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Analysis of Deep Neural Network for Forecasting of the Turmeric yield in Telangana

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ABSTRACT

Artificial Neural Network is the mostly used machine learning method for forecasting, in this paper work was carried out on a new technique by introducing Deep neural network concept by increasing the number of hidden layers (two layers) in the existing levenberg Marqardt algorithm and is applied on the data set of the turmeric crop for the forecasting of the accurate yield .to test the algorithm by introducing the two hidden layers the concept of Deep learning was introduced for the forecasting problem to try a new method instead of traditional linear methods and non linear ANN methods.

Keywords : Deep Learning.

I. INTRODUCTION

The crop yield forecasting will determine future value of a crop yield for any given particular area/region for a particular year or season. It has gained significance due to the rapidly growing population, industrialization and globalization. A successful forecast of a crop yield will result in significant profits. An accurate crop yield forecast helps farmers in storage management and planning for the next year's crop and helps governments for better post-harvest management in terms of storage, transportation and distribution at local / regional / national level, and plan import/export strategies accordingly. It is particularly useful for us as our economy primarily depends on agriculture and agriculture based products. Moreover, almost two-third of the employed class in our country lives on the business of agriculture. forecasting of turmeric yield help the farmers and the stake holder to prepare and plan for the storage of the crop so that the quality of the turmeric damages with severe weather conditions of a particular crop, the data of the parameters which will have impacted on the crop yield is collected from the regional agriculture office were we found that the Rainfall, temperature, humidity, soil (NPK) and precipitation are the parameters which have greater impact on the turmeric yield. As Turmeric spice is an important ingredient in our country and mostly used in food items, medicines and cosmetics and our country contributes about 80 percent of total exports carried out in the world.

Collection of Data Set :

The turmeric is a rain fed crop and sown before monsoon season. Though many factors affect the yield of Turmeric, we consider only the physical factors (climatic conditions) because of an easy availability of the data. As the climatic condition requirements for any crop are different throughout the life cycle of the crop, we consider environmental factors of each month as Individual factor in our study. In this manner there are 24 factors for three months as in Telangana Turmeric is sown in the month of Feb and harvested at the end of the month of April. The 24 factors are average monthly rainfall, maximum temperature in a month, minimum temperature in a month, average monthly humidity, mean sea level pressure, mean wind speed (km/h), maximum sustained speed (km/h) and number of days of rain occurred in the 9 months of crop life cycle. The crop production related data are collected from the Ministry of Agriculture, Government of Telangana and other online sources of Government of Telangana. The meteorological data are collected from the official website of the Indian Meteorological Department and other online sources.

Sample Portion of Data Set Collected for Yield Estimation of Turmeric Crop in Telangana State

Year	N	P	K	Annual Rainfall	Average Precipitation	Average Humidity	Average Temperature	Area	Yield
1975	106.8	31.3	30.2	3254	46.8	43.9	29.3	5967.0	27385.0
...	....	....	....	....	...	....	...	....	....
2011	95.8	31.2	26.7	569.1	49.1	46.9	29.0	19843.0	124311.0
2012	91.4	24.2	27.1	1021.9	43.2	47.2	27.7	19983.0	115607.0
2013	116.2	32.6	32.6	589.1	41.5	49.6	27.6	17733.0	123113.0
2014	101.1	33.2	24.1	851.6	56.4	48.7	27.6	18433.6	110417.4

II. METHODOLOGY

The levenberg Marqardt algorithm is one of the Gradient methods. It is used for optimization using indirect method i.e. this algorithm considers the function which will have zero gradient at the point of extreme minimum. Levenberg's main contribution to the method was the introduction of the damping factor **λ**. This value is summed to every member of the approximate Hessian diagonal before the system is solved for the gradient. Typically, **λ** would start as a small value such as *0.1*. Then, the Levenberg-Marquardt equation is solved, commonly by using a LU decomposition. However, the system can only be solved if the approximated Hessian has not become singular (not having an inverse). If this is the case, the equation can still be solved by using a SVD decomposition. After the equation is solved, the weights **w** are updated using **δ** and network errors for each entry in the training set are recalculated. If the new sum of squared errors has decreased, **λ** is decreased and the iteration ends. If it has not, then the new weights are discarded and the method is repeated with a higher value for **λ**.

The Levenberg-Marquardt algorithm is a very efficient method for approximating a function. Basically, it uses the equation:

$$(JtJ + \lambda I)\delta = JtE$$

Where **J** is the Jacobian matrix for the system, **λ** is the Levenberg's damping factor, **δ** is the weight update vector that we want to find and **E** is the error vector containing the output errors for each input vector used on training the network. The **δ** tell us by how much we should change our network weights to achieve a (possibly) better solution. The J^tJ matrix can also be known as the approximated Hessian. The **λ** damping factor is adjusted at each iteration, and guides the optimization process. If reduction of **E** is rapid, a smaller value can be used, bringing the algorithm closer to the Gauss–Newton algorithm, whereas if iteration gives insufficient reduction in the residual, λ can be increased, giving a step closer to the gradient descent direction.

Data simulation using Deep Levenberg-Marquardt algorithm(with two hidden layers)

Deep Levenberg-Marquardt algorithm uses two multi layer perceptron models for training and simulation. By running the process ten times with both the 20 node hidden-layer MLP and 30 node hidden-layer MLP, the simulations produce a highly satisfactory average outcome for both training and testing .The difference is that the latter achieves a slightly lower MSE and a higher correlation than the former but both show a high consistency between the results of training and simulation or testing.

