MA653-Computational Financial Modelling

Assignment_1

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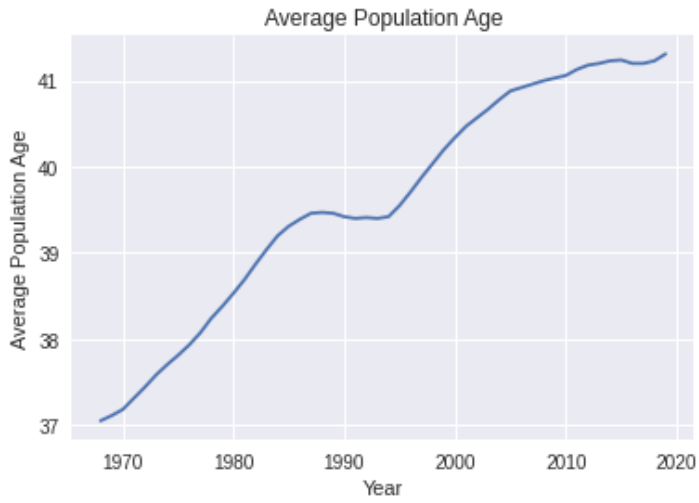
Question No_3:-

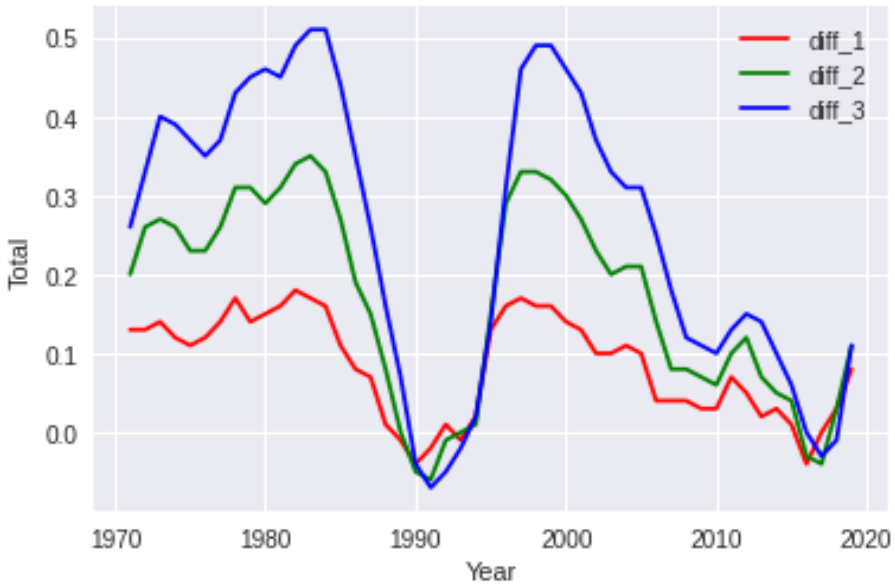
1.Time Series Plot of Original Data:-



Conclusion:-

From the above Original Time Series Graph, we can conclude that the graph has trending nature so this time series graph can be Non-Stationary in nature, so we have found the First Difference, 2nd Difference, and 3rd difference from the above dataset. And check the stationarity of the given time series data. Also, ACF and PACF are used to determine the stationarity of the diff and original data.

2. Time Series plot of the Difference Data:-



From the above graph, we can observe that the Upward trend in the original dataset is removed. And this time-series graph becomes more time stationary.

3.Check for Stationarity:-

```
Augmneted Dickey_fuller Statistic: -1.500795
p-value: 0.533118
critical values at different levels:
        1%: -3.581
        5%: -2.927
        10%: -2.602
```

Fig. AdFuller stat for Original Data

```
Augmneted Dickey_fuller Statistic: -2.839892
p-value: 0.052798
critical values at different levels:
        1%: -3.585
        5%: -2.928
        10%: -2.602
```

Fig. AdFuller stat for Diff-1 Data

```
Augmneted Dickey_fuller Statistic: -3.092805
p-value: 0.027090
critical values at different levels:
        1%: -3.601
        5%: -2.935
        10%: -2.606
```

Fig. AdFuller stat for Diff-2 Data

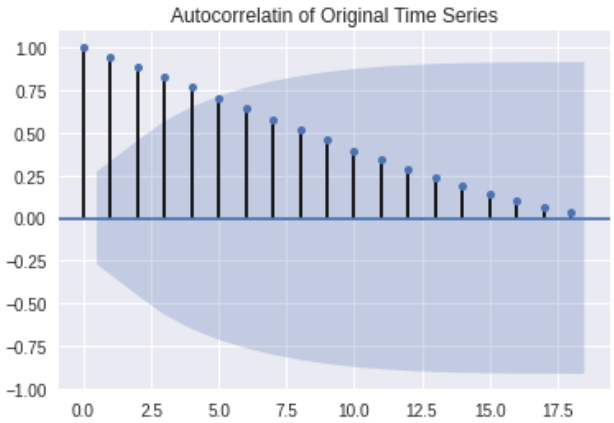
```
Augmneted Dickey_fuller Statistic: -2.534642
p-value: 0.107271
critical values at different levels:
        1%: -3.601
        5%: -2.935
        10%: -2.606
```

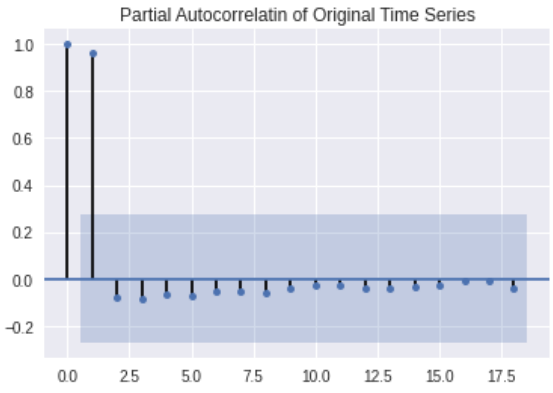
Fig. AdFuller stat for Diff-3 Data

From the above ADfuller Sats we can conclude that the values pf p-value is less than for Diff-2 and Diff-3. This mean Diff-2 and Diff-3 are more stationary than Diff-1 and original time Series data is not Stationary.

