

RETAIL GIANT “GLOBAL MART” SALES FORECASTING

Case study by,

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Abhshek Sinha

Ayon Sarkar

Prasenjit K. Deb

Of Cohort -6

“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.

Our goal: Now as a sales/operations manager, we have to finalize the plan for the next 6 months. So, you want to forecast the sales and the demand for the next 6 months, that would help you manage the revenue and inventory accordingly.

Data understanding:

The data we have is transactional data where each row represents a particular order made on the online store.

We have 24 attributes out of which Market, segment, quantity, sales and profit are of interest.

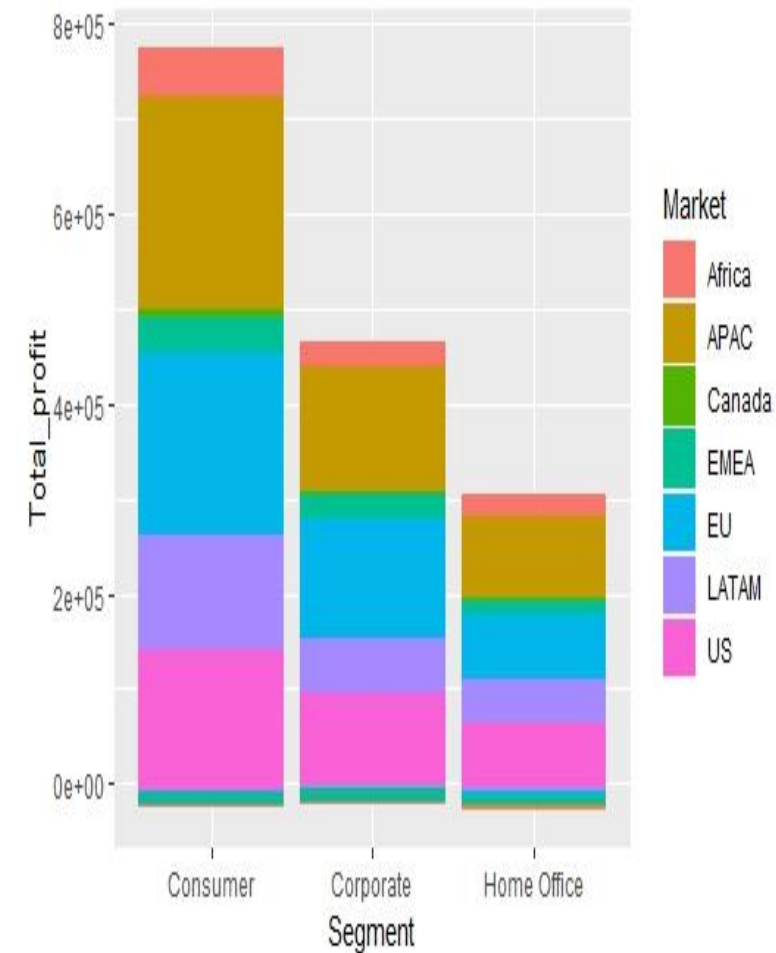
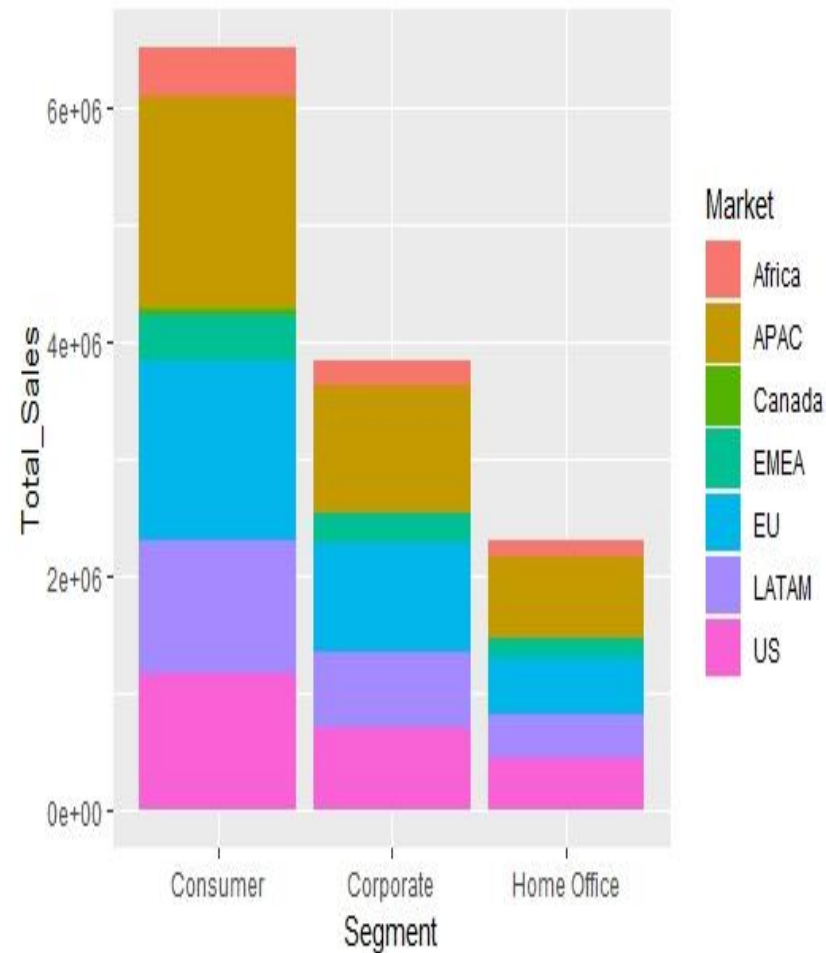
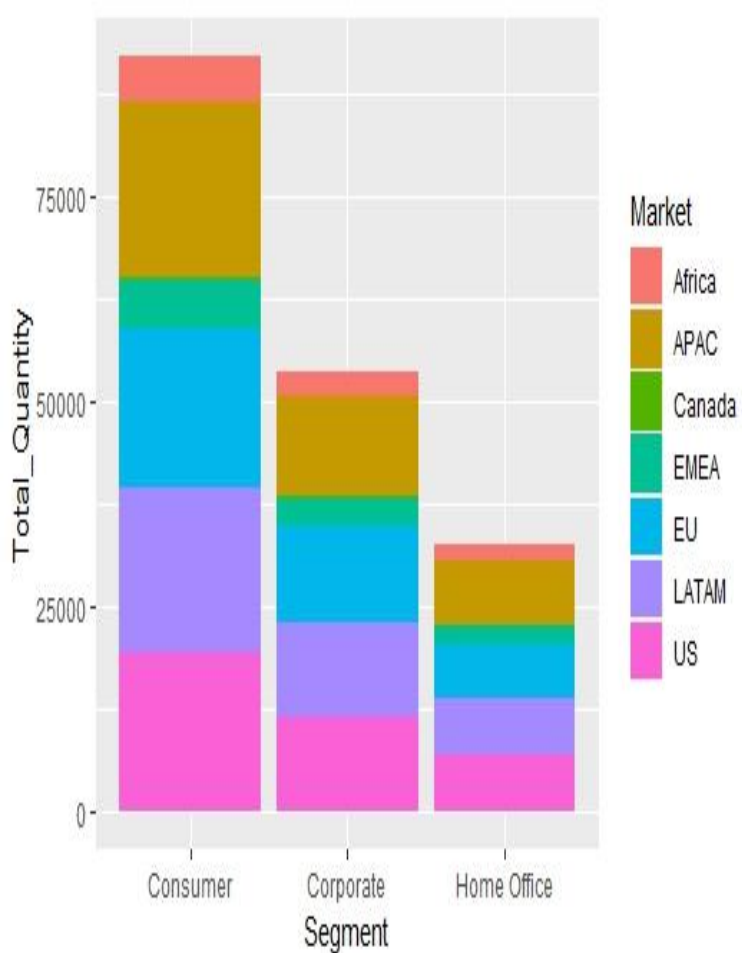
The store caters to 7 different market segments and in 3 major categories. We want to forecast at this granular level, so we subset our data into 21 (7×3) buckets before analysing these data.

We need to find out 2 most profitable (and consistent) segment from these 21 and forecast the sales and demand for these segments.

PROBLEM SOLVING METHODOLOGY

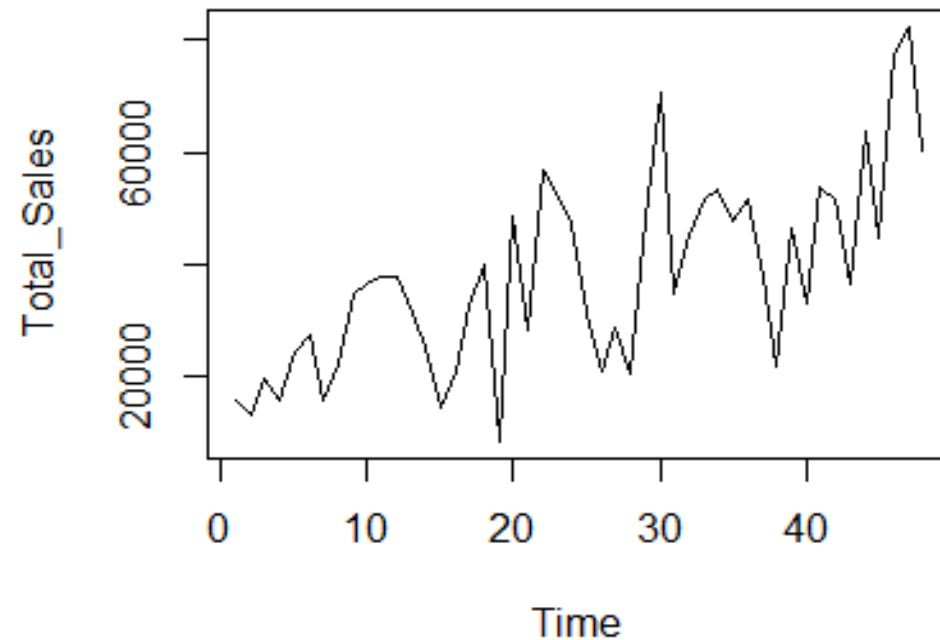
1. Business understanding
2. Data understanding
3. Data preparation & data cleaning
4. Aggregate the value and find monthly value segments
5. EDA to find the most profitable and most consistent market segment using covariance (sd/mean)
6. Plotting univariate Time series graphs— Time Vs Sales & Time Vs Quantity For APAC and EU Consumer Segments
7. Training and testing, data segregation
8. Applied Smoothing Techniques – Moving Average Smoothing
9. Decomposed time series , ACF/PACF check, Auto ARIMA for model building
10. Model prepared that closely represents trend and seasonality
11. MAPE value check for Model evaluation and further forecasting for the next six months

