TomatoProject.R

HP

2020-12-19

```
# Read CSV File

my_data <- read.csv("E:/NDSU/NDSU_ Classes/Applied Regression/Project/Final Project/Tomato5.csv"
)

#See the Summary of the data

summary(my_data)
```

```
##      Date           Sales.Per.Day
##  Length:83          Min.   :  20
##  Class :character   1st Qu.: 545
##  Mode  :character   Median :1420
##                     Mean   :1434
##                     3rd Qu.:2075
##                     Max.   :4930
```

```
#Check out the library
library(fpp2)
```

```
## Warning: package 'fpp2' was built under R version 4.0.3
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
## -- Attaching packages ---------------------------------------------- fpp2 2.4 --
```

```
## v ggplot2   3.3.2     v fma       2.4
## v forecast  8.13      v expsmooth 2.3
```

```
## Warning: package 'ggplot2' was built under R version 4.0.3
```

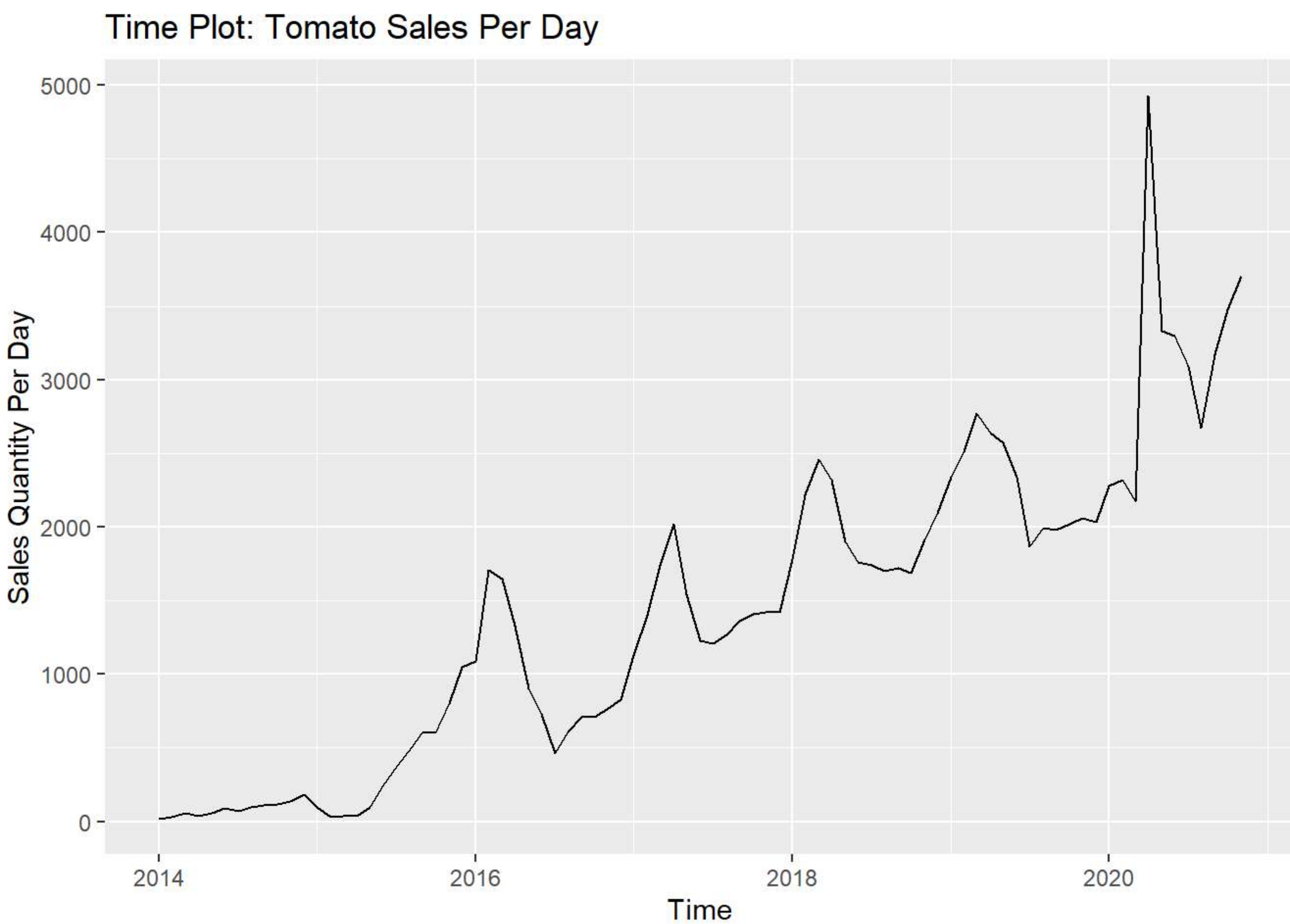
```
## Warning: package 'forecast' was built under R version 4.0.3
```

```
## Warning: package 'fma' was built under R version 4.0.3
```

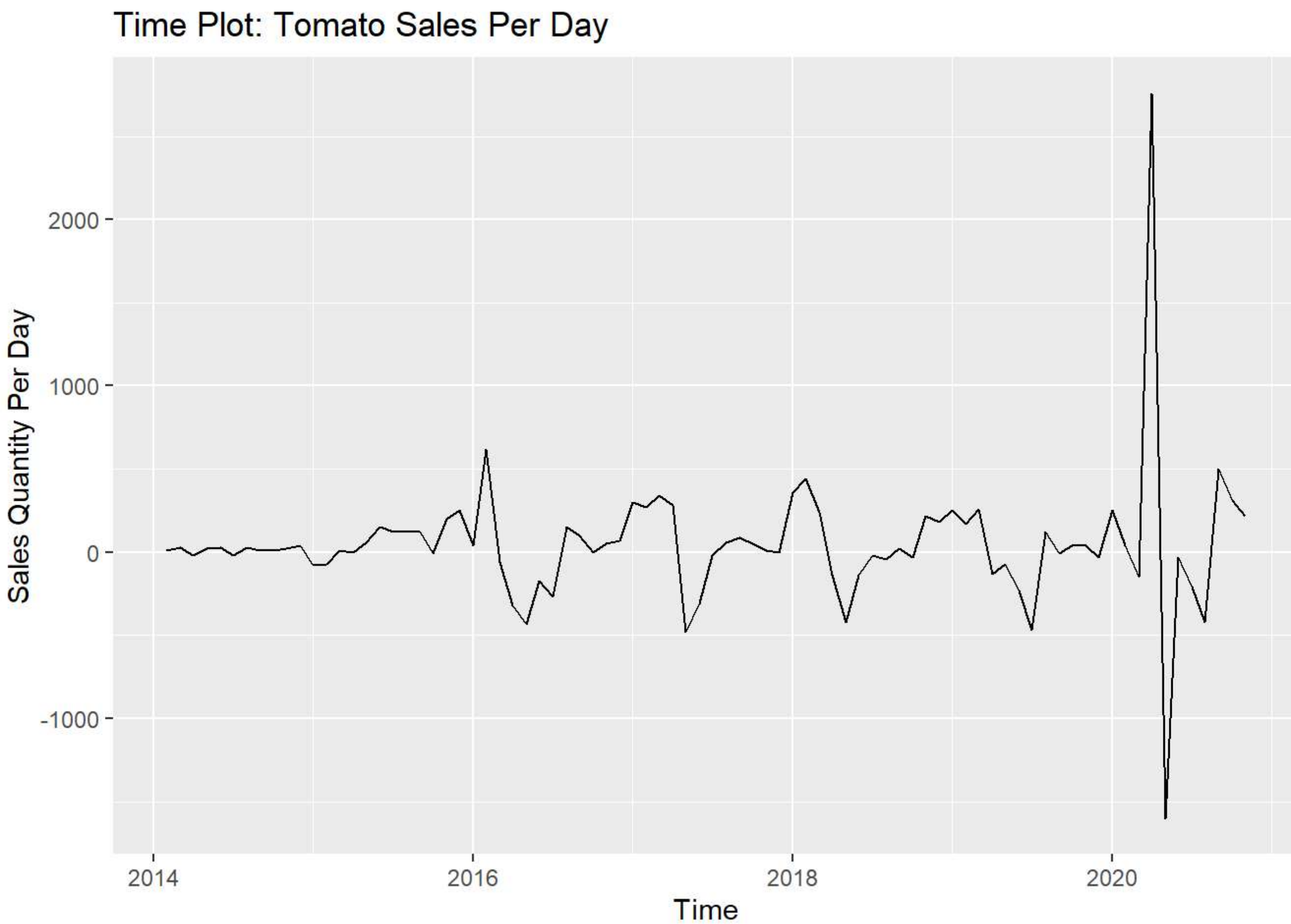
```
## Warning: package 'expsmooth' was built under R version 4.0.3
```

```
##
```

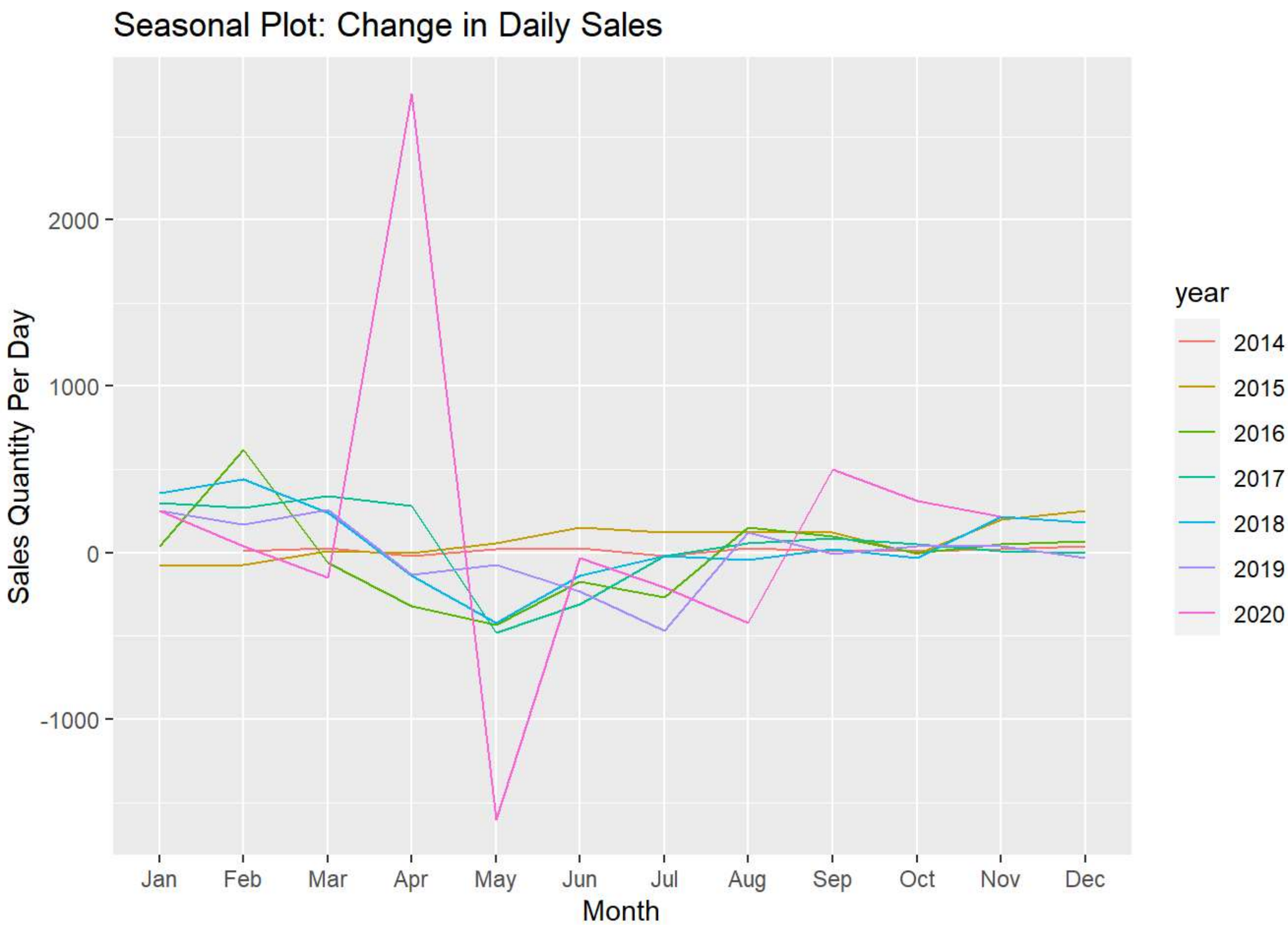
```
#Convert the data frame into time series data

Y<-ts(my_data[,2],start=c(2014,1),frequency = 12)

#Plot the main time series v alues

autoplot(Y)+ggtitle("Time Plot: Tomato Sales Per Day")+
  ylab("Sales Quantity Per Day")
```



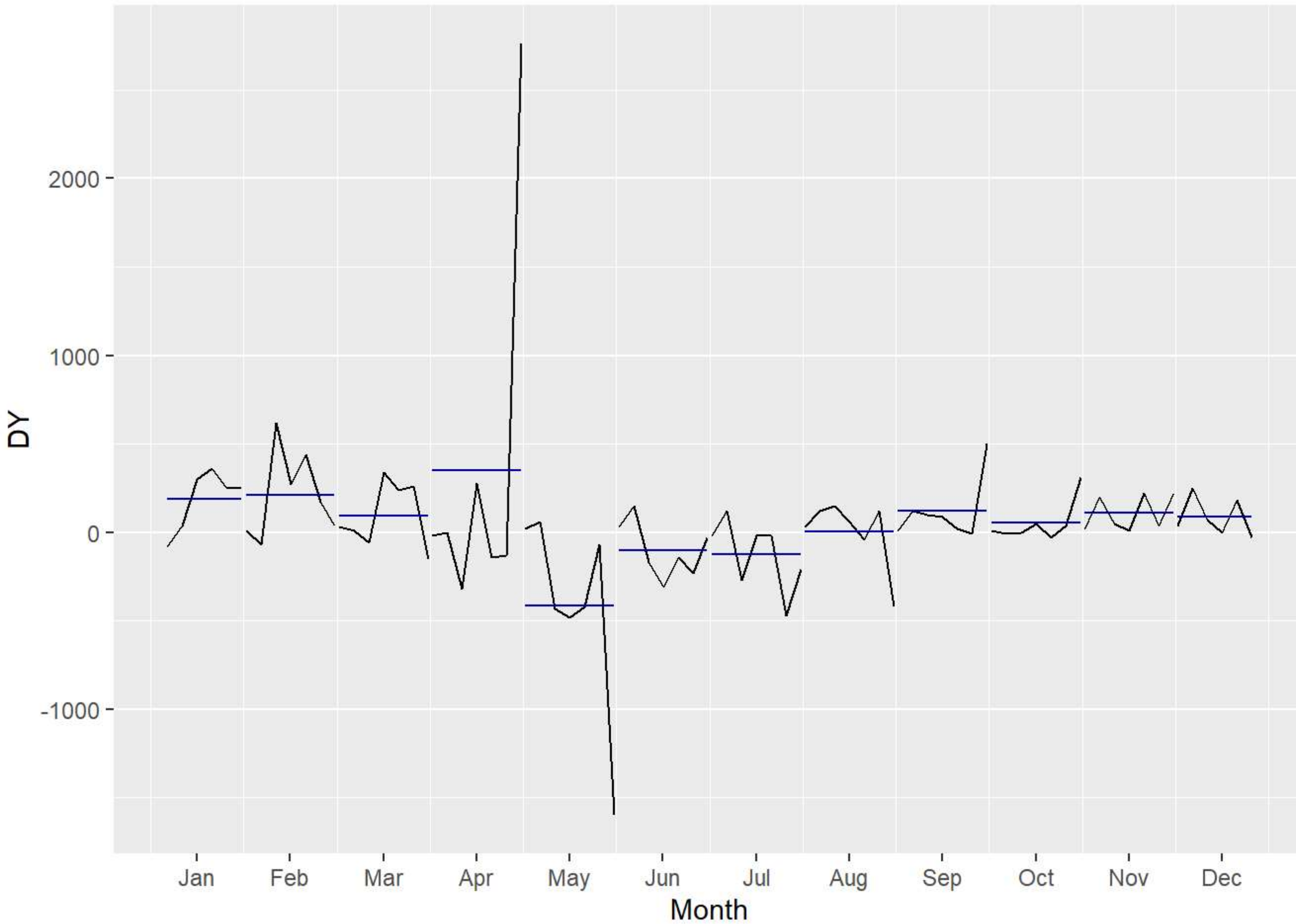

```
#Differencing the Y value

DY<-diff(Y)

#Plot the modified time series values

autoplot(DY)+ggtitle("Time Plot: Tomato Sales Per Day")+
  ylab("Sales Quantity Per Day")
```




```
#Plot a seasonal chart

ggseasonplot(DY)+
  ggtitle("Seasonal Plot: Change in Daily Sales")+
  ylab("Sales Quantity Per Day")
```




```
#Plot a subseries chart

ggsubseriesplot(DY)
```

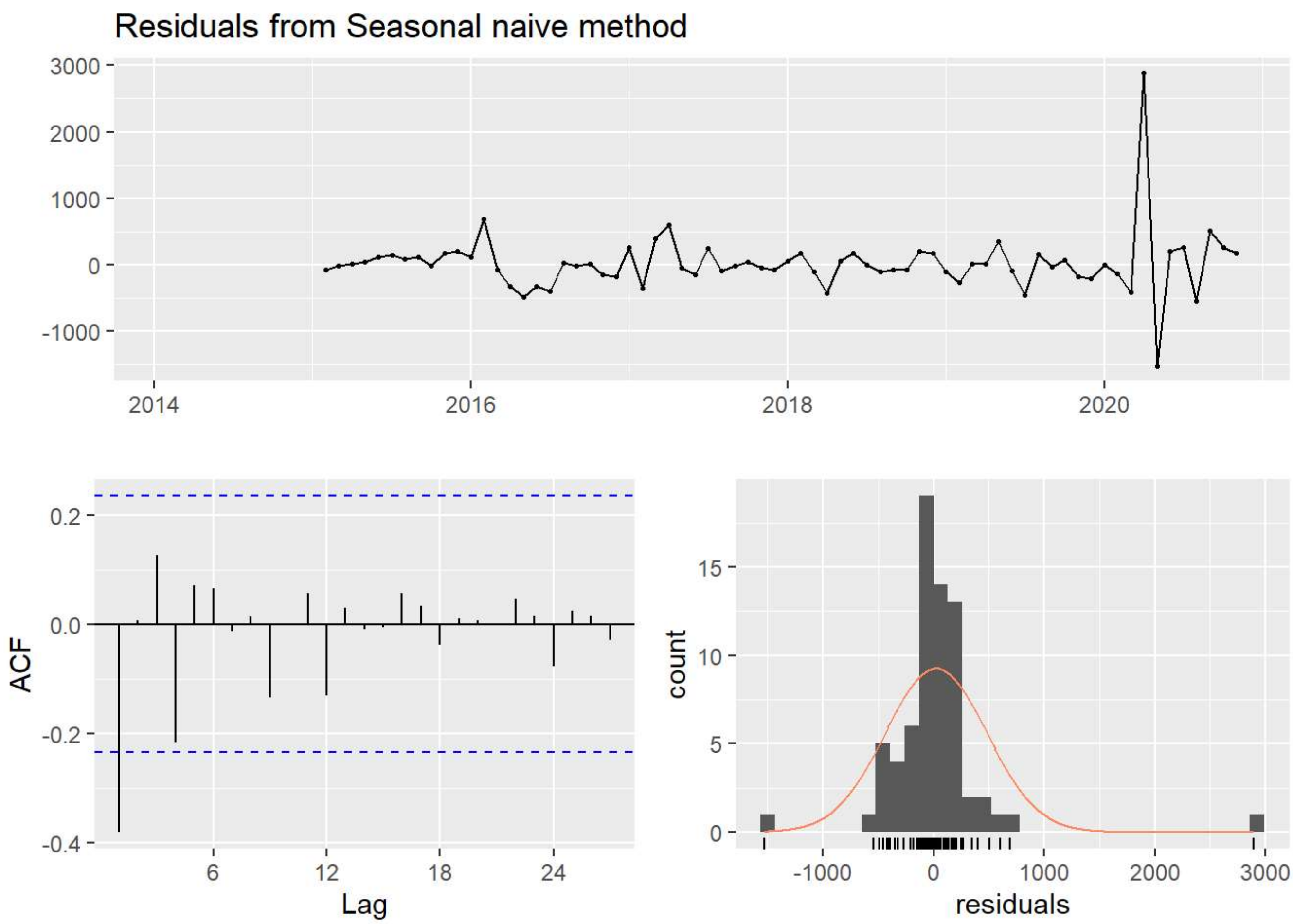



```
#Seasonal Naive Method as our benchmark #Residual sd: 45.699
#y_t=y_{t-s}+e_t

fit<-snaive(DY)
print(summary(fit))
```

```
##
## Forecast method: Seasonal naive method
##
## Model Information:
## Call: snaive(y = DY)
##
## Residual sd: 456.9902
##
## Error measures:
##                    ME     RMSE      MAE MPE MAPE MASE      ACF1
## Training set 22.28571 456.9902 237.4286 NaN  Inf    1 -0.381392
##
## Forecasts:
##          Point Forecast       Lo 80      Hi 80      Lo 95     Hi 95
## Dec 2020            -30  -615.65645   555.6564  -925.6842  865.6842
## Jan 2021            250  -335.65645   835.6564  -645.6842 1145.6842
## Feb 2021             40  -545.65645   625.6564  -855.6842  935.6842
## Mar 2021           -150  -735.65645   435.6564 -1045.6842  745.6842
## Apr 2021           2760  2174.34355  3345.6564  1864.3158 3655.6842
## May 2021          -1600 -2185.65645 -1014.3436 -2495.6842 -704.3158
## Jun 2021            -30  -615.65645   555.6564  -925.6842  865.6842
## Jul 2021           -210  -795.65645   375.6564 -1105.6842  685.6842
## Aug 2021           -420 -1005.65645   165.6564 -1315.6842  475.6842
