Retail Giant’s Sales Forecasting

Time Series Forecasting

Problem Statement

- Global Mart is an online supergiant store that has worldwide operations. This store takes orders and delivers across the globe and deals with all the major product categories — consumer, corporate & home office.
- As a sales manager for this store, I have to forecast the sales of the products for the next 6 months, so that I have a proper estimate and can plan our inventory and business processes accordingly.

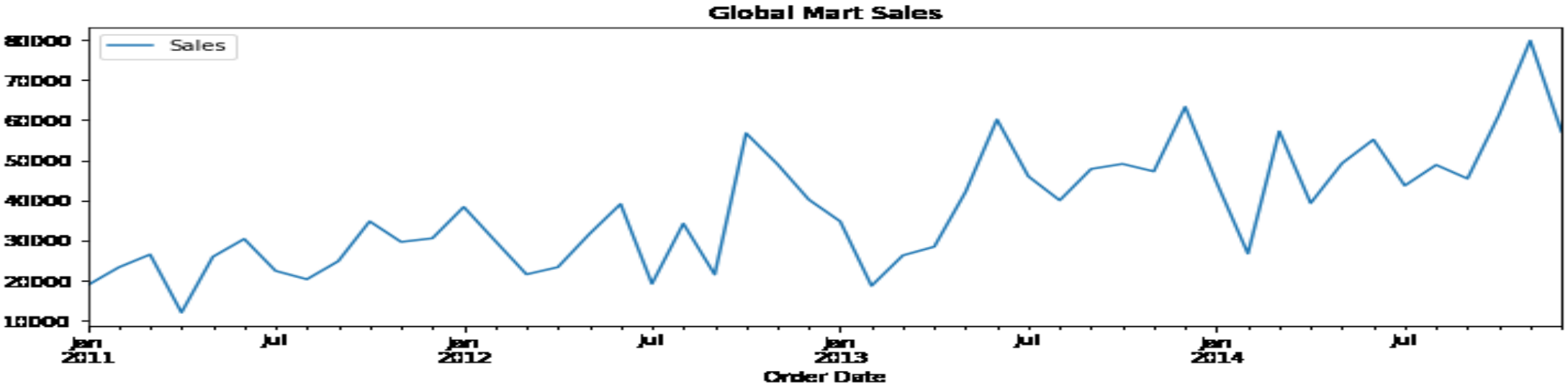
CoV of Different Market Segments

Market-Segment	
APAC-Consumer	0.522725
APAC-Corporate	0.530051
APAC-Home Office	1.008219
Africa-Consumer	1.310351
Africa-Corporate	1.891744
Africa-Home Office	2.012937
Canada-Consumer	1.250315
Canada-Corporate	1.786025
Canada-Home Office	2.369695
EMEA-Consumer	2.652495
EMEA-Corporate	6.355024
EMEA-Home Office	7.732073
EU-Consumer	0.595215
EU-Corporate	0.722076
EU-Home Office	0.938072
LATAM-Consumer	0.683770
LATAM-Corporate	0.882177
LATAM-Home Office	1.169693
US-Consumer	1.010530
US-Corporate	1.071829
US-Home Office	1.124030

