

A Study on Arrivals and Prices of Red Chillies in Khammam Market Yard –A Time Series Approach

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ABSTRACT

The present study was conducted to forecast the arrivals and prices of Red Chillies in Khammam Market yard using the secondary time series monthly data of arrivals and prices of Red Chillies during April 2002 to December 2017(189 months). Different time series models were fitted to the data to capture the trend, seasonality and the best model was identified based on the highest R^2 , and lowest Bayesian information criterion (BIC), Root Mean Square Error (RMSE), Mean Absolute Error (MAE) criteria. ARIMA (2,0,1) (2,1,0) and ARIMA (0,1,0) (1,1,1) were identified as the best models for arrivals and prices respectively. Based on the best models the Red Chillies arrivals and prices were forecasted for a period of two years i.e., 24 months. The forecasts of arrivals showed high during the month of March for both the years (2018 & 2019) and the forecasts of prices showed high during the months of January for both the years(2018 and 2019).

Key words: ARIMA, R^2 , RMSE, MAE, MAPE, BIC, Forecast

Chillies popularly known as ‘wonder spice’ is a major spice crop as well as vegetable crop grown in many countries. Red Chillies are one of the most important commercial crops of India. The second highest production of Red chillies in India comes from Telangana state. Khammam market yard is one of the largest chilli markets in Telangana. The agricultural market environment is changing with unprecedented speed and in very diverse ways locally and globally. These dynamics affect farm prices and thereby farm income.

Now a day’s agriculture has become highly input and cost intensive. With the help of forecasted arrivals and prices, farmers can find the forecast for the specific month fetching high and remunerative price of their produce and government can frame policies accordingly.

Price and arrivals forecasting is vital to facilitate farmers to take efficient decisions and it will play a major role in coordinating the supply and demand of the commodities. Forecasting involves analysing and deciding the future values of variables of interest using past and present information.

The ARIMA models were more powerful and flexible in handling the time series data. Many studies also reported that ARIMA models can be used for capturing the fluctuations, mainly for the seasonal data and also gives nearly accurate forecasts.

MATERIAL AND METHODS

The secondary time series monthly data on arrivals and prices of Red chillies of Khammam market yard was collected from the registers maintained by market committee. The study period was from April,

2002 to December, 2017 (189 months). Data on monthly arrivals recorded in thousand tonnes and monthly prices in Rs/qtl.

To identify the trend, seasonality and other components of time series various models were fitted which were given here under

Exponential smoothing

The Exponential Smoothing model is given by the model equation

$$y(t) = \beta(t) + \varepsilon(t),$$

where $\beta(t)$ takes a constant at the time t and may change slowly over the time; $\varepsilon(t)$ is a random variable and is used to describe the effect of stochastic fluctuation.

Formally, the simple exponential smoothing equation takes the form of

$$F_{t+1} = \alpha y_t + (1-\alpha)F_t$$

where y_t is the actual, known series value at the time t ; F_t is the forecast value of the variable Y at the time t ; F_{t+1} is the forecast value at the time $t+1$; α is the smoothing constant. The forecast F_{t+1} is based on weighting the most recent observation y_t with a weight α and weighting the most recent forecast F_t .

ARIMA Model

The ARIMA (p,d,q) model can be represented by the following general forecasting equation:

$$Y_t = \mu + \sum_{i=1}^p \phi_i Y_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \varepsilon_t$$

Table 1. Fitted time series models of Khammam Market Yard Red Chillies Arrivals

Model		Criteria				
		R Square	RMSE	MAPE	MAE	BIC
Exponential Smoothing	Winters method	0.85	2.07	269.55	1.29	
ARIMA	ARIMA (1,0,0) (1,1,0)	0.89	1.85	145.94	1.03	1.32
	ARIMA (1,0,0) (2,1,0)	0.90	1.78	157.46	1.00	1.35
	ARIMA (2,0,0) (1,1,0)	0.89	1.83	171.08	1.03	1.32
	ARIMA (2,0,0) (2,1,0)	0.89	1.79	181.94	1.01	1.32
	ARIMA (1,1,1) (1,1,0)	0.89	1.87	147.45	1.05	1.33
	ARIMA (2,0,1) (2,1,0)	0.90	1.78	135.69	0.98	1.28

