STUDY OF CLIMATE CHANGE TO INCREASE RAISIN PRODUCTION

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Abstract – The unseasonal rain and hailstorm over the past years have impact on standing rabbi crops across Maharashtra and Madhya Pradesh. The rain has affected standing crops such as wheat, corn, onion, jowar (sorghum) and green gram on about 1.24 lakh hectares in Maharashtra. Grape, orange and banana farms too have suffered wide damage. In this paper we can focus on climate change particular in Sangli district where massive production of sweet grapes. The unseasonal rains during period of September to December can huge effect on raisins production. So to increase production of raisins with good quality and tonnage the prediction of climate change is essential to take precaution.

Forecasting of weather change can be done by developing artificial neural network model using nntool. The cascaded forward back propagation model using nntool is most commonly used prediction model, Due to its ease of training. The back-propagation-feed forward neural network can be used for various applications such as speech or voice recognition, image pattern recognition, medical diagnosis, and automatic controls weather prediction. This paper implements weather prediction applications by developing neural network model for training and testing of data sets particularly in Sangli district.

*Key Words***:** agriculture, prediction, cascade forward back propagation algorithm, NNTOOL, MATLAB.

1. INTRODUCTION

Indian agriculture is affected by natural threats. Raisin producers are not exception for this phenomenon. Raisins producer of the Sangli district have faced the problems of natural hazards. Heavy rainfall affects the raisin production in Sangli district. Raisins are damaged in drying stage during the month of March to May; therefore, the product should be protected during this period. Humid weather changes the color of raisins. It gets black color. The study region receives uncertain rainfall from cyclones occurred on Bay of Bengal and Indian Ocean. The cyclones rain proceeds to Sangli region November, December and January, sometimes with clouds and mists only. Due to cloudy and high weather, foggy condition prevails in the study region. Such humid climate affects the pollen germination, cap fall and environmental disease and pest increase i.e. downy mildew. It affected growth of the grapes and ultimately on the yield. Therefore, the lack of raw material problem was made for raisins production. Out of the total sample respondents, 89.81 per cent are faced the problem of heavy, uncertain rainfall and foggy weather.[1]

Forecast of weather can be done by smartly 'evaluating' the trend from a previously available huge historical set of climate data by developing ANN model. Apart from ANN, the other models are either mathematical or statistical. These models have been found to be very correct in calculation, but not in forecast as they cannot familiar to the irregularly changing patterns of climate data which can neither be written in form of a function, nor calculated from a formula. These actual conditions have been found to be better understood by 'artificial neurons' which can learn from experience, i.e. by back-propagation of errors in next guess and so on. This may lead to a compromise in accuracy, but give us a better advantage in 'understanding the problem'. Amongst all meteorological conditions, rainfall plays the most vital role in agriculture sector. Raisin production industry to a great extent depends upon frequency of rainfall and amount to various scales. Several random models have been tried to predict the occurrence of rainfall and to investigate its seasonal changes to predict the annual/monthly precipitation in some geographic areas. The paper implemented an ANN model to forecast average monthly precipitation in the Sangli district of Maharashtra. Indian economy is relies on the agriculture sector. So prediction of rainfall is a challenging topic to Indian atmospheric scientists. Forecasting of the unseasonal rainfall in September to December over Sangli district of Maharashtra by implementing cascade forward back propagation algorithm model.[3]

METHODOLOGY OF IMPLEMENTATION

Steps of developing prediction models are as follows:

1. Selection of the input and the target data for the supervised BP learning.
    - Input data- temperature data, humidity data.
    - Target data- rainfall.
2. Normalization of the input and the target data if huge data for training. Otherwise by observing various plots of input data divide it into 1 and 0.
    - Rain- 1
    - No rain- 0
3. Training of the morphological data using back-propagation learning.
4. Testing the goodness of fit of the model.
5. Comparing the predicted output with the desired output.