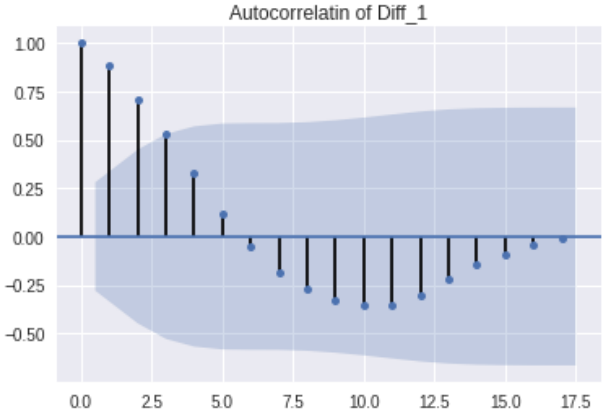
4. ACF and PACF Graphs:-

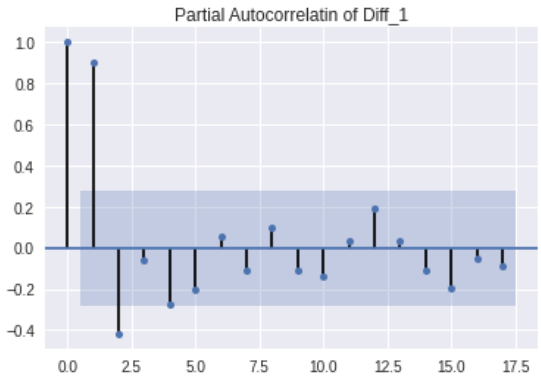
4.1 Original Data



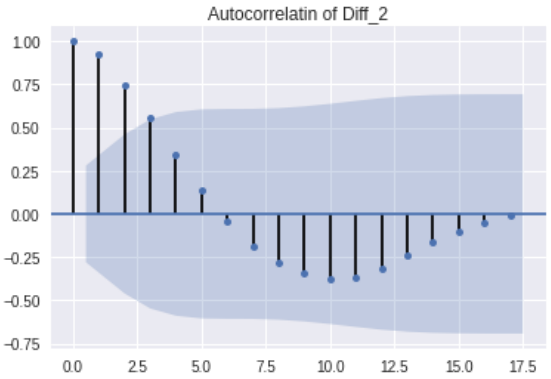


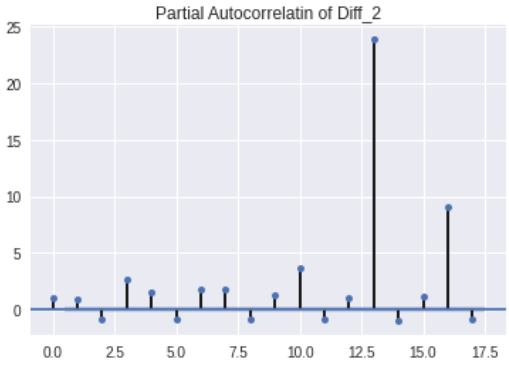
4.2 Diff-1 Data:-



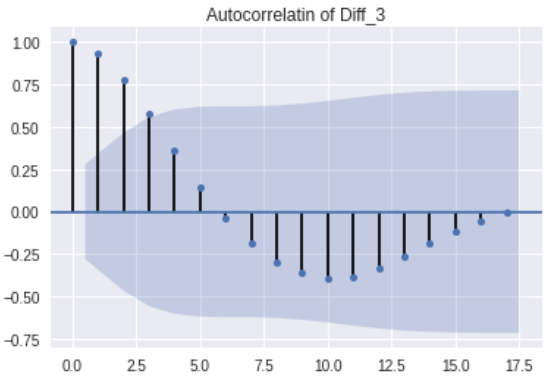


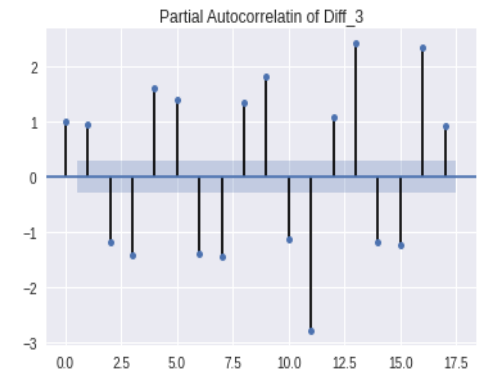
4.3 Diff-2 Data:-





4.3 Diff-3 Data:-

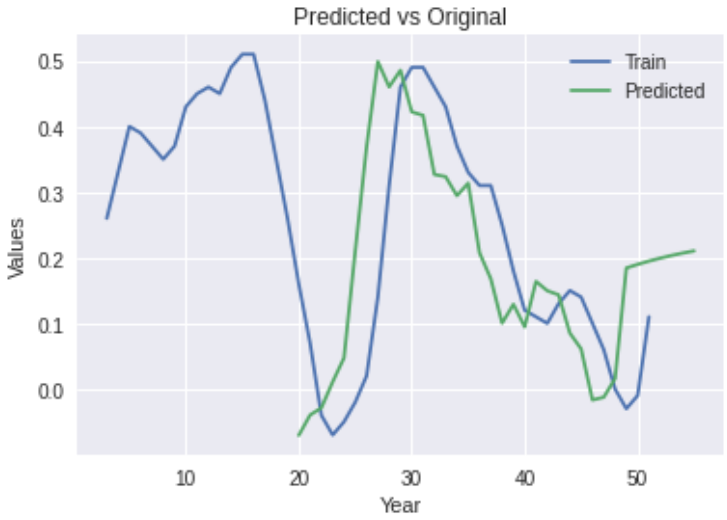




From the graphs of the autocorrelation and partial autocorrelation, we can conclude that the original data plot has a slow decrement for ACF values and the decrement in the Diff-2 and Diff-3 is more, this indicates that Diff-2 and Diff-3 are more stationary than Diff-1 and Original data.

Conclusion:- From the above graphs and figures we can conclude that Diff-2 and Diff-3 are Stationary and we don't need to calculate further differences to bring stationarity. So Below are fitting the ARMA model on Diff-2 data.

5. ARMA Model Result:-



Here I have trained the ARMA model on the Diff-2 Data and Predicted some values for future years also and the Result shows that the predicted values are following the original Training Data values.

