

# Retail-Giant Sales Forecasting Case Study

## SUBMISSION

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# Business Problem

- “Global Mart” is an online store super giant having worldwide operations. It takes orders and delivers across the globe and deals with all the major product categories - consumer, corporate & home office.
- The store caters to 7 different markets and in 3 major segments.
- To finalize the plan for the next 6 months, the most consistently profitable segments from the store’s buckets need to be identified. For these two market segments, sales and demand will be forecast for the next 6 months to be able to manage the revenue and inventory accordingly.



## Business Problem Understanding

- “Global Mart” has worldwide operations and deals with consumer, corporate & home office product categories in 7 different markets.
- To manage inventory and revenue for the next 6 months, the most consistently profitable segments from the store’s buckets need to be identified and their sales and demand will be forecast.

## Understanding Data

- Sales data from 2011-2014 is available.
- Dataset has 51290 observations and 24 variables where row represents unique products demanded under the same order ID.
- Africa, APAC, Canada, EMEA, EU, LATAM and US are the markets of Global Mart services.

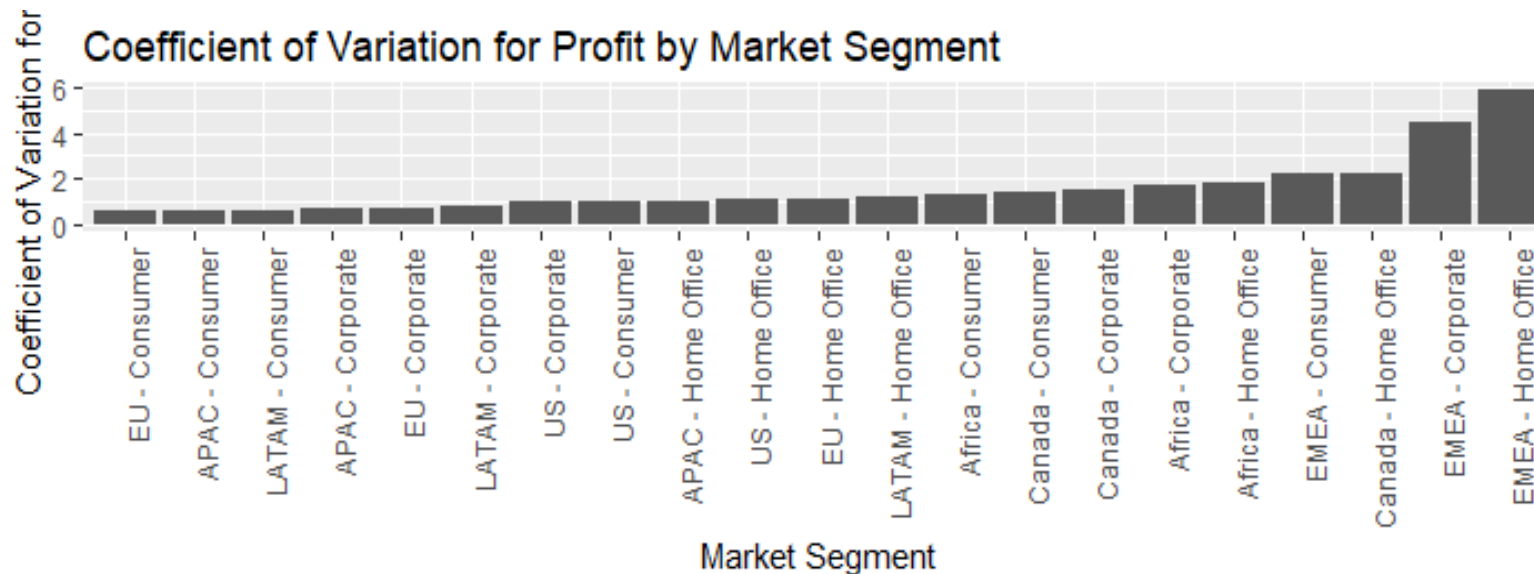
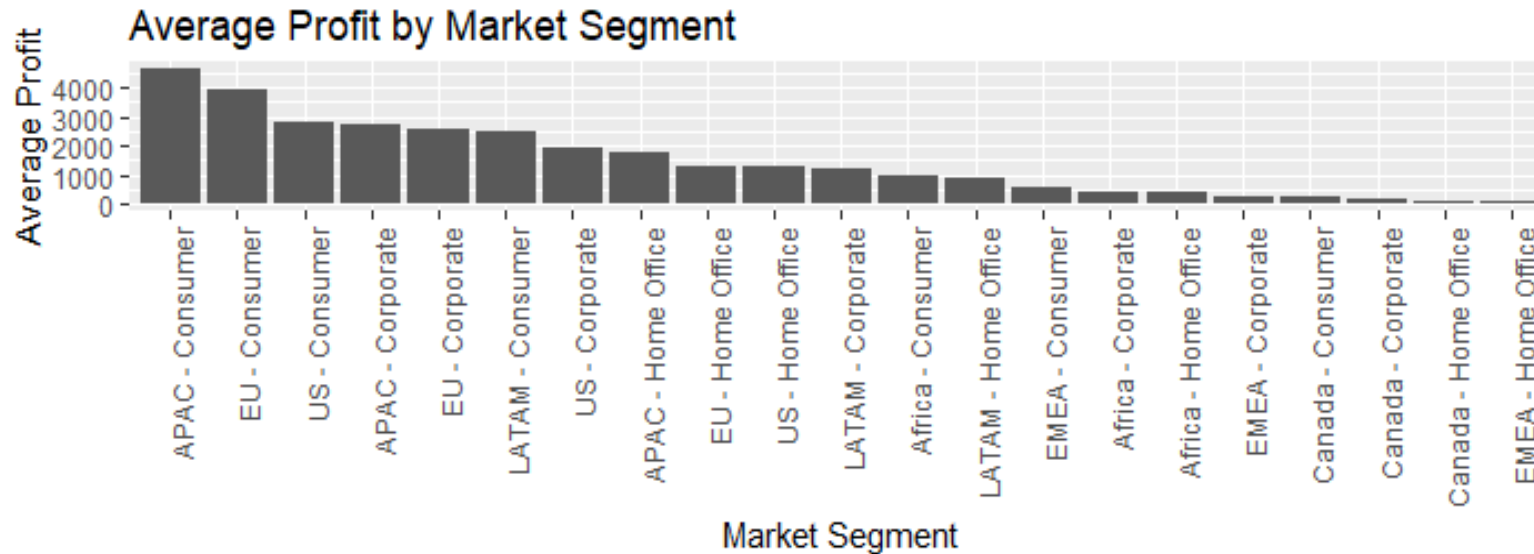
## Data Preparation

- Checking for Duplicates
- Clean format of date variables
- Removing unnecessary features
- Consolidate data by Month for Analysis
- Identify Best market segments based on volume and consistency of profits.

## Modelling & Forecasting

- Prepare & plot Time Series Data for Sales & Quantity
- Segregation of data to training and test
- Smoothen TS Data using Moving Average Smoothing
- Decompose TS, obtain ACF/PACF plot
- Predict values obtained via Classical Decomposition and Auto ARIMA
- Use MAPE to test accuracy

# Selection of Top 2 Market Segments



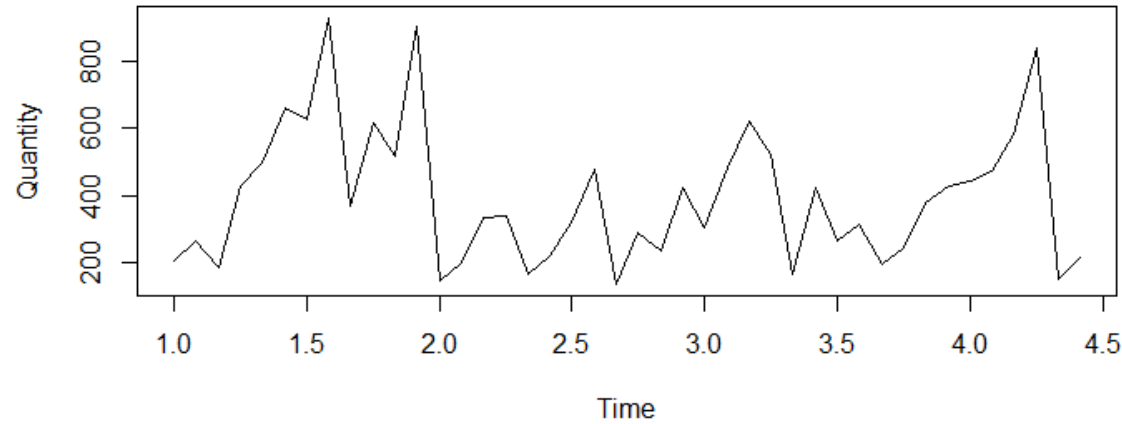
Judging by the average profit and the coefficient of variation for profit, the two market segments consistently most profitable are:

