Thota, Sunil Raj – Time Series in R.R

```
# Intermediate Analytics
# ALY 6015
# Module 5 - Time Series in R
# 02/015/2021
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# NUID: 001099670

# Get and set the working directories
getwd()
```

```
## [1] "G:/NEU/Coursework/2021 Q1 Winter/ALY 6015 IA/Discussions & Assignment
s"
```

```
setwd('G:/NEU/Coursework/2021 Q1 Winter/ALY 6015 IA/Discussions & Assignments
')
getwd()
```

```
## [1] "G:/NEU/Coursework/2021 Q1 Winter/ALY 6015 IA/Discussions & Assignment
s"
```

```
# Installed the above packages into the work space
install.packages("plyr")
install.packages("dplyr")
install.packages("tidyr")
install.packages("TTR")
install.packages("forecast")

# Loaded the below libraries into the work space
library(plyr)
library(dplyr)
library(tidyr)
library(TTR)
library(forecast)

# PART A
# Problem 1

tsData <- scan("http://robjhyndman.com/tsdldata/data/fancy.dat")
tsData
```

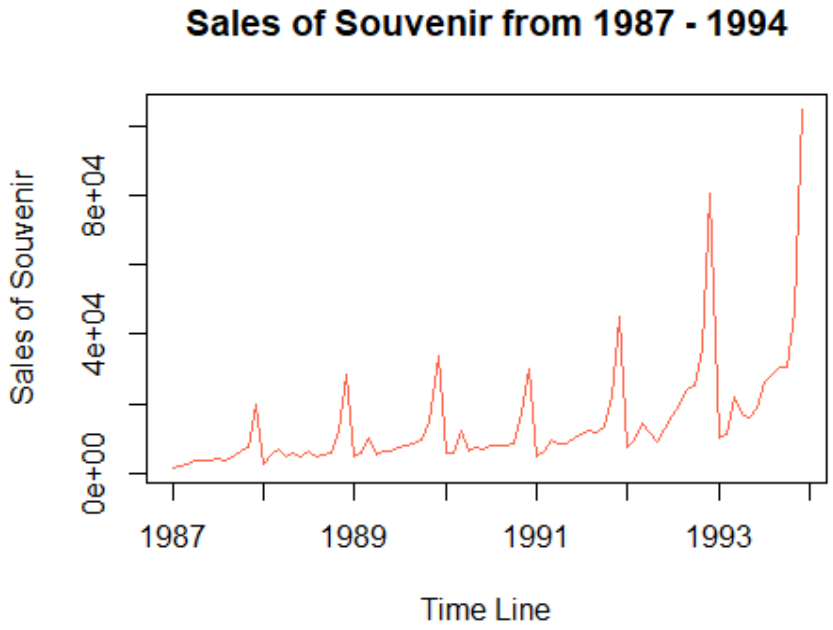
```
##  [1]   1664.81   2397.53   2840.71   3547.29   3752.96   3714.74   4349.61
##  [8]   3566.34   5021.82   6423.48   7600.60  19756.21   2499.81   5198.24
## [15]   7225.14   4806.03   5900.88   4951.34   6179.12   4752.15   5496.43
## [22]   5835.10  12600.08  28541.72   4717.02   5702.63   9957.58   5304.78
## [29]   6492.43   6630.80   7349.62   8176.62   8573.17   9690.50  15151.84
```

```
## [36]  34061.01   5921.10   5814.58  12421.25   6369.77   7609.12   7224.75
## [43]   8121.22   7979.25   8093.06   8476.70  17914.66  30114.41   4826.64
## [50]   6470.23   9638.77   8821.17   8722.37  10209.48  11276.55  12552.22
## [57]  11637.39  13606.89  21822.11  45060.69   7615.03   9849.69  14558.40
## [64]  11587.33   9332.56  13082.09  16732.78  19888.61  23933.38  25391.35
## [71]  36024.80  80721.71  10243.24  11266.88  21826.84  17357.33  15997.79
## [78]  18601.53  26155.15  28586.52  30505.41  30821.33  46634.38 104660.67

View(tsData)
str(tsData)

##  num [1:84] 1665 2398 2841 3547 3753 ...

head(tsData)

## [1] 1664.81 2397.53 2840.71 3547.29 3752.96 3714.74

tail(tsData)

## [1]  26155.15  28586.52  30505.41  30821.33  46634.38 104660.67

summary(tsData)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1665    5884    8772   14316   16889  104661

# Let's perform some Exploratory Data Analysis and Time series analysis using
"sales" data set. To get this data set we need to search on Google as Monthly
Sales for a Souvenir Shop in Australia from Jan 1987 - Dec 1993. After that,
i have loaded the data set using scan() function. I also installed all the ne
cessary package from the packages tab which is right side to the work space i
n R Studio.

# Or we can also install the packages by using install.packages("package name
") command. Once it is loaded we can use it in the code for further analysis
and calculations. Loaded the necessary library into the work space. Loaded th
e sales Data set into the Environment.

# I have also installed TTR package enables us to use SMA function which is r
equired to smooth time data series by using Simple Moving Average. I have als
o installed 'TTR', 'SMA', to perform Smooth Time Data series by simply moving
the averages. Let's install all the above packages.

# To View the diabetes Data set we use View() command, To observe the structu
re of the Data set we use str() command, and head () and tail() shows first a
nd last few rows in the Data set. Summary() Provides the Descriptive Stats of
the sales columns. We noticed 5 variables from the statistics given in the su
mmary.