A) SELECTION OF THE INPUT AND THE OUTPUT DATA

In Maharashtra the months of September to December are identified as the unseasonal rainfall with May, June, July, August, and October as the main monsoon seasons. Thus the implemented study explores the data of these months. The Input parameters are the average Humidity and the average Temperature for the 4 months of 5years data. In the target parameter is average rainfall in the 4 months of 5 years data. Normalization of input and target data is to be done if data is huge. Otherwise by observing input data and target data plots divide data into 1-rain, 0-no rain. The data stated above was retrieved from https://en.tutiempo.net/climate/india.html

B) NORMALIZATION OF INPUT AND TARGET DATA:

The input and the target data obtained have to be normalized because they are of dissimilar units and otherwise there will be no relationship between the input and the output values. First the mean of all the data separately were taken for humidity, temperature and rainfall.

Let the mean be M. **M= sum of all entries/number of entries** Then the standard deviation, SD, for each of these parameters individually were calculated. Now after the calculation of mean and SD for every parameter, the values for each parameter were normalized

Normalized value = (x-M)/SD

Normalization of data using excel

Normalized data denotes to any number that is part of a distributed set of numbers that has been adjusted for the mean, or average, of that set and the set's standard deviation

In Microsoft Excel, we can use the STANDARDIZE formula to normalize any number.

Open a new Excel workbook. Enter a set of data in column A1 starting with cell A2. Type a name for the data in cell A1.

Type Average under the data in column A. Type = AVERAGE() next to the words Average in column B. Place the cursor in parentheses and highlight the data in column A. Press Enter to calculate the formula. The formula is: = AVERAGE(A2:A13).

Enter the standard deviation below the word average. Switch to column B and type = STDEV(). Place the pointer between parentheses again, highlight the data cell, and press Enter. In the screenshot example, the formula is: = STDEV(A2:A13).

Place the cursor in cell B2, beside the first value in column A. Type =STANDARDIZE() in the cell and place the

pointer between the parenthesis. Type three cells coordinate:

Type A1 for the cell to be normalized, then a comma.

Type B$ and then the cell number having the AVERAGE formula, such as B$15, followed by a comma.

Place the cursor next to the first value in column A in cell B2. Type = STANDARDIZE() in the cell and place the cursor between parentheses. Type three cells coordinate:

Enter A1 for the cell you need to normalize, and then enter a comma.

Type B$ and enter the cell number that has the AVERAGE formula, for example B$15, followed by a comma.

Type B$ and the cell number containing the STDEV formula ,for example B$16.

Press Enter to calculate the formula that looks like this: = STANDARDIZE(A2,B $15,B $16).

Press Ctrl-C to copy cell B2. Highpoint all the cells in B2 next to the first column value and press Ctrl-V to paste the formula into these cells. Each value in column A now has a normalized value in column B.

If morphological data to be less, then by observing various plots of input data and target data divide data into 0-no rain and 1-rain.

C) TRAINING OF INPUT DATA-

The next step is to use Matlab Back Propagation Algorithm (BPA) to train the input data. We can implement ANN model which is basically two-layered neural network cascade back-propagation learning.

D) TESTING AND VALIDATION OF TRAINED DATA

After the data training is completed, the testing of data is completed and the error is lower than the tolerance level. For more accurate results, the MSE can be as small as possible. MSE can be observed from the performance scenario. The validation in the performance curve is at a minimum, and then the MSE should be the lowest.

E) PLOT COMPARISON OF ACTUAL DATA AND PREDICTED DATA

When testing of data is complete, the results are saved in the workspace and a graph is drawn between the actual output and the predicted output for comparison. This figure is an effective way to compare the two types of data that we have available. Accuracy of the model can also be calculated by observing plots. In this paper, when graphs are drawn between actual and predicted values, they show a high degree of similarity, which proves that our ANN model, is very accurate in the prediction.

RESULT AND DISCUSSION

NNTOOL is used to implement a cascade forward backward propagation algorithm in Matlab.