TOTAL QUANTITY, TOTAL SALES, TOTAL PROFIT IN EACH SEGMENTS FOR DIFFERENT MARKETS

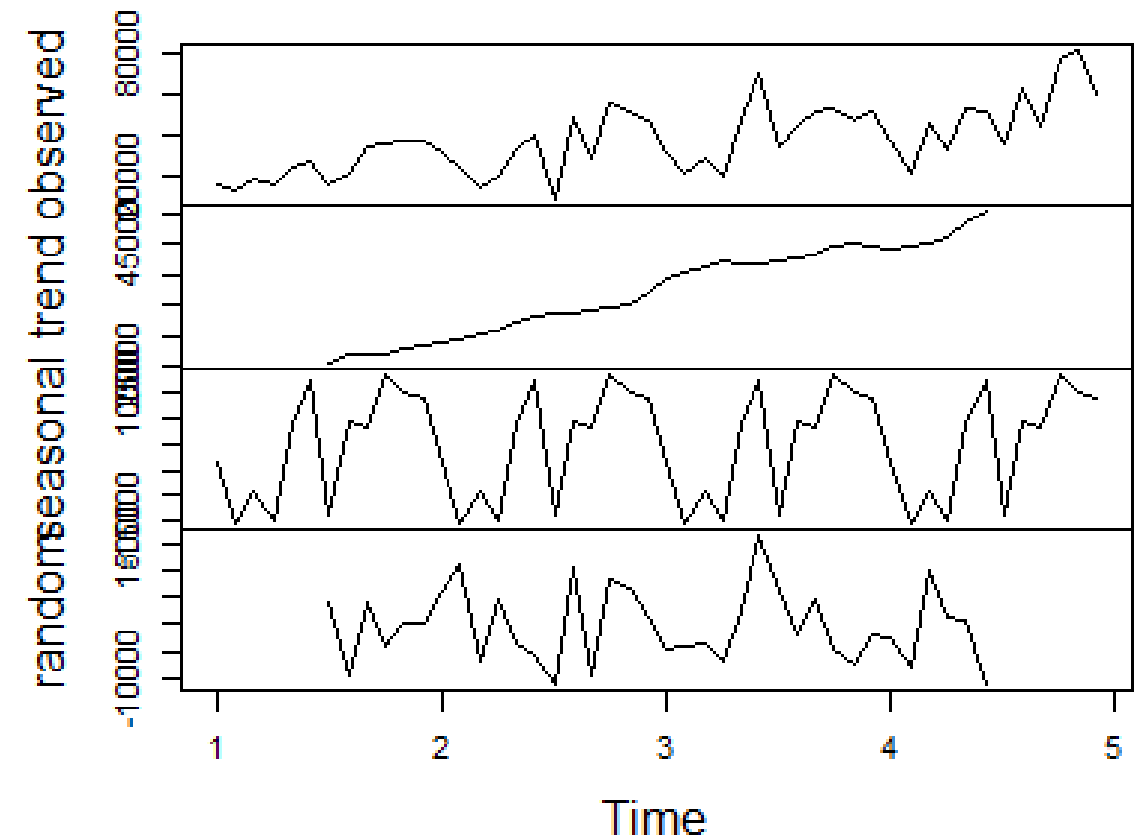


APAC CONSUMER : SALES AND QUANTITY

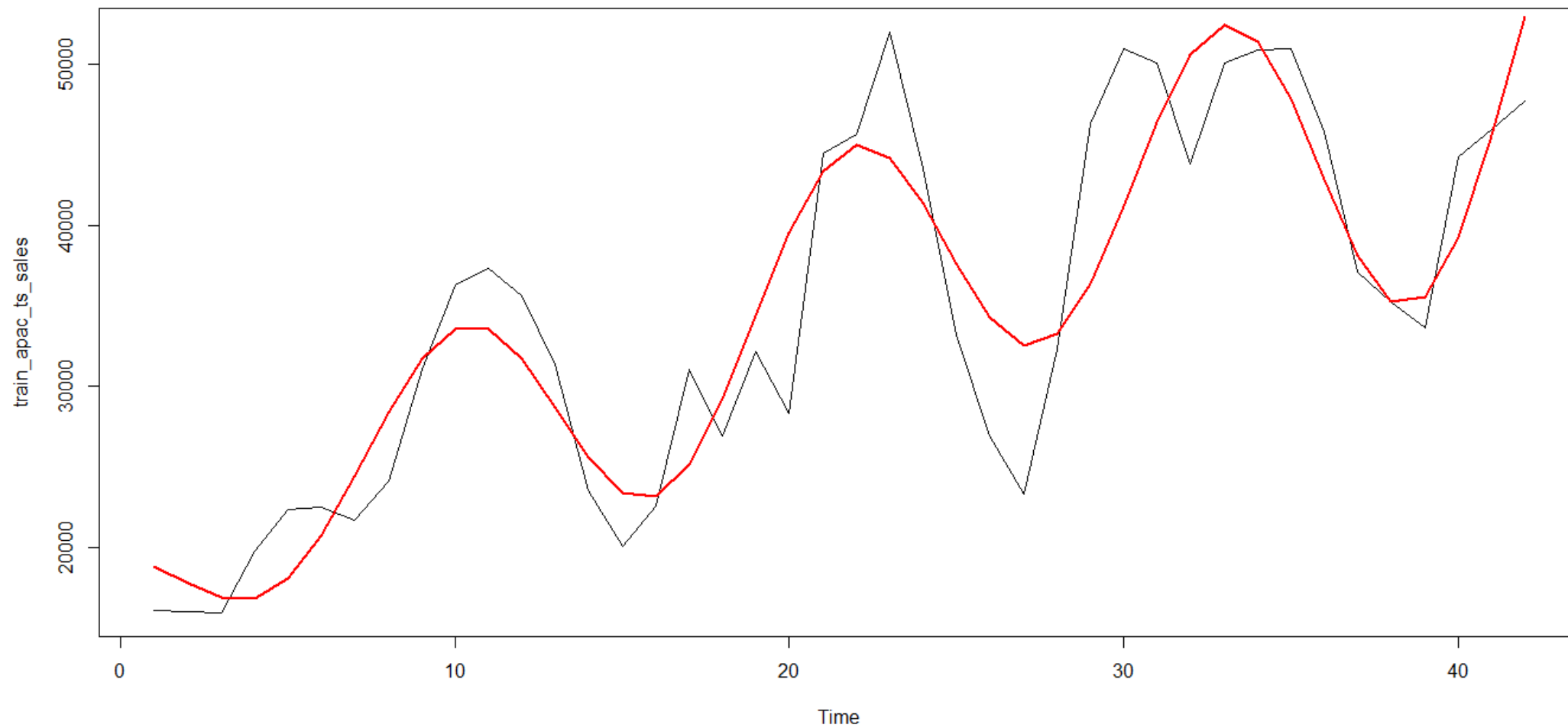
APAC CONSUMER : TIME SERIES OF SALES



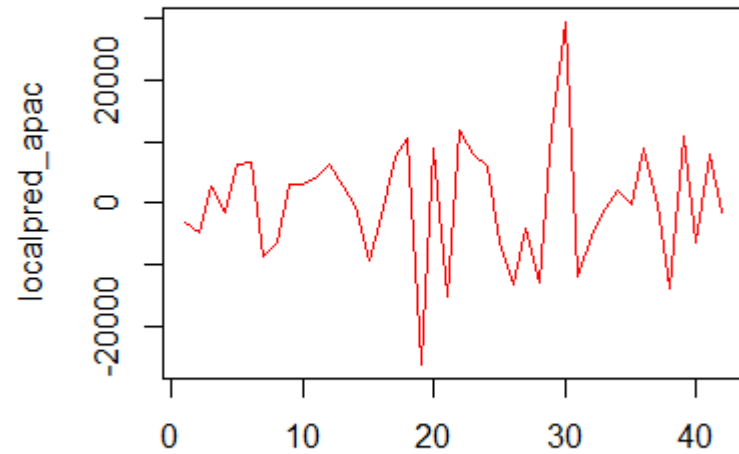
Decomposition of additive time series



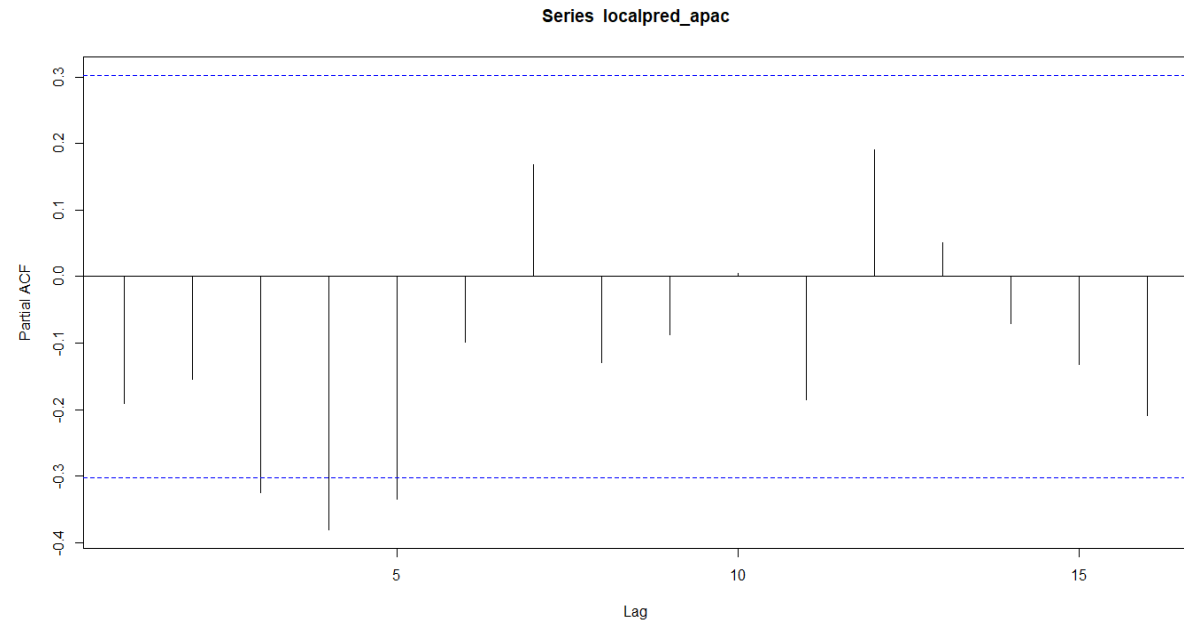
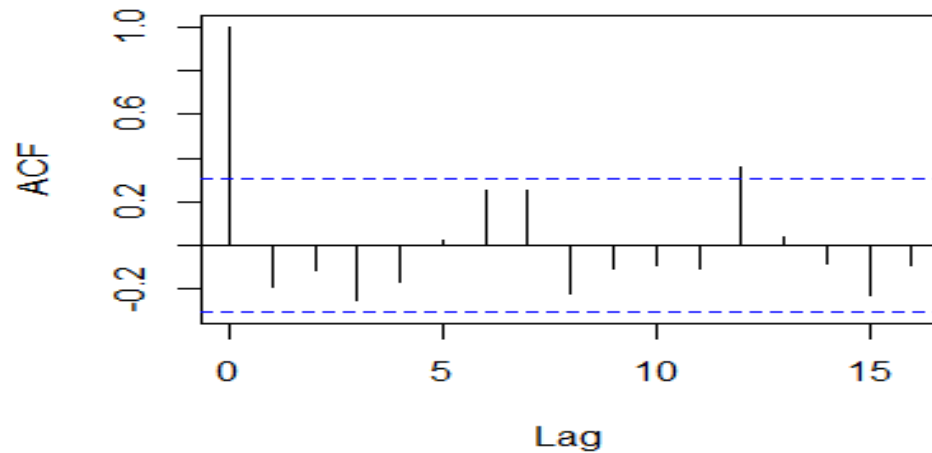
SMOOTHENED SERIES AND LINEAR FIT



Local Prediction (Sales)



