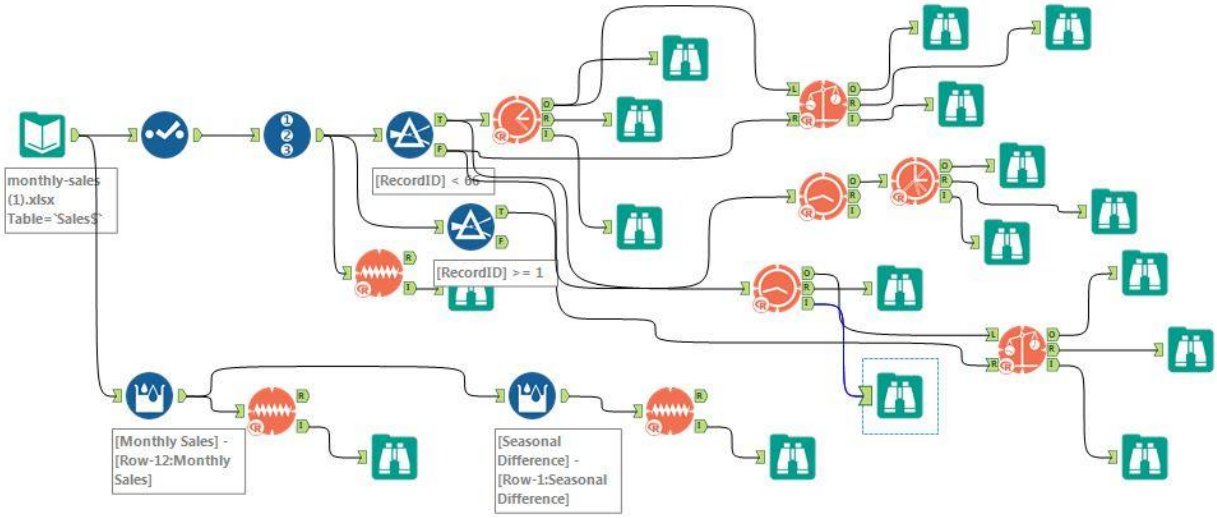
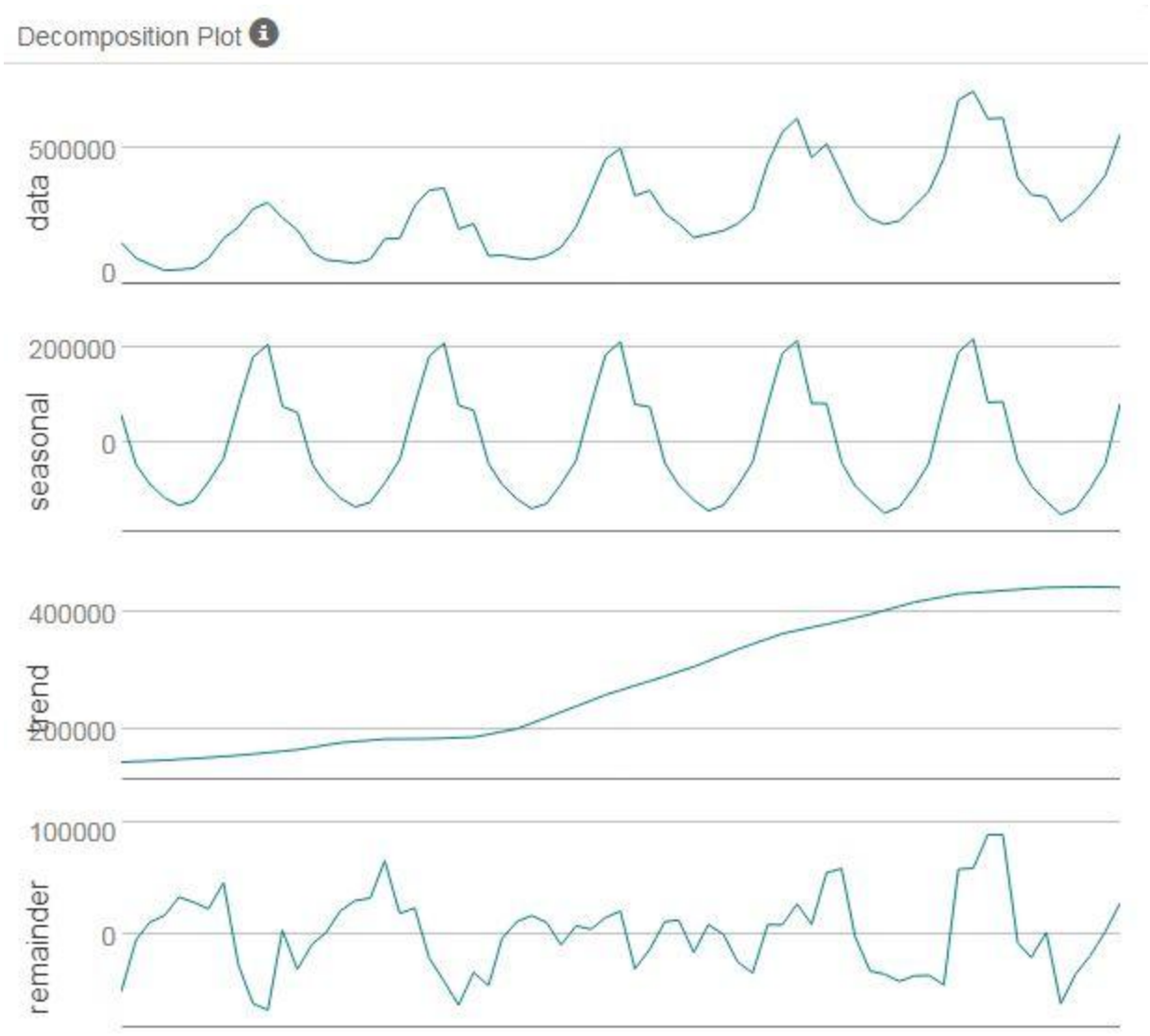
# Forecast Video Game Demand

