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Decomposition and forecasting of tomato price in Bhopal district, Madhya Pradesh

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Abstract Vegetable crops are harder to forecast due to their highly perishable and seasonal nature. Madhya Pradesh recorded the maximum share of area and production under tomato in India at 12.14% and 13.33% respectively. This was followed by the share of Andhra Pradesh (6.79% and 11.13%) and Karnataka (8.31% and 10.17%). The analysis done in the Bhopal market shows, relatively higher arrivals in March with a seasonality index of 1.65 and average production at 3378.11 thousand MT. The lowest tomato arrival was found in June and July. The price of tomato touched its peak with seasonality indices of 1.80 and the wholesale price at Rs. 3688. A decomposition of tomato prices and arrivals indicates that arrivals showed a downward trend and price showed an upward trend over time. In May, tomato price is mostly less than the median value and the plot is skewed upwards, which shows right tail skewness, and in September, the price is more than the median value and the plot is skewed downwards, which shows left tail skewness. ACF show the sine wave pattern which indicate that there is a seasonal component in the data. On the basis of previous year data, we predicted that the price will decrease over the period and remain in the range of Rs 2000 to Rs 4500, respectively at the confidence interval of 80% and 95%, respectively.

Keywords: Tomato, arrival, price, forecasting, ARIMA, ACF

JEL codes Q02, Q11, Q41, R15

Introduction

In India, the horticulture sector contributes 33% to Gross Value Added (GVA) in agriculture, making it a very significant contributor to the overall economy as well. Besides ensuring nutritional security, horticulture offers alternative employment opportunities, diversification in farm activities, and an increase in farmers' incomes. Currently, India produces about 320.48 MT of horticulture produce every year which is exceeding production of food grains. And this is from an acreage much smaller (25.66 million ha) than that is utilized for production of food grains (127.6 million ha). As shown in Annexure Table 1, total area and production of tomato in India is 842.75 thousand ha and 20694.30 thousand MT respectively. The proportionate area and production has decreased by 0.21% and 2.29%, respectively (Anonymous, 2021). Among the states, the maximum share of total area and production is in Madhya Pradesh (12.14% and 13.33%), followed by Andhra Pradesh (6.79% and11.13%) and Karnataka (8.31% and 10.17%). The productivity of horticulture crops is much higher at 12.49 tones/ha as compared to the food grains at 2.23 tones/ha (Anonymous, 2021). In recent years, there has been an increase in the price volatility of many agricultural commodities, leading to an increase in risk for the producers. Producers look for accurate price forecasts for their products in near future to combat

risks. The price forecasting serves this purpose as it provides producers with information which allows them to make more accurate decisions and also manage the risks involved (Ticlavilca et al., 2010). Vegetable crops are relatively difficult to forecast due to their highly perishable and seasonal nature.

We undertake a decomposition analysis in this paper to examine the seasonal price variations in tomato crop. An ARIMA model is used to forecast monthly wholesale tomato prices in district Bhopal, Madhya Pradesh based on the reported arrivals and prices. The time period taken for the analysis is from 2015 to 2023. Based on the findings, some suggestions are made.

Data and methodology

The annual and monthly data on arrivals and price are gathered from the National Horticulture Board from January 2015 to August 2023. The National Horticulture Board provides wholesale prices of the local variety of tomato. Based on the series, we have estimated the trends, irregularity and seasonality and price forecasting in the Bhopal markets. The markets were selected on the basis of location as well as volume of produce handled.

Seasonality analysis

In order to analyze the seasonal variations in arrivals and prices, ratio to moving average method is applied. A twelve month centred moving average is used based on a multiplicative model is used:

$Y_t = S_t \times T_t \times I_t$

Y_t = observed value of time series at time t
S_t = the seasonal component at time period t
T_t = the trend component at time period t
I_t = the irregular component at time period t

To estimate the seasonal index, 12 month moving averages are calculated as follows:

$$M1 = \frac{Y1 + Y2 + Y3 \ldots \ldots \ldots + Y12}{12}$$

$$M1 = \frac{Y2 + Y3 + Y4 \ldots \ldots \ldots + Y13}{12}$$

*

*

$$M12 = \frac{Y12 + Y13 + Y14 \ldots \ldots \ldots + Y23}{12}$$

In the next step, the original series is divided by the centered moving average. This gives the first estimate of seasonal components, expressed as percentage.

$$S_t = \frac{Yt}{(TC)t} = \frac{S_t \times T_t \times I_t}{Tt \times Ct}$$

Price forecasting

The time series data is checked for the unit root problem. A few diagnostic checks are done to test the adequacy of the model. The model is diagnosed using the Ljung-Box Q statistic to check the overall adequacy of the model.

H0 = There is no stationarity in the data

H1 + There is stationarity in the data

If p value is less then 0.05 then we reject the null hypothesis, which may mean that data is stationary and is ready for forecast.

Auto regression model

Yt = b1*Yt Lag1 + b2*Yt Lag2+ b3*YtLag3 + b4*YtLag4+ ……..+ bp*YtLagp + C

where,

- Yt Lag1, Yt Lag2…… YtLagp = Lagged value of p in the previous month. If "t" is the current year, then "t-1" will be the last.
- b1,b2,b3……bp = bp is coefficient, which is multiplies with Xt-1. The value of bp will always be 1 or -1.
- C = Difference between the period t value and the correct value ($C = yt - \hat{y}t$)

The analysis is done in R Studio with suitable package

install.packages("dplyr")

install.packages("readxl")

install.packages("writexl")

install.packages("fpp2")

install.packages("ggplot2")

install.packages("ggfortify")

