



Retail Giant Sales Forecasting Assignment

Global Mart is an online superstore that deals with 7 markets in the geographical space and has 3 segments such as consumer, corporate and home office

They want to forecast the sales and quantity for the most profitable market segment so that can they plan their inventory.

Hence the objectives of the analysis are as below:

1. Data Preparation
2. Finding the most profitable market segment
3. Building models to forecast sales and quantity for the most profitable market segment
4. Finding the optimum method in Smoothing Techniques and Regression Techniques

1. **Data Preparation**
2. Finding the most profitable market segment
3. Building models to forecast sales and quantity for the most profitable market segment
4. Finding the optimum method in Smoothing Techniques and ARIMA Techniques

The following attributes are given the data along with their description:

Attributes	Description
Order Date	Date on which the order was placed
Segment	The market segment to which the product belongs
Market	Market segment to which the customer belongs
Sales	Total sales value of the transaction
Quantity	Quantity of the product ordered
Profit	Profit made on the transaction

1. The market attribute has 7 factor levels representing the geographical market sector that the customer belongs to.
2. Also, the segment attribute tells which out of the 3 customer segments does the customer belong to

Market
Africa
APAC (Asia Pacific)
Canada
EMEA(Middle East)
EU (European Union)
LATAM (Latin America)
US (United States)

Segment
Consumer
Corporate
Home Office

1. Thus the total number of unique market segments are 21 as shown below

APAC	Consumer
APAC	Corporate
APAC	Home Office
EU	Consumer
EU	Corporate
EU	Home Office
US	Consumer
US	Corporate
US	Home Office
Africa	Consumer
Africa	Corporate
Africa	Home Office

Canada	Consumer
Canada	Corporate
Canada	Home Office
LATAM	Consumer
LATAM	Corporate
LATAM	Home Office
EMEA	Consumer
EMEA	Corporate
EMEA	Home Office

1. Data Preparation
- 2. Finding the most profitable market segment**
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The coefficient of the variation was used to calculate the most profitable market segment. The order of market segments in the increasing order of their COVs is given below

APACConsumer	0.522725
APACCorporate	0.530051
EUConsumer	0.595215
LATAMConsumer	0.68377
EUCorporate	0.722076
LATAMCorporate	0.882177
EUHome Office	0.938072
APACHome Office	1.008219
USConsumer	1.01053
USCorporate	1.071829
USHome Office	1.12403
LATAMHome Office	1.169693

CanadaConsumer	1.250315
AfricaConsumer	1.310351
CanadaCorporate	1.786025
AfricaCorporate	1.891744
AfricaHome Office	2.012937
CanadaHome Office	2.369695
EMEAConsumer	2.652495
EMEACorporate	6.355024
EMEAHome Office	7.732073

Finding the Most Profitable Market Segment

The segment with the lowest COV value is APAC Consumer. And thus this is the most profitable market segment and we have to forecast sales and quantity for this market

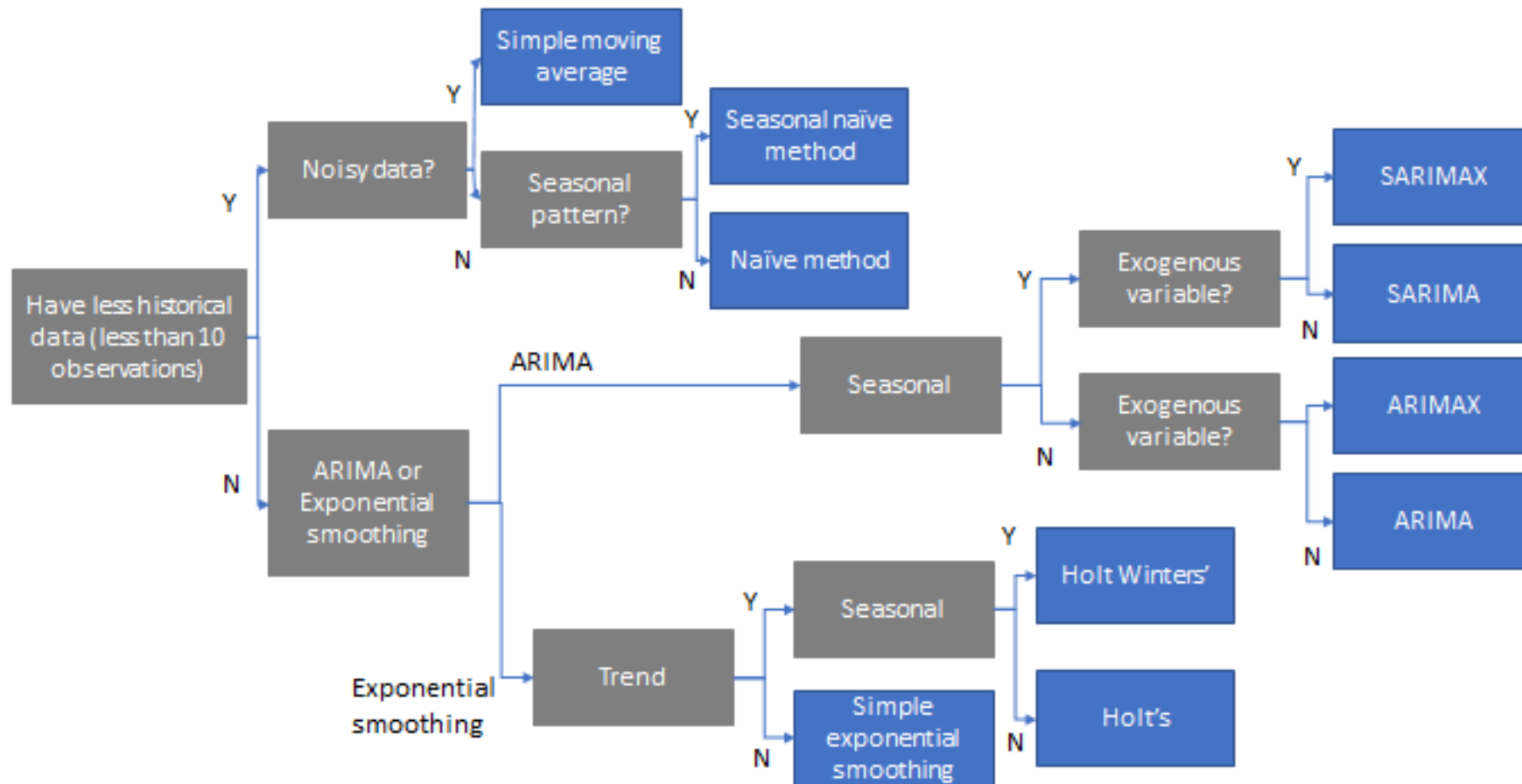
segment	APACConsumer	0.522725
	APACCorporate	0.530051
	EUConsumer	0.595215
	LATAMConsumer	0.68377
	EUCorporate	0.722076
	LATAMCorporate	0.882177
	EUHome Office	0.938072
	APACHome Office	1.008219
	USConsumer	1.01053
	USCorporate	1.071829
	USHome Office	1.12403
	LATAMHome Office	1.169693