Alteryx Worflow used:-




Q1. Does the dataset meet the criteria of a time series dataset? Make sure to explore all four key characteristics of a time series data?




Ans 1. A conclusion can be derived on after analyzing the decomposition plot that the dataset meets the criteria of a time series data. The characteristics of a time series data that can be interpreted from the decomposition plot are:-

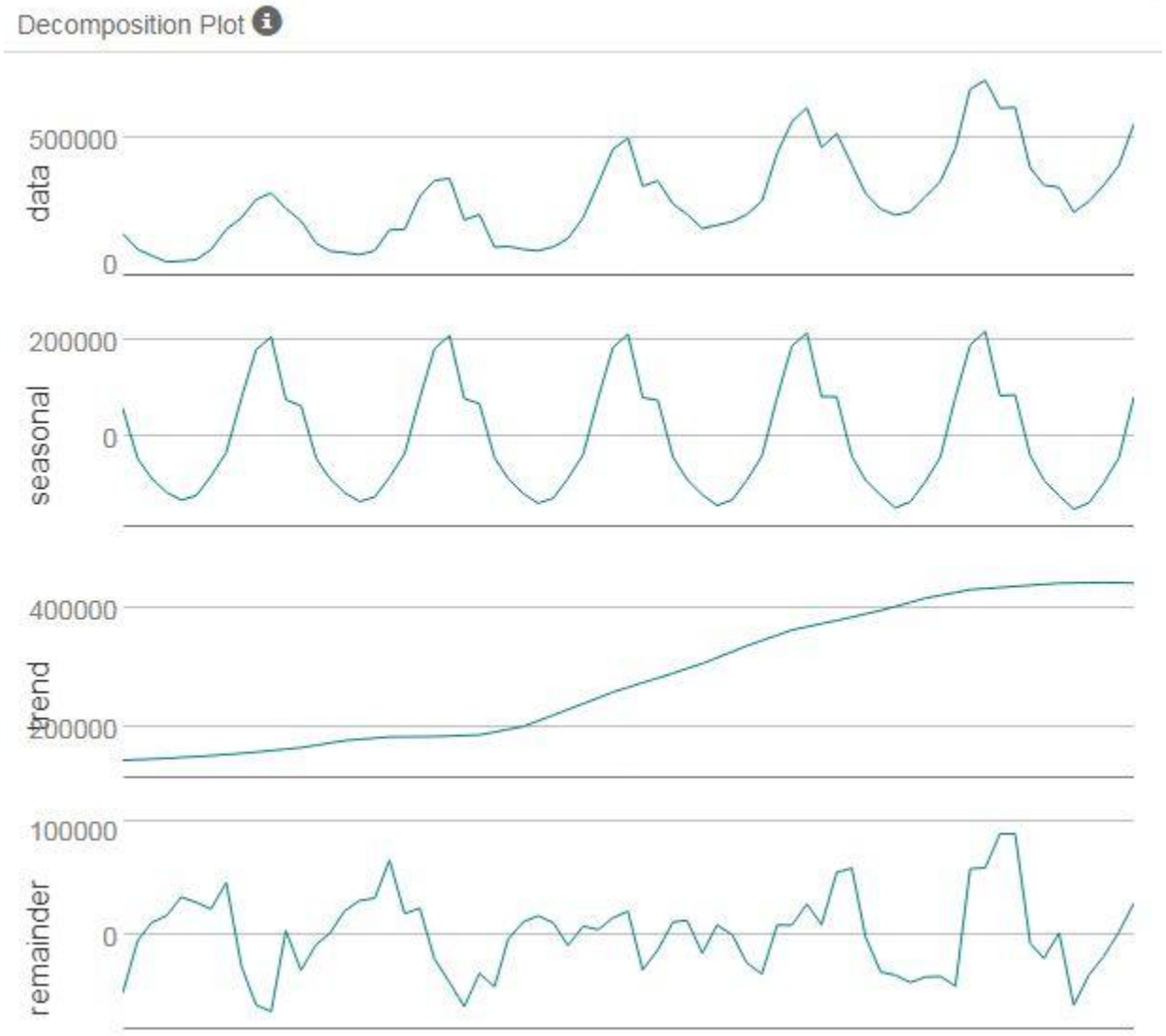
- The series is over a continuous time interval
- Sequential measurements across that interval
- There is equal spacing between every two consecutive measurements
- Each time unit within the time interval has at most one data point

