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K.T.H.M.COLLEGE NASHIK 422002
(K.R.T.ARTS,B.H.COMMERCE AND A.M.SCIENCE COLLEGE NASHIK)

A PROJECT REPORT
On
"Statistical Analysis Of Arrival And Modal Price Of Onion for Lasalgaon And Pimpalgaon Market"
Submitted to

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
In the partial fulfillment of T.Y.BSc (Statistics)
By

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Under the guidance of
Dr.G.S.Phad Year 2019-20

*** CERTIFICATE ***

This is to certify that project report entitled, **"Statistical Analysis Of Arrival And Modal Price Of Onion for Lasalgaon And Pimpalgaon Market"** is a benefited work carried out by,

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The students of T.Y.BSc (Statistics) K.T.H.M.College,Nashik-2 for the partial fulfilment of degree of graduation of "**SAVITRIBAI PHULE PUNE UNIVERSITY**".

Dr.G.S.Phad
Project Guide

Dr.A.S.Padhye
Head of Department,
Department of Statistics

Date: 02/03/2020
Place: K.T.H.M.College, Nashik-2

DECLARATION BY THE STUDENTS

We declare that the project entitled **"Statistical Analysis Of Arrival And Modal Price Of Onion For Lasalgaon And Pimpalgaon Market"** submitted by us for the partial fulfilment of our bachelor degree of science in statistics during 2019-2020 is our original work. We further declare that the analysis has been carried out based on the Secondary data (taken from www.nhrdf.org).

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Date: 02/03/2020

Place: K.T.H.M.College, Nashik-2.

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Introduction

Onion is one of the most significant and commonly used ingredients in Indian recipe. Thus the changes in prices have a huge impact on the food security, farmer and consumer by way of increase in food welfare. An increase in price of onion affects the consumer by way of increase food consumption budget,while a decrease in onion prices below the cost of cultivation affects the producer. There is enough evidence to show that prices of agricultural commodities are more volatile than those of the non-form commodities. These commodities are less elastic to priceand income and inherently unstable due to weather and industrial risks. The high volatility in prices of agricultural commodities can have a disproportionate, typically nonlinear or asymmetric impact on the economy and may fail to endure exceptional shocks. This impact is prominent if government and households are well adapted to normal volatility but fail to anticipate or consider making worthwhile provisions against extreme shocks.

Onion is one of the most market sensitive commodity that creates ripples in the trade as well as in political circles. It has significant position in the diets across all income groups .It is an important ingredient in many Indian recipe causes wide ranging effects of any significant price change. It is equally important for the poor as also the middle class. Thus the changes in prices causes stir among farmers and consumers. High price variability in case of primary products affects both producers as well as consumers though a spill over effect to the other sectors, thereby leading to high inflation in the economy. Thus it is major concern for the politicians, policy makers and experts. Among agricultural products, prices of onions are more volatile than those of the non-farm commodities due to low price and income elasticity and inherently unstable production. Additionally, market inefficiencies, weak supply chains and traders cartels in the market aggravate the problem. The spurt in food inflation in the recent months has bought to forefront some critical issues of price volatility and market inefficiency. The Inter -Ministerial Group (IMG) on Inflation Advised improving agricultural productivity, strengthening food supply chains as a durable solution to inflation in an economy with rising income levels.

Our project is on Arrival of onion in the market in quintals and Price of onion for that onion . We first took daily data from www.nhrdf.org then we found that lots of data is missing because on certain occasions and holidays, Markets have off etc .

Lots of values are missing in the daily and weekly data So we neither find the missing values nor predict future values . Hence we use the data by finding the averages for Month and then representing the data by month . Modal price means the price of onion which has most

frequency . That means the rate at which maximum onion is sold/bought .Lots of values are missing in the daily and weekly data . Due to this our prediction will be inappropriate . Hence we use monthly data which is

- Addition of all the arrival of onion in the month .
- Minimum value among all the minimum prices all over month .
- Maximum value among all the maximum prices all over month .
- Average value among all the modal prices all over month .

Acknowledgment

The compilation of this project could not have been possible without the participation and assistance of so many whose names may not all be enumerated . Their contribution are sincerely appreciated and gratefully acknowledged.

The group would like to express their deep gratitude to University Of Pune for providing us an opportunity for carrying out this project . It gives us a great pleasure to thank Principal Dr.V.B.Gaikwad (Sir) of our KTHM College Nashik .We express deep and sincere gratitude to Dr. A.S.Padhye (Mam), Head of Department Of Statistics And Prof . Dr. G.S.Phad for endless support, guidance,encouragement, suggestion and understanding spirit have contributed immensely to the evolution of our ideas on project . We are very much thankful to other teaching staff Dr.K.P.Amrutkar, Mrs.N.V.Khangar, Mr.D.B.Upahde, Mrs.P.D.Patil for teaching us the subject well enough . We also wish to express our gratitude to Official And other staff members of college who rendered their help during the period of our project . We give special thanks to maintanance incharge of WWW.NHRDF.ORG .

To all relatives, Friends and Others who in one way or another shared their support, either morally, financially and physically, Thank you .

Motivation

We live in the Nashik district which is the one of biggest Onion producer in India. Our most of relatives are the onion producers . We discuss with our relatives that what are the main problems that you are facing while selling the onions in the market . The main drawback of our society is that a farmers can't decide the rate of onion . The rates of onion depends upon the production of onion. By observation, We know that Pimpalgaon and Lasalgaon are both big markets in our districts . So we discussed this topic with our mentor and started collecting information about onion .

Objectives

(1) To find whether seasonal variation is present or not in the arrival of onion, Prices of onion for Pimpalgaon and Lasalgaon market .

(2) Prediction of the Arrival of onion (in quintals) for Pimpalgaon and Lasalgaon market for next 36 months .

(3) Prediction of the Minimum Price of onion in quintals for Pimpalgaon and Lasalgaon market for next 36 months .

(3) Prediction of the Maximum Price of onion in quintals for Pimpalgaon and Lasalgaon market for next 36 months .

(4) Prediction of the Modal Price of onion in quintals for Pimpalgaon and Lasalgaon market for next 36 months for next 36 months .

(5) To check whether Original values for 2019 of Arrival of onions and Modal price lies within 95% confidence bound predicted by us.

Abstract

We took monthly data from www.nhrdf.org containing Arrival of onion in quintals, Minimum price of onion, Maximum price of onion and Modal price of onion . We checked the normality of the data, Dependency of variables and Mann-whitney test for checking the distribution of data is same or not .

First we plot time series for Arrival of onions (in quintals), Minimum prices, Maximum prices and Modal price by using ITSM 2000 . We found that there is upward trend in the data and in minimum prices and maximum prices, there is variation in data so we use box-cox transformation . After that we use Autocorrelation function(ACF) to check seasonality of data . We fit classical model and forecast the value of Arrival of onions (in quintals), Minimum prices, Maximum prices and Modal price for next 3 years

Keywords

- Modal price
- Classical Model
- Mann-Whitney U test
- Chi-square test
- Autocorrelation Function(ACF)
- Maximum Price
- Minimum Price
- Arrival
- Forecasting
- Box-Cox transformation

TOOLS USED

For the analysis of data in our project we have used the following statistical tools,

- **MS-excel**
- **MS-word**
- **R-Software**
- **R-studio**
- **ITSM 2000 Pro**

- **MS-excel :**

We input collected data in MS-excel worksheet. We draw Some descriptive graph using MS-excel.

- **MS-word :**

To typing, arranging,adjusting the. Pages of the project .

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- **R-SOFTWARE**

We perform chi-square test of independence of Attribute using R-Software.

- **R-STUDIO**

We import data from excel sheet using R-studio .
We perform Kruskal Wallis Test And Shapiro test
To check normality of the data

- **ITSM PRO 2000**

We use ITSM2000 For plotting time series, to calculate the Seasonality, Trend of the data, to fitting classical model for the data ,to calculating Seasonal Component of data. To forecasting the future value with 95% Confidence bound and Graph

Theoretical Background

Time series : Arrangement of statistical data in chronological order i.e.,in accordance with occurrence of time,is known as 'Time series'.

According to Spiegel,mathematically a time series is defined by the values $Y_1, Y_2, \ldots, Y_n, \ldots$ of the time series time plays the role of an independent variable and Y(t) is dependent variable .

Following are the **examples** of time series:

1. Daily price of gold.
2. Weekly sales of departmental store.
3. Monthly deposits in certain bank.
4. Yearly production of Food grains in certain country .
5. Hourly bacterial count in certain culture at laboratory .
6. Population of country at census year.

Utility of Time series Analysis :

1. ***Past behavior*** : It enables to describe the past behavior of the variable of variables. Time series analysis reveals the forces working behind the series such as technological and economical developments, changes in import, export policies.
2. ***Forecasting*:** Forecasting is one of the important use of analysis of time series .The forecasting in business plays important role in planning decision -making, inventory, scheduling of purchases and sales etc.
3. ***Comparison* :** Time series analysis facilitates the comparison between the two related time series. For example, (a) Prices of gold and prices of shares,

   (b) National income and cost of living indices.

   Comparison between actual and expected performance can be made comparison between two similar time series at two different places.

Components of Time Series :

Time Series values of Y_t is composed of four factors or component viz.

1. Trend,
2. Seasonal Variations,
3. Cyclic variations,
4. Irregular Variations.

These factors cause fluctuations in the values of Y_t . A time series may have some or all the component present in it .

1. **Trend or Secular Trend (T) :**

a) Trend is due to the reasons of following nature, changes in population, technological development, changes in economy, changes in habits and tastes of people.

b) Trend is a long period movement however, the period cannot be precisely defined.

c) Trend is mostly monotonic .

2. **Seasonal Variation (s):**

Seasonal variations are the fluctuation in a time series which repeat regularly every year or after some specific period of time .

For example, sales of umbrellas and raincoats is the highest in rainy season; sales of woolen garments attains its peak in winter season. Even the bank deposits and bank clearing are affected by seasonal swings.

Seasonal variations are extremely useful in marketing and business.

3. **Cyclic variation:**

The repeatation of pattern in time series is called cyclic variation.

Cyclic Variation consists of four phases

a) Prosperity : Prosperity is a condition in which a person or commodity is doing well financially.

b) Recession : Recession is a period when the economy doing badly.

c) Depression : A depression is a time when there is a very little economy activity.

d) Recovery : When there is recovery that means it improves

4.Irregular variation:

The variation due to unknown reason are called irregular variation or random variation.

Irregular Variation are not predictable.

A general approach to time series modelling:

1. Plot the series and examine the main feature of graph checking in particular whether there is 1. Trend,2. Seasonal component,3. Any apparent sharp changes behavior,4. Any outline observation.
2. Remove the trend and seasonal component to get stationary residual .

3. Choose a model to fit a stationary residual.
4. Forecasting will be achieve by forecasting a stationary residual and then inverting the transformation to arrive at forecast of original time series.

Autocorrelation Function (ACF):

Let $\{X_t\}$ be a stationary time series then ACF of $\{X_t\}$ at log h is

$$P_x(h)=\text{corr}(X_{t+h}, X_t)=\gamma_x(h)/\gamma_x(0)$$

The autocorrection function (ACF) does not represent time series uniquely . That is, it is possible that

Two different times series having the same autocorrelation function .

Classical Decomposition Model :

Let $\{X_t\}$ be the time series then, $\{X_t\}$ can be model as,

$$X_t = m_t + S_t + Y_t$$

Where,

m_t : Trend Component

S_t : Seasonal Component

$Y_{t.}$: Random noise component /Error

Description :

m_t : Slowly changing function known as trend component .

S_t : A function with known period d referred as seasonal component .

$Y_{t.}$: Random noise component which is stationary .

Test for independence of two attribute :

Suppose that the given data are classified into r levels of attributes A denoted by A_1, A_2, …,A_i, …,A_r and s level of attribute B represented by B_1, B_2, …,B_j, …, B_s . Then different class frequencies can be represented by in the following table :

	B1 B2 …. Bj … Bs	Total
A1	O11 O12 …. O1j …O1s	(A1)
A2	O21 O22 …. O2j …O2s	(A2)
⋮		⋮
Ai	Oi1 Oi2 …. Oij …Ois	(Ai)
⋮		⋮
Ar	Or1 Or2 …. Orj …Ors	(Ar)
Total	(B1) (B2) …. (Bj) …(Bs)	N

Where,

$N=\sum \sum O_{ij}$= Total observed frequency,

Here we wish to test,

H_0 : Two attributes A and B are independent .

Against

H_1 : Two attributes A and B are not independent .

Test statistics : $\chi^2 = \sum\sum (Oij-eij)^2 / eij$

Where $eij = (A_i) (B_i) / N$

$$\chi^2 = \sum\sum (o_{ij}{}^2 / e_{ij}) - N$$

Table value : $\chi^2_{(r-1)(s-1):\alpha}$

Decision Rule : If : $\chi^2_{(r-1)(s-1)} \geq \chi^2_{(r-1)(s-1):\alpha,}$ then reject H_0 . Accept H_0 otherwise.

· If any cell frequency is less than 5 then go for Yate's correction .

$\chi^2_1 = \{|ad - bc|-N/2\}^2 N / (a+b) (c+d)(a+c)(b+d)$

Mann – Whitney U test :

Assumptions :

1. The sample are random and independent of each other,
2. $F_x(.) = F_y(.)$ are continuous distribution function .

Hypothesis :

$H_0 : F_x (x) = F_y(y)$

Vs

$H_1: F_x (x) \geq F_y(y)$ or

$H_1: F_x (x) \neq F_y(y)$ or

$H_1: F_x (x) \leq F_y(y)$

Test statistics : $U = W - (n_1(n_1 +1)) / 2$

Where, $W = \sum r (x_i)$

Decision Rule :

1. Reject H_0 if $U \leq C\alpha$ when alternative hypothesis is $H_1: F_x (x) \geq F_y(y)$.
2. Reject H_0 if $U \geq C'\alpha$ when alternative hypothesis is $H_1: F_x (x) \leq F_y(y)$.
3. Reject H_0 if $U \leq C\alpha_{/2}$ or $U \geq C'\alpha_{/2}$ when alternative hypothesis is $H_1: F_x (x) \neq F_y(y)$.
   Where $C'\alpha = n_1 n_2 - C\alpha$

Statistical Analysis

Checking Normality of Arrival Of Onion In Lasalgaon Market :

H_0 : Arrival of onion in Lasalgaon market comes from normal population .

v/s

H_1 : Arrival of onion in Lasalgaon market does not comes from normal population .

```
brary(readxl)
> library(readxl)
> monthlydata <- read_excel("Desktop/monthlydata.xlsx",
+     sheet = "Lasalgaon", range = "D1:D260")
> View(monthlydata)
> y=unlist(monthlydata,use.names=False)
Error in unlist(monthlydata, use.names = False) :
  object 'False' not found
> y=unlist(monthlydata,use.names=F)
> y
  [1] 225063 196164 178992 192592 237574 175308 156282 173892 138648 149113  96295
240615 241225
 [14] 229550 130885 223608 251132 138178 235057 235143 252960 208213 145358
106968 125731 152960
 [27] 281027 119035 233819 272471 158223 112556 100767  40024  49798 153905 236001
154785 228760
 [40] 130225 199710 179780 180555 134955  98877  94707 136140 286748 390783 485232
254922 142314
 [53] 207700 232644 231626 250288 214857 181765 179130 336645 295435 239095
205975 196415 198160
 [66] 280932 194034 200958 211026 229926 131803 257505 324553 296530 146337
193777 307034 215520
 [79] 256294 205068 169212 130732 164663 418649 465031 343124 244700 255049
298130 237440 199729
 [92] 208150 187333 108321 230372 381268 371920 320754 272505 255298 262106
213767 203020 221511
[105] 177640 156268 133382 332186 366672 314122 262074 235586 186382 182565
192020 193688 159196
[118]  73833  37705 265712 377164 328744 246948 291532 317721 265321 217182 209481
246130 170520
[131] 193125 368625 433795 359701 320005 320725 304004 144160 243280 219996
174015 101965 138732
[144] 425447 543060 488225 263577 349090 425780 378525 318417 262570 213235
247350 206577 412130
```

[157] 478190 358300 371350 350525 346707 177015 279840 249515 258355 290545
172545 240935 305760
[170] 359172 231181 142620 164225 134595 264372 221141 187605 136230 186705
185620 200600 262305
[183] 316230 208545 179763 181725 184347 145980 123625 161650 164585 213720
367695 400213 236050
[196] 255260 353360 324365 340655 300643 207828 321063 256677 498275 498705
393745 260887 276680
[209] 274920 216030 188508 132903 75145 42100 175083 343533 467015 278214 241705
261547 338372
[222] 270205 233690 228355 285620 156115 70545 246504 451297 556743 494835
351124 399992 351605
[235] 231948 61147 34925 30532 178713 438498 585743 316410 284061 250742 339277
287120 60720
[248] 237087 217497 238523 154117 431097 718808 774405 524264 209417 474592
264699 335178
> shapiro.test(y)

Shapiro-Wilk normality test

W = 0.94158, p-value = 1.245e-08

Here p-value < 0.05, Hence we can reject H_0 at 5% level of significance

Conclusion : We may conclude that, Arrival of onion in Lasalgaon market does not comes from normal population .