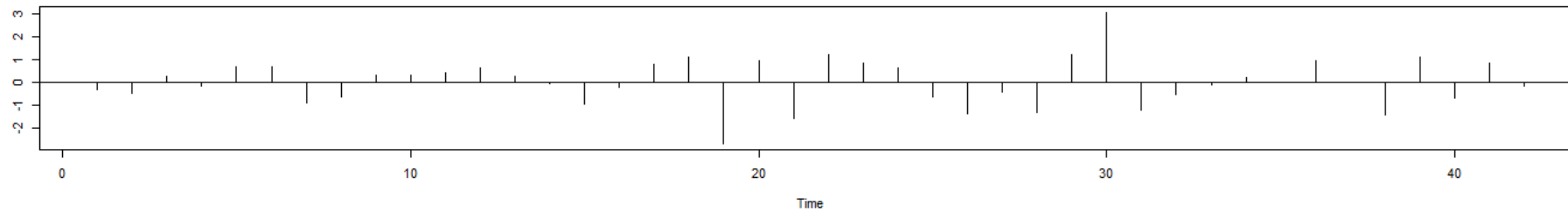
Series localpred_apac



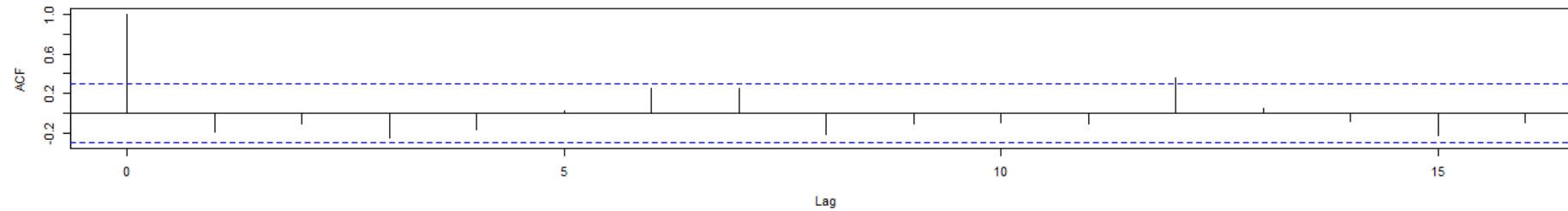
Local Part is stationary :
adf.test : 0.01 , kpss.test : 0.1, ARIMA(0,0,0) with
zero mean