Q2. Which records should be used as the holdout sample?

Ans 2. The 4 most recent records i.e. from 2013-06 to 2013-09 have been used as the holdout sample as the forecast needs to be done for the next 4 months.

Q3. Determine Trend, Seasonal, and Error Components

Ans3.




- The trend moves in a linearly
- The seasonality shows a slight increase every year
- The error shows change in variance as the time series moves along

Q4. What are the model terms for ETS? Explain why you chose those terms.

Ans4. The trend moves in a linear fashion which suggests applying trend additively.

The seasonality increases slightly every year and hence needs to be applied multiplicatively.

The error shows change in variance as the time series moves along and hence needs to be applied multiplicatively.

Thus, the model becomes ETS (M, A, M).

Q5. Describe the in-sample errors. Use at least RMSE and MASE when examining results

Ans 5. For ETS models the RMSE and MASE values are given below.

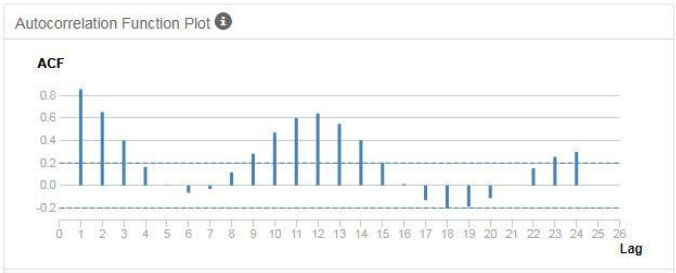
In-sample error measures:

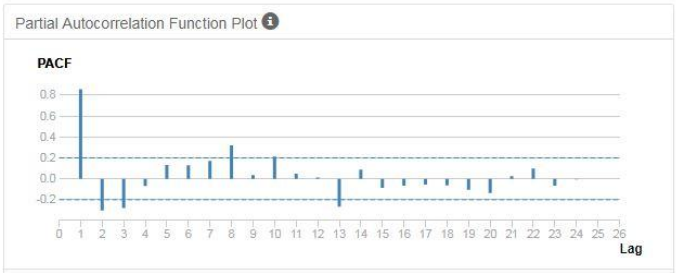
| ME | RMSE | MAE | MPE | MAPE | MASE | ACF1 |
|---|---|---|---|---|---|---|
| 2818.2731122 | 32992.7261011 | 25546.503798 | -0.3778444 | 10.9094683 | 0.372685 | 0.0661496 |

The two important components in the in-sample error measures are RMSE and MASE. RMSE represents the sample standard deviation of the differences between predicted values and observed values. MASE is the mean absolute error of the model divided by the mean absolute value of the first difference of the series which implies that it measures the relative reduction in error compared to a naive model.