	CanadaConsumer	1.250315
	AfricaConsumer	1.310351
	CanadaCorporate	1.786025
	AfricaCorporate	1.891744
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1. Data Preparation
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Estimating the Best Time Series Model using the Flow Chart

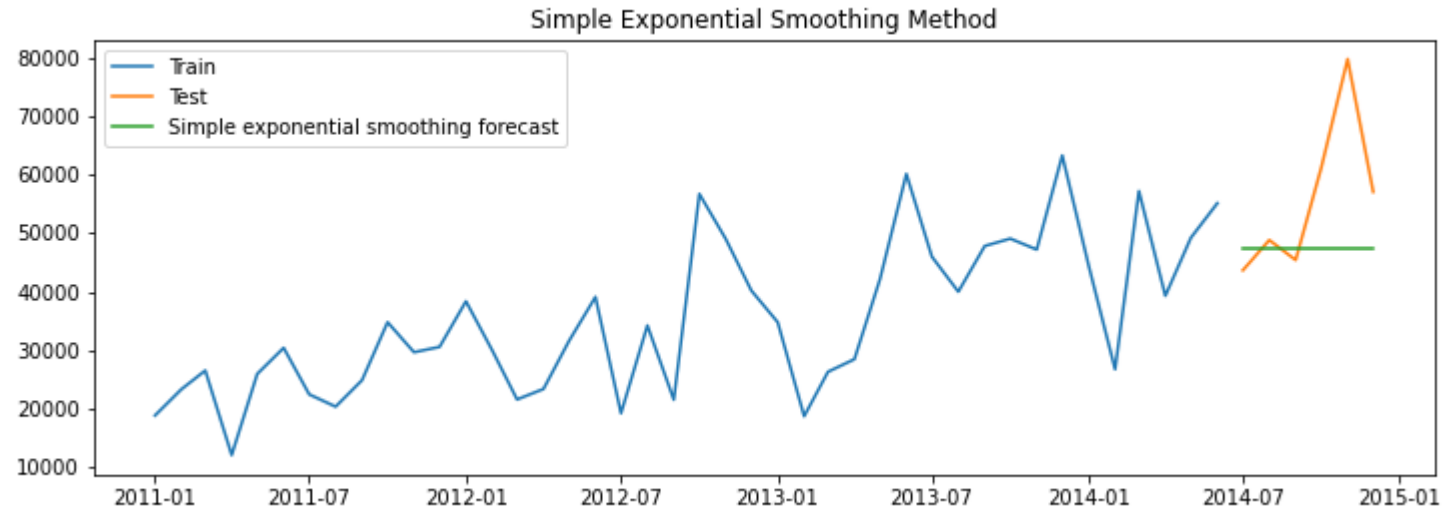
Choosing the Right Time Series Method



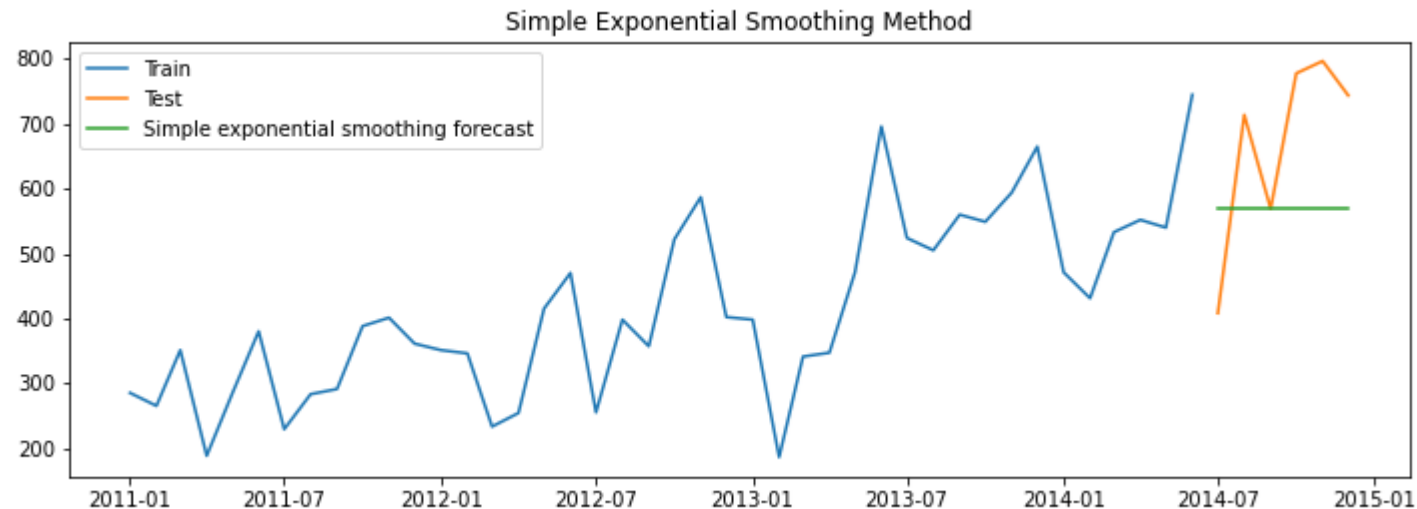
Estimating the Best Time Series Model using the Flow Chart

1. When we check the sales for the data of APAC Consumer, we can see that the data has more than 10 observations.
2. It has trend for sure
3. It also exhibits some seasonality that looks from the graph but we can't be for sure yet
4. Based on this, we can say that the best smoothing method to forecast sales would be the Holt-Winters' method
5. Among the ARIMA models, for predicting seasonality without an exogenous variable we can go say that SARIMA method should forecast well. The data does not have any exogenous variable
6. Similarly, when we check the quantity plot for the entire data, we can see that again there some trend and some seasonal pattern
7. Again with the same explanation, Holt-Winters' method and SARIMA method will work work among the techniques.

