1; if u_k does not belong to A_i at all, the membership will be zero ; otherwise a number from (0, 1) is chosen as the degree to which u_k belongs to A_i. All the fuzzy sets A_i (i = 1, ..., 6) are expressed as follows :-

A_1 = { u_1 / 1, u_2 / 0.5, u_3 / 0, u_4 / 0, u_5 / 0, u6 / 0 },

A_2 = { u_1 / 0.5, u_2 / 1, u_3 / 0.5, u_4 / 0, u_5 / 0, u_6 / 0},

A_3 = {u_1 / 0, u_2 / 0.5, u_3 / 1, u_4 / 0.5, u_5 / 0, u_6 / 0},

A_4 = {u_1 / 0, u_2 / 0, u_3 / 0.5, u_4 / 1, u_5 / 0.5, u_6 / 0},

A_5 = {u_1 / 0, u_2 / 0, u_3 / 0, u_4 / 0.5, u_5 / 1, u_6 / 0.5}.

A_6 = {u_1 / 0, u_2 / 0, u_3 / 0, u_4 / 0, u_5 /0.5, u_6 / 1}.

where u_i (i = 1, ..., 6) is the element and the number below ' / ' is the membership of u_i to A_j (j = 1, ..., 6).

Step 4

The available data are fuzzified based on gaussian function which is furnished in Table 2 given below :-

Table 2: Actual Shoot Length and Fuzzy Set

Actual Shoot Length	A1	A2	A3	A4	A5	A6	Fuzzy Set
19	1.0	0.9	0.0	0.0	0.0	0.0	A1
24	0.6	1.0	0.4	0.0	0.0	0.0	A2
28	0.2	1.0	0.8	0.0	0.0	0.0	A2
33	0.0	0.7	1.0	0.3	0.0	0.0	A3
37	0.0	0.3	1.0	0.7	0.0	0.0	A3
41	0.0	0.0	0.9	1.0	0.1	0.0	A4
45	0.0	0.0	0.5	1.0	0.5	0.0	A4
49	0.0	0.0	0.1	1.0	0.9	0.0	A4
54	0.0	0.0	0.0	0.6	1.0	0.4	A5
57	0.0	0.0	0.0	0.3	1.0	0.7	A5
59	0.0	0.0	0.0	0.1	1.0	.9	A5
63	0.0	0.0	0.0	0.0	0.7	1.0	A6
66	0.0	0.0	0.0	0.0	0.4	1.0	A6

Step 5

Under artificial neural network system, a feed forward back propagation neural network is used which comprises of a 6 noded input layer, 6 noded output layer and 2 noded hidden layer.

The value of the artificial neural network parameters are furnished in Table 3. It is to mention the M_1 array be the matrix of weights from input to the hidden layer, M_2 array be the matrix of weights from hidden to output layer, A array be the threshold value for jth hidden layer, K array be the threshold or bias to jth output layer as furnished in Table 3. The value of learning rate B_l is taken as 1.5 and B_h as 2.0. The momentum parameter α is taken as 0.7

Table 3: The value of Parameters (Feed Forward Back Propagation NN)

M_1 array 0.06 0.04
0.2 0.08
0.05 0.3
0.3 0.07
0.2 0.3
0.32 0.23

M_2 array 0.09 0.43 0.25 0.5 0.3 0.35
0.11 0.07 0.07 0.05 0.2 0.23

K array 0.15 0.25 0.32 0.35 0.28 0.38

A array 0.2 0.3

Step 6.

The predicted values for the shoot length are calculated which are furnished in table 4.

Table 4: Forecasted Value and Forecasted Error using ANN with fuzzy input

Actual Value	Forecasted Value	Forecasted Error(%)
19	-	-
24	24	0
28	27	3.57
33	32	3.00
37	36	2.77
41	39	4.82
45	46	2.2
49	48	2.04
54	55	1.80
57	57	0
59	59	0
63	62.5	0.79
66	65.5	0.78

Average Error 1.68%

Step-7

From the available shoot length obtained from the estimated value of ANN(Artificial Neural Network) computed in previous step, percentage error is calculated. The fitness function is assumed as 1 / percentage error. If the percentage error is 0 , then it is treated as high fitness and we assign it 999. If the fitness function value is less than 0.35 , we assign 0 and the said data has to be rejected and will not be considered in the next step otherwise we assigned 1. and data value will be considered in the next subsequent steps. All the items are furnished in Table 5.