## Sep 2021            500   -85.65645  1085.6564  -395.6842 1395.6842
## Oct 2021            310  -275.65645   895.6564  -585.6842 1205.6842
## Nov 2021            220  -365.65645   805.6564  -675.6842 1115.6842
## Dec 2021            -30  -858.24329   798.2433 -1296.6888 1236.6888
## Jan 2022            250  -578.24329  1078.2433 -1016.6888 1516.6888
## Feb 2022             40  -788.24329   868.2433 -1226.6888 1306.6888
## Mar 2022           -150  -978.24329   678.2433 -1416.6888 1116.6888
## Apr 2022           2760  1931.75671  3588.2433  1493.3112 4026.6888
## May 2022          -1600 -2428.24329  -771.7567 -2866.6888 -333.3112
## Jun 2022            -30  -858.24329   798.2433 -1296.6888 1236.6888
## Jul 2022           -210 -1038.24329   618.2433 -1476.6888 1056.6888
## Aug 2022           -420 -1248.24329   408.2433 -1686.6888  846.6888
## Sep 2022            500  -328.24329  1328.2433  -766.6888 1766.6888
## Oct 2022            310  -518.24329  1138.2433  -956.6888 1576.6888
## Nov 2022            220  -608.24329  1048.2433 -1046.6888 1486.6888
##          Point Forecast       Lo 80      Hi 80      Lo 95     Hi 95
## Dec 2020            -30  -615.65645   555.6564  -925.6842  865.6842
## Jan 2021            250  -335.65645   835.6564  -645.6842 1145.6842
## Feb 2021             40  -545.65645   625.6564  -855.6842  935.6842
## Mar 2021           -150  -735.65645   435.6564 -1045.6842  745.6842
## Apr 2021           2760  2174.34355  3345.6564  1864.3158 3655.6842
## May 2021          -1600 -2185.65645 -1014.3436 -2495.6842 -704.3158
## Jun 2021            -30  -615.65645   555.6564  -925.6842  865.6842
## Jul 2021           -210  -795.65645   375.6564 -1105.6842  685.6842
## Aug 2021           -420 -1005.65645   165.6564 -1315.6842  475.6842
## Sep 2021            500   -85.65645  1085.6564  -395.6842 1395.6842
## Oct 2021            310  -275.65645   895.6564  -585.6842 1205.6842
## Nov 2021            220  -365.65645   805.6564  -675.6842 1115.6842
## Dec 2021            -30  -858.24329   798.2433 -1296.6888 1236.6888
## Jan 2022            250  -578.24329  1078.2433 -1016.6888 1516.6888
```

```
## Feb 2022           40  -788.24329   868.2433 -1226.6888 1306.6888
## Mar 2022         -150  -978.24329   678.2433 -1416.6888 1116.6888
## Apr 2022         2760  1931.75671  3588.2433  1493.3112 4026.6888
## May 2022        -1600 -2428.24329  -771.7567 -2866.6888 -333.3112
## Jun 2022          -30  -858.24329   798.2433 -1296.6888 1236.6888
## Jul 2022         -210 -1038.24329   618.2433 -1476.6888 1056.6888
## Aug 2022         -420 -1248.24329   408.2433 -1686.6888  846.6888
## Sep 2022          500  -328.24329  1328.2433  -766.6888 1766.6888
## Oct 2022          310  -518.24329  1138.2433  -956.6888 1576.6888
## Nov 2022          220  -608.24329  1048.2433 -1046.6888 1486.6888
```

```
checkresiduals(fit)
```




```
##
##  Ljung-Box test
##
## data:  Residuals from Seasonal naive method
## Q* = 19.838, df = 16, p-value = 0.2276
##
## Model df: 0.   Total lags used: 16
```

```
#Fit on ARIMA Model