Table 1 Seasonal indices of tomato arrivals and prices in Bhopal market

Month	Price (Rs/qtl)				Arrival (000MT)			
	Seasonality (St)	Trend (Tt)	Irregular (It)	Yt = Tt*St*It	Seasonality (St)	Trend (Tt)	Irregular (It)	Yt = Tt*St*It
Jan	0.56	1906.36	1.26	1299.00	1.21	2416.39	0.92	2684.44
Feb	0.38	1919.25	1.17	815.22	1.48	2413.17	0.81	2909.89
Mar	0.34	1932.14	1.26	814.22	1.65	2409.94	0.85	3378.11
Apr	0.37	1945.03	1.05	756.67	1.08	2406.72	1.03	2707.22
May	1.07	1957.92	0.88	1904.67	0.72	2403.50	1.27	2292.89
Jun	1.53	1970.81	0.90	2774.89	0.62	2400.27	1.13	1717.77
Jul	1.80	1983.70	1.03	3688.89	0.65	2397.05	1.07	1703.33
Aug	1.54	1996.58	0.89	2857.11	0.77	2393.83	1.01	1848.29
Sep	1.32	1932.14	0.76	2044.50	0.85	2409.94	0.97	1990.29
Oct	1.47	1945.03	0.81	2373.38	0.74	2406.72	1.08	1919.47
Nov	1.12	1957.92	1.02	2211.50	0.90	2403.50	0.99	2143.50
Dec	0.69	1970.81	1.00	1349.63	1.25	2400.27	0.87	2612.51

Results and discussion

Table 1 furnishes results on the seasonal patterns in arrivals and prices of tomato based on monthly arrivals and wholesale prices in markets in Bhopal district. We find relatively higher arrivals during the peak period in the month of March with seasonality index 1.65 and average production 3378.11 thousand MT. The lowest arrival is found to be in the months of June and July. The price of tomato is high with seasonality indices at 1.80 and wholesale price of tomato to be Rs. 3688. The lowest seasonal index of wholesale price is recorded during march i.e., in the beginning of harvest season, whereas, the highest is reported in June and July. The latter months represent off season for tomato which could be because tomato is brought from cold storage to the market yards. Figure 1 shows the relationship between tomato prices and arrivals. High seasonal indices are observed from July, indicating high post harvest arrivals. During the peak season, post-harvest arrivals are high and hence prices are low. While in the off-season, prices are high due to shortage and inadequate storage facilities. That is why a negative relationship between prices and arrivals is observed.

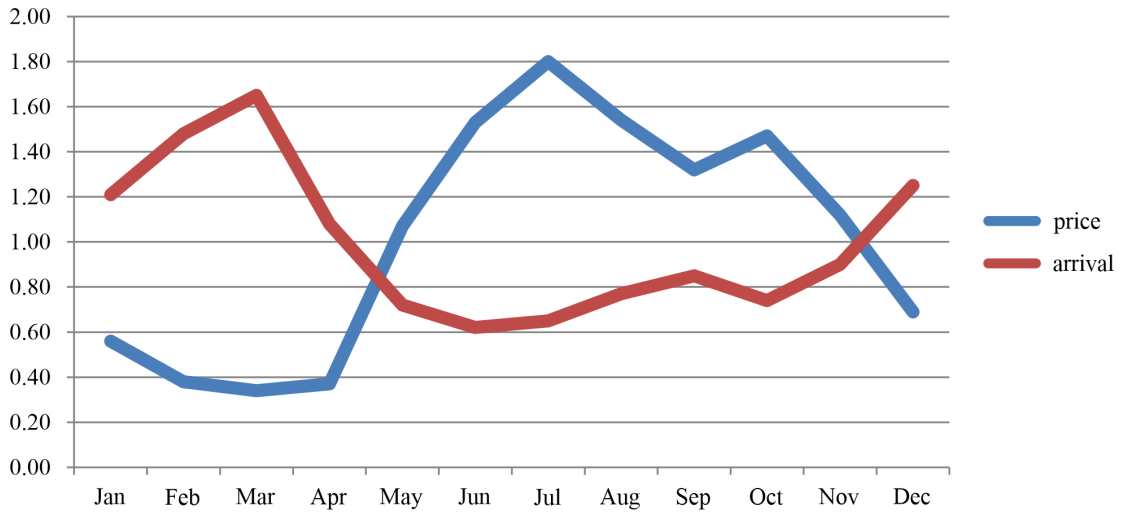

Figure 1 Seasonality (St) of Tomato Arrivals and Prices in Bhopal Market

Decomposition analysis of tomato from 2015 to 2023

Figure 2 and 3 reveal price decomposition of tomato from 2015 to 2023 in Bhopal markets*. The estimated trend refers to a long-term pattern or behavior that persists for a prolonged period. In case of arrival, it shows a downward trend whereas in case of price, the trend is upward. Due to shortage of supply of tomato, the price increase. The curvature of the trend line is flatter in both price and arrival which shows more elasticity i.e. the arrival and price gradually change over time. Seasonality refers to a regular and predictable pattern of fluctuations in time series data that occur at specific intervals. In case tomato arrivals and prices, the seasonality increases. Irregularity, also known as noise or residuals, represents random fluctuations or variations that cannot be attributed to the trend or seasonality. The irregularity fluctuation decreases over time.

Price forecasting of tomato

For forecasting, it is very important that the data series is stationary i.e. the mean and variance remain constant over time. The result of stationarity tested using the Ljung-Box statistic tool is given below:

```
Box-Ljung test

data:  diff(Price)
X-squared = 21.444, df = 10, p-value = 0.0182
```

A p value less than 0.05 may reject the null hypothesis. In other words, we find that data is stationary and ready for forecasting.

