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Comparison between Exponential Smoothing and Artificial Neural Network Price Forecast Model for Moong Crop in Sumerpur Market of Rajasthan

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Abstract

Forecasts of agricultural production and prices are intended to be useful for farmers, governments, and agribusiness industries. Moong is an important agriculture commodity especially for the state of Rajasthan. It is important to forecast its price, as this could help the policy makers in coming up with production and marketing plan to improve the economy as well as the farmers'welfare. In this paper, we take up time series modelling and forecasting of the moong price. The various forms of Artificial Neural Network (ANN) and Exponential Smoothing models (Single, Double and Triple) were employed to predict the future prices of moong in Sumerpur market. The performance of fitted models were examined by computing the various measure of goodness of fit, viz., Mean Absolute Deviation (MAD), Mean Standard Error (MSE) and Mean Absolute Percentage Error (MAPE). ANN model for moong were found to be the most appropriate model with MAD Value 11.25 , MSE value of 27205.92 and MAPE value 2.90 per cent. The validity of the forecasted price values of moong was checked by comparing them with their actual market price values during the post sample forecast period i.e. July 2012 to December 2012 for moong crops. The accuracy percentage between the forecasted and actual price value of moong were found to be 95 to 98 per cent. Our empirical results show that Artificial Neural Network Price Forecast time series models fit the price series well and they have correctly predicted the future trend of the price series within the sample period of study. Thus, it was the most representative model for the price forecast of moong in Sumerpur market of Rajasthan. The developed model can be used as a policy instrument for the producers and seller.

Key Word:- Forecast, Moong, Price, ANN, Exponential Smoothing

Introduction

India produces a quarter of the world's pulses and accounting for one third of the total acreage under pulses. Indians consume 30 per cent of the world's pulses but domestic production of pulses has not kept pace with population growth.

According to second advanced estimates of moong 2013-14 the total production . production under moong has increased by 7.56 per cent to 1.28 million tonnes compared to 1.19 million tonne in the previous year in India. The major moong producing states are Karnataka, Andhra Pradesh, Bihar, Rajasthan, Maharashtra, Tamilnadu, Assam, Kerala, Punjab, Madhya Pradesh and Uttar Pradesh.

In Rajasthan, moong is mainly grown in kharif season in most of the districts. According to second advance estimates of moong for 2013-14, area under moong has increased by 29.07 % to 10.19 lakh hectares as compared to 7.9 lakh hectares in the previous year. Likewise the production under moong has increased by 66.99 per cent to 3.9 lakh tonnes compared to 2.34 lakh tonne in 2012-13.

Inadequate market infrastructure and too many intermediaries between the producers and consumers lead to high marketing costs, resulting in lower share of producer in consumer's rupee. The lack of market intelligence about the potential markets and the pattern of arrivals and prices are important in regional and national markets further add to the woes of the farmers. Therefore, the need for proper market intelligence has been felt and voice raised from time to time by many scholars (Kallo and Pandey, 2002; Rai and Pandey, 2004; Singh *et al.*, 2004). The availability of market intelligence on aspects like potential markets, the quantum of market arrivals, prevailing and expected prices in different regional, national and international markets during different months of the year shall go a long way in mitigating many of these problems, not only that it shall help the farmers in adjusting their cropping pattern in a way, so that they could sell their produce at a time when the prices are reasonably high in markets.

Market intelligence is an essential function for the formulation of a sound price and trade policy and its successful implementation. The formulation

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of a sound price policy requires an analysis of long-term trends in the data on prices, arrivals, demand, supply and other information. Thus, market intelligence provides the necessary data for such an analysis and for an understanding of the behaviour of relevant factors; and helps in the evolution of a proper price policy.

Thus, Agricultural Market Intelligence is to help in getting higher net prices by producers besides increasing regional agricultural trade and food security by improving and linking the existing regional efforts to generate, disseminate, and make commercial use of market information for better scientific decision-making by farming community, traders, firms and researchers among different States.

Naturally forecasting is one of the main objectives of time series analyses having the art of saying that what will happen in the future rather than why ? There are various forecasting models in use now a days. Forecaster can choose his own method of forecasting based on his knowledge and available external information. As the process goes on, this procedure can be modified to address the present conditions and to satisfy the current situation. Different forecasting models may be fitted more or less equally well to the data, but they forecasts different future values. Unfortunately, there will be many occasions when analysts are not going to be certain which forecasting method or model is best one and there will be situations where it will appear that several models could do the job quite successfully. Even if we are certain of how to make a decision, we might work with different parameters and generate several forecasts, which will, again, raise the question of the best forecasts. Thus, it is very much needed that the forecaster should take care to the best possible because a large number of people are using such forecasts.