APAC CONSUMER (SALES) ARIMA RESIDUALS

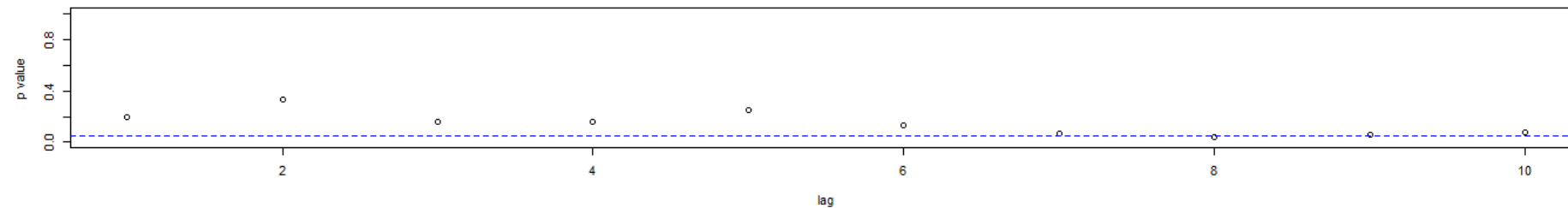
Standardized Residuals



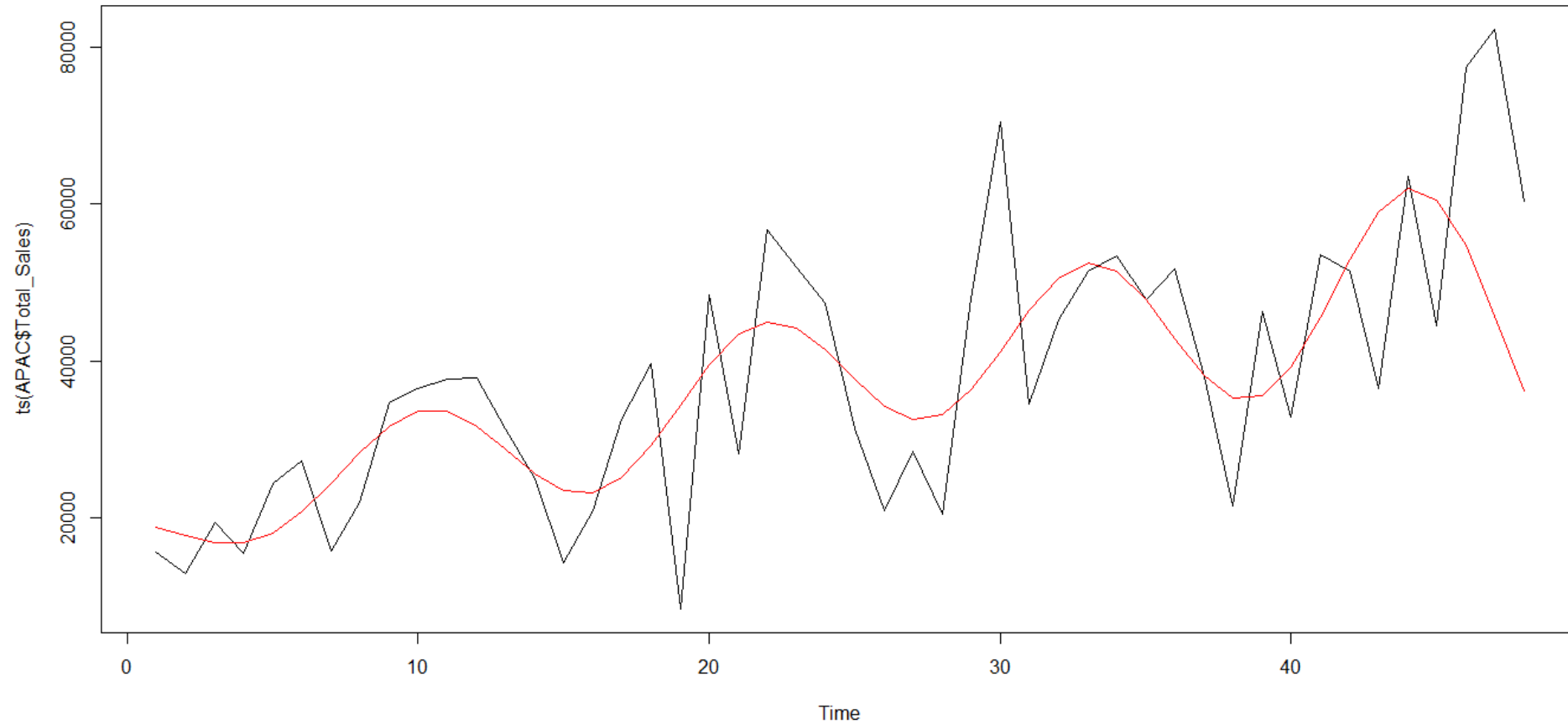
ACF of Residuals



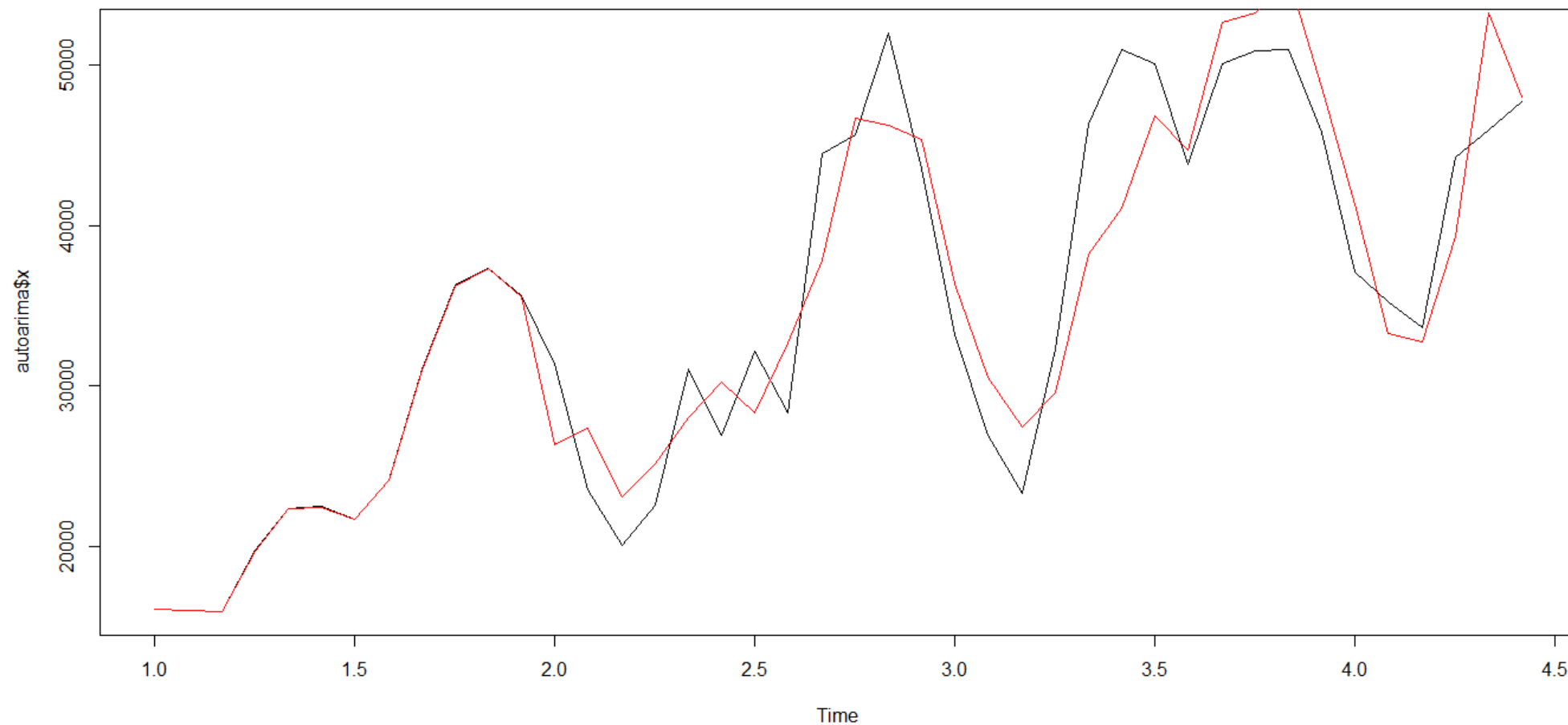
p values for Ljung-Box statistic



GLOBAL AND LOCAL PREDICTION FOR SALES FOR THE LAST 6 MONTHS

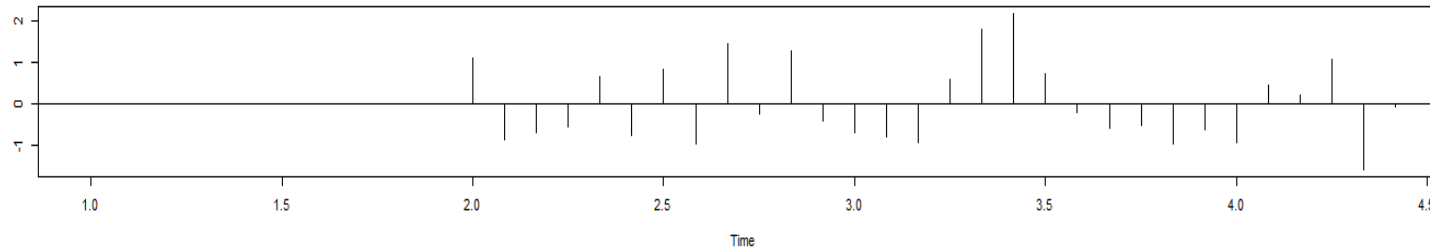


AUTO ARIMA FITS : WITH SEASONALITY

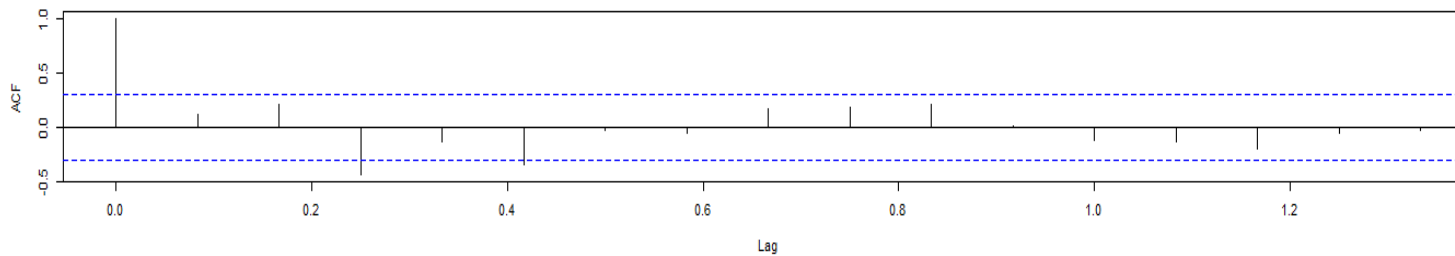


AUTO ARIMA FITS : RESIDUALS

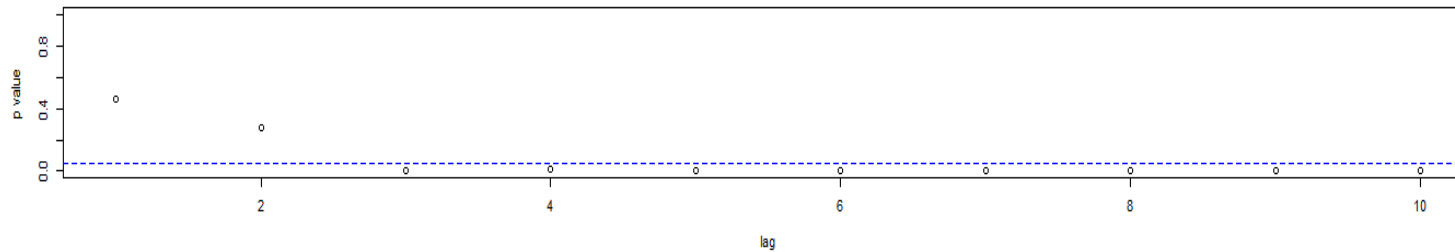
Standardized Residuals



ACF of Residuals



p values for Ljung-Box statistic



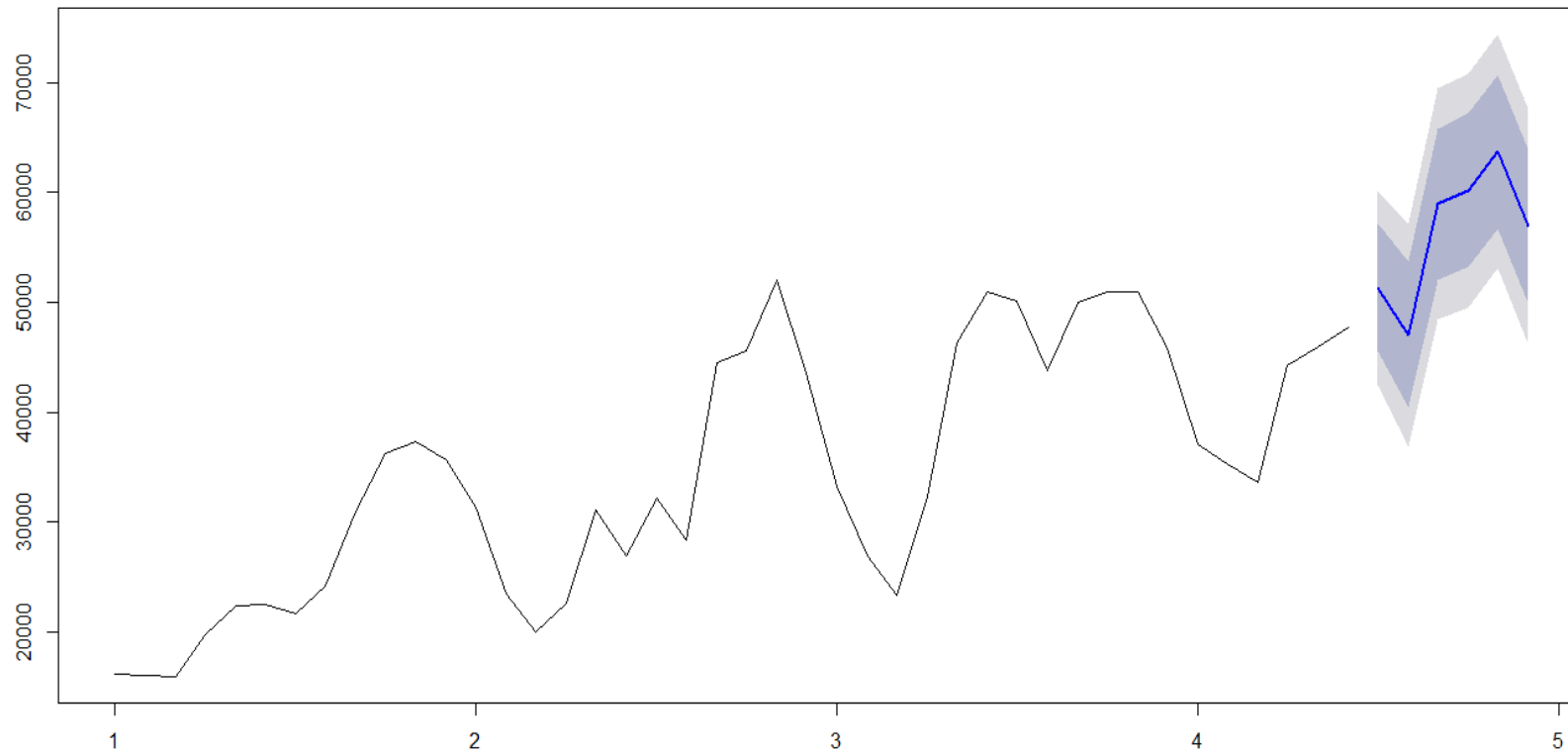
ARIMA(1,0,0)(1,1,0)[12] with drift
 Coefficients: ar1 sar1 drift 0.5569 -0.5294
 674.1800 s.e. 0.1485 0.1647 107.7582 sigma^2
 estimated as 20539851: log likelihood=-295.71
 AIC=599.43 AICc=601.03 BIC=605.03

Adf : 0.02185

Kpss: 0.1

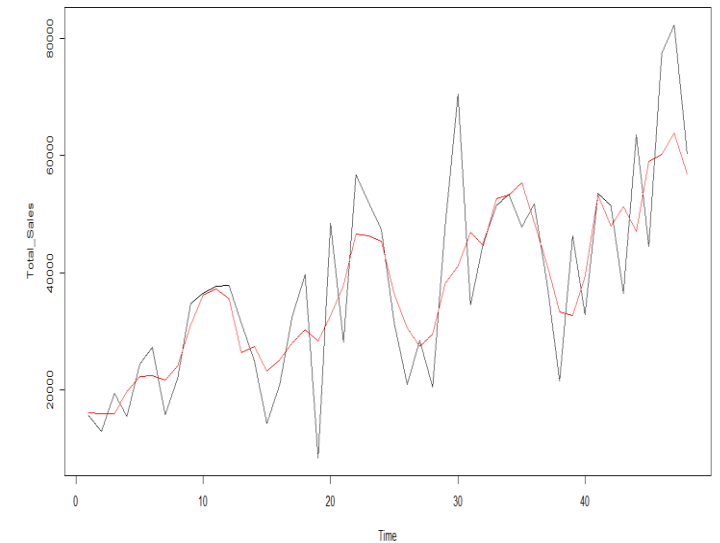
AUTO ARIMA FITS : FORECAST TESTING & MAPE