Checking Normality of Arrival Of Onion In Pimpalgaon Market :

H_0 : Arrival of onion in Pimpalgaon market comes from normal population .

v/s

H_1 : Arrival of onion in Pimpalgaon market does not comes from normal population .

```
> library(readxl)
> monthlydata <- read_excel("Desktop/monthlydata.xlsx",
+     sheet = "Pimpalgaon", range = "D1:D270",
+     col_types = c("numeric"))
> View(monthlydata)
> y=unlist(monthlydata,use.names=F)
> y
  [1] 174521 143686 194398 103984 123900 113545 112597 186566 249063  36792 231145
188485 100632
 [14]  91603  79488  14571  61590 172317 197678 165305 151993 118147 283161 157910
161917 133320
 [27]  88508  98673  74820 257928 297952 340914 146924  83005 264922 227715 195125
168538 167785
 [40] 145614  90442 221441 296571 244585  90995 274185 269259 224026 172923 116834
143247 155299
 [53] 153099 331558 399475 308096 109636 150061 299814 211636 253206 161841
156036 117027 205478
 [66] 344520 355186 185818  95130 224080 299435 194841 208675 225663 194538 100835
241440 371518
 [79] 293031 197910 215713 286606 292636 220410 248298 231096 227282 123584
104740 275954 388303
 [92] 287590 165430 296788 399479 266523 228900 233823 151555  42673  69682 340691
387920 294037
[105] 249884 344394 345639 340936 296728 286370 272222 209257 198482 415497
352842 315811 344990
[118] 439758 417858 207113 211745 177108 105812  46973 144925 468432 503486
389508 179018 327448
[131] 612790 419648 412486 297173 225979 272917 207039 467287 435569 258091
390218 522629 416235
[144] 306110 294277 303981 336323 195101 150679 228197 187791 283900 204279
265769 262795 190850
[157] 292597 284670 296521 219823 171350 135783 175103 297538 259198 130868
249671 193586 169724
[170] 221839 233103 242284 277760 365202 316592 313415 152193 243071 486334
374042 408216 330554
```

[183] 233410 215464 158414 365489 274460 218440 187828 346038 550571 260163
195282 150787 72823
[196] 33626 232751 371551 284095 160975 113472 86855 82747 75037 67536 98372
271715 133119
[209] 80227 312503 376807 360834 270349 408437 469054 303647 248556 108548 67793
82731 303269
[222] 455240 506740 302065 226969 212027 420605 366482 73490 289247 352928
296036 257309 532148
[235] 559366 522633 272306 528996 829306 390863 578753 420988 357980 284042
409886 549611 383075
[248] 414546 356702 359127 695659 363458 376096 394185 354767 281164 271731
454377 543170 412115
[261] 160649 654551 662230 490530 349439 397193 246142 123571 41720
> shapiro.test(y)

Shapiro-Wilk normality test

W = 0.96306, p-value = 2.194e-06

Here p-value < 0.05, Hence we can reject H_0 at 5% level of significance .

Conclusion : We may conclude that, Arrival of onion in Pimpalgaon market does not comes from normal population .

Checking Normality of Modal Price Of Onion In Lasalgaon Market :

H_0 : Modal Price of onion per quintals in Lasalgaon market comes from normal population .

V/s

H_1 : Modal Price of onion per quintals in Lasalgaon market does not comes from normal population .

```
> library(readxl)
> monthlydata <- read_excel("Desktop/monthlydata.xlsx",
+     sheet = "Lasalgaon", range = "G1:G270",
+     col_types = c("numeric"))
> View(monthlydata)
> y=unlist(monthlydata,use.names=F)
> y
  [1]  226  186  243  254  269  367  368  340  317  492  376  385  290  271  273  214  213  195
 [19]  168  210  241  331  711  837 1037  920  417  258  321  583  844 1343 1908 2632 1689 1069
 [37]  498  271  233  358  533  443  429  397  619  611  439  306  225  197  211  212  188  177
 [55]  204  278  303  440  601  512  494  340  320  263  223  308  359  532  497  547  745  413
 [73]  250  214  193  177  187  297  358  442  436  577  389  244  166  140  235  309  340  448
 [91]  459  507  537  748  597  679  814  723  393  297  303  381  366  389  400  502  386  319
[109]  263  244  194  270  187  274  344  639  920 1175 1134  548  306  214  151  234  208  331
[127]  309  346  358  419  600  700  868  960  639  449  482  768  856 1179 1475 1358  724  458
[145]  256  248  299  272  246  376  703  776  643  612  917 1079 1238 1113  726  468  483  660
[163]  610  656  666 1368 1417 1263 1311 1000  626  515  552  599  651  859 1353 1393 1452 2011
[181] 2379  829  430  548  549  725  843 1084 1056  844  763  575  375  341  330  407  372  475
[199]  534  593  490  802 1049 1207 1441 1436  992  838  912 1385 2102 3694 4593 4197 2983 1335
[217]  978  746  837  888  988 1367 1886 1610 1340 1422 1432 1514 1301 1404 1206 1093 1198
1554
[235] 2118 4124 4130 3248 2134 1280 1157  778  706  779  770  844  829  706  420  597  921  629
[253]  615  482  504  409  452  551  772 1917 1542 2031 2852 2871 2849 1544  792  670  698

> shapiro.test(y)

        Shapiro-Wilk normality test

W = 0.72379, p-value < 2.2e-16
```

Here p-value < 0.05, Hence we can reject H_0 at 5% level of significance

Conclusion : We may conclude that, Model price of onion per quintals in Pimpalgaon market does not comes from normal population .

Checking Normality of Modal Price Of Onion In Pimpalgaon Market :

H_0 : Modal Price of onion per quintals in Pimpalgaon market comes from normal population.

V/s

H_1 : Modal Price of onion per quintals in Pimpalgaon market does not comes from normal population .

```
> library(readxl)
> monthlydata <- read_excel("Desktop/monthlydata.xlsx",
+     sheet = "Pimpalgaon", range = "G1:G269",
+     col_types = c("numeric"))
> View(monthlydata)
> y=unlist(monthlydata,use.names=F)
> y
  [1]  151  201  260  345  655  881 1140  919  454  235  297  576  870 1385 1862 2754 1513 1069
 [19]  501  302  214  361  493  469  441  395  608  587  396  316  224  218  242  214  222  200
 [37]  215  269  309  465  602  531  508  339  323  264  220  304  360  533  506  565  742  411
 [55]  249  211  196  179  204  295  351  446  447  612  402  258  166  139  231  303  335  449
 [73]  461  508  538  788  630  697  811  721  397  299  310  382  367  397  407  532  418  339
 [91]  279  249  205  303  225  292  352  622  919 1129 1134  546  309  220  163  236  224  308
[109]  324  358  342  378  597  706  903  992  646  446  488  789  848 1163 1473 1334  666  479
[127]  255  259  304  276  253  372  685  775  645  635  983 1074 1217 1079  711  441  475  636
[145]  611  639  650 1340 1316 1182 1302  938  580  520  589  633  650  830 1336 1383 1586 1832
[163] 2190  864  424  548  597  703  816 1046 1043  860  789  584  367  326  311  417  363  456
[181]  555  608  505  827  969 1183 1440 1448  963  809  898 1394 2087 3712 4650 4134 2936 1306
[199]  977  701  769  748  624  916 1366 1200 1316 1377 1471 1453 1208 1357 1160 1022 1145
1445
[217] 1882 4163 4167 2858 1854 1111 1004  693  633  736  715  689  652  649  403  537  748  700
[235]  594  479  525  550  431  534  757 1905 1444 2262 2930 2691 2786 1574  818  652  679  904
[253] 1117  994  803 1350 1097  661  567  425  605  886  928 1175 1251 1808 3234 3096

> shapiro.test(y)
```

Shapiro-Wilk normality test

$W = 0.73101$, p-value $< 2.2*10^{-16}$

Here p-value < 0.05, Hence we can reject H_0 at 5% level of significance

Conclusion : We may conclude that, Model price of onion per quintals in Lasalgaon market does not comes from normal population .

Chi-square test for independency of price of onion and Arrival of onion

Arrival of Onion		Price of Onion for Lasalgaon		
		0-1000	1000-2000	2000 and above
	0-1 lakh	12	9	6
	1-2 lakh	53	10	5
	2-3 lakh	70	14	3
	3andAbove	64	20	3

Arrival of Onion		Price of Onion for Pimpalgaon		
		0-1000	1000-2000	2000 and above
	0-1 lakh	4	4	8
	1-2 lakh	60	13	6
	2-3 lakh	93	14	4
	3andAbove	58	21	2

Arrival of Onion		Price of Onion (Both Market)		
		0-1000	1000-2000	2000 and above
	0-1 lakh	16	13	14
	1-2 lakh	113	23	11
	2-3 lakh	163	28	7
	3andAbove	122	41	5

H_0 : Arrival of Onion and Price of Onion are independent .

V/s

H_1 : Arrival of Onion and Price of Onion are dependent .

```
> x=c(16,13,14,113,23,11,163,28,7,122,41,5)
> y=matrix(x,byrow=T,ncol=3)
> y
     [,1] [,2] [,3]
[1,]   16   13   14
[2,]  113   23   11
[3,]  163   28    7
[4,]  122   41    5
```

```
> chisq.test(y)
        Pearson's Chi-squared test

X-squared = 68.486, df = 6, p-value = 8.354e-13
```

Here p-value < 0.05, Hence we can reject H_0 at 5% level of significance

Conclusion : We may conclude that, Arrival of onion And Price of Onion are dependent .

Mann-Whitney Test For checking Average Arrival for Two Markets :

H_0 : The Distribution of Arrival for Lasalgaon market And Pimpalgaon market of onion is same .

V/S

H_1 : The Distribution of Arrival for Lasalgaon market And Pimpalgaon market of onion is different .

```
> library(readxl)
> monthlydata <- read_excel("Desktop/monthlydata.xlsx",
+     sheet = "Lasalgaon", range = "D1:D280",
+     col_types = c("numeric"))
> View(monthlydata)
> x=unlist(monthlydata,use.names=FALSE)
>  [1] 235057 235143 252960 208213 145358 106968 125731 152960 281027 119035 233819 272471 158223
 [14] 112556 100767  40024  49798 153905 236001 154785 228760 130225 199710 179780 180555 134955
 [27]  98877  94707 136140 286748 390783 485232 254922 142314 207700 232644 231626 250288 214857
 [40] 181765 179130 336645 295435 239095 205975 196415 198160 280932 194034 200958 211026 229926
 [53] 131803 257505 324553 296530 146337 193777 307034 215520 256294 205068 169212 130732 164663
 [66] 418649 465031 343124 244700 255049 298130 237440 199729 208150 187333 108321 230372 381268
 [79] 371920 320754 272505 255298 262106 213767 203020 221511 177640 156268 133382 332186 366672
 [92] 314122 262074 235586 186382 182565 192020 193688 159196  73833  37705 265712 377164 328744
[105] 246948 291532 317721 265321 217182 209481 246130 170520 193125 368625 433795 359701 320005
[118] 320725 304004 144160 243280 219996 174015 101965 138732 425447 543060 488225 263577 349090
[131] 425780 378525 318417 262570 213235 247350 206577 412130 478190 358300 371350 350525 346707
[144] 177015 279840 249515 258355 290545 172545 240935 305760 359172 231181 142620 164225 134595
[157] 264372 221141 187605 136230 186705 185620 200600 262305 316230 208545 179763 181725 184347
[170] 145980 123625 161650 164585 213720 367695 400213 236050 255260 353360 324365 340655 300643
[183] 207828 321063 256677 498275 498705 393745 260887 276680 274920 216030 188508 132903  75145
[196]  42100 175083 343533 467015 278214 241705 261547 338372 270205 233690 228355 285620 156115
[209]  70545 246504 451297 556743 494835 351124 399992 351605 231948  61147  34925  30532 178713
[222] 438498 585743 316410 284061 250742 339277 287120  60720 237087 217497 238523 154117 431097
[235] 718808 774405 524264 209417 474592 264699 335178 267236 277045 239548 262515 498452 433924
[248] 394130 266172 248490 406825 275370 271826 324628 229624 209515 139908 380142 430409
> y=unlist(pq,use.names=FALSE)
> y
 [1] 174521 143686 194398 103984 123900 113545 112597 186566 249063  36792 231145 188485 100632
[14]  91603  79488  14571  61590 172317 197678 165305 151993 118147 283161 157910 161917 133320
```

[27] 88508 98673 74820 257928 297952 340914 146924 83005 264922 227715 195125 168538 167785
[40] 145614 90442 221441 296571 244585 90995 274185 269259 224026 172923 116834 143247 155299
[53] 153099 331558 399475 308096 109636 150061 299814 211636 253206 161841 156036 117027 205478
[66] 344520 355186 185818 95130 224080 299435 194841 208675 225663 194538 100835 241440 371518
[79] 293031 197910 215713 286606 292636 220410 248298 231096 227282 123584 104740 275954 388303
[92] 287590 165430 296788 399479 266523 228900 233823 151555 42673 69682 340691 387920 294037
[105] 249884 344394 345639 340936 296728 286370 272222 209257 198482 415497 352842 315811 344990
[118] 439758 417858 207113 211745 177108 105812 46973 144925 468432 503486 389508 179018 327448
[131] 612790 419648 412486 297173 225979 272917 207039 467287 435569 258091 390218 522629 416235
[144] 306110 294277 303981 336323 195101 150679 228197 187791 283900 204279 265769 262795 190850
[157] 292597 284670 296521 219823 171350 135783 175103 297538 259198 130868 249671 193586 169724
[170] 221839 233103 242284 277760 365202 316592 313415 152193 243071 486334 374042 408216 330554
[183] 233410 215464 158414 365489 274460 218440 187828 346038 550571 260163 195282 150787 72823
[196] 33626 232751 371551 284095 160975 113472 86855 82747 75037 67536 98372 271715 133119
[209] 80227 312503 376807 360834 270349 408437 469054 303647 248556 108548 67793 82731 303269
[222] 455240 506740 302065 226969 212027 420605 366482 73490 289247 352928 296036 257309 532148
[235] 559366 522633 272306 528996 829306 390863 578753 420988 357980 284042 409886 549611 383075
[248] 414546 356702 359127 695659 363458 376096 394185 354767 281164 271731 454377 543170

> wilcox.test(x,y)

Wilcoxon rank sum test with continuity correction

data: x and y

W = 35721, p-value = 0.4461

alternative hypothesis: true location shift is not equal to 0

Here p-value > 0.05, Hence we cannot reject H_0 at 5% level of significance .

i.e We may Accept H_0 at 5% level of significance

Conclusion : We may conclude that, Average Arrival for Lasalgaon market And Pimpalgaon market of onion is same

Mann-Whitney Test For checking Average Modal price for Two Markets :

H_0 : Average modal price for Lasalgaon market And Pimpalgaon market of onion is same .

V/S

H_1 : Average modal price Lasalgaon market And Pimpalgaon market of onion is different .

```
> library(readxl)
> pq <- read_excel("Documents/Project 2020 new/merge.price.xlsx",
+     range = "c1:c280", col_types = c("numeric"))
> View(pq)
> x=unlist(x,use.names=FALSE)
> x
 [1]  168  210  241  331  711  837 1037  920  417  258  321  583  844 1343 1908 2632 1689 1069
 [19]  498  271  233  358  533  443  429  397  619  611  439  306  225  197  211  212  188  177
 [37]  204  278  303  440  601  512  494  340  320  263  223  308  359  532  497  547  745  413
 [55]  250  214  193  177  187  297  358  442  436  577  389  244  166  140  235  309  340  448
 [73]  459  507  537  748  597  679  814  723  393  297  303  381  366  389  400  502  386  319
 [91]  263  244  194  270  187  274  344  639  920 1175 1134  548  306  214  151  234  208  331
[109]  309  346  358  419  600  700  868  960  639  449  482  768  856 1179 1475 1358  724  458
[127]  256  248  299  272  246  376  703  776  643  612  917 1079 1238 1113  726  468  483  660
[145]  610  656  666 1368 1417 1263 1311 1000  626  515  552  599  651  859 1353 1393 1452 2011
[163] 2379  829  430  548  549  725  843 1084 1056  844  763  575  375  341  330  407  372  475
[181]  534  593  490  802 1049 1207 1441 1436  992  838  912 1385 2102 3694 4593 4197 2983 1335
[199]  978  746  837  888  988 1367 1886 1610 1340 1422 1432 1514 1301 1404 1206 1093 1198
1554
[217] 2118 4124 4130 3248 2134 1280 1157  778  706  779  770  844  829  706  420  597  921  629
[235]  615  482  504  409  452  551  772 1917 1542 2031 2852 2871 2849 1544  792  670  698  975
[253] 1144  945  767 1310  879  685  575
> View(rs)
> library(readxl)
> rs <- read_excel("Documents/Project 2020 new/merge.price.xlsx",
+     range = "d1:d280", col_types = c("numeric"))
> y=unlist(rs,use.names=FALSE)
> y
```

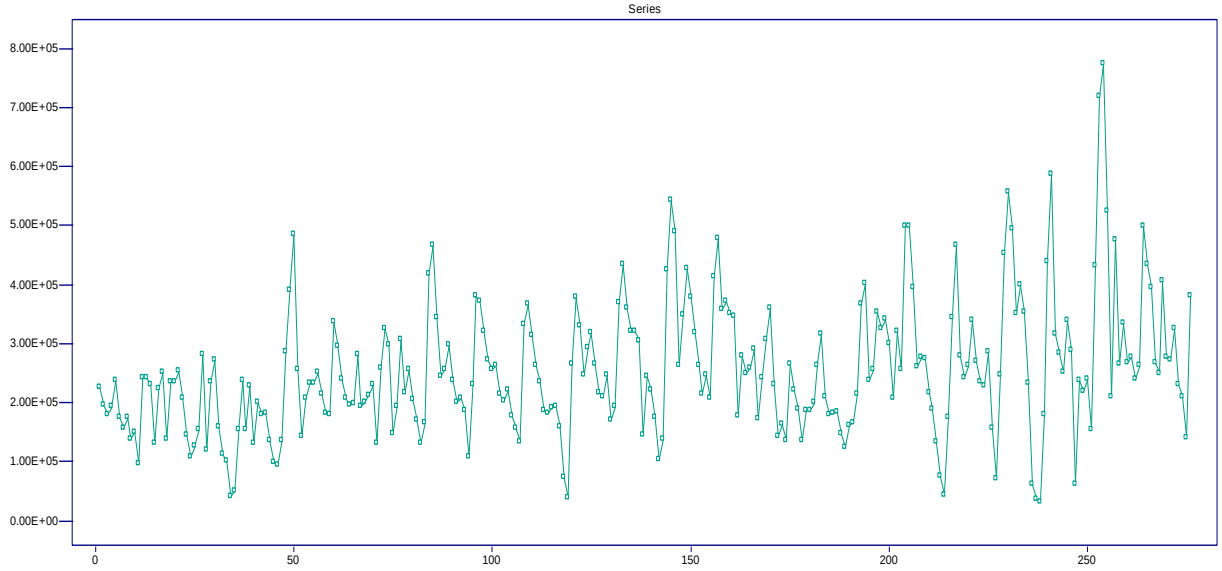
[1] 151 201 260 345 655 881 1140 919 454 235 297 576 870 1385 1862 2754 1513 1069
[19] 501 302 214 361 493 469 441 395 608 587 396 316 224 218 242 214 222 200
[37] 215 269 309 465 602 531 508 339 323 264 220 304 360 533 506 565 742 411
[55] 249 211 196 179 204 295 351 446 447 612 402 258 166 139 231 303 335 449
[73] 461 508 538 788 630 697 811 721 397 299 310 382 367 397 407 532 418 339
[91] 279 249 205 303 225 292 352 622 919 1129 1134 546 309 220 163 236 224 308
[109] 324 358 342 378 597 706 903 992 646 446 488 789 848 1163 1473 1334 666 479
[127] 255 259 304 276 253 372 685 775 645 635 983 1074 1217 1079 711 441 475 636
[145] 611 639 650 1340 1316 1182 1302 938 580 520 589 633 650 830 1336 1383 1586 1832
[163] 2190 864 424 548 597 703 816 1046 1043 860 789 584 367 326 311 417 363 456
[181] 555 608 505 827 969 1183 1440 1448 963 809 898 1394 2087 3712 4650 4134 2936 1306
[199] 977 701 769 748 624 916 1366 1200 1316 1377 1471 1453 1208 1357 1160 1022 1145
1445
[217] 1882 4163 4167 2858 1854 1111 1004 693 633 736 715 689 652 649 403 537 748 700
[235] 594 479 525 550 431 534 757 1905 1444 2262 2930 2691 2786 1574 818 652 679 904
[253] 1117 994 803 1350 1097 661 567
> wilcox.test(x,y)

Wilcoxon rank sum test with continuity correction

data: x and y
W = 36473, p-value = 0.8713
alternative hypothesis: true location shift is not equal to 0
Here p-value > 0.05, Hence we cannot reject H_0 at 5% level of significance .
i.e We may Accept H_0 at 5% level of significance
Conclusion : We may conclude that, Distribution of modal price for Lasalgaon market And Pimpalgaon market of onion is same .

