Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 1630-1632
Received: 19-07-2018
Accepted: 21-08-2018

Kiran Kumar V
Department of Agricultural Statistics College of Agriculture, UAS, Dharwad, Karnataka, India

ARS Bhat
Department of Agricultural Statistics College of Agriculture, UAS, Dharwad, Karnataka, India

Pavithra NL
Department of Agricultural Statistics College of Agriculture, UAS, Dharwad, Karnataka, India

Megha J
Department of Agricultural Statistics College of Agriculture, UAS, Dharwad, Karnataka, India

Correspondence
Kiran Kumar V
Department of Agricultural Statistics College of Agriculture, UAS, Dharwad, Karnataka, India

Comparative performance of ANN and ARIMA models in redgram price forecasting - Kalaburagi market

Kiran Kumar V, ARS Bhat, Pavithra NL and Megha J

Abstract
The fluctuations in market arrivals largely contribute to price instability. Analysis of price overtime is important for formulating a sound agricultural policy. In view of this, the present study was undertaken by collecting monthly prices of redgram in Kalaburagi regulated Market of Karnataka for a period of 15 years (2002 to 2016). The purpose of this study was also to compare the forecasting performances of different time series methods for forecasting redgram prices. The various forms of Auto Regressive Integrated Moving Average (ARIMA) time series model and Artificial Neural Network (ANN) were employed to predict the future prices. On comparing the alternative models, it was observed that among ARIMA models Akaike Information criteria (4468.98) and Root Mean Square Error (291.74) were the least for ARIMA (3, 1, 2) model and ANN model with minimum RMSE value 244.01 and with highest R^2= 98.17 per cent. The validity of the forecasted price values of redgram was checked and observed an accuracy of 95 to 98 per cent between actual and forecasted value. Therefore, price forecasting using ANN model was considered the most suitable for redgram in Kalaburagi Regulated market.

Keywords: ARIMA, ANN, forecasting, red gram

Introduction
Agriculture provides direct and indirect livelihood support to the large majority of the rural population, and is still a key sector of Indian economy. A variety of crops are grown in India. Pulses are rich in protein and constitute about 10-15 per cent of India's food grain diet. Among pulses, redgram or tur or arhar (*Cajanus cajan*) is an important pulse crop after Bengal gram. Forecasting of redgram price in Kalaburagi (Gulbarga) market was considered for this study. Redgram is a perennial legume from the family Fabaceae.

In Karnataka state, the area under redgram crop was 6.57 lakh ha with a production of 2.41 lakh tonnes and productivity of 387 kg/ha during the year 2015-16. In Kalaburagi district the area under redgram crop was 2.61 lakh ha with a production of 0.94 lakh tonnes and productivity of 383 kg/ha which contributes 39.71 per cent in area and 39.31 per cent in production to Karnataka state followed by Bijapur which contributes 20.64 per cent in area and 16.37 per cent in production and Yadgir contributes 12.14 per cent in area and 9.79 per cent in production (Anon., 2016) [2]. Redgram constitutes an important crop in the farm economy of Gulbarga district, occupying about 25 per cent of the total cropped area. In view of the dominance of the redgram crop in the farm economy of the district, it is important to study the different issues relating to the marketing of this crop. Although the production of redgram in the country and Karnataka in general and Gulbarga district, in particular, has decreased over the years. It is argued that redgram producers are not getting remunerative price for their produce, whereas, consumers have to pay a higher price for the same.

Gulbarga region is known as redgram bowl of Karnataka. The Market rate of the redgram during the year 2014-15 was above the MSP (Minimum Support Price). Hence no procurement of redgram was made during the year 2014-15. Accordingly, procurement of redgram made during 2013-14 was 2, 51, 012 Qtls. Hence, in order to assist and help the farmers through predicting the prices of redgram, performance of ARIMA and ANN models were compared. The best model with minimum error were suggested.

Material and methods
The study on performance of two forecasting models (ARIMA & ANN) was purposively taken up. The secondary data on modal price of redgram were used to analyze the performance of forecasting models. The price data of redgram from Kalaburagi APMC (Agricultural Produce Market Committee), Karnataka state of India. The data covered for the period from 2002 to 2016 and predicted the price for 2017. Data used for the study was collected from Krishimaratavahini website.