```

```r
# Problem 2

tsTime <- ts(tsData, frequency = 12, start = c(1987, 1))
tsTime
```

```
##           Jan       Feb       Mar       Apr       May       Jun       Jul
## 1987   1664.81   2397.53   2840.71   3547.29   3752.96   3714.74   4349.61
## 1988   2499.81   5198.24   7225.14   4806.03   5900.88   4951.34   6179.12
## 1989   4717.02   5702.63   9957.58   5304.78   6492.43   6630.80   7349.62
## 1990   5921.10   5814.58  12421.25   6369.77   7609.12   7224.75   8121.22
## 1991   4826.64   6470.23   9638.77   8821.17   8722.37  10209.48  11276.55
## 1992   7615.03   9849.69  14558.40  11587.33   9332.56  13082.09  16732.78
## 1993  10243.24  11266.88  21826.84  17357.33  15997.79  18601.53  26155.15
##           Aug       Sep       Oct       Nov       Dec
## 1987   3566.34   5021.82   6423.48   7600.60  19756.21
## 1988   4752.15   5496.43   5835.10  12600.08  28541.72
## 1989   8176.62   8573.17   9690.50  15151.84  34061.01
## 1990   7979.25   8093.06   8476.70  17914.66  30114.41
## 1991  12552.22  11637.39  13606.89  21822.11  45060.69
## 1992  19888.61  23933.38  25391.35  36024.80  80721.71
## 1993  28586.52  30505.41  30821.33  46634.38 104660.67
```

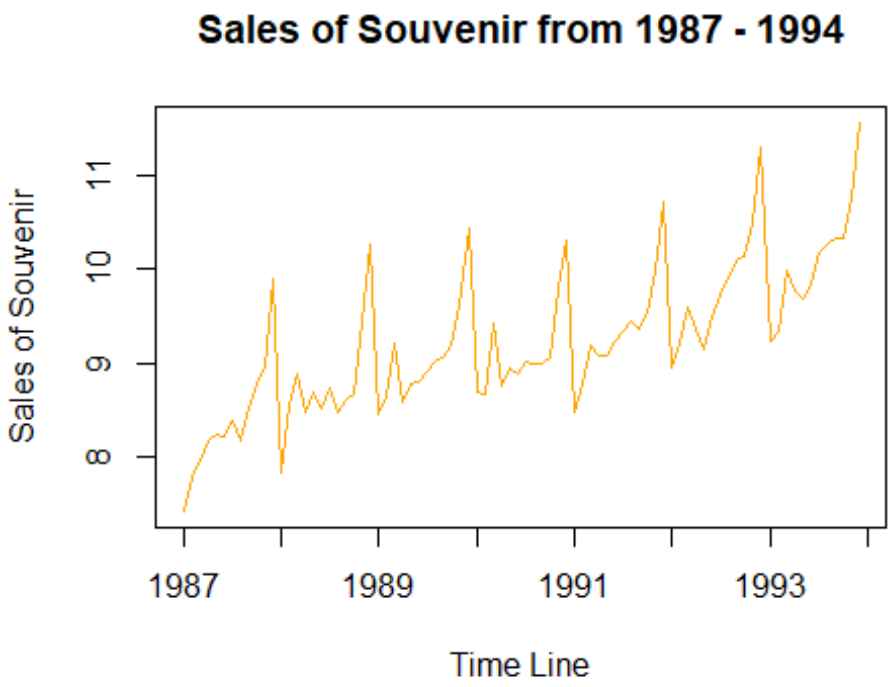
```r
ts.plot(
  tsTime,
  xlab = "Time Line",
  ylab = "Sales of Souvenir",
  main = "Sales of Souvenir from 1987 - 1994",
  col = "tomato"
)
```



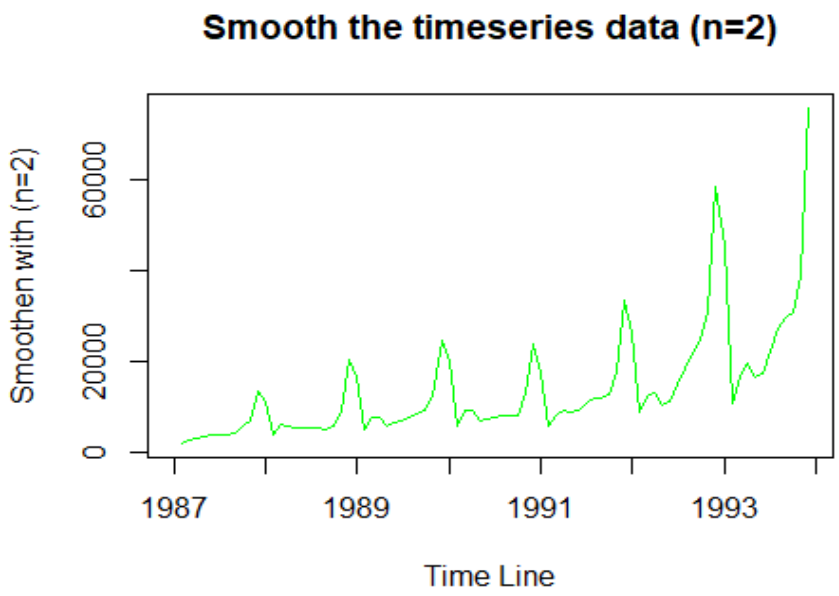
```r
tsToLog <- log(tsTime)
tsToLog
```

```
##            Jan       Feb       Mar       Apr       May       Jun       Jul
## 1987  7.417466  7.782194  7.951809  8.173939  8.230300  8.220064  8.377841
## 1988  7.823970  8.556075  8.885322  8.477627  8.682857  8.507414  8.728931
## 1989  8.458933  8.648683  9.206089  8.576364  8.778392  8.799481  8.902404
## 1990  8.686278  8.668124  9.427164  8.759319  8.937103  8.885268  9.002236
## 1991  8.481906  8.774967  9.173549  9.084910  9.073646  9.231072  9.330481
## 1992  8.937879  9.195195  9.585923  9.357668  9.141265  9.478999  9.725125
## 1993  9.234373  9.329623  9.990896  9.761770  9.680206  9.830999 10.171801
##            Aug       Sep       Oct       Nov       Dec
## 1987  8.179295  8.521548  8.767715  8.935982  9.891223
## 1988  8.466352  8.611854  8.671647  9.441458 10.259122
## 1989  9.009034  9.056393  9.178901  9.625877 10.435909
## 1990  8.984600  8.998762  9.045077  9.793375 10.312759
## 1991  9.437653  9.361978  9.518332  9.990679 10.715766
## 1992  9.897902 10.083029 10.142164 10.491963 11.298763
## 1993 10.260691 10.325659 10.335962 10.750093 11.558479
```

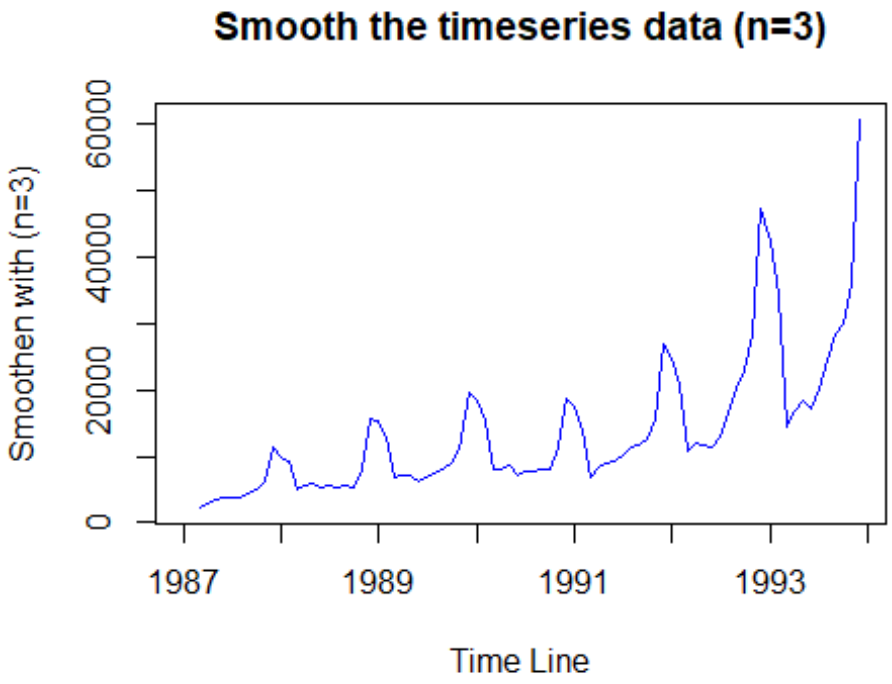
```r
ts.plot(
  tsToLog,
  xlab = "Time Line",
  ylab = "Sales of Souvenir",
  main = "Sales of Souvenir from 1987 - 1994",
  col = "orange"
)
```



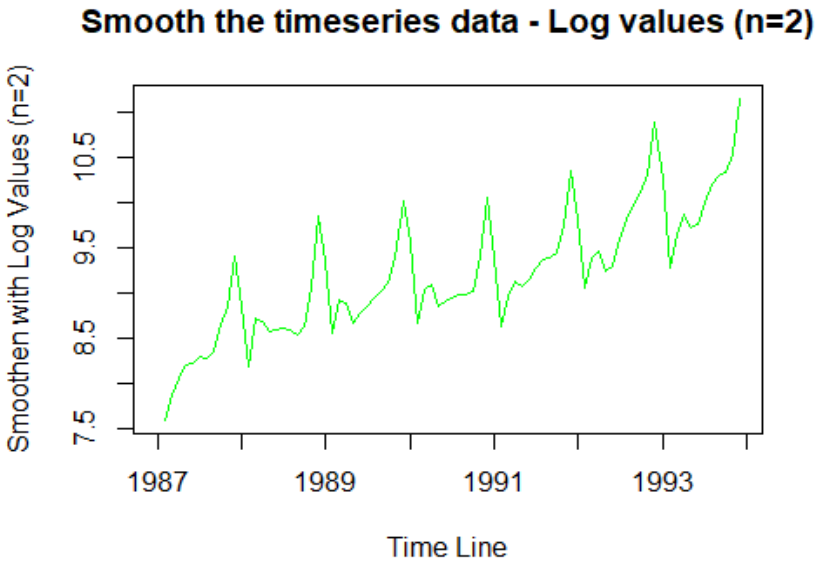
```
# I have utilized the "ts" function to time series data. I took frequency as
12 to format the data into 12 levels as the months are 12 from 1987 - 1993. I
used "ts.plot" function to plot the time series data. In this plot, X Axis de
picts the time line and Y Axis plots the number of sales of souvenir. The plo