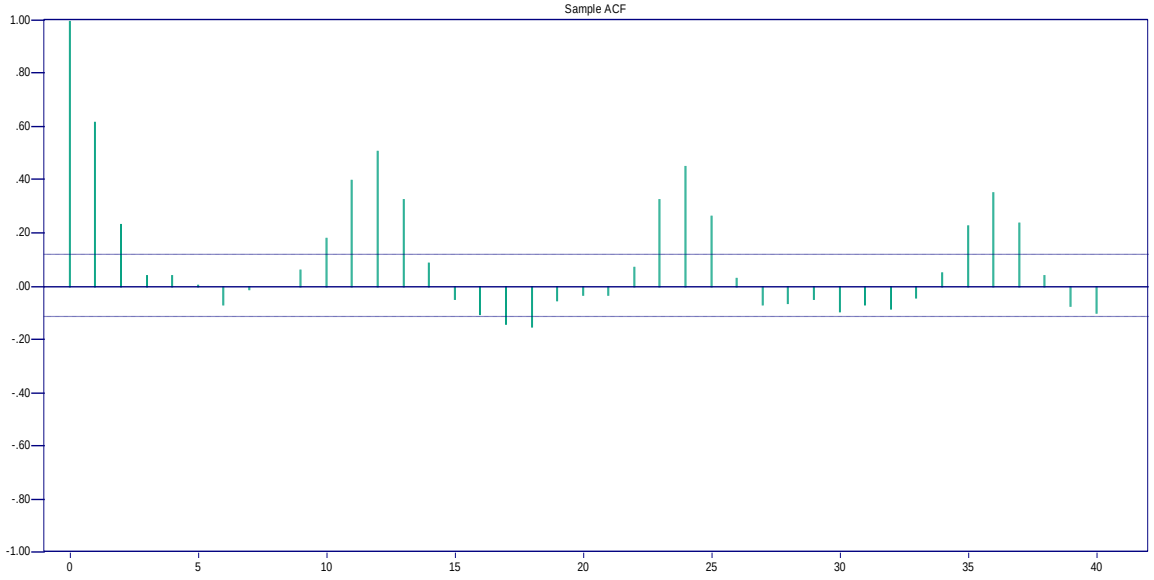
1) Analysis of arrival of onion in quintals of Lasalgaon :

The time series of monthly arrival of onion in quintals in the market situated at Lasalgaon, Tal -Niphad, Dist-Nashik from January 1996 to December 2018 shown below:



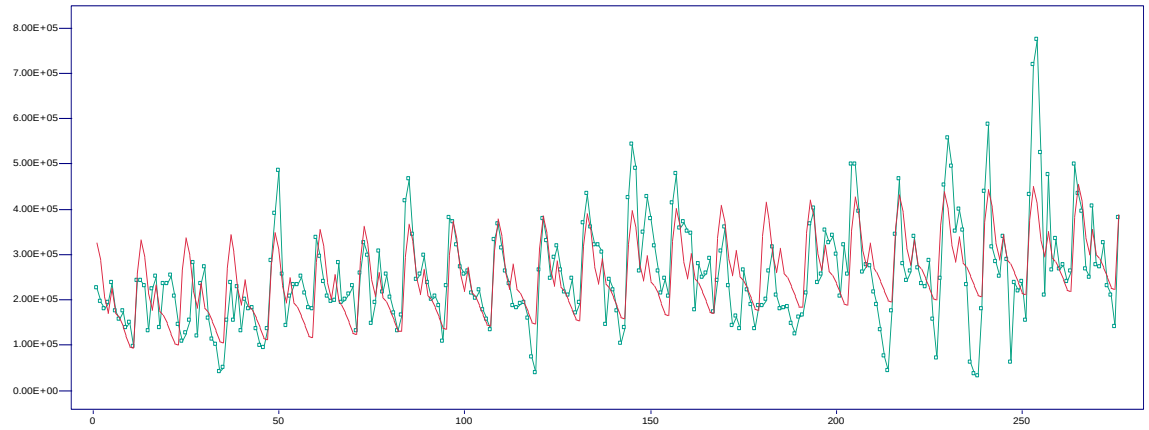
By looking at series we conclude that there is upward trend in the data. The arrivals of onion usually increases in the month of December and January and decreases in the month September, October and November.

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The graph shown the original time series coincides with classical fitted time series. Therefore we conclude that the classical model is good fitted to arrival of onion data.

The fitted classical model with seasonality of period d=12 to arrival of onion in Lasalgaon market is shown below :

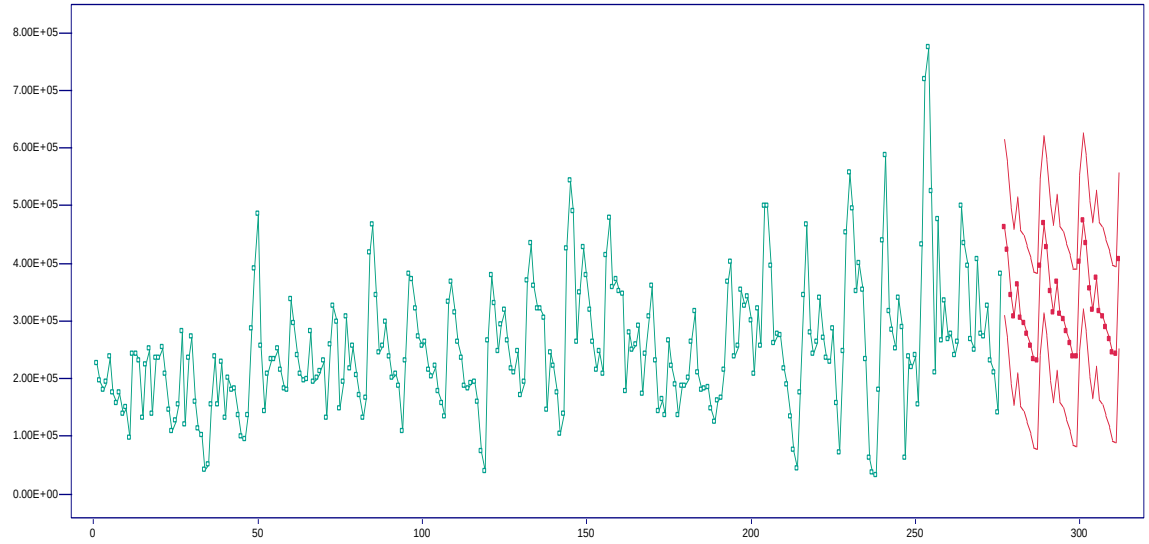
$X_t = 492.21*t + 184500$

Seasonal fit of period = 12

Seasonal components:

Sr.No.	Month	Seasonal Component
1	January	140520
2	February	100350
3	March	21619
4	April	-15797
5	May	38647
6	June	-18321
7	July	-28105
8	August	-48544
9	September	-70026
10	October	-93138
11	November	-95586
12	December	68380

By using above model we forecast for next 3 year (i.e. 36 months) monthly arrival of onion in Lasalgaon market with 95% confidence bounds and same is shown in the following graph:



The predicted values for arrival of onion are calculated by putting value of t in fitted model and adding Seasonal component for that month

For example :

For January 2019, t = 277 and seasonal component = 140520

Therefore, X_{277} = 492.21*277 + 184500 + (140520)

X_{277} = 461362.17 approximately

X_{277} = 461370 .

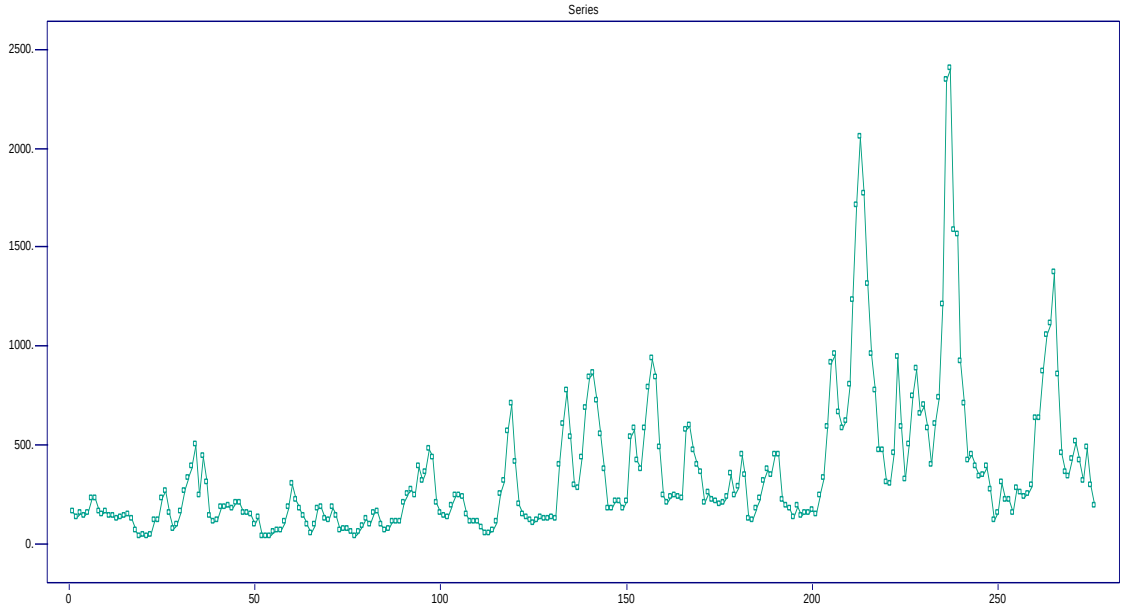
The numerical values of forecast for next 3 year (i.e. 36 months) monthly arrival of onion in Lasalgaon market with 95% confidence bounds shown in following table:

			95% confidence bound.	
Sr.No.	Month	Predicted Arrival	Lower bound	Upper Bound
277	Jan-19	461370	308580	614150
278	Feb-19	421690	268900	574470
279	Mar-19	343450	190660	496230
280	Apr-19	306530	153740	459310
281	May-19	361460	208680	514250
282	Jun-19	304990	152200	457770

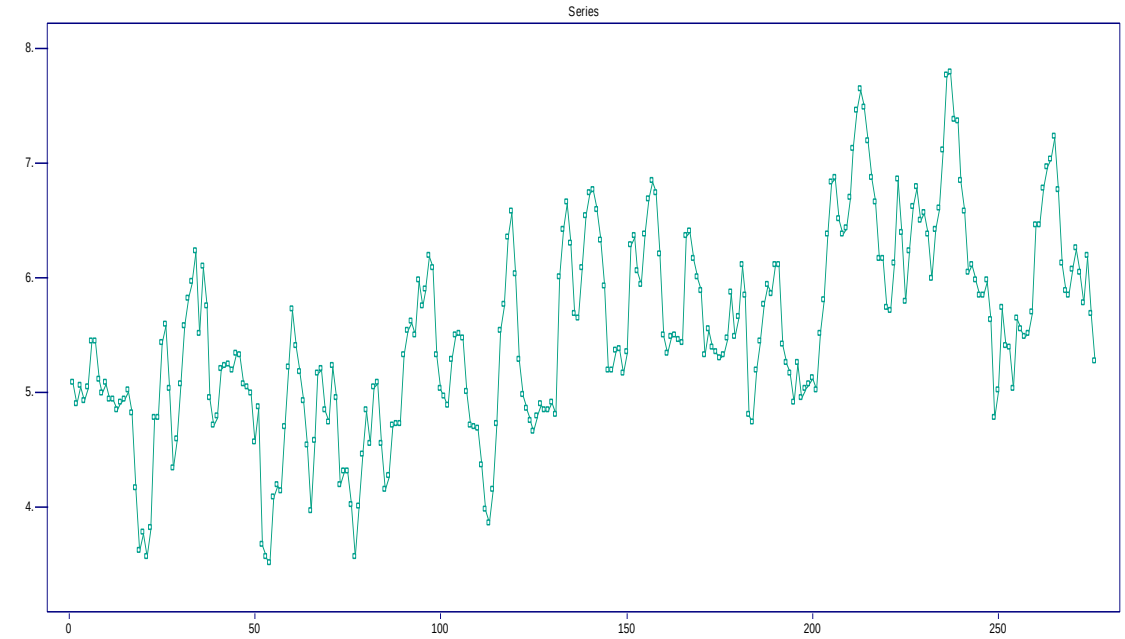
283	Jul-19	295690	142910	448480
284	Aug-19	275750	122960	428530
285	Sep-19	254760	101970	407540
286	Oct-19	232140	79353	384920
287	Nov-19	230180	77397	382970
288	Dec-19	394640	241860	547420
289	Jan-20	467270	314490	620060
290	Feb-20	427590	274810	580380
291	Mar-20	349360	196570	502140
292	Apr-20	312430	159650	465220
293	May-20	367370	214580	520150
294	Jun-20	310890	158110	463680
295	Jul-20	301600	148820	454390
296	Aug-20	281650	128870	434440
297	Sep-20	260660	107880	413450
298	Oct-20	238040	85260	390830
299	Nov-20	236090	83304	388870
300	Dec-20	400550	247760	553330
301	Jan-21	473180	320390	625960
302	Feb-21	433500	280720	586290
303	Mar-21	355260	202480	508050
304	Apr-21	318340	165550	471120
305	May-21	373270	220490	526060
306	Jun-21	316800	164010	469580
307	Jul-21	307510	154720	460290
308	Aug-21	287560	134780	440340
309	Sep-21	266570	113790	419360
310	Oct-21	243950	91166	396740
311	Nov-21	241990	89210	394780
312	Dec-21	406450	253670	559240

2) Analysis of minimum prices of onion in rupees per quintals of Lasalgaon Market :

The time series of monthly minimum price of onion in rupees per quintals in the market situated at Lasalgaon, Tal -Niphad, Dist-Nashik from January 1996 to December 2018 shown below:

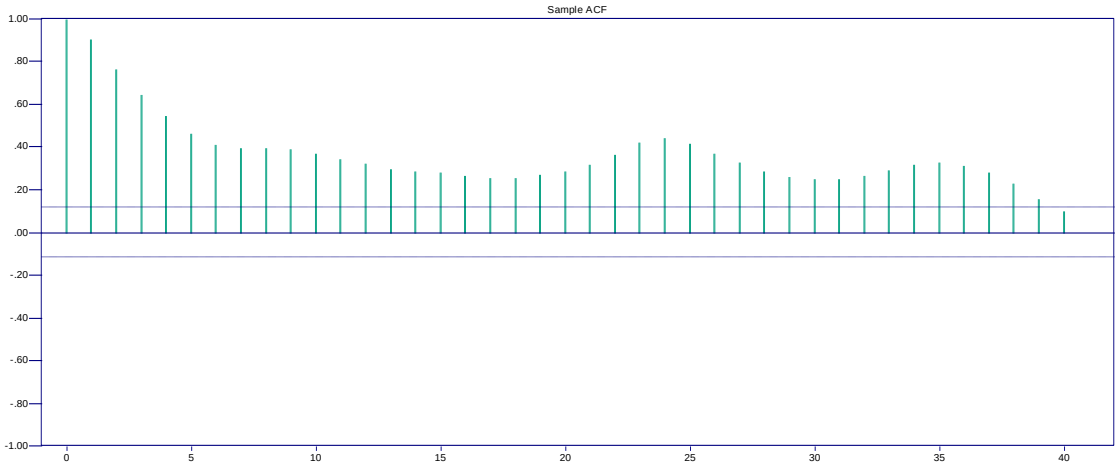


By looking at series we conclude that variation in prices of onion is increasing continuously, Hence we use box-Cox transformation with parameter 0 .