NNTOOL - open Network/Data Manager. Nntool can be used to implement single layer and multilayer algorithm.

The cascade forward back-propagation algorithm implemented in nntool shows good consistency and accuracy with the target data. For multi-layer structures, we use one input layers, one output layer and ten hidden layers, each with ten neurons for cascade back propagation experiments.

The first nntool was used to test the back-propagation algorithm for sample data, and the following observations were made:

Enter nntool in the command window to first open NNTOOL.

NNTOOL
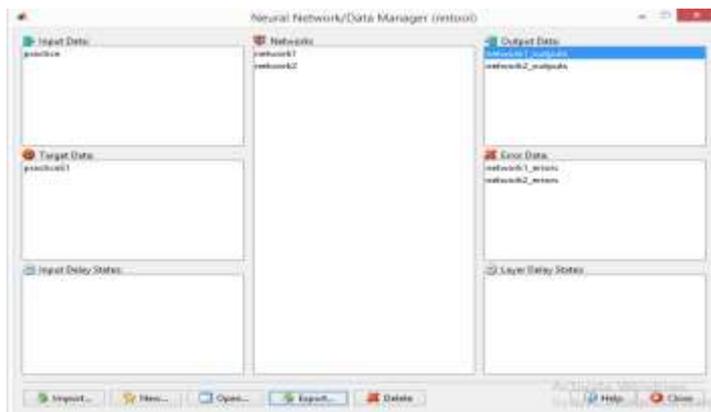
FIGURE1.NNTOOL

IMPORT TO NETWORK DATA MANAGER
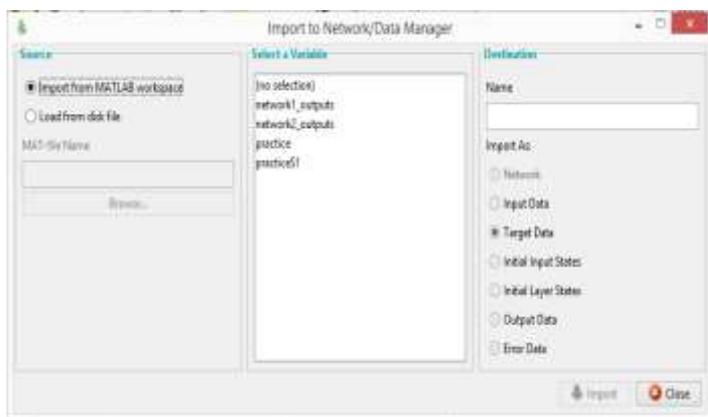
FIGURE2. IMPORT TO NETWORK DATA MANAGER

From figure 2 it can be seen that data to be imported from matlab workspace.

CREATE NETWORK OR DATA

After that, I can use the cascading forward-backward propagation algorithm to create the network. I can choose temperature and humidity data as input and rainfall data as output. I can use TRAINLM as a training function, LEARNGDM as an adaptive learning function, and MSE as a performance function. I can develop two layers of functionality. Among them I can use 10 neurons and TANSIG transfer functions.

FIGURE3.CREATE NETWORK OR DATA

NETWORK
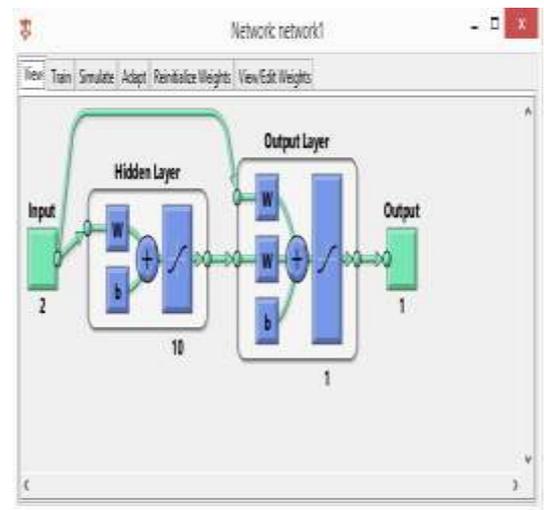
FIGURE4.VIEW OF NETWORK

The figure 4 shows the network view. We can see that the cascade network has 2 inputs, 1 output, and 10 hidden layers.