Summary of price from 2015 to 2023 in Bhopal markets

We have estimated a box plot, also known as a box-and-whisker plot. It is a graphical representation that

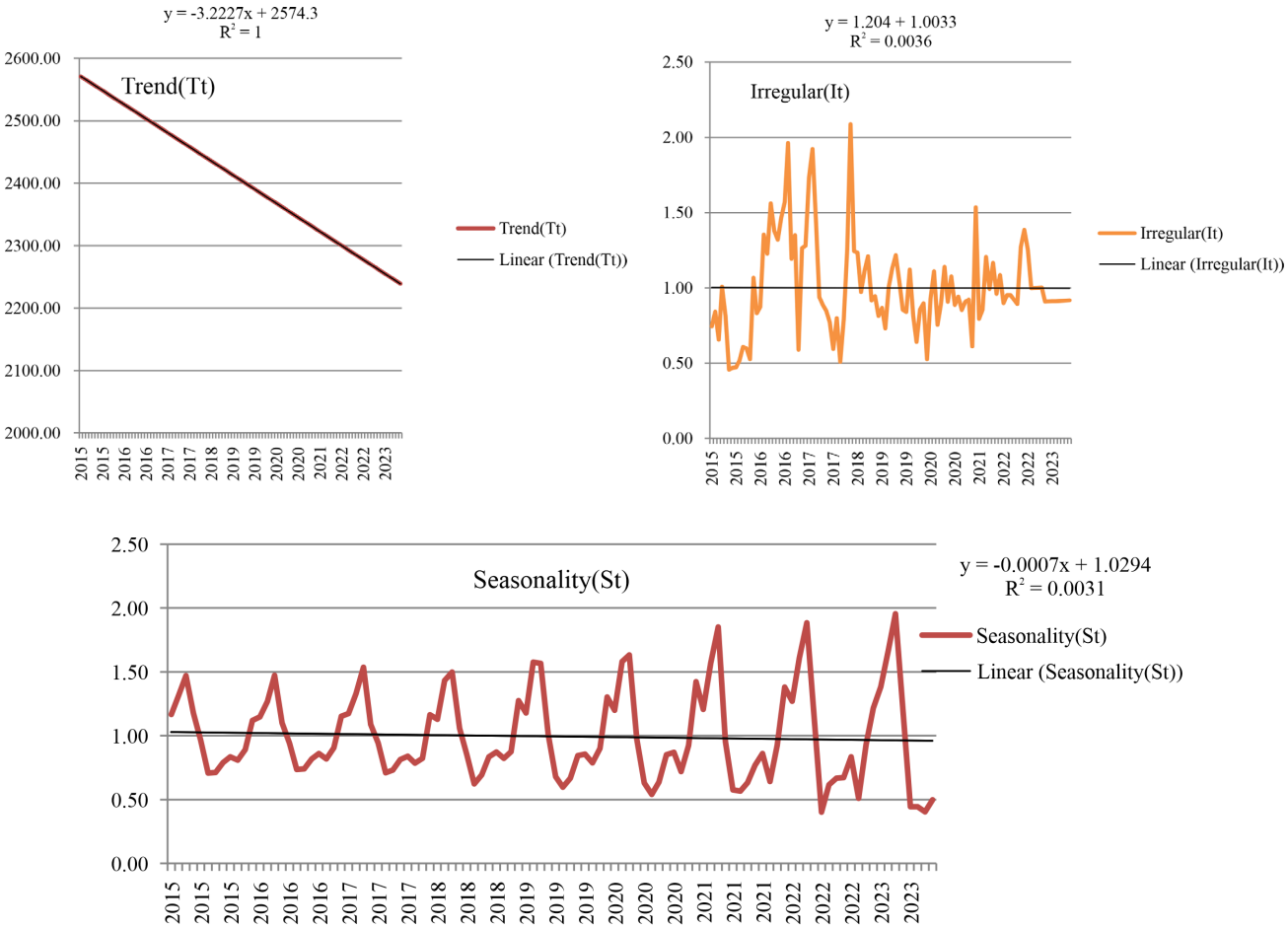

Figure 2 Trend, irregularity and seasonality of tomato arrivals in Bhopal market

*Selected Bhopal Market : Bhopal (F & V), Berasia, Bhopal Market

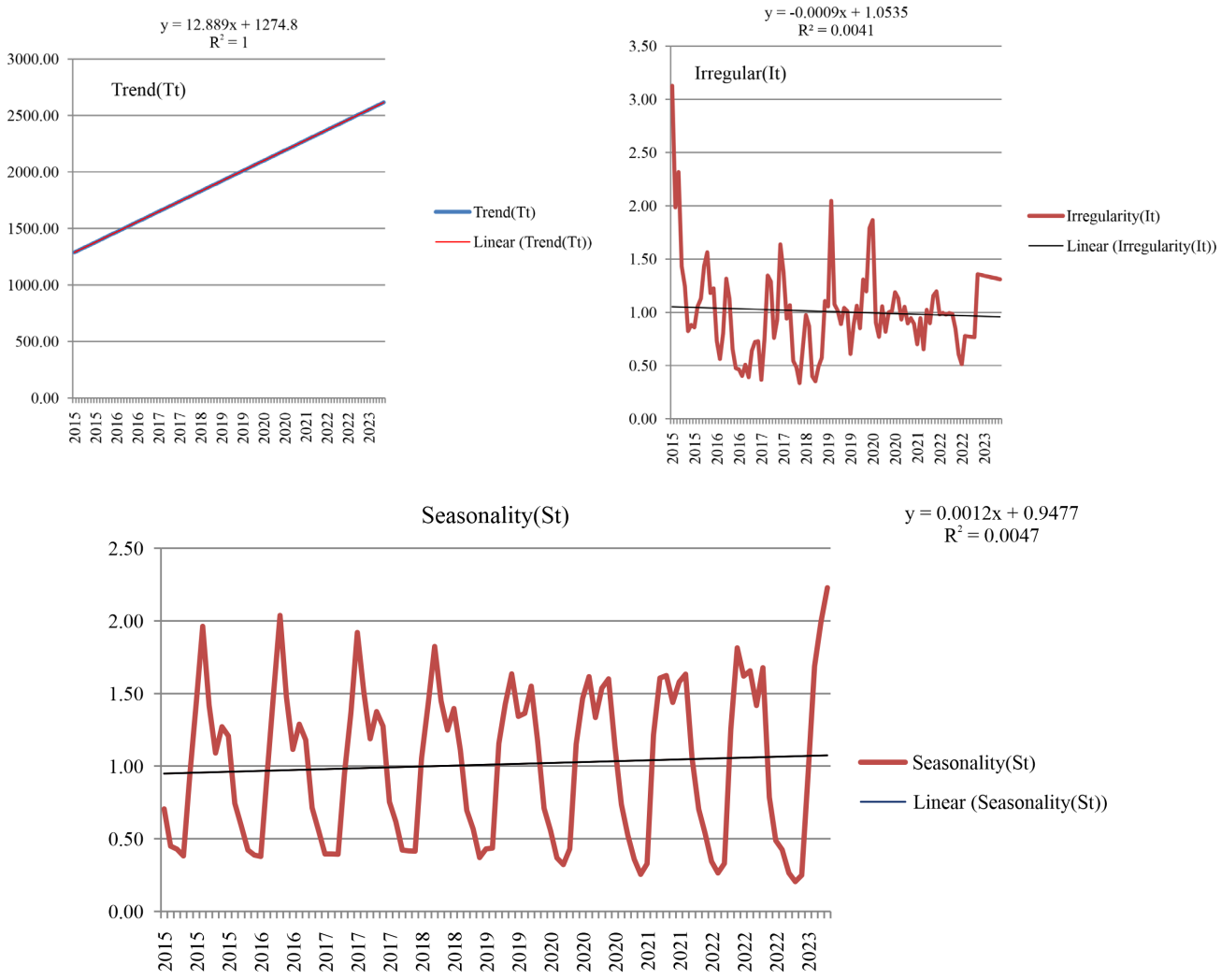

Figure 3 Trend, irregularity and seasonality of tomato price in Bhopal market

```
summary(Price)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    313     892    1631    1904    2602    7638
```

provides a visual summary of a dataset's distribution. It displays key statistical measures and highlights the spread and skewness of the data. The plot consists of a box, which represents interquartile range (IQR), and "whiskers" that extend from the box to display data's variability. As shown in Figure 4, the median value of tomato price is Rs 1631 and the mean value is Rs. 1904. We may note that the price decreased gradually from Rs. 1299 per day in January to about Rs. 756 per day in April. After that from May to July, price increased gradually and then decreased. The points show months with outlier price counts: one day in June and two days in July showing high price compared to other days in the month. In July, one day shows low price compared to other days. In May, price is mostly less than the median value and plot is skewed upward which shows right tail skewness. In September, price is more than the median value and the plot is skewed downward which shows left tail skewness. Highest price was seen in the month of July having right tail skewness.

Auto-correlation function

We use an Auto-Correlation Function (ACF) to analyze correlation between a time series and its lagged values. It helps to identify the underlying patterns or trends in the data. Figure 5 shows the ACF of tomato Price. The dashed lines are called "confidence bounds" or "significance bounds" which help to determine if the