1. EU Consumer
2. APAC Consumer

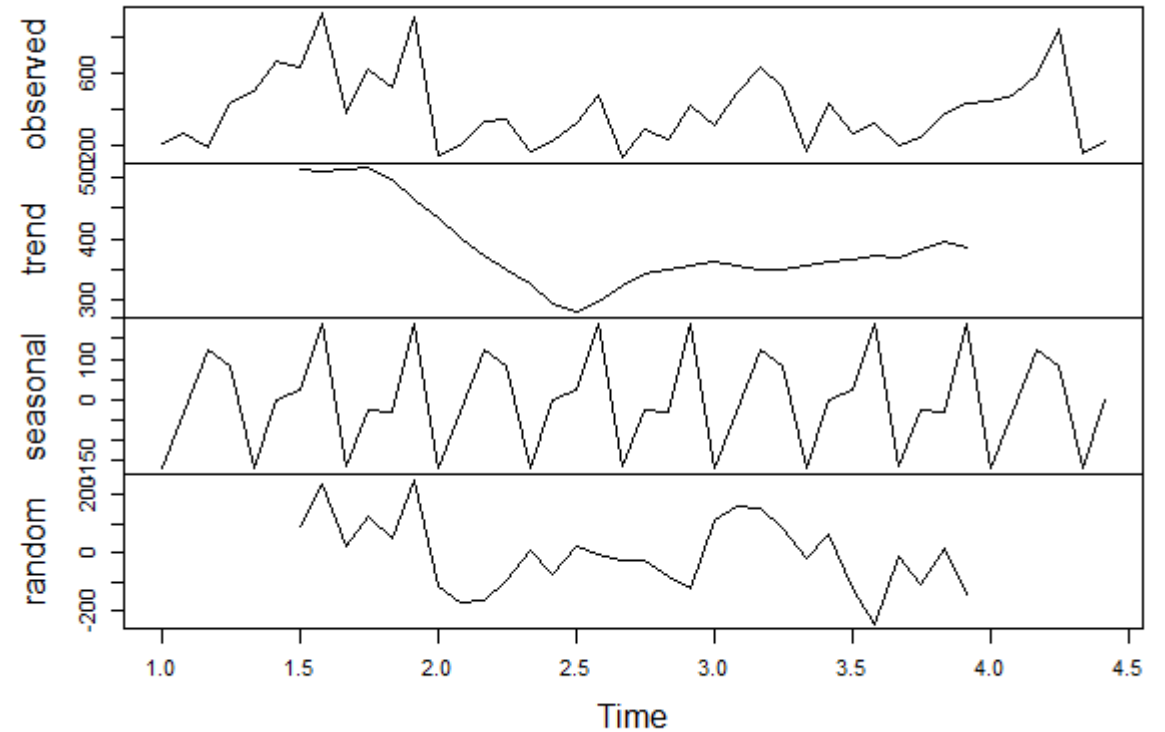
Both Market Segments have the highest average profit and lowest coefficient of variation for profit.

# EU Consumer Segment – Quantity Demanded

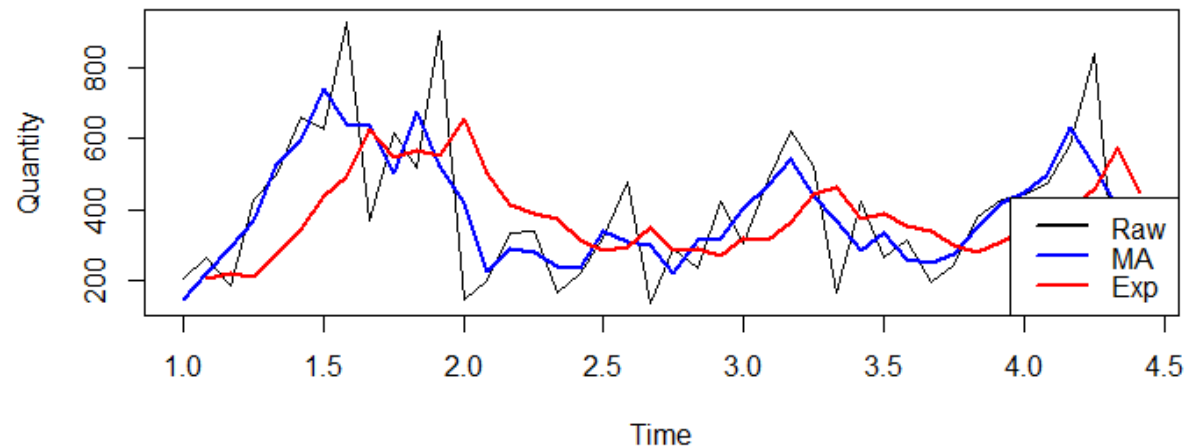
**TS Plot of Quantity (EU- Consumer Segment)**



**Decomposed TS of Quantity (EU- Consumer Segment)**



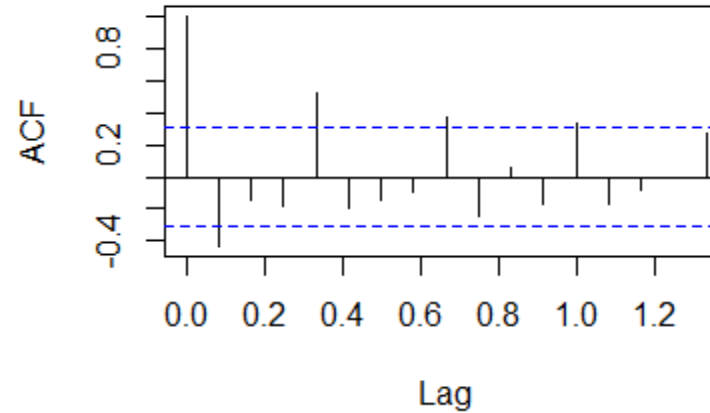
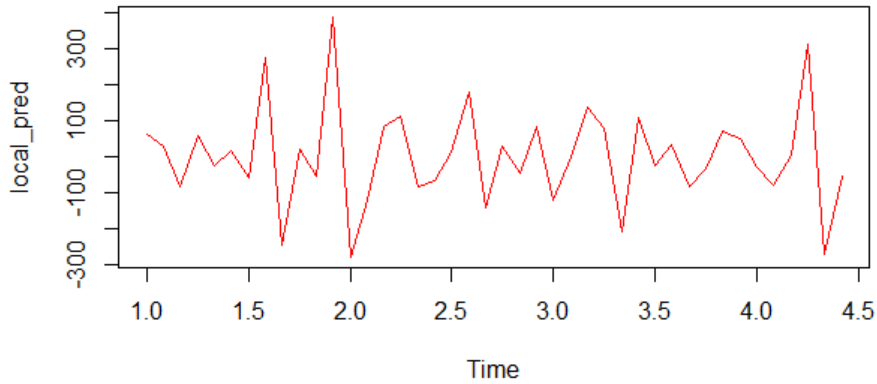
**Smoothed TS Plot of Quantity (EU- Consumer Segment)**