t is of Additive type which is not applicable to utilize it for the time seri
es analysis.

# Because the the difference between consecutive time series data is same. To
analyze time series data, I need to convert it to multiplicative types by tak
ing "Log" natural for the above dataset. Let's plot the data as shown above.
I had used 'plot.ts' but it did not provide any differentiation and produced
the same result.

# Problem 3

tsTimeSMAPlot1 <- plot(
  SMA(tsTime, n = 2),
  main = "Smooth the timeseries data (n=2)",
  col = "green",
  xlab = "Time Line",
  ylab = "Smoothen with (n=2)"
)
```



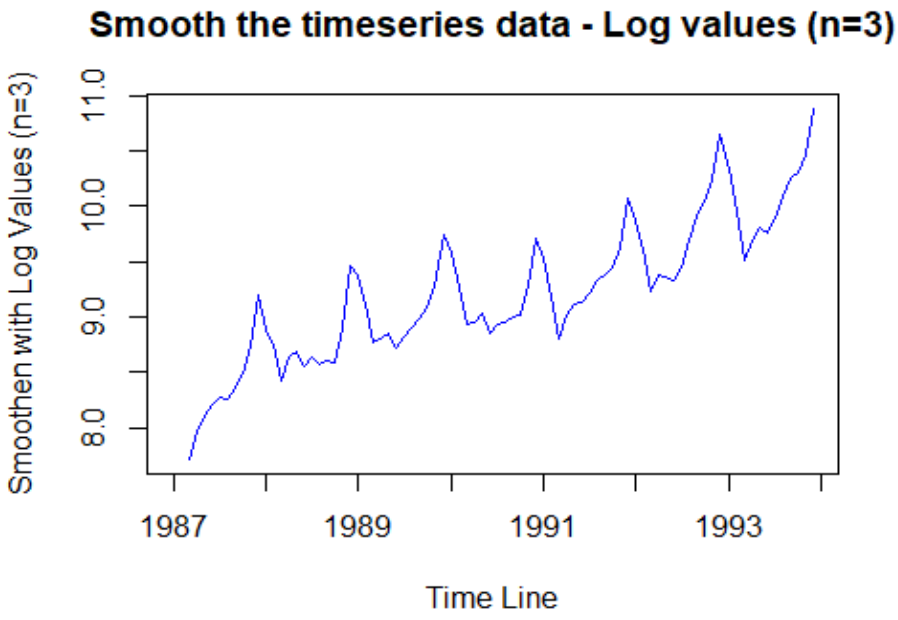

```
tsTimeSMAPlot2 <- plot(
  SMA(tsTime, n = 3),
  main = "Smooth the timeseries data (n=3)",
  col = "blue",
  xlab = "Time Line",
  ylab = "Smoothen with (n=3)"
)
```




```
tsTimeSMAPlot3 <- plot(
  SMA(tsToLog, n = 2),
  main = "Smooth the timeseries data - Log values (n=2)",
  col = "green",
  xlab = "Time Line",
  ylab = "Smoothen with Log Values (n=2)"
)
```



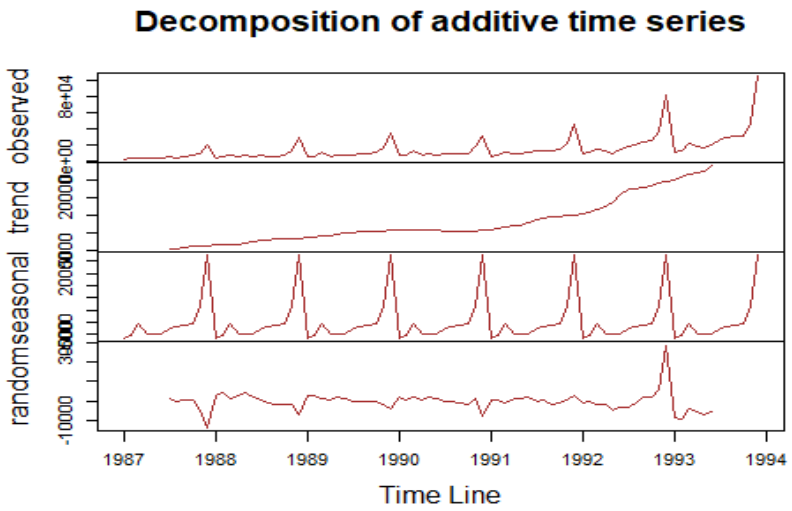
```
tsTimeSMAPlot4 <- plot(
  SMA(tsToLog, n = 3),
  main = "Smooth the timeseries data - Log values (n=3)",
  col = "blue",
  xlab = "Time Line",
  ylab = "Smoothen with Log Values (n=3)"
)
```




```
tsTimeDec <- decompose(tsTime)
tsTimeDec

## $x
##            Jan       Feb       Mar       Apr       May       Jun       Jul
## 1987   1664.81   2397.53   2840.71   3547.29   3752.96   3714.74   4349.61
## 1988   2499.81   5198.24   7225.14   4806.03   5900.88   4951.34   6179.12
## 1989   4717.02   5702.63   9957.58   5304.78   6492.43   6630.80   7349.62
## 1990   5921.10   5814.58  12421.25   6369.77   7609.12   7224.75   8121.22
## 1991   4826.64   6470.23   9638.77   8821.17   8722.37  10209.48  11276.55
## 1992   7615.03   9849.69  14558.40  11587.33   9332.56  13082.09  16732.78
## 1993  10243.24  11266.88  21826.84  17357.33  15997.79  18601.53  26155.15
##            Aug       Sep       Oct       Nov       Dec
## 1987   3566.34   5021.82   6423.48   7600.60  19756.21
## 1988   4752.15   5496.43   5835.10  12600.08  28541.72
## 1989   8176.62   8573.17   9690.50  15151.84  34061.01
## 1990   7979.25   8093.06   8476.70  17914.66  30114.41
## 1991  12552.22  11637.39  13606.89  21822.11  45060.69
## 1992  19888.61  23933.38  25391.35  36024.80  80721.71
## 1993  28586.52  30505.41  30821.33  46634.38 104660.67
##
```

```
## $seasonal
##             Jan        Feb        Mar        Apr        May        Jun
## 1987 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
## 1988 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
## 1989 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
## 1990 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
## 1991 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
## 1992 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
## 1993 -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
##             Jul        Aug        Sep        Oct        Nov        Dec
## 1987 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
## 1988 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