Forecasts from ARIMA(1,0,0)(1,1,0)[12] with drift



Smoothened Series with Forecast

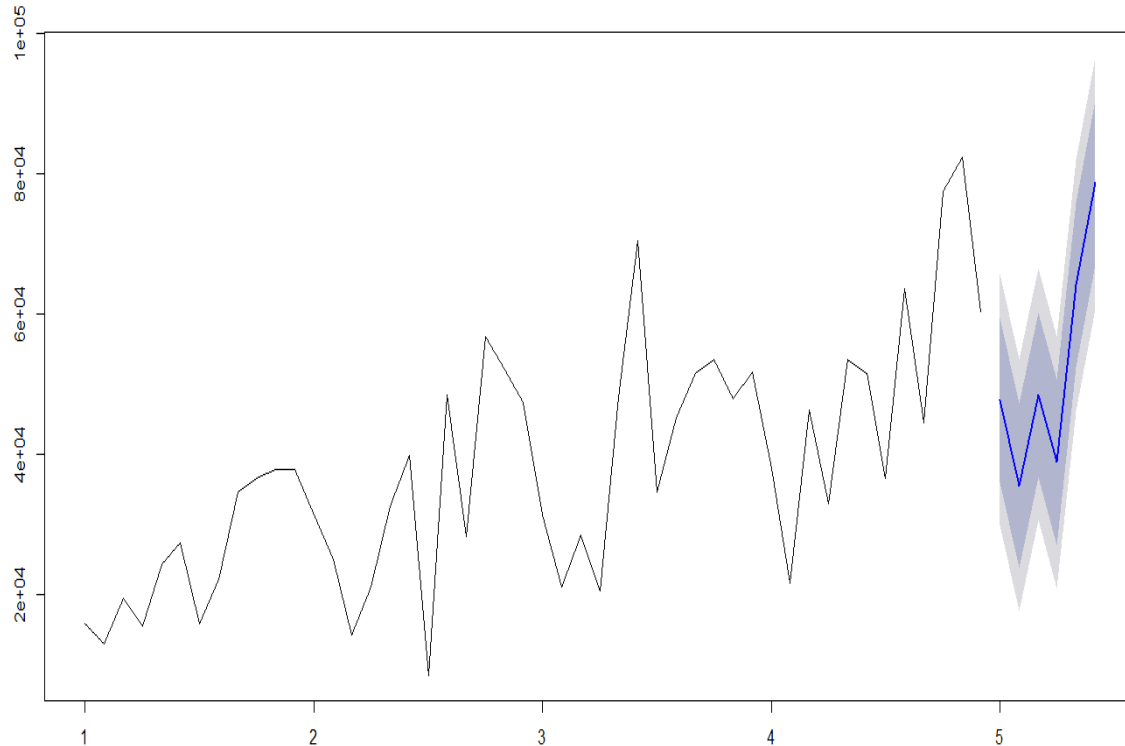
MAPE : 24.90061



Original with Forecast

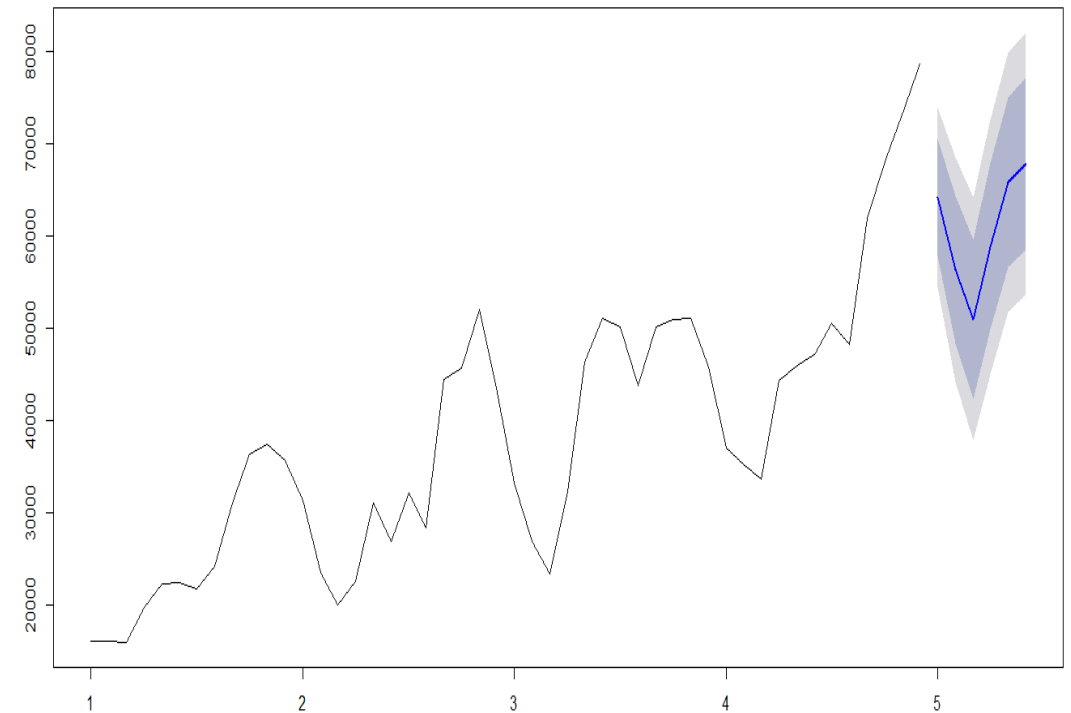
AUTO ARIMA FORECAST : SALES

Forecasts from ARIMA(0,0,0)(1,1,0)[12] with drift



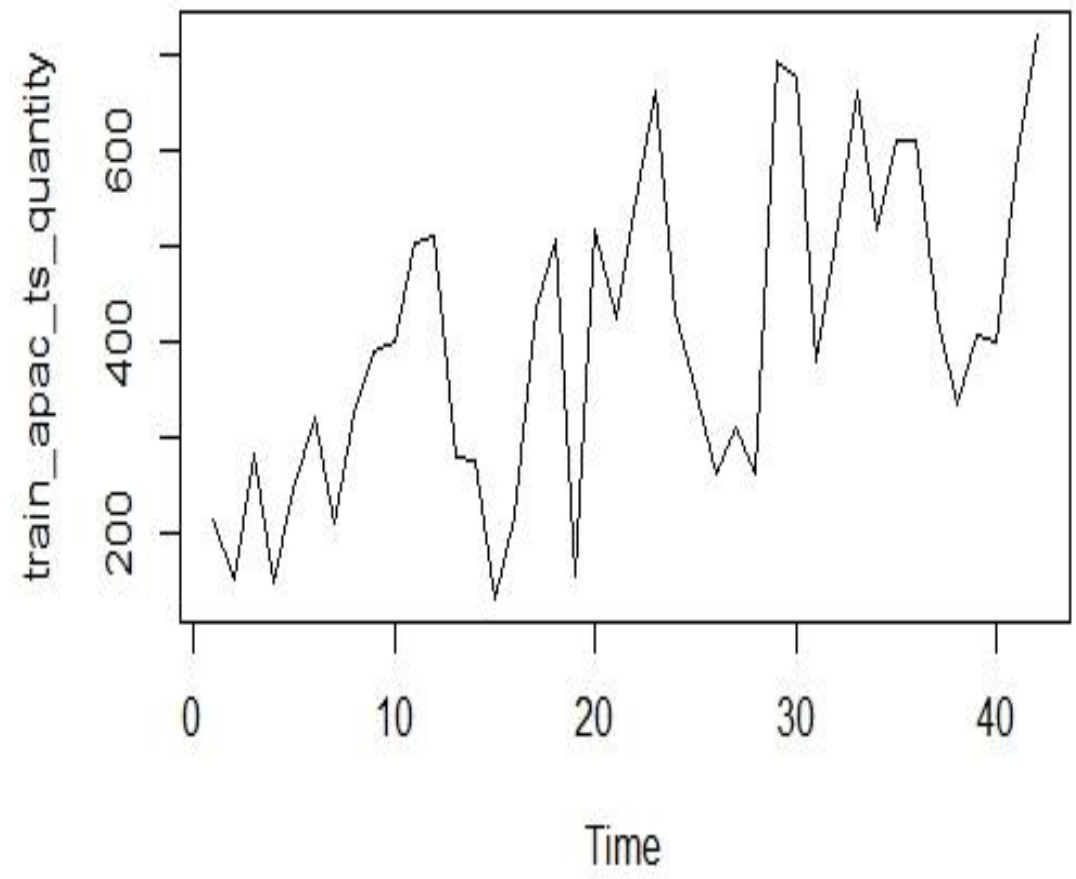
ARIMA on Original Series with Forecast

Forecasts from ARIMA(1,0,0)(1,1,0)[12] with drift