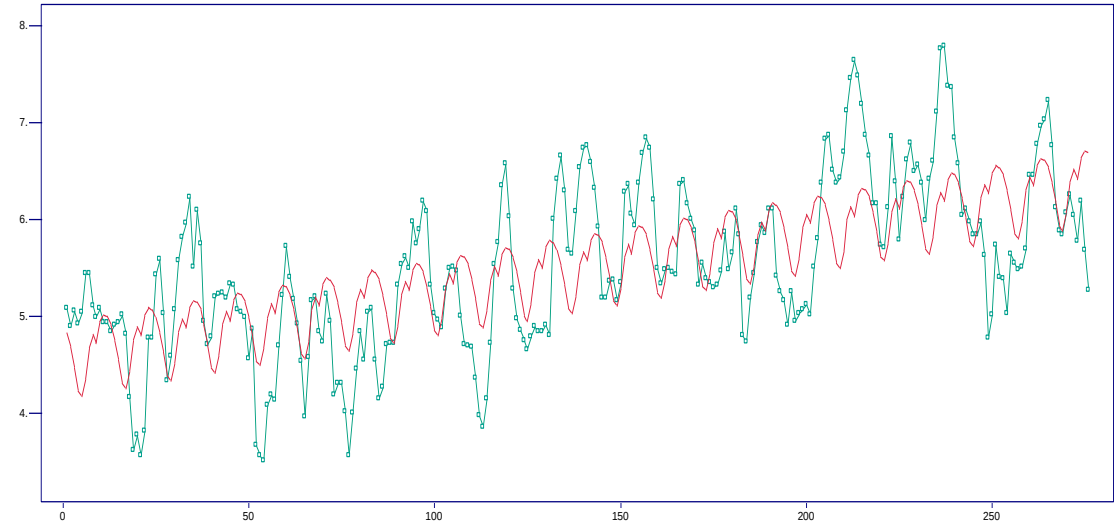
After Box-Cox transformation, There is upward trend in the minimum prices of onion series.

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The graph shown the original time series coincides with classical fitted time series. Therefore we conclude that the classical model is good fitted to minimum price of onion data.

The fitted classical model with seasonality of period d=12 to minimum prices of onion in Lasalgaon market is shown below :

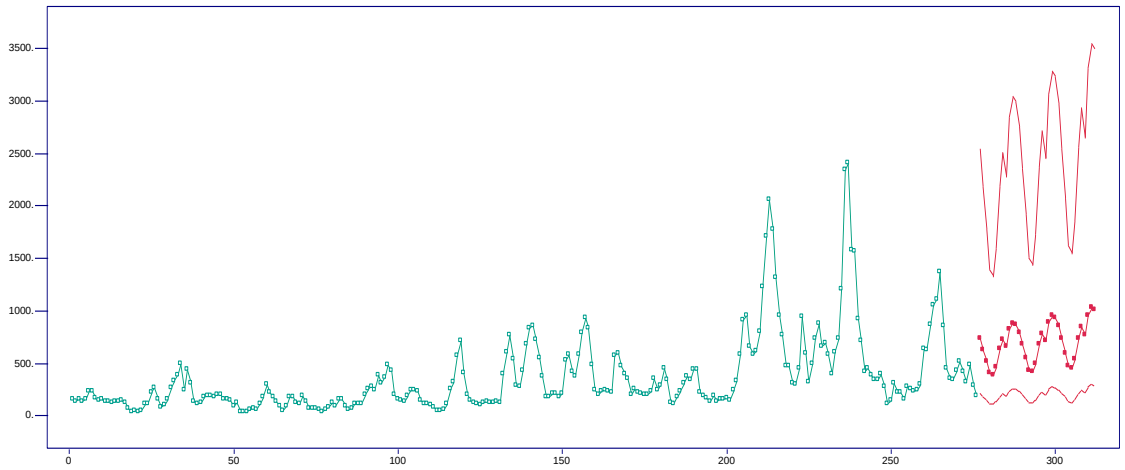
$Log(X_t) = 0.0064328 * t + 4.6129$

Seasonal fit of period = 12

Seasonal components:

Sr.No.	Month	Seasonal Component
1	January	0.20689
2	February	0.044468
3	March	-0.16589
4	April	-0.41443
5	May	-0.47128
6	June	-0.29069
7	July	0.020343
8	August	0.14915
9	September	0.043153
10	October	0.25912
11	November	0.32104
12	December	0.29812

Forecasting : By using above model we forecast for next 3 year (i.e. 36 months) monthly minimum price of onion per quintals in Lasalgaon market with 95% confidence bounds and same is shown in the following graph:



The predicted values for minimum price of onion are calculated by putting value of t in fitted model and adding Seasonal component for that month and taking antilog .

For example :

For January 2019, t = 277 and seasonal component = 0.20689

Therefore, $Log(X_{277}) = 0.0064328 * 277 + 4.6129 + 0.20689$

$Log(X_{277}) = 6.6016756$

$X_{277} = e^{6.6016756} = 736.3279$.

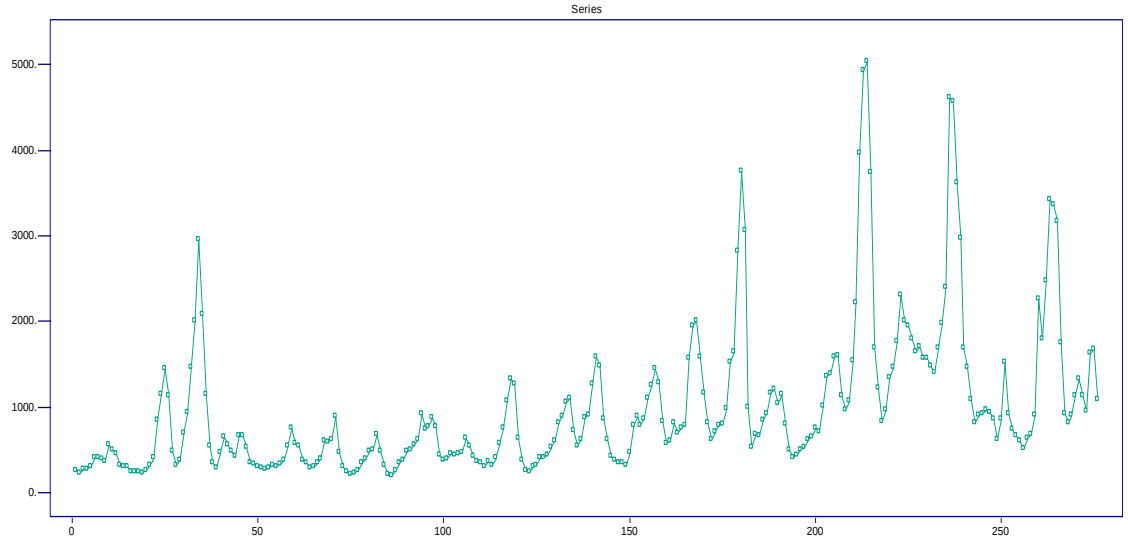
The numerical values of forecast for next 3 year (i.e. 36 months) monthly minimum price of onion per quintals in Lasalgaon market with 95% confidence bounds shown in following table:

			95% confidence bound.	
Sr.No.	Month	Predicted Arrival	Lower bound	Upper Bound
277	Jan-19	736.35	213.06	2544.9
278	Feb-19	630	182.29	2177.3
279	Mar-19	513.78	148.66	1775.7
280	Apr-19	403.3	116.69	1393.8
281	May-19	383.47	110.96	1325.3
282	Jun-19	462.34	133.78	1597.9
283	Jul-19	635.08	183.76	2194.9
284	Aug-19	727.05	210.37	2512.7
285	Sep-19	658.15	190.43	2274.6
286	Oct-19	822.07	237.86	2841.1
287	Nov-19	880.23	254.69	3042.1
288	Dec-19	865.84	250.53	2992.4
289	Jan-20	795.44	230.16	2749.1
290	Feb-20	680.56	196.92	2352
291	Mar-20	555.01	160.59	1918.2
292	Apr-20	435.67	126.06	1505.7
293	May-20	414.25	119.86	1431.7
294	Jun-20	499.44	144.51	1726.1

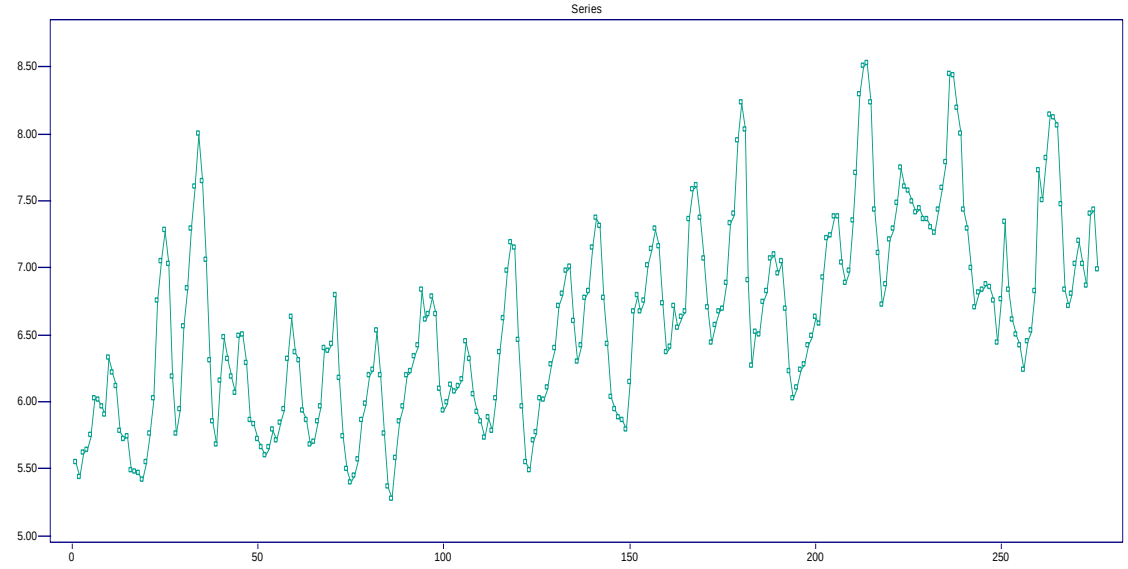
295	Jul-20	686.05	198.51	2371
296	Aug-20	785.4	227.25	2714.4
297	Sep-20	710.97	205.72	2457.1
298	Oct-20	888.05	256.95	3069.1
299	Nov-20	950.87	275.13	3286.3
300	Dec-20	935.33	270.63	3232.5
301	Jan-21	859.28	248.63	2969.7
302	Feb-21	735.17	212.72	2540.8
303	Mar-21	599.55	173.48	2072.1
304	Apr-21	470.63	136.17	1626.5
305	May-21	447.49	129.48	1546.6
306	Jun-21	539.52	156.11	1864.6
307	Jul-21	741.11	214.44	2561.3
308	Aug-21	848.43	245.49	2932.2
309	Sep-21	768.02	222.22	2654.3
310	Oct-21	959.31	277.57	3315.4
311	Nov-21	1027.2	297.21	3550
312	Dec-21	1010.4	292.35	3492

3) Analysis for Lasalgaon of Maximum price of Onion :

The time series of monthly Maximum price of onion in quintals in the market situated at Lasalgaon, Tal -Niphad, Dist-Nashik from January 1996 to December 2018 shown below:

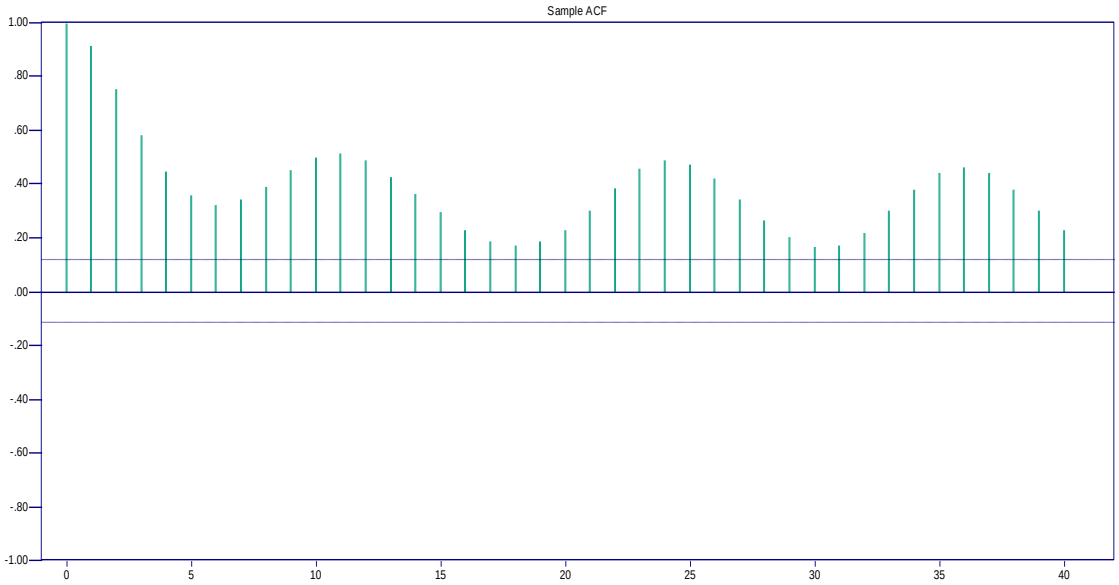


By looking at series we conclude that variation is increasing continuously,Hence we use box-Cox transformation with parameter 0 .



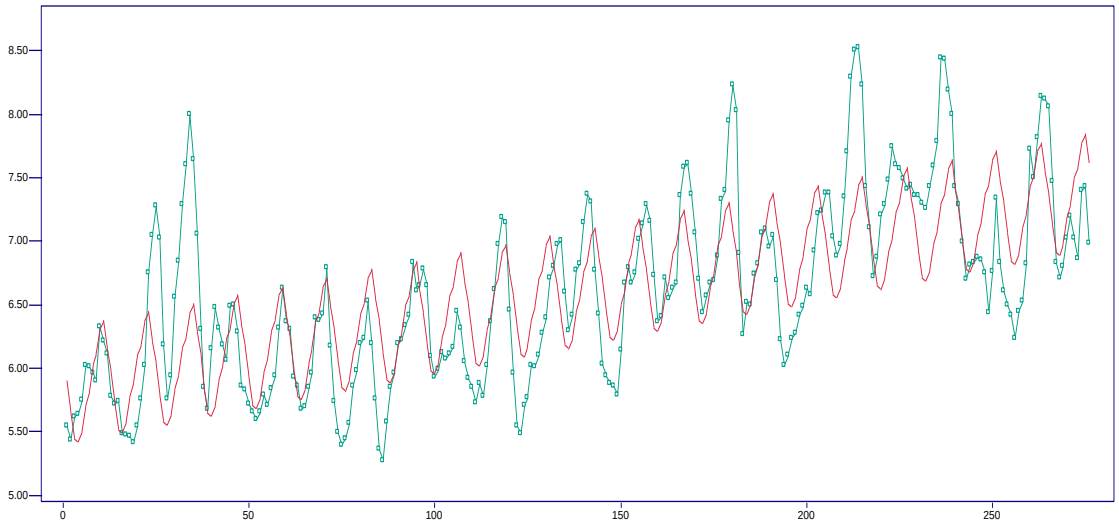
After Box-Cox transformation, There is upward trend in Maximum price of onion series .