## 1989 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
## 1990 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
## 1991 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
## 1992 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
## 1993 -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
##
## $trend
##            Jan       Feb       Mar       Apr       May       Jun       Jul
## 1987        NA        NA        NA        NA        NA        NA  5421.133
## 1988  6517.855  6643.493  6712.677  6707.937  6891.732  7466.107  7924.554
## 1989  8566.257  8757.715  9028.598  9317.438  9584.403  9920.696 10200.837
## 1990 10729.094 10753.020 10724.792 10654.212 10718.755 10669.431 10459.387
## 1991 10913.802 11235.815 11574.035 11935.474 12312.042 13097.614 13836.559
## 1992 15392.422 15925.448 16743.464 17746.816 18829.614 20907.268 22502.653
## 1993 25224.785 25979.797 26616.045 27116.128 27784.443 29223.966        NA
##            Aug       Sep       Oct       Nov       Dec
## 1987  5572.621  5872.002  6107.134  6249.078  6390.100
## 1988  8037.954  8172.822  8307.455  8352.884  8447.509
## 1989 10255.671 10362.989 10510.016 10600.920 10672.196
## 1990 10441.103 10352.485 10338.690 10487.217 10657.966
## 1991 14093.552 14439.348 14759.589 14900.270 15045.387
## 1992 22671.211 23033.112 23576.381 24094.515 24602.210
## 1993        NA        NA        NA        NA        NA
##
## $random
##              Jan         Feb         Mar         Apr         May         J
un
## 1987          NA          NA          NA          NA          NA
NA
## 1988   2632.1169   4116.8522   1204.3337   2699.9580   4083.3862   2312.68
05
## 1989   2800.9240   2507.0205   1620.8524    589.2071   1982.2662   1537.55
14
## 1990   1842.1673    623.6647   2388.3287    317.4221   1964.6037   1382.76
68
## 1991    562.9994    796.5205  -1243.3947   1487.5609   1484.5666   1939.31
34
## 1992  -1127.2306   -513.6528  -1493.1930  -1557.6212  -4422.8150  -2997.73
```

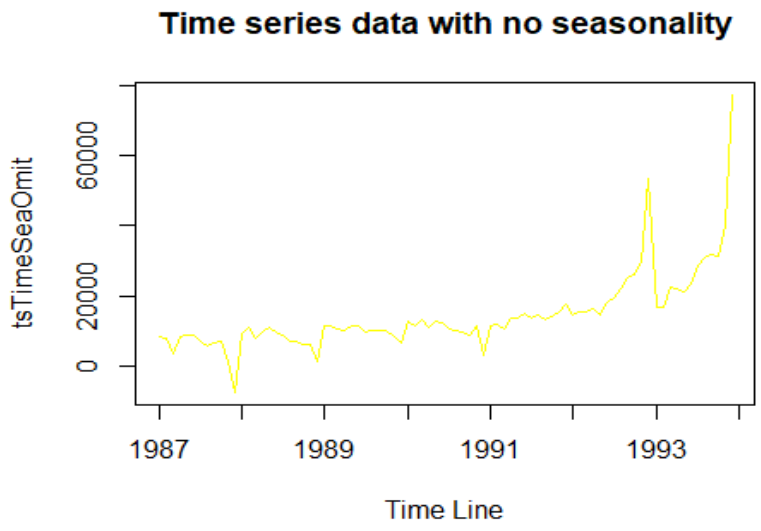
```
07
## 1993  -8331.3839  -9150.8120  -4097.3338  -5156.9337  -6712.4146  -5794.98
82
##              Jul         Aug         Sep         Oct         Nov         D
ec
## 1987   1381.1125     83.1381    459.3348    742.1522  -4990.0804 -13977.35
47
## 1988    707.2021  -1196.3844  -1366.8748  -2046.5482  -2094.4058  -7249.25
38
## 1989   -398.5808     10.3681   -480.3019   -393.7099  -1790.6816  -3954.65
09
## 1990    114.4692   -372.4336   -949.9082  -1436.1836   1085.8409  -7887.02
09
## 1991   -107.3729    548.0868  -1492.4411   -726.8928    580.2375   2671.83
82
## 1992  -3317.2370   -693.1819   2209.7843   2240.7755   5588.6825  28776.03
53
## 1993          NA          NA          NA          NA          NA
NA
##
## $figure
##  [1] -6650.1615 -5562.1051  -691.8707 -4601.8646 -5074.2387 -4827.4476
##  [7] -2452.6359 -2089.4193 -1309.5168  -425.8064  6341.6020 27343.4647
##
## $type
## [1] "additive"
##
## attr(,"class")
## [1] "decomposed.ts"

plot(tsTimeDec,
     col = "brown",
     xlab = "Time Line")
```



```