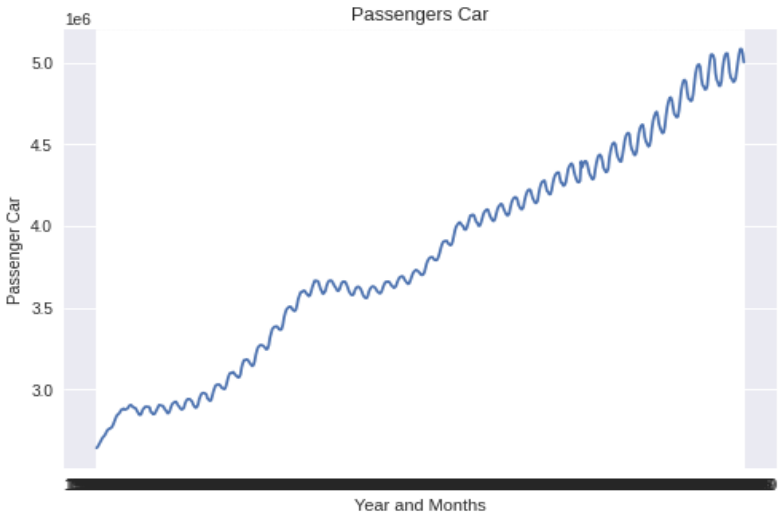
Predicted Values for the Next 11 Years:-

	0
45	0.061021
46	-0.016651
47	-0.012514
48	0.015948
49	0.184336
50	0.189860
51	0.194851
52	0.199359
53	0.203432
54	0.207111
55	0.210435

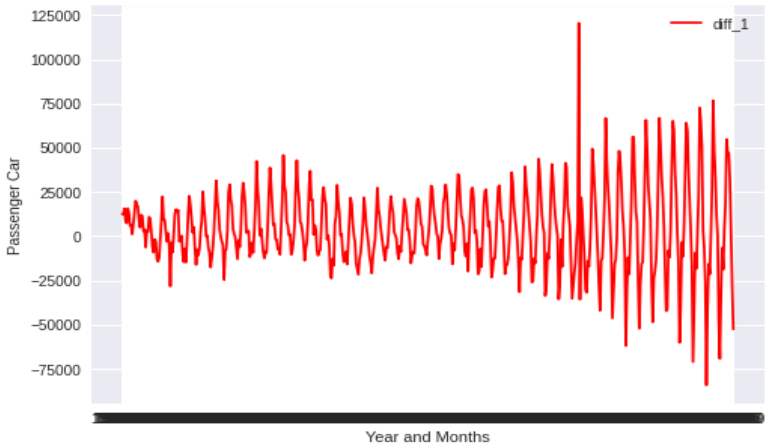
Question_4:-

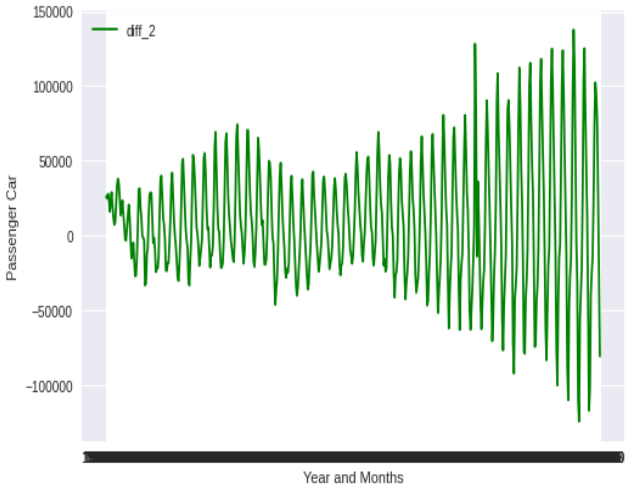
1.Time Series Plot of Original Data:-

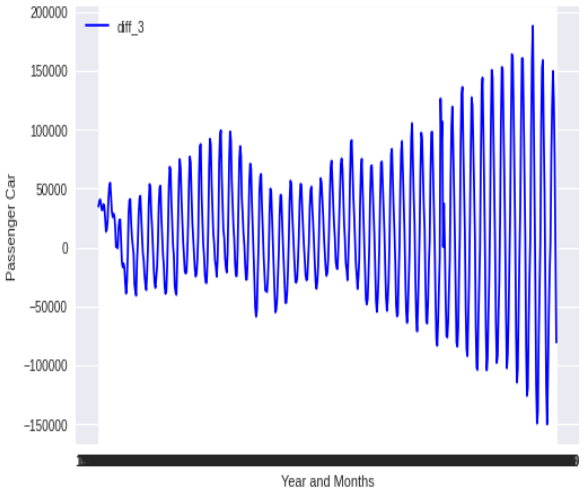
This Time Series data plot shows the Upward increasing trend, By observing we can conclude that this time series data is not stationary, So we have to apply Differencing methos to bring it to stationarity.



2. Time Series plot of the Difference Data:-







All 3 Difference models shows show stationarity in the mean. These graphs don't have any upward or downwards trends.

3. Check for Stationarity:-

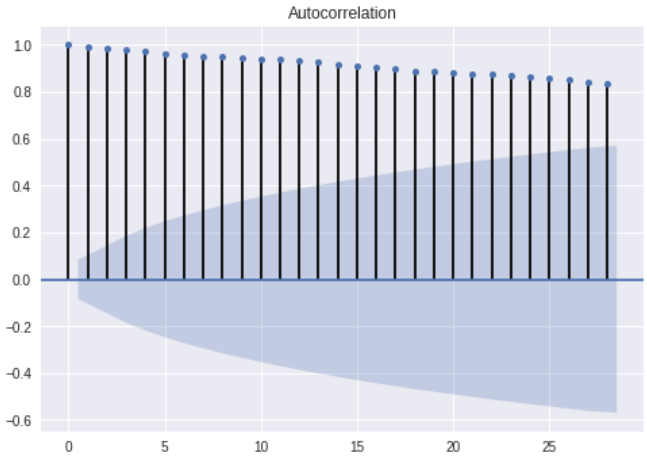
```
Augmneted Dickey_fuller Statistic: 0.756482
p-value: 0.990900
critical values at different levels:
        1%: -3.443
        5%: -2.867
        10%: -2.570
```