Table 5: FITNESS function and Expected Count

Actual Value	Forecasted Value	Forecasted Error(%)	Fitness Function = 1/Forcasted Error	Expected count
19				
24	24	0	999	1
28	27	3.57	0.28	0
33	32	3.03	0.33	0
37	36	2.70	0.37	1
41	39	4.87	0.205	0
45	46	2.22	0.45	1
49	48	2.04	0.49	1
54	55	1.85	0.54	1
57	57	0	999	1
59	59	0	999	1
63	62	1.58	0.63	1
66	65	1.51	0.66	1

Step-8.

From the available obtained from the estimated value of ANN (Artificial Neural Network) computed in previous step, error is calculated. The available data are converted into equivalent binary number which is considered as initial population. From the available binary data (population), mating pool has to be chosen between two consecutive data. The selection of bits among the two consecutive population data has to be decided based on the minimum error of the two values. The new population is furnished in Table 6.

Step-9

After getting all the new population data from step-8, the binary data is converted into decimal number. Now error analysis of the estimated data is made based on actual data. If average error lies below a particular value as decided earlier, the entire process stops, otherwise, all the procedures of step-7 are carried out over the new data . It is to note that it has to be observed that during selection/reproduction the genetic diversity is not lost. The acceptable available data are now carried through mating pool process in step-8.

Step-10

The entire procedures described in step-8 are repeated until average error lies below a particular value as decided earlier depending on the type of particular application. After getting the estimated data, error analysis is made based on the actual data.

Table 6: Mating POOL, Crossover Site AND NEW Value

Population Value	Crossover Site	New Value
37	5	36
45	5	46
49	4	49
54	4	54
63	4	63
66	4	64

Table 7-Forecasted value and FORECASTING ERROR using Neuro-fuzzy GA Approach

Actual Value	Forecasted Value	Forecasting Error(%)
24	24	0
37	36	2.70
45	46	2.22
49	49	0
54	54	0
57	57	0
59	59	0
63	63	0
66	64	3.030
Average Error		0.88 %

4. RESULTS ANALYSIS

The average error of Neuro-Fuzzy GA learning as against Statistical Models as follows

Table 7: Average Error

Model	Average Error
Least Square Technique based on Linear Equation	2.88%
Least Square Technique based on Exponential Equation	8.80
Least Square Technique based on Logarithmic Equation	4.39
Least Square Technique based on Asymptotic Equation	3.134
Fuzzy Time Series	5.83
Artificial Neural network with fuzzy input	1.68
Neuro-Fuzzy-Genetic system	0.88

It has been observed that neuro-fuzzy-genetic system is the more suitable as against the neuro-fuzzy-genetic system and other statistical model for the forecasting of futuristic prediction of shoot length data .Here in neuro-fuzzy-genetic system is used only cross over of all forecasted value from artificial neural network with fuzzy input. The graphical representation of forecasted value for different model has been furnished in Fig2. So, in this type of time series data, soft computing model based on neuro-fuzzy-genetic can be used. After the selection of model, final shoot length has been calculated and based on final shoot the pod yield has been predicted. Shoot length after 95 days is 145.98 and the pod yield will be 9.7 gm.

5. CONCLUSIONS AND FUTURE SCOPE

Since in neuro genetic system is used only cross over of all forecasted value from artificial neural network with fuzzy input and here is not computing fitness function(the function will be the inverse of mean square error or absolute distance error. The mean square error $E = 1/N \sum (O_i - t_i)^2$. The absolute distance error $A = 1/ N \sum | O_i - t_i |$ where N is the number of training data, and O_i and t_i are the ith obtained and target outputs) and actual count by from Roulette Wheel, some new fitness must be found so that average error lies below a particular value as decided earlier depending on the type of particular application and during selection/reproduction the genetic diversity will not lost. This approach will be applied in different types of time series data like stoke market, financial data, and market demand and supply prediction.

6. REFERENCES

[1] Q. Song and B. S. Chissom, "Forecasting enrollments with fuzzy time series part I", Fuzzy Sets and Systems 54(1993) 1 - 9.