Autoregressive Integrated Moving Average process (ARIMA)

ARIMA is one of the most traditional methods of non-stationary time series analysis. In contrast to the regression models, the ARIMA model allows rt to be explained by its past, or lagged values and stochastic error terms. It is expressed in the form:

If $w_t = \nabla^d r_t = (1-B)^d r_t$ then

$$w_t = \phi_1 w_{t-1} + \phi_2 w_{t-2} + \dots + \phi_p w_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \dots - \theta_q \varepsilon_{t-q}$$

If $\{W_t\}$ follows the ARMA (p, q) model, and $\{r_t\}$ is an ARIMA (p, d, q) process. For practical purposes, we can take is usually d = 1 or 2 at most. Above equation is also written

as: $\phi(B) w^t = \theta_0 + \theta(B)\varepsilon_t$

Where $\phi(B)$ is a stationary autoregressive operator, $\theta(B)$ is a stationary moving average operator, and ε_t is white noise and θ_0 is a constant. In the case of the pattern of seasonal time series ARIMA model is written as follows:

$$\phi(B)\Phi(B)\nabla^d \nabla_s^D r_t = \theta(B)\Theta(B)\varepsilon_t$$

Where;

$w_t = \nabla^d \nabla_s^D r_t$

$\nabla^d = (1-B)^d$ Is the number of regular differences?

$\nabla_s^D = (1-B^s)^D$ Is the number of seasonal differences?

Seasonal ARIMA model is denoted by (p, d, q) (P, D, Q), where p denotes the number of autoregressive terms, q, number of moving average terms and d, number of times a series must be differenced to induce stationary. P, number of seasonal autoregressive components, Q, number of seasonal moving average terms and D denotes the number of seasonal differences required to induce stationary [1, 2].

Artificial Neural Network (ANN) Model

Neural Networks are simulated networks with interconnected simple processing neurons which aim to mimic the function of the brain central nervous system. The ANN structure for a particular problem in time series prediction includes determination of number of layers and total number of nodes in each layer. It is usually determined through experimentation as there is no theoretical basis for determining these parameters.

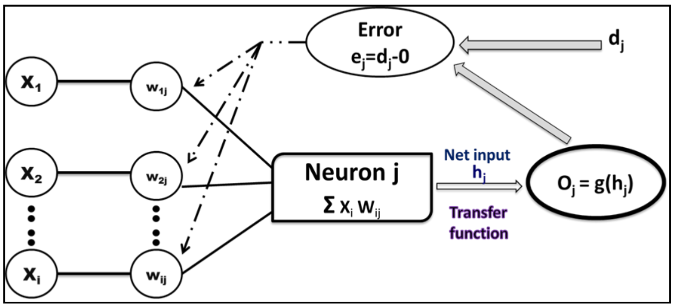
Different network structure will be designed having different numbers of Neurons in the input and the hidden layer. The output layer has only one neuron which gives the forecasted index value. The first input node presents seasonal average price, the second node will have previous seasonal average price value as an input and likewise goes on and output layer will be the next seasonal forecast value. The back-propagation (BP) neural network learning methodology will be used in obtaining the output. A subset of available average price data is used to construct the neural network.

A single hidden layer feed forward ANN with one output node is most commonly used in forecasting applications [1, 2]. ANN model of p×q×1 is

$y_t = \emptyset_0 + \Sigma\emptyset_{jg} + [\theta_{0j} + \Sigma\theta_{ij} y_{t-i}] + \epsilon_t$

Here, *j* (*j* 0,1,2,...,*q*), *ij*(*i*0,1,2,..., *p*; *j* 1,2,...,*q*) are the weights, 0, 0*j* are the bias terms, and ε_t is the white noise.

Back-propagation (BP) algorithm is represented as



$X_1, X_2 \dots X_i$ = input

$W_{1j}, W_{2j} \dots W_{ij}$ = weights

h_j = initial output

O_j = final output

d_j = error at neuron j

In the above structure, actual redgram price series (X1, X2…X_i) being connected to neuron j *with* weights (W_1j, W_{2j}…W_{ij}) on each connection. The neuron sums all the signals it receives, with each signal being multiplied by its associated weights on the connection. This output (*hj)* is then passed through a transfer function, *g (h)* that is normally non-linear to give the final output or forecasted redgram price (*Oj).*

Results and discussion

The results from different ARIMA models for redgram price forecasting in Kalaburagi from 2002 – 2016 is furnished in Table 1**.** Among different ARIMA models fitted, ARIMA (3,1, 2) was found to be best model with low Akaike Information Criteria (AIC) value 4468.98 and RMSE value 291.74. The results of ANN reveals that the errors from ANN method was comparatively less than the ARIMA model, RMSE value of ANN is 244.01 which is less than that of ARIMA and also coefficient of determination was found to be higher 98.17 per cent. To validate the performance of both the models the redgram price was predicted for the year 2017 using the models and the predicted values are compared with the actual price of redgram, it was shown in Table 2.