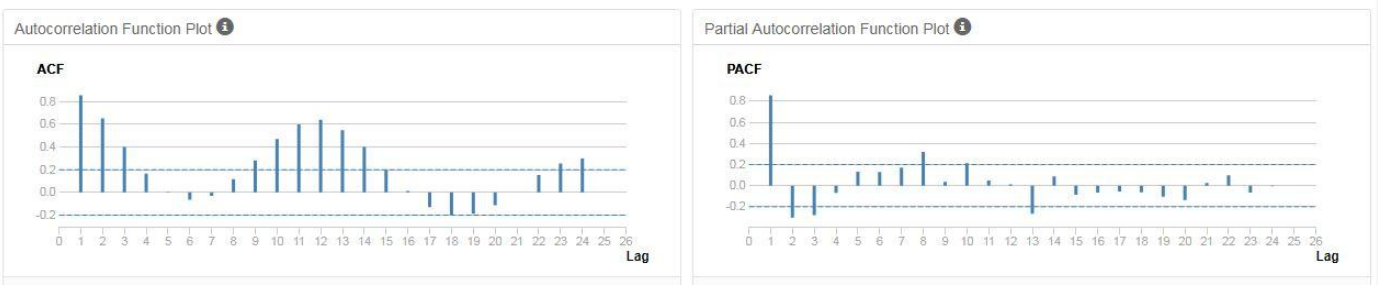
Q6. What are the model terms for ARIMA? Explain why you chose those terms. Graph the Auto-Correlation Function (ACF) and Partial Autocorrelation Function Plots (PACF) for the time series and seasonal component and use these graphs to justify choosing your model terms. Regraph ACF and PACF for both the Time Series and Seasonal Difference and include these graphs in your answer.

Ans 6. Analyzing the ACF and PACF plots below, we can see that the series isn't stationary and therefore we need to use differencing to make the series straight.

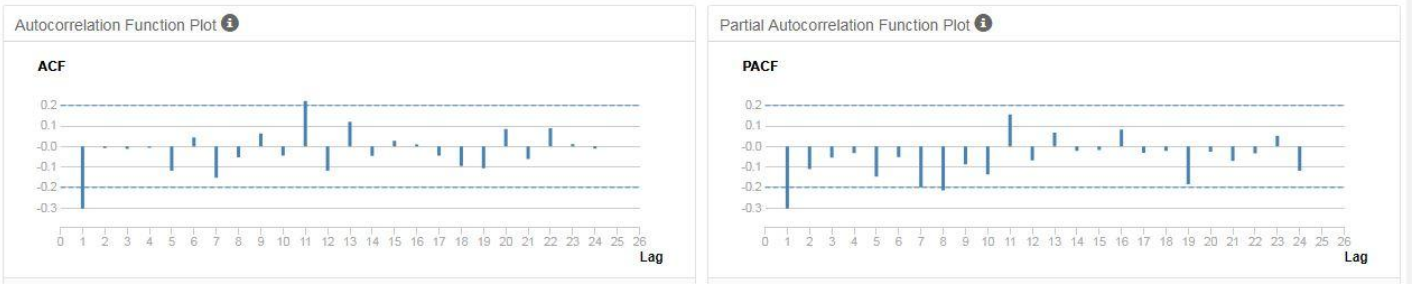


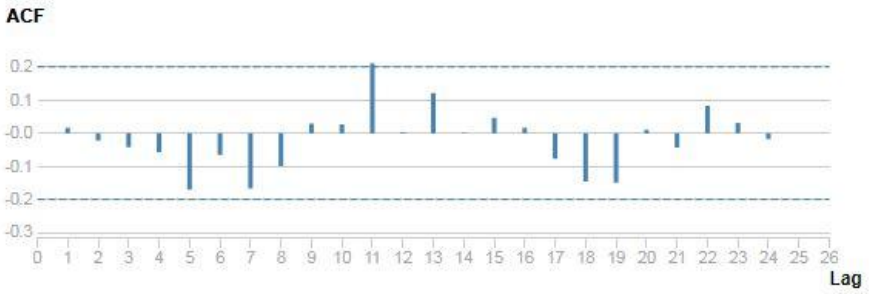

In the ACF/PACF plot below after seasonal differencing the seasonal component is gone however, the series is still not stationary.