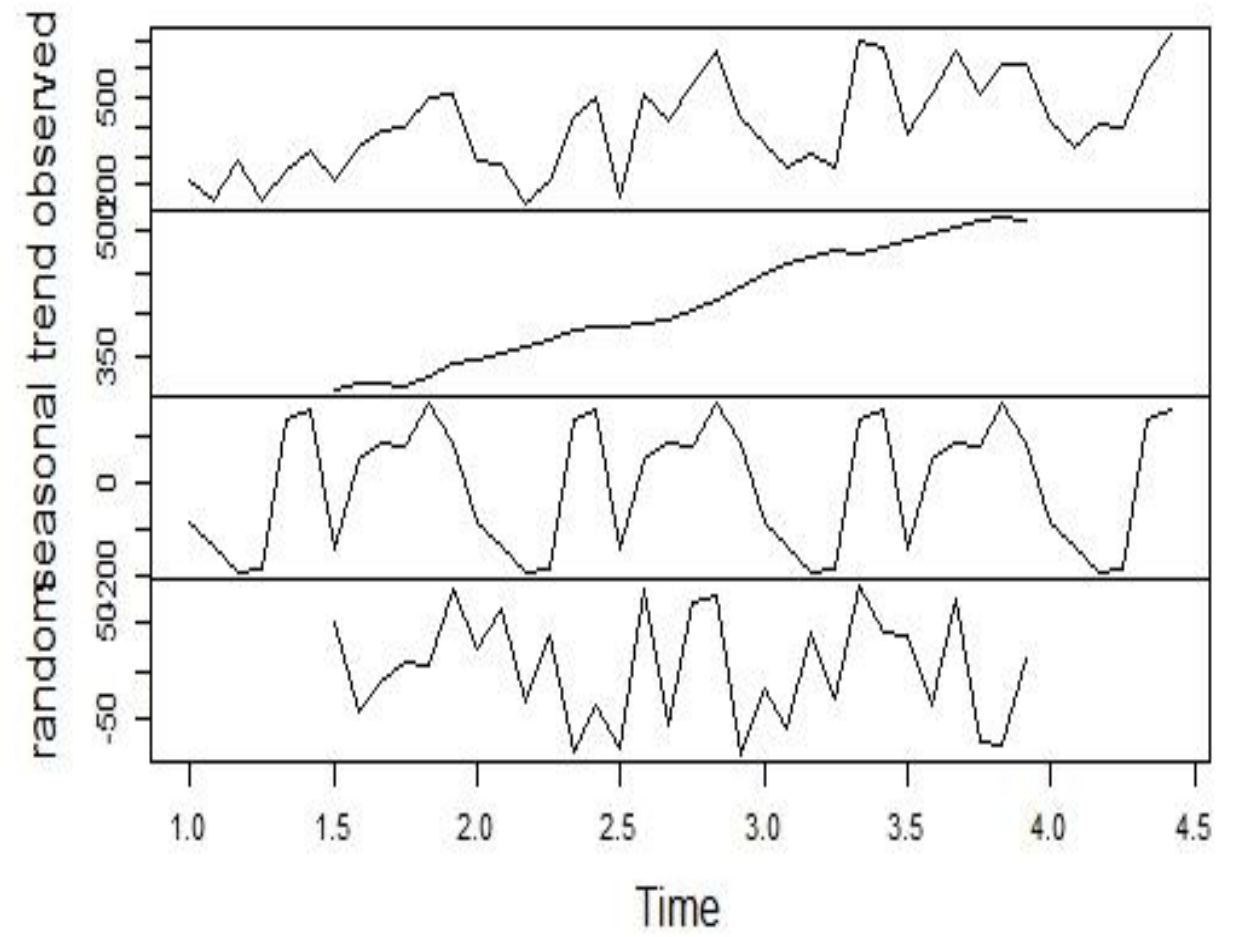


ARIMA on Smoothened series with Forecast

APAC CONSUMER — TIME SERIES OF QUANTITY

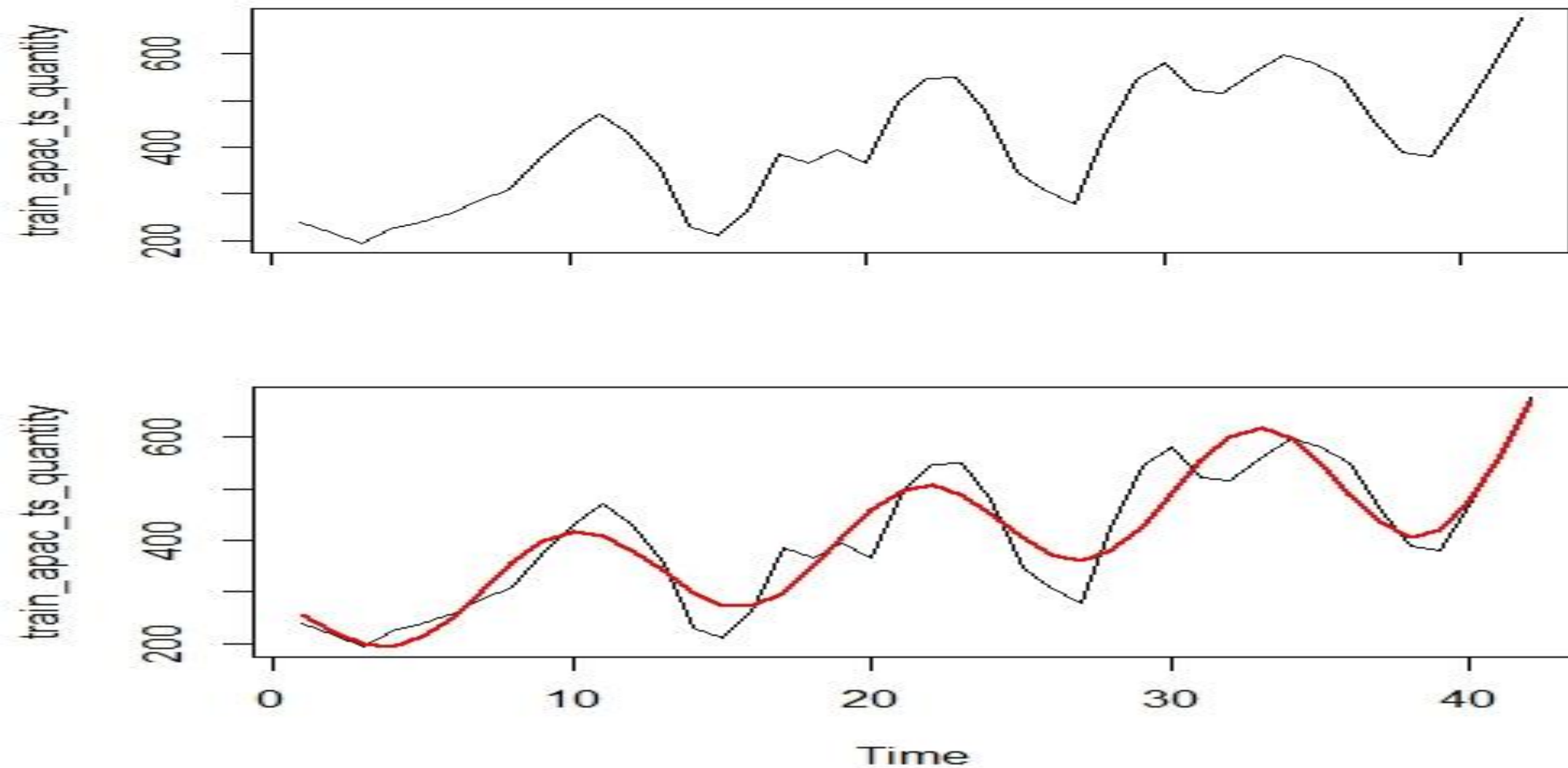


Decomposition of additive time series

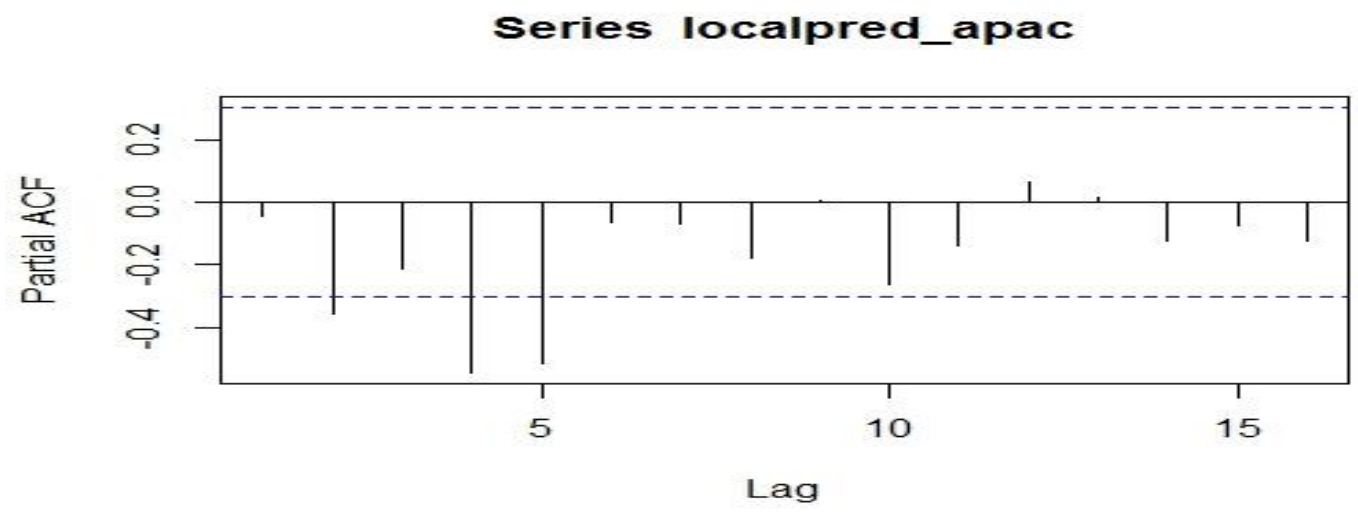
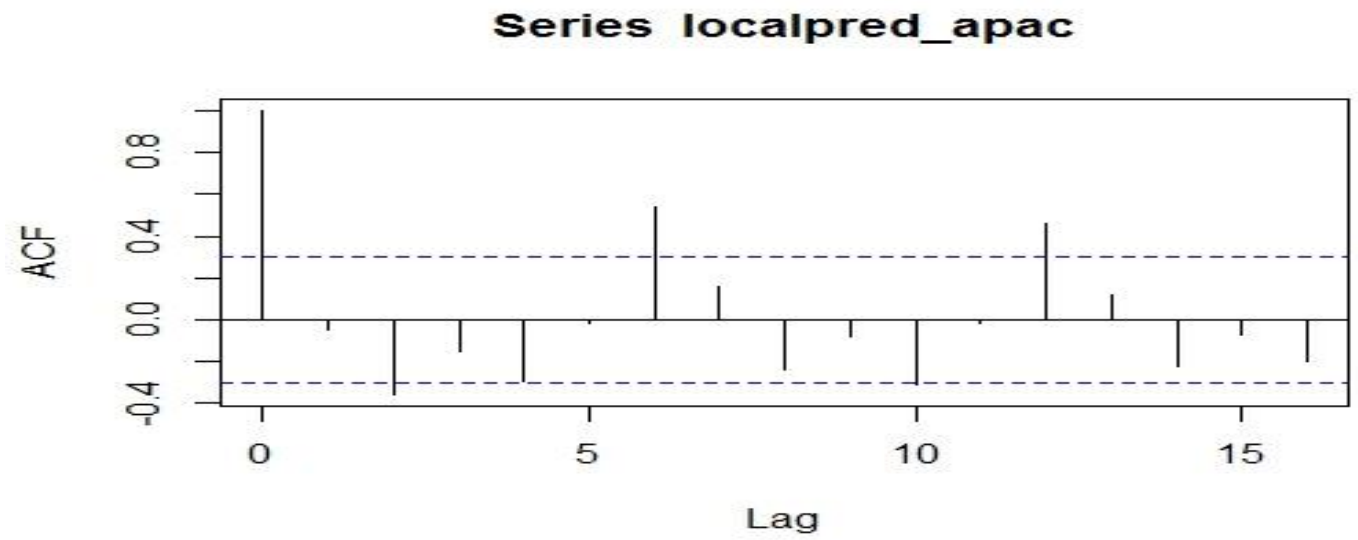
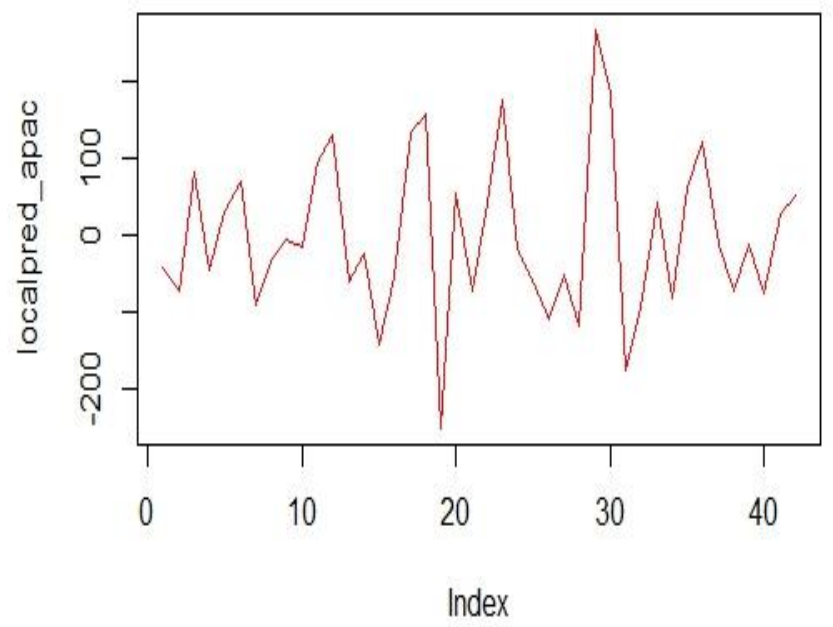




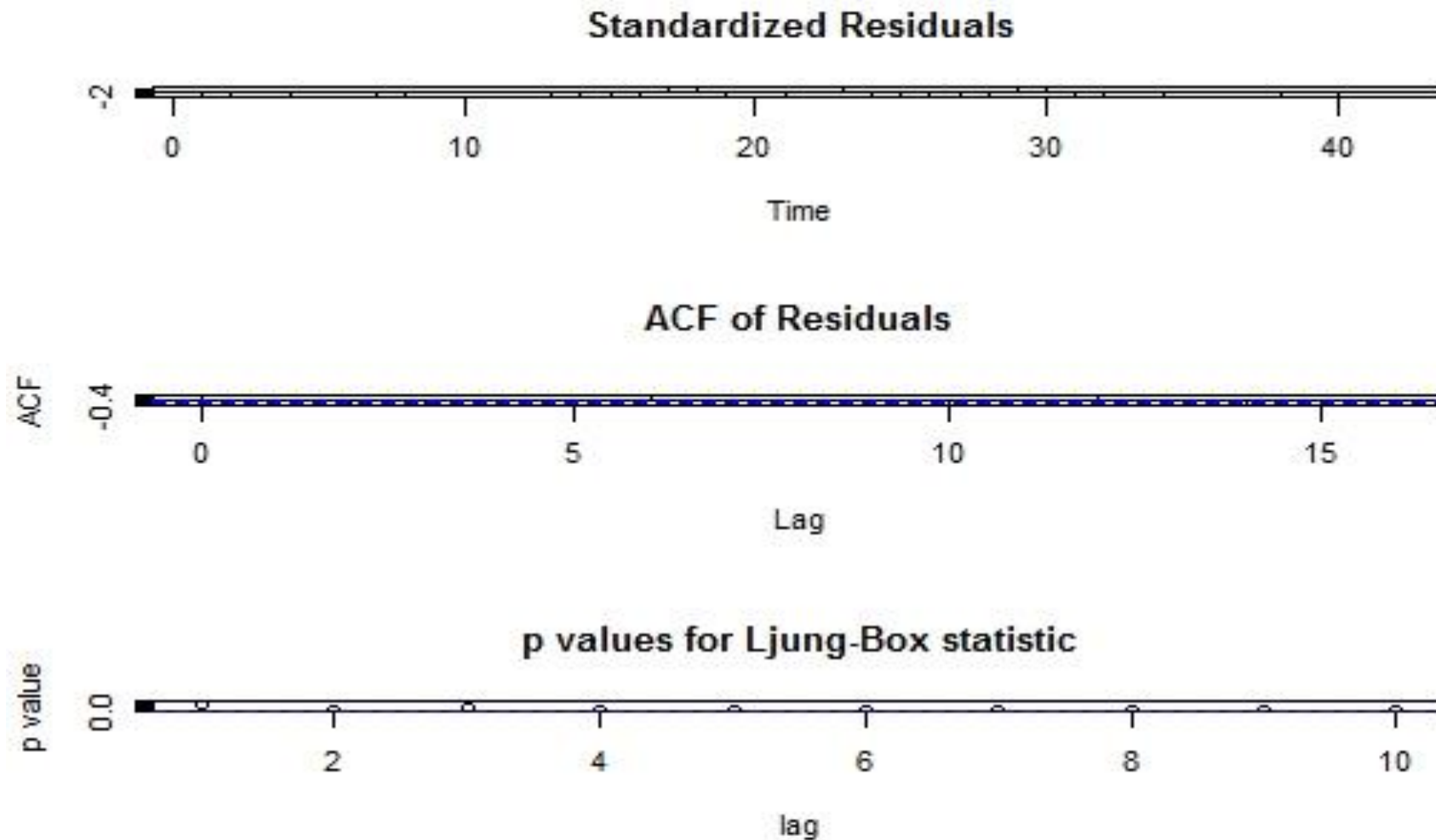
SMOOTHENING THE APAC TIME SERIES - QUANTITY