fit_arima<-auto.arima(Y,d=1,D=1,stepwise = FALSE,approximation = FALSE,trace=TRUE)
```

```
##
##  ARIMA(0,1,0)(0,1,0)[12]                    : 1058.163
##  ARIMA(0,1,0)(0,1,1)[12]                    : 1055.437
##  ARIMA(0,1,0)(0,1,2)[12]                    : 1057.277
##  ARIMA(0,1,0)(1,1,0)[12]                    : 1056.817
##  ARIMA(0,1,0)(1,1,1)[12]                    : 1057.51
##  ARIMA(0,1,0)(1,1,2)[12]                    : 1059.262
##  ARIMA(0,1,0)(2,1,0)[12]                    : 1055.746
##  ARIMA(0,1,0)(2,1,1)[12]                    : Inf
##  ARIMA(0,1,0)(2,1,2)[12]                    : Inf
##  ARIMA(0,1,1)(0,1,0)[12]                    : 1048.205
##  ARIMA(0,1,1)(0,1,1)[12]                    : 1045.49
##  ARIMA(0,1,1)(0,1,2)[12]                    : 1047.594
##  ARIMA(0,1,1)(1,1,0)[12]                    : 1046.676
##  ARIMA(0,1,1)(1,1,1)[12]                    : 1047.695
##  ARIMA(0,1,1)(1,1,2)[12]                    : Inf
##  ARIMA(0,1,1)(2,1,0)[12]                    : 1045.821
##  ARIMA(0,1,1)(2,1,1)[12]                    : 1046.245
##  ARIMA(0,1,1)(2,1,2)[12]                    : 1048.633
##  ARIMA(0,1,2)(0,1,0)[12]                    : 1050.324
##  ARIMA(0,1,2)(0,1,1)[12]                    : 1047.704
##  ARIMA(0,1,2)(0,1,2)[12]                    : 1049.823
##  ARIMA(0,1,2)(1,1,0)[12]                    : 1048.902
##  ARIMA(0,1,2)(1,1,1)[12]                    : 1049.962
##  ARIMA(0,1,2)(1,1,2)[12]                    : 1052.05
##  ARIMA(0,1,2)(2,1,0)[12]                    : 1048.09
##  ARIMA(0,1,2)(2,1,1)[12]                    : 1048.635
##  ARIMA(0,1,3)(0,1,0)[12]                    : 1052.554
##  ARIMA(0,1,3)(0,1,1)[12]                    : 1049.701
##  ARIMA(0,1,3)(0,1,2)[12]                    : 1051.709
##  ARIMA(0,1,3)(1,1,0)[12]                    : 1051.01
##  ARIMA(0,1,3)(1,1,1)[12]                    : 1051.98
##  ARIMA(0,1,3)(2,1,0)[12]                    : 1049.677
##  ARIMA(0,1,4)(0,1,0)[12]                    : Inf
##  ARIMA(0,1,4)(0,1,1)[12]                    : Inf
##  ARIMA(0,1,4)(1,1,0)[12]                    : Inf
##  ARIMA(0,1,5)(0,1,0)[12]                    : Inf
##  ARIMA(1,1,0)(0,1,0)[12]                    : 1049.598
##  ARIMA(1,1,0)(0,1,1)[12]                    : 1047.438
##  ARIMA(1,1,0)(0,1,2)[12]                    : 1049.634
##  ARIMA(1,1,0)(1,1,0)[12]                    : 1048.681
##  ARIMA(1,1,0)(1,1,1)[12]                    : 1049.675
##  ARIMA(1,1,0)(1,1,2)[12]                    : Inf
##  ARIMA(1,1,0)(2,1,0)[12]                    : 1047.582
##  ARIMA(1,1,0)(2,1,1)[12]                    : 1047.805
##  ARIMA(1,1,0)(2,1,2)[12]                    : 1050.195
##  ARIMA(1,1,1)(0,1,0)[12]                    : 1050.324
##  ARIMA(1,1,1)(0,1,1)[12]                    : 1047.682
##  ARIMA(1,1,1)(0,1,2)[12]                    : Inf
##  ARIMA(1,1,1)(1,1,0)[12]                    : 1048.892
##  ARIMA(1,1,1)(1,1,1)[12]                    : Inf
##  ARIMA(1,1,1)(1,1,2)[12]                    : Inf
##  ARIMA(1,1,1)(2,1,0)[12]                    : Inf
```