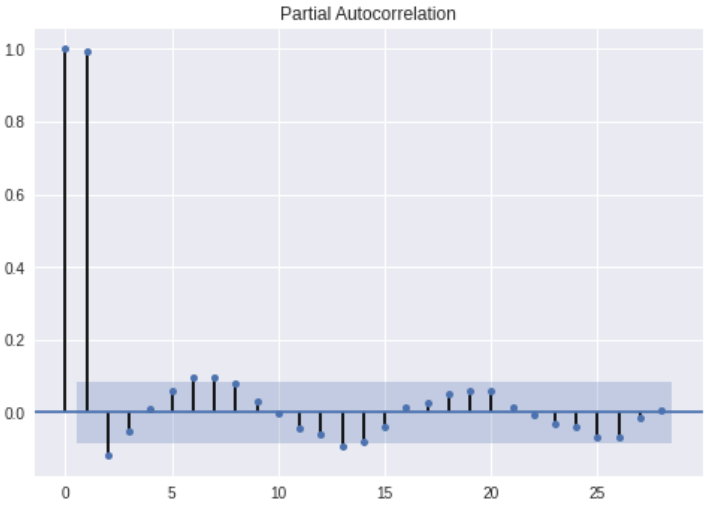
```
Augmneted Dickey_fuller Statistic: -4.282420
p-value: 0.000476
critical values at different levels:
        1%: -3.443
        5%: -2.867
        10%: -2.570
```

From the above ADFuller stats, we can conclude that the p-value for the Original value is 0.99 and the p-value for the 2nd difference is 0.00047, from these values we can conclude that the Original time series model data is not stationary but the 2nd difference time series data is stationary. And we are going to consider this 2nd difference data for ARMA model fitting and training.

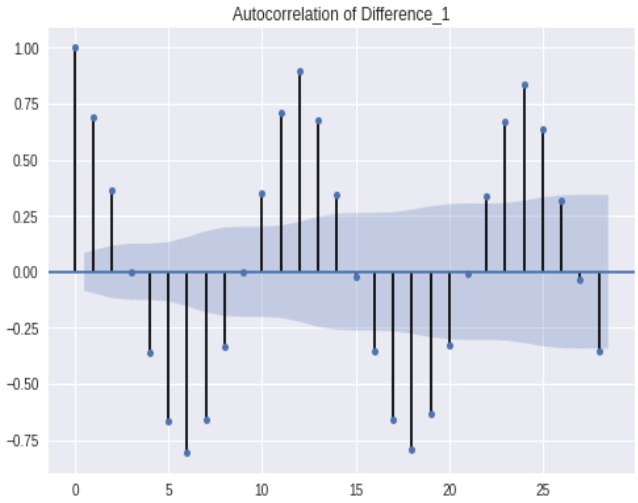
4. ACF and PACF Graphs:-

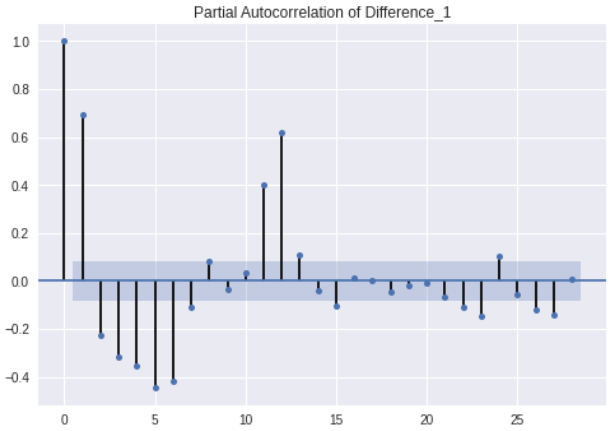
4.1 Original Time Series data.



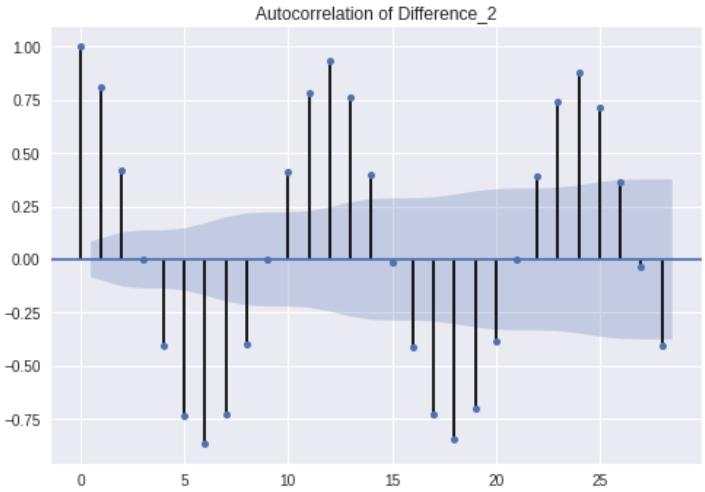


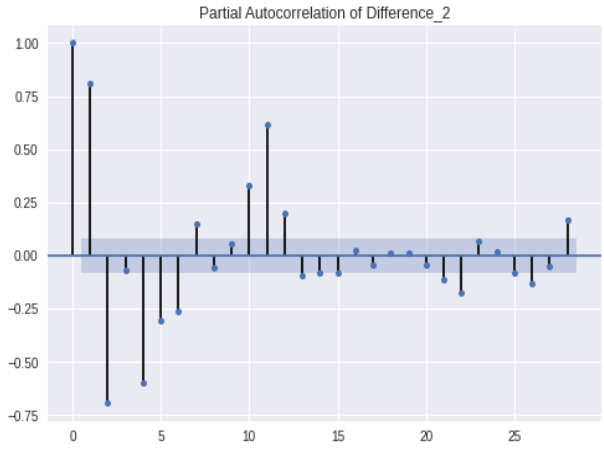
4.2 1st Differerence Time Series data.



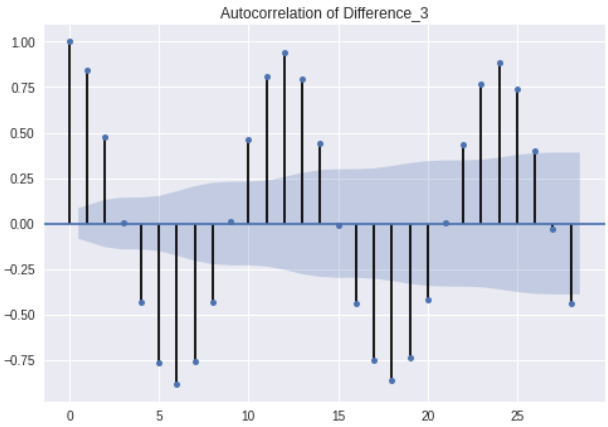


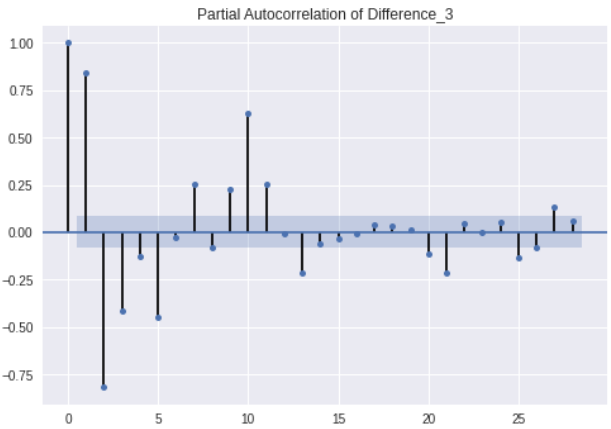
4.3 2nd Difference Time Series data.





