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A study on arrivals and price behavior & forecasting of lathyrus in Krishi Upaj Mandis of Chhattisgarh plains

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Abstract
An attempt has been made in this study to examine the arrivals and price behavior & forecasting of lathyrus in Krishi Upaj Mandis of Chhattisgarh plains. Krishi Upaj Mandi (KUM) Bhatapara, KUM Mungeli, KUM Rajnandgaon, KUM Kabirdham and KUM Bemetra were selected on the basis of maximum arrivals of lathyrus. The seasonal variations in prices and arrivals of pulses and their seasonal indices was calculated by employing twelve months ratio to moving average method to achieve the behavior. ARIMA model was applied for forecasting of arrivals and prices of lathyrus in selected Krishi Upaj Mandis of Chhattisgarh plains. This model also called Box-Jenkins model. Three peak arrivals was found in month March (1886.17), April (1248.42) and May (403.91). However, seasonal indices of price of lathyrus. It indicates that there are three peak prices was found in month October (89.36), November (46.69) and July (45.78). The study was found that forecasts the arrivals of lathyrus would be ranging from the minimum 832.55 tonnes in September, 2018 to the maximum 4299.91 tonnes in March, 2021 and forecasted prices of lathyrus in the selected market were more or less closer. Forecasts price of lathyrus would be ranging from the minimum Rs./qtl 1050.31/- in April, 2018 to the maximum Rs./qtl 2467.94/- in October 2019.These informations were useful to strengthen their plan and policy makers arrivals to the conclusion on through forecasts of arrivals and prices in future months.

Keywords: Lathyrus, seasonal variations and forecasting of arrivals and prices of lathyrus

Introduction
In Chhattisgarh, the total area under pulses was 8.14 lakh ha and production was 4.84 lakh metric tonnes, which rises 43 per cent in 2017-18 as compared to 2003-04. Five major pulse growing districts of Chhattisgarh are Mungeli, Bemetra, Kabirdham, Rajnandgaon and Bilaspur & have indentified in term of area and production first Bemetra and Mungeli respectively (Commissioner of Land Revenue, 2016-17) [1]. Healthy marketing system acts as an incentive for the farmers and various intermediaries to use the recourses prudently. Krishi upaj mandi is one, which aims at the elimination of the unhealthy and unscrupulous practices, reducing marketing charges and providing facilities to producers.

Krishi Upaj Mandis played a vital role in marketing of pulses in the state. The total arrival of agricultural produce to Krishi Upaj Mandis during 2016-17 was 9.41 million tones among them total arrival of pulses was 0.85 lakh tones (0.91 per cent). Pulse arrivals was more in KUM, Bhatapara, KUM, Mungeli, KUM, Rajnandgaon, KUM, Kawardha and KUM, Bemetra then that of other Krishi Upaj Mandis of Chhattisgarh plains (CG Mandi Board, 2016-17). The pulses which are cultivated in these districts are gram, lathyrus, pigeonpea, blackgram, horsegram, lentil, green gram, pea and cowpea. lathyrus was found to be the major pulse grown by farmers so that this crop was considered for the study. The farmers are facing various problems during marketing of their produce; these are exploitation by traders, price fluctuation of produce, transportation & storage facility, transparency in pricing system, transaction taking place in market area, market organization and operation of marketing system *etc*.

Looking to above facts, a study has been undertaken with the following specific objectives.

Specific objectives of study
1. To examine pattern of arrivals and prices of lathyrus in the selected krishi upaj mandi of Chhattisgarh plain.
2. To examine forecasting of arrivals and prices of lathyrus in the selected krishi upaj mandi of Chhattisgarh plain.

Methodology

1. Arrivals and Price Analysis

Yt= T x C x S x I

Where,
Yt= Original value at time
T = Element of trend
C = Element of cyclical
S = Variation of Seasonal
I = Irregular fluctuation

Estimation of seasonal indices of monthly data

To measure the seasonal variations value in prices and arrivals, seasonal indices have been calculated employing twelve months ratio to moving average method. The seasonal indices were calculated by adopting the following steps

1. Firstly generate a series of twelve months moving totals
2. Generate a series of twelve months moving averages: A series of twelve months moving averages was generated by dividing twelve months moving totals by twelve.
3. Generate a series of centered twelve months moving averages. This step involves taking averages of pairs of two subsequent twelve months moving averages and entering between each pair. There are no corresponding moving averages for the first six and last six months.
4. Express each original value as a percentage of corresponding centered moving average. The percentage of moving average represents indices of seasonal and irregular components combined.
5. Arrange the percentages of moving averages in the form of monthly arrays.
6. Next, the average index for each month has been calculated.