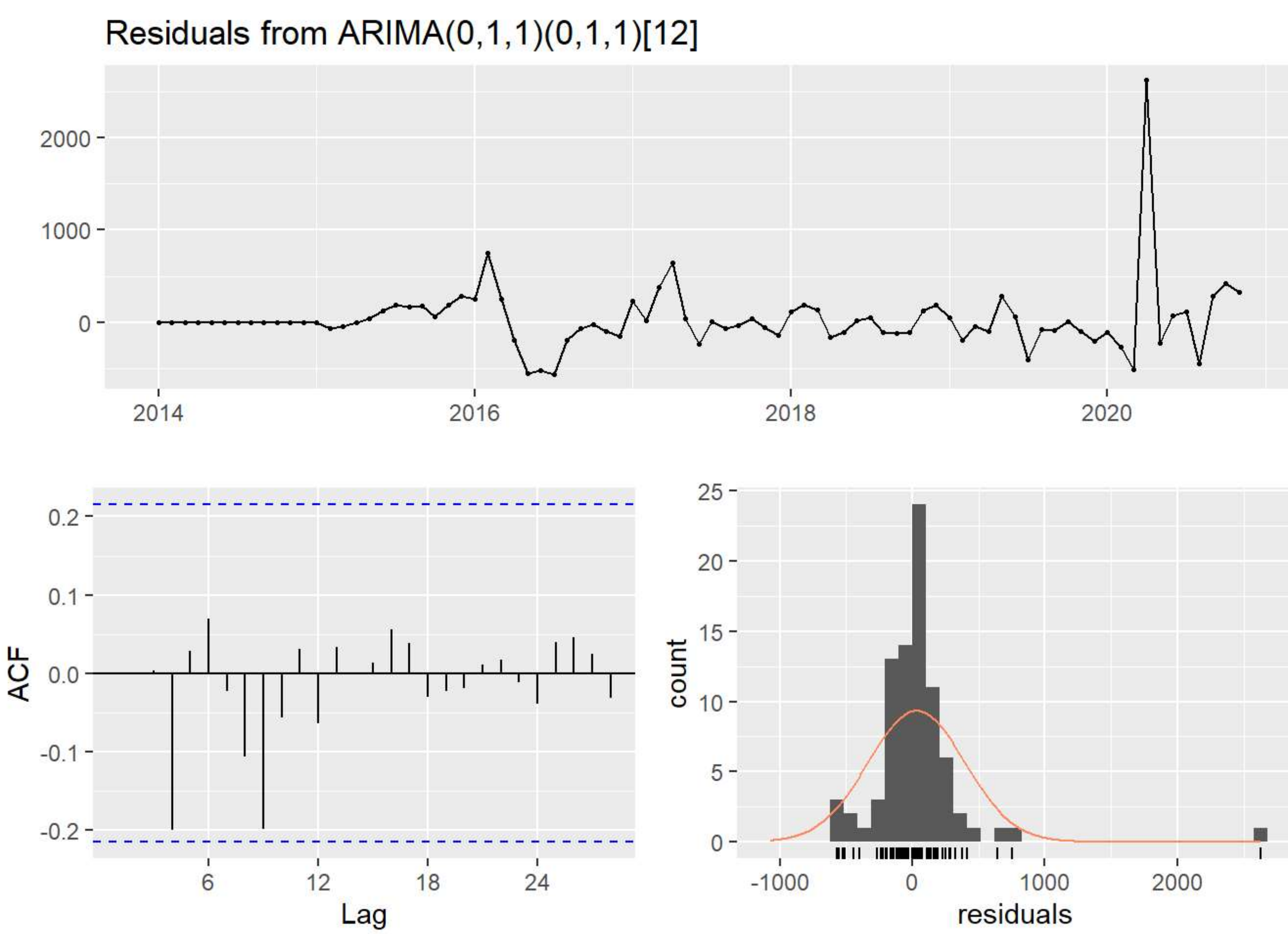
```
##  ARIMA(1,1,1)(2,1,1)[12]                    : 1048.343
##  ARIMA(1,1,2)(0,1,0)[12]                    : 1052.574
##  ARIMA(1,1,2)(0,1,1)[12]                    : 1049.636
##  ARIMA(1,1,2)(0,1,2)[12]                    : Inf
##  ARIMA(1,1,2)(1,1,0)[12]                    : 1050.751
##  ARIMA(1,1,2)(1,1,1)[12]                    : Inf
##  ARIMA(1,1,2)(2,1,0)[12]                    : Inf
##  ARIMA(1,1,3)(0,1,0)[12]                    : 1053.972
##  ARIMA(1,1,3)(0,1,1)[12]                    : Inf
##  ARIMA(1,1,3)(1,1,0)[12]                    : 1053.14
##  ARIMA(1,1,4)(0,1,0)[12]                    : Inf
##  ARIMA(2,1,0)(0,1,0)[12]                    : 1049.993
##  ARIMA(2,1,0)(0,1,1)[12]                    : 1048
##  ARIMA(2,1,0)(0,1,2)[12]                    : 1050.295
##  ARIMA(2,1,0)(1,1,0)[12]                    : 1049.123
##  ARIMA(2,1,0)(1,1,1)[12]                    : 1050.314
##  ARIMA(2,1,0)(1,1,2)[12]                    : Inf
##  ARIMA(2,1,0)(2,1,0)[12]                    : 1048.55
##  ARIMA(2,1,0)(2,1,1)[12]                    : 1049.092
##  ARIMA(2,1,1)(0,1,0)[12]                    : 1051.34
##  ARIMA(2,1,1)(0,1,1)[12]                    : Inf
##  ARIMA(2,1,1)(0,1,2)[12]                    : Inf
##  ARIMA(2,1,1)(1,1,0)[12]                    : Inf
##  ARIMA(2,1,1)(1,1,1)[12]                    : Inf
##  ARIMA(2,1,1)(2,1,0)[12]                    : Inf
##  ARIMA(2,1,2)(0,1,0)[12]                    : 1053.558
##  ARIMA(2,1,2)(0,1,1)[12]                    : Inf
##  ARIMA(2,1,2)(1,1,0)[12]                    : Inf
##  ARIMA(2,1,3)(0,1,0)[12]                    : 1055.236
##  ARIMA(3,1,0)(0,1,0)[12]                    : 1051.835
##  ARIMA(3,1,0)(0,1,1)[12]                    : 1050.262
##  ARIMA(3,1,0)(0,1,2)[12]                    : 1052.65
##  ARIMA(3,1,0)(1,1,0)[12]                    : 1051.371
##  ARIMA(3,1,0)(1,1,1)[12]                    : 1052.656
##  ARIMA(3,1,0)(2,1,0)[12]                    : 1050.918
##  ARIMA(3,1,1)(0,1,0)[12]                    : 1053.633
##  ARIMA(3,1,1)(0,1,1)[12]                    : Inf
##  ARIMA(3,1,1)(1,1,0)[12]                    : Inf
##  ARIMA(3,1,2)(0,1,0)[12]                    : Inf
##  ARIMA(4,1,0)(0,1,0)[12]                    : 1052.497
##  ARIMA(4,1,0)(0,1,1)[12]                    : 1050
##  ARIMA(4,1,0)(1,1,0)[12]                    : 1051.35
##  ARIMA(4,1,1)(0,1,0)[12]                    : 1054.7
##  ARIMA(5,1,0)(0,1,0)[12]                    : 1054.525
##
##
##
##  Best model: ARIMA(0,1,1)(0,1,1)[12]
```

```
print(summary(fit_arima))
```

```
## Series: Y
## ARIMA(0,1,1)(0,1,1)[12]
##
## Coefficients:
##           ma1     sma1
##       -0.4452  -0.4181
## s.e.   0.1164   0.1709
##
## sigma^2 estimated as 162703:  log likelihood=-519.56
## AIC=1045.13   AICc=1045.49   BIC=1051.87
##
## Training set error measures:
##                    ME     RMSE     MAE       MPE     MAPE      MASE
## Training set 30.57467 365.1016 183.916 -3.745538 17.46485 0.3396107
##                      ACF1
## Training set -0.001002148
```