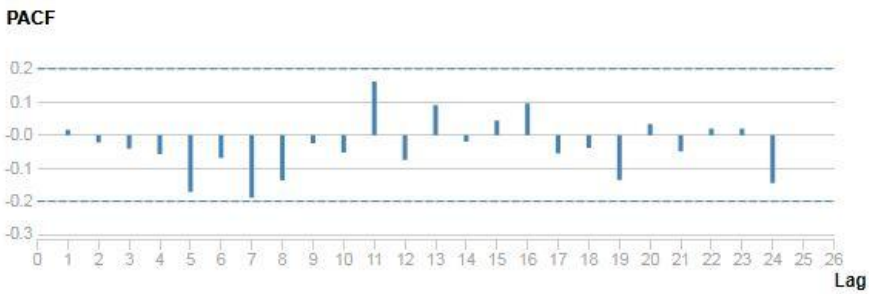



The third ACF/PACF plot below shows the series after first difference. The series is now stationary except for lag 1.




Finally after adding the MA term the series is stationary (as shown by the ACF/PACF plots below).



Interpreting the ACF and PACF plots, the model turns out to be ARIMA(0,1,1)(0,1,0)[1,2] .

Q7. Describe the in-sample errors. Use at least RMSE and MASE when examining results

Ans 7. For ARIMA models the RMSE and MASE values are given below.

In-sample error measures:

| ME | RMSE | MAE | MPE | MAPE | MASE | ACF1 |
|---|---|---|---|---|---|---|
| -356.2665104 | 36761.5281724 | 24993.041976 | -1.8021372 | 9.824411 | 0.3646109 | 0.0164145 |

Q9. Which model did you choose? Justify your answer by showing: in-sample error measurements and forecast error measurements against the holdout sample.

Ans9. ARIMA model is better for forecasting among the two as looking at the metrics shown below ARIMA ranks better in almost all the aspects.

ETS Model (In sample error measure)

In-sample error measures:

| ME | RMSE | MAE | MPE | MAPE | MASE | ACF1 |
|---|---|---|---|---|---|---|
| 2818.2731122 | 32992.7261011 | 25546.503798 | -0.3778444 | 10.9094683 | 0.372685 | 0.0661496 |

ARIMA Model (In sample error measure)

In-sample error measures:

| ME | RMSE | MAE | MPE | MAPE | MASE | ACF1 |
|---|---|---|---|---|---|---|
| -356.2665104 | 36761.5281724 | 24993.041976 | -1.8021372 | 9.824411 | 0.3646109 | 0.0164145 |

The accuracy measures of the holdout sample of ETS.

Actual and Forecast Values:

| Actual | ETSModel1 |
|---|---|
| 271000 | 248063.01908 |
| 329000 | 351306.93837 |
| 401000 | 471888.58168 |
| 553000 | 679154.7895 |

Accuracy Measures:

| Model | ME | RMSE | MAE | MPE | MAPE | MASE | NA |
|---|---|---|---|---|---|---|---|
| ETSModel1 | -49103.33 | 74101.16 | 60571.82 | -9.7018 | 13.9337 | 1.0066 | NA |

The accuracy measures of the holdout sample of ARIMA.

