Prediction of Rice Production of India Using Neuro Static Model

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ABSTRACT

There are many statistical based predictive models for prediction of productivity of rice. In this paper, a hybrid model using statistic and neural network is used to predict the production of rice in India. The statistics equations like linear, Exponential, Fourier, Gaussian, Polynomial are applied on time series data. One equation is selected based on minimum average error. The values of constants of selected equation are further modified using neural network. It is observed that the error of prediction is further minimized using statistic neuron mode compare to prediction based on statistic.

Keywords: Time Series Data, Soft Computing Model, Statistical Models, Neural Network, Average Error.

1. Introduction

Time series analysis is a statistical technique or trend analysis. Many technologies are also available for evaluation of time series forecast [1]. Time series modeling is a dynamic research area and most of the researchers are trying to develop appropriate time series equations for real life data set. Many important models have been proposed in literature for improving the accuracy and efficiency of time series modeling and forecasting [2]. The main aim of time series modeling is to collect past data carefully and to analyses the data set for finding the relationship among data elements in the set. Finally, an appropriate model will be developed which describes the inherent structure of the series. The future data will be predicted based on predicted structure of the series [3]. The accurate and the most efficient forecasting may support making correct decision to raise accuracy of our expectations up to 100%. This may be impossible yet we try to reduce forecasting errors [4].

In this paper, one time series data set of Rice production for India from 1981 to 2003 is taken for analysis to predict future production. The statistical equations like linear, exponential, gaussian, polynomial, Fourier series and sum of sine are applied on this data set. One equation is selected based on error analysis. The prediction accuracy is further improved using back propagation neural network. The paper is divided into the following parts. The first part (2) of this paper deals with the Artificial neural network and error analysis. The second part (3) deals with the proposed model. the third part (4) and (5) deals with authentic data used to prediction value using different statistical

equations and prediction value using neural network on Fourier series. Part (5) conclusion and future scope. Finally, the reference is described as part (6).

2. Artificial Neural Network and error analysis

2.1. Feed forward back propagation neural network

The feed forward back propagation neural network is shown in fig. 1. It has no feedback connections but errors are back propagated during training. An error at output terminal is measured from hidden layer output errors. The errors of hidden layers are computed by 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.

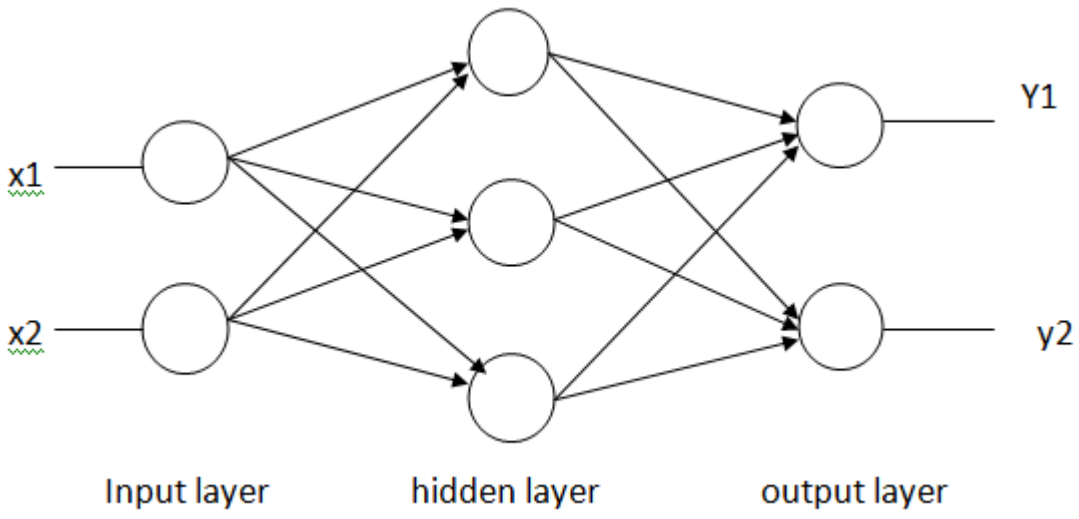


Fig 1. Feed forward back propagation neural network

2.2. Find the Forecasted error and average forecasted error -

- Mean Square Error (MSE) = $\sum^{n}_{i=1}(\text{Actual Value}_{(i)} - \text{Forecast Value}_{(i)})^2 / n$.
- Average Forecasting error = $\sum^{n}_{i=1}[\text{mod}(E_i - F_i) / E_i] / n$.