Simple Exponential Smoothing Technique

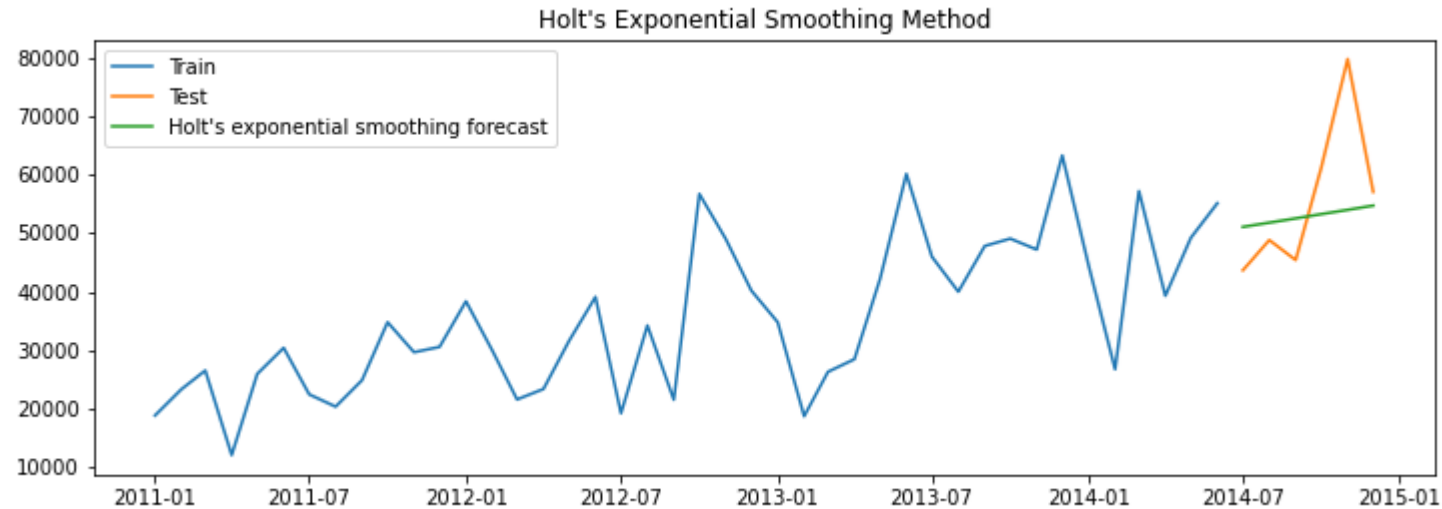


Sales Forecast for
APAC Consumer
(MAPE = 15.99)

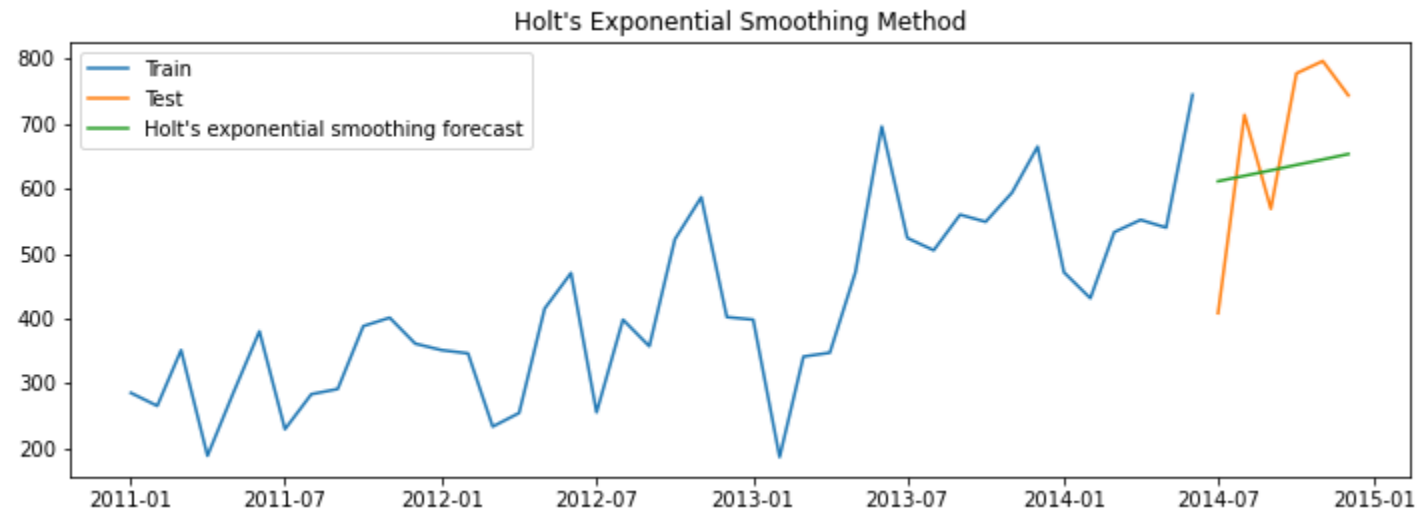


Quantity Forecast
for APAC Consumer
(MAPE = 23.10)