Arrivals and Price Forecasting Analysis

ARIMA model was applied for forecasting of arrivals and prices of lathyrus in selected Krishi Upaj Mandis of Chhattisgarh plains. This model also called Box-Jenkins model. This model includes autoregressive terms, moving average terms, and differencing operations. ARIMA model is an extrapolation method for forecasting and like any other such method, it requires only the historical time series data on the variables under forecasting. It is robust to handle any data pattern.

Forecasting of arrivals and prices of lathyrus in Chhattisgarh plains in required four steps. In the first step includes the identification of model through coding under which p, d, q indicates non-seasonality and P, D, Q reform to seasonality. The steps II has estimated the parameters of model. When the step III made diagnostic checking with respect to reliability of model and in last steps IV made forecasting of arrivals and prices of major pulses, which is presented on follows:

Model Identification

A seasonal ARIMA (p, d, q) x $(P, D, Q)_{12}$ model were identified by finding the initial values for the orders of non-seasonal parameters p and q and seasonal parameters P and Q with 12^{th} lag intervals. They were obtained by looking for significant spikes in autocorrelation and partial autocorrelation functions.

Estimation of parameters

At the identification stage one or more models are tentatively chosen that seem to provide statistically adequate representations of the available data. Then we attempt to obtain precise estimates of parameters of the model by least squares as advocated by Box and Jenkins. Standard computer packages like R program.

Diagnostic checking

In this step, model must be checked for adequacy by considering the properties of the residuals whether the residual from an ARIMA model must has the normal distribution and should be random. An overall check of model adequacy is provided by the Ljung-Box Q statistic. The test statistic Q is

$$Q_m = n(n+2)\sum_{k=1}^{m}\frac{{r_k}^2\,(e)}{n-k}$$

Which follows a chi-square distribution with (m-r) degrees of freedom

Where,
$r_k\,(e)$= the residual autocorrelation at lag k
n = the number of residuals
m = the number of time lags includes in the test.
r = p+q

If the p-value associated with the Q statistic is small (p-value<), the model is considered inadequate. The analyst should considered a new or modified model and continue the analysis until a satisfactory model has been determined.

After satisfying the adequacy of the fitted model, it can be used for forecasting based on the model

Evaluating forecast accuracy

The best model is obtained with following diagnostics based on Least Mean Absolute Percentage Error (MAPE), Mean Absolute Square Error (MASE) value and highest Root Mean Squared Error (RMSE) value.

Scale-dependent errors

Mean absolute error: MAE = mean ($|e_i|$).

Root mean squared error: RMSE =$\sqrt{\text{mean}(e_i^2)}$

Where, e_i=y_i-$\hat{y}$, y_i denote the i^{th} observation and $\hat{y}$ denote a forecast of y_i. When comparing forecast methods on a single data set, the MAE is popular as it is easy to understand and compute.

Percentage errors

The percentage error is given by $p_i = (e_i/y_i)$x100. Percentage errors have the advantage of being scale-independent, and so are frequently used to compare forecast performance between different data sets. The most commonly used measure is:

Mean absolute percentage error: MAPE = mean ($|p_i|$).

Results and Discussion

Seasonal indices of arrivals and price of chickpea in the selected Krishi Upaj Mandi of Chhattisgarh plains

The patterns of variations in arrivals within a year as revealed by the seasonal indices were computed for each month. The final estimates were stabilized monthly seasonal indices *i:e;* shown in Table 1 and Fig. 1 & 2. It indicates that there were three peak arrivals was found in month March (1886.17), April (1248.42) and May (403.91) while the lowest arrivals were observed that during the month of September (-620.16), October (-538.09) and November (-627.88). However, seasonal indices of price of lathyrus. It indicates that there are three peak prices was found in month October (89.36),

November (46.69) and July (45.78) while the lowest prices indices were observed that during the month of and March (-121.36), February (-88.23) and January (-29.97).