Name: Profit, dtype: float64

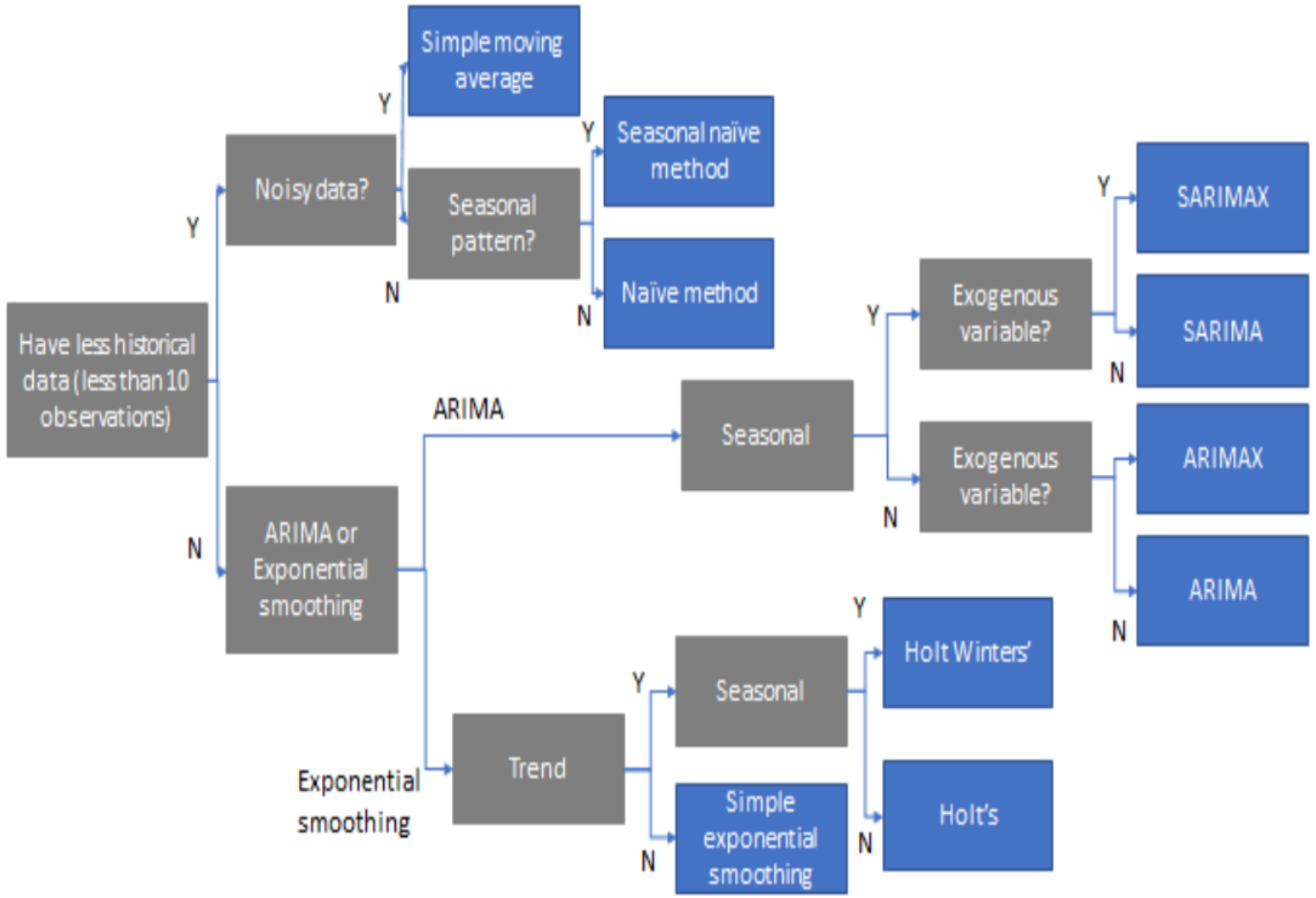
- In the dataset, there are 21 unique market segments.
- APAC-Consumer has the lowest coefficient of Variation (CoV) of 0.52, which signifies this Market-Segment is the most stable one.
- In this time series forecasting, I have done the forecasting for only APAC-Consumer Market-Segment as this is the most stable Market-Segment

Time Series Data – APAC-Consumer Segment



- The data set contains monthly sales data of 4 years. So, we have data of 48 months.
- So after splitting the dataset into train and test set, train dataset contains 42 months data and test data set contains 6 months data.

