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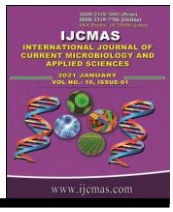

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Medium Range Forecast of Maximum Temperature of Coimbatore using ANN

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A B S T R A C T

Climate is the most important dominant factor influencing the plant growth for particular region. Artificial neural network is a nonlinear modelling used for efficient forecast of weather parameter. Daily data on maximum temperature were collected from Agro climatic Research Centre, TNAU over the period of 1991 – 2017.Analysis has been carried out using the R software 3.4.1. Datasets were split into training and test datasets. The training data were used as input. It has been observed that, NNAR model (6,1,5) [365] was predict the maximum temperature with greater accuracy.

Introduction

In agricultural development, the weather plays an important role. It has a profound impact on a crop's growth, development, and yields, pest and disease incidence, irrigation, and fertilizer requirements. The weekly weather favours outbreak of pest and disease which hamper the crop yield. Predicting weather parameter help in such activity so has to get better output (returns) from agriculture. Forecasting of weather condition up to three days is known as short-range forecasting. Forecasting up to seven days is known as medium-range forecasting. Forecasting up to thirty days is known as long-range forecasting.

Toth *et al.*, (2000) studied the comparison of short-term rainfall prediction models for real-time flood forecasting. Zhang (2003)using a hybrid ARIMA and neural network model to forecast time series data. Bilgili *et al.*, (2007) studied the application of an artificial neural networks for the wind speed prediction of target stations using the reference stations data. Pandey *et al.*, (2008) compared the neural network and fuzzy model to forecast wheat production in India. Gasse *et al.*, (2014)applied the hybrid algorithm for Bayesian network structure learning. In this study, an attempt has been made to predict the maximum temperature of Coimbatore using ANN.

Materials and Methods

Data collection

The secondary data on maximum temperature of Coimbatore were collected from agro climatic research centre of Tamil Nadu agricultural university, Coimbatore. Daily data were taken from the periods of 1st January 1991 to 10th December 2017 with 9841 observations.

Artificial neural network

An Artificial Neural Network (ANN) is a computational model based on the structure and functions of biological neural networks. ANNs are considered nonlinear statistical data modelling tools where the complex relationships between inputs and outputs are modelled or patterns are found.

Multiplication, summation, and activation are the three simple sets of rules in ANN. The input is multiplied by its appropriate weights. The weights represent the interconnection between the neuron in the neural network. The weighted inputs are all summed up inside the computing unit and bias. The sum is passed through a nonlinear function known as an activation function or transfer function. The activation function is usually having a sigmoid shape. The output is

$$\hat{Y} = f\left\{\sum_j^q w_{kj}\, f\left(\sum_i^p w_{ij} x_i + b_j\right) + b_k\right\}$$

Where f is an activation function, x_i is the input vector and 'b' is the bias, 'p' is the number of neurons in the input layer, 'q' is the number of neurons in the output layer, 'w' is the weight and i, j, k are the neurons of the input, middle and output respectively.

Accuracy measures

The difference between the original value and the predicted value is known as residuals. Assume y_i denote the i^{th} observation of y and $\hat{y}_i$ is predicted value of y_i, then residuals are

$$e_i = (y_i - \hat{y}_i)$$

Scale-dependent errors denote that data and the residuals are on the same scale. The most commonly used scale-dependent errors is Root mean squared error(RMSE)=$\sqrt{\text{mean}\,(e_t^2)}$. The model which have a minimum value of error is considered the best model.

Results and Discussion

Neural Network Auto regression was fitted to maximum temperature data with help of R software. Daily weather data on maximum temperature with 9841 observations was spilt into training datasets and test data sets. The last 10 days' data points consider testing data sets, to validate the medium-range forecast. Training datasets were normalized and 20 repeats were used in neural network auto regression. In NNAR (p,P,k) where p indicates the lagged value of non-seasonal time series AR(p), p is the lagged inputs for seasonal time series AR(P). and k indicates the nodes in the hidden layer. NNAR model (6,1,5) [365] for daily data on maximum temperature was best fitted with greater accuracy. Root mean square value is used for model accuracy. This NNAR model (6,1,5) [365]has RMSE value of 2.35.

In conclusion the neural network Auto regression model was fitted to weather data. NNAR model (6,1,5) [365]was predict the maximum temperature of Coimbatore with greater accuracy.

Table.1 Actual vs fitted values of maximum temperature Coimbatore

Days	Actual	ANN
D1	24.50	29.83
D2	26.50	29.05
D3	25.20	28.43
D4	29.00	29.04
D5	30.50	29.53
D6	30.50	29.84
D7	31.00	30.04
D8	31.50	30.06
D9	32.00	30.21
D10	32.00	30.39

Fig.1 Working principle of ANN

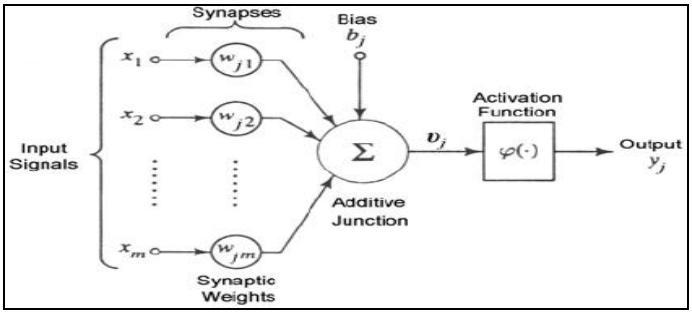
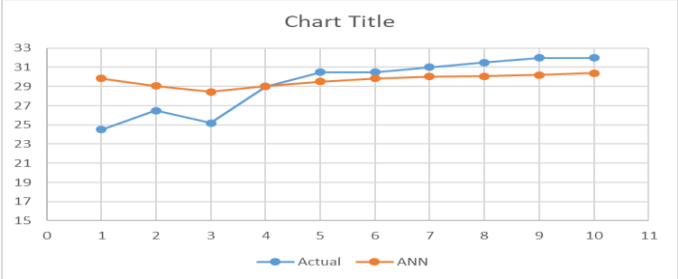


Fig.2 Actual vs fitted plot of maximum temperature



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