The study of behaviour and magnitude of the prices of moong is important for the farmers as it helps them in taking the decision pertaining to the time of sale of their produce. Traders may also plan their purchase and sale in accordance with the movement of prices over the months. Looking to the importance of price forecast to the producers in particular and traders, consumers and policy makers in general various price forecasting models were tried moong commodity in the study

Methodology

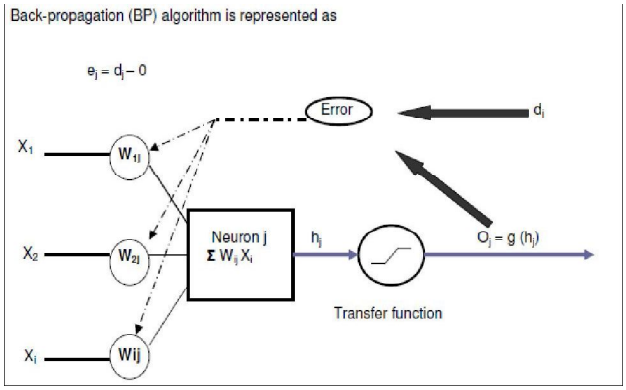
Sumrpur market was purposively selected for the price data as the market arrivals of moong were maximum in the state of Rajasthan. The various price forecasting models were tried to identify the most suitable model which suits to actual market price of moong. The data of moong prices in Sumerpur regulated market for the period Jan. 2002 to June, 2012 were utilized for model fitting and data for subsequent period i.e. from July 2012 to December 2012 were used for validation. The details of forecasting models are as follows:

Artificial Neural Network (ANN)

ANN is employed in case of homogeneous input data set. In the present study moong price is considered as homogeneous. After running ANN programme in MS Excel package, the input data set for individual selected species divided in to two parts namely training and testing data set. Moong price series from January, 2002 to June, 2012 was used as training data set in obtaining the output by neural network and the remaining data set (testing set) containing 18 points was considered for validation of the neural network. Different network structures were designed having different numbers of Neurons in the input and the hidden layer. The output layer had only one neuron which gave the forecasted index value. The first input node presented seasonal average price, the second node gave previous seasonal average price value as an input and likewise goes on and output layer for the next seasonal forecast value.

The back-propagation (BP) neural network learning methodology was used in obtaining the output. A subset of available average price data was used to construct the neural network. The network so constructed was trained using the training data set.

The overall errors were tracked until a minimum is obtained by altering the above mentioned parameters. The obtained minimum error was saved and this trained network was used in predicting future price value. The neural network producing minimum values of average absolute error was selected as best network and further used in one year ahead price forecasting of



Where,
X1, X2…Xi = inputs
W1, W2 …Wj = weights
hj = initial output
Oj = final output
dj = error at neuron j

In the above structure, actual moong price series (X1, X2…Xi) being connected to neuron *j* with weights (W1, W2…Wj) 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 moong price (*Oi)*.

Exponential smoothing method for forecasting

If the weights for exponential smoothing are available, the calculation can be carried out simply by the formula

New Estimate = W (last measurement) + (1-W) (last estimate)

The term "last estimate" refers to the previous estimate made in the same way and "W' is called the smoothing factor at the start of series, any reasonable value can be choosen for the "last estimate term", it is quickly discounted by the method and any effects due to an error in the initial value quickly disappear. This system using a discounted average is referred to an exponential smoothing or adoptive smoothing.

Single exponential smoothing method

This method is also called as method of estimation of forecasts of single weight parameter. Under exponential smoothing equal weights have been given to all items, the weights assigned in geometric progression. Greater weights are assigned to recent observation and smaller weights are given distant observation.

In the present study MINITAB package was used to obtain value of appropriate value of W1.

Double Exponential smoothing method

This method is also called as trend adjusted exponential smoothing. Single exponential smoothing can be improved by the introduction of a second equation with a second smoothing constant/ second weight (W2) assuming moong price is influenced by the trend component and this represents the double exponential smoothing.

Triple exponential smoothing method:

To handle seasonality present in the time series data, the third parameter is added. Assuming moong price is influenced by seasonal factor, third equation being introduced along with new weight (W3) in order to take care of seasonality and to forecast moong price. The resulting set of equations is called the "Holt-Winters" (HW) method after the names of the inventors.

Selection of weights (W1, W2, W3)

Values of all three smoothing constant/weights were obtained by trial and error method. The moong price time series were analyzed by giving different weights and the best exponential model in each case wais selected, based on the minimum MAPE and MSD value under different weights.

Results and Discussion

Moong is mainly a kharif pulse crop in Rajasthan. Now zaid moong is also taken in the state. The monthly wholesale price series (Jan. 2002 to June, 2012) of moong from Sumerpur regulated market was used to predict the price forecast. The detailed results obtained from different price forecasting models are discussed as below:

Artificial Neural Network (ANN)

The proposed ANN model was applied to forecast the moong prices for Sumerpur regulated market. Different number of neural networks were tried for same data set and the best performing five networks from each data set was selected based on minimum average absolute error and higher R^2 (Table 1) and such networks were used for further analysis. In case of moong price forecasting, 87 data points were considered as training set and 18 data points were considered as testing set.

ANN5 method out of five models tried was found better fitted with R^2 equal to 0.96 and lowest average absolute error value of 123.53 with highest value of correlation coefficient (0.98) in Sumerpur market.