# EU Consumer Segment – Quantity Demanded

## Classical Decomposition

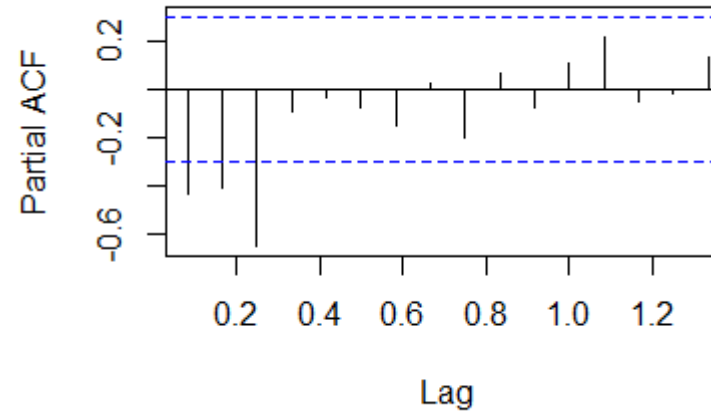
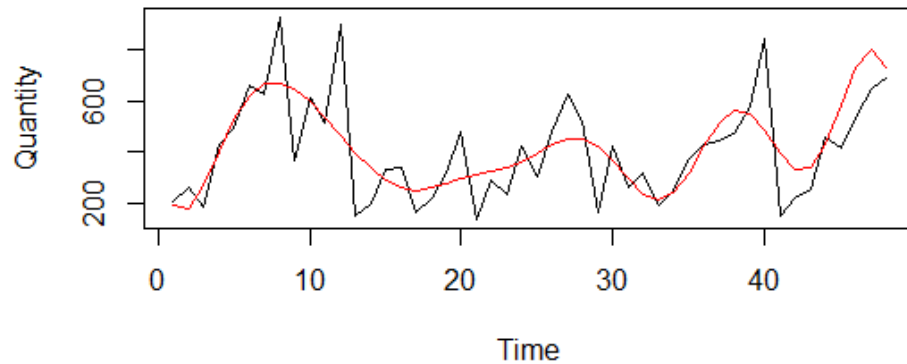
Locally Predictable Series- Quantity (EU Consumer Segment)



Auto ARIMA

ARIMA	(3,0,0)
ADF Test p-value	0.01
KPSS Test p-value	0.1
AIC	518.26
MAPE	34.47

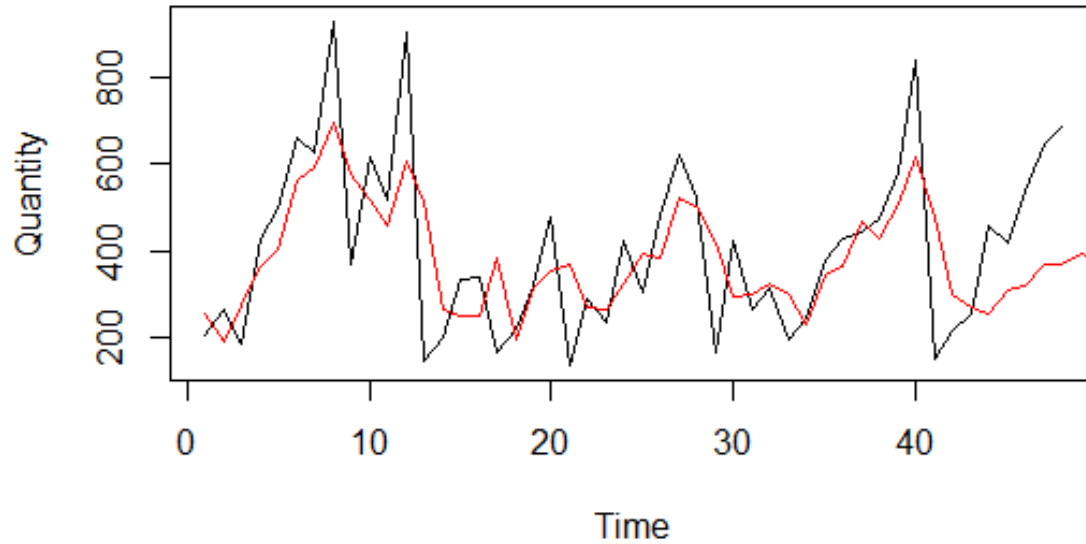
TS predicted via Classical Decomposition  
Quantity (EU Consumer)



# EU Consumer Segment – Quantity Demanded

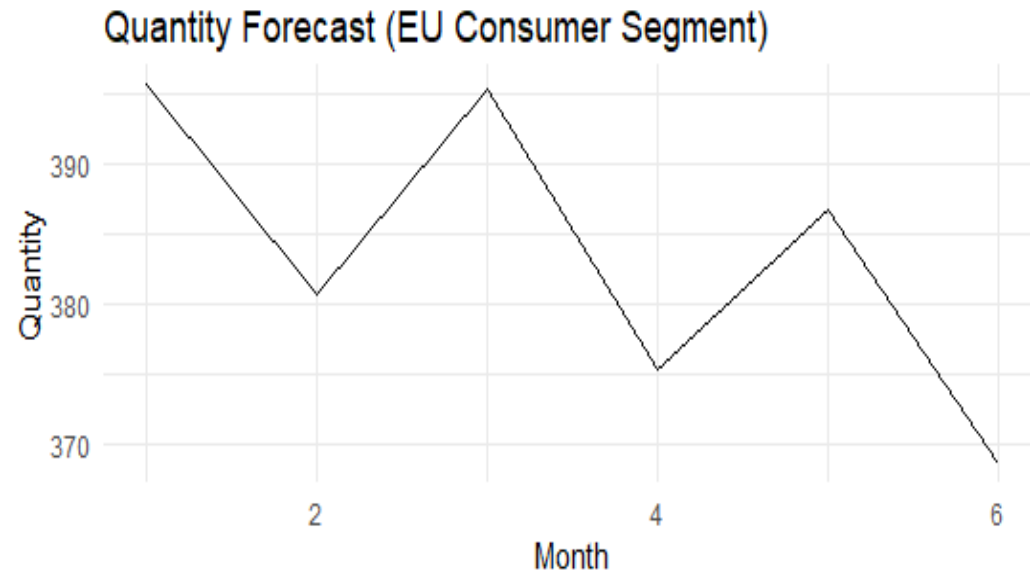
## Auto ARIMA

**Predicted TS- Quantity (EU- Consumer Segment)**



Auto ARIMA	
ARIMA	(3,0,1)
ADF Test p-value	0.3173
KPSS Test p-value	0.1
AIC	494.34
MAPE	34.48

# EU Consumer Segment – Quantity Demanded Forecast

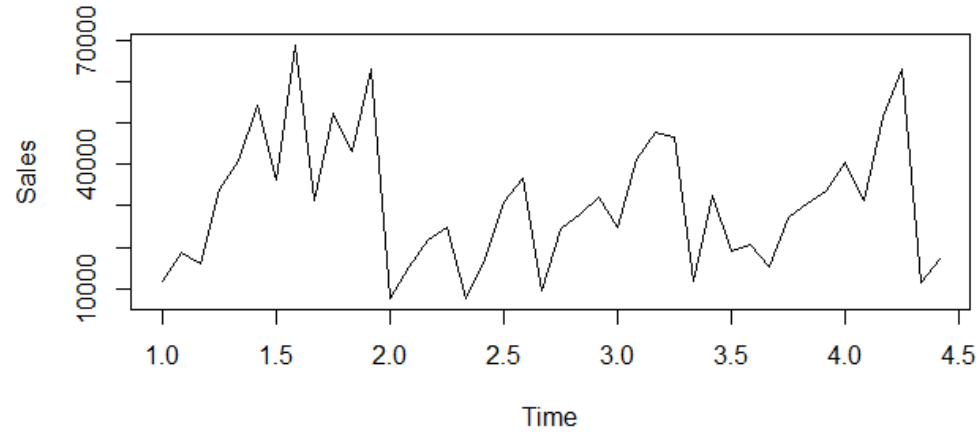


Forecast for the next 6 months for Quantity Demanded of EU Consumers shows a downward trend. This means the Demand is likely to fall.