```
##                    ME     RMSE     MAE       MPE     MAPE      MASE
## Training set 30.57467 365.1016 183.916 -3.745538 17.46485 0.3396107
##                      ACF1
## Training set -0.001002148
```


```
checkresiduals(fit_arima)
```

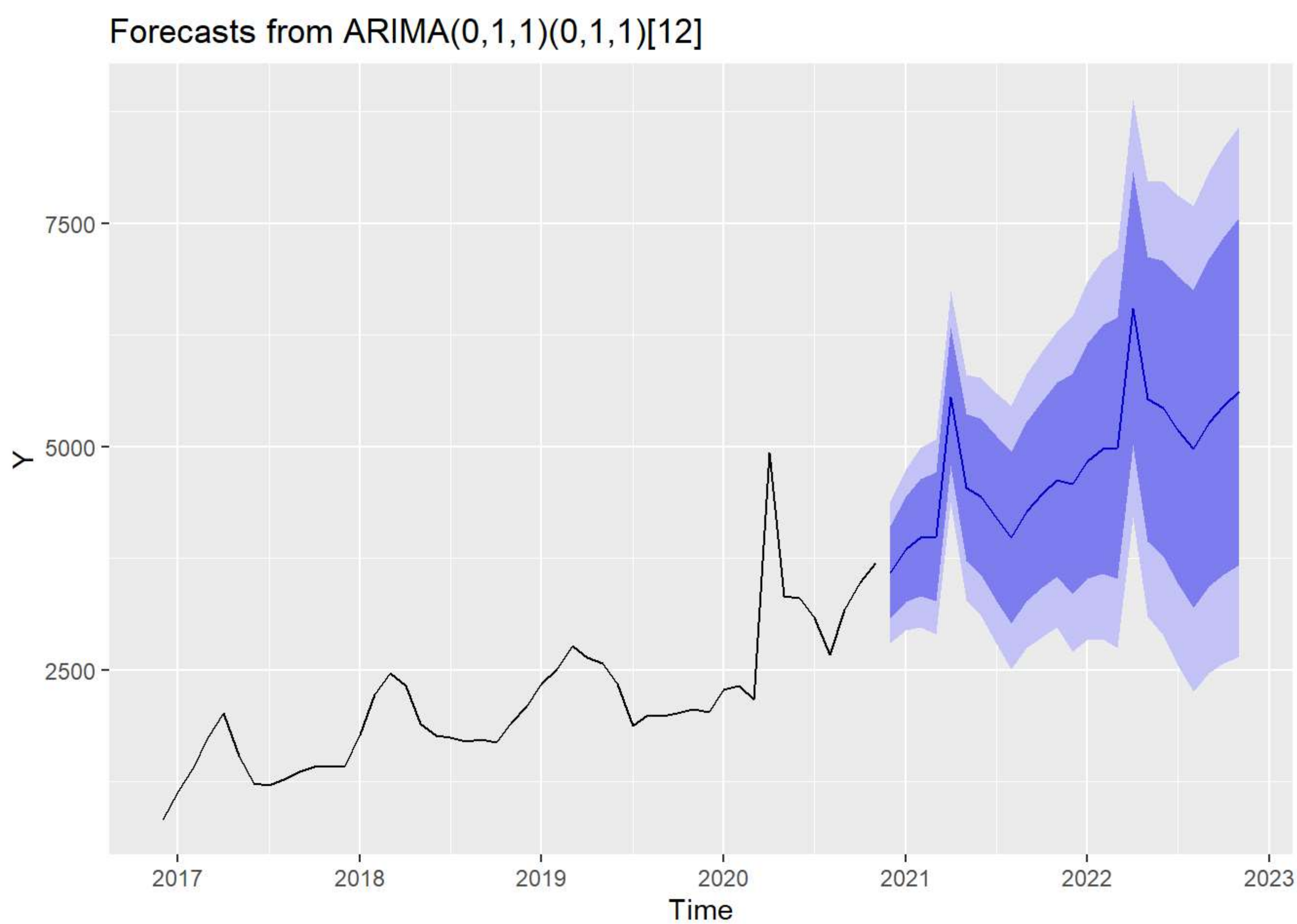


```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,1)(0,1,1)[12]
## Q* = 10.395, df = 15, p-value = 0.7942
##
## Model df: 2.   Total lags used: 17
```

```
sqrt(162703)
```

```
## [1] 403.3646
```

```
#Forecasting on ARIMA Model

fcst<-forecast(fit_arima,h=24)
autoplot(fcst,include=48)
```




```
print(summary(fcst))
```

```
##
## Forecast method: ARIMA(0,1,1)(0,1,1)[12]
##
## Model Information:
## Series: Y
## ARIMA(0,1,1)(0,1,1)[12]
##
## Coefficients:
##           ma1     sma1
##       -0.4452  -0.4181
## s.e.   0.1164   0.1709
##
## sigma^2 estimated as 162703:  log likelihood=-519.56
## AIC=1045.13   AICc=1045.49   BIC=1051.87
##
## Error measures:
##                    ME     RMSE     MAE       MPE     MAPE      MASE
## Training set 30.57467 365.1016 183.916 -3.745538 17.46485 0.3396107
##                      ACF1
## Training set -0.001002148
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## Dec 2020       3591.388 3074.449 4108.328 2800.798 4381.979
## Jan 2021       3847.541 3256.381 4438.701 2943.440 4751.643
## Feb 2021       3979.102 3322.053 4636.151 2974.232 4983.972
## Mar 2021       3993.106 3276.198 4710.015 2896.690 5089.523
## Apr 2021       5559.518 4787.377 6331.658 4378.631 6740.404
## May 2021       4540.993 3717.316 5364.670 3281.287 5800.699
## Jun 2021       4438.388 3566.214 5310.562 3104.513 5772.263
## Jul 2021       4194.946 3276.833 5113.059 2790.813 5599.078
## Aug 2021       3981.996 3020.136 4943.856 2510.958 5453.034
## Sep 2021       4279.213 3275.511 5282.915 2744.183 5814.243
## Oct 2021       4468.395 3424.526 5512.263 2871.935 6064.854
## Nov 2021       4631.550 3549.005 5714.096 2975.940 6287.161
## Dec 2021       4582.788 3351.041 5814.536 2698.993 6466.583
## Jan 2022       4838.941 3526.300 6151.582 2831.430 6846.453
## Feb 2022       4970.502 3581.673 6359.331 2846.471 7094.533
## Mar 2022       4984.506 3523.457 6445.556 2750.024 7218.989
## Apr 2022       6550.917 5021.053 8080.782 4211.192 8890.643
## May 2022       5532.393 3936.678 7128.107 3091.958 7972.827
## Jun 2022       5429.788 3770.835 7088.740 2892.639 7966.937
## Jul 2022       5186.346 3466.478 6906.213 2556.036 7816.655
## Aug 2022       4973.396 3194.699 6752.093 2253.114 7693.678
## Sep 2022       5270.613 3434.971 7106.255 2463.241 8077.985
## Oct 2022       5459.794 3568.921 7350.667 2567.954 8351.635
## Nov 2022       5622.950 3678.414 7567.486 2649.039 8596.861
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## Dec 2020       3591.388 3074.449 4108.328 2800.798 4381.979
## Jan 2021       3847.541 3256.381 4438.701 2943.440 4751.643
## Feb 2021       3979.102 3322.053 4636.151 2974.232 4983.972
## Mar 2021       3993.106 3276.198 4710.015 2896.690 5089.523
## Apr 2021       5559.518 4787.377 6331.658 4378.631 6740.404
```