Actual and Forecast Values:

| Actual | ARIMA |
|---|---|
| 271000 | 263228.48013 |
| 329000 | 316228.48013 |
| 401000 | 372228.48013 |
| 553000 | 493228.48013 |

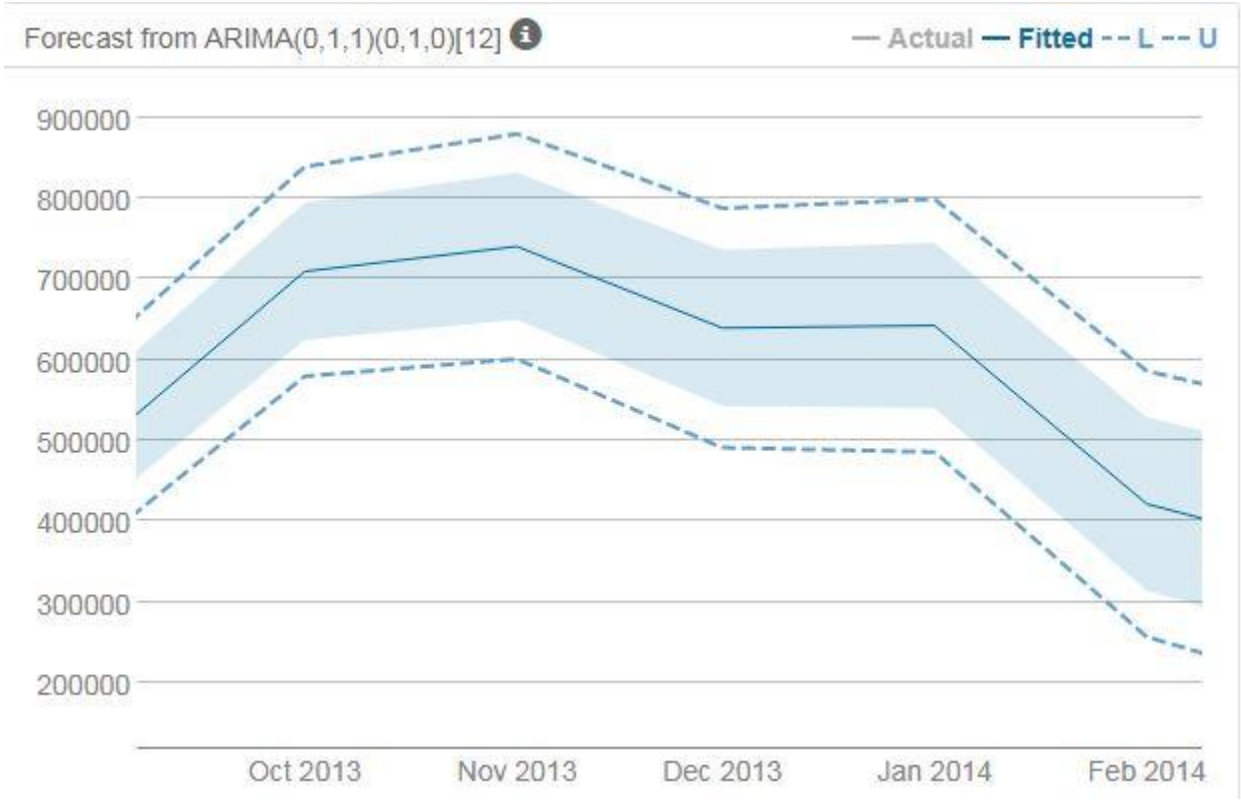
Accuracy Measures:

| Model | ME | RMSE | MAE | MPE | MAPE | MASE | NA |
|---|---|---|---|---|---|---|---|
| ARIMA | 27271.52 | 33999.79 | 27271.52 | 6.1833 | 6.1833 | 0.4532 | NA |

Q10. What is the forecast for the next four periods? Graph the results using 95% and 80% confidence intervals.

Ans 10. The forecast for the next four periods is

| Period | Sub_Period | forecast | forecast_high_95 | forecast_high_80 | forecast_low_80 | forecast_low_95 |
|---|---|---|---|---|---|---|
| 6 | 10 | 754854.460048 | 834046.21595 | 806635.165997 | 703073.754099 | 675662.704146 |
| 6 | 11 | 785854.460048 | 879377.753117 | 847006.054462 | 724702.865635 | 692331.166979 |
| 6 | 12 | 684854.460048 | 790787.828211 | 754120.566407 | 615588.35369 | 578921.091886 |
| 7 | 1 | 687854.460048 | 804889.286634 | 764379.419903 | 611329.500193 | 570819.633462 |


Forecast from ARIMA(0,1,1)(0,1,0)[12]
— Actual — Fitted - - L - - U
900000
800000
700000
600000
500000
400000
300000
200000
Oct 2013
Nov 2013
Dec 2013
Jan 2014
Feb 2014