Seasonal movements of lathyrus on arrivals indicate that season start from March and peak arrival was observed during the month of March and the lowest arrival was seen in the month of November. While the highest arrivals and lowest price March and September. The study was revealed that the inversely relation has been observed in between arrivals and prices of lathyrus. The study has supported to the decision making of farmers and marketing intermediaries.

Forecasting of arrivals and prices of lathyrus in selected Krishi Upaj Mandi of Chhattisgarh plains

Identification of the Model

ARIMA model was estimated after transforming the arrivals and price data of lathyrus into stationary series. The Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) values are graphically presented in Figure 3 and 4. Based on p, d, q values many models were tested. A seasonal ARIMA (p, d, q) x $(P, D, Q)_{12}$ model were identified by finding the initial values for the orders of non-seasonal parameters p and q and seasonal parameters P and Q with 12^{th} lag intervals.

They were obtained by looking for significant spikes in autocorrelation and partial autocorrelation functions. At the identification stage, one or more models were tentatively chosen which seem to provide statistically adequate representations of the available data. Then precise estimates of parameters of the model were obtained by least squares. Finally, the ARIMA (2,1,2) $(0,1,0)_{12}$ and ARIMA (3,1,2) $(1,1,3)_{12}$ were selected as ARIMA (2,1,2) $(0,1,0)_{12}$ and (3,1,2) (1,1,3) were selected as the most suitable models to forecasts of lathyrus arrivals as well as prices based on Least Mean Absolute Percentage Error (MAPE), Mean absolute error (MAE) value and highest Root Mean Square Error (RMSE) are presented in Table 2.

Estimation of parameters

The parameters of best fitted model of arrivals and prices were presented in Table 3. The non-seasonal specification of Autocorrelation (AR), differencing, and Moving Average (MA), and then the seasonal specification of seasonal AR, seasonal differencing, seasonal MA, and period or span for the seasonality.

Diagnostic Checking

The time series plot of the standardized residuals mostly indicates that there was no trend in the residuals, no outliers, and in general, no changing variance across the time (Figure 4.19 and 4.20). The ACF of the residuals shows non significant autocorrelations that is a good result. The bottom plot gives p-values for the Ljung-Box-Pierce statistics for each lag up to 36 months.

These statistics consider the accumulated residual autocorrelation from lag 1 up to and including the lag on the horizontal axis. The dashed blue line was at .05. All p-values were above it. That was a good result. Diagnostic checking for arrivals and prices are graphically presented in the Figure 5 and 6.

Forecasting

After identification of the model and its adequate checking then model used to forecast the arrivals and prices of lathyrus in the coming periods. Hence, we used the identified ARIMA model to forecast the arrivals and prices of lathyrus in the Chhattisgarh plains for the period of April 2018 to March 2021 and the results of forecasted arrivals and prices were presented in Table 4 and illustrated in Figure 7 and 8. As can be seen from the graph that the actual and forecasted arrivals and prices of lathyrus in the selected market were more or less closer. The study was found that forecasts the arrivals of lathyrus would be ranging from the minimum 832.55 tonnes in September, 2018 to the maximum 4299.91 tonnes in March, 2021. As can also be seen from the graph that the actual and forecasted prices of lathyrus in the selected market were more or less closer. Forecasts price of lathyrus would be ranging from the minimum Rs./qtl 1050.31/- in April, 2018 to the maximum Rs./qtl 2467.94/- in October 2019.

The study was reported that the maximum price is near to minimum arrivals month. It is noticed that the inversely relationship between arrivals and price of lathyrus in selected mandis of Chhattisgarh plains. The study reported that pattern of arrivals and prices were directly supported in decision making to the farmers and various intermediaries.

