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Backpropagation Algorithm for Forecasting the Price of Pulpwood –Eucalyptus

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Abstract: Artificial neural networks (ann)are massively interconnected networks of simple elements, which try to interact with the objects of the real world in the same way as that the biological nervous system.forest and forest products play a significant role in the socio economic development in the country. Consumption of paper per person increases every year. Wood pulp is the basic raw material for the paper industries. This paper is an attempt to forecast the price of the pulpwood (eucalyptus) using artificial neural networks.a levenberg-marquardt back propagation (lmbp) algorithm has been used to develop the ann models with input neurons, hidden neurons and the output neurons. A feed forward back propogation network (bpn) algorithm is used for forecasting.

Keywords: artificial neural networks (ann), wood pulp, levenberg-marquardt back propagation (lmbp), pulpwood,back propogation network (bpn)

I. INTRODUCTION

Forest contributes an important natural resource base of India. To meet the varied demand of the expanding population, trees are being cut down at a massive rate. The indiscriminant felling of trees and the usage of forest products affects the economy of the nation. The forest cover is 23.58% [1] against the mandatory requirement of 33%.As the forest cover is declining at a faster rate, it has reduced the availability of raw materials to major consumers like paper industries. Wood pulp is the basic raw material for the paper industries, particularly one from softwood as it lends strength and superiority to the end product. So forest based industries have to raise their raw materials through agroforestry programs[2]. Forest College and Research Institute developed industrial linkages with pulp and paper industries in the state of Tamil Nadu, India through a National Agricultural Innovation Project on a consortium mode. Eucalyptus, Casuarina, Subabul etc. are used for making pulp. Over twenty years of the price data of pulpwood (Eucalyptus) collected from Tamil nadu Newsprint and Papers Limited (TNPL), is used for forecasting. The forecasting is done in Artificial Neural Networks using MATLAB. ANN is mainly used for forecasting because they are based on the primitive biological model of the nervous system and it provides accuracy.

II. LITERATURE REVIEW

Artificial Neural Networks (ANNs) are modelsbased on the neural structure of the brain. The brain learns from experience. Artificial neural networks try to mimic the functioning of brain. Neural networks are artificial intelligence tools that have recently been applied to diverse forecasting problems such as tornado detection [3] and quantitative precipitation forecasting [4]. These systems were first designed to mimic human learning processes. The ANNs employed the Levenberg–Marquardt training (trainlm function in MATLAB) algorithm [5]. Trainlm provided a learning rate that was rapid enough to maintain efficiency during the various training stages, while being more thorough than quicker algorithms [6].The various applications of ANN are pattern recognition, classification, Time series analysis, forecasting etc. Forecasting involves rainfall forecasting, stock market – price forecasting, temperature forecasting, cash forecasting in bank etc.

Forecasting is usually carried out using various statistical analysis. Forecasting the price of timber is done using statistical analysis. Forecasting the price of pulpwood(Eucalyptus) using Artificial Neural Network is the first of its kind. Learning is a process by which the parameters of a neural network are adapted through a process of stimulation by the environment in which the network is embedded.The type of learning is determined by the manner in which the parameter changes take place. Supervised Learning incorporates an external teacher, so that each output unit is told what its desired response to input signals ought to be. During the learning process global information may be required. Paradigms of supervised learning include error-correction learning (back propagation algorithm), reinforcement learning and stochastic learning.

Most popular supervised training algorithm is BPN. Back propagation is a form of supervised learning for multi-layer nets, also known as the generalized delta rule. Error data at the output layer is "back propagated" to earlier ones, allowing incoming weights to these layers to be updated. It is most often used as training algorithm in current neural network applications. The back propagation algorithm was developed by Paul Werbos in 1974 and rediscovered independently by Rumelhart and Parker. Since its rediscovery, the back propagation algorithm has been widely used as a learning algorithm in feed forward multilayer neural networks.What makes this algorithm different than the others is the process by which the weightsare calculated during the learning network. In general, the difficulty with multilayerPerceptrons is calculating the weights of the hidden layers in an efficient

way that resultin the least (or zero) output error; the more hidden layers there are, the more difficult itbecomes. To update the weights, one must calculate an error. At the output layer thiserror is easily measured; this is the difference between the actual and desired (target)outputs. At the hidden layers, however, there is no direct observation of the error; hence,some other technique must be used. To calculate an error at the hidden layers that will cause minimization of the output error, as this is the ultimate goal.