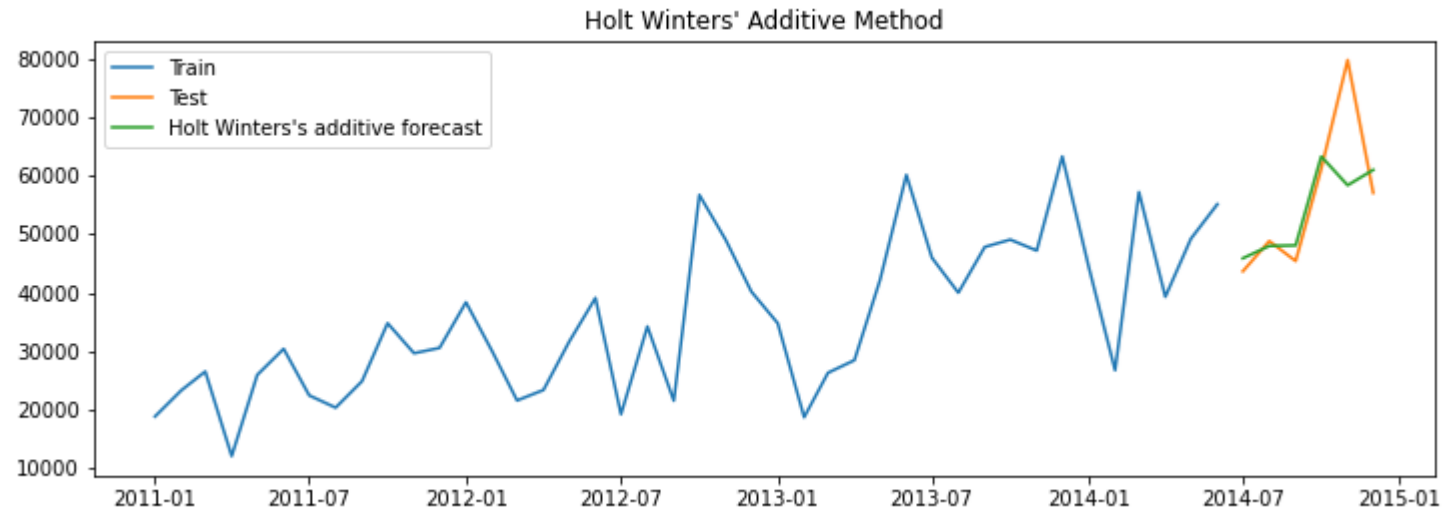
Holt's Exponential Smoothing Technique



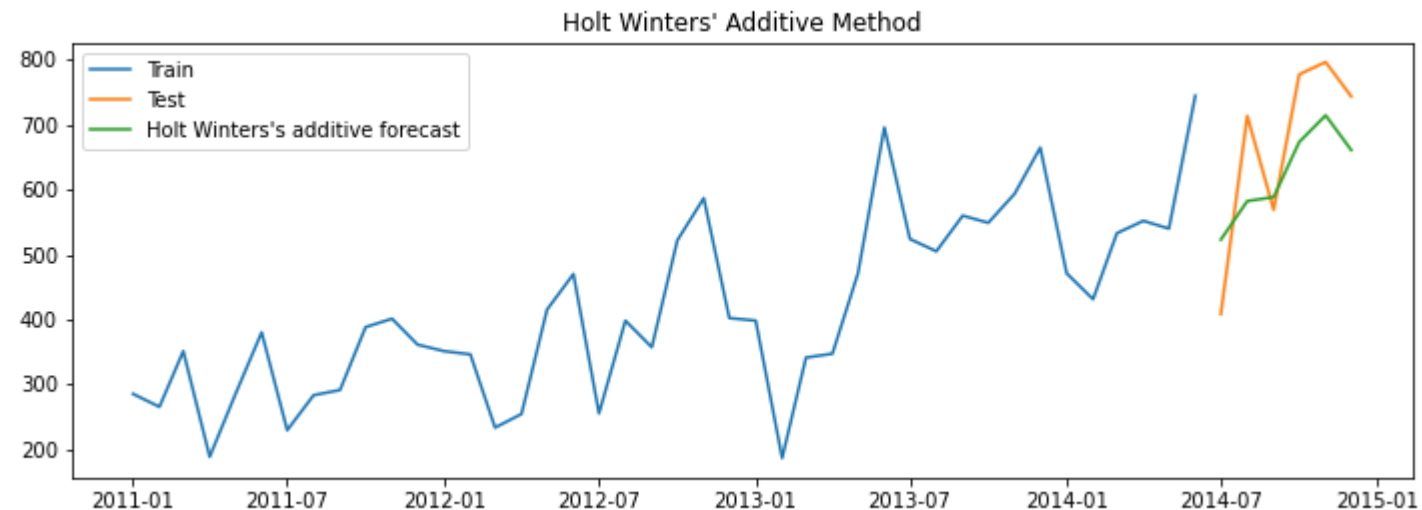
Sales Forecast for
APAC Consumer
(MAPE = 15.03)



Quantity Forecast
for APAC Consumer
(MAPE = 20.83)

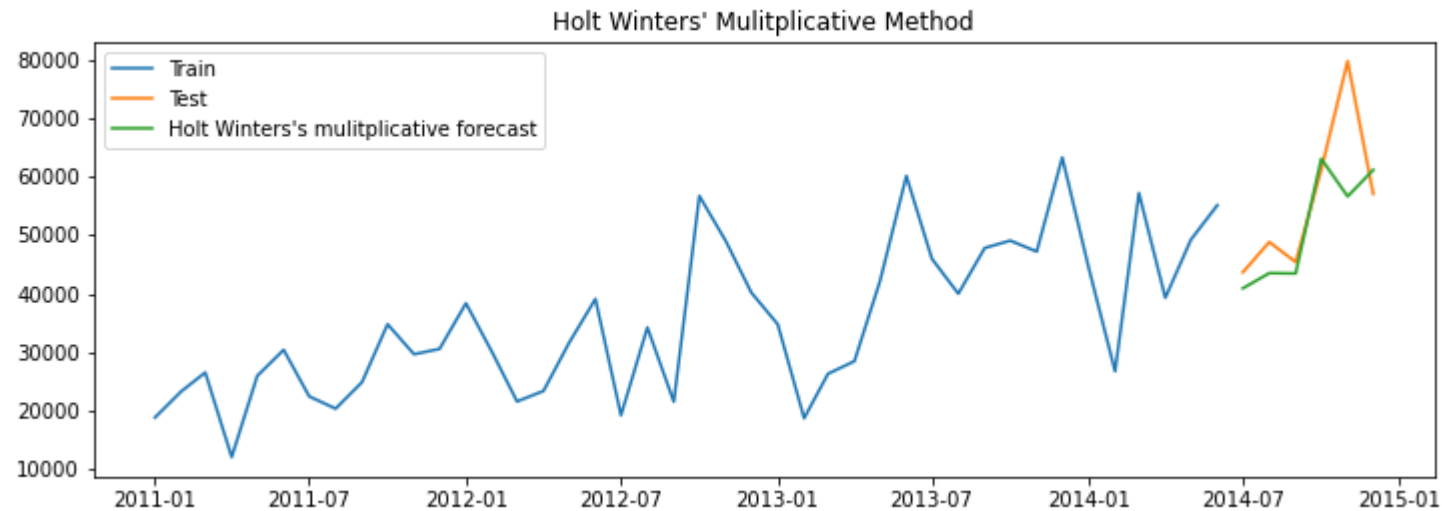


Sales Forecast for
APAC Consumer
(MAPE = 8.84)

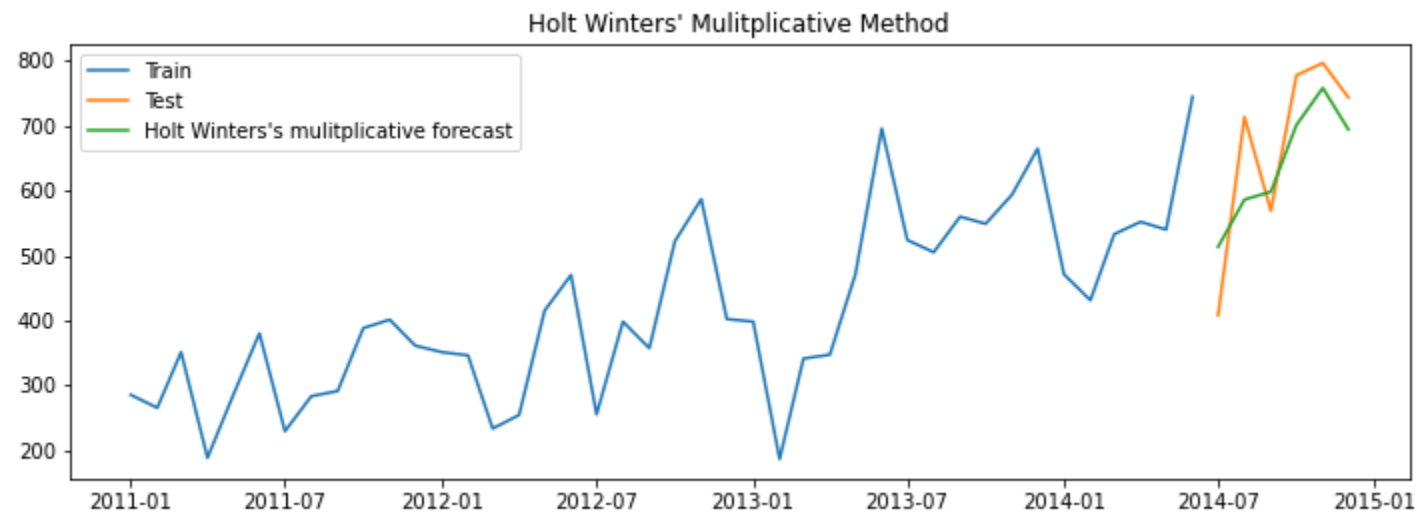


Quantity Forecast
for APAC Consumer
(MAPE = 14.38)