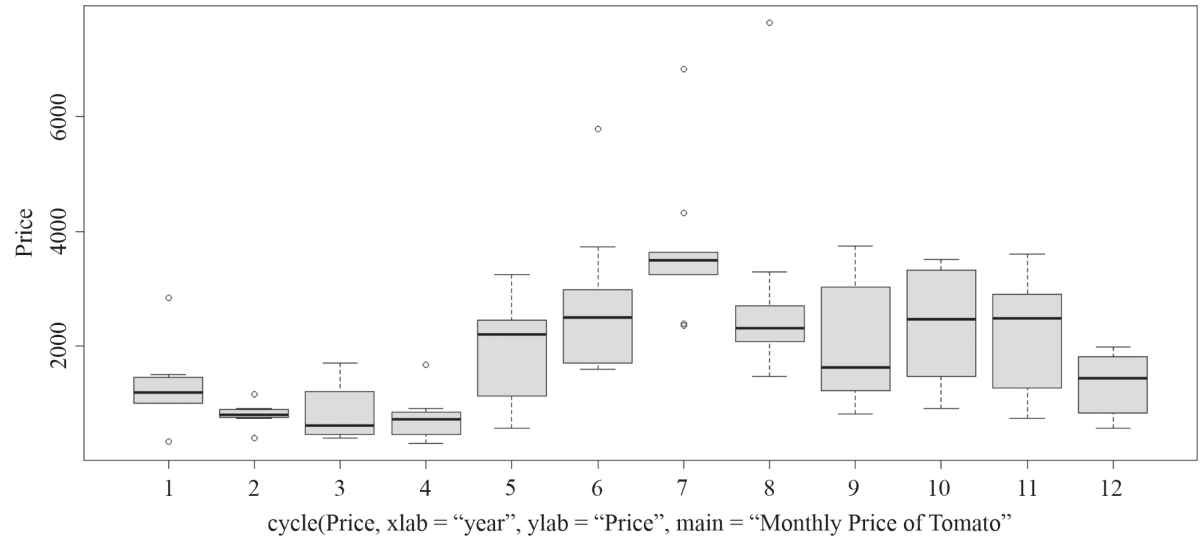

Figure 4 Boxplot analysis of tomato price in Bhopal market

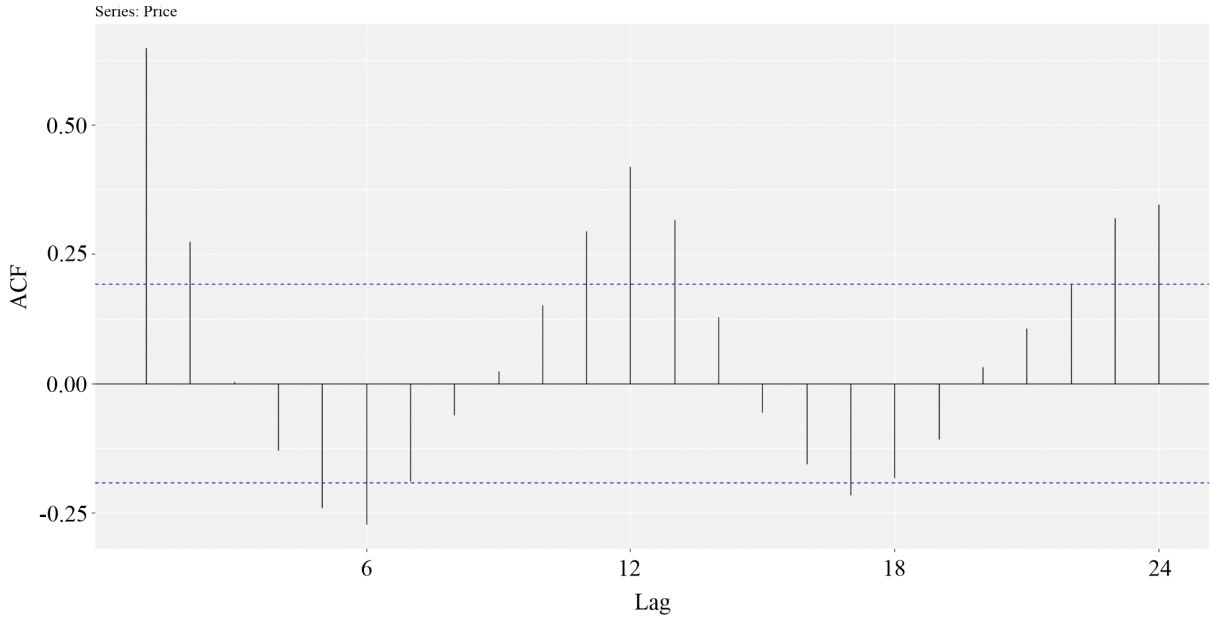

Figure 5 Auto-correlation function of tomato price

correlation values at specific lags are statistically significant. Lag 1, lag 2, lag11, lag12, lag23 and lag 24 show a positive correlation and lag 5, lag 6 and lag 17 show a negative correlation. It indicates that there is a meaningful lag which may help in the forecasting of tomato price. The ACF shows a Sine Wave Pattern which indicates that there is a seasonal component in the data. Peaks in the ACF plot indicate significant correlations at those lags. This may suggest that the tomato price has a repeating pattern or structure at those time gaps. Valleys, on the other hand, indicate lags where the correlation is low or negative.

Figure 7 shows movement of tomato price from 2015 to 2023 based on ggseasonplot. It shows that over time, the price of tomato gradually increased. The reason is that the tomato arrival in the market gradually decreased. Due to a shortage of supply of tomato in the market, the price of tomato increases. A sharp increase in price was seen in the month of august 2023. The reason behind a hike in price was that the supply of rabi crop is between March and August. A sudden