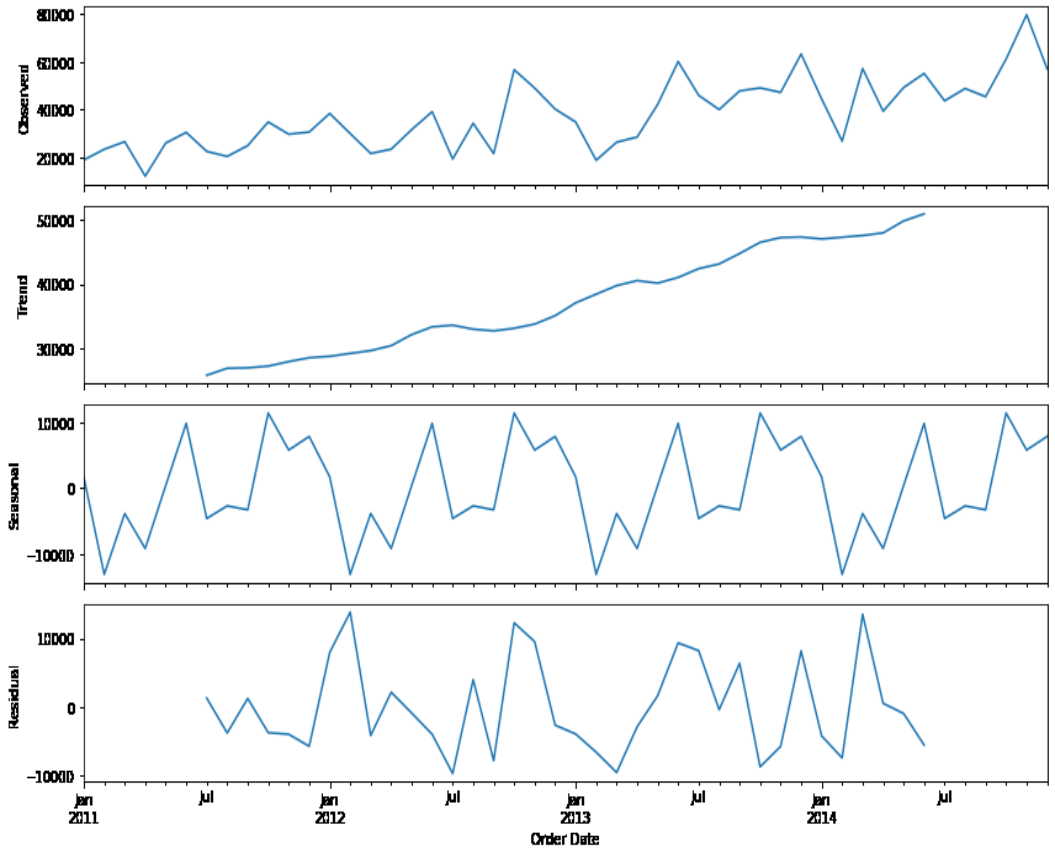
Choosing The Right Time Series Method



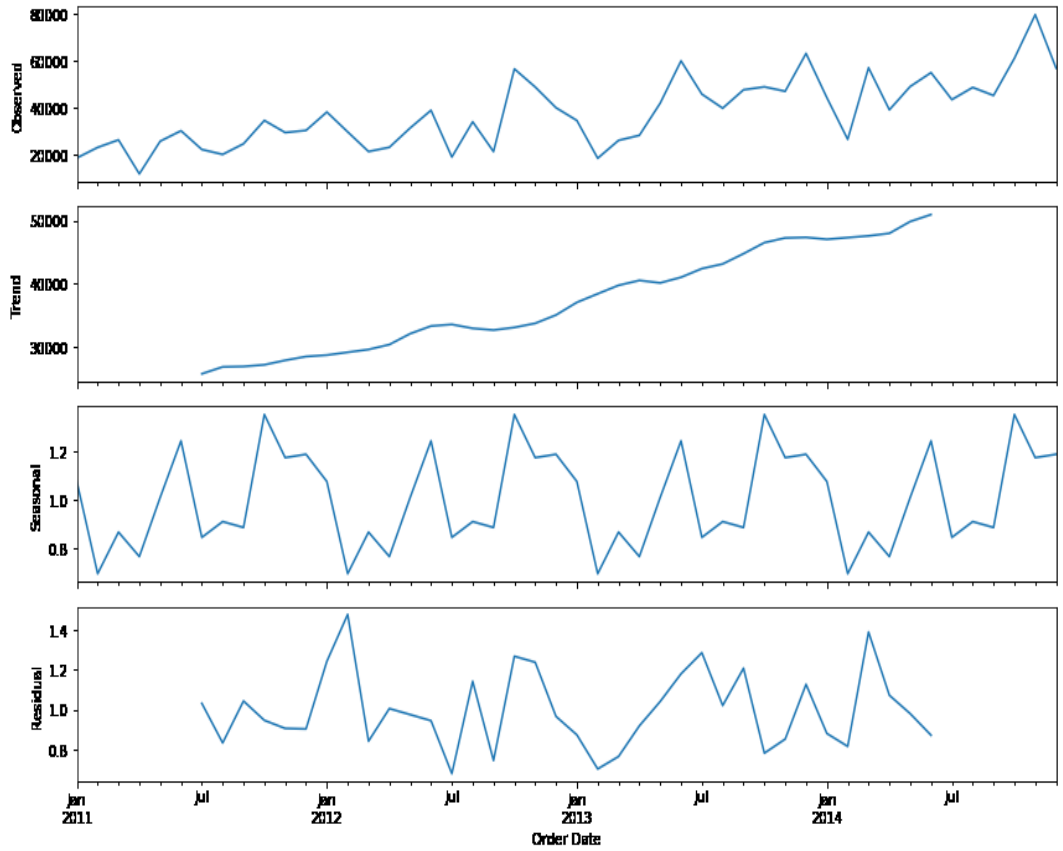
- As per this flow chart, the suitable methods for forecasting are –
  - Holt Winter's Method (Exponential Smoothing Techniques)
  - SARIMA Method (Autoregressive Methods)
- However, we have checked all the methods and saw which method is able to forecast the sales values accurately.