TRAINING INFO

FIGURE5.TRAINING INFO

Figure 5 shows training info in which we can select input and target for training of the network.

TRAINING PARAMETER
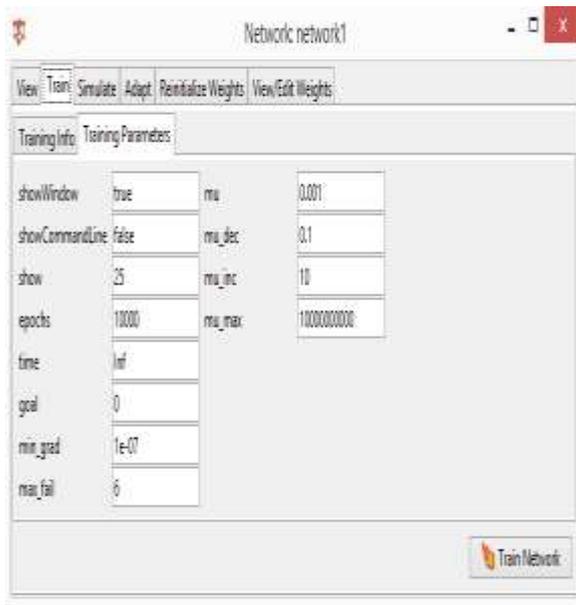
FIGURE6.TRAINING PARAMETER

Figure 6 shows training parameter in which we can select parameters like no of epochs, minimum gradient, max fail, mu etc.to increase the accuracy of network we can increases the no of epochs.

TRAINING NETWORK TOOL
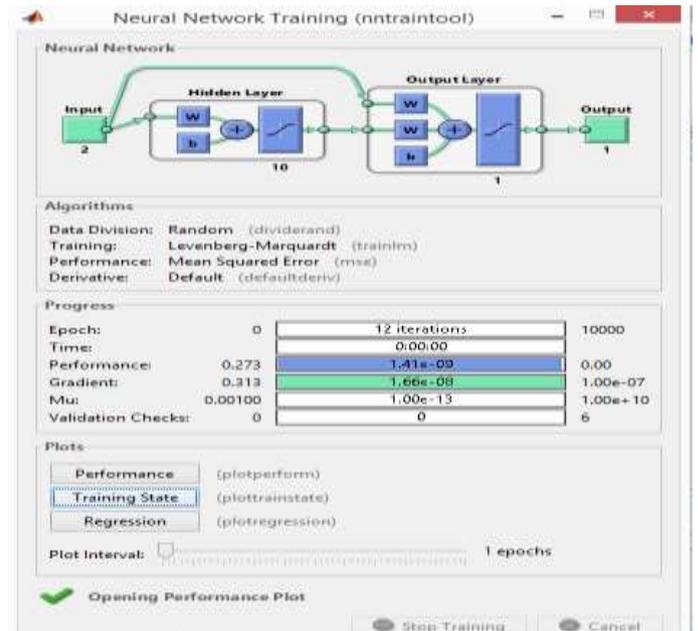
FIGURE7.TRAINING OF NEURAL NETWORK

DATA NETWORK OUTPUT
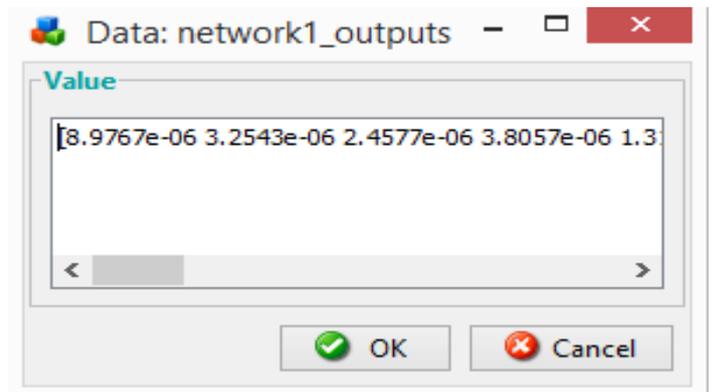
FIGURE8.OUTPUT OF TRAINED NEURAL NETWORK