tsTimeSeaOmit <- tsTime - tsTimeDec$seasonal
tsTimeSeaOmit
```

```
##            Jan       Feb       Mar       Apr       May       Jun       Jul
## 1987  8314.971  7959.635  3532.581  8149.155  8827.199  8542.188  6802.246
## 1988  9149.971 10760.345  7917.011  9407.895 10975.119  9778.788  8631.756
## 1989 11367.181 11264.735 10649.451  9906.645 11566.669 11458.248  9802.256
## 1990 12571.261 11376.685 13113.121 10971.635 12683.359 12052.198 10573.856
## 1991 11476.801 12032.335 10330.641 13423.035 13796.609 15036.928 13729.186
## 1992 14265.191 15411.795 15250.271 16189.195 14406.799 17909.538 19185.416
## 1993 16893.401 16828.985 22518.711 21959.195 21072.029 23428.978 28607.786
##            Aug       Sep       Oct       Nov       Dec
## 1987  5655.759  6331.337  6849.286  1258.998 -7587.255
## 1988  6841.569  6805.947  6260.906  6258.478  1198.255
## 1989 10266.039  9882.687 10116.306  8810.238  6717.545
## 1990 10068.669  9402.577  8902.506 11573.058  2770.945
## 1991 14641.639 12946.907 14032.696 15480.508 17717.225
## 1992 21978.029 25242.897 25817.156 29683.198 53378.245
## 1993 30675.939 31814.927 31247.136 40292.778 77317.205
```

```
plot(tsTimeSeaOmit,
     main = "Time series data with no seasonality",
     col = "yellow",
     xlab = "Time Line")
```




```
# Let's smoothen the above four plots by using simple moving averages "SMA()" function. This function usually requires 2, 3 consecutive numbers and avg. them and take the next consecutive by averaging the data set. Let's use various values of "n" to alter the smoothing level. The peaks in the time series analysis is determined by SMA. Let's now analyze the components of a time series by using the "decompose()" function to segregate various components.
```

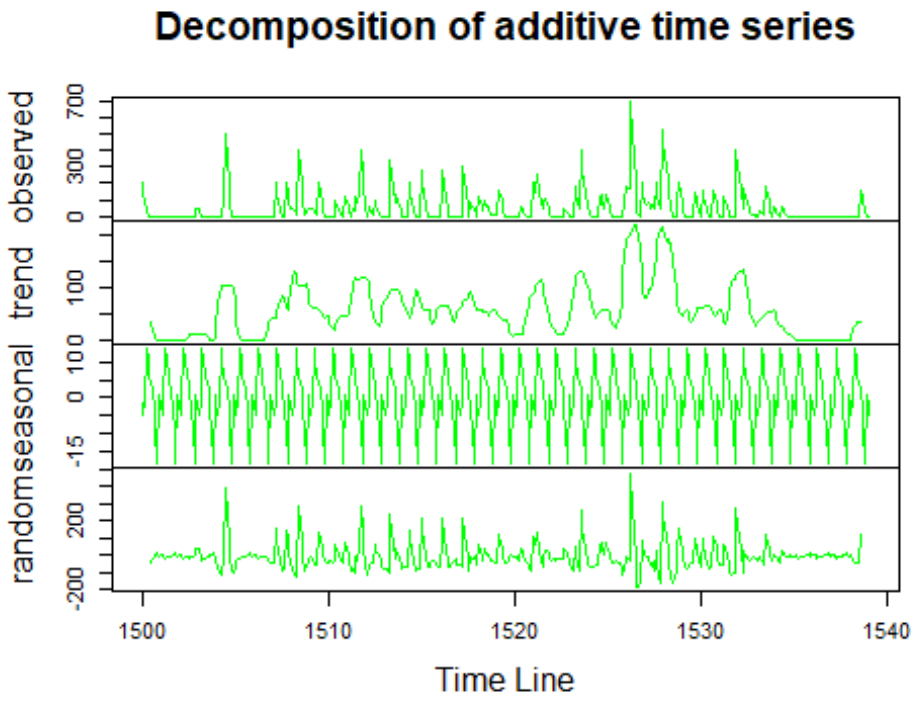
```r
# After that, I have plotted the graph to analyze these components. In this,
we already saw that there are four various components in this time series ana
lysis as observed, trend, random, and seasonal. The seasonal attribute is rec
urring over the time line and is capable. To get a sure shot on this data we
need to eradicate the seasonal aspect which does not give exact analysis of t
he trends

# Once that component is eradicated from the analysis we can see more precise
information on the time series data behavior to observe the rise and fall of
the data. From the plot we can depict that the unseasoned hike in the end

# PART B
# Problem 1

volcanoData <-
  scan("http://robjhyndman.com/tsdldata/annual/dvi.dat", skip = 1)
volcanoData

View(volcanoData)
str(volcanoData)

##  num [1:470] 200 150 100 50 0 0 0 0 0 0 ...

head(volcanoData)

## [1] 200 150 100  50   0   0

tail(volcanoData)

## [1] 120  80  40   0   0   0

summary(volcanoData)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    0.00    2.50   57.24   80.00  695.00

# Let's perform some Exploratory Data Analysis and Time series analysis using
"volcano" data set. After that, i have loaded the data set using scan() funct
ion. I also installed all the necessary package from the packages tab which i
s right side to the work space in R Studio.