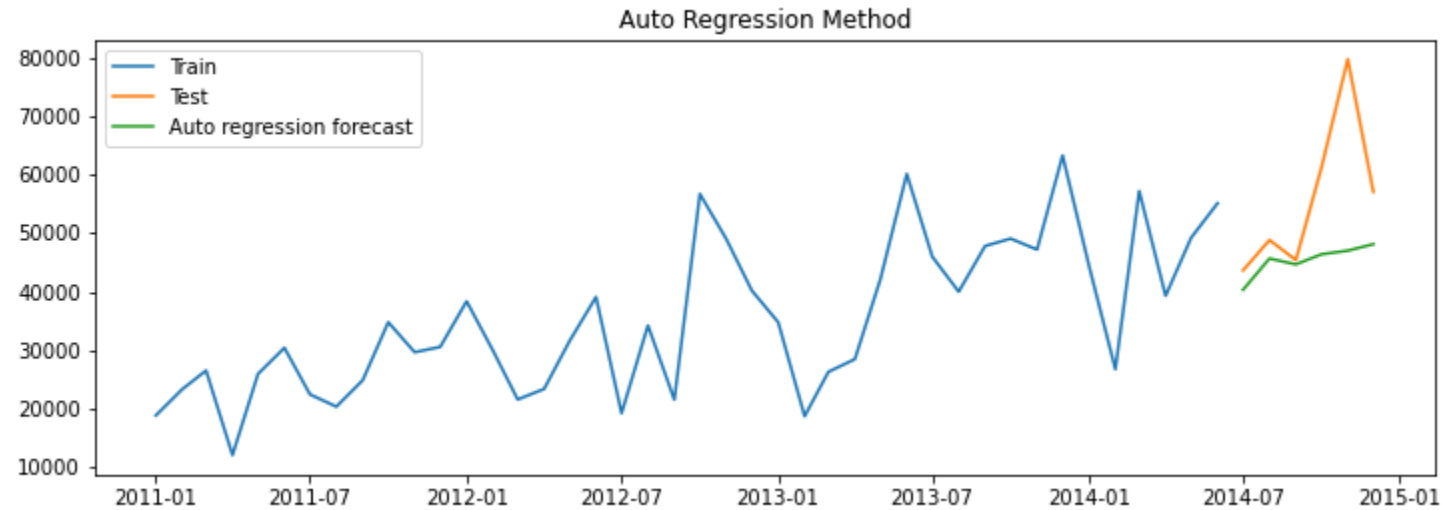
Holt-Winters' Multiplicative Method



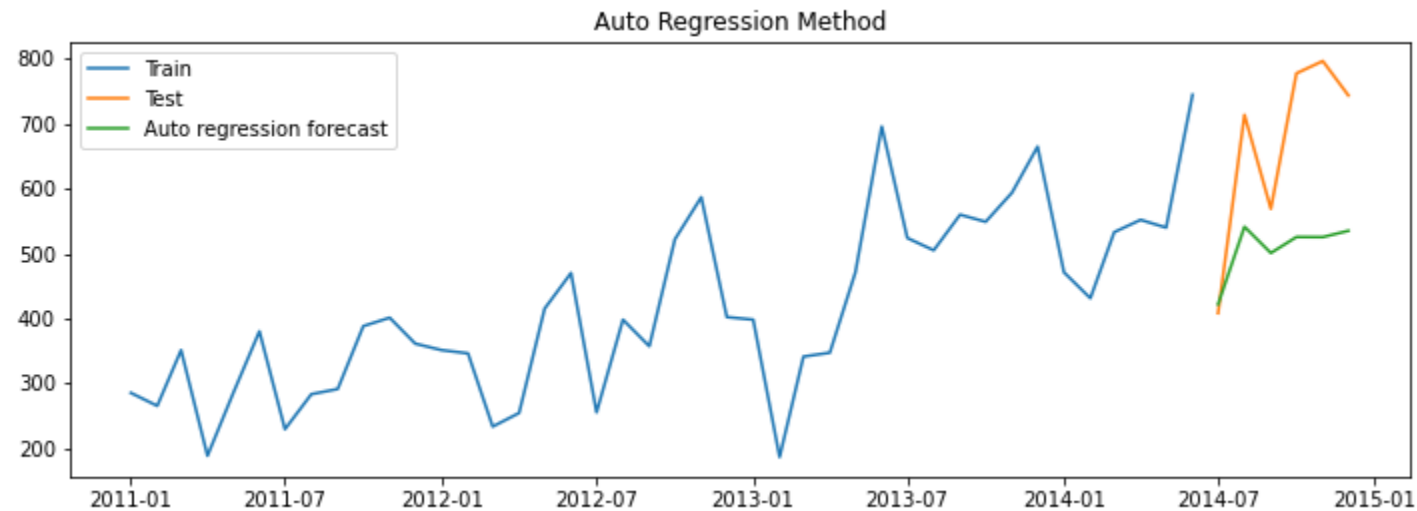
Sales Forecast for
APAC Consumer
(MAPE = 10.12)



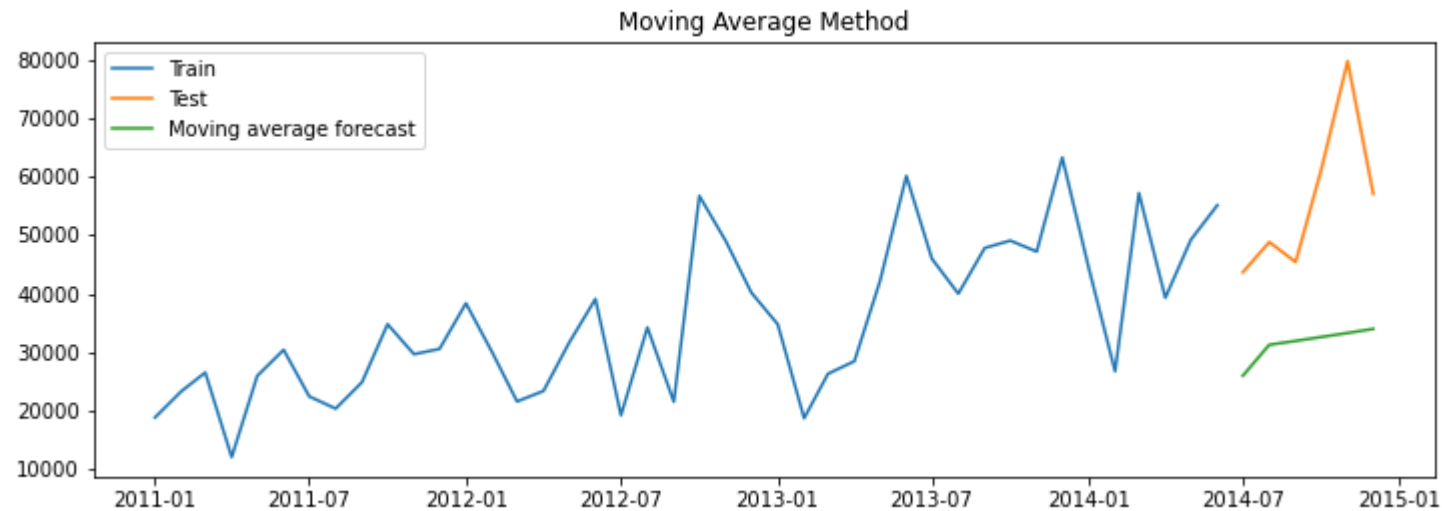
Quantity Forecast
for APAC Consumer
(MAPE = 11.71)