Time Series Decomposition

Additive Seasonal Decomposition



Multiplicative Seasonal Decomposition



- The decomposition shows that the data shows an upward trend and have seasonality also.

Basic Time Series Forecasting Methods

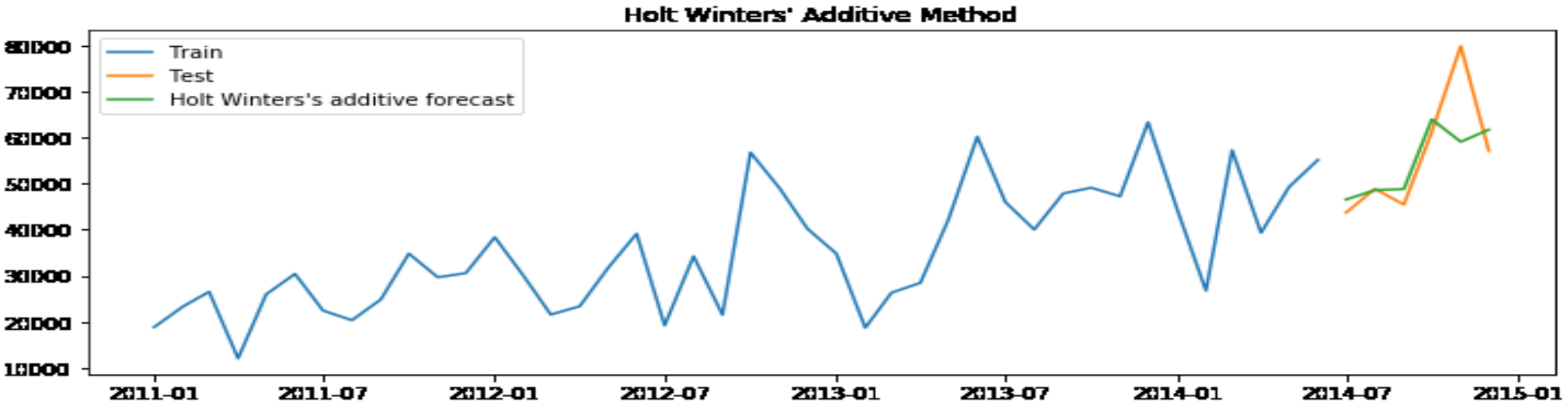
Method	MAPE
Naïve Method	17.47
Simple Average Method	34.34
Simple Moving Average Method	16.10

- Out of all the simple time series forecasting methods, Simple moving average method has the lowest MAPE value. But these methods do not capture any trend or seasonality. So these forecasting method is not suitable for our dataset as our dataset has both trend and seasonality.

Exponential Smoothing Methods

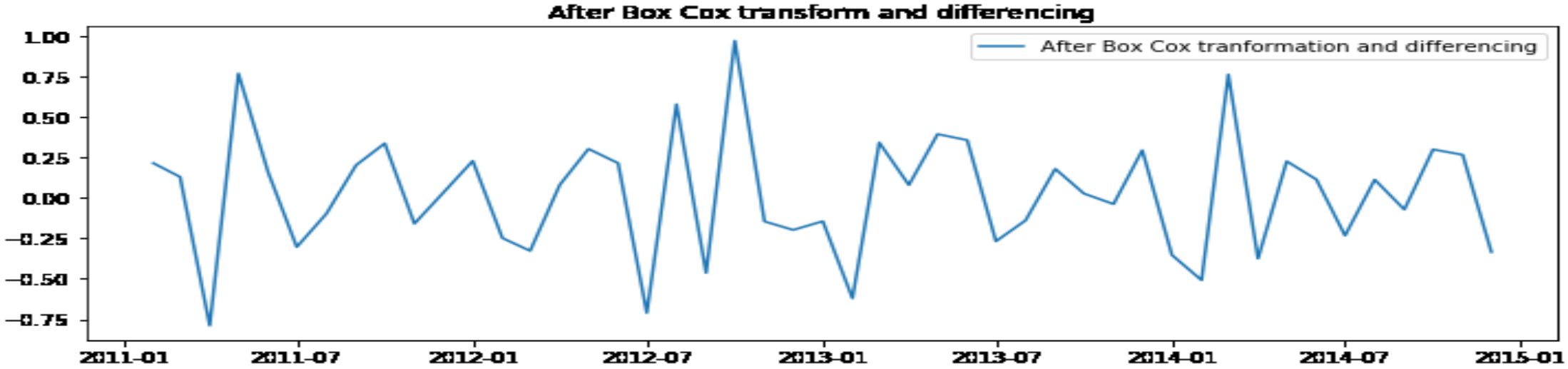
Method	MAPE
Simple Exponential Smoothing Method	15.99
Holt's Exponential Smoothing Method	34.57
Holt Winter's Additive Method	8.84
Holt Winter's Multiplicative Method	10.12