# Or we can also install the packages by using install.packages("package name
") command. Once it is loaded we can use it in the code for further analysis
and calculations. Loaded the necessary library into the work space. Loaded th
e sales Data set into the Environment. I have also installed forecast package
enables us to forecast. Let's install all the above packages.

# To View the diabetes Data set we use View() command, To observe the structu
re of the Data set we use str() command, and head () and tail() shows first a
nd last few rows in the Data set. Summary() Provides the Descriptive Stats of
the volcano columns. We noticed 5 variables from the statistics given in the
summary. Let's use the ARIMA to discover the correlations and its problems
```

```r
# Problem 2

tsVolcanoData <- ts(volcanoData, start = c(1500), frequency = 12)
tsVolcanoData
```

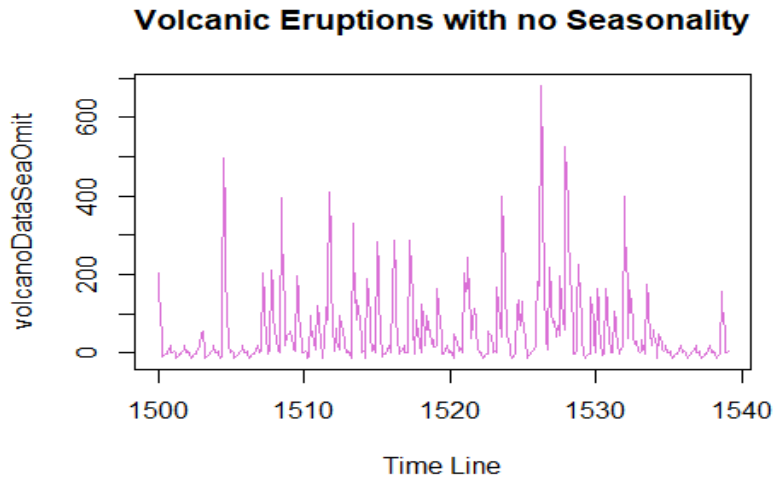
```
##      Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
## 1500 200 150 100  50   0   0   0   0   0   0   0   0
## 1501   0   0   0   0   0   0   0   0   0   0   0   0
## 1502   0   0   0   0   0   0   0   0   0   0   0  50
## 1503  50  50   0   0   0   0   0   0   0   0   0   0
## 1504   0   0   0   0   0 100 500 350 200 100   0   0
## 1505   0   0   0   0   0   0   0   0   0   0   0   0
## 1506   0   0   0   0   0   0   0   0   0   0   0   0
## 1507   0   0 200 150 100  50   0   0   0 200 150 100
## 1508  50  40  30  20  10 400 300 210 110  10  20  50
## 1509  50  50  40  30  20  10 200 150 100  50   0   0
## 1510   0   0   0   0   0 100  75  50  25   0   0 120
## 1511  90  60  30   0  40  30 120  85 150 400 275 175
## 1512  75   0  60  45  30  15 100  75  50  25   0   0
## 1513   0   0   0   0 340 255 170  85 130 100  65  30
## 1514   0   0   0   0 200 150 100  50   0   0   0   0
## 1515 280 210 140  70   0   0   0   0   0   0   0   0
## 1516   0 140 285 205 105  45   0   0   0   0   0   0
## 1517   0   0   0 300 225 150  75   0  80  60  40  20
## 1518   0 120  90  60  30 100  75  50  55  15  15  15
## 1519  15  15 160 130  90  50   0   0   0   0   0   0
## 1520   0   0   0   0  60  45  30  15   0   0   0   0
## 1521 200 150 160 255 150  95  40  80 110  77  45  13
## 1522   0   0   0   0   0   0   0   0  50  37  25  13
## 1523   0   0   0 180 135  90  45 400 300 200 160  45
## 1524  30  15   0   0   0   0   0 120 130  90  50 130
## 1525  90  60  30   0   0   0   0   0   0   0   0  80
## 1526 180 170 170 695 490 375 195  30  15   0 200 150
## 1527 100  70  80  65  50  75  50 200 130  80  40 525
## 1528 450 375 300 225 150  75   0   0   0 100 205 140
## 1529  90  30   0   0   0   0   0   0 140 105  70  35
## 1530   0 160 120  80  40   0   0   0 160 120  80  40
## 1531   0   0   0 120  90  60  30   0   0   0   0 400
## 1532 300 240 170  50 170 125  85  45  20  15  10   5
## 1533   0   0  30  25  15   5 180 135  90  45   0  60
## 1534  45  30  15   0  60  45  30  15   0   0   0   0
## 1535   0   0   0   0   0   0   0   0   0   0   0   0
## 1536   0   0   0   0   0   0   0   0   0   0   0   0
## 1537   0   0   0   0   0   0   0   0   0   0   0   0
## 1538   0   0   0   0   0   0   0 160 120  80  40   0
## 1539   0   0
```