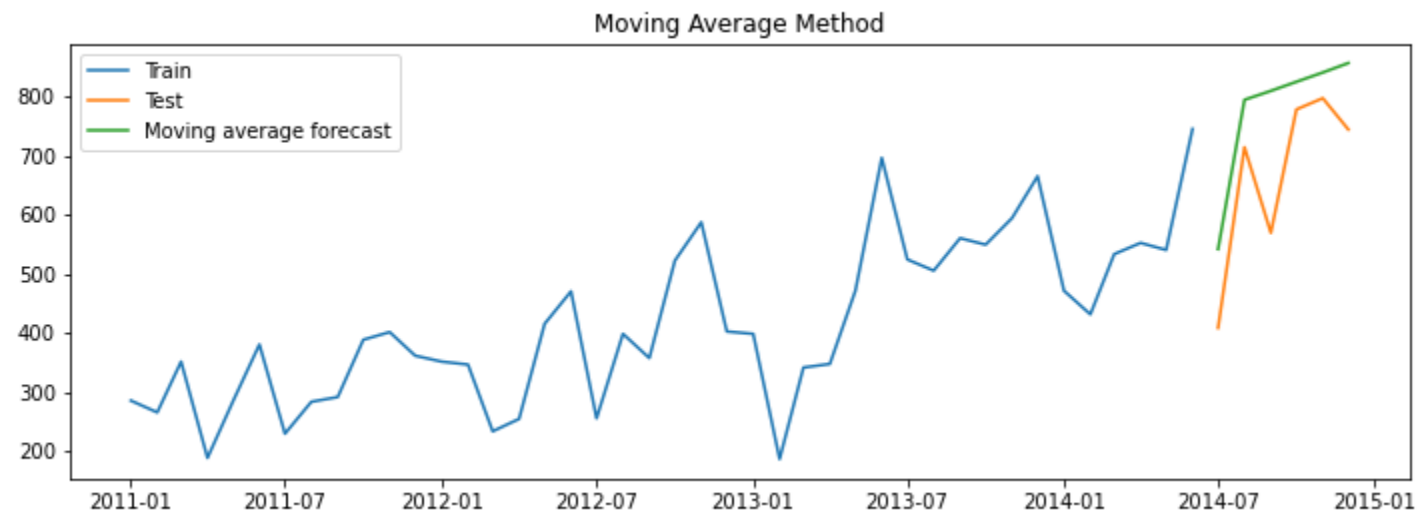
Sales Forecast for
APAC Consumer
(MAPE = 16.11)



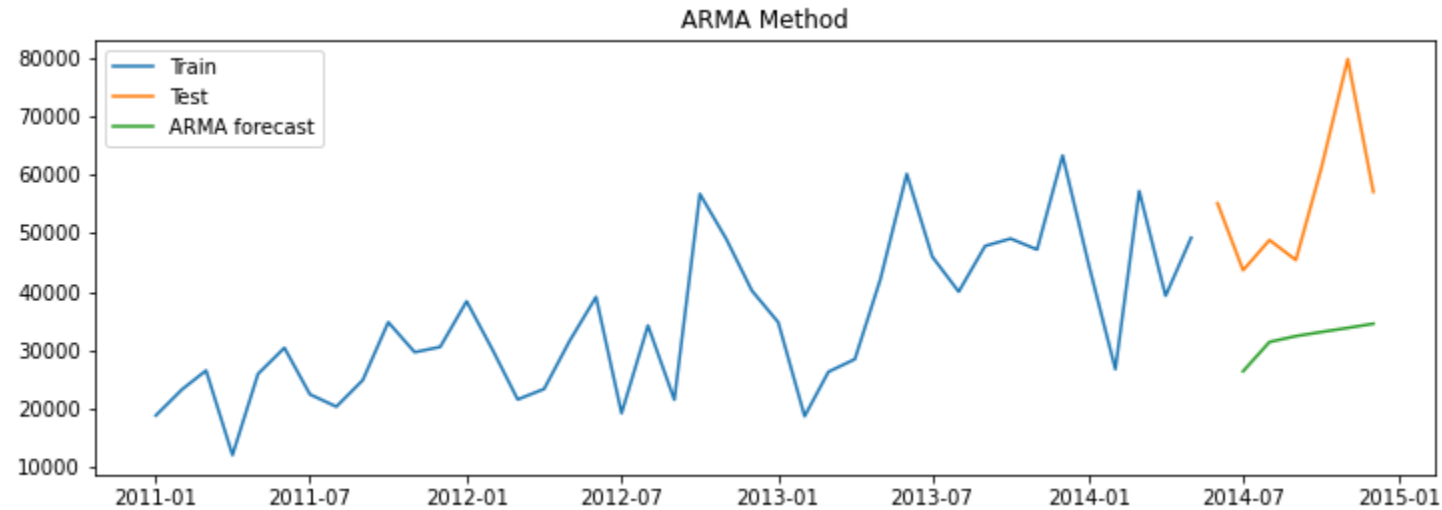
Quantity Forecast
for APAC Consumer
(MAPE = 22.36)