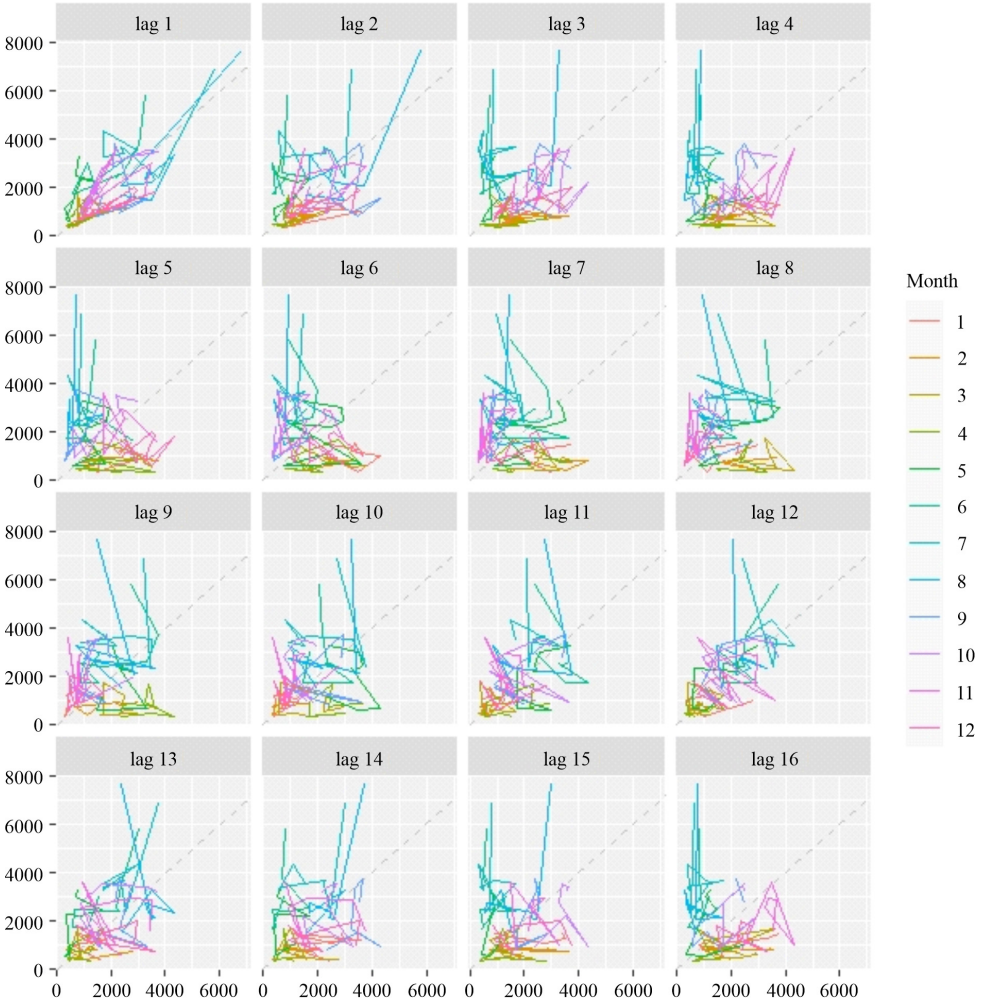

Figure 6 gglagplot of tomato price in Bhopal market

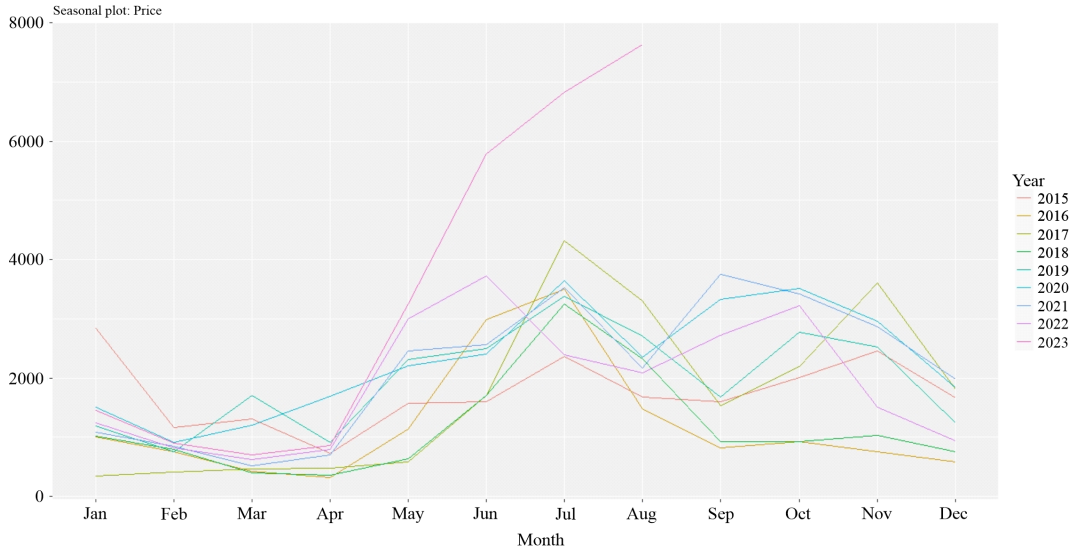

Figure 7 ggseasonplot of tomato price from 2015-2023 in Bhopal market

heat wave affected tomato harvest, causing pests to attack the crop, thereby resulting in lower yields and higher market prices. The leaf virus havoc affected Karnataka, Madhya Pradesh, and Maharashtra considerably that the local Agriculture produce market Committee received only 3.2 lakh quintals of tomatoes in 2023 instead of 5.50 lakh quintals in 2022. Due to unseasonal rains in May, the supply from the producing states was disrupted, affecting harvesting and transportation (thehindu.com).

Price forecasting of tomato from September 2023 to August 2028

ARIMA (AutoRegressive Integrated Moving Average) is used for the purpose. This model is useful when data exhibits certain patterns and dependencies over time. Figure 8 shows the forcast of tomato price from September 2023. Its show that after a huge price hike in the month of July and August, price will decrease over time and will remain in the range of Rs 2000 to

```
Forecast method: ARIMA(1,0,0)(0,1,1)[12]

Model Information:
Series: Price
ARIMA (1,0,0)(0,1,1)[12]

Coefficients:
         ar1     sma1
      0.8078  -0.5116
s.e.  0.0901   0.1356

sigma^2 = 636448:  log likelihood = -746.57
AIC=1499.14   AICc=1499.41   BIC=1506.7

Error measures:
                    ME     RMSE      MAE       MPE     MAPE      MASE     ACF1
Training set 76.20222 742.1405 508.8826 -4.709807 33.35027 0.6600945 0.00683
```

