

A STUDY ON ARRIVALS AND PRICES OF RED CHILLIES IN GUNTUR 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 Guntur Market yard using the secondary of 189 months i.e., April 2002 to December 2017. Different time series models were fitted to the data 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. The best models identified for arrivals and prices are ARIMA (1, 0, 0) (0, 1, 1) and ARIMA (2, 1, 2) (2, 1, 0) respectively. Based on the identified best model the arrivals and prices were forecasted for a period of two years i.e., 24 months. The forecasted arrivals showed during the month of March it is high in both the years (2018 & 2019) and the forecasted prices showed high during the month of December in 2018 and January in 2019.

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

INTRODUCTION

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 highest production of Red chillies in India comes from Andhra Pradesh. Guntur is the Asia's largest chilli market yard. The agricultural market environment is changing with unprecedented speed and in very diverse ways locally and globally. These dynamics affect the 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.

Forecasting of Price and arrivals 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.

Though the ARIMA method is powerful and flexible, it is not able to handle the volatility that is present in the data. To handle the volatility in the data the current study included the use of ARCH and GARCH models too. Using the forecasts obtained from ARIMA model is a benchmark, the forecast obtained from the ARCH and GARCH model will be evaluated.

MATERIAL AND METHODS

The secondary time series monthly data on arrivals and prices of Red chillies of Guntur 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/qlt.

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:

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

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

CRITERION OF MODEL SELECTION

For the arrivals and prices of Red chillies in Guntur market, 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 Guntur market for two years i.e., 2018 and 2019.

RESULTS

a) Identification of the Model

Different time series models and its selection criteria for arrivals and prices of Red chillies in Guntur market yard has been presented here under:

1) Arrivals

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

Model		Criteria				
		R Square	RMSE	MAPE	MAE	BIC
Exponential Smoothing	winters method	0.810	8.61	35.83	6.57	
	ARIMA (1,0,0) (1,1,0)	0.806	8.73	35.03	6.59	4.42
ARIMA	ARIMA (1,0,1) (1,1,0)	0.810	8.66	35.46	6.58	4.43
	ARIMA (1,1,1) (1,1,0)	0.805	8.78	35.55	6.65	4.46
	ARIMA (1,1,2) (1,1,0)	0.809	8.72	35.71	6.66	4.47
	ARIMA (1,1,2) (2,1,0)	0.813	8.66	35.28	6.61	4.49
	ARIMA (1,0,0) (0,1,1)	0.813	8.55	32.93	6.44	4.35
GARCH (1,1)		0.410	17.67	45.87	10.54	15.19

From the table 1, it was observed that ARIMA (1,0,0) (0,1,1) as the best model for forecasting arrivals of Red chillies in Guntur market yard because it is having highest R^2 (0.813) and least Mean Absolute Percent Error (MAPE) (32.93), Mean Absolute Error(MAE) (6.44), Root Mean Square Error(RMSE) (8.55), Bayesian Information Criterion(BIC) (4.35) values. Chaitanya (2015) also reported that ARIMA model as best model for forecasting cotton arrivals in Adoni and Khammam markets.

2) Prices

Table 2. Fitted time series models of Red chillies prices in Guntur market yard

Model		Criteria				
		R Square	RMSE	MAPE	MAE	BIC
Exponential Smoothing	winters method	0.900	928.18	11.44	626.45	
	ARIMA (1,0,0) (1,1,0)	0.896	952.79	12.31	663.61	13.83
ARIMA	ARIMA (1,0,0) (2,1,0)	0.901	930.99	11.87	638.38	13.82
	ARIMA (1,1,0) (1,1,0)	0.894	962.47	12.22	665.46	13.82
	ARIMA (1,1,0) (2,1,0)	0.899	940.90	11.72	642.36	13.81
	ARIMA (2,1,2) (1,1,0)	0.901	936.80	12.26	667.76	13.84
	ARIMA (2,1,2) (2,1,0)	0.906	913.89	10.02	545.02	13.81

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GARCH (1,1)	0.790	1033.48	10.77	690.65	25.37
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From the table 2, it was observed that ARIMA (2,1,2) (2,1,0) is the best model for forecasting arrivals of Red chillies in Guntur market yard because it is having highest R^2 (0.906) and least Mean Absolute Percent Error (MAPE) (10.02), Mean Absolute Error (MAE) (545.02), Root Mean Square Error (RMSE) (913.89), Bayesian Information Criterion (BIC) (13.81) values. Naidu et al. (2014) also reported that ARIMA model as best model for forecasting red chilli price in Khammam market.

b) Forecasting of arrivals and prices

1) Arrivals

The future projections of arrivals of Red Chillies in Guntur market yard up to December, 2019 were estimated by using ARIMA (1,0,0) (0,1,1) model are tabulated as follows:

Table 3. Forecasted Red Chilli Arrivals of Guntur Market Yard

Month	Forecasted Arrival (000' tonnes)	Month	Forecasted Arrival (000' tonnes)
Jan-18	54.71	Jan-19	48.62
Feb-18	86.93	Feb-19	82.32
Mar-18	92.67	Mar-19	89.18
Apr-18	84.39	Apr-19	81.75
May-18	41.21	May-19	39.22
Jun-18	34.09	Jun-19	32.58
Jul-18	27.60	Jul-19	26.46
Aug-18	34.40	Aug-19	33.54
Sep-18	28.57	Sep-19	27.92
Oct-18	23.12	Oct-19	22.63
Nov-18	26.96	Nov-19	26.59
Dec-18	32.98	Dec-19	32.70

Table 3. reveals that the highest Red Chilli arrivals were found in the month of March in 2018 (92.67 thousand tonnes) as well as in 2019 (89.18 thousand tonnes). Similar results were reported by the Pushpavalli (1993) on arrivals of Groundnut in Tiruvannamali market.

2) Prices

The future projections of prices of Red Chillies in Guntur market yard up to December, 2019 were forecasted by using ARIMA (2,1,2) (2,1,0) model are tabulated as follows:

Table 4. Forecasted Red Chilli Prices of Guntur Market Yard

Month	Forecasted Price (Rs.)	Month	Forecasted Price (Rs.)
Jan-18	5674.19	Jan-19	4353.92
Feb-18	5635.84	Feb-19	4288.28
Mar-18	5495.16	Mar-19	3806.39
Apr-18	5379.70	Apr-19	3401.80
May-18	4704.34	May-19	2522.66
Jun-18	4776.45	Jun-19	2121.14

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Jul-18	6525.54	Jul-19	4611.83
Aug-18	6935.60	Aug-19	5031.02
Sep-18	7168.67	Sep-19	5078.12
Oct-18	7928.28	Oct-19	5706.88
Nov-18	7170.39	Nov-19	4834.99
Dec-18	6179.25	Dec-19	3787.88

Table 4. revealsthat highest Red Chilli prices were found in the month of October in 2018 (Rs.7928.28 per quintal) as well as in 2019 (Rs.5706.88 per quintal). Similar results were reported by Sangeetha (2004) on prices of onion in Lasalgaon market.

The Observed and forecasted arrivals and prices of Red chillies in Guntur market yard are:

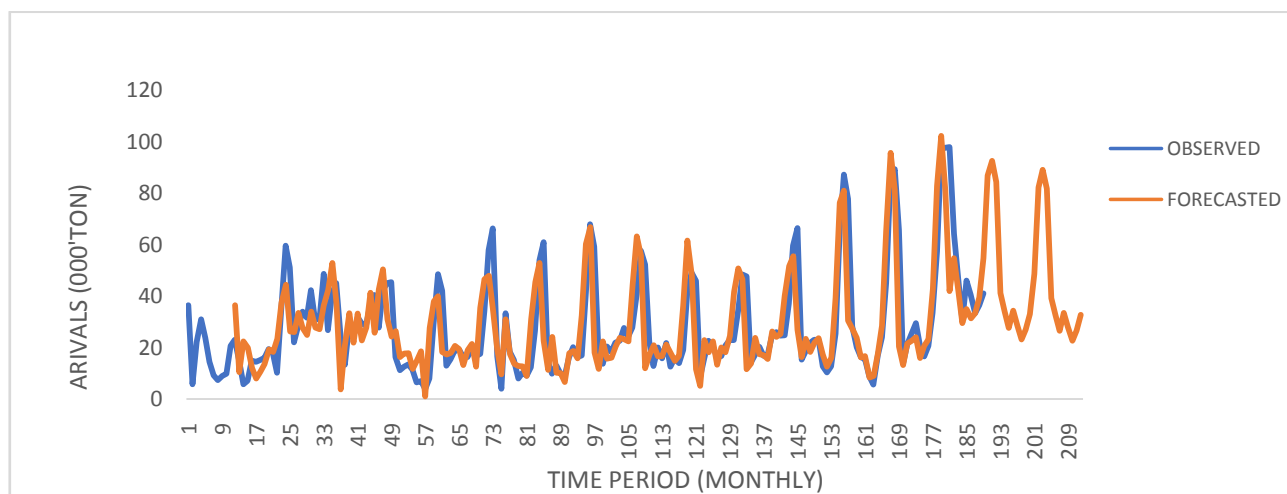


Figure 1. Observed and Forecasted Arrivals of Red Chillies in Guntur Market Yard

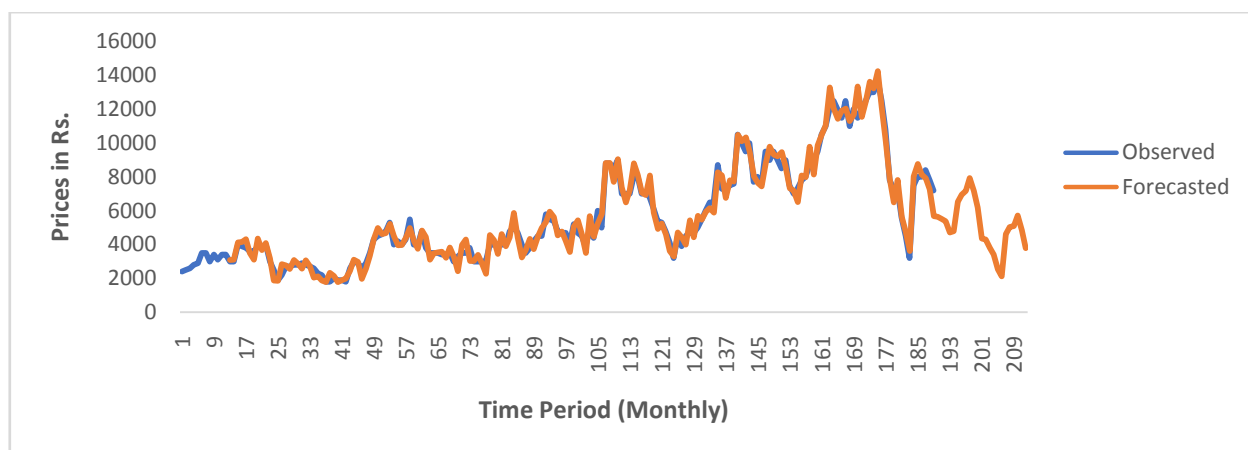


Figure 2. Observed and Forecasted prices of Red Chillies in Guntur Market Yard

Relationship between Arrivals and Prices

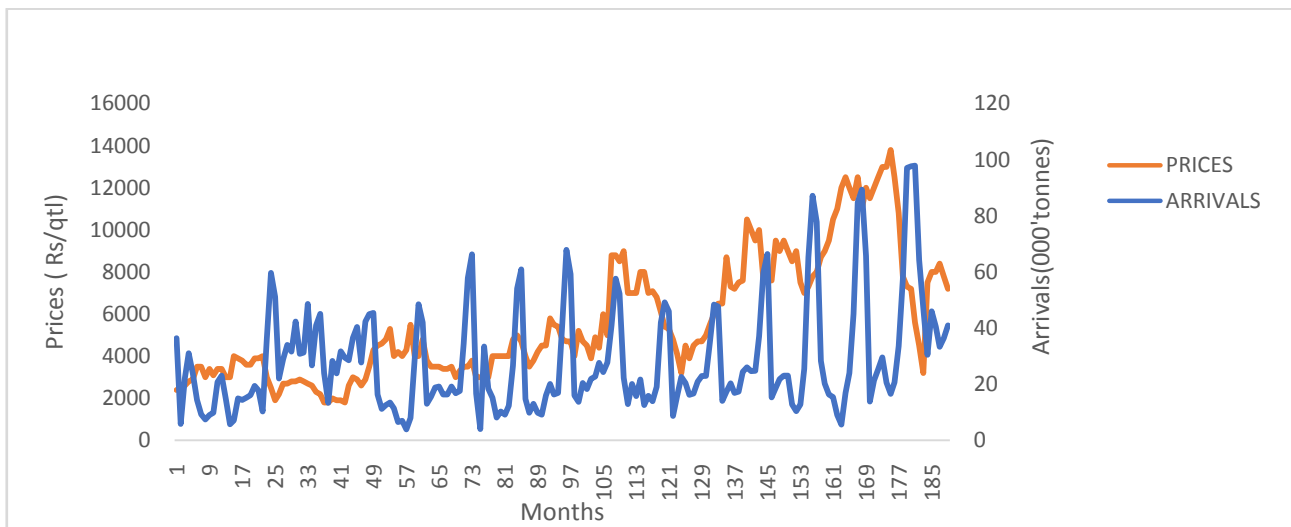


Figure 3. Arrivals and prices scenario of Red Chillies in Guntur Market Yard

In the Guntur market yard, the relationship between the arrivals and prices are identified by correlation coefficient (0.13). So the relation is slightly positive and non-significant. From the Fig. 3. it is clear that the relationship between the arrivals and prices of Red Chillies are slightly directproportional.

CONCLUSIONS

- 1) In Guntur Market Yard, ARIMA (1, 0, 0) (0, 1, 1) is identified as best model for forecasting Red Chillies arrivals and the forecasts showed highest during the month of March for both the years 2018 (92.67 thousand tonnes) and 2019 (89.18 thousand tonnes).
- 2) In Guntur Market Yard, ARIMA (2, 1, 2) (2, 1, 0) is identified as best model for forecasting Red Chillies Prices and forecasts showed highest during the month of October for both the years 2018 (Rs. 7928.28 per quintal) and 2019 (Rs. 5706.88 per quintal). Hence, to get good prices the farmers can bring their produce to the Guntur market in the month of October during 2018 and 2019.

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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