In India there are about 600 paper mills and out of which 30 to 40% of the industries use wood as a raw material predominantly [7]. In Tamil Nadu, there are about 39 paper mills and of which only 2 paper mills are wood base.

Three main pulp wood based industries in Tamil Nadu are

a. Tamilnadu Newsprint and Papers Limited (TNPL), karur District.
b. Seshasayee paper and Boards (SPB), Erode District.
c. South India Viscose industries Limited, Mettupalayam, Coimbatore District.

The major supply of pulp wood firms in Tamil Nadu are:

a. State Forest Department
b. Tamil Nadu State Forest Plantation Corporation((TAFCORN)
c. Private Plantations

MATLAB is a high-level language and provides an interactive environment that enables us to perform computationally intensive tasks faster than with traditional programming languages. Neural Network Toolbox provides tools for designing, implementing, visualizing, forecasting and simulating neural networks. Using Matlab, the data collected at TNPL is trained using Levenberg–Marquardt training, a supervised training algorithm - Back Propogation algorithm and the price is forecasted.

III. METHODOLOGY

This study is based on the data collected at the Tamilnadu Newsprint and Papers Limited (TNPL) in Karur District, Tamil Nadu. Over twenty years of data with government cost was collected for pulpwood (Eucalyptus).The data collected is used as a training data using ANN. A neural network architecture is constructed as in Fig.1.

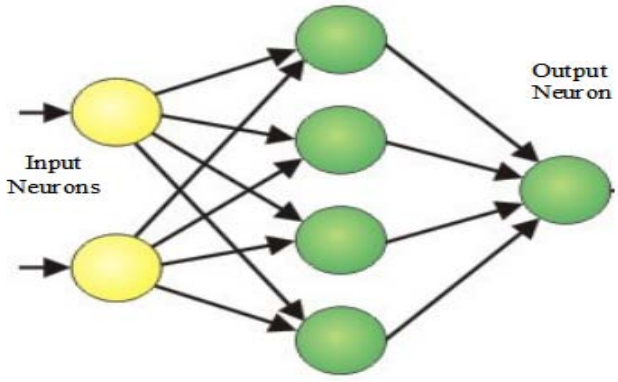

Figure. 1 Neural network architecture

The first step in training is to set a feed forward network to create the network object. The function newff creates a feed forward network, it is done with the data in Table.1. It requires inputs and returns the network object. Before training a feed forward network, we must initialize the weights and biases. The newff command automatically initializes the weights, but we might want to reinitialize them. We do this with the init command. The function sim simulates a network. sim takes the network input and the network object and returns the network outputs. Once the network weights and biases are initialized, the network is ready for training. The network can be trained with the Levenberg-Marquardt (trainlm). The simplest implementation of back propagation [8] learning updates the network weights and biases in the direction in which the performance function decreases most rapidly, the negative of the gradient.

Table.1 Sample Data of the price of Pulp Wood (Eucalyptus) in Rupees (Rs)

Year	**Price (Rs)** -Normalized
1990	0.1720
1991	0.1800
1992	0.1980
1993	0.2170
1994	0.2370
1995	0.2580
1996	0.4000