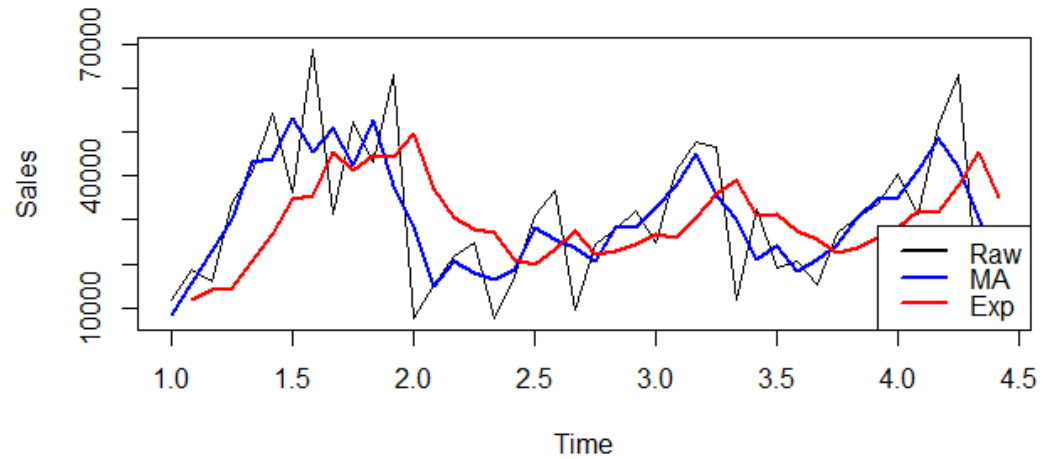


# EU Consumer Segment - Sales

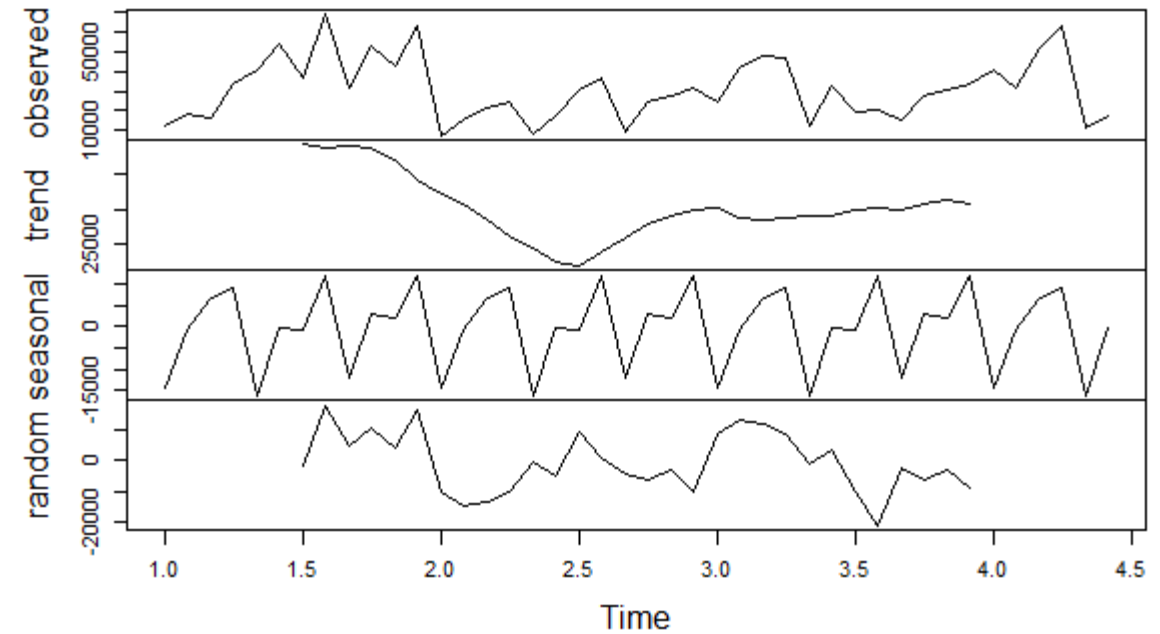
**TS plot of Sales (EU-Consumer Segment)**



**Smoothed TS plot of Sales (EU-Consumer Segment)**



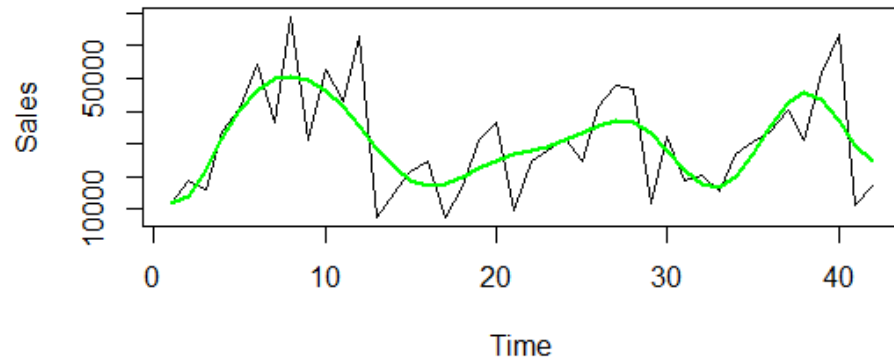
**Decomposition of additive time series**



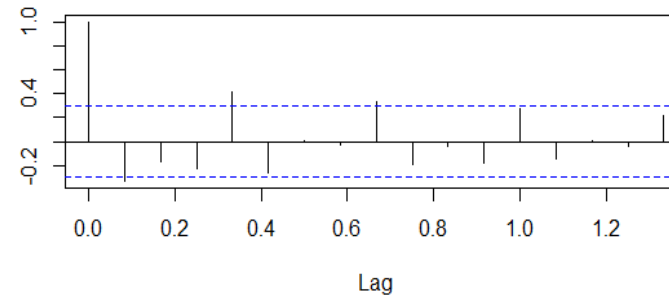
# EU Consumer Segment - Sales

## Classical Decomposition

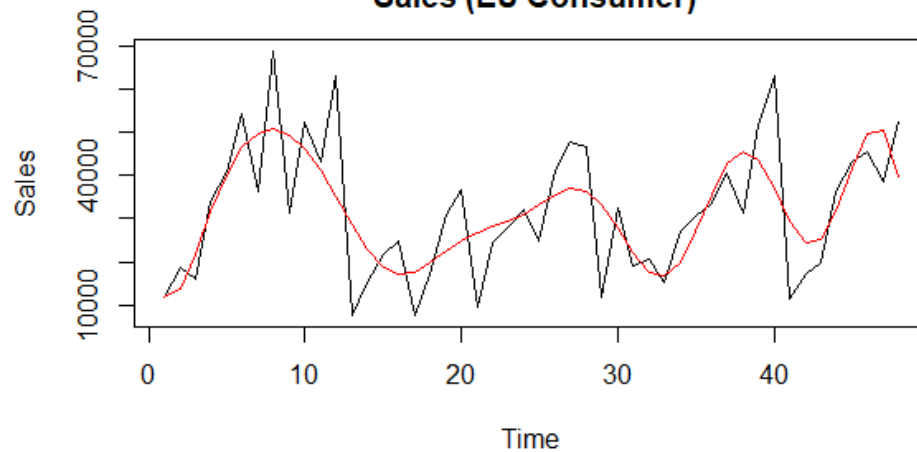
**Trend of Sales (EU-Consumer Segment)**