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The fitted classical model with seasonality of period d=12 to maximum prices of onion in Lasalgaon market is shown below :

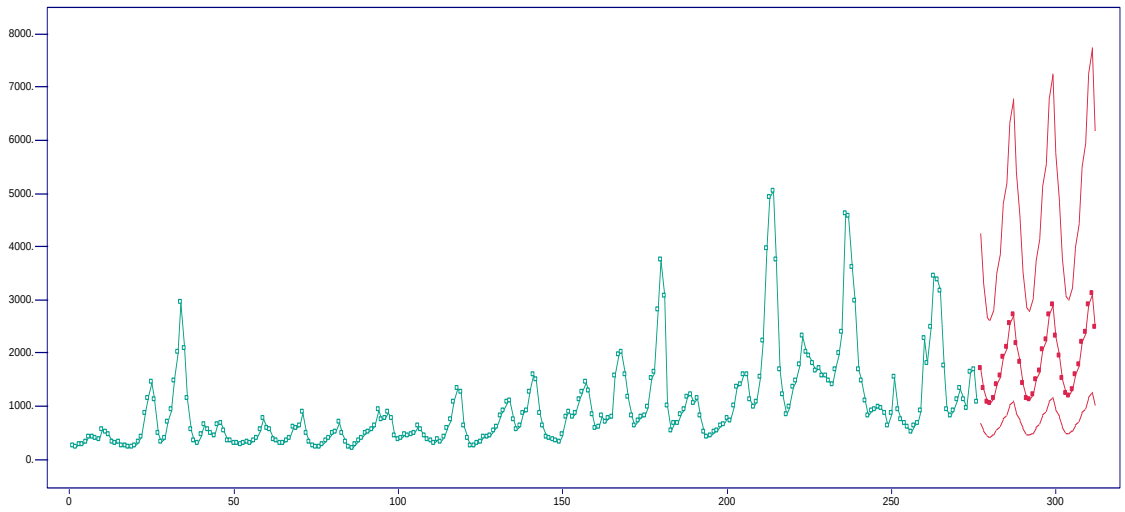
$Log(X_t) = 0.0055554 * t + 5.8336$

Seasonal fit of period = 12

Seasonal components:

Sr.no.	Month	Seasonal component
1	January	0.064382
2	February	-0.18573
3	March	-0.40536
4	April	-0.43332
5	May	-0.35717
6	June	-0.15942
7	July	-0.052782
8	August	0.15202
9	September	0.2311
10	October	0.4177
11	November	0.48037
12	December	0.24819

Forecasting : By using above model we forecast for next 3 year (i.e. 36 months) monthly Maximum price of onion per quintals in Lasalgaon market with 95% confidence bounds and same is shown in the following graph:



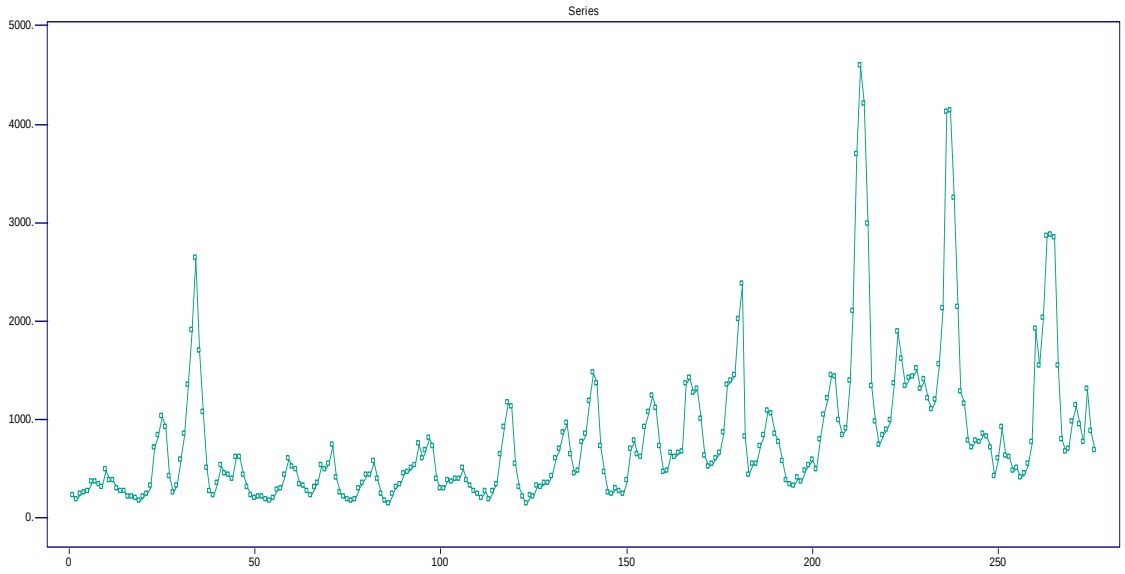
The numerical values of forecast for next 3 year (i.e. 36 months) monthly maximum price of onion per quintals in Lasalgaon market with 95% confidence bounds shown in following table:

Sr.No.	Month	Prediction	Lower bound	Upper Bound
277	Jan-19	1697.4	681.11	4230.1
278	Feb-19	1329.2	533.35	3312.4
279	Mar-19	1073	430.57	2674.1
280	Apr-19	1049.2	421.03	2614.8
281	May-19	1138.6	456.87	2837.4
282	Jun-19	1395.3	559.87	3477.1
283	Jul-19	1560.9	626.34	3889.9
284	Aug-19	1926.3	772.98	4800.6
285	Sep-19	2096.5	841.25	5224.6
286	Oct-19	2540.6	1019.5	6331.5
287	Nov-19	2720	1091.5	6778.6
288	Dec-19	2168.5	870.13	5404
289	Jan-20	1814.4	728.07	4521.7
290	Feb-20	1420.8	570.12	3540.7
291	Mar-20	1147	460.25	2858.4
292	Apr-20	1121.6	450.05	2795.1
293	May-20	1217	488.36	3033
294	Jun-20	1491.4	598.47	3716.8
295	Jul-20	3716.8	669.52	4158.1
296	Aug-20	2059.1	826.27	5131.6
297	Sep-20	2241	899.24	5584.8
298	Oct-20	2715.8	1089.8	6768
299	Nov-20	2907.5	1166.7	7245.9
300	Dec-20	2317.9	930.12	5776.5
301	Jan-21	1939.5	778.26	4833.4
302	Feb-21	1518.7	609.42	3784.8
303	Mar-21	1226.1	491.98	3055.4

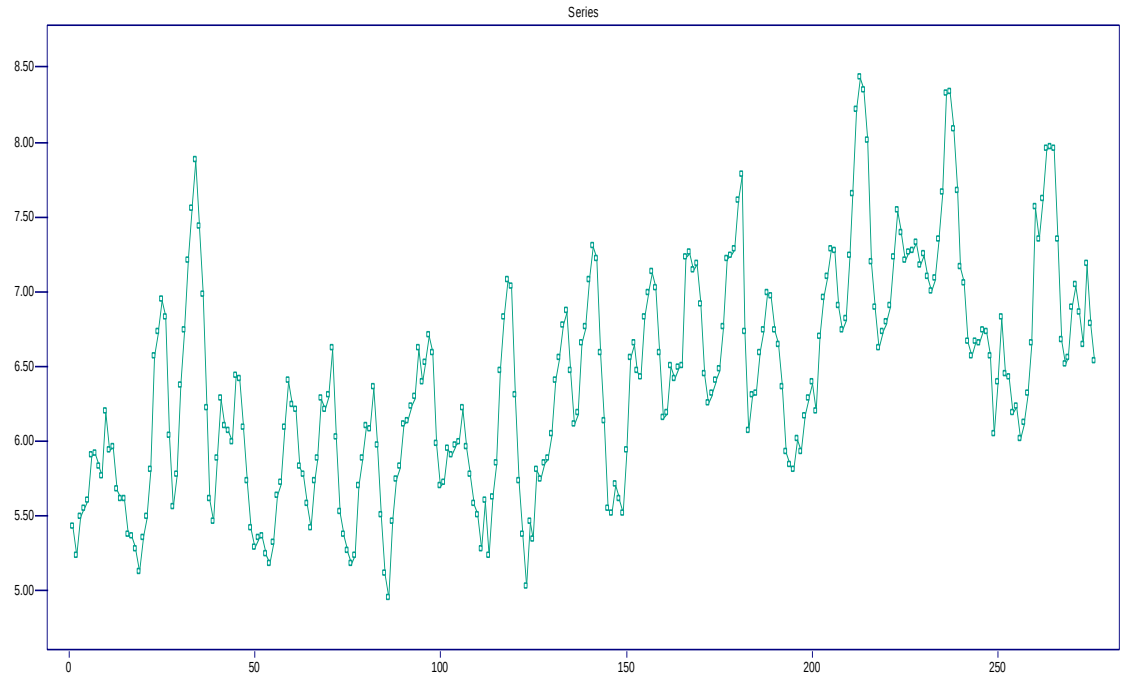
304	Apr-21	1198.9	481.08	2987.7
305	May-21	1301	522.03	3242.1
306	Jun-21	1594.3	639.72	3973
307	Jul-21	1783.5	715.68	4444.7
308	Aug-21	2201.1	883.23	5485.3
309	Sep-21	2395.5	961.24	5969.8
310	Oct-21	2903	1164.9	7234.6
311	Nov-21	3108	1247.1	7745.4
312	Dec-21	2477.7	994.24	6174.8

4) Analysis for Lasalgaon of Modal price of Onion :

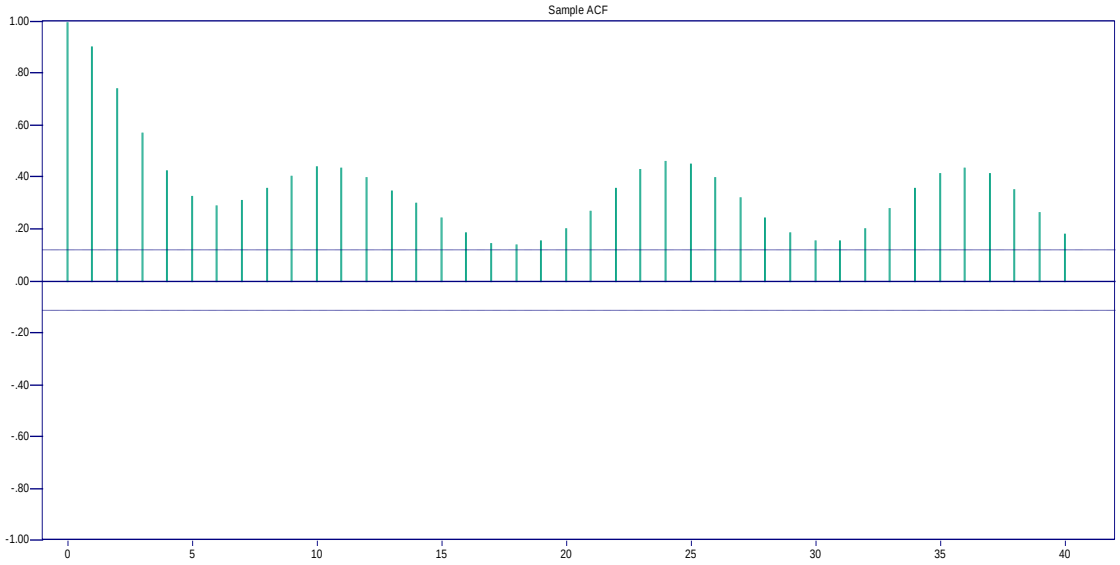
The time series of monthly Modal price of onion in quintals in the market situated at Lasalgaon, Tal -Niphad, Dist-Nashik from January 1996 to December 2018 shown below:



By looking at series we conclude that variation is increasing continuously,Hence we use box-Cox transformation with parameter 0 .

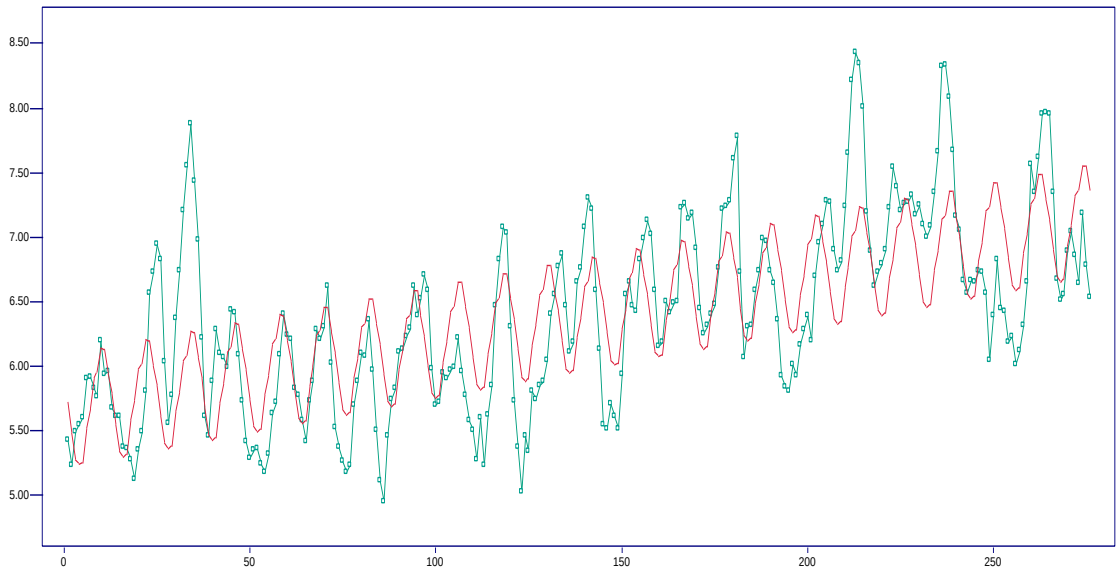


After Box-Cox transformation, There is upward trend in modal price of onion series .
The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The fitted classical model with seasonality of period d=12 to modal prices of onion in Lasalgaon market is shown below :

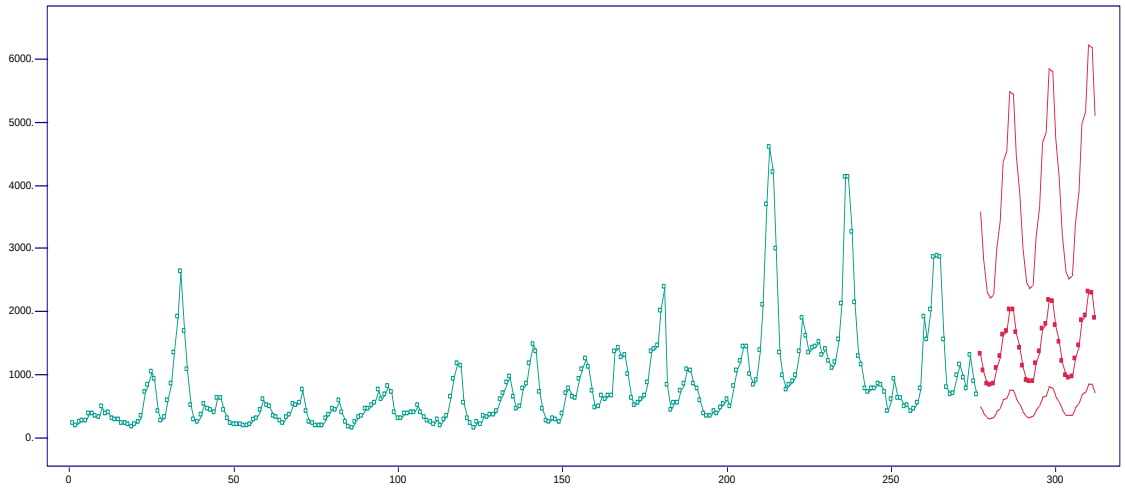
$Log(X_t) = .0053578 * t + 5.6501$

Seasonal fit of period = 12

Seasonal components:

Sr.No.	Month	Seasonal component
1	January	0.056576
2	February	-0.17879
3	March	-0.39293
4	April	-0.43851
5	May	-0.42343
6	June	-0.16097
7	July	-0.012532
8	August	0.21881
9	September	0.25522
10	October	0.43373
11	November	0.42197
12	December	0.22084

Forecasting : By using above model we forecast for next 3 year (i.e. 36 months) monthly Modal price of onion per quintals in Lasalgaon market with 95% confidence bounds and same is shown in the following graph:



The numerical values of forecast for next 3 year (i.e. 36 months) monthly modal price of onion per quintals in Lasalgaon market with 95% confidence bounds shown in following table:

Sr.No.	Month	Prediction	Lower Bound	Upper Bound
277	Jan-19	1327.2	491.46	3584
278	Feb-19	1054.5	390.48	2847.6
279	Mar-19	855.79	316.9	2311
280	Apr-19	822.05	304.41	2219.9
281	May-19	839.02	310.69	2265.8
282	Jun-19	1096.7	406.11	2961.6
283	Jul-19	1279	473.63	3454
284	Aug-19	1620.6	600.12	4376.4
285	Sep-19	1689.7	625.71	4563.1
286	Oct-19	2030.8	752.02	5484.2
287	Nov-19	2017.9	747.22	5449.2
288	Dec-19	1659.1	614.36	4480.3
289	Jan-20	1415.3	524.1	3822
290	Feb-20	1124.5	416.41	3036.7
291	Mar-20	912.62	337.95	2464.5
292	Apr-20	876.64	324.62	2367.4
293	May-20	894.74	331.32	2416.2
294	Jun-20	1169.5	433.08	3158.3
295	Jul-20	1364	505.08	3683.3
296	Aug-20	1728.2	639.97	4667
297	Sep-20	1801.9	667.26	4866.1
298	Oct-20	2165.7	801.95	5848.3
299	Nov-20	2151.8	796.84	5811
300	Dec-20	1769.2	655.16	4777.8
301	Jan-21	1509.3	558.9	4075.8

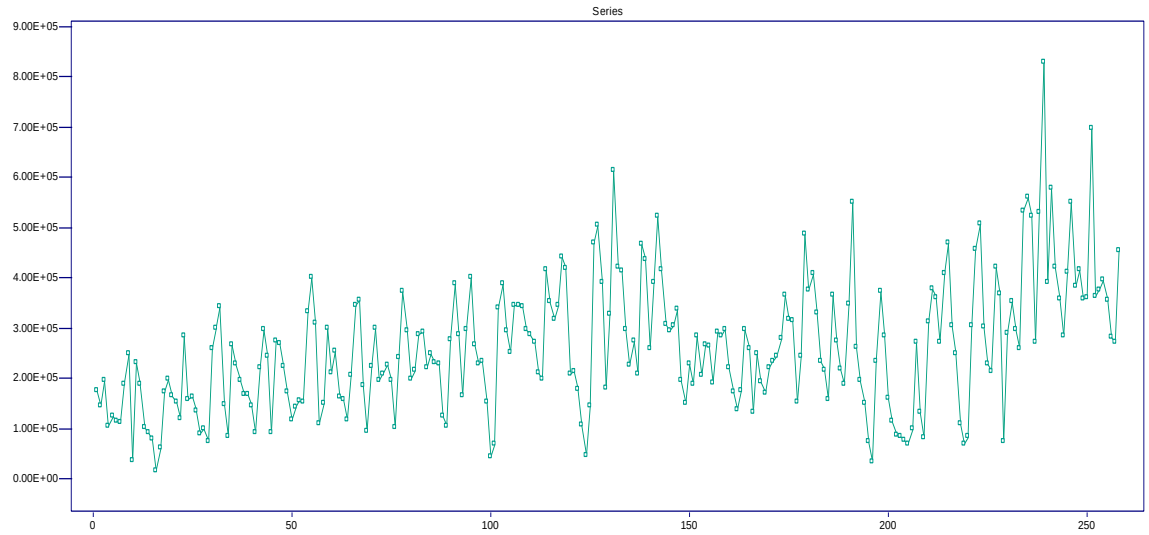
302	Feb-21	1199.2	444.06	3238.4
303	Mar-21	973.22	360.39	2628.2
304	Apr-21	934.86	346.18	2524.6
305	May-21	954.15	353.33	2576.7
306	Jun-21	1247.2	461.84	3368
307	Jul-21	1454.5	538.62	3927.9
308	Aug-21	1843	682.47	4977
309	Sep-21	1921.6	711.57	5189.2
310	Oct-21	2309.5	855.21	6236.7
311	Nov-21	2294.7	849.75	6196.9
312	Dec-21	1886.7	698.66	5095.1