Tables

Table 1: Seasonal indices of arrivals and prices of lathyrus in selected KUM of Chhattisgarh plains (2003-04 to 2017-18)

Month	Arrival	Price	Month	Arrival	Price
Jan	-500.60	-29.97	July	-307.23	45.78
Fab	-54.76	-88.23	Aug	-401.43	-11.03
Mar	1886.17	-121.36	Sep	-620.16	12.36
Apr	1248.42	24.20	Oct	-538.09	89.36
May	403.91	29.11	Nov	-627.88	46.69
Jun	-137.32	16.30	Dec	-351.00	-13.22

Table 2: Identification of models by selected parameters of arrivals and prices of Lathyrus

Type	Model	RMSE	MAPE	MASE
Arrivals	(2,1,2)(0,1,0)	632.56	42.12	0.72
Prices	(3,1,2) (1,1,3)	201.46	6.81	0.94

Table 3: Estimation of parameters of identified model for arrivals and prices of lathyrus in Chhattisgarh plains

Type	Model	Term	Coefficient	SE
Arrivals		AR1	-0.31	0.08
	ARIMA $(2,1,2)\ (0,1,0)_{12}$	AR2	0.42	0.08
		MA1	-0.03	0.03
		MA2	-0.96	0.03
		AR1	0.38	0.17
Prices	ARIMA $(3,1,2)\ (1,1,3)_{12}$	AR2	-0.32	0.17
		AR3	-0.33	0.08
		MA1	-0.35	0.17
		MA2	0.34	0.17
		Seasonal AR1	-0.26	0.20
		Seasonal MA1	-0.74	0.20
		Seasonal MA2	-0.51	0.17

Table 4: Forecast arrival and price of lathyrus in selected Krishi Upaj Mandi of Chhattisgarh plains (2018-19 to 2020-21)

Month/Year	2018-2019		2019-20		2020-21	
	Arrival (tonnes)	Price (Rs/qtl)	Arrival (tonnes)	Price (Rs/qtl)	Arrival (tonnes)	Price (Rs/qtl)
April	2525.34	1050.31	2629.67	1939.60	2711.97	2250.24
May	1477.86	1108.61	1538.05	2102.82	1616.03	2201.85
June	1665.56	1200.99	1761.95	2175.61	1843.49	2114.56
July	1420.31	1282.22	1486.78	2389.06	1565.39	2132.18
August	2180.44	1465.16	2271.52	2294.73	2352.55	2021.17
September	832.55	1479.76	903.33	2317.07	982.36	2110.70
October	1348.56	1640.71	1436.06	2467.94	1516.73	2229.06
November	1849.73	1650.06	1923.43	2441.61	2002.76	2159.23
December	1044.32	1805.41	1129.39	2176.61	1209.83	2132.18
January	2617.38	2130.49	2693.09	2016.80	2772.61	2224.72
February	2027.39	1980.96	2110.81	2022.88	2191.09	1933.88
March	4143.19	1938.11	4220.26	2020.87	4299.91	1955.34

Graph

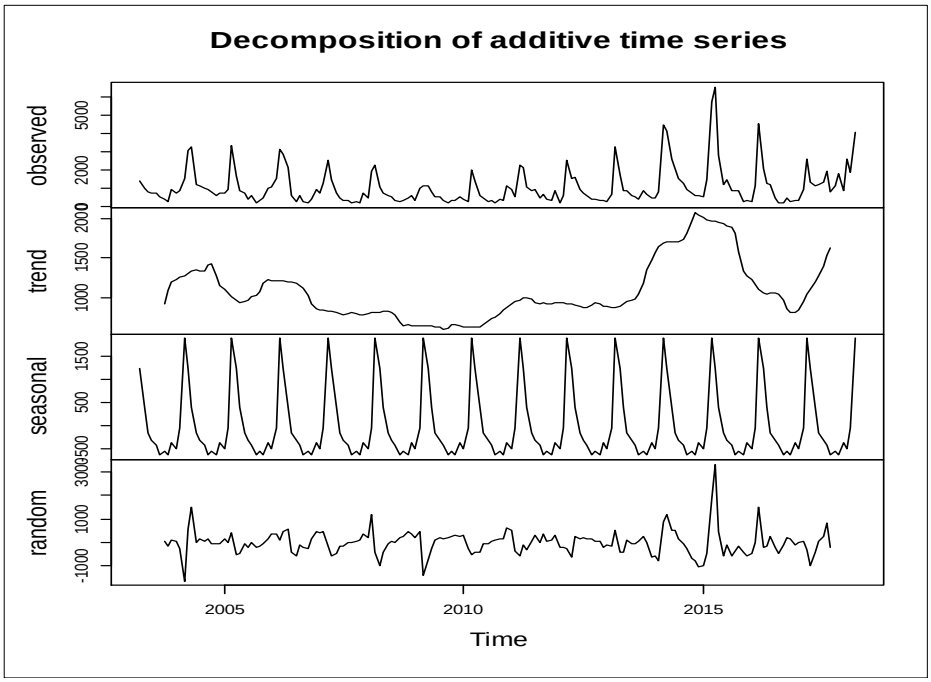

Fig 1: Seasonal arrivals indices of lathyrus in selected Krishi Upaj Mandi of Chhattisgarh plains