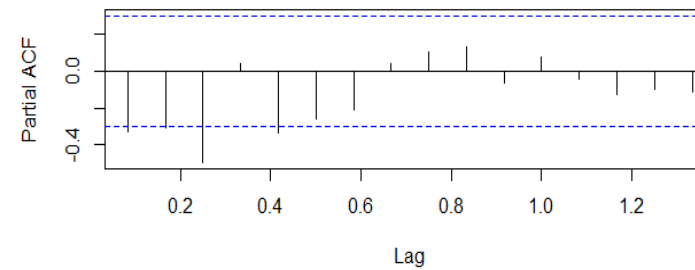
**Series local\_pred**



**TS Predicted via Classical Decomposition  
Sales (EU Consumer)**



**Series local\_pred**

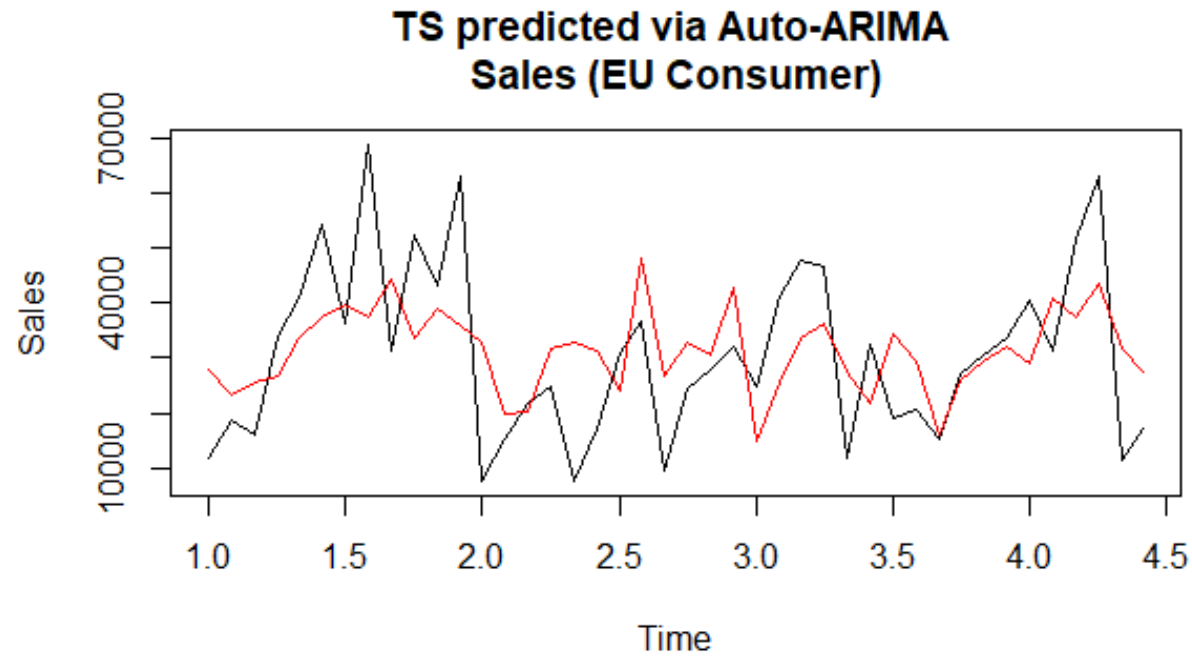


### Classical Decomposition

ARIMA	(3,0,0)
ADF Test p-value	0.01
KPSS Test p-value	0.1
AIC	887.52
MAPE	17.54

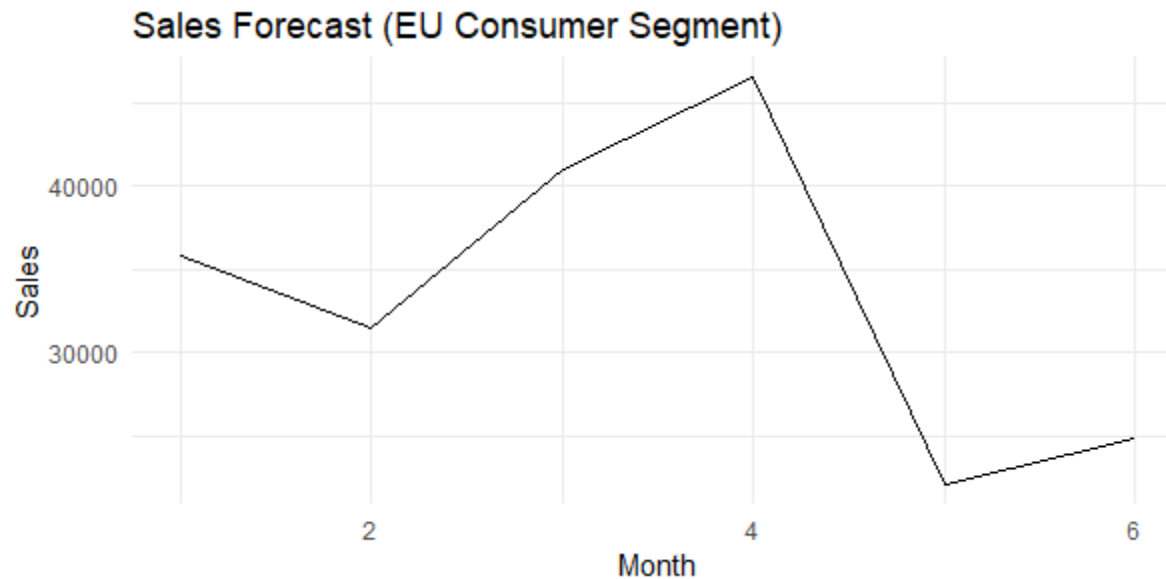
# EU Consumer Segment - Sales

## Auto ARIMA



Auto ARIMA	
ARIMA	(1,0,0)(1,0,0)[12]
ADF Test p-value	0.52
KPSS Test p-value	0.1
AIC	930.62
MAPE	28.94

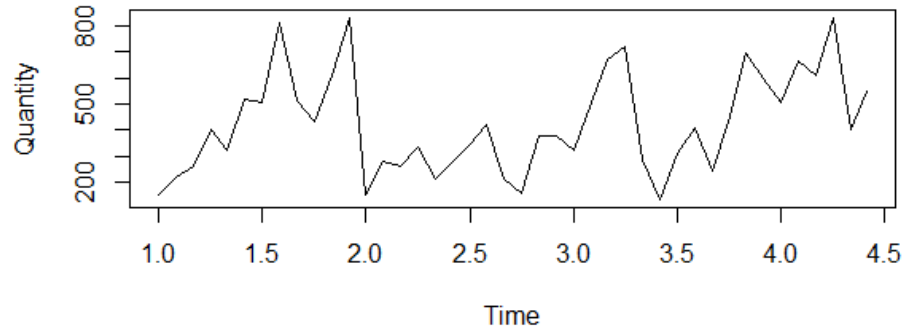
# EU Consumer Segment – Sales Forecast



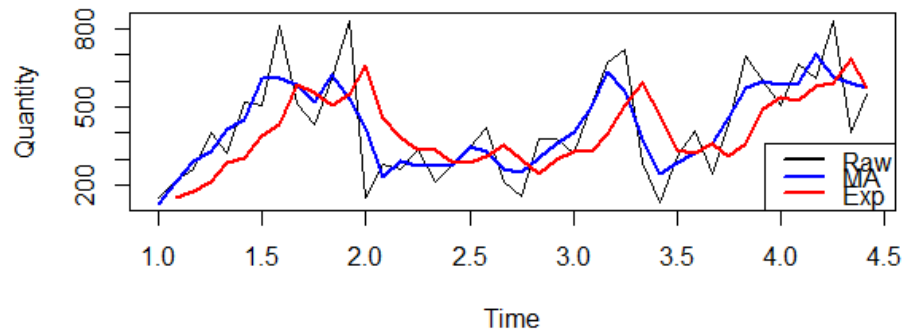
Forecast for the next 6 months for Sales of EU Consumers shows a downward trend. This means the Sales is likely to fall.

# APAC Consumer Segment – Quantity

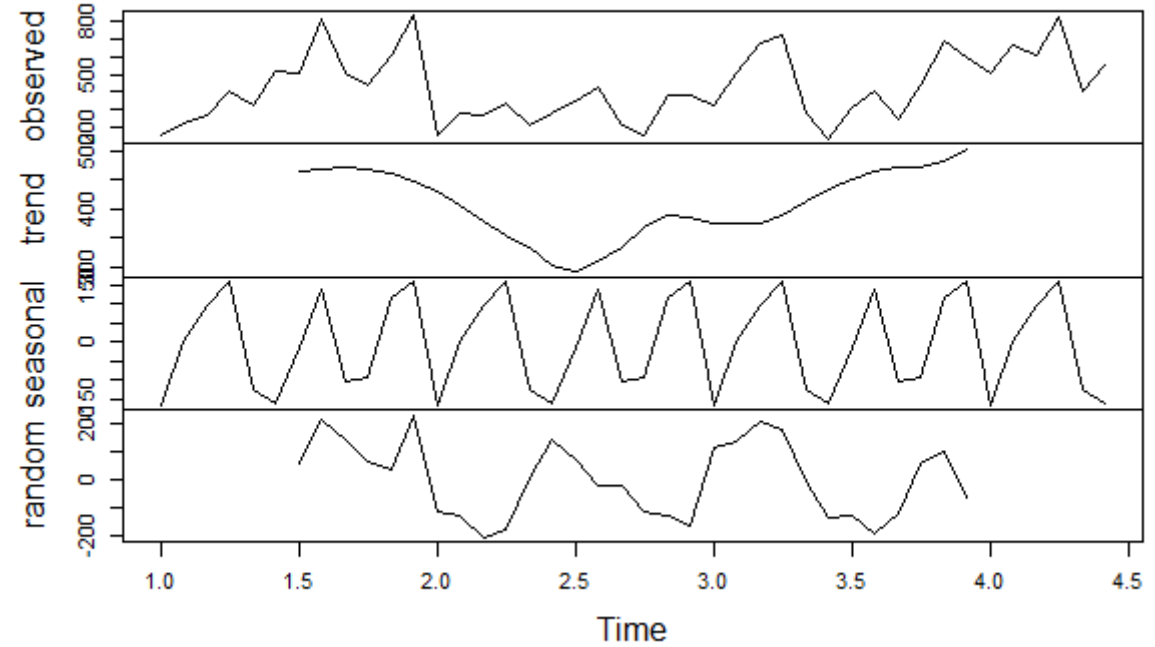
**TS plot of Quantity (APAC Consumer Segment)**