4.4 3rd Differerence Time Series data.



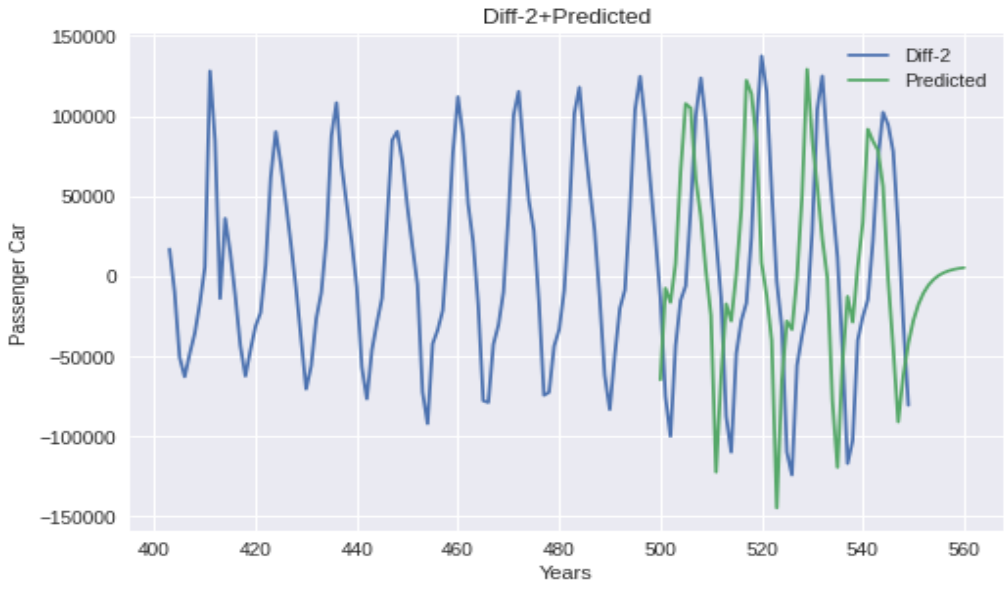


ACF plot of the original plot decreases slowly and have a strong correlation between adjacent data samples. Whereas in diff model don't have high correlation between adjacent data points.

5. Next 12 Month Predicted Values:-

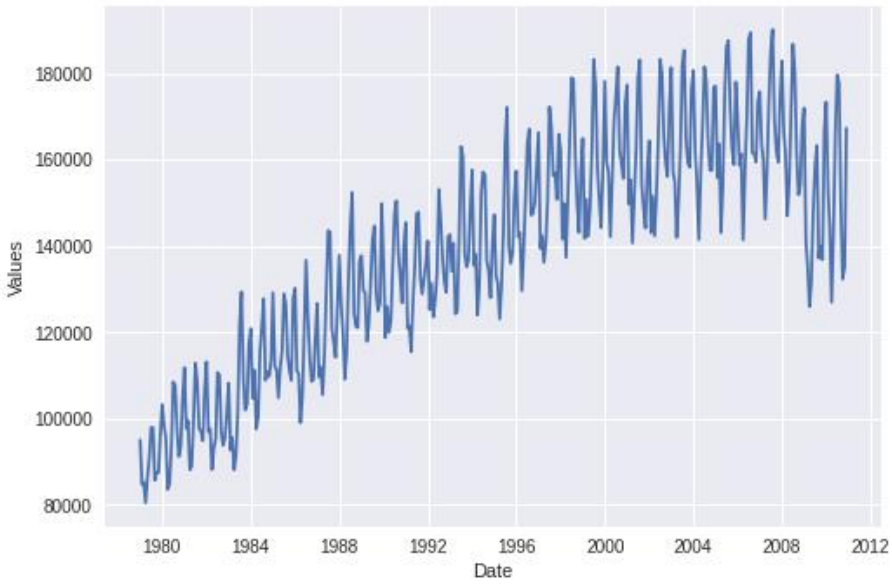
0
-41751.568633
-27476.748144
-17434.292773
-10369.341592
-5399.089463
-1902.475602
557.421437
2287.979537
3505.441606
4361.936335
4964.487525
5388.387318

6.Predicted vs Diff-2 Graph.