Table 1: Different neural networks model for forecast of moong price

Criteria	Neural Networks Model				
	ANN1	ANN2	ANN3	ANN4	ANN5
Average AE	133.81	162.44	140.1	133.93	123.53
R square	0.97	0.96	0.97	0.96	0.96
Correlation	0.98	0.98	0.98	0.98	0.98

Exponential Smoothing

Under exponential smoothing, the weights (W1, W2, and W3) were assigned in geometric progression. All three techniques (Single, Double and Triple) of exponential smoothing methods were considered for forecasting prices for selected moong commodity of Sumerpur regulated market and results are presented in Table 2.

Table 2: Different exponential smoothing model for forecast of moong price

Criteria	Exponential Smoothing Model		
	SES	DES	TES
MAPE	6.1	6.2	12
MAD	171.3	174.6	354
MSD	58170.6	59245.7	236311

SES= Single Smoothing Exponential
DES= Double Smoothing Exponential
TES= Triple Smoothing Exponential

It can be inferred that the SES model was the preferred model for forecasting moong price due to minimum value of MAPE (6.1), MAD (171.3) and MSD (58170.6) when compared to double exponential and triple exponential Smoothing models.

The performance of ANN and Exponential moong price forecasting models was measured in terms of Mean Absolute Deviation (MAD), Mean Standard Error (MSE) and Mean Absolute Percentage Error (MAPE). The comparative performances of different models are presented in Table 3.

Table 3: Extent of Accuracy through Different Criterion

Criteria	SES	ANN5
MAD	1088.59	11.25
MSE	1461092.00	27205.92
MAPE	21.84	2.90

From the Table 3, it can be inferred that the ANN5 model was the preferred model for forecasting moong price due to the minimum values of MAD (11.25), MSE (27205.92) and MAPE (2.90) when compared to the SES model. The actual monthly wholesale prices of moong in Sumerpur market for July, 2012 to December, 2012 and the predicted values for these months through various models are presented in Table 4. In order to check the validity of these forecasted values, they were compared with the actual values of price of moong during the post sample forecast period i.e. from July-2012 to Dec.-2012. The accuracy percentages vary from 95.81 to 98.13% based on ANN 5 model. It was observed that the accuracy percentage out of different forecasting models, the prevailing market price of moong and based on ANN5 model was very close to actual value as compared to other predicted model prices. The accuracy percentage varied from 75.22 to 83.16 in case of SES model. This proved that the ANN5 model was the best fit model for forecasting the price of moong for Sumerpur market during the period under study.

Table 4: Forecast price of moong by different models (Rs./quintal)

Month	Actual Price	Price forecasted by SES	Price forecasted by ANN5
Jul-12	4656	3872.08(83.16)	4849.94(95.83)
Aug-12	4908	3872.08(78.89)	4999.77(98.13)
Sep-12	4826	3872.08(80.23)	4937.58(97.69)
Oct-12	5106	3872.08(75.83)	4984.09(97.61)
Nov-12	5148	3872.08(75.22)	4932.43(95.81)
Dec-12	5120	3872.08(75.63)	4992.67(97.51)

Figure in parentheses are the percentages of respective actual prices.

Thus, in present investigation a large scale comparison of different models has been done in order to know the best model for forecasting moong price. The comparison of all the three Exponential Smoothing and ANN models was carried out in the process based on the MAD,MSE and MAPE values which were considered to be least. ANN model for moong were found to be the most appropriate model with MAD Value 11.25 , MSE value of 27205.92 and MAPE value 2.90 per cent. The validity of the forecasted price values of moong was checked by comparing them with their actual market price values during the post sample forecast period i.e. July 2012 to December 2012 for moong crops. The accuracy percentage between the forecasted and actual price value of moong were found to be 95 to 98 per cent. It was observed that the ANN5 model was found to be the most suitable for forecasting the prices of moong commodity. This information can be used for further research in this area of price forecasting.

Policy Implications

- Ø Adequate and continuous efforts should be made to disseminate the market intelligence and market information, particularly of price forecast to help the stake holders.
- Ø Regular price forecast should be available to the stakeholders to take the appropriate decisions regarding buying and selling of moong commodity.

References

Peter Zhang, G and Min Qi. (2003). Neural network forecasting for seasonal and trend time series, Eur. J. Ope. Res. 160(2) : 501-514

Premchand Kumar and Ekta Walia (2006). Cash Forecasting : An Application of Artificial Neural Networks in Finance. *Int. J. Comp. Sci & App.* 3(1) : 61 – 77

Satya Pal, Ramasubramanian V. and Mehta, S. C. (2007). Statistical models for Forecasting Milk Production in India, *J. Ind. Soc. Agril. Stat.* 61(2), 2007 : 80-83.

Witt, C. A and Witt, S. F. (2003). Appraising an econometric forecasting model. *J. Trav. Res.* 28(3) : 30-34

Zapata, H. O and Garcia, P. (1990). Price forecasting with time-series methods and nonstationarity data : an application to monthly U. S. cattle prices, *West. J. Agric. Eco.* 15(1) : 123-132

*Burark.*S.S. Pat, D.C. Sharma, Hemant Bheel S.K.(2011) "Price forecast of Coriander-A case study of Kota Market of Rajasthan" Indian Journal of Agricultural Marketing,25(3):72-82.