Analysis For Pimpalgaon market

1) Analysis of arrival of onion in quintals of Pimpalgaon :

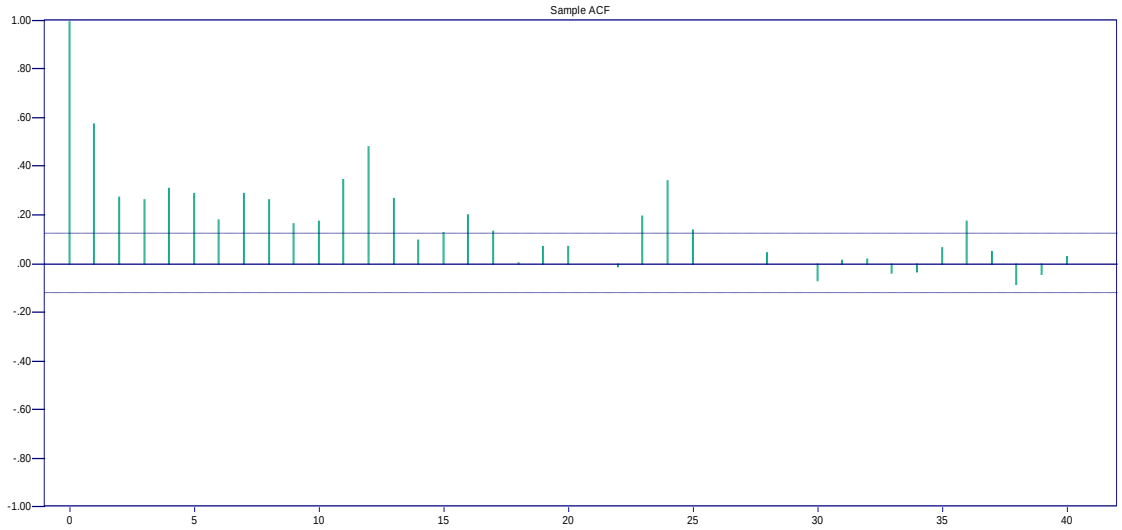
The time series of monthly arrival of onion in quintals in the market situated at Pimpalgaon, Tal -Niphad, Dist-Nashik from July 1997 to December 2018 shown below:

Original time series:



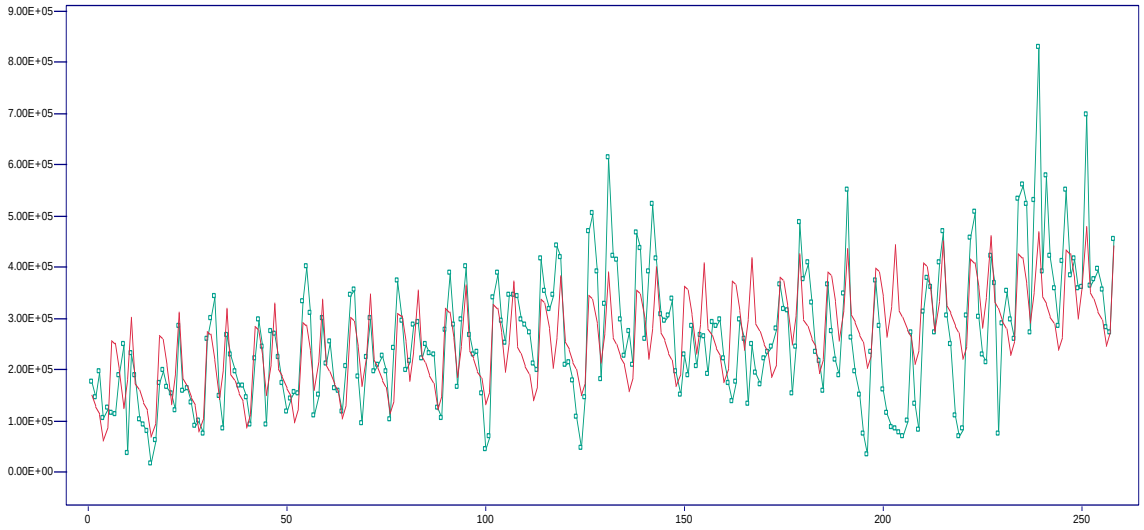
By looking at series we conclude that there is upward trend in the data. The arrivals of onion usually increases in the month December and January and decreases in the month September, October and November.

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The graph shown the original time series coincides with classical fitted time series. Therefore we conclude that the classical model is good fitted to arrival of onion data.

The fitted classical model with seasonality of period d=12 to arrival of onion in Pimpalgaon market is shown below :

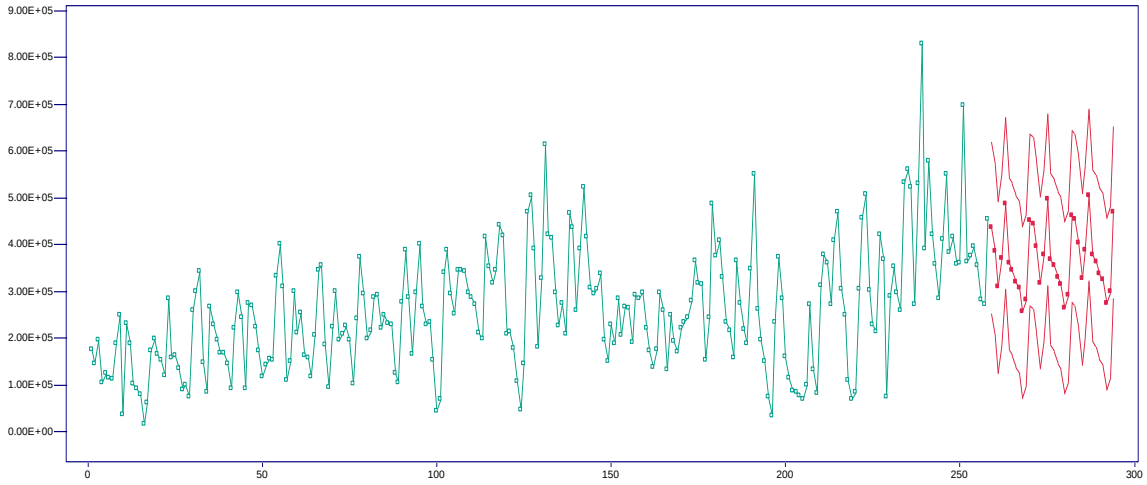
$X_t = 737.52^* t + 163790$

Seasonal fit of period = 12

Seasonal components:

Sr.no.	Month	Seasonality
1	January	0.14235
2	February	39600
3	March	55200
4	April	106000
5	May	79800
6	June	88400
7	July	80900
8	August	30600
9	September	47100
10	October	11800
11	November	130000
12	December	629

By using above model we forecast for next 3 year (i.e. 36 months) monthly arrival of onion in Pimpalgaon market with 95% confidence bounds and same is shown in the following graph:



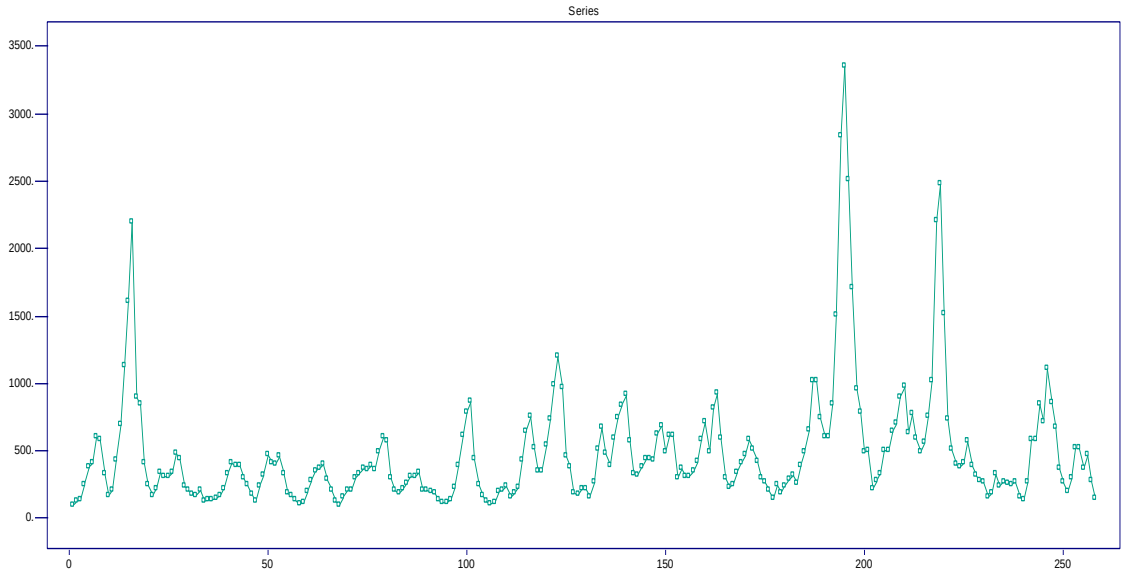
The numerical values of forecast for next 3 year (i.e. 36 months) monthly arrival of onion in Lasalgaon market with 95% confidence bounds shown in following table:

Sr. No.	Month	Year	Prediction	Lower Bound	Upper Bound
259	January	2019	435680	252110	619250
260	February	2019	386180	202610	569750
261	March	2019	309140	125570	492710
262	April	2019	368860	185290	552430
263	May	2019	487720	304150	671290
264	June	2019	359120	175550	542690
265	July	2019	345000	161430	528560
266	August	2019	320360	136790	503930
267	September	2019	305530	121960	489100
268	October	2019	255100	71536	438670
269	November	2019	282390	98820	465960
270	December	2019	451270	267700	634840
271	January	2020	444530	260960	628100

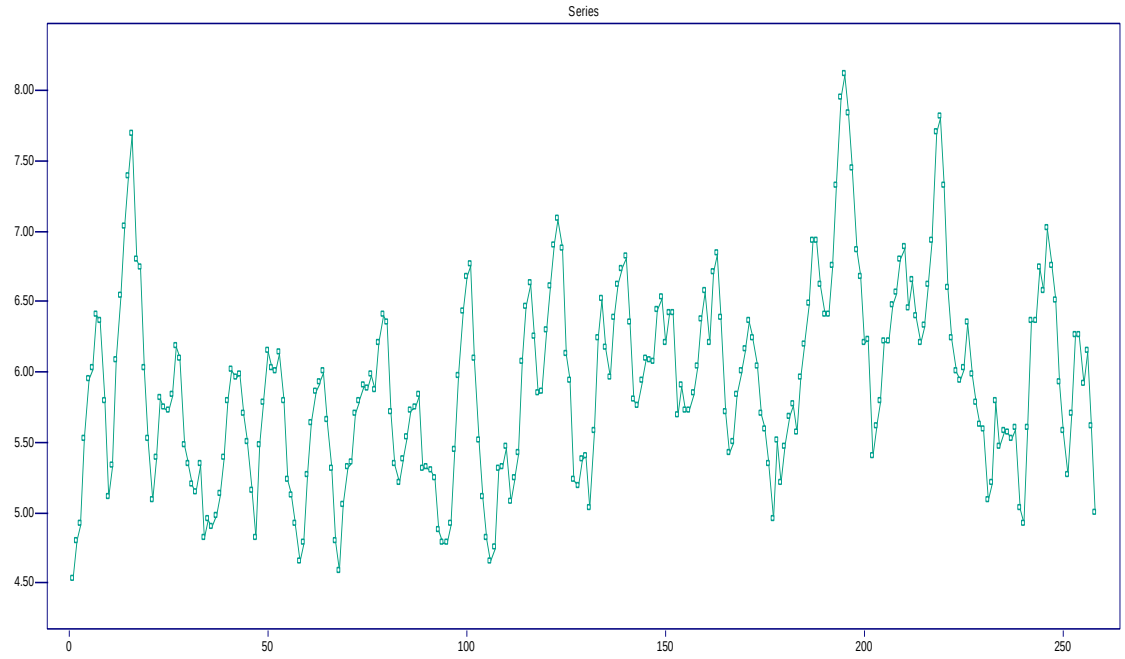
272	February	2020	395030	211460	578600
273	March	2020	317990	134420	501560
274	April	2020	377710	194140	561280
275	May	2020	496570	313000	680140
276	June	2020	367970	184400	551540
277	July	2020	353850	170280	537420
278	August	2020	329210	145640	512780
279	September	2020	314380	130810	497950
280	October	2020	263950	80386	447520
281	November	2020	291240	107670	474810
282	December	2020	460120	276550	643690
283	January	2021	453380	269810	636950
284	February	2021	403880	220310	587450
285	March	2021	326840	143270	510410
286	April	2021	386560	202990	570130
287	May	2021	505420	321850	688990
288	June	2021	376820	193250	560390
289	July	2021	362700	179130	546270
290	August	2021	338060	154490	521630
291	September	2021	323230	139660	506800
292	October	2021	272800	89236	456370
293	November	2021	300090	116520	483660
294	December	2021	468970	285400	652540

2) Analysis of minimum prices of onion in rupees per quintals of Pimpalgaon Market :

The time series of monthly minimum price of onion in rupees per quintals in the market situated at Pimpalgaon, Tal -Niphad, Dist-Nashik from July 1997 to December 2018 shown below:

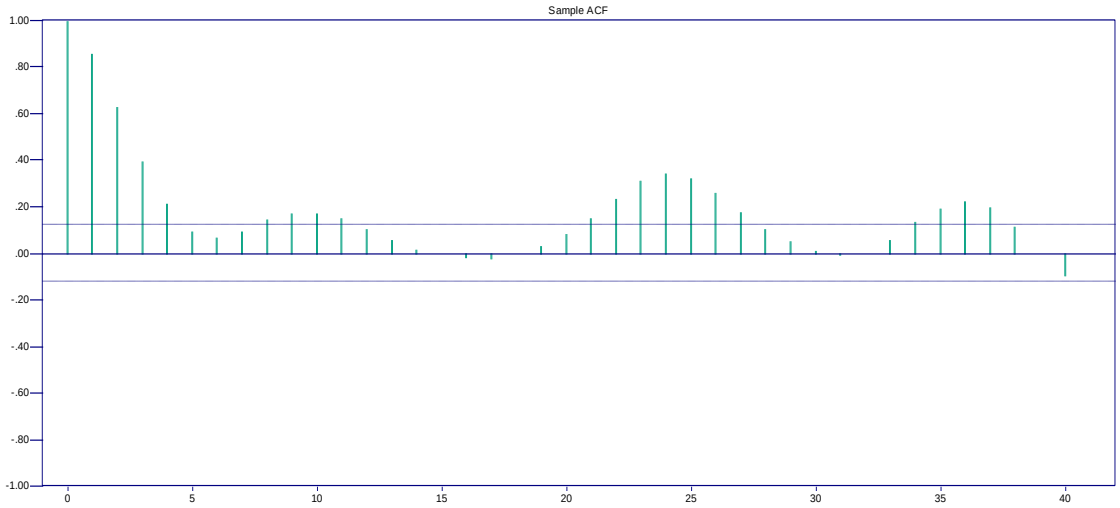


By looking at series we conclude that variation in prices of onion is increasing continuously,Hence we use box-Cox transformation with parameter 0 .



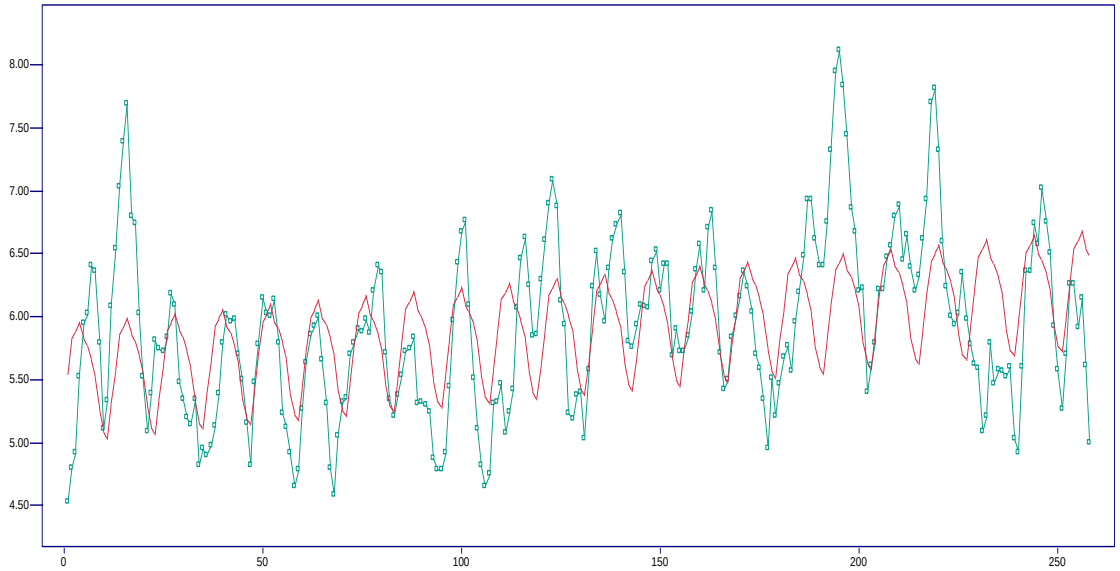
After Box-Cox transformation, There is upward trend in the minimum prices of onion series.