**Smoothed TS plot of Quantity (APAC Consumer Segment)**



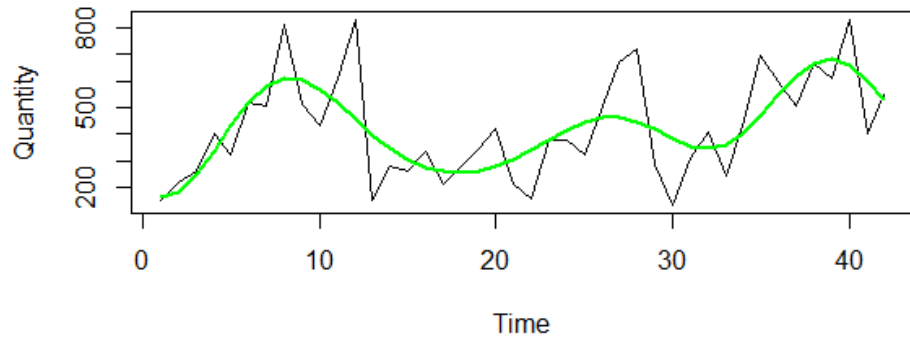
**Decomposition of additive time series**



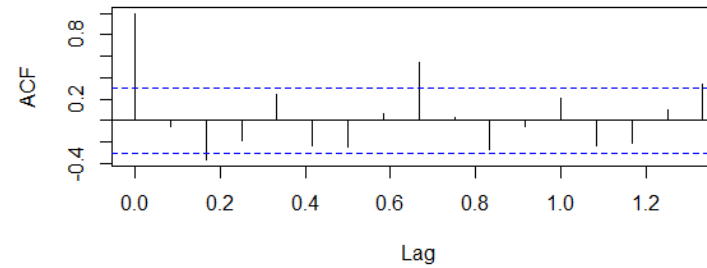
# APAC Consumer Segment – Quantity

## Classical Decomposition

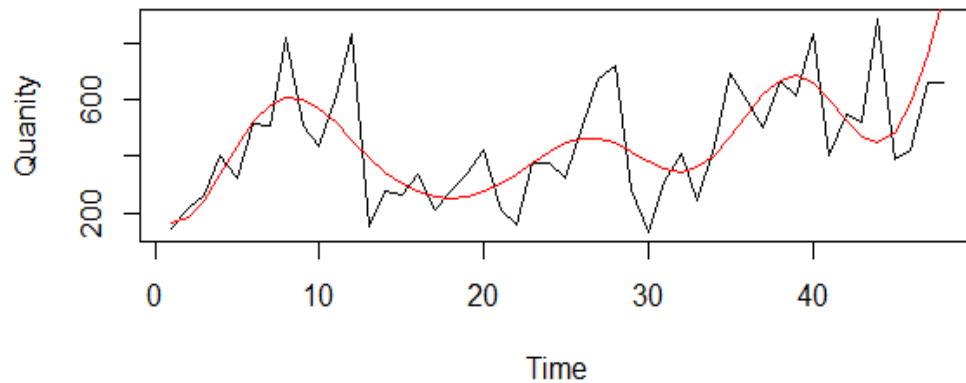
**Trend of Quantity (APAC-Consumer Segment)**



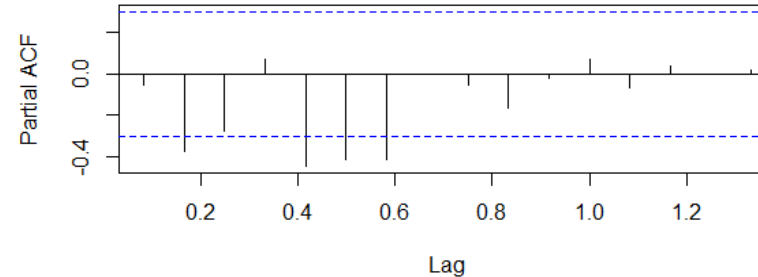
**Series local\_pred**



**TS Predicted via Classical Decomposition  
Quantity (APAC Consumer)**



**Series local\_pred**



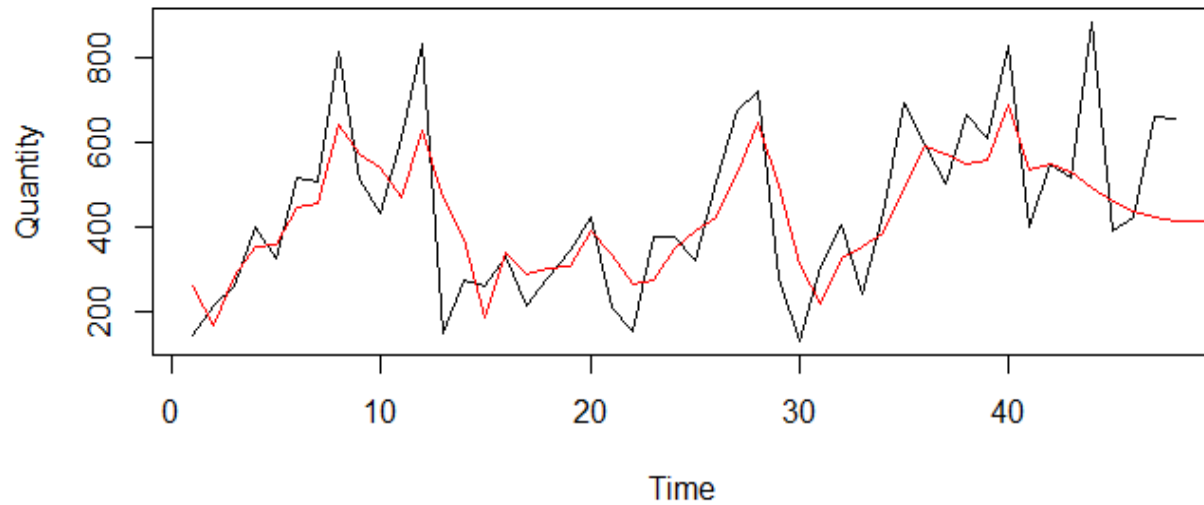
### Classical Decomposition

ARIMA	(0,0,0)
ADF Test p-value	0.04
KPSS Test p-value	0.1
AIC	533.3
MAPE	30.47

# APAC Consumer Segment - Quantity

## Auto ARIMA

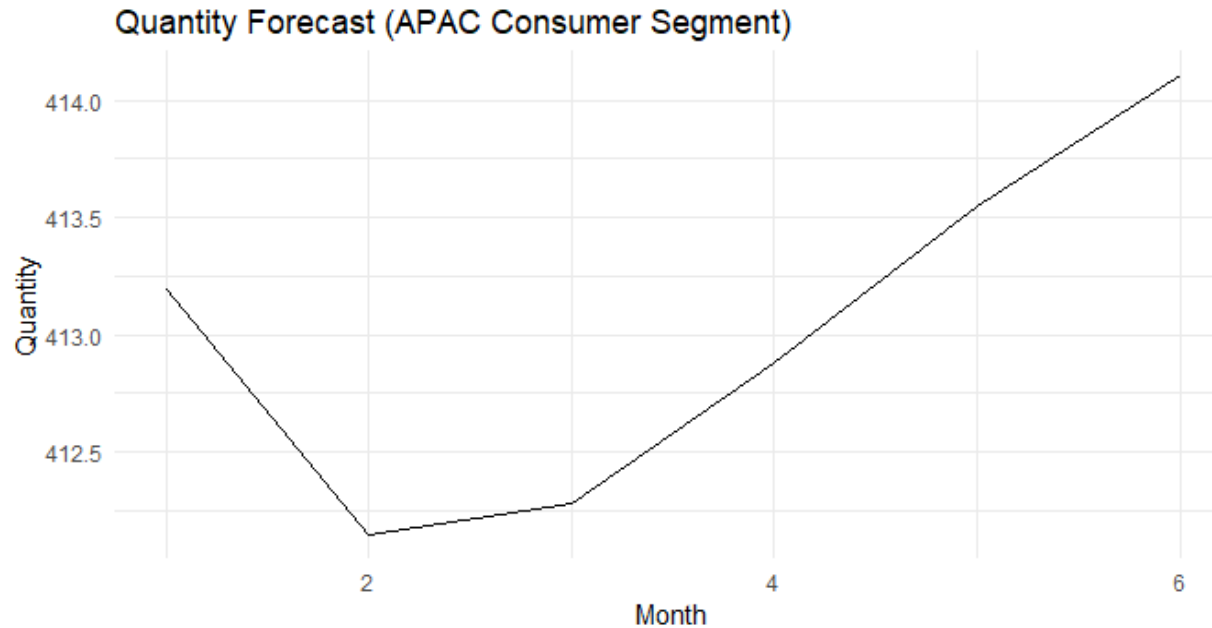
Predicted TS- Quantity (APAC- Consumer Segment)