Table 1: Performance result of different ARIMA models

Criteria	**Arima Models**			
	(1,0,1)	**(0,1,1)**	**(1,1,0)**	**(3,1,2)**
RMSE	302.97	304.03	303.59	291.74
AIC	4505.05	4486.46	4485.56	4468.98

Table 2: Forecasted price of different models

Date	(0,1,1)	(1,1,0)	(1,0,1)	(3,1,2)	ANN	Actual
Jan-17	4871.88	4839.95	4399.73	4145.44	4547.95	4496
Feb-17	4871.88	4839.95	4374.29	4186.87	4117.62	4361
Mar-17	4871.88	4839.95	4349.29	4252.60	4205.87	4372
Apr-17	4871.88	4839.95	4324.70	4148.50	4350.09	4237
May-17	4871.88	4839.95	4300.53	4199.72	3855.83	3908
Jun-17	4871.88	4839.95	4276.77	4236.62	4046.38	3710
Jul-17	4871.88	4839.95	4253.41	4153.98	3599.83	3688
Aug-17	4871.88	4839.95	4230.44	4207.86	4171.45	4158
Sep-17	4871.88	4839.95	4207.86	4223.42	3782.35	4029
Oct-17	4871.88	4839.95	4185.65	4160.64	3546.69	3691
Nov-17	4871.88	4839.95	4163.84	4212.36	3568.68	3779
Dec-17	4871.88	4839.95	4142.39	4212.98	4200.52	4084

The ANN method used for price forecasting of redgram – Kalaburagi market producing RMSE value of 244.014 as an acceptable minimised error. The minimised errors in ANN method may be due to back-propagation algorithm works by minimizing the error between the output and the target (Actual) by propagating the error back in to the network. The weights on each of the connections between the neurons are changed according to size of the initial error. The input data are then feed forward again, producing a new output and error. Once the acceptable error obtained the training is halted, the resulting model selected as a best model. This study is supported by Ramyalakshmi (2014) [4] who analyzed the arrival pattern and price trends of chillies, price volatility, price forecasts and validated them with real time prices, analyzed the extent of market integration among major chilli markets and studied export competitiveness of chillies in India. Arrival and price data required for the study (1991-92 to 2012-13) were collected from various published and unpublished sources. When the forecasts were compared with the real time prices, it was observed that trend analysis was relatively closer in respect of Guntur and Byadagi markets, while ANN model was better than the other models in respect of Khammam and Nagpur markets and ARIMA was a better model with regard to Virudhunagar. This result was supported with the findings of Selvam *et al.* (2008) [5] reported that ANN model shows better performance than the ARIMA models in case of banana price forecasting in Trichy Gandhi market.

Conclusion

The major purpose of studies on forecasting accuracy is to help the forecasters in selecting best forecasting model. In the present investigation forecasting models like ANN and ARIMA are considered to produce forecast and to measure the forecast accuracy among two models. As a policy implication, it is suggested that to facilitate marketing of red gram, transportation facilities, storage structures and market outlets should be developed. The farmers can organize self-help groups and co-operative societies in their areas to get rid of the superfluous marketing charges being charged by the middleman agencies and that way they can get the higher share in the consumer's rupee. Since many tested models are available for forecasting, they can be exploited in getting accuracy in forecasting prices. The government can entrust these work to certain agencies which can forecast the prices and disseminate these forecasts among the farmers so that, farmers can plan for production and marketing of the crop efficiently in order to get fair price for their produce.The price obtained is found to be increasing for various reasons, notably due to the fluctuations in supply. It is hoped that the identification of the best forecasting model would help the consumers as well as suppliers in taking appropriate decisions. By knowing predicted values, it helps the decision makers to take decision on redgram growing and purchasing.

References

1. Anil kumar HS, Evaluation of statistical models in price forecasting-A case of timber trade. M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka (India), 2010.
2. Anonymous. Directorate of Economics and Statistics, Karnataka, DES database. 2016b. http: // www. des.kar.nic.in
3. Armstrong JS, Collopy F. Error measures for generalizing about forecasting methods: Empirical Comparisons. Int. J Forec. 1979; 8(1):69-80.
4. Ramyalakshmi SB. Spatial and temporal behaviour of arrivals and prices of chillies in India. M. Sc. (Agri.) Thesis, Acharya N. G. Ranga Agri. Univ., Guntur, Andhra Pradesh, 2014.
5. Selvam S, Malarvizhi A, Raveendran N, Karrnam L, Anita S. Comparative performance of ANN and ARIMA models in banana price forecasting, Ind. J Agril. Mktg. 2008; 22(1):35-44
6. Thakur GSM, Bhattacharyya R, Mondal SS. Artificial Neural Network based model for forecasting of inflation in India. Int. J Fuzzy Inf. & Eng. 2016; 8:87-100
www. krishimaratavahini.kar.nic.in