Where E_i =Actual value and F_i = forecast value.

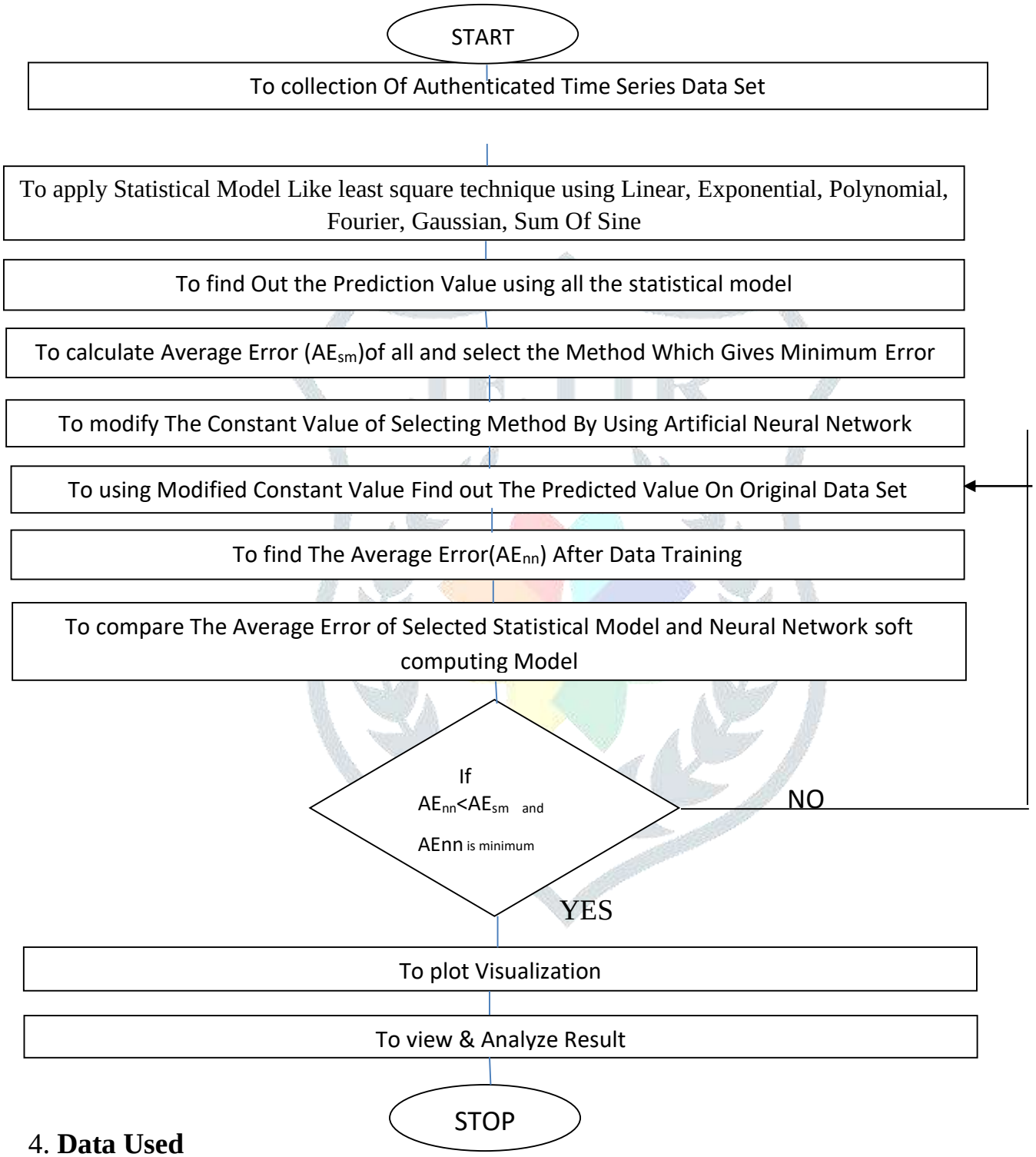
- Residual Analysis –

Absolute Residual = mod [Actual value – Forecast value].