### Auto ARIMA

ARIMA	(2,0,0)
ADF Test p-value	0.30
KPSS Test p-value	0.1
AIC	489.99
MAPE	23.46

## APAC Consumer Segment - Quantity Forecast

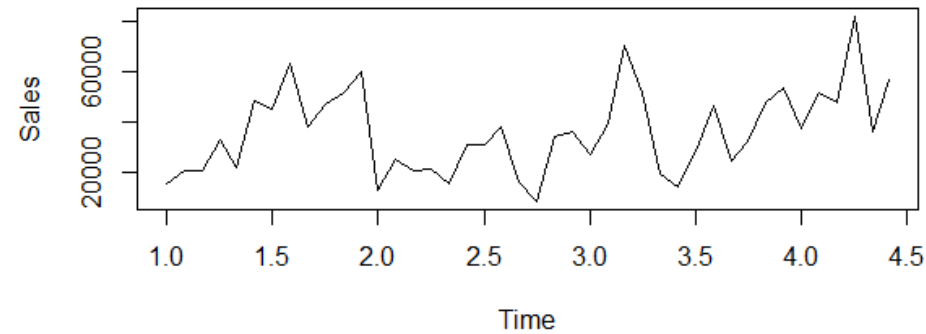


Forecast for the next 6 months for Quantity Demanded of APAC Consumers shows a drop followed by an increasing trend. This means the Demand is likely to rise.

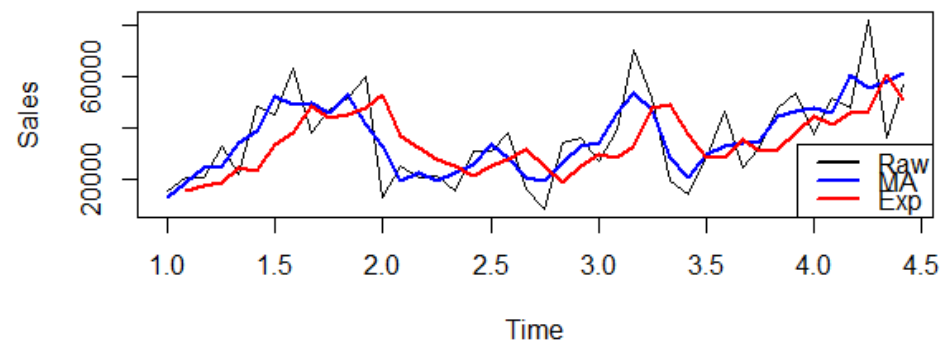


# APAC Consumer Segment - Sales

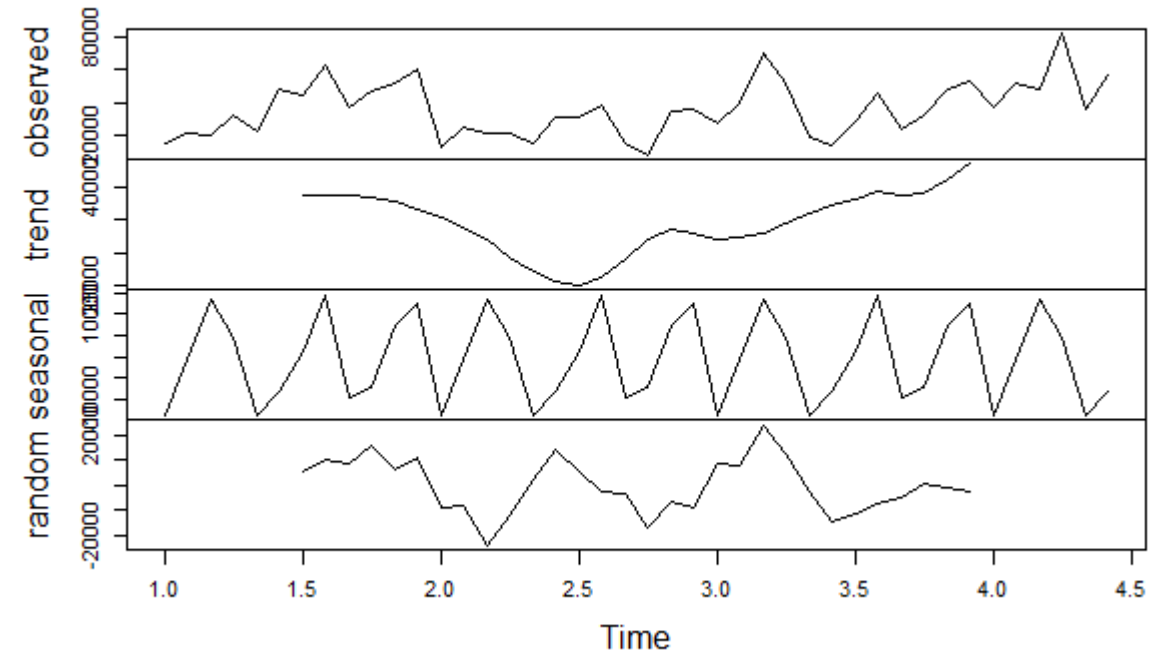
**TS Plot of Sales (APAC Consumer)**



**Smoothed TS Plot of Sales (APAC Consumer)**



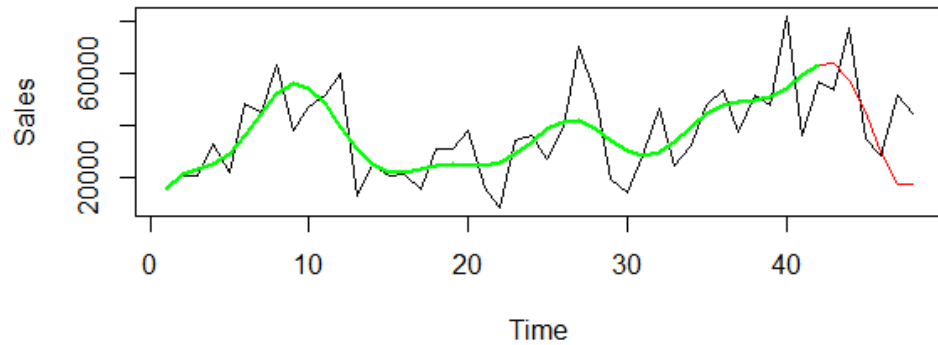
**Decomposition of additive time series**