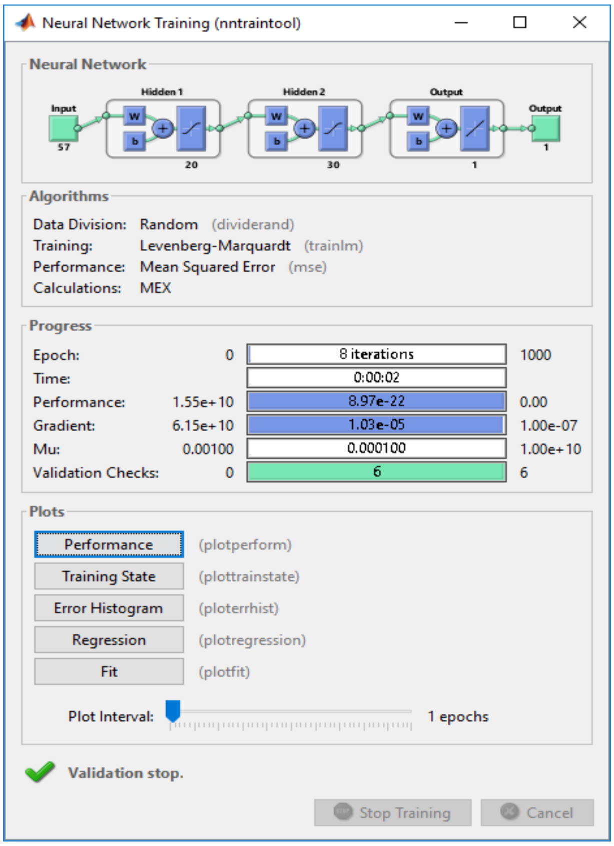

Fig 1 : Training of Turmeric Yield forecasting using Deep Levenberg Marquardt algorithm.

It takes eight iterations to complete the training of this algorithm by using Mat lab the performance of the training which gives mean square error.

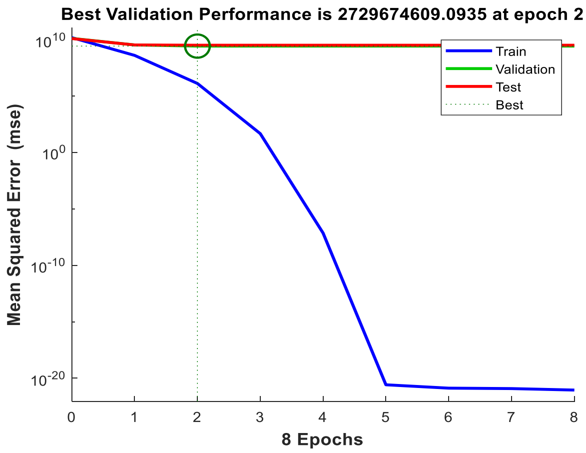

Fig 2 : Mean square error of Deep Levenberg Marquardt training

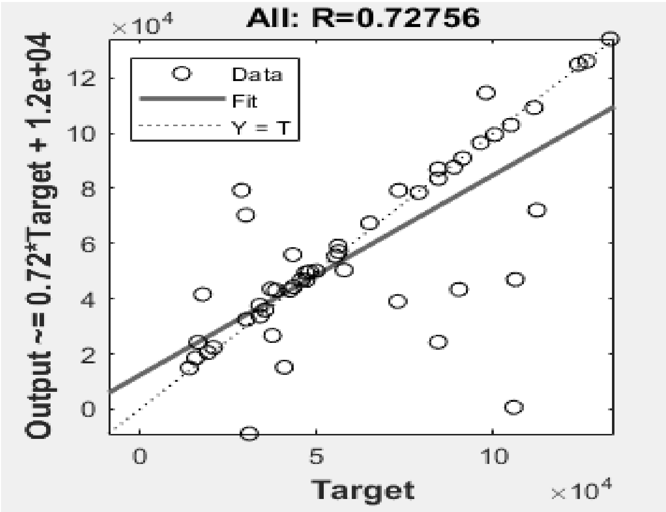

Fig 3 : Regression Performance of Deep Levenberg Marquardt algorithm R=0.55926 (55.26%)

The regression value of 55.26% we got when we trained the data set using the above algorithm

Table 1 : Deep Levenberg Marquardt algorithm NN models for Turmeric Yield forecasting

Run	R (LM)	MSE (LM)
1	66.63%	30.37%
2	67.93%	32.07%
3	61.57%	34.43%
4	73.15%	27.85%
5	65.93%	33.07%
Average	67.44%	31.55%

The results above display the mean square error and regression values and their related figures which are illustrated above. In the above work it is clearly displayed that Deep Levenberg Marquardt Algorithm shows better results of MSE and R values when training and testing is done using Mat lab program

III. CONCLUSION

In this paper the work is carried out using the data set of a turmeric crop for forecasting of the crop and model used is Deep Levenberg marquardt algorithm (with two hidden layers) , here the term deep is used because we are using two hidden layers and the mat lab is used to calculate the MSE and R values related that data set for five times we got average of 67.44% of R and the 31.55% of MSE which is better than the linear and general neural network methods so the deeper form of any algorithm will give good results depending on the problem.

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