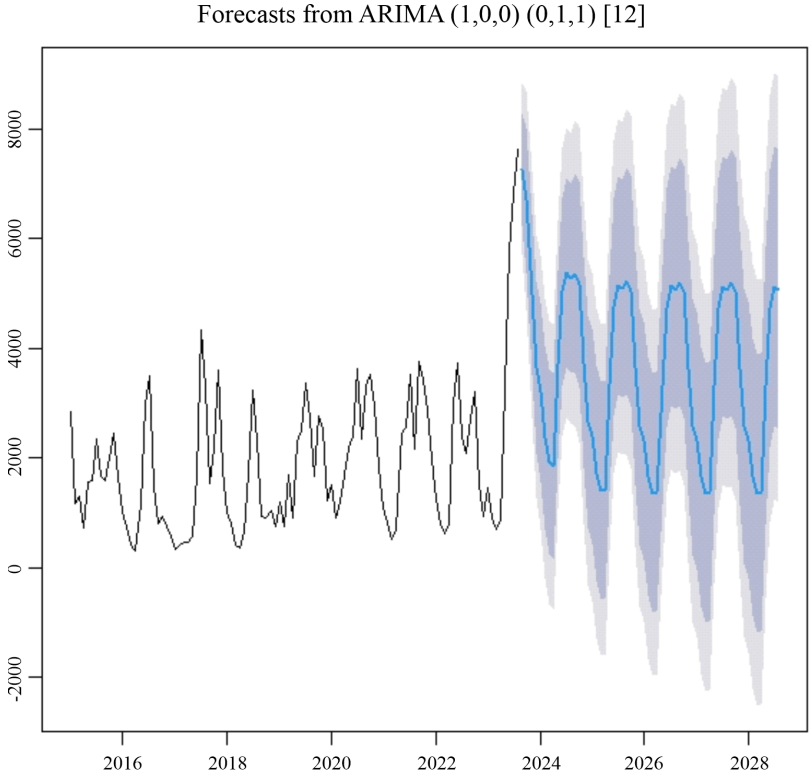

Figure 8 Forecast of tomato price from September 2023-August 2028

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Sep 2023	7277.212	6254.81124	8299.612	5713.58517	8840.838
Oct 2023	6705.792	5391.49798	8020.087	4695.75256	8715.832
Nov 2023	4990.529	3516.61572	6464.443	2736.37298	7244.686
Dec 2023	3664.730	2095.39322	5234.066	1264.63676	6064.822
Jan 2024	3204.961	1576.37419	4833.547	714.25255	5695.669
Feb 2024	2372.814	706.69992	4038.928	-175.28754	4920.915
Mar 2024	1938.437	248.28515	3628.589	-646.42715	4523.301
Apr 2024	1846.446	140.79185	3552.100	-762.12684	4455.019
May 2024	3698.803	1983.10941	5414.497	1074.87597	6322.730
Jun 2024	5035.307	3313.09408	6757.521	2401.40943	7669.205
Jul 2024	5379.314	3652.86045	7105.768	2738.93091	8019.698
Aug 2024	5276.557	3547.34161	7005.772	2631.95026	7921.164
Sep 2024	5369.685	3546.32947	7193.040	2581.10363	8158.265
Oct 2024	5164.930	3282.68487	7047.174	2286.28474	8043.574
Nov 2024	3745.851	1826.15462	5665.547	809.92890	6681.772
Dec 2024	2659.303	715.55950	4603.046	-313.39597	5632.001
Jan 2025	2392.797	433.52372	4352.070	-603.65275	5389.246
Feb 2025	1716.764	-252.57834	3686.106	-1295.08508	4728.613
Mar 2025	1408.493	-567.39208	3384.377	-1613.36223	4430.347
Apr 2025	1418.367	-561.77479	3398.509	-1609.99866	4446.733
May 2025	3353.010	1370.09469	5335.925	320.40286	6385.617
Jun 2025	4755.982	2771.25984	6740.705	1720.61127	7791.353
Jul 2025	5153.681	3167.78035	7139.582	2116.50799	8190.854
Aug 2025	5094.295	3107.62564	7080.964	2055.94649	8132.643
Sep 2025	5222.457	3162.64542	7282.268	2072.24720	8372.666
Oct 2025	5046.002	2939.83418	7152.169	1824.89638	8267.107
Nov 2025	3649.783	1513.91080	5785.656	383.24823	6916.318
Dec 2025	2581.701	426.66808	4736.734	-714.13756	5877.540
Jan 2026	2330.112	162.66922	4497.554	-984.70559	5644.929
Feb 2026	1666.128	-509.37519	3841.632	-1661.01710	4993.273
Mar 2026	1367.590	-813.15690	3548.337	-1967.57462	4702.755
Apr 2026	1385.327	-798.83468	3569.489	-1955.06006	4725.714
May 2026	3326.321	1139.93356	5512.708	-17.46979	6670.111
Jun 2026	4734.423	2546.58548	6922.261	1388.41414	8080.432
Jul 2026	5136.266	2947.48234	7325.050	1788.81019	8483.722
Aug 2026	5080.227	2890.82654	7269.628	1731.82774	8428.627
Sep 2026	5211.093	2955.75018	7466.436	1761.84366	8660.343
Oct 2026	5036.823	2739.47236	7334.173	1523.32857	8550.317
Nov 2026	3642.368	1318.01810	5966.719	87.58132	7197.156
Dec 2026	2575.712	233.91248	4917.511	-1005.76118	6157.185
Jan 2027	2325.274	-27.83980	4678.387	-1273.50281	5924.050
Feb 2027	1662.220	-698.24833	4022.688	-1947.80477	5272.245
Mar 2027	1364.433	-1000.82194	3729.688	-2252.91235	4981.779
Apr 2027	1382.777	-985.59637	3751.150	-2239.33745	5004.891
May 2027	3324.261	953.85489	5694.666	-300.96209	6949.483
Jun 2027	4732.759	2361.02831	7104.490	1105.50980	8360.009
Jul 2027	5134.922	2762.32682	7507.517	1506.35079	8763.493
Aug 2027	5079.142	2705.98270	7452.301	1449.70825	8708.575
Sep 2027	5210.216	2776.13351	7644.299	1487.60795	8932.825
Oct 2027	5036.114	2563.08764	7509.141	1253.94645	8818.282
Nov 2027	3641.796	1143.68640	6139.906	-178.73305	7462.325
Dec 2027	2575.249	60.90856	5089.590	-1270.10313	6420.602
Jan 2028	2324.900	-199.97388	4849.774	-1536.56149	6186.362
Feb 2028	1661.918	-869.80654	4193.643	-2210.02073	5533.857
Mar 2028	1364.189	-1171.99560	3900.375	-2514.57088	5242.950
Apr 2028	1382.580	-1156.51109	3921.671	-2500.62476	5265.785
May 2028	3324.102	783.11598	5865.087	-562.00056	7210.204
Jun 2028	4732.631	2190.40981	7274.852	844.63931	8620.622
Jul 2028	5134.818	2591.79155	7677.845	1245.59453	9024.042
Aug 2028	5079.058	2535.50555	7622.610	1189.03031	8969.085

Rs 4500 per qtl respectively at the confidence interval of 80% and 95% respectively. At the time of harvesting, tomato arrivals in the market are high. Due to increased supply, the price of tomato reaches Rs 2000 per qtl. However during shortage of supply, the price may go upto Rs 4500 per qtl.