[2]J.Sullivan and William H. Woodall,"A Comparison of Fuzzy Forecasting and Markov Modelling", Fuzzy Sets and Systems 64(1994) 279 - 293.

[3] Q. Song and B. S. Chissom, "Fuzzy Time Series and its Models", Fuzzy Sets and Systems 54(1993) 269-277.

[4] H. Bintley, "Time Series analysis with REVEAL", Fuzzy Sets and Systems 23(1987) 97-118.

[5] Q. Song and B. S. Chissom, "Forecasting enrollments with fuzzy time series - part II", Fuzzy Sets and Systems 62(1994) 1-8.

[6] G. A. Tagliarini, J. F. Christ, E. W. Page, "Optimization using Neural Networks, IEEE Transactions on Computers. vol. 40. no 12. December '91 1347-1358

[7] T. K. Bhattacharya and T. K. Basu, "Medium range forecasting of power system load using modified Kalman filter and Walsch transform", Electric Power and Energy Systems", vol. 15, no 2, 109 -115, 1993.

[8] F. G. Donaldson and M. Kamstra, "Forecast combining with Neural Networks", Journal of Forecasting 15(1996) 49-61

[9] J. V. Hansen and Ray D. Nelson, "Neural Networks and Traditional Time Series Methods: A Synergistic combination in state Economic Forecasts", IEEE Transactions on Neural Networks vol. 8, no 4, July 1997

[10] S. F. Brown, A. J. Branford, W. Moran, "On the use of Artificial Neural Networks for the analysis of Survival Data", IEEE Transactions on Neural Networks, vol. 8, no 5, Sept. 1997.

[11] M. Sugeno and K. Tanaka, "Successive Identification of a Fuzzy Model and its applications to prediction of a complex system", Fuzzy Sets and Systems 42(1991) 315-334.

[12] L. Zuoyong, Chen Zhenpei, Li Jitao, "A model of Weather Forecast by Fuzzy Grade Statistics", Fuzzy Sets and Systems 26(1998) 275-281.

[13] L. feng and Xu Xia Guang, "A Forecasting Model of Fuzzy Self Regression", Fuzzy Sets and Systems 58(1993) 239-242.

[14] M. Ishikawa, T. Moriyama, "Prediction of Time Series by a Structural Learning of Neural Networks", Fuzzy Sets and Systems 82(1996) 167-176.

[15] D.H.Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley Inc, 1999.

[16] J. Paul Choudhury, Dr. Bijan Sarkar and Prof. S. K. Mukherjee, "Some Issues in building a Fuzzy Neural Network based Framework for forecasting Engineering Manpower", Proceedings of 34th Annual Convention of Computer Society of India, Mumbai, pp. 213-227, October -November 1999.

[17] J. Paul Choudhury, Dr. Bijan Sarkar and Prof. S. K. Mukherjee, "Rule Base of a Fuzzy Expert Selection System", Proceedings of 34th Annual Convention of Computer Society of India, Mumbai, pp. 98-104, October -November 1999.

[18] J. Paul Choudhury, Dr. Bijan Sarkar and Prof. S. K. Mukherjee, "A Fuzzy Time Series based Framework in the Forecasting Engineering Manpower in comparison to Markov Modeling", Proceedings of Seminar on Information Technology, The Institution of Engineers(India), Computer Engineering Division, West Bengal State Center, Calcutta, pp. 39-45, March 2000.

[19] G. P. Bansal, A. Jain, A. K. Tiwari and P. K. Chanda, "Optimization in the operation of Process Plant through Genetic Programming", IETE Journal of Research, vol 46, no 4, July-August 2000, pp 251-260.

[20] K. K. Shukla, Neuro-genetic prediction of Software Development Effort", Information and Software Technology 42(2000), pp 701-713.

[21] S. Bandyopadhaya and U. Maulik, "An Improved Evolutionary Algorithm as Function Optimizer", IETE Journal of Research, vol 46, no 1 and 2, pp 47-56, 2000.

[22] B. Banerjee, A. Konar and S. Mukhopadhayay, " A Neuro-GA approach for the Navigational Planning of a Mobile Robot", Proceedings of International Conference on Communication, Computers and Devices(ICCD-2000), Department of Electronics and Electrical Engineering, Indian Institute of Technology, Kharagpur, December 2000, pp 625-628.