Mean Absolute Residual = mod [Actual value – Forecast value]/Actual value

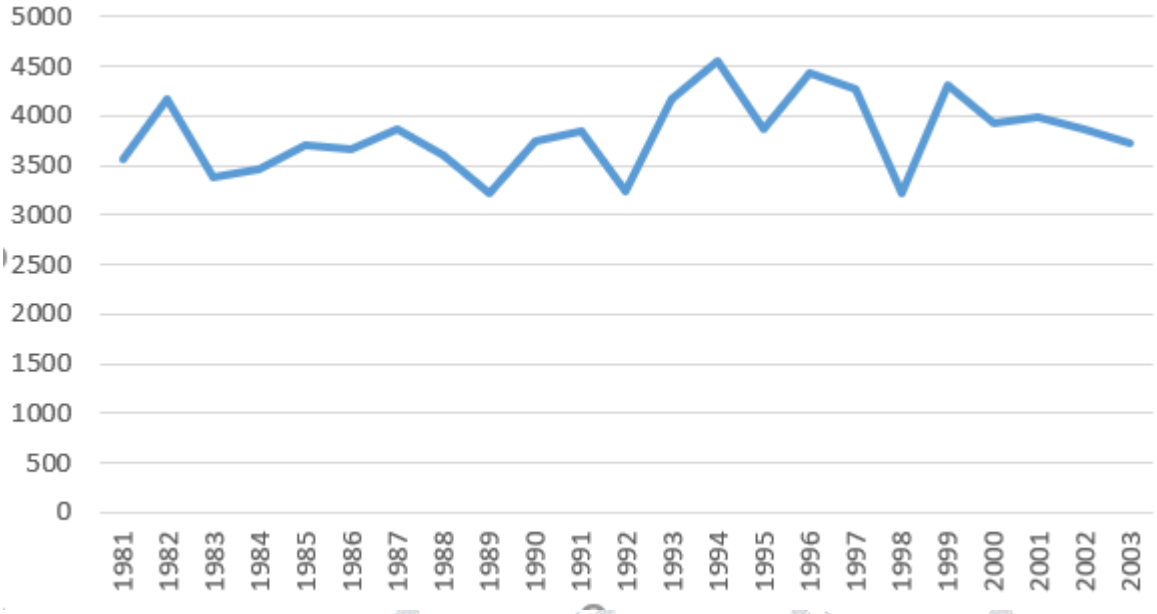
3. Proposed model

In this paper, the prediction model is developed based on the statistic equation followed by neural network. The pictorial representation of this model is given in fig.2.



4. Data Used

Rice production for India on the premise of historical time series rice data. Real time data of patna nagar farm, G.B. Pant University of Agriculture & Technology [2]. The graphical representation of data set is given in fig 3.



5 Result

5.1 Prediction using statistical equation

The statistical equations like linear, exponential, gaussian, polynomial, Fourier series and sum of sine are applied on this data set and the predicted data set have been calculated is shown in table 1. The error analysis is given in table 2. The minimum errors are underlined. The graphical representation of predicted errors is shown in fig.4. The feed forward neural network is applied on selected equation and the minimum prediction error is further reduced are given in table 3 and table 4. The final error analysis is also shown in fig 5.

Table 1. Actual data to predicted data based on statistic equations -

Year	Actual Data	Predicted Data for Polynomial	Predicted Data for Linear	Predicted Data for Exponential	Predicted Data for Fourier	Predicted Data for Gaussian	Predicted Data for Sum of Sine
1981	3552	3610	3643	3615	3695	3536	3535
1982	4177	3629	3625	3633	4132	3574	3573