PERFORMANCE PLOT
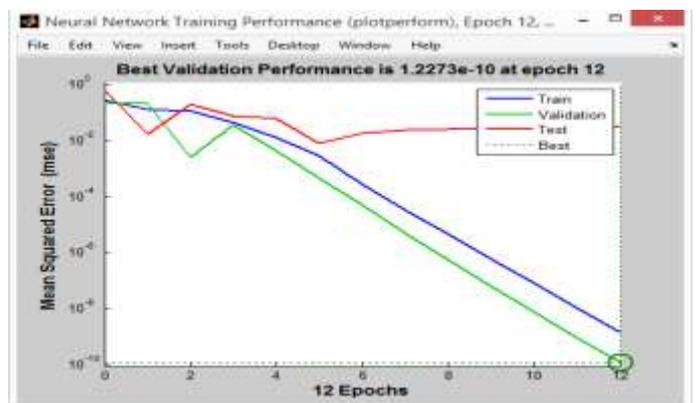
FIGURE9.PERFORMANCE PLOT

- Check performance plot

    1. The mean-square error is as small as possible.

    2. No vital over fitting has happened (where the finest validation performance arises).

TRAINING STATE
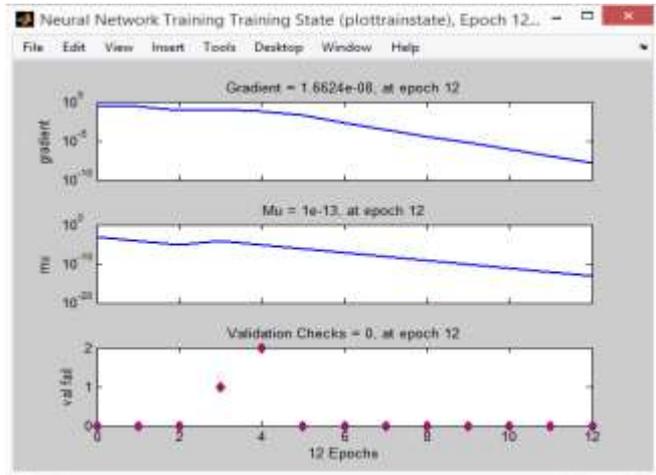
FIGURE10.TRAINING STATE

Figure 10 shows the change in the gradient coefficient with respect to the number of epochs. The final value of the gradient coefficient at epoch's number 12 is 0.313, which is approximately equal to zero. Least the value of gradient coefficient better will be training and testing of networks. From figure it can be seen that gradient values goes on decreasing with increasing in number of epochs.

REGRESSION PLOT
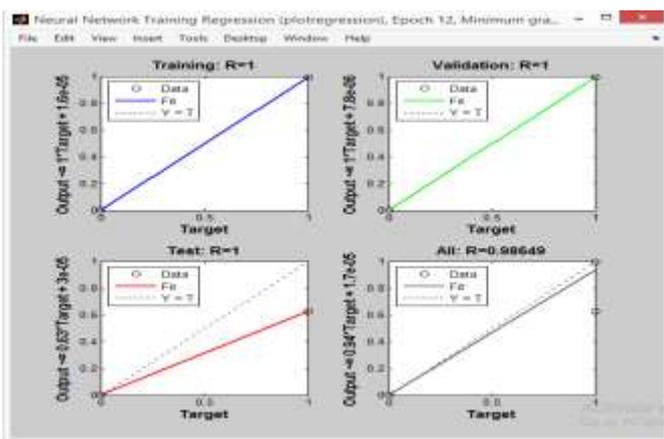
FIGURE11.REGRESSION PLOT

The next step in calculate accuracy of the network is to create a regression plot, which gives the relationship between the outputs of the network and the targets. If the training were accurate, the network outputs and the targets would be matching each other, but the relationship is hardly accurate in practice. For weather prediction example, we can create a regression plot.