[23] J. Paul Choudhury, Dr. Bijan Sarkar and Prof. S. K. Mukherjee, "Forecasting using Time Series Model Direct Method in comparison to Indirect Method", Proceedings of International Conference on Communication, Computers and Devices(ICCD-2000), Department of Electronics and Electrical Engineering, Indian Institute of Technology, Kharagpur, December 2000, pp 655-658.

[24] R.A. Aliev and R. R. Aliev, "Soft Computing and its applications", World Scientific, 2002.

[25] G.W.Snedecor and W.G.Cochran, "Statistical Methods", eight edition, East Press, 1994.

[26] Dr. J. Paul Choudhury, Satyendra Nath Mandal, Prof Dilip Dey, Prof. S. K. Mukherjee, Bayesian Learning versus Neural Learning : towards prediction of Pod Yield", Proceedings of National Seminar on Recent advances on Information Technology(RAIT-2007), Department of Computer Science and Engineering, Indian School of Mines University, Dhanbad, India , pp 298-313, February 2007.

[27] Dr. J. Paul Choudhury, Satyendra Nath Mandal, Prof. S. K. Mukherjee, "Shoot Length Growth Prediction of Paddy Plant using Neural Fuzzy Model", Proceedings of National Conference on Cutting Edge

Technologies in Power Conversion & Industrial Drives PCID, Department of Electrical and Electronics Engineering , Bannari Amman Institute of Technology, Sathyaamangalam, Tamilnadu, India , pp 266-270, February 2007.

[28] Shyi-Ming Chen and Jeng-Ren Hwang ," Temperature Prediction Using Fuzzy Time Series", IEEE Transaction on Systems, Man and Cybernetics,pp263-275,Vol.30,No 2,April 2008.

[29] Surajit Chattopadhyay and Monojit Chattopadhyay,"A soft computing Technique in rainfall forecasting ", proceedings of International Conference on IT,HIT, pp523-526, March 19-20,2007.

[30]S. Chaudhury and S. Chatto Padhyay ," Neuro – Computing Based Short Range Prediction of Some meteorological Parameter during Pre-monsoon Season", Soft Computing –A fusion of Foundations Methodologies and Application ,pp349-354,2005.

[31]M. Zhang and A.R. Scofield," Artificial Neural Network Techniques for Estimating rainfall and recognizing Cloud Merger from satellite data", International journal for Remote Sensing,16,3241-3262,1994.

[31]M.J.C ,Hu, Application of ADALINE system to weather forecasting , Technical Report ,Standford Electron, 1964.

[32] D.W. McCann ," A Neural Network Short Term Forecast of Significant Thunderstroms", Weather and Forecasting,7,525-534,doj:10.1175/1520-0434,1992.

[33]D.F Cook and M.L. Wolfe, " A back propagation Neural Network to predict the average air Temperature", AI Applications 5,40-46,1991.

[34]Mohsen Hayati and Zahra Mohebi ," Application Artificial Neural Networks for Temperature Forecasting " , Proceedings of WASET , pp275-279,vol 22, July 2007,ISSN 1307-6884.

[35]P. Sangarun, W. Srisang, K. Jaroensutasinee and M. Jaroensutasinee ,"Cloud Forest Characteristics of Khao Nan, Thailand", Proceedings of WASET,Vol 26, December 2007,ISSN 1307-6884.

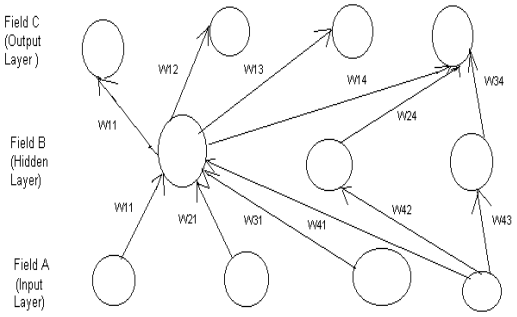
[36] Tahseen Ahmed Jilani, syed Muhammad, Agil Burney and Cemal Ardil ," Fuzzy Metric Approach for Fuzzy Time Series Forecasting based on Frequency Density Based Partitioning", Proceedings of WASET ,Vol 23, August 2007, ISSN 1307-6884.