Conclusion

The results obtained in the study indicate that the wholesale price of tomato in Bhopal district of Madhya Pradesh show a downward trend during 2015 to 2023. Based on the forecasts predicted from ARIMA (1, 0, 0) (0,1, 1)12 model, it is clear that significant changes would occur by September 2023 at 5% and 20% levels of significance. In order to forecast tomato price accurately and timely, it is important to develop better price forecast methods which take seasonality into consideration. At the time of high fluctuations in the price of agricultural commodities, accurate price forecasts disseminated among stakeholder groups are helpful to farmers in making informed decisions. Farmers' income amidst price fluctuations can be stabilized by adopting cooperative farming and contract farming. The price can be shifted from farmers to large retailers. Based on the forecasted price fluctuations, farmers can hedge their positions by using the forecast price information to store tomatoes in cold storage, or sell the produce in other markets where prices are higher, or process the tomatoes into paste, sauce etc. if price is anticipated to be low.

References

Divisekara, R W, G J M S R Jayasinghe, and K W S N Kumari. 2020. Forecasting the red lentils commodity market price using SARIMA models. *SN Business & Economics* 1 (1): 20.

GOI: Horticulture Statistics Division, 2021. Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare,1-456 pages (2022).

https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/jul/doc202271470601.pdf

https://www.outlookindia.com/business/tomato-trouble-why-tomato-prices-are-rising-and-can-we-expect-a-price-ease-soon—news-302805

https://www.thehindu.com/business/Economy/explained-what-is-behind-the-soaring-tomato-prices/article67099213.ece

Laxkar, H, and A K Sarawgi. 2022. Growth and seasonality of arrivals and prices of tomato: A case of Indore district of Madhya Pradesh in India. *The Pharma Innovation Journal* 11 (9S): 1765-1767.

Mutwiri, R M. 2019. Forecasting of tomatoes wholesale prices of Nairobi in Kenya: time series analysis using SARIMA model. *International Journal of Statistical Distributions and Applications* 5 (3): 46-53

Reddy, A A. 2019. Price forecasting of tomatoes. *International Journal of Vegetable Science 25* (2): 176-184.

Ticlavilca, A M, Dillon M Feuz, and Mac McKee. 2010. Forecasting Agricultural Commodity Prices Using Multivariate Bayesian Machine Learning Regression. Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. St. Louis, MO. [http://www.farmdoc.illinois.edu/nccc134].

Annexure Table 1 Area and production of tomato during 2021-22

S.No.	State	Area	% age share of area	Production	Area in '000 Ha Production in '000 MT % age share of Production
1	Madhya Pradesh	102.37	12.14	2760.16	13.33
2	Andhra Pradesh	57.27	6.79	2303.79	11.13
3	Karnataka	70.09	8.31	2104.68	10.17
4	Gujarat	67.75	8.03	1961.53	9.47
5	Tamil Nadu	54.03	6.41	1623.17	7.84
6	West Bengal	59.72	7.08	1258.77	6.08
7	Maharashtra	63.46	7.53	1243.22	6.00
8	Chhattisgarh	66.47	7.88	1232.45	5.95
9	Odisha	75.10	8.91	1145.02	5.53
10	Bihar	53.00	6.28	1007.00	4.86
11	Uttar Pradesh	22.78	2.70	909.35	4.39
12	Himachal Pradesh	14.00	1.66	577.00	2.78
13	Telangana	17.39	2.06	516.05	2.49
14	Assam	18.78	2.22	430.83	2.08
15	Haryana	18.91	2.24	397.00	1.91
16	Jharkhand	22.73	2.69	294.30	1.42
17	Punjab	10.39	1.23	269.90	1.30
18	Rajasthan	20.13	2.38	238.39	1.15
19	Uttarakhand	9.41	1.11	110.67	0.53
20	Jammu & Kashmir	3.85	0.45	101.99	0.49
21	Tripura	2.08	0.24	66.67	0.32
22	Manipur	3.33	0.39	36.94	0.17
23	Meghalaya	2.19	0.26	35.21	0.17
24	Mizoram	2.80	0.33	27.13	0.13
25	Nagaland	2.60	0.30	19.82	0.09
26	Others	0.99	0.11	13.92	0.06
27	Sikkim	0.44	0.05	4.61	0.02
28	Kerala	0.35	0.04	2.52	0.01
29	Arunachal Pradesh	0.24	0.02	2.15	0.01
30	Total	842.75	100.00	20694.30	100.00

Source National Horticulture Board

Annexure 2 Syntax of R studio for forecasting price of tomato

```
getwd()
View(bhopal)
head(bhopal)
#Subsetting for a column
trand<-bhopal[,"Price"]
View(trand)
#Converting the dataframe object as a time series object 'ban'
Price<-ts(trand,start=2015,frequency=12)
autoplot(Price)
frequency(tre)
ggseasonplot(Price, size=10)
ggseasonplot(Price, polar = TRUE)
gglagplot(Price)
ggAcf(Price)
ggAcf(diff(Arrival))
Box.test(diff(Price), lag = 10, type = "Ljung")
fit <- auto.arima(Price, lambda = 0)
fit
boxplot(Price~cycle(Price,xlab="year",ylab="Price",main="Monthly Price of Tomato"))
# Fit an ARIMA model
arima_model <- auto.arima(Price)

# Print the ARIMA model summary
print(arima_model)

# Make forecasts
forecast_horizon <- 60
forecasts <- forecast(arima_model, h = forecast_horizon)

# Print the forecasted values
print(forecasts)
plot(forecasts)
summary(forecasts)
```