Apac global
pattern vs.
linear
pattern

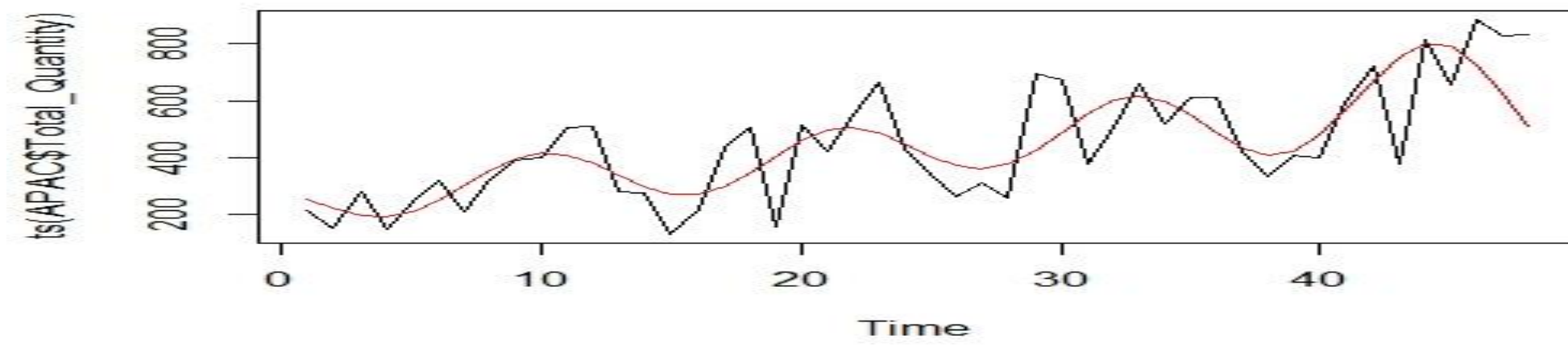
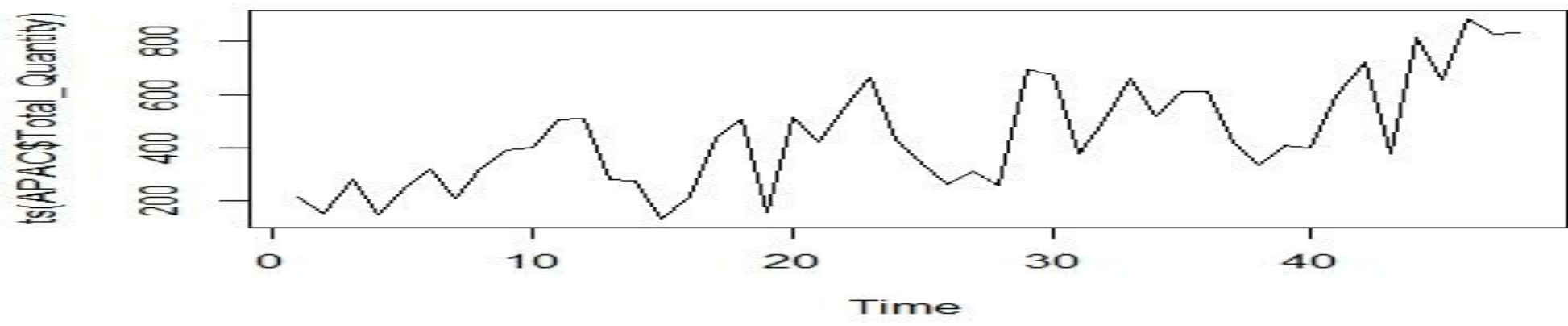


APAC CONSUMER (QUANTITY) ARIMA RESIDUALS

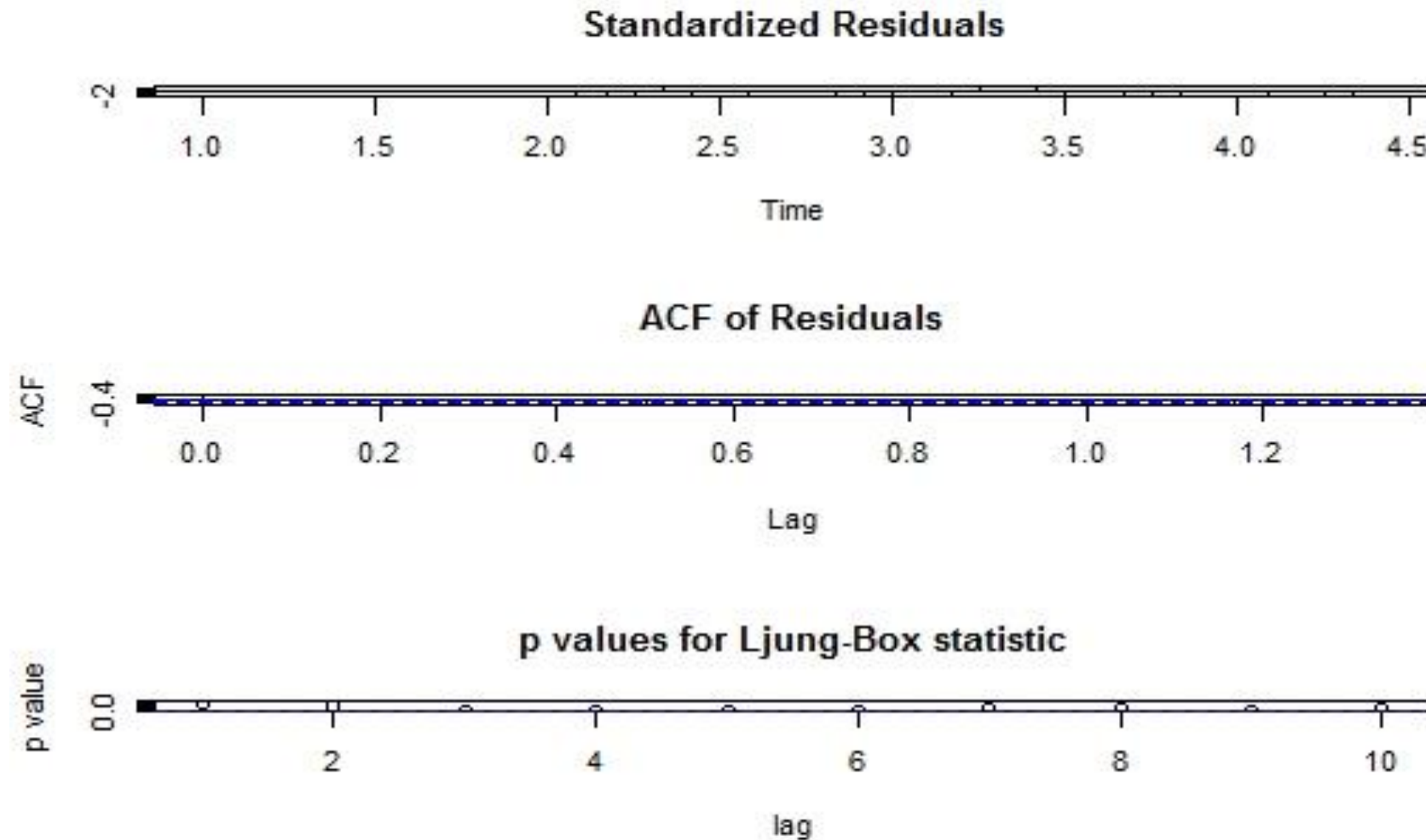




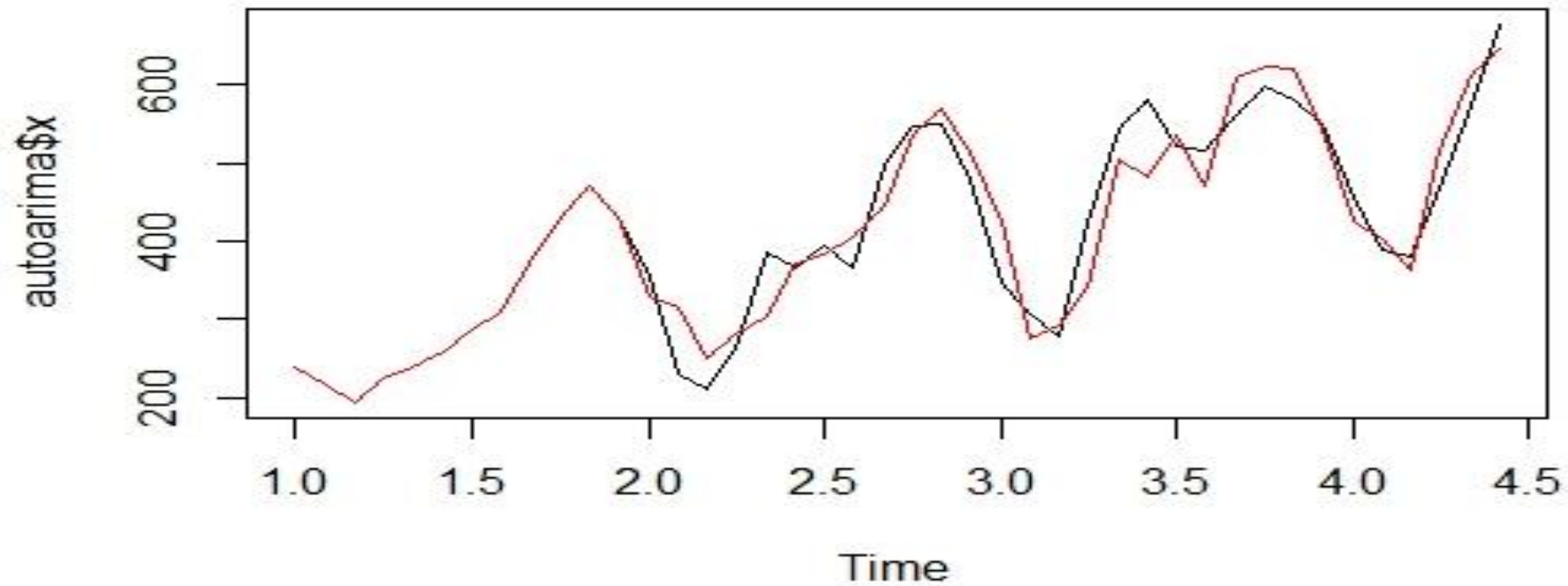
GLOBAL AND LOCAL PREDICTION FOR THE LAST 6 MONTHS – APAC QUANTITY