- Out of all the exponential smoothing methods, Holt Winter's additive method has the lowest MAPE value.
- The Holt-Winters' smoothing technique forecasts the level, trend as well as the seasonality for a time series data and forecast values are the most accurate as the error for this method is the lowest.



Stationarity Test – KPSS Test

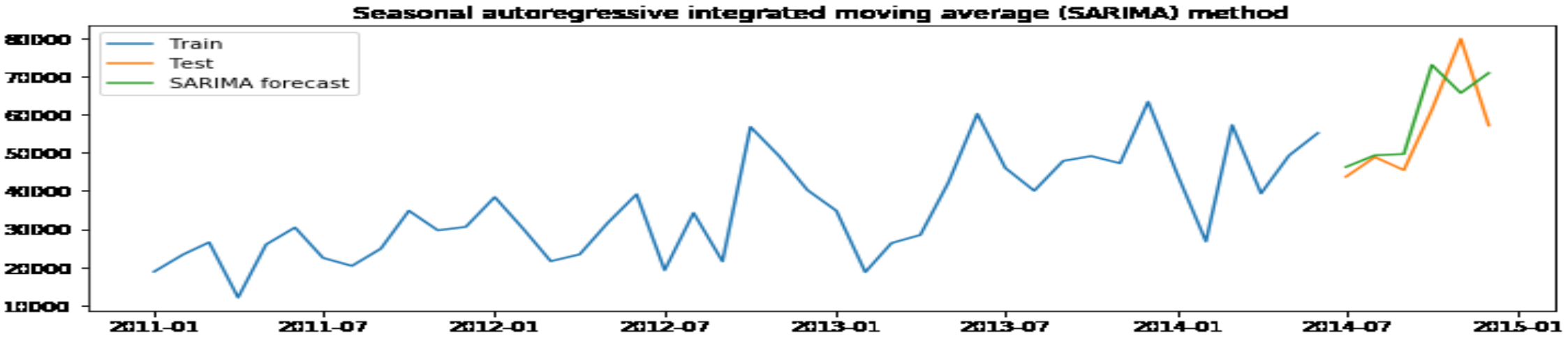
- KPSS Statistic: 0.577076
- Critical Values @ 0.05: 0.46
- p-value: 0.024720
- KPSS test shows that the p-value is less than 0.05. So the series is not stationary. we need to make it stationary first by making the variance and the mean constant.
- Converting the series to stationary is done by the Box-Cox transformation and the Differencing over the time series



Auto Regressive (AR) Methods

Method	MAPE
Autoregressive (AR) Method	13.56
Moving Average (MA)Method	33.93
ARMA Method	32.40
ARIMA Method	32.40
SARIMA Method	12.87

- Out of all the Autoregressive methods, SARIMA method has the lowest MAPE value.
- SARIMA models future observation as linear regression of past observations and past forecast errors and future seasonality as linear regression of past observations of seasonality andpast forecast errors of seasonality.
- SARIMA forecast values are the most accurate as the error for this method is the lowest.



Conclusion

- Most stable and profitable market-segment is APAC-Consumer
- Basic forecasting methods are not suitable for our dataset as our dataset has both trend and seasonality.
- Out of all the exponential smoothing methods, Holt Winter’s additive method is able to predict the sales closer to the actual values.
- Out of all the Autoregressive methods, SARIMA method is able to predict the sales closer to the actual values.