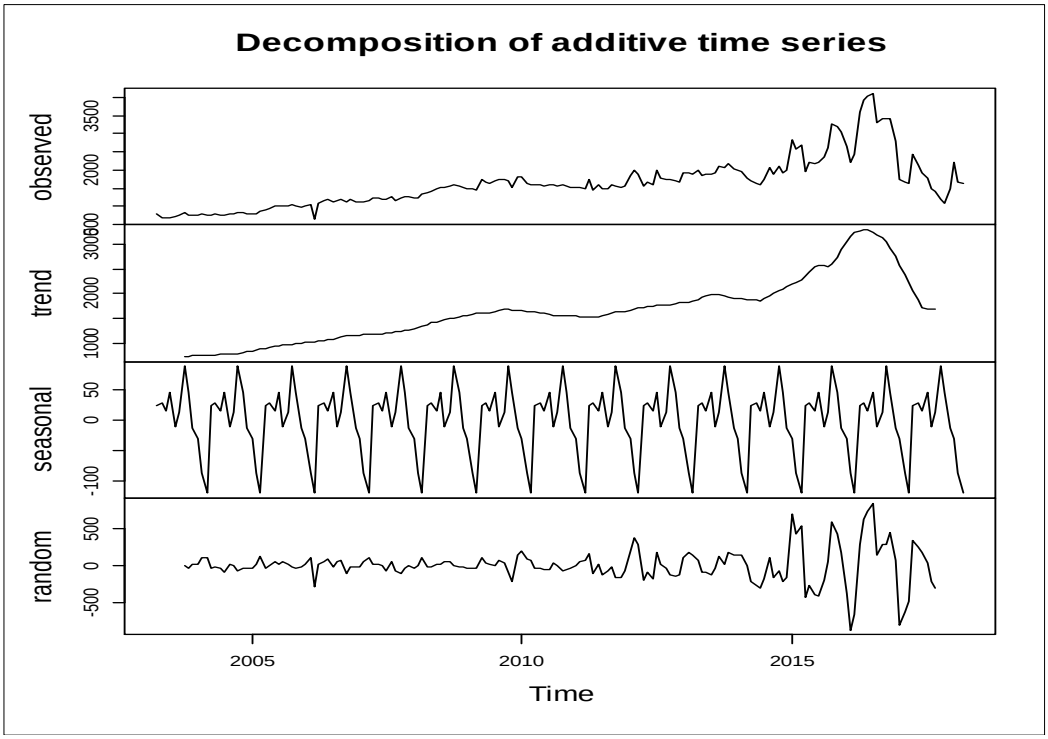

Fig 2: Seasonal price indices of lathyrus in selected Krishi Upaj Mandi of Chhattisgarh plains