```r
volcanoDataDec <- decompose(tsVolcanoData)
plot(volcanoDataDec,
```

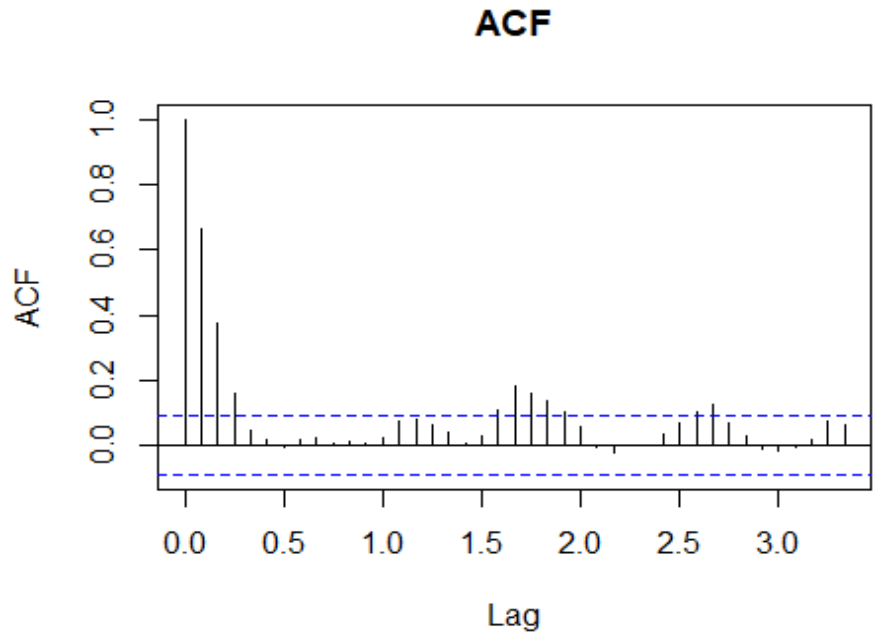
```
     col = "green",
     xlab = "Time Line")
```



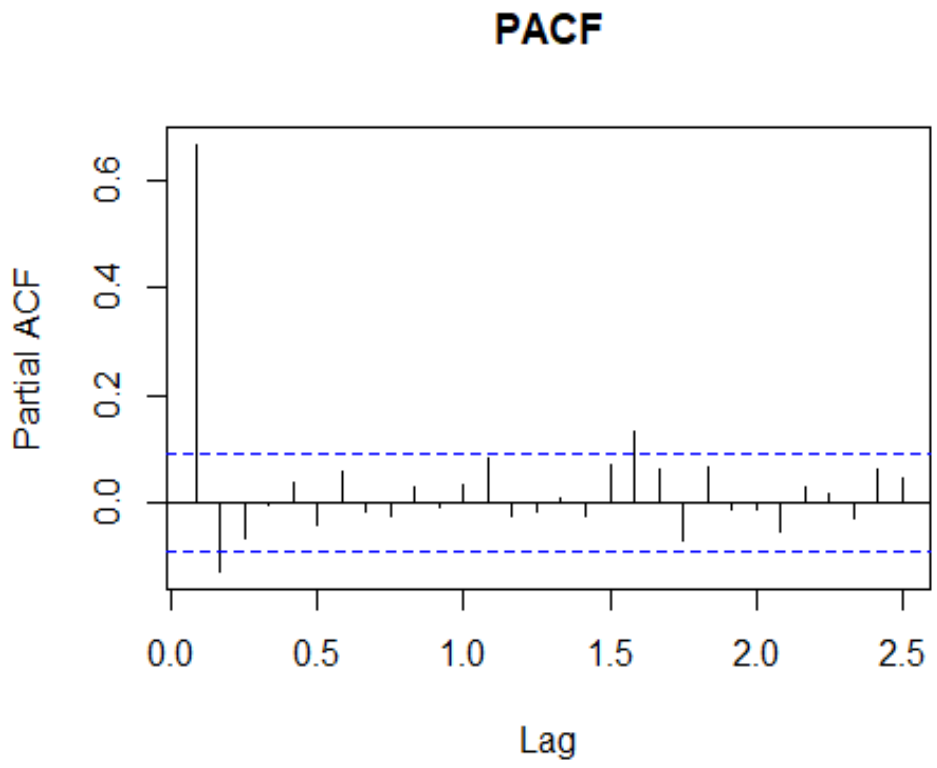

```
volcanoDataSeaOmit <- tsVolcanoData - volcanoDataDec$seasonal
plot(volcanoDataSeaOmit,
     main = "Volcanic Eruptions with no Seasonality",
     xlab = "Time Line",
     col = "orchid")
```




```
acf(tsVolcanoData, lag.max = 40, main = "ACF")
```




```r
pacf(tsVolcanoData, lag.max = 30, main = "PACF")
```




```r
acf(tsVolcanoData, lag.max = 40, plot = FALSE)
```

```
##
## Autocorrelations of series 'tsVolcanoData', by lag
##
## 0.0000 0.0833 0.1667 0.2500 0.3333 0.4167 0.5000 0.5833 0.6667 0.7500 0.83
33
##  1.000  0.666  0.374  0.162  0.046  0.017 -0.007  0.016  0.021  0.006  0.0
10
## 0.9167 1.0000 1.0833 1.1667 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.75
00
##  0.004  0.024  0.075  0.082  0.064  0.039  0.005  0.028  0.108  0.182  0.1
59
## 1.8333 1.9167 2.0000 2.0833 2.1667 2.2500 2.3333 2.4167 2.5000 2.5833 2.66
67
##  0.139  0.100  0.056 -0.005 -0.020  0.001  0.001  0.034  0.067  0.103  0.1
25
## 2.7500 2.8333 2.9167 3.0000 3.0833 3.1667 3.2500 3.3333
##  0.071  0.030 -0.010 -0.016 -0.004  0.017  0.075  0.060
```

```
pacf(tsVolcanoData, lag.max = 30, plot = FALSE)
```

```
##
## Partial autocorrelations of series 'tsVolcanoData', by lag
##
## 0.0833 0.1667 0.2500 0.3333 0.4167 0.5000 0.5833 0.6667 0.7500 0.8333 0.91
67
##  0.666 -0.126 -0.064 -0.005  0.040 -0.039  0.058 -0.016 -0.025  0.028 -0.0
08
## 1.0000 1.0833 1.1667 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.7500 1.83
33
##  0.036  0.082 -0.025 -0.014  0.008 -0.025  0.073  0.131  0.063 -0.069  0.0
68
## 1.9167 2.0000 2.0833 2.1667 2.2500 2.3333 2.4167 2.5000
## -0.009 -0.010 -0.051  0.029  0.018 -0.026  0.062  0.049
```

```
tsVolcanoData1 <- ts(volcanoData, start = c(1500))
tsVolcanoData1
```

```
## Time Series:
## Start = 1500
## End = 1969
## Frequency = 1
##   [1] 200 150 100  50   0   0   0   0   0   0   0   0   0   0   0   0   0
0
##  [19]   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
50
##  [37]  50  50   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
100
##  [55] 500 350 200 100   0   0   0   0   0   0   0   0   0   0   0   0   0
0
##  [73]   0   0   0   0   0   0   0   0   0   0   0   0   0   0 200 150 100
50
```

```
##  [91]   0   0   0 200 150 100  50  40  30  20  10 400 300 210 110  10  20
50
## [109]  50  50  40  30  20  10 200 150 100  50   0   0   0   0   0   0   0
100
## [127]  75  50  25   0   0 120  90  60  30   0  40  30 120  85 150 400 275
175
## [145]  75   0  60  45  30  15 100  75  50  25   0   0   0   0   0   0 340
255
## [163] 170  85 130 100  65  30   0   0   0   0 200 150 100  50   0   0   0
0
## [181] 280 210 140  70   0   0   0   0   0   0   0   0   0 140 285 205 105
45
## [199]   0   0   0   0   0   0   0   0   0 300 225 150  75   0  80  60  40
20
## [217]   0 120  90  60  30 100  75  50  55  15  15  15  15  15 160 130  90
50
## [235]   0   0   0   0   0   0   0   0   0   0  60  45  30  15   0   0   0
0
## [253] 200 150 160 255 150  95  40  80 110  77  45  13   0   0   0   0   0
0