Back propagation is a general purpose learning algorithm. It is powerful but also expensive in terms of computational requirements for training. A back propagation network with a single hidden layer of processing elements can model any continuous function to any degree of accuracy. Signal forward propagation, from the input layer of different input samples in the hidden layer to the output layer behind. If the output layer of the desired output and the actual output does not match, then control is transferred to the error backpropagation stage. Error back propagation is the expected output and the actual output error in some form through the hidden layer to the input layer by layer back propagation and its allocation to each layer of all units, thereby get the desired output. The backpropagation (BPN) algorithm is the most commonly used trainingmethod for feed forward networks. It stops when the error falls below apredetermined threshold or when the change in error falls below anotherpredetermined threshold or when the number of epochs exceeds a predeterminedmaximal number of epochs. self-adaptation of the learning rate of the backpropagation algorithm helps in improving the approximation of a function [9]. The modified backpropagation algorithm with self-adaptive learning rates is based on a combination of two updating rules-one for updating the connection weights and the other for updating the learning rate. when measurement of error is small then, actual output approaches to desired output using Levenberg-Marquardt algorithm [10] and therefore error reduces greatly.

IV. RESULTS AND DISCUSSION

The network is trained and it uses the default Levenberg-Marquardt algorithm. During training, a training window opens as in Fig2. This window displays the training progress. The training stopped when the validation error increased for six iterations, which occurred at iteration 207 for government wood land cost. The results are forecasted

with the one hidden layer. Several iterations are carried out for each neuron in the hidden layer. Taking data of both the government and the open market wood land cost for over twenty years from TNPL, the data is trained with neural network and with those data the forecast is made and it is Rupees 4268 for the forthcoming year for the government wood land cost. The Open market land cost is forecasted to be Rupees 3532 for the forthcoming year.

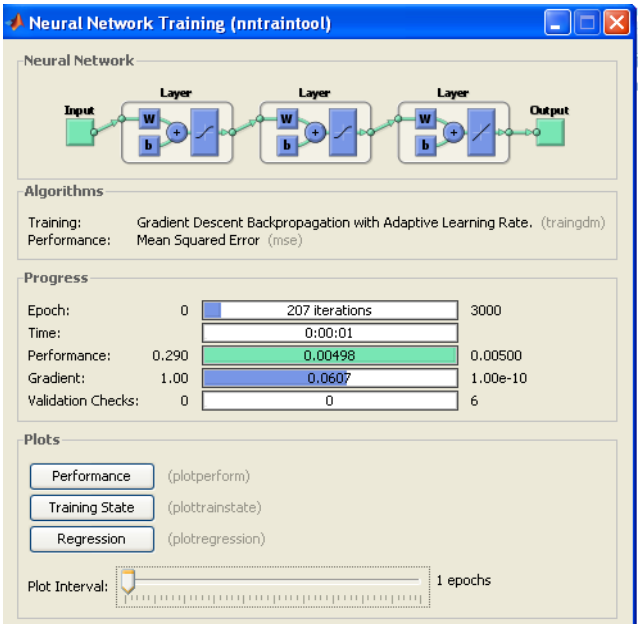

Figure. 2 Neural network training for price data

Traingdm is a network training function that updates weight and bias values according to gradient descent with adaptive learning rate. net - Neural network, Pd - Delayed input vectors, Tl - Layer target vectors, Ai - Initial input delay conditions, Q - Batch size, TS - Time steps, VV - Either empty matrix [ ] or structure of validation vectors, and returns, net - Trained network, TR - Training record of various values over each epoch: TR. epoch - Epoch number, TR.perf - Training performance, TR. vperf - Validation performance, TR. tperf - Test performance. Artificial Neural Network gives accuracy in forecasting the data with back propogation algorithm.

V. CONCLULSION

This study is conducted to forecast the price of pulpwood (Eucalyptus) for the government wood land cost from the data collected at Tamil Nadu News print and Papers Limited (TNPL), karur district, Tamil Nadu, that will help the farmers and the traders. The study can further be extended for forecasting the demand and the supply of various species of wood. It can also be further extended to find out the species of wood that is preferred and mostly used. To obtain the best performance in prediction, we can follow an experimental approach analyzing the entire ANN design space and applying different training strategies. ANN provides a numerical solution to the problem of minimizing a nonlinear function. It is fast and has stable convergence.

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