1983	3372	3647	3618	3651	3571	3610	3609
1984	3455	3666	3643	3668	3766	3644	3643
1985	3702	3685	3694	3686	4107	3677	3676
1986	3670	3703	3738	3704	3528	3709	3706
1987	3865	3722	3752	3722	3839	3738	3735
1988	3592	3741	3738	3740	4068	3766	3763
1989	3222	3759	3726	3758	3499	3792	3788
1990	3750	3778	3743	3777	3911	3816	3812
1991	3851	3797	3790	3795	4016	3838	3833
1992	3231	3815	3841	3813	3486	3858	3835
1993	4170	3834	3866	3832	3978	3876	3871
1994	4554	3853	3860	3851	3954	3893	3888
1995	3872	3871	3845	3869	3489	3907	3902
1996	4439	3890	3854	3888	4036	3919	3915
1997	4266	3909	3896	3907	3884	3929	3926
1998	3219	3927	3950	3926	3508	3937	3935
1999	4305	3946	3986	3945	4084	3943	3942
2000	3928	3965	3989	3964	3812	3947	3947
2001	3978	3983	3974	3983	3542	3948	3950
2002	3870	4002	3975	4003	4118	3948	3951
2003	3727	4021	4010	4022	3739	3945	3951

Table 2. MSE , RMSE , Average Errors form Actual data to predicted data

Equation	MSE	RMSE	Average Error
Polynomial	124761.5	353.2159	0.07044
Linear	124451.4	352.7767	0.07000
Exponential	124921.4	353.4423	0.07061

Fourier	87590.65	295.9572	0.06707
Gaussian	123361.9	351.2291	0.06885
Sum of Sine	122626.6	350.1808	0.06855

Table 3. **Compare the Prediction Value Using Neural Network on Fourier Series with Simple Fourier series -**

Year	Actual Data	Predicted Data for Fourier	Predicted Data for Artificial Neural Network(ANN)
1981	3552	3695	3550
1982	4177	4132	4175
1983	3372	3571	3494
1984	3455	3766	3640
1985	3702	4107	4156
1986	3670	3528	3426
1987	3865	3839	3736
1988	3592	4068	4115
1989	3222	3499	3376
1990	3750	3911	3833
1991	3851	4016	4054
1992	3231	3486	3346
1993	4170	3978	3927
1994	4554	3954	3978
1995	3872	3489	3340
1996	4439	4036	4011
1997	4266	3884	3889

1998	3219	3508	3356
1999	4305	4084	4081
2000	3928	3812	3794
2001	3978	3542	3394
2002	3870	4118	4134
2003	3727	3739	3696

Table 4, **Show the Average Error, MSE, RMSE From Actual Data to Predicted Data**

Methods	MSE	RMSE	Average Error
Fourier	87590.65	295.9572	0.06707
Artificial Neural Network(ANN)	95119.74	308.4149	0.06418

Table 5. **Future prediction from 2004 to 2010 using artificial neural network**

Year	Forecast Data
2004	3452
2005	4166
2006	3601
2007	3526
2008	4176
2009	3515
2010	3614

6. CONCLUSION AND FUTURE SCOPE

In this paper, one time series data named rice prediction from 1981 to 2003 is used for prediction. Some statistical equations like linear, exponential, gaussian, polynomial, Fourier series and sum of sine are applied on this data set. The Fourier series is selected based on error analysis. The error is further reduced by artificial neural network based on proper selecting of constants of Fourier series. It is observed that the proposed model is given better

performance. The more methods and comparison will be applied on same time series data in future.

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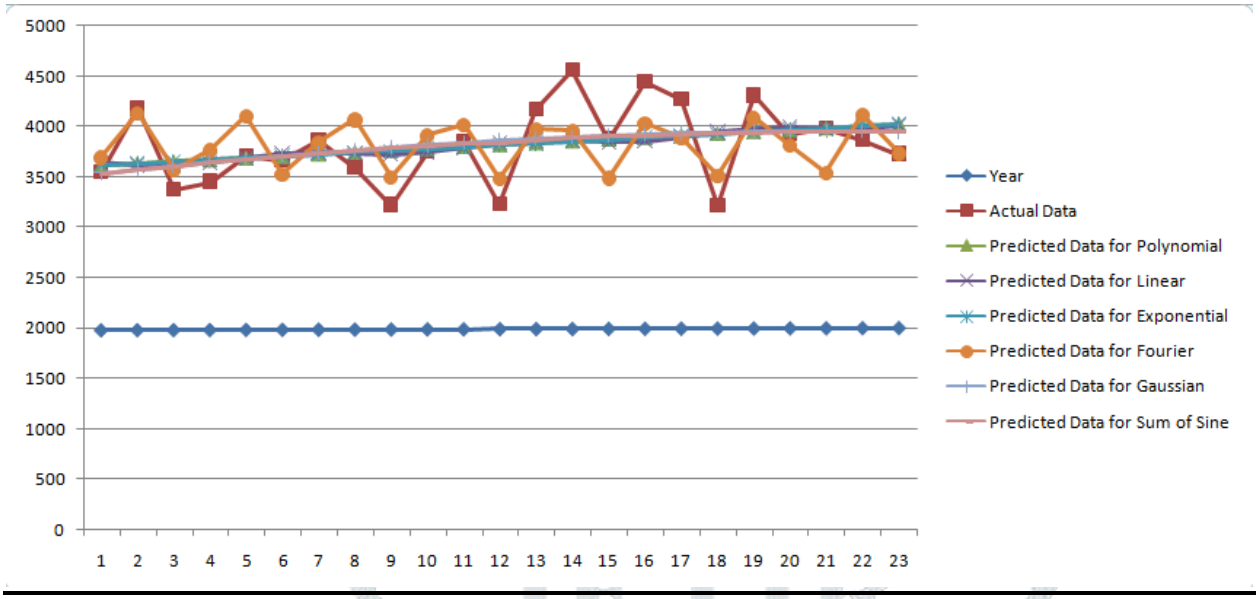