Table 2. Fitted time series models of Khammam Market Yard Red chillies prices

Model		Criteria				
		R Square	RMSE	MAPE	MAE	BIC
Exponential Smoothing	Winters method	0.86	847.32	10.86	539.66	
ARIMA	ARIMA (1,0,0) (1,1,0)	0.85	884.67	12.65	593.24	13.65
	ARIMA (1,0,0) (1,1,1)	0.89	799.49	11.69	518.20	13.38
	ARIMA (1,0,0) (2,1,0)	0.87	801.43	11.68	537.12	13.48
	ARIMA (1,1,1) (1,1,1)	0.88	779.43	10.56	509.00	13.44
	ARIMA (1,1,1) (2,1,0)	0.88	809.67	10.91	530.87	13.54
	ARIMA (0,1,0) (1,1,1)	0.89	779.27	10.29	508.90	13.37

Table 3. Forecasted Values of Khammam Market Yard Red Chilli Arrivals

Month	Forecasted Arrival (000' tonnes)	Month	Forecasted Arrival (000' tonnes)
18-Jan	6.06	19-Jan	6.89
18-Feb	15.56	19-Feb	16.24
18-Mar	23.79	19-Mar	24.1
18-Apr	21.68	19-Apr	20.28
18-May	10.17	19-May	8.93
18-Jun	4.62	19-Jun	4.26
18-Jul	2.28	19-Jul	2.28
18-Aug	1.00	19-Aug	1.18
18-Sep	0.76	19-Sep	0.98
18-Oct	0.54	19-Oct	0.78
18-Nov	0.84	19-Nov	1.09
18-Dec	2.26	19-Dec	2.92

Table 4. Forecasted Values of Khammam Market Yard Red Chilli Prices

Month	Forecasted Price (Rs.)	Month	Forecasted Price (Rs.)
18-Jan	7785.23	19-Jan	8201.34
18-Feb	7650.47	19-Feb	7687.62
18-Mar	7734.04	19-Mar	7648.32
18-Apr	7725.27	19-Apr	7100.34
18-May	7659.74	19-May	6753.76
18-Jun	6514.28	19-Jun	5640.38
18-Jul	5951.23	19-Jul	5209.88
18-Aug	5942.5	19-Aug	5366.46
18-Sep	5930.57	19-Sep	5307.94
18-Oct	6053.15	19-Oct	5236.9
18-Nov	6284.74	19-Nov	5395.77
18-Dec	7185.26	19-Dec	7374.95

where μ is the mean of series, the Φ_1, \dots, Φ_p are the parameters of the AR model, the $\theta_1 \dots \theta_q$ are the parameters of the MA model and the $\epsilon_t, \epsilon_{t-1}, \dots, \epsilon_{t-q}$ are the noise error terms. The value of p is called the order of AR model while the value of q is called the order of the MA model.

Since seasonal data is taken for this study so ARIMA model will be extended readily to handle seasonal aspects and the general shorthand notation in ARIMA

(p,d,q) (P,D,Q) [s]

(Non seasonal part of model) (seasonal part of model),
s = number of periods per season

Criterion of Model Selection:

For the arrivals and prices of Red chillies in Khammam market yard, the best model is identified based on highest R^2 , lowest Mean Absolute Percentage Error (MAPE), lowest Mean Absolute Error (MAE), and lowest Root Mean Square Error (RMSE) criterion, Bayesian Information Criterion (BIC). Based on the best model the forecasting is done to forecast the arrivals and prices of Red chillies in the Khammam market yard for two years i.e., 2018 and 2019.

RESULTS AND DISCUSSION

Identification of the Model

Different time series models and their selection criteria for arrivals and prices of Red chillies in Khammam marketyard has been presented here under:

Arrivals

From the table 1, it was observed that ARIMA (2,0,1) (2,1,0) as the best model for forecasting arrivals of Red chillies in Khammam market yard because it is having highest R^2 (0.90) and least Mean Absolute Percent Error (MAPE) (135.69), Mean Absolute Error (MAE) (0.98), Root Mean Square Error (RMSE) (1.78), Bayesian Information Criterion (BIC) (1.28) values. Chaithanya (2015) also reported that ARIMA model as best model for forecasting cotton arrivals in Adoni and Khammam markets.

Prices

From the table 2, it was observed that ARIMA (0,1,0) (1,1,1) is the best model for forecasting prices of Red chillies in Khammam market yard because it is having highest R^2 (0.89) and least Mean Absolute Percent Error (MAPE) (10.29), Mean Absolute Error (MAE) (508.93), Root Mean Square Error (RMSE) (779.27), Bayesian Information Criterion (BIC) (13.37) values. Keerthi and Naidu (2013) also reported that ARIMA models are the best models for forecasting prices of tomato in Madanapalli market.