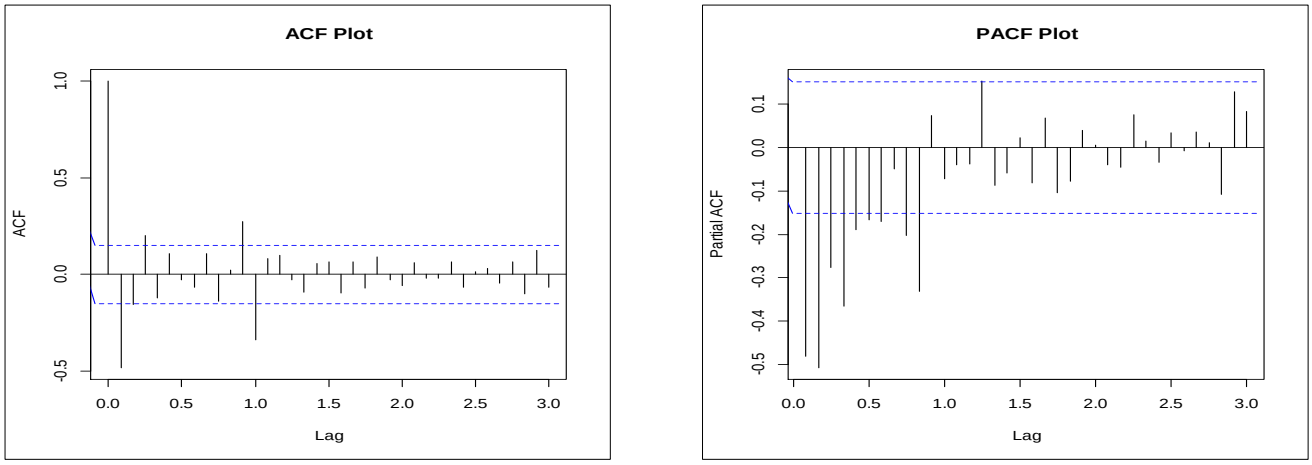

Fig 3: Expressed Auto-Correlation Function (ACF) and Partial Auto-Correlation Function (PACF) plot of arrivals data of lathyrus in selected Krishi Upaj Mandi of Chhattisgarh plains

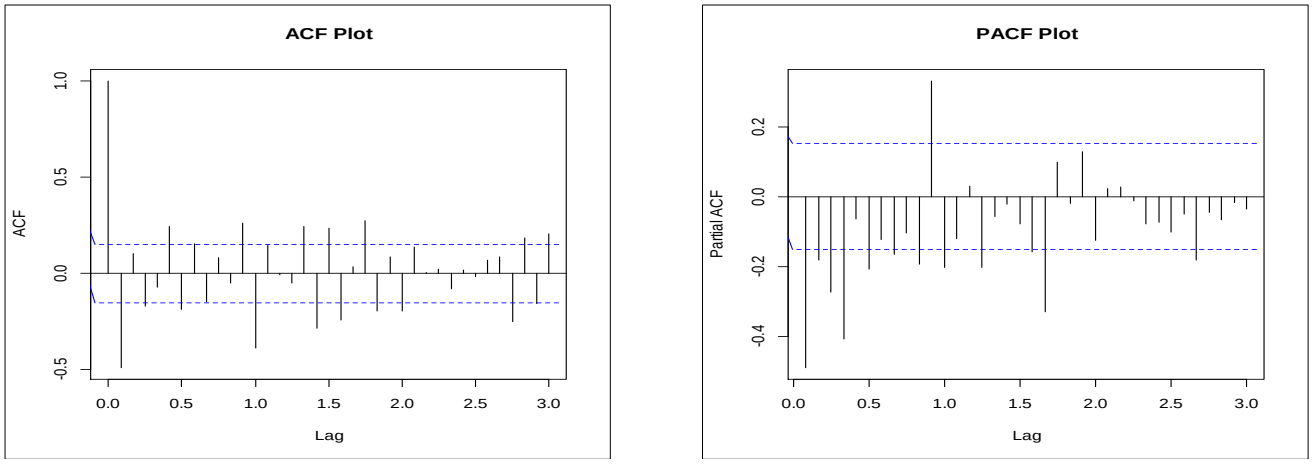

Fig 4: Expressed Auto-Correlation Function (ACF) and Partial Auto-Correlation Function (PACF) plot of price data of lathyrus in selected Krishi Upaj Mandi of Chhattisgarh plains