```
## May 2021       4540.993 3717.316 5364.670 3281.287 5800.699
## Jun 2021       4438.388 3566.214 5310.562 3104.513 5772.263
## Jul 2021       4194.946 3276.833 5113.059 2790.813 5599.078
## Aug 2021       3981.996 3020.136 4943.856 2510.958 5453.034
## Sep 2021       4279.213 3275.511 5282.915 2744.183 5814.243
## Oct 2021       4468.395 3424.526 5512.263 2871.935 6064.854
## Nov 2021       4631.550 3549.005 5714.096 2975.940 6287.161
## Dec 2021       4582.788 3351.041 5814.536 2698.993 6466.583
## Jan 2022       4838.941 3526.300 6151.582 2831.430 6846.453
## Feb 2022       4970.502 3581.673 6359.331 2846.471 7094.533
## Mar 2022       4984.506 3523.457 6445.556 2750.024 7218.989
## Apr 2022       6550.917 5021.053 8080.782 4211.192 8890.643
## May 2022       5532.393 3936.678 7128.107 3091.958 7972.827
## Jun 2022       5429.788 3770.835 7088.740 2892.639 7966.937
## Jul 2022       5186.346 3466.478 6906.213 2556.036 7816.655
## Aug 2022       4973.396 3194.699 6752.093 2253.114 7693.678
## Sep 2022       5270.613 3434.971 7106.255 2463.241 8077.985
## Oct 2022       5459.794 3568.921 7350.667 2567.954 8351.635
## Nov 2022       5622.950 3678.414 7567.486 2649.039 8596.861
```

```
#Check with Original vs Predicted Value

YTest<-ts(my_data[,2],frequency=12,start=c(2014,1),end=c(2019,12))
fitTest<-auto.arima(YTest,d=1,D=1,stepwise=FALSE,approximation = FALSE,trace=TRUE)
```

```
##
##  ARIMA(0,1,0)(0,1,0)[12]                    : 808.3935
##  ARIMA(0,1,0)(0,1,1)[12]                    : 795.9805
##  ARIMA(0,1,0)(0,1,2)[12]                    : Inf
##  ARIMA(0,1,0)(1,1,0)[12]                    : 799.3952
##  ARIMA(0,1,0)(1,1,1)[12]                    : Inf
##  ARIMA(0,1,0)(1,1,2)[12]                    : Inf
##  ARIMA(0,1,0)(2,1,0)[12]                    : 799.3141
##  ARIMA(0,1,0)(2,1,1)[12]                    : Inf
##  ARIMA(0,1,0)(2,1,2)[12]                    : Inf
##  ARIMA(0,1,1)(0,1,0)[12]                    : 808.2001
##  ARIMA(0,1,1)(0,1,1)[12]                    : 794.7672
##  ARIMA(0,1,1)(0,1,2)[12]                    : Inf
##  ARIMA(0,1,1)(1,1,0)[12]                    : 799.4682
##  ARIMA(0,1,1)(1,1,1)[12]                    : Inf
##  ARIMA(0,1,1)(1,1,2)[12]                    : Inf
##  ARIMA(0,1,1)(2,1,0)[12]                    : 798.6091
##  ARIMA(0,1,1)(2,1,1)[12]                    : Inf
##  ARIMA(0,1,1)(2,1,2)[12]                    : Inf
##  ARIMA(0,1,2)(0,1,0)[12]                    : 809.5609
##  ARIMA(0,1,2)(0,1,1)[12]                    : 797.0715
##  ARIMA(0,1,2)(0,1,2)[12]                    : Inf
##  ARIMA(0,1,2)(1,1,0)[12]                    : 801.3493
##  ARIMA(0,1,2)(1,1,1)[12]                    : Inf
##  ARIMA(0,1,2)(1,1,2)[12]                    : Inf
##  ARIMA(0,1,2)(2,1,0)[12]                    : 800.9482
##  ARIMA(0,1,2)(2,1,1)[12]                    : Inf
##  ARIMA(0,1,3)(0,1,0)[12]                    : 811.8644
##  ARIMA(0,1,3)(0,1,1)[12]                    : 799.4181
##  ARIMA(0,1,3)(0,1,2)[12]                    : Inf
##  ARIMA(0,1,3)(1,1,0)[12]                    : 803.7328
##  ARIMA(0,1,3)(1,1,1)[12]                    : Inf
##  ARIMA(0,1,3)(2,1,0)[12]                    : 803.2117
##  ARIMA(0,1,4)(0,1,0)[12]                    : 813.9531
##  ARIMA(0,1,4)(0,1,1)[12]                    : Inf
##  ARIMA(0,1,4)(1,1,0)[12]                    : Inf
##  ARIMA(0,1,5)(0,1,0)[12]                    : Inf
##  ARIMA(1,1,0)(0,1,0)[12]                    : 808.7955
##  ARIMA(1,1,0)(0,1,1)[12]                    : 795.0395
##  ARIMA(1,1,0)(0,1,2)[12]                    : Inf
##  ARIMA(1,1,0)(1,1,0)[12]                    : 799.8518
##  ARIMA(1,1,0)(1,1,1)[12]                    : Inf
##  ARIMA(1,1,0)(1,1,2)[12]                    : Inf
##  ARIMA(1,1,0)(2,1,0)[12]                    : 798.9885
##  ARIMA(1,1,0)(2,1,1)[12]                    : Inf
##  ARIMA(1,1,0)(2,1,2)[12]                    : Inf
##  ARIMA(1,1,1)(0,1,0)[12]                    : 809.6018
##  ARIMA(1,1,1)(0,1,1)[12]                    : 797.0715
##  ARIMA(1,1,1)(0,1,2)[12]                    : Inf
##  ARIMA(1,1,1)(1,1,0)[12]                    : 801.3309
##  ARIMA(1,1,1)(1,1,1)[12]                    : Inf
##  ARIMA(1,1,1)(1,1,2)[12]                    : Inf
##  ARIMA(1,1,1)(2,1,0)[12]                    : 800.9665
```

```
##  ARIMA(1,1,1)(2,1,1)[12]                    : Inf
##  ARIMA(1,1,2)(0,1,0)[12]                    : 811.8635
##  ARIMA(1,1,2)(0,1,1)[12]                    : Inf
##  ARIMA(1,1,2)(0,1,2)[12]                    : Inf
##  ARIMA(1,1,2)(1,1,0)[12]                    : 803.7221
##  ARIMA(1,1,2)(1,1,1)[12]                    : Inf
##  ARIMA(1,1,2)(2,1,0)[12]                    : Inf
##  ARIMA(1,1,3)(0,1,0)[12]                    : Inf
##  ARIMA(1,1,3)(0,1,1)[12]                    : Inf
##  ARIMA(1,1,3)(1,1,0)[12]                    : Inf
##  ARIMA(1,1,4)(0,1,0)[12]                    : Inf
##  ARIMA(2,1,0)(0,1,0)[12]                    : 809.8791
##  ARIMA(2,1,0)(0,1,1)[12]                    : 796.9422
##  ARIMA(2,1,0)(0,1,2)[12]                    : Inf
##  ARIMA(2,1,0)(1,1,0)[12]                    : 801.4879
##  ARIMA(2,1,0)(1,1,1)[12]                    : Inf
##  ARIMA(2,1,0)(1,1,2)[12]                    : Inf
##  ARIMA(2,1,0)(2,1,0)[12]                    : 800.7361
##  ARIMA(2,1,0)(2,1,1)[12]                    : Inf
##  ARIMA(2,1,1)(0,1,0)[12]                    : 811.8761
##  ARIMA(2,1,1)(0,1,1)[12]                    : Inf
##  ARIMA(2,1,1)(0,1,2)[12]                    : Inf
##  ARIMA(2,1,1)(1,1,0)[12]                    : Inf
##  ARIMA(2,1,1)(1,1,1)[12]                    : Inf
##  ARIMA(2,1,1)(2,1,0)[12]                    : Inf
##  ARIMA(2,1,2)(0,1,0)[12]                    : Inf
##  ARIMA(2,1,2)(0,1,1)[12]                    : Inf
##  ARIMA(2,1,2)(1,1,0)[12]                    : Inf
##  ARIMA(2,1,3)(0,1,0)[12]                    : Inf
##  ARIMA(3,1,0)(0,1,0)[12]                    : 812.1188
##  ARIMA(3,1,0)(0,1,1)[12]                    : 798.8604
##  ARIMA(3,1,0)(0,1,2)[12]                    : Inf
##  