Figure 4: prediction observation of all statistical equation's vs actual data

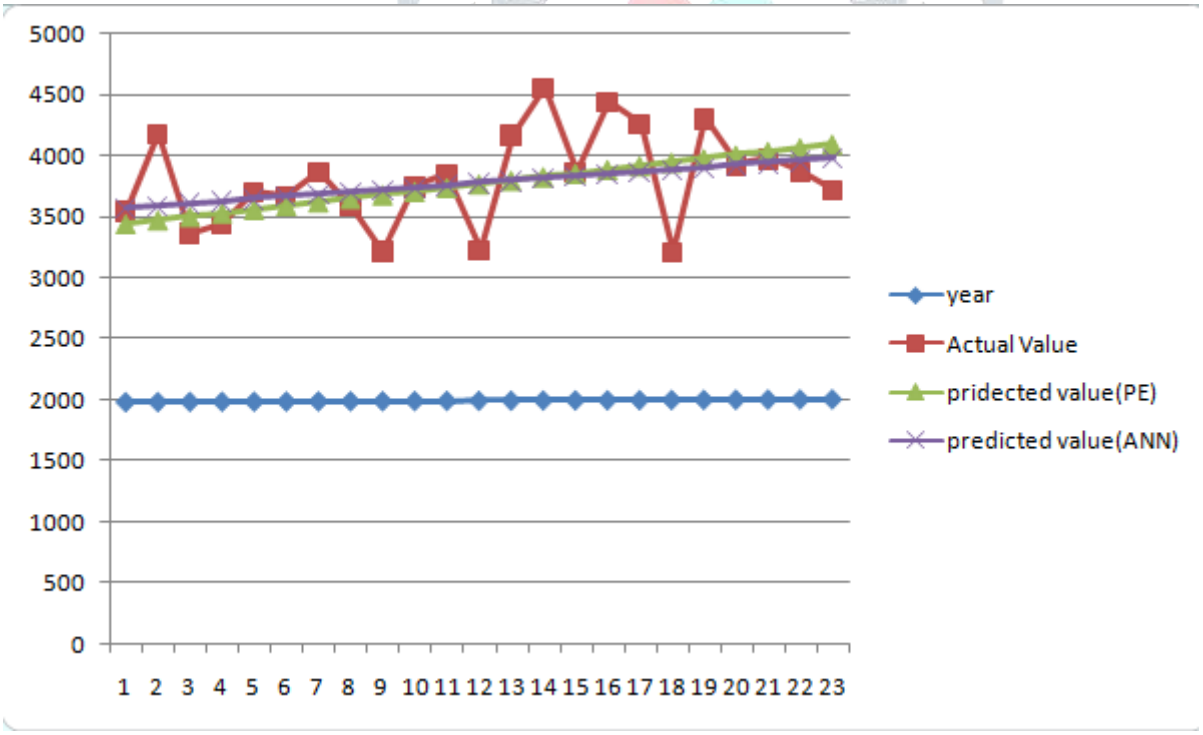

Figure 5: predicted data (ANN) vs actual data