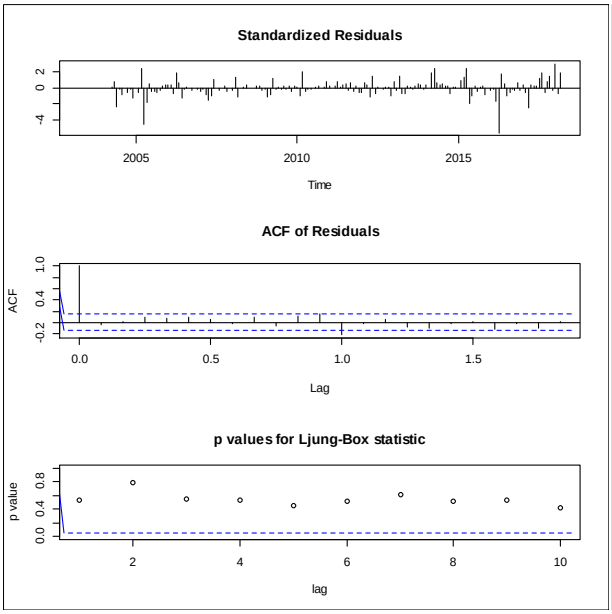

Fig 5: Diagnostic checking for arrivals data

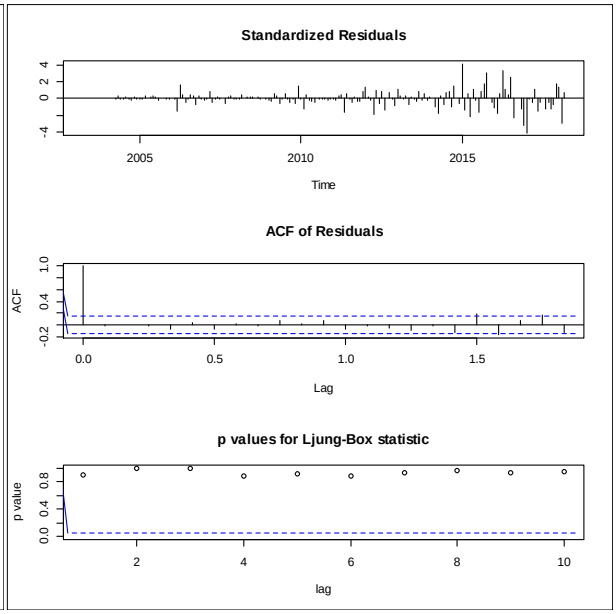

Fig 6: Diagnostic checking for prices data

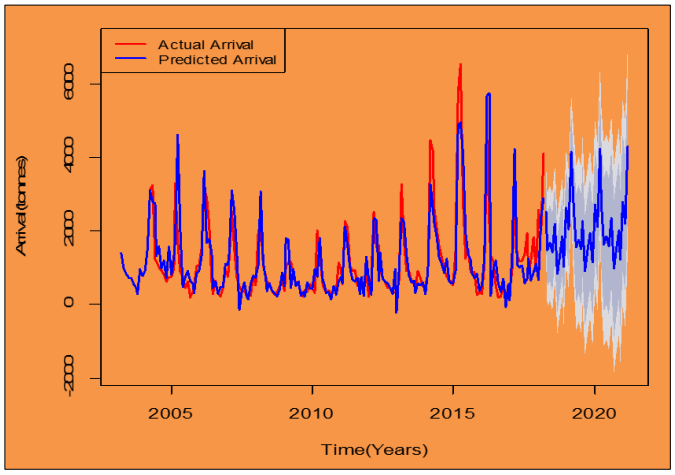

Fig 7: Actual and predicted arrivals of lathyrus in Chhattisgarh plains

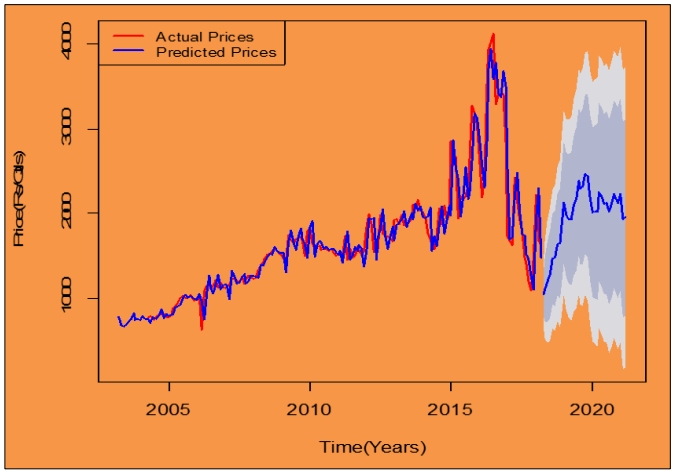

Fig 8: Actual and predicted price of lathyrus in Chhattisgarh plains

Conclusion

The study was reported that the maximum price is near to minimum arrivals month. It is noticed that the inversely relationship between price and arrivals of lathyrus in selected market of Chhattisgarh plains The study reported that pattern of arrivals and prices were directly supported in decision making to the farmers and various intermediaries.

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