[37] S. Kotsiantis, E. Koumanakos, D. Tzelepis and V. Tampakas ," Forecasting Fraudulent Financial Statements using Data Mining",
International journal of Computational Intelligence,pp104-110, Vol 3 No 2.

[38] Paras, Sanjay Mathur, Avinash Kumar and Mahesh Chandra ," A Feature Based Neural Network Model for Weather Forecasting ",Proceedings of WASET ,Vol 23, August 2007, ISSN 1307-6884.

[39] Marco Grubert ," Simulated Plant Growth", A ACM Student Magazine.

[40] Satyendra Nath Mandal, J. Pal Choudhury, Dilip De and S. R. Bhadrachaudhuri , " A framework for development of Suitable Method to find Shoot Length at Maturity of Mustard Plant Using Soft Computing Model" , International journal of Computer Science and Engineering Vol. 2 ,No. 3



Layout of a Feed Forward Back Propagation Neural Network

Figure 1

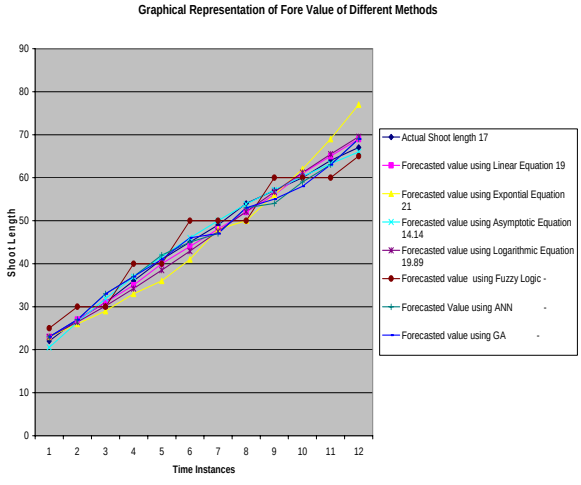


Figure 2

Satyendra Nath Mandal (23/10/1975) has received his B.Tech & M.Tech in Computer Science & Engineering from university of Calcutta, West Bengal India. He is now working as a lecturer in department of Information Technology at Kalyani Govt. Engg. College , Kalyani , Nadia, West Bengal, India. His field of research areas include cryptography & network Security, fuzzy logic, Artificial Neural Network, Genetic Algorithm etc. He has about 15 research papers in national and International conferences. His one research paper is published in International journal of computer science and Engineering published by WASET.

Dr. J. Paul Choudhury(Jagannibas Paul Choudhury) completed Bachelor of Electronics and Tele-Communication Engineering(Hons) from Jadavpur University, Kolkata M. Tech in Electronics and Electrical Engineering under the specialization of Control and Automation Engineering from Indian Institute of Technology, Kharagpur and. thereafter completed PhD(Engg) from Jadavpur University, Kolkata. At present Dr. Paul Choudhury is with Information Technology Department, Kalyani Government Engineering College, Dt Nadia, West Bengal, India, and he has 60 publications in National and International Journals and in Conference Proceedings. His field of interest is Soft Computing, Data Base, Object Oriented Methodology, etc.

Dr. S. R. Bhadra Chaudhuri is Professor & Head of Department of Electronics & Tele Communications, Bengal Engineering and Science University, Shibpur, Howrah, West Bengal, India. He completed B.E,M.E in Electronics & Telecommunication , M.B.A from University of Calcutta and Ph.D(Engg.) from Jadavpur University, India. He has 29 in Engineering and 8 in Management research publication . He field of interest are Microwave, Communication, Network Security and Soft computing.

Dr Dilip Kumar De (01/11/1950) is Professor & Head , Department of Plant Breeding , Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia,West Bengal, India. Dr. De completed B.Sc(Ag.) & M.Sc(Ag.) from Banaras Hindu University,India and he received Ph.D from Bidhan Chandra Krishi Viswavidyalaya. His field of research area is Genetics and Plant Breeding. He has published a book named " Production and Protection Management of Forage Crops , 51 research papers and 3 Scientific article in Science Reporter of CSIR.