## [271]   0   0  50  37  25  13   0   0   0 180 135  90  45 400 300 200 160
45
## [289]  30  15   0   0   0   0   0 120 130  90  50 130  90  60  30   0   0
0
## [307]   0   0   0   0   0  80 180 170 170 695 490 375 195  30  15   0 200
150
## [325] 100  70  80  65  50  75  50 200 130  80  40 525 450 375 300 225 150
75
## [343]   0   0   0 100 205 140  90  30   0   0   0   0   0   0 140 105  70
35
## [361]   0 160 120  80  40   0   0   0 160 120  80  40   0   0   0 120  90
60
## [379]  30   0   0   0   0 400 300 240 170  50 170 125  85  45  20  15  10
5
## [397]   0   0  30  25  15   5 180 135  90  45   0  60  45  30  15   0  60
45
## [415]  30  15   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
0
## [433]   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
0
## [451]   0   0   0   0   0   0   0   0   0   0   0   0   0 160 120  80  40
0
## [469]   0   0
```

```
volcanoDataARIMA <- auto.arima(tsVolcanoData1)
volcanoDataARIMA
```

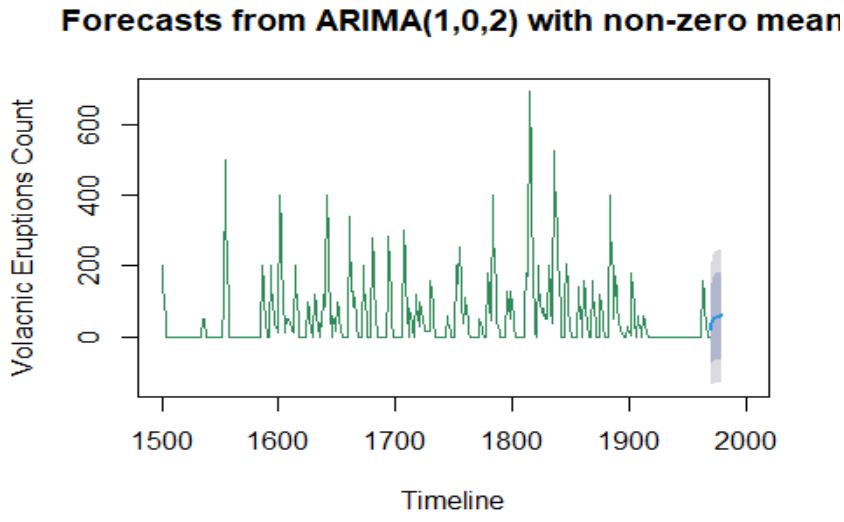
```
## Series: tsVolcanoData1
## ARIMA(1,0,2) with non-zero mean
##
```

```
## Coefficients:
##          ar1     ma1     ma2     mean
##       0.4723  0.2694  0.1279  57.5178
## s.e.  0.0936  0.0969  0.0752   8.4883
##
## sigma^2 estimated as 4897:  log likelihood=-2661.84
## AIC=5333.68   AICc=5333.81   BIC=5354.45
```

```
volcanoDataForecast <- forecast(volcanoDataARIMA)
volcanoDataForecast
```

```
##      Point Forecast     Lo 80    Hi 80     Lo 95    Hi 95
## 1970       22.67720 -67.00065 112.3550 -114.4732 159.8276
## 1971       38.42748 -73.22746 150.0824 -132.3340 209.1890
## 1972       48.50091 -71.10909 168.1109 -134.4268 231.4286
## 1973       53.25886 -68.05471 174.5724 -132.2742 238.7920
## 1974       55.50617 -66.18421 177.1965 -130.6032 241.6155
## 1975       56.56763 -65.20665 178.3419 -129.6701 242.8053
## 1976       57.06898 -64.72400 178.8620 -129.1973 243.3353
## 1977       57.30579 -64.49137 179.1029 -128.9669 243.5785
## 1978       57.41764 -64.38045 179.2157 -128.8565 243.6917
## 1979       57.47046 -64.32783 179.2688 -128.8040 243.7449
```

```
plot(
  volcanoDataForecast,
  xlim = c(1500, 2000),
  col = "seagreen",
  xlab = "Timeline",
  ylab = "Volacnic Eruptions Count"
)
```




```
# Let's check the time series data for Volcano and took frequency as 12 becau
se it has 12 levels for 12 months. To check for seasonality let's use decompo
```

```
se() and eradicate this component from the data and observe the volcanic erup
tions trends

# The plot depicts the total number of volcanic eruptions from 1500 - 1540. A
nd, also let's use acf() and pacf() functions to check correlation. Where acf
() is auto correlation and pacf() is partial correlation. acf() performs auto
-correlation on the time series data with lagged attributes. Where pacf() is
partial auto-correlation function that is used to observe the residuals corre
lation

# Let's create time series with ARIMA function for the volcanoes data set. au
to.arima() function checks the best value of q, p, and automatically. forecas
t() function is used to predict the volcanic eruptions trends. We can see tha
t a prediction at the timeline end.
```