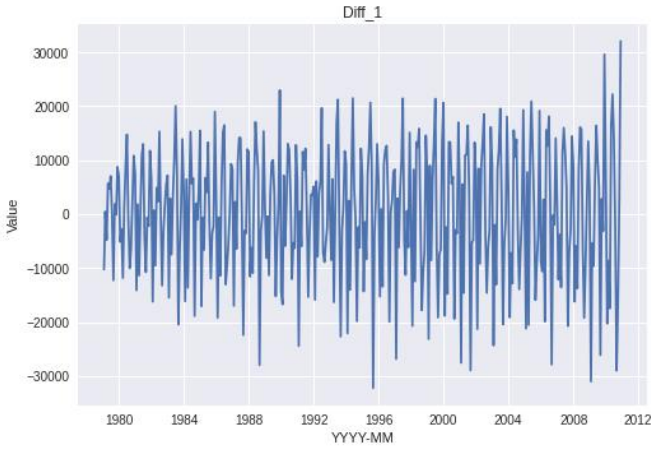


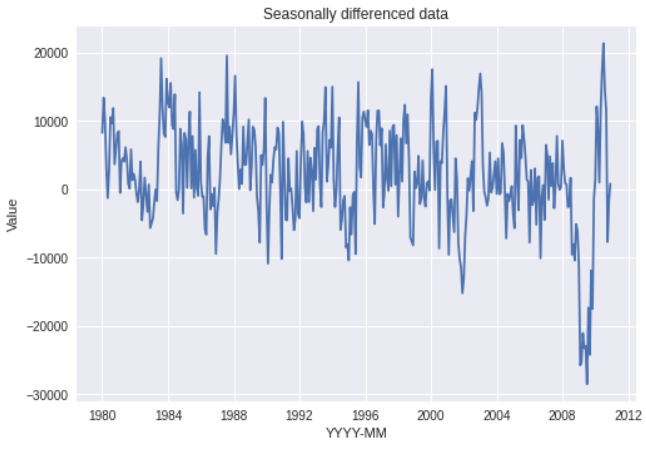
Question_5:-

1.Original Time Series Data Plot



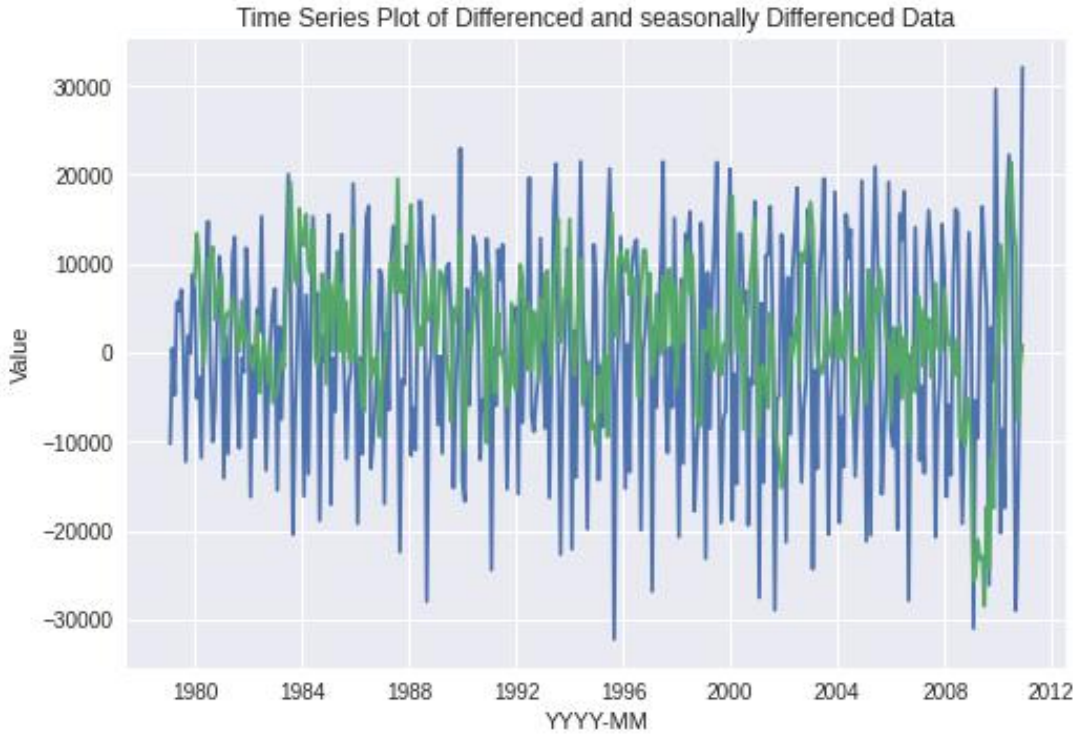
2. 1st Difference and Seasonally Difference Time Series Plot.





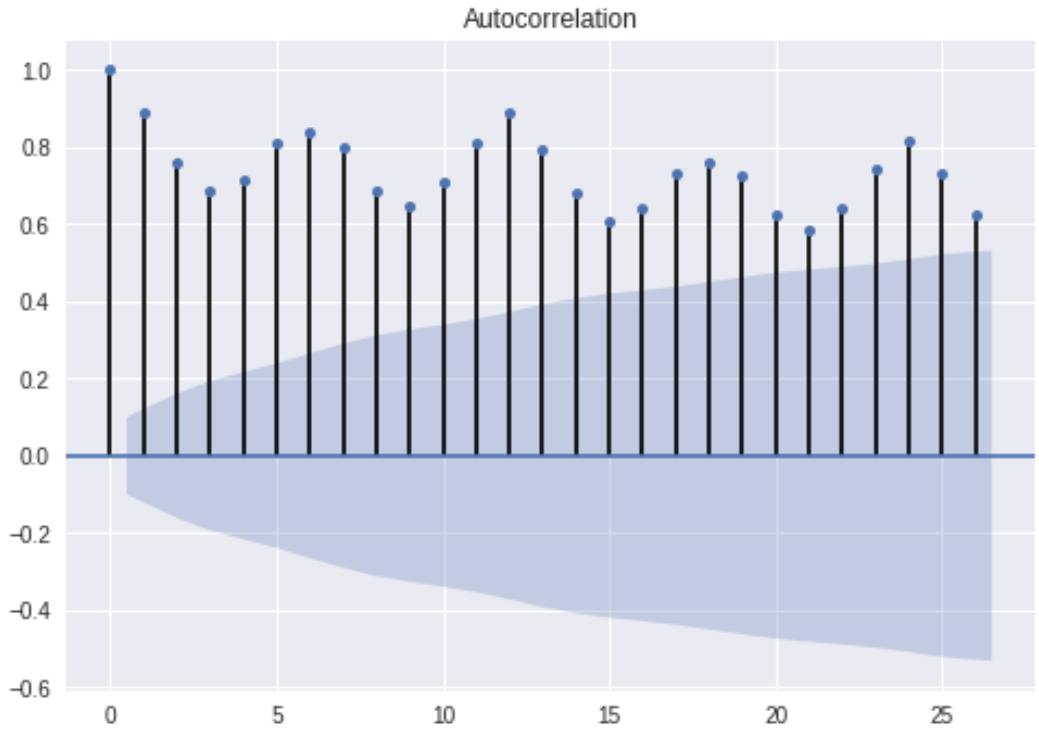
Here this Dataset have a seasonally difference which is repeated after every 12 months, I have calculated the 1st Time Difference time series model and 12th-time series model. And plotted the respective plot.