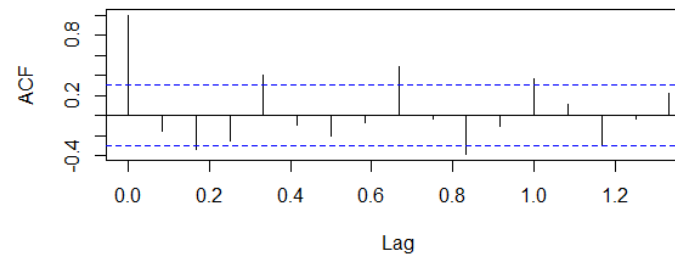
# APAC Consumer Segment - Sales

## Classical Decomposition

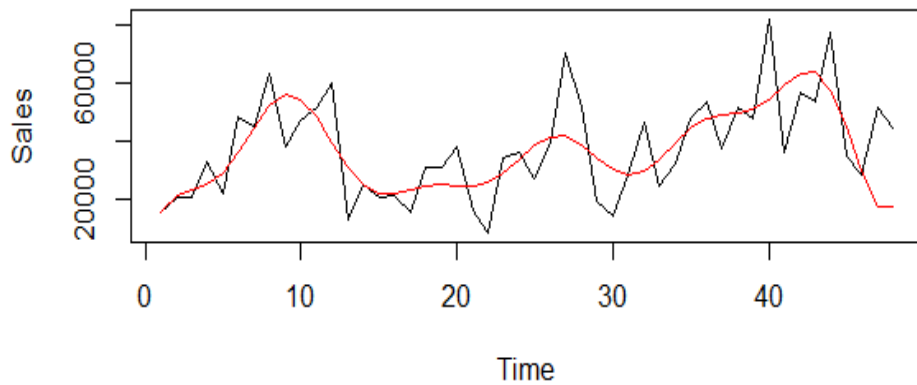
TS Predicted via Classical Decomposition  
Sales (APAC Consumer)



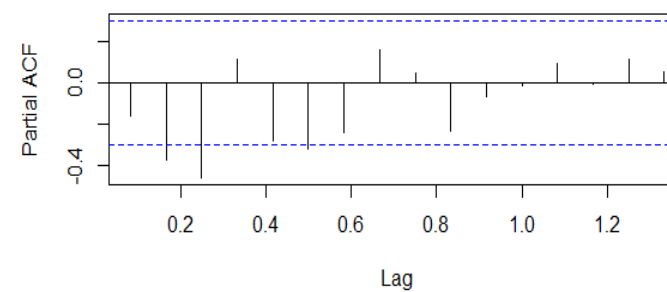
Series local\_pred



TS Predicted via Classical Decomposition  
Sales (APAC Consumer)



Series local\_pred



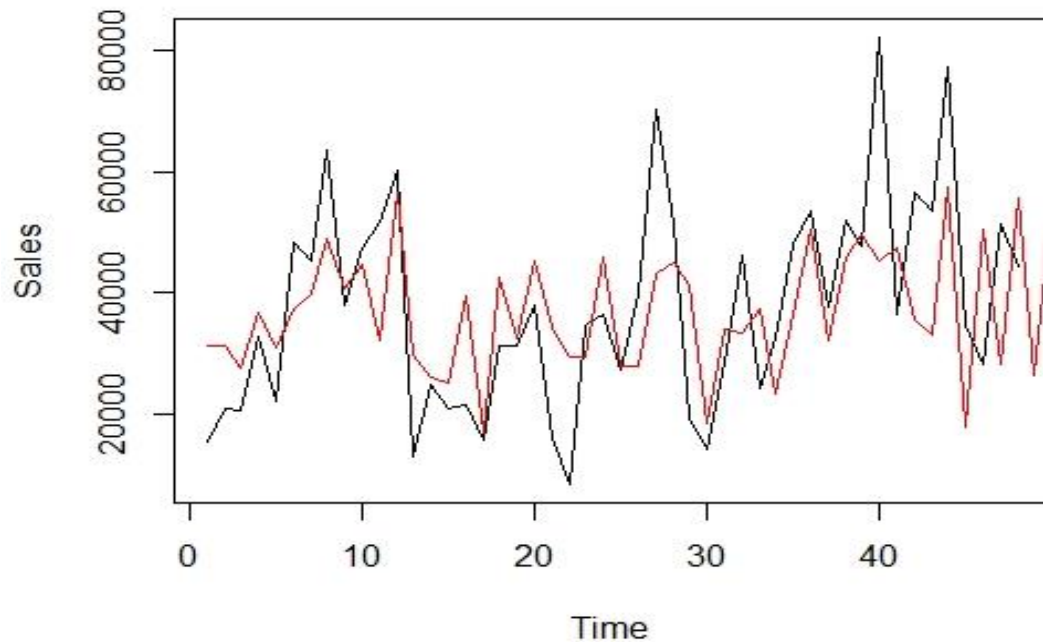
### Classical Decomposition

ARIMA	ARIMA(0,0,0)(1,0,0)[12]
ADF Test p-value	0.02
KPSS Test p-value	0.1
AIC	902.18
MAPE	34.63

# APAC Consumer Segment - Sales

## Auto ARIMA

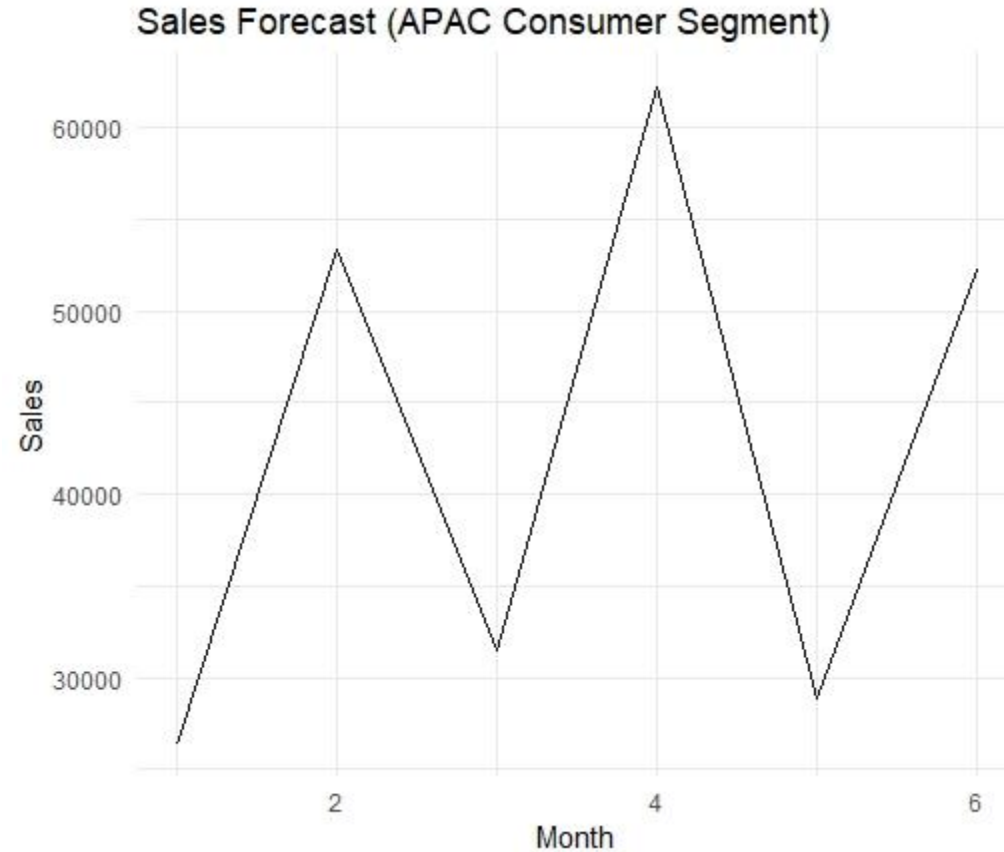
**Predicted TS- Sales (APAC- Consumer Segment)**



### Auto ARIMA

ARIMA	ARIMA(1,0,2)(1,0,0)[12]
ADF Test p-value	0.44
KPSS Test p-value	0.1
AIC	929.83
MAPE	43.62

# APAC Consumer Segment - Sales Forecast



Forecast for the next 6 months for Sales of APAC Consumers doesn't show a consistent trend. This means the Sales is likely to fluctuate.

- The two most consistently profitable segments are:
  - APAC Consumer
  - EU Consumer

MAPE Comparison			
	Classical Decomposition	Auto ARIMA	Performance
EU Consumer Quantity	34.47	34.48	Similar
EU Consumer Sales	17.54	28.94	Classical Decomposition performs better
APAC Consumer Quantity	30.47	23.46	Auto ARIMA performs better
APAC Consumer Sales	34.63	43.62	Classical Decomposition performs better

- In the EU Consumer Segment, *Quantity Demanded* would show a downward trend in the next six months. Inventory would have to be kept low. *Sales* would show a drop in the next six months. Marketing could be increased to boost Sales.
- In the APAC Consumer Segment, *Quantity Demanded* is predicted to show an immediate drop followed by an increment. Inventory would have to be kept low for next two months and increased from the third month onwards. *Sales* does not show a consistent trend and is likely to fluctuate.