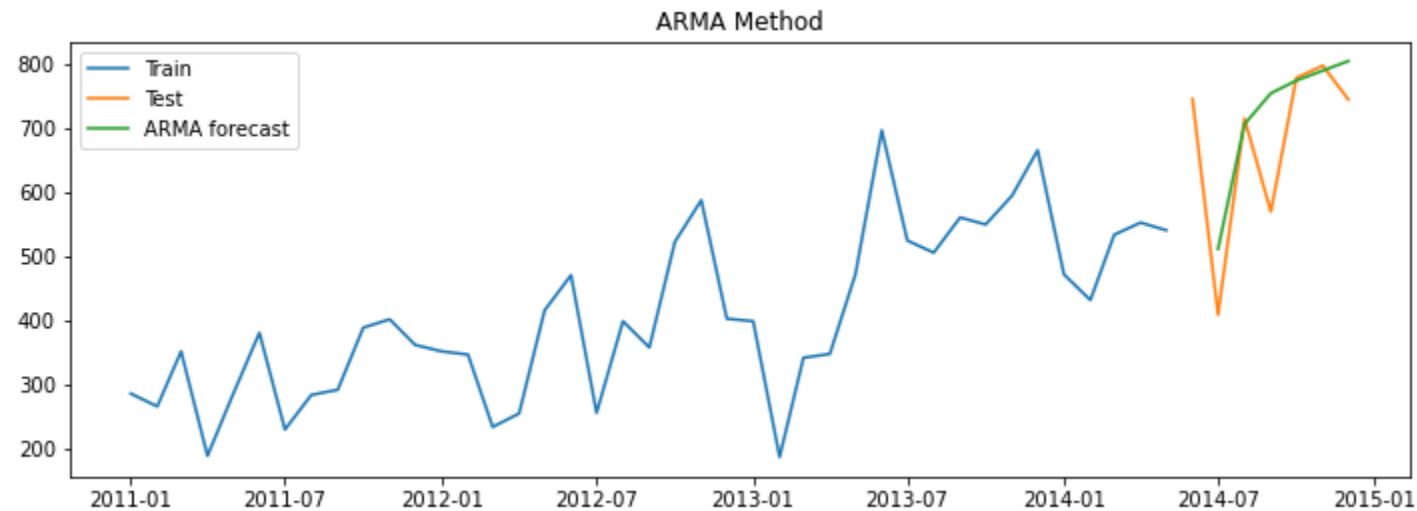
Sales Forecast for
APAC Consumer
(MAPE = 41.97)



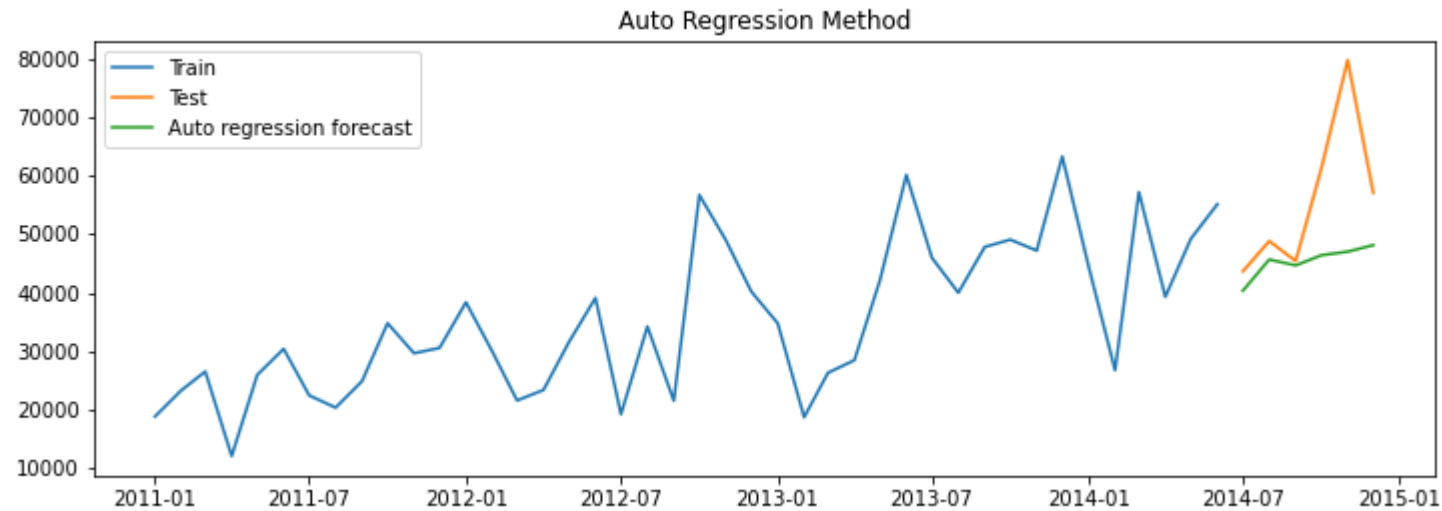
Quantity Forecast
for APAC Consumer
(MAPE = 18.80)



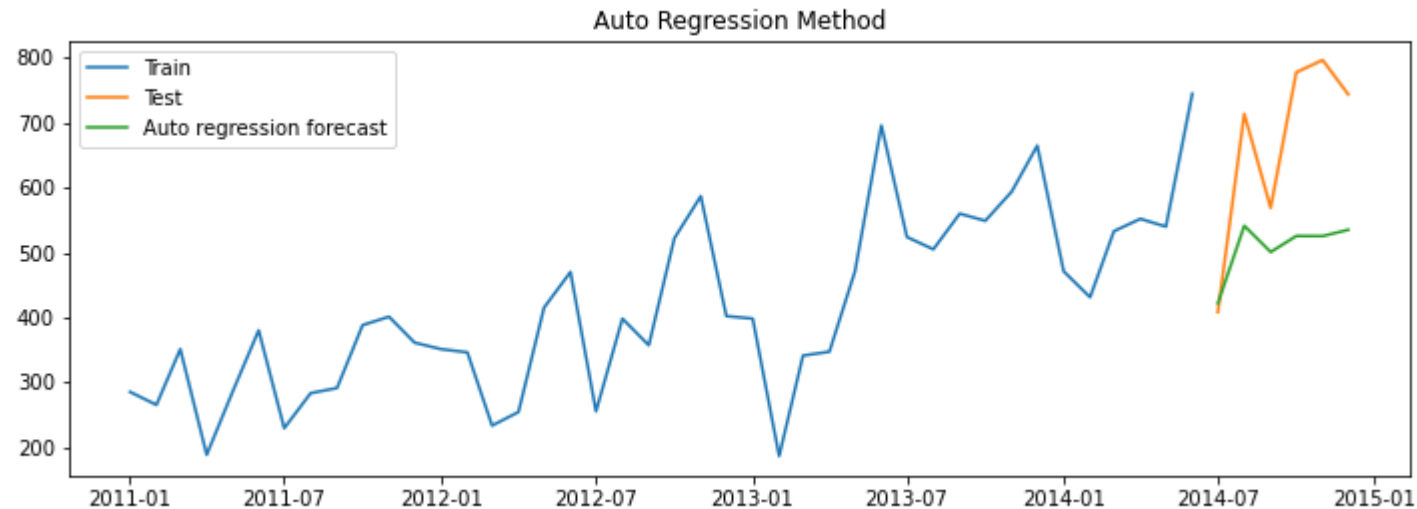
Sales Forecast for
APAC Consumer
(MAPE = 41.17)