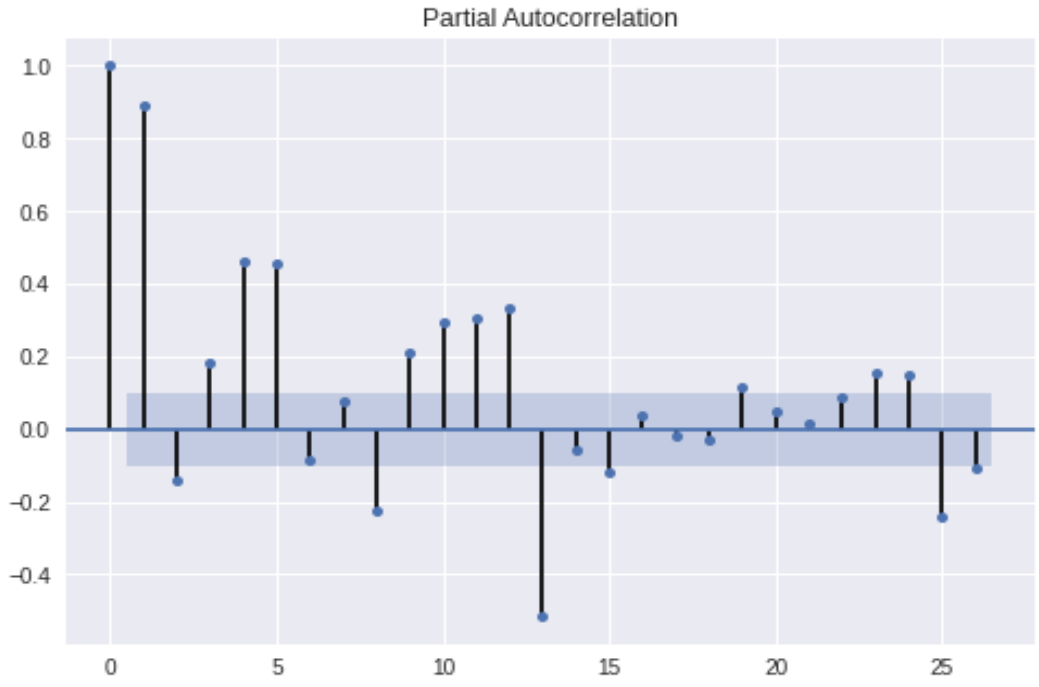
3. Differenced and seasonally differenced series of data