DATA EXPORT TO WORKSPACE
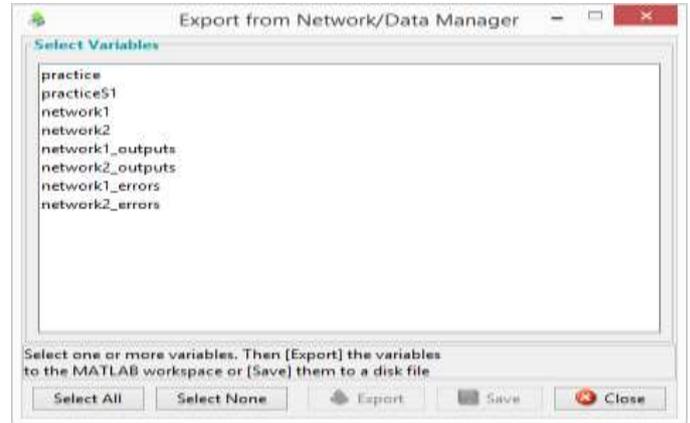
FIGURE12.DATA EXPORT TO WORKSPACE

Output data to be export the workspace for evaluation of results. Plot the results of actual and predicted data.

OUTPUT
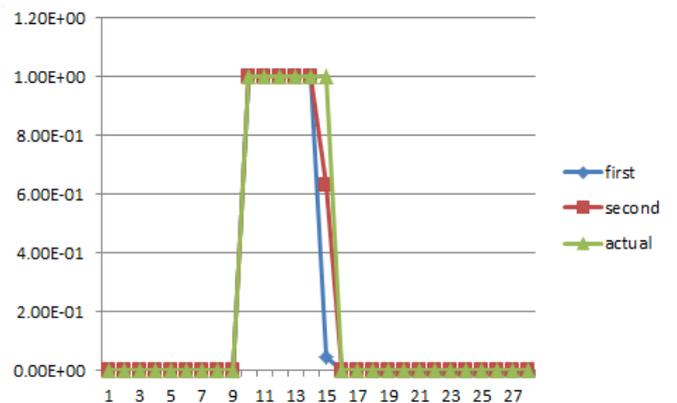
CHART1.LINE PLOT FOR OUTPUT AND ACTUAL RAINFALL

CHART2.BAR PLOT FOR OUTPUT AND ACTUAL

TABLE1. WEATHER CONDITIONS AND PESTICIDE CONTROL

0	1
	(23-24) TEMPERATURE (80-86) HUMIDITY. (23-24)TEMPERATURE (90-97) HUMIDITY. (25-27)TEMPERATURE (90-97) HUMIDITY. (25-27)TEMPERATURE (70-79) HUMIDITY.
NO RAIN	RAIN
NO PESTICIDE CONTROL	PESTICIDE CONTROL:-BLACK ROT-CARBENDIZZAM 1GM+MANCOZED 2GM PER LITER. KEVDA/DOWNY-(METALAXYL+MANCOZEB) 5GM PER LITER

CONCLUSION

From above observation we conclude that for more accurate prediction result mean square error should be as small as possible. For that we can try different training functions. We can increase no of neurons and hidden layers. Trainlm is the fastest back-propagation algorithm training function in toolbox and learngdm is the best learning function. Multi-layer Algorithm is better than Single-layer algorithm terms of performance. NNTOOL is simple way to implement prediction model of back-propagation algorithm. Huge amount of input data, which can reduces the MSE. The input /output data should be normalized if they are of very high order.

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