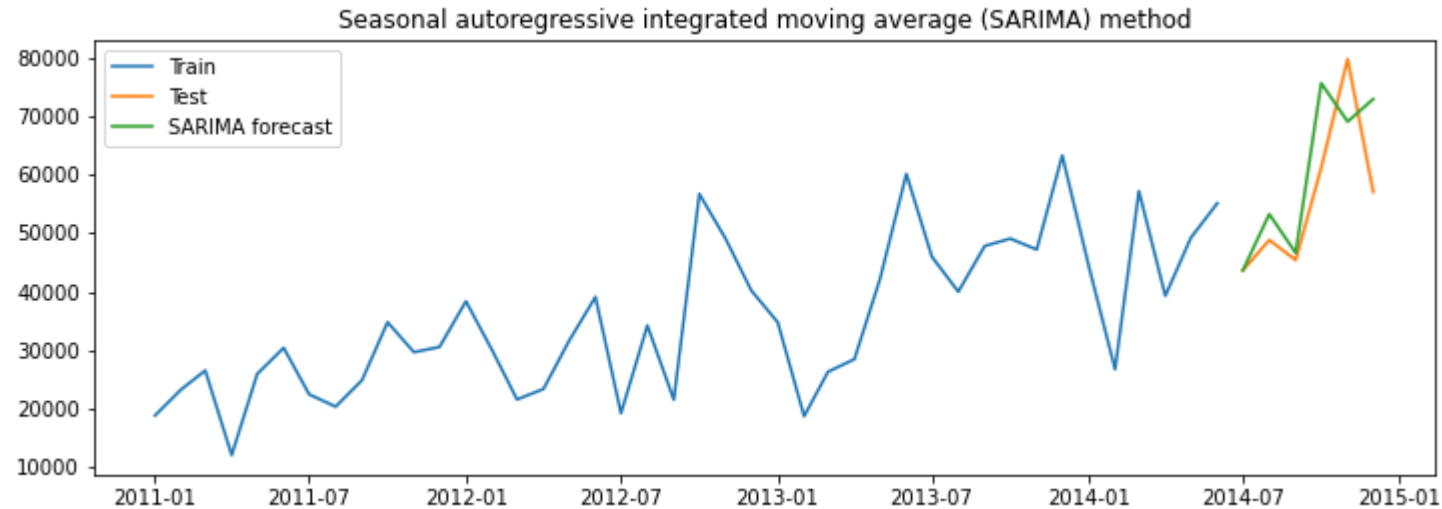
Quantity Forecast
for APAC Consumer
(MAPE = 11.43)



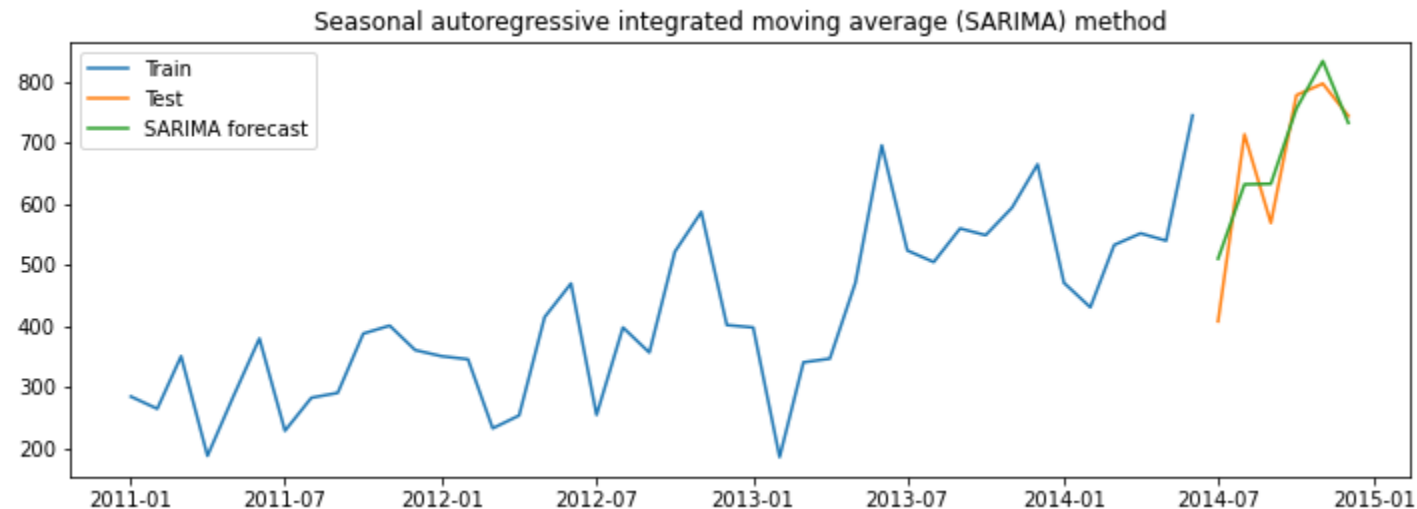
Sales Forecast for
APAC Consumer
(MAPE = 16.11)



Quantity Forecast
for APAC Consumer
(MAPE = 22.36)



Sales Forecast for
APAC Consumer
(MAPE = 12.79)



Quantity Forecast
for APAC Consumer
(MAPE = 9.47)

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4. **Finding the optimum method in Smoothing Techniques and ARIMA Techniques**

Sales Forecast (APAC Consumer)

Method	MAPE
Simple exponential smoothing method	15.99
Holt's exponential smoothing method	15.03
Holt Winters' additive method	8.84
Holt Winters' multiplicative method	10.12
AR	16.11
MA	41.97
ARMA	41.17
ARIMA	16.11
SARIMA	12.79

Quantity Forecast (APAC Consumer)

Method	MAPE
Simple exponential smoothing method	23.10
Holt's exponential smoothing method	20.83
Holt Winters' additive method	14.38
Holt Winters' multiplicative method	11.71
AR	22.36
MA	18.80
ARMA	11.43
ARIMA	22.36
SARIMA	9.47

1. For the sales forecast, the Holt-Winters additive plot is able to predict the level, trend as well the seasonality better and the forecast fits better to the actual values as compared to other models
2. The trend appears linearly varying in the sales data and thus the Holt-Winters' additive method works well as compared to the multiplicative method.
3. This is also able to predict the seasonal component better as compared to the other models
4. Also, the MAPE value for this method is the least that is around 8.84

1. For the sales forecast, the SARIMA plot is better to the actual values as compared to other models and it fits the sales plot the best among all the ARIMA techniques
2. This is also able to predict the seasonal component better as compared to the other models
3. Also, the MAPE value for this method is the least that is around 12.79

1. For the quantity forecast, the Holt-Winters multiplicative plot is able to predict the level, trend as well the seasonality better and the forecast fits better to the actual values as compared to other models
2. The trend appears slightly non-linearly varying in the sales data and thus the Holt-Winters' multiplicative method works well as compared to the additive method.
3. This is also able to predict the seasonal component better as compared to the other models
4. Also, the MAPE value for this method is the least that is around 11.71

1. For the quantity forecast also, the SARIMA plot is better to the actual values as compared to other models and it fits the sales plot the best among all the ARIMA techniques
2. This is also able to predict the seasonal component better as compared to the other models
3. Also, the MAPE value for this method is the least that is around 9.47

Thank You