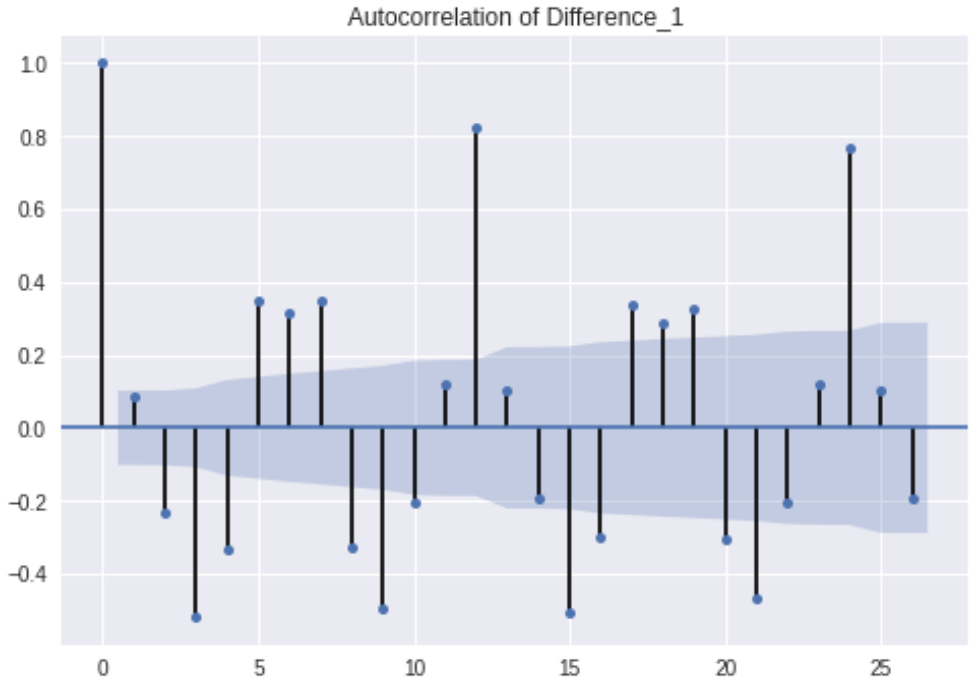
4. ACF and PACF Plots

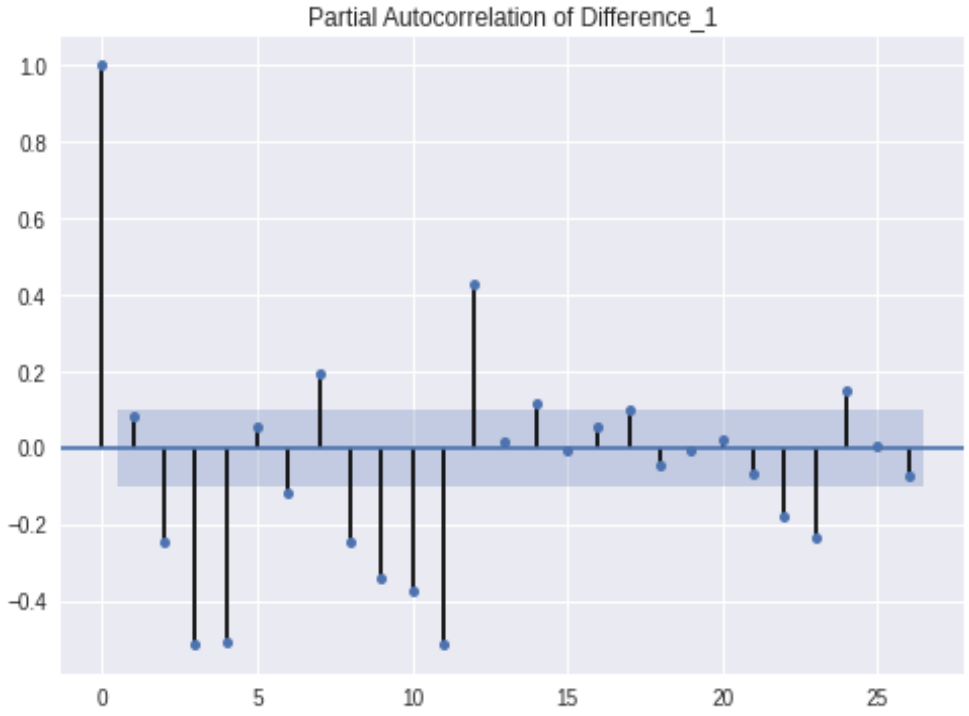
1. Original Data



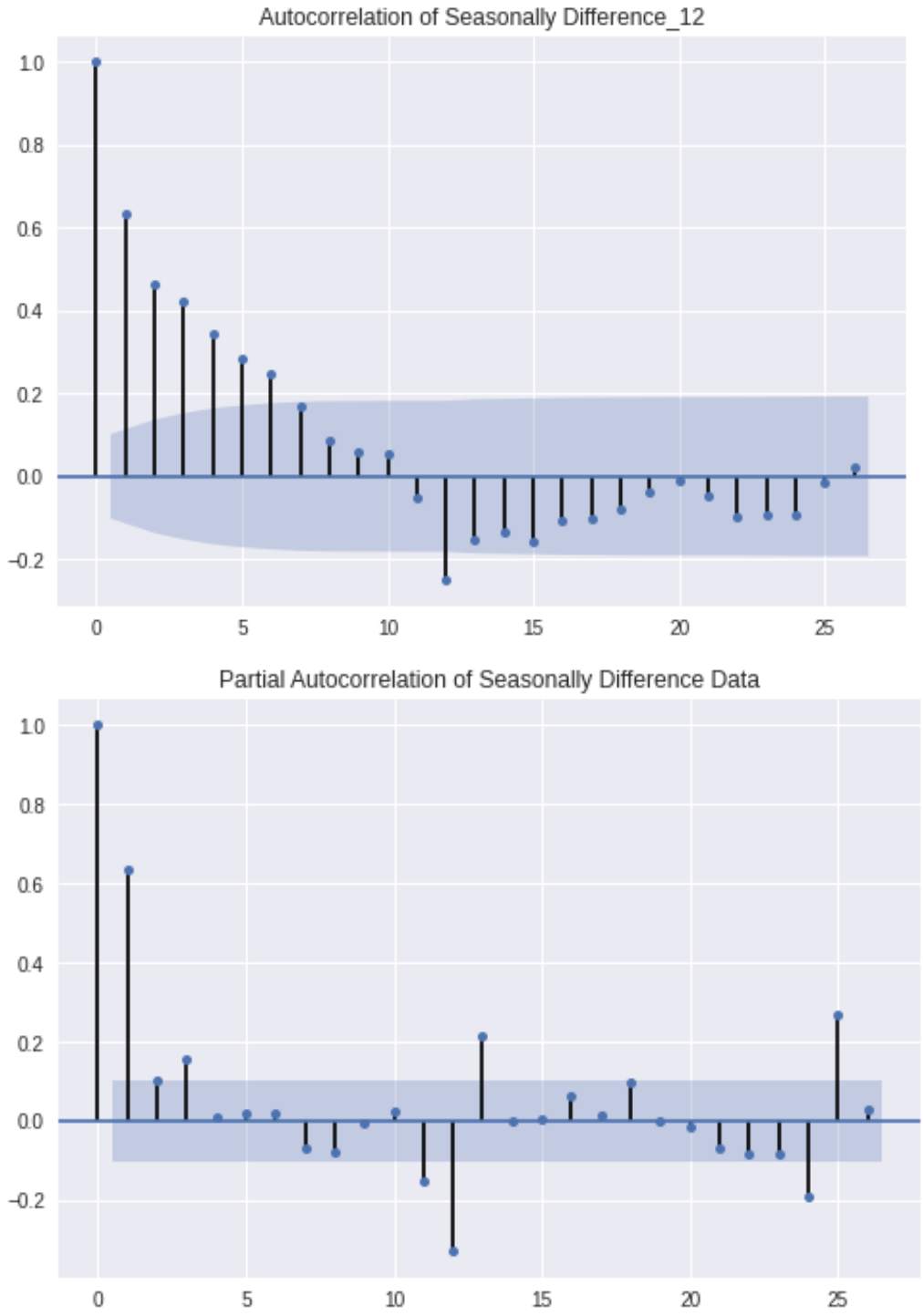


2. Differenced Data


Autocorrelation of Difference_1
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
0
5
10
15
20
25


Partial Autocorrelation of Difference_1
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
0
5
10
15
20
25

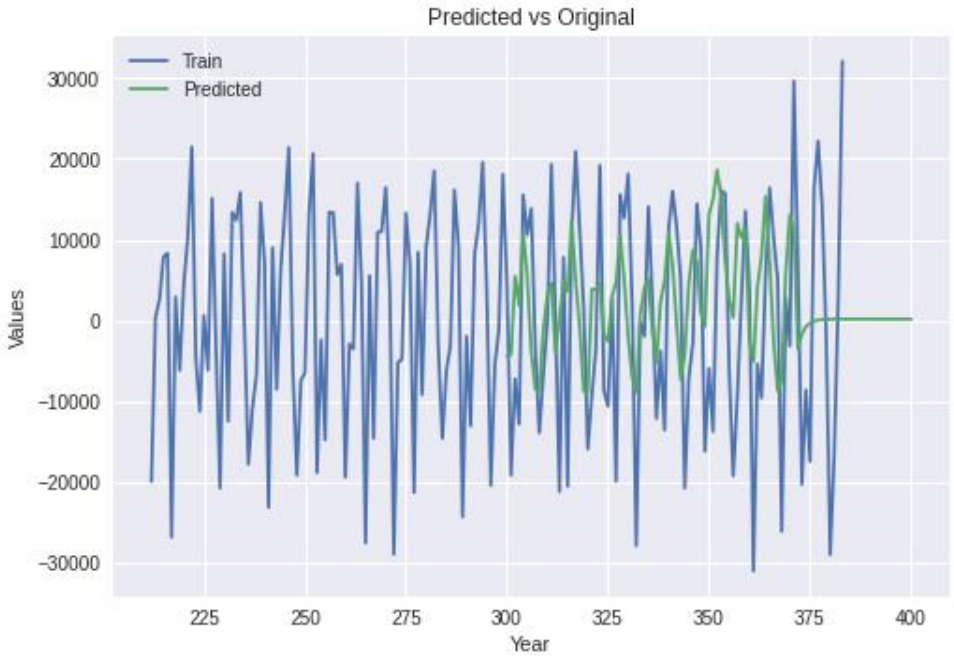
3.Seasonally time Series data



By observing ACF and PACF plots we can observe that Diff-1 and Diff-12 data are more stationary than Original time Series data. ACF plot of the original plot decreases slowly and have a strong correlation between adjacent data samples. Whereas in diff model don't have high correlation between adjacent data points.

Predicted Data and Graph:-

This Graph is predicted using an ordinary ARMA model. We can observe that the Predicted values allow the Train values with very less error. Also the Future values for next 12 Months are plotted by using ordinary ARMA model. Values for next future 12 months are given bellow.



Predicted Values using Ordinary ARMA Model:-

169.505021
169.541955
169.560781
169.570376
169.575267
169.577760
169.579031
169.579678
169.580008
169.580177
169.580262
169.580306
169.580328