ARIMA(3,1,0)(1,1,0)[12]                    : 803.8553
##  ARIMA(3,1,0)(1,1,1)[12]                    : Inf
##  ARIMA(3,1,0)(2,1,0)[12]                    : 802.6333
##  ARIMA(3,1,1)(0,1,0)[12]                    : Inf
##  ARIMA(3,1,1)(0,1,1)[12]                    : Inf
##  ARIMA(3,1,1)(1,1,0)[12]                    : Inf
##  ARIMA(3,1,2)(0,1,0)[12]                    : Inf
##  ARIMA(4,1,0)(0,1,0)[12]                    : 813.9395
##  ARIMA(4,1,0)(0,1,1)[12]                    : 799.9092
##  ARIMA(4,1,0)(1,1,0)[12]                    : 804.6628
##  ARIMA(4,1,1)(0,1,0)[12]                    : 816.3976
##  ARIMA(5,1,0)(0,1,0)[12]                    : 816.3737
##
##
##
##  Best model: ARIMA(0,1,1)(0,1,1)[12]
```

```
ftest<-forecast(fitTest,h=11)
print(summary(ftest))
```

```
##
## Forecast method: ARIMA(0,1,1)(0,1,1)[12]
##
## Model Information:
## Series: YTest
## ARIMA(0,1,1)(0,1,1)[12]
##
## Coefficients:
##          ma1     sma1
##       0.2540  -0.7301
## s.e.  0.1294   0.2615
##
## sigma^2 estimated as 33097:  log likelihood=-394.17
## AIC=794.33   AICc=794.77   BIC=800.56
##
## Error measures:
##                    ME     RMSE      MAE       MPE     MAPE      MASE       ACF1
## Training set 0.783362 161.8688 110.6011 -1.825139 12.66811 0.2421922 0.01522368
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80     Lo 95    Hi 95
## Jan 2020       2200.752 1965.244 2436.259 1840.5741 2560.929
## Feb 2020       2461.146 2084.469 2837.823 1885.0689 3037.224
## Mar 2020       2638.349 2160.534 3116.164 1907.5945 3369.104
## Apr 2020       2573.680 2012.673 3134.687 1715.6940 3431.666
## May 2020       2338.253 1704.888 2971.617 1369.6057 3306.900
## Jun 2020       2189.398 1491.134 2887.661 1121.4958 3257.299
## Jul 2020       2024.009 1266.386 2781.633  865.3241 3182.695
## Aug 2020       2094.998 1282.339 2907.657  852.1429 3337.853
## Sep 2020       2138.197 1273.999 3002.394  816.5211 3459.872
## Oct 2020       2151.263 1238.433 3064.093  755.2101 3547.315
## Nov 2020       2241.560 1282.560 3200.559  774.8969 3708.223
##          Point Forecast    Lo 80    Hi 80     Lo 95    Hi 95
## Jan 2020       2200.752 1965.244 2436.259 1840.5741 2560.929
## Feb 2020       2461.146 2084.469 2837.823 1885.0689 3037.224
## Mar 2020       2638.349 2160.534 3116.164 1907.5945 3369.104
## Apr 2020       2573.680 2012.673 3134.687 1715.6940 3431.666
## May 2020       2338.253 1704.888 2971.617 1369.6057 3306.900
## Jun 2020       2189.398 1491.134 2887.661 1121.4958 3257.299
## Jul 2020       2024.009 1266.386 2781.633  865.3241 3182.695
## Aug 2020       2094.998 1282.339 2907.657  852.1429 3337.853
## Sep 2020       2138.197 1273.999 3002.394  816.5211 3459.872
## Oct 2020       2151.263 1238.433 3064.093  755.2101 3547.315
## Nov 2020       2241.560 1282.560 3200.559  774.8969 3708.223
```

```
#Testing With Original Data

original_2020<-tail(Y,11)
print(original_2020)
```

```
##       Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov
## 2020 2280 2320 2170 4930 3330 3300 3090 2670 3170 3480 3700
```