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The graph shown the original time series coincides with classical fitted time series. Therefore we conclude that the classical model is good fitted to minimum price of onion data.
The fitted classical model with seasonality of period d=12 to minimum prices of onion in Pimpalgaon market is shown below :

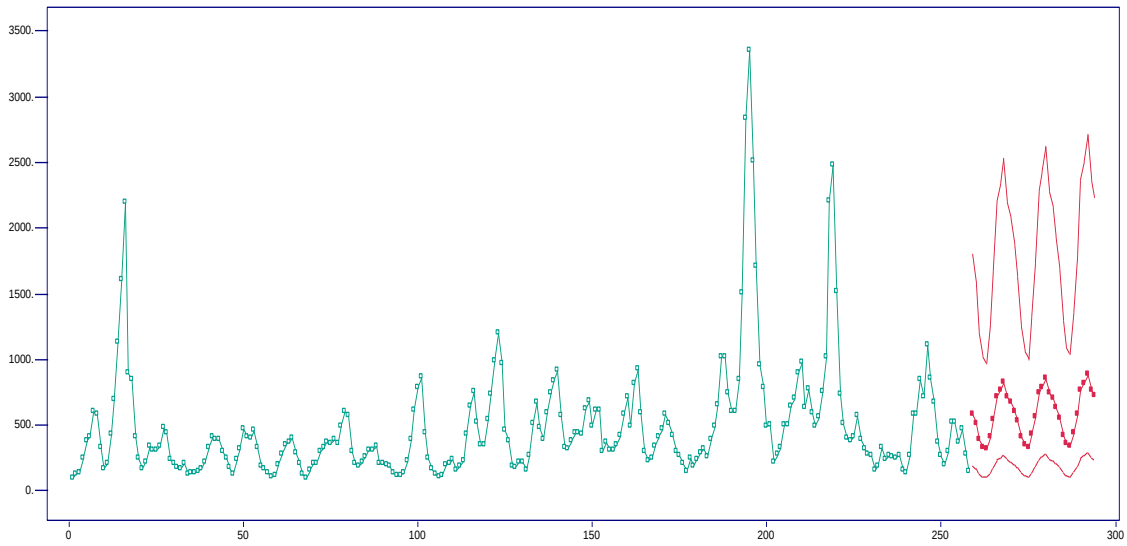
$Log(X_t) = 0.0028576 * t + 5.5352$

Seasonal fit of period = 12

Seasonal components:

Sr. No.	Month	Seasonality
1	January	0.0094199
2	February	0.28104
3	March	0.33922
4	April	0.41321
5	May	0.26827
6	June	0.20968
7	July	0.099839
8	August	-0.039085
9	September	-0.30898
10	October	-0.47745
11	November	-0.53317
12	December	-0.26199

Forecasting : By using above model we forecast for next 3 year (i.e. 36 months) monthly minimum price of onion per quintals in Pimpalgaon market with 95% confidence bounds and same is shown in the following graph:



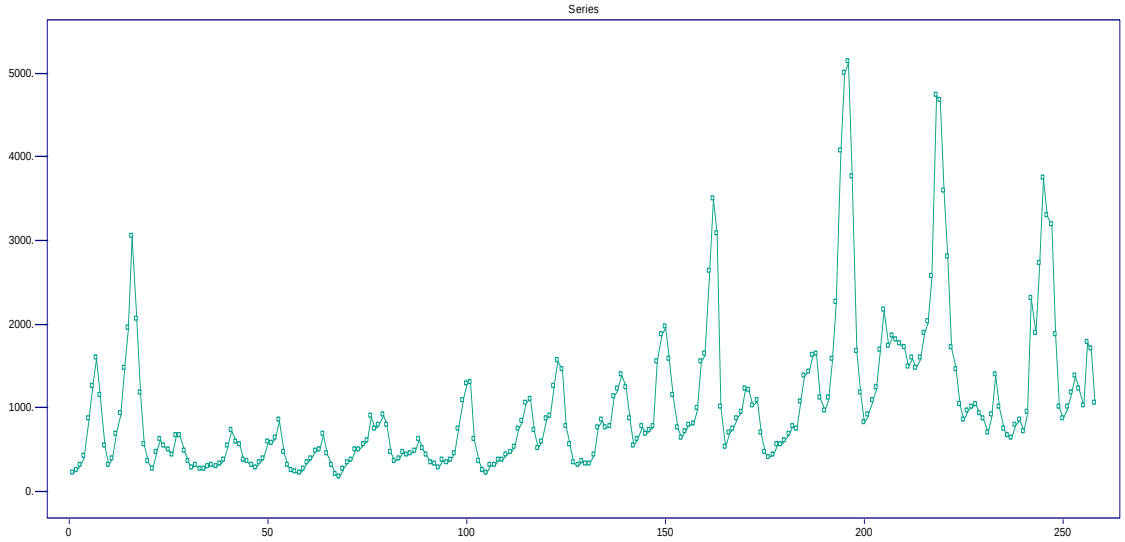
The numerical values of forecast for next 3 year (i.e. 36 months) monthly minimum price of onion per quintals in Lasalgaon market with 95% confidence bounds shown in following table:

Sr. No.	Month	Year	Prediction	Lower Bound	Upper Bound
259	January	2019	587.08	190.99	1804.6
260	February	2019	512.4	166.69	1575
261	March	2019	392.31	127.63	1205.9
262	April	2019	332.44	108.15	1021.9
263	May	2019	315.32	102.58	969.26
264	June	2019	414.73	134.92	1274.8
265	July	2019	545.6	177.5	1677.1
266	August	2019	717.93	233.56	2206.8
267	September	2019	763.11	248.26	2345.7
268	October	2019	824.07	268.09	2533.1
269	November	2019	714.92	232.58	2197.6
270	December	2019	676.17	219.97	2078.5
271	January	2020	607.56	197.65	1867.6
272	February	2020	530.27	172.51	1630
273	March	2020	406	132.08	1248
274	April	2020	344.03	111.92	1057.5
275	May	2020	326.32	106.16	1003.1
276	June	2020	429.2	139.63	1319.3
277	July	2020	564.64	183.69	1735.6
278	August	2020	742.97	241.7	2283.8
279	September	2020	789.74	256.92	212427.6
280	October	2020	852.82	277.44	2621.5
281	November	2020	739.86	240.69	2274.2
282	December	2020	699.76	227.65	2151
283	January	2021	628.76	204.55	1932.7

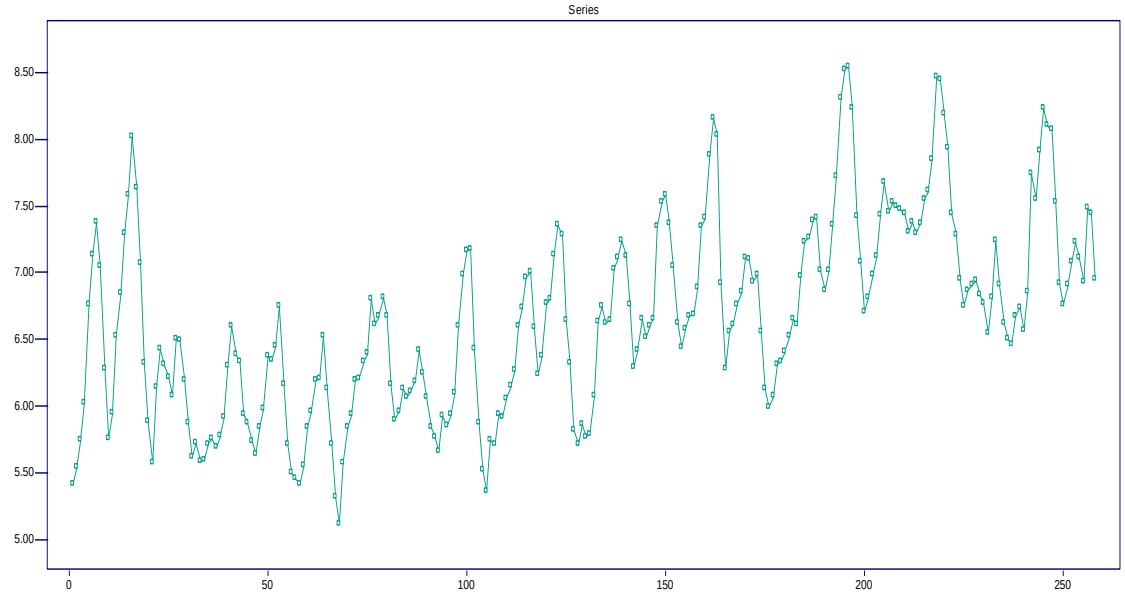
284	February	2021	548.77	178.53	1686.9
285	March	2021	420.16	136.69	1291.5
286	April	2021	356.04	115.83	1094.4
287	May	2021	337.7	109.86	1038.1
288	June	2021	444.17	144.5	1365.3
289	July	2021	584.33	190.1	1796.2
290	August	2021	768.89	250.14	2363.5
291	September	2021	817.29	265.88	2512.2
292	October	2021	882.57	287.12	2712.9
293	November	2021	765.67	249.09	2353.6
294	December	2021	724.17	235.59	2226

3) Analysis for Pimpalgaon of Maximum price of Onion :

The time series of monthly Maximum price of onion in quintals in the market situated at Pimpalgaon, Tal -Niphad, Dist-Nashik from July 1997 to December 2018 shown below:

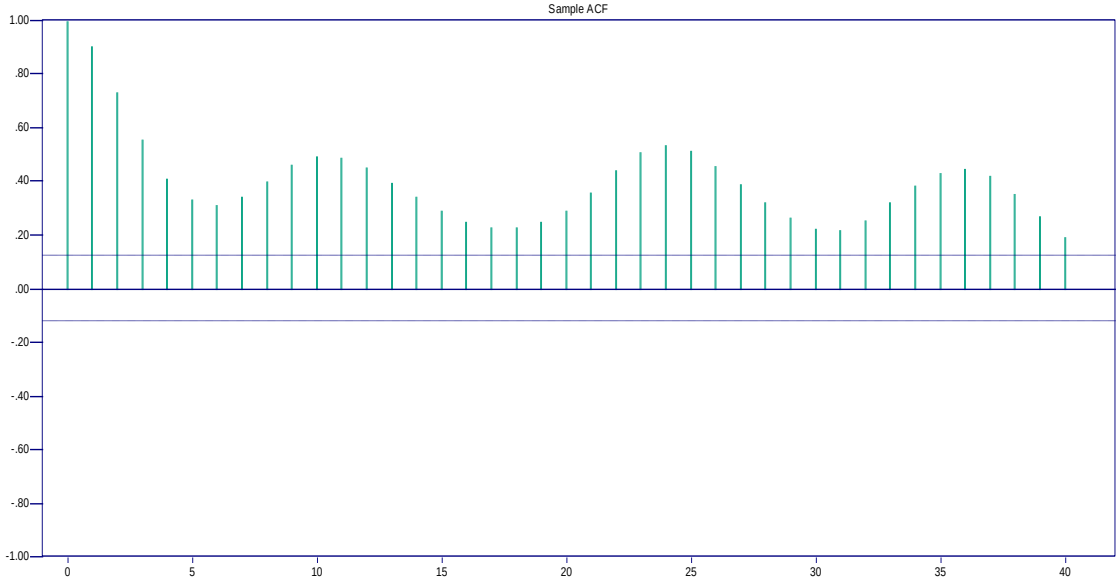


By looking at series we conclude that variation is increasing continuously,Hence we use box-Cox transformation with parameter 0 .



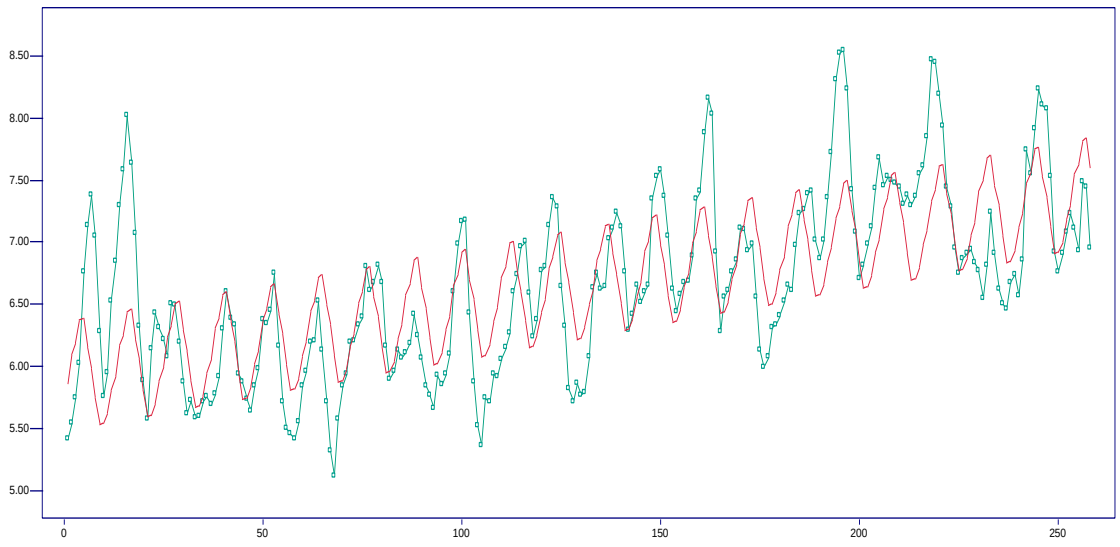
After Box-Cox transformation, There is upward trend in Maximum price of onion series .

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The fitted classical model with seasonality of period d=12 to maximum prices of onion in Lasalgaon market is shown below :

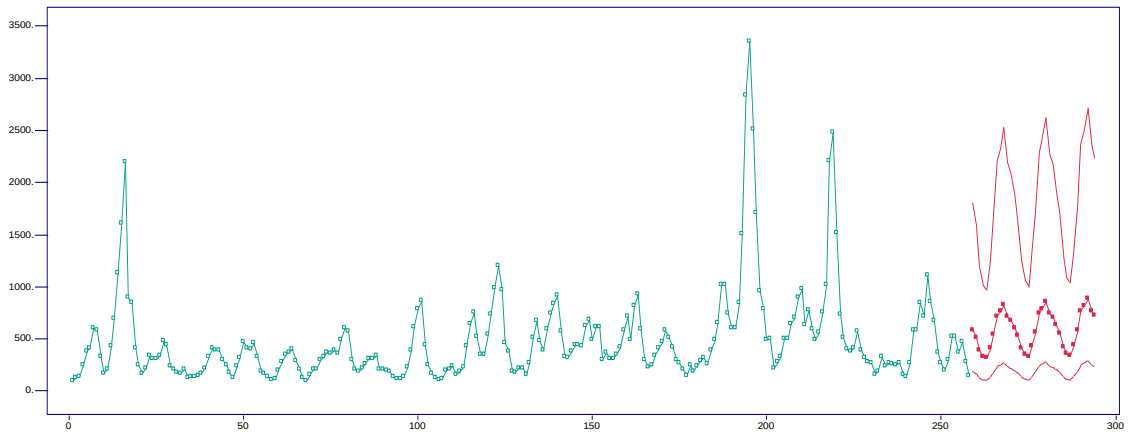
$\text{Log}(X_t) = 0.0028576 * t + 5.5352$

Seasonal fit of period = 12

Seasonal components:

Sr. No.	Month	Seasonality
1	January	0.0094199
2	February	0.28104
3	March	0.33922
4	April	0.41321
5	May	0.26827
6	June	0.20968
7	July	0.099839
8	August	-0.039085
9	September	-0.30898
10	October	-0.47745
11	November	-0.53317
12	December	-0.26199

Forecasting : By using above model we forecast for next 3 year (i.e. 36 months) monthly Maximum price of onion per quintals in Lasalgaon market with 95% confidence bounds and same is shown in the following graph:



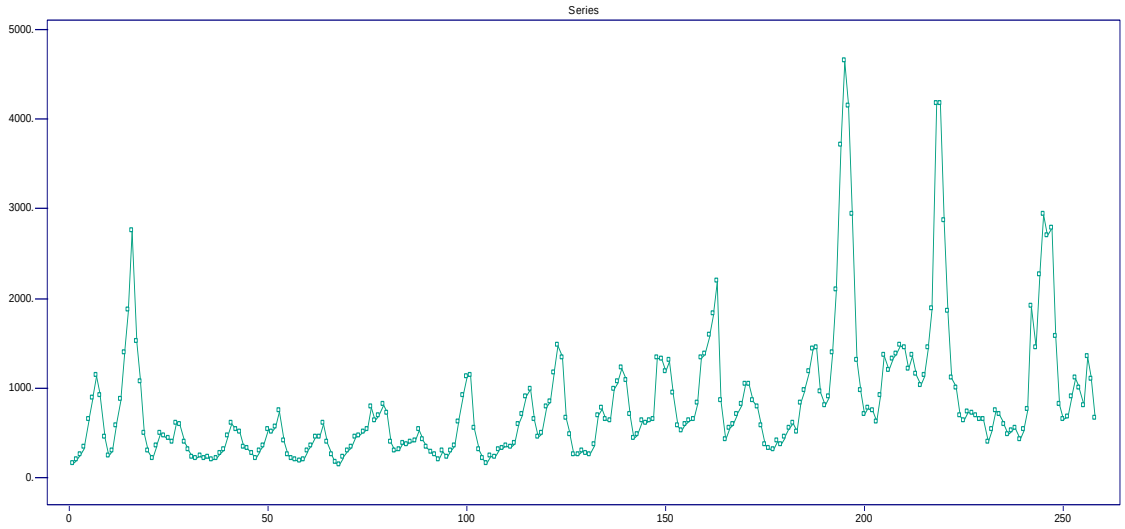
The numerical values of forecast for next 3 year (i.e. 36 months) monthly maximum price of onion per quintals in Lasalgaon market with 95% confidence bounds shown in following table:

Sr. No.	Month	Year	Prediction	Lower Bound	Upper Bound
259	January	2019	1684.3	1684.3	4400.9
260	February	2019	1322.4	506.09	3455.4
261	March	2019	1069.7	409.37	2795
262	April	2019	1081.6	413.93	2826.1
263	May	2019	1186	453.87	3098.9
264	June	2019	1421.8	544.13	3715.1
265	July	2019	1593.3	609.78	4163.3
266	August	2019	2027.2	775.81	5297
267	September	2019	2225.7	851.78	5815.7
268	October	2019	2655.4	1016.3	6938.6
269	November	2019	2707.5	1036.2	7074.5
270	December	2019	2124.8	813.18	5552.1
271	January	2020	1804.3	690.5	4714.5
272	February	2020	1416.6	542.15	3701.6
273	March	2020	1145.9	438.54	2994.2
274	April	2020	1158.6	443.42	3027.5
275	May	2020	1270.5	486.21	3319.7
276	June	2020	1523.1	582.9	3979.8
277	July	2020	1706.9	653.23	4460
278	August	2020	2171.6	831.09	5674.4
279	September	2020	2384.3	912.48	6230
280	October	2020	2844.7	1088.7	7433
281	November	2020	2900.4	1110	7578.6
282	December	2020	2276.2	871.12	5947.7
283	January	2021	1932.8	580.79	5050.4
284	February	2021	1517.6	739.71	3965.4
285	March	2021	1227.5	469.78	3207.5

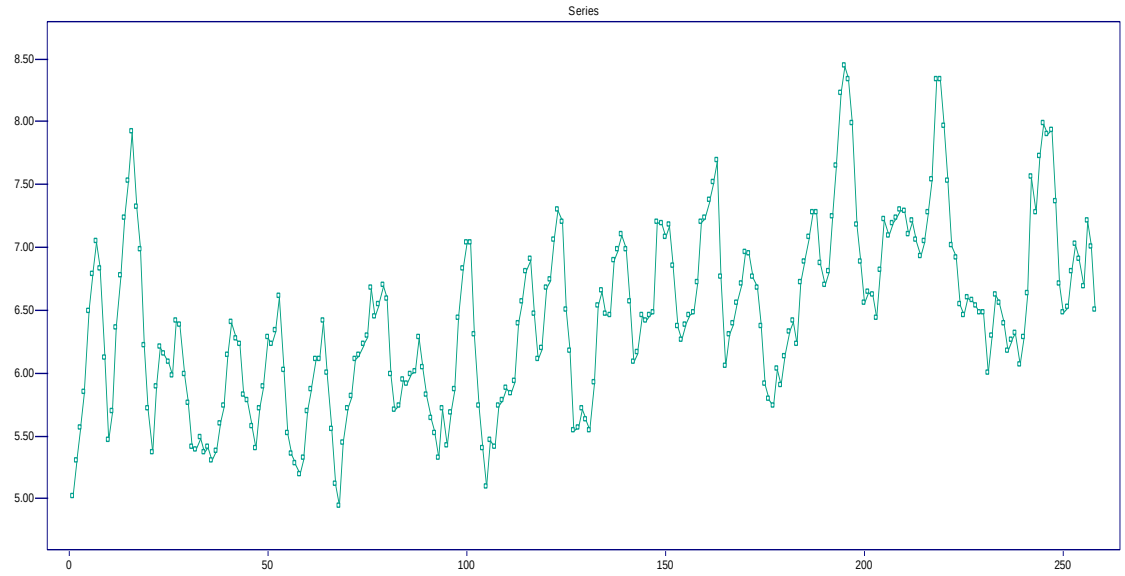
286	April	2021	1241.2	475.02	3243.2
287	May	2021	1361	520.86	3556.2
288	June	2021	1631.6	624.43	4263.4
289	July	2021	1828.5	699.77	4777.8
290	August	2021	2326.4	890.31	6078.7
291	September	2021	2554.2	977.49	6674
292	October	2021	3047.3	1166.2	7962.6
293	November	2021	3107.1	1189.1	8118.7
294	December	2021	2438.4	933.19	6371.5

4) Analysis for Lasalgaon of Modal price of Onion :

The time series of monthly Modal price of onion in quintals in the market situated at Lasalgaon, Tal -Niphad, Dist-Nashik from January 1996 to December 2018 shown below:

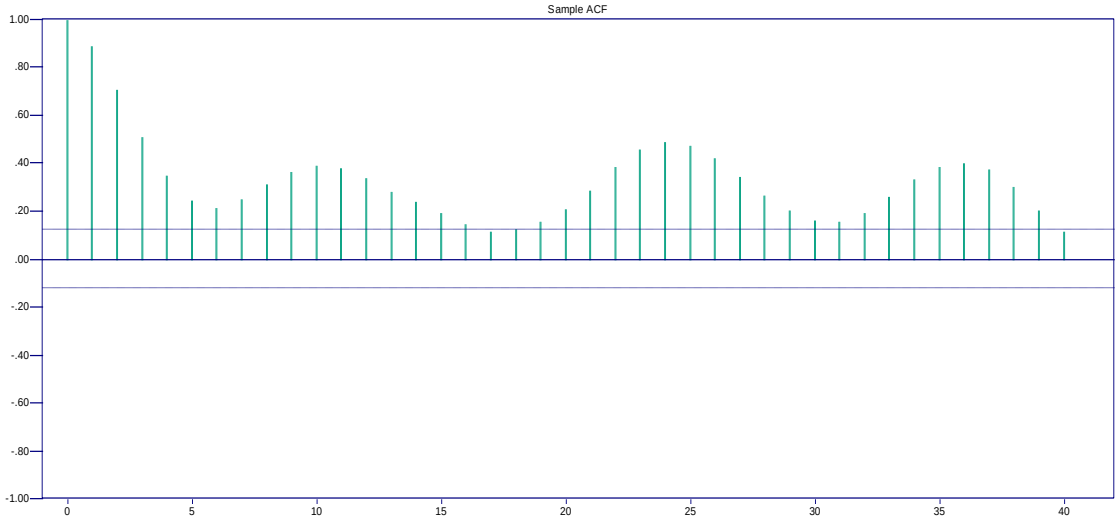


By looking at series we conclude that variation is increasing continuously, Hence we use box-Cox transformation with parameter 0 .



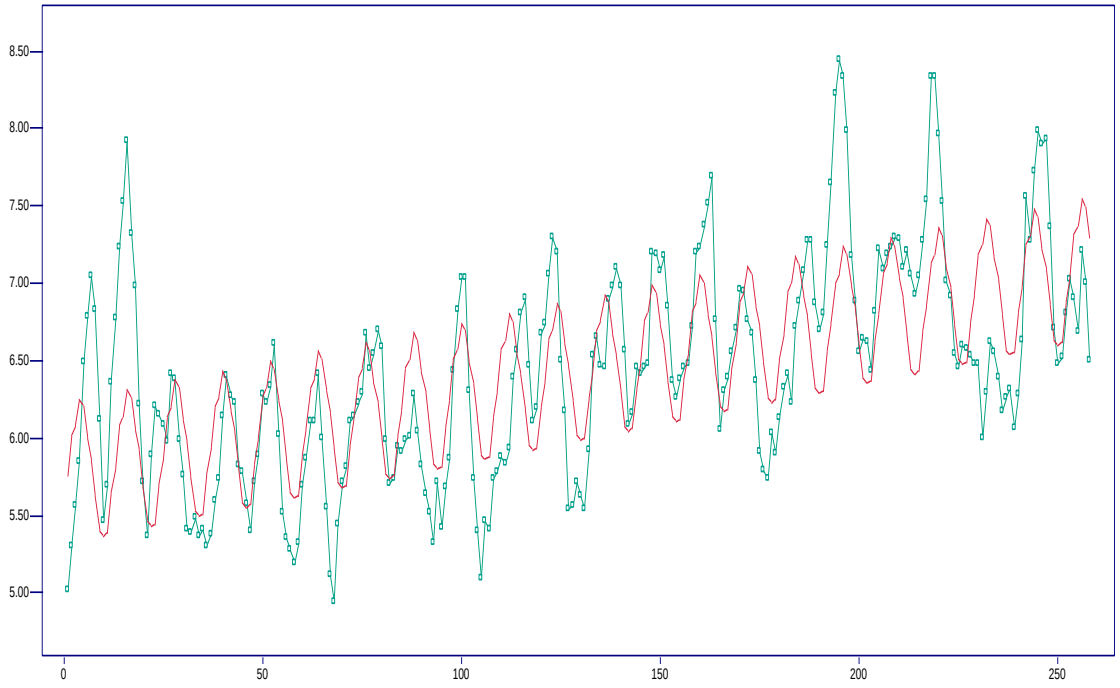
After Box-Cox transformation, There is upward trend in the data.

The Graph of Sample ACF shown below:



After observing original time series and sample ACF graph we know that the seasonality is of 12. Hence we decided to fit classical model by taking seasonal period d=12. We use ITSM software to fit the classical model.

The original time series along with classical fitted time series are shown in the following graph:



The fitted classical model with seasonality of period d=12 to modal prices of onion in Lasalgaon market is shown below :

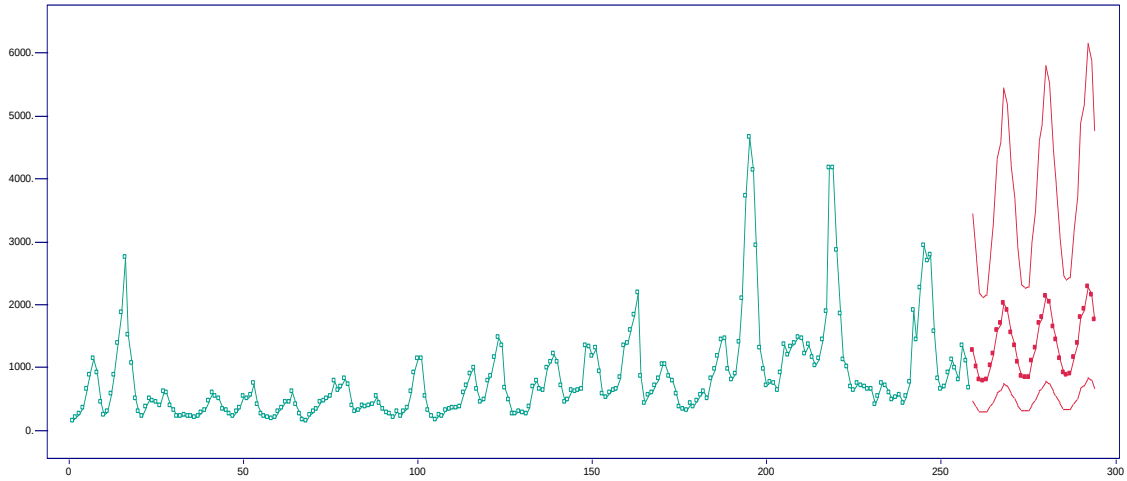
$\text{Log}(X_t) = 0.0051275 * t + 5.7644$

Seasonal fit of period = 12

Seasonal components:

Sr. No.	Month	Seasonality
1	January	-0.015985
2	February	0.24514
3	March	0.30105
4	April	0.46645
5	May	0.40905
6	June	0.1966
7	July	0.055377
8	August	-0.18137
9	September	-0.41066
10	October	-0.44725
11	November	-0.43808
12	December	-0.18032

Forecasting : By using above model we forecast for next 3 year (i.e. 36 months) monthly Modal price of onion per quintals in Lasalgaon market with 95% confidence bounds and same is shown in the following graph:



The numerical values of forecast for next 3 year (i.e. 36 months) monthly modal price of onion per quintals in Lasalgaon market with 95% confidence bounds shown in following table:

Sr. No.	Month	Year	Prediction	Lower Bound	Upper Bound
259	January	2019	1271.3	468.68	3448.5
260	February	2019	1008.5	371.78	2735.5
261	March	2019	805.95	297.12	2186.2
262	April	2019	780.98	287.92	2118.4
263	May	2019	792.23	292.06	2149
264	June	2019	1030.4	379.88	2795.1
265	July	2019	1220.7	450.03	3311.3
266	August	2019	1593.1	587.32	4321.4
267	September	2019	1693.4	624.29	4593.4
268	October	2019	2008.2	740.36	5447.4
269	November	2019	1906	702.66	5170
270	December	2019	1549.1	571.09	4202
271	January	2020	1352	498.42	3667.3
272	February	2020	1072.5	395.37	2909.1
273	March	2020	857.1	315.98	2324.9
274	April	2020	830.55	306.19	2252.9
275	May	2020	842.51	310.6	2285.3
276	June	2020	1095.8	403.99	2972.5
277	July	2020	1298.2	478.59	3521.4
278	August	2020	1694.2	624.59	4595.7
279	September	2020	1800.9	663.91	4884.9
280	October	2020	2135.7	787.34	5793.1
281	November	2020	2026.9	747.25	5498.1
282	December	2020	1647.4	607.33	4468.6
283	January	2021	1437.8	530.05	3900.1
284	February	2021	1140.5	420.46	3093.7
285	March	2021	911.49	336.03	2472.4

286	April	2021	883.26	325.62	2395.9
287	May	2021	895.98	330.31	2430.4
288	June	2021	1165.4	429.63	3161.1
289	July	2021	1380.6	508.97	3744.9
290	August	2021	1801.8	664.23	4887.3
291	September	2021	1915.2	706.04	5194.9
292	October	2021	2271.2	837.31	6160.8
293	November	2021	2155.6	794.67	5847.1
294	December	2021	1752	645.87	4752.2

Conclusion :

(1) Arrival of Onion and Price of Onion are dependent .

(2) The Distribution of Arrival for Lasalgaon market And Pimpalgaon market of onion is same .

(3) Distribution of modal price for Lasalgaon market And Pimpalgaon market of onion is same .

(4) Checking the adequecy of predicted values Of arrival of onion of Lasalgaon market and observe values of Year-2019 :

				95% confidence bound.		
Sr.No.	Month	Original Arrival	Predicted Arrival	Lower bound	Upper Bound	Conclusion (lies or not lies)
277	Jan-19	430409	461370	308580	614150	Lies
278	Feb-19	565455	421690	268900	574470	Lies
279	Mar-19	293615	343450	190660	496230	Lies
280	Apr-19	338879	306530	153740	459310	Lies
281	May-19	377073	361460	208680	514250	Lies
282	Jun-19	411052	304990	152200	457770	Lies
283	Jul-19	417244	295690	142910	448480	Lies
284	Aug-19	342558	275750	122960	428530	Lies
285	Sep-19	168771	254760	101970	407540	Lies
286	Oct-19	68705	232140	79353	384920	Not lies
287	Nov-19	32950	230180	77397	382970	Not lies

Checking the adequecy of predicted values Of modal price of onion of Lasalgaon market and observe values of Year-2019

				95% confidence bound.		
Sr.No.	Month	Original modal price	Predicted Modal price	Lower bound	Upper Bound	Conclusion (lies or not lies)
277	Jan-19	575	1327.2	491.46	3584	Lies
278	Feb-19	423	1054.5	390.48	2847.6	Lies
279	Mar-19	577	855.79	316.9	2311	Lies
280	Apr-19	873	822.05	304.41	2219.9	Lies
281	May-19	958	839.02	310.69	2265.8	Lies
282	Jun-19	1231	1096.7	406.11	2961.6	Lies
283	Jul-19	1241	1279	473.63	3454	Lies
284	Aug-19	1864	1620.6	600.12	4376.4	Lies
285	Sep-19	3128	1689.7	625.71	4563.1	Lies
286	Oct-19	3156	2030.8	752.02	5484.2	Lies
287	Nov-19	5105	2017.9	747.22	5449.2	Lies

Checking the adequecy of predicted values Of arrival of onion of Pimpalgaon market and observe values of Year-2019

				95% confidence bound.		
Sr.No.	Month	Original Arrival	Predicted Arrival	Lower bound	Upper Bound	Conclusion (lies or not lies)
277	Jan-19	543170	435680	252110	619250	Lies
278	Feb-19	412115	386180	202610	569750	Lies
279	Mar-19	160649	309140	125570	492710	Lies
280	Apr-19	654551	368860	185290	552430	Not Lies
281	May-19	662230	487720	304150	671290	Lies
282	Jun-19	490530	359120	175550	542690	Lies
283	Jul-19	349439	345000	161430	528560	Lies
284	Aug-19	397193	320360	136790	503930	Lies
285	Sep-19	246142	305530	121960	489100	Lies
286	Oct-19	123571	255100	71536	438670	lies
287	Nov-19	41720	282390	98820	465960	Not Lies

Checking the adequecy of predicted values Of modal price of onion of Pimpalgaon market and observe values of Year-2019

				95% confidence bound.		
Sr.No.	Month	Original modal price	Predicted Modal price	Lower bound	Upper Bound	Conclusion (lies or not lies)
277	Jan-19	567	1327.2	491.46	3584	Lies
278	Feb-19	425	1054.5	390.48	2847.6	Lies
279	Mar-19	605	855.79	316.9	2311	Lies
280	Apr-19	886	822.05	304.41	2219.9	Lies
281	May-19	928	839.02	310.69	2265.8	Lies
282	Jun-19	1175	1096.7	406.11	2961.6	Lies
283	Jul-19	1251	1279	473.63	3454	Lies
284	Aug-19	1808	1620.6	600.12	4376.4	Lies
285	Sep-19	3234	1689.7	625.71	4563.1	Lies
286	Oct-19	3096	2030.8	752.02	5484.2	Lies
287	Nov-19	4641	2017.9	747.22	5449.2	Lies

Limitations And Scope

(1) In our project, We have not considered the effect of random events such as Rainfall, Weather conditions etc can effect the production and price of onion .

(2) The excess import of onion from other countries can decrease the price, that are not considered in our project .

(3) The excess export of onion from other countries can increase the price that are not considered in our project

(4) We have taken the data from www.nhrdf.org, If we take data directly from market then 95% confidence bound can decrease .

References

1) www.nhrdf.org
2) Fundamental of Applied Statistics
3) Time series analysis SYBSc (Nirali Publication)