Forecasting of arrivals and prices

Arrivals

The future projections of arrivals of Red Chillies up to December, 2019 were forecasted for Khammam Market Yardby using the best model identified ARIMA (2,0,1) (2,1,0) and forecasted values are tabulated as follows:

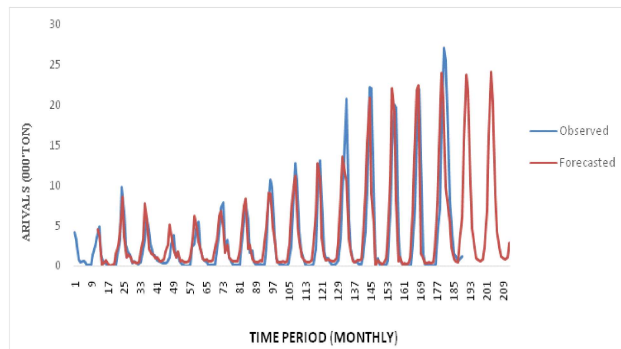


Figure 1. Observed and Forecasted Arrivals of Red Chillies in Khammam Market Yard

Table 3 and Fig.1 reveals that highest Red Chilli arrivals were found in the month of March in 2018 (23.79 thousand tonnes) as well as in 2019 (24.10 thousand tonnes). It was also observed that there is a seasonality and positive trend in the arrivals. Similar results were reported by the Pushpavalli (1993) on arrivals of Groundnut in Tiruvannamali market.

Prices

The future projections of Prices of Red Chillies up to December, 2019 were forecasted by using the best model identified i.e, ARIMA (0,1,0) (1,1,1) for Khammam Market Yard and the forecasted prices were tabulated as follows:

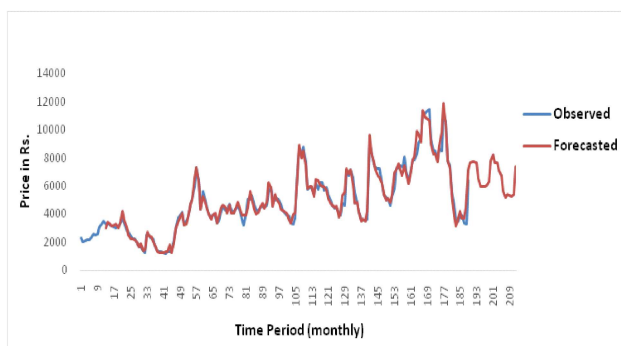


Figure 2. Observed and Forecasted prices of Red Chillies in Khammam Market Yard

Table 4 and Fig.2 reveals that there is a seasonality in prices and the highest Red Chilli prices were observed in the month of January in 2018 (Rs.7785.23) as well as in 2019 (Rs.8201.34). Similar results were reported by Sangeetha (2004) on prices of onion in Lasalgaon market.



Figure 3. Arrivals and Prices scenario of Red Chillies in Khammam Market Yard

Relationship between Arrivals and Prices

The Khammam market yard red chillies arrivals and prices relationship was identified through correlation coefficient ($r=0.40$). It was found that there is a positive non-significant association between the arrivals and prices in Khammam market yard. i.e more number of buyers are coming during the period of high arrivals and giving best price. But it is non – significant. From the graph (Fig. 3) it can also be observed that the relationship between the arrivals and prices of Red Chillies are proportional in Khammam market yard.

CONCLUSION

In Khammam market yard, ARIMA (2, 0, 1) (2, 1, 0) is identified as the best model for forecasting Red Chillies arrivals and the predicted values indicate that the highest arrivals observed in the month of March every year including the years 2018 (23.79 thousand tonnes) and 2019 (24.10 thousand tonnes).

As per the prices is concerned, the ARIMA (0, 1, 0) (1, 1, 1) is identified as the best model for forecasting Red Chillies prices the predicted values indicate that the highest prices observed in the month of January every year including the coming years 2018 (Rs. 7785.23 per quintal) and 2019 (Rs. 8201.34 per quintal). To get high price for Red chillies, farmers can bring their produce to the Khammam market yard in the month of January.

These results could be used as a guideline for formulation of policies regarding Red chilli production, distribution and supply to get more profit or to minimize distress sales.

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Received on 01.06.2018 and revised on 05.06.2018