AUTO ARIMA FITS : RESIDUALS — APAC QUANTITY

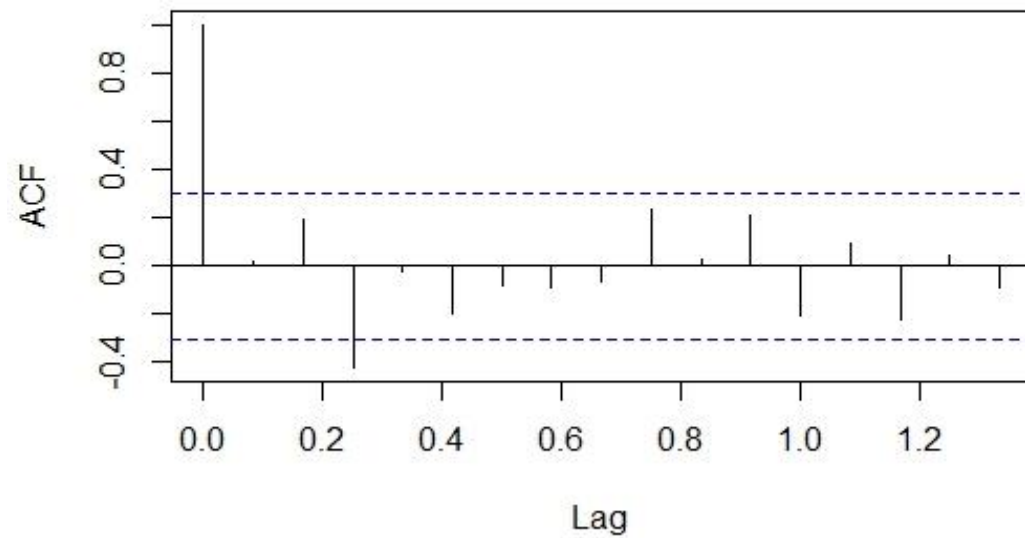


AUTO ARIMA FITS WITH SEASONALITY— APAC QUANTITY

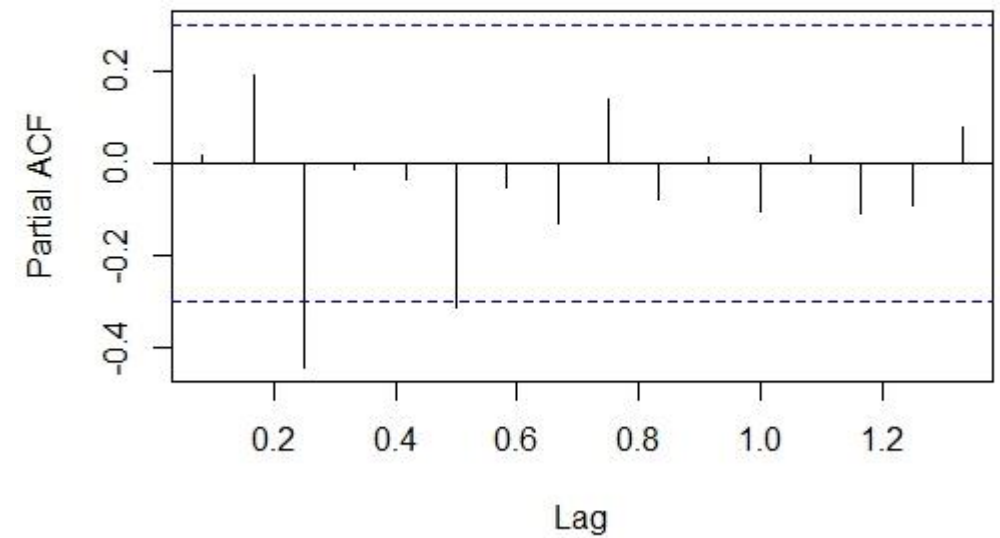


AUTO ARIMA FITS RESIDUALS: APAC QUANTITY

Series resi_auto_arima

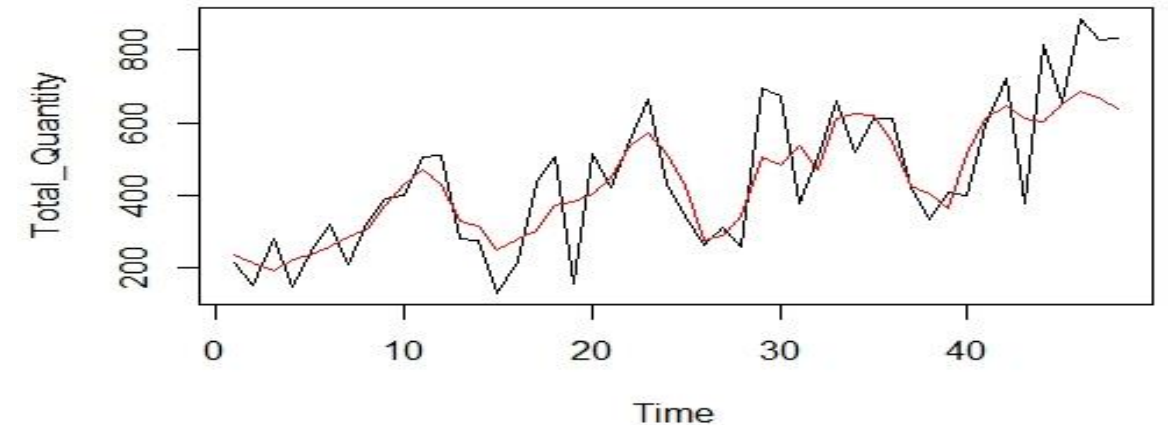
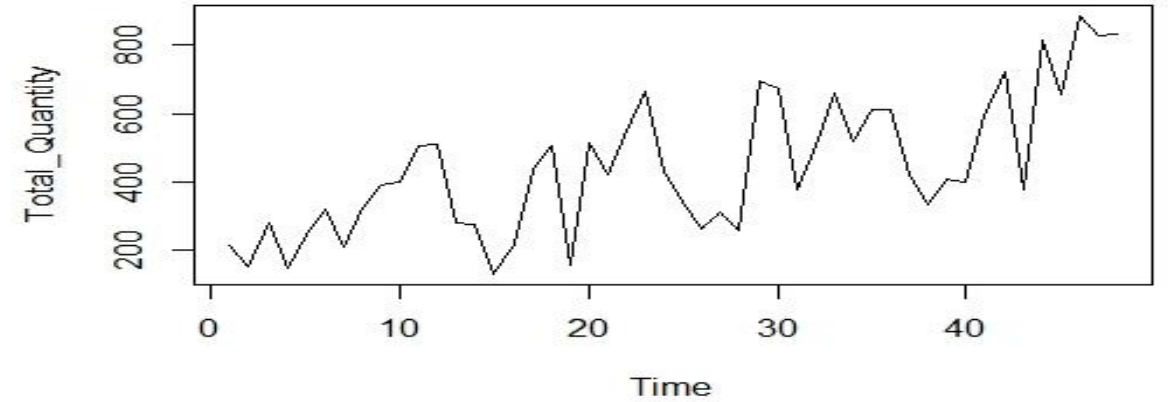
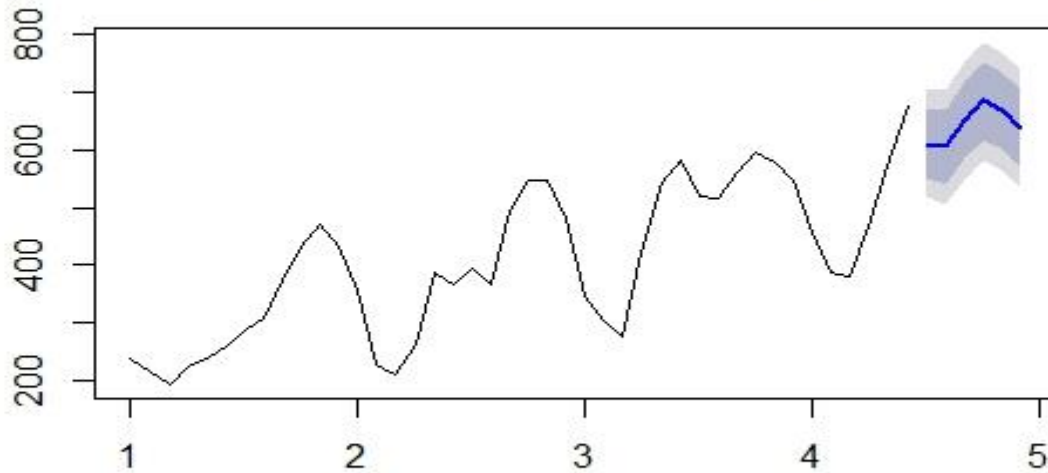


Series resi_auto_arima



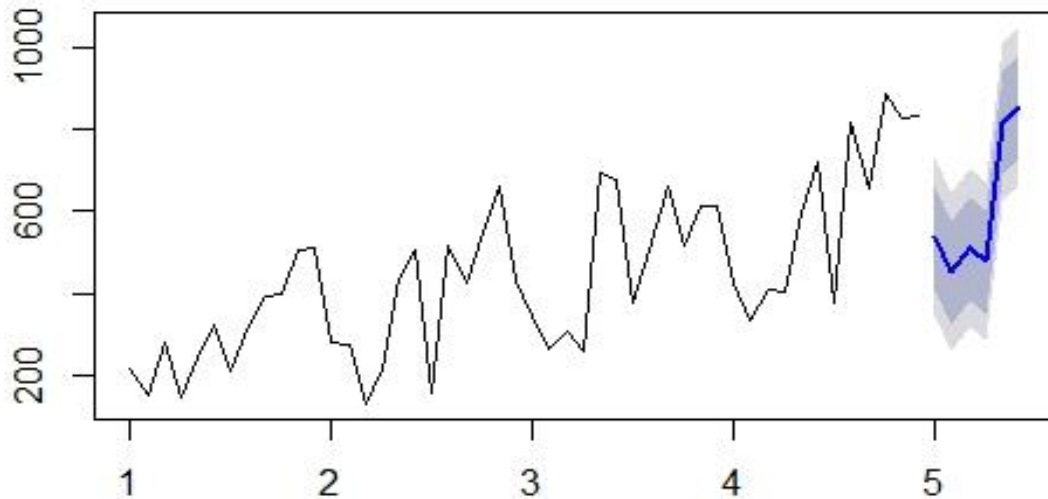
AUTO ARIMA FITS : FORECAST TESTING & MAPE, APAC QUANTITY

Forecasts from ARIMA(1,0,0)(0,1,0)[12] with drift



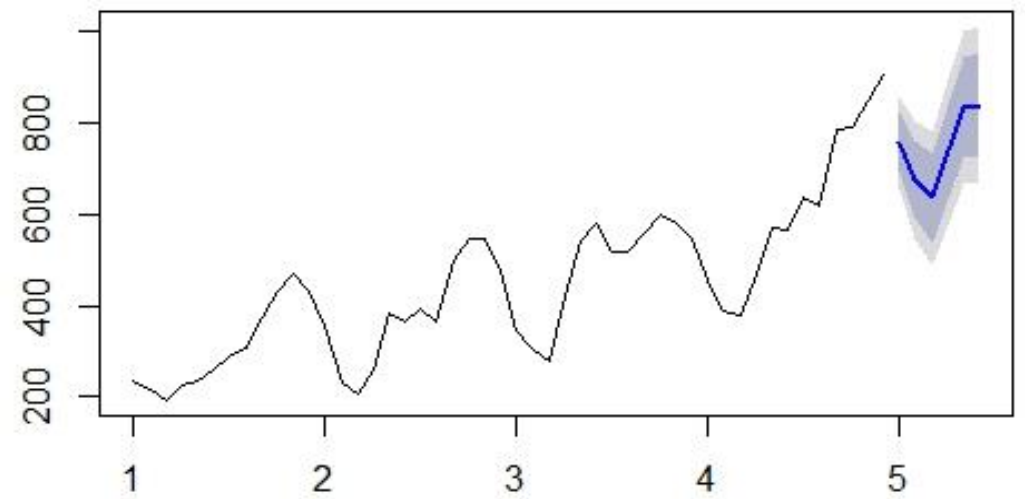
AUTO ARIMA FORECAST : APAC QUANTITY

Forecasts from $ARIMA(0,0,0)(1,1,0)[12]$ with drift



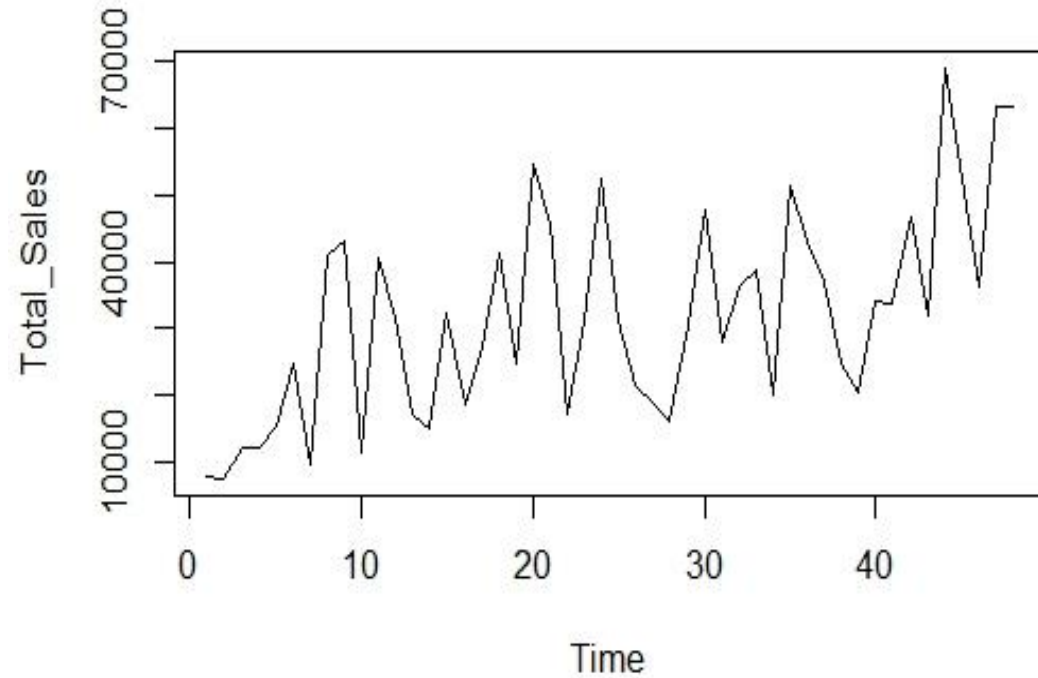
ARIMA ON ORIGINAL SERIES

Forecasts from $ARIMA(1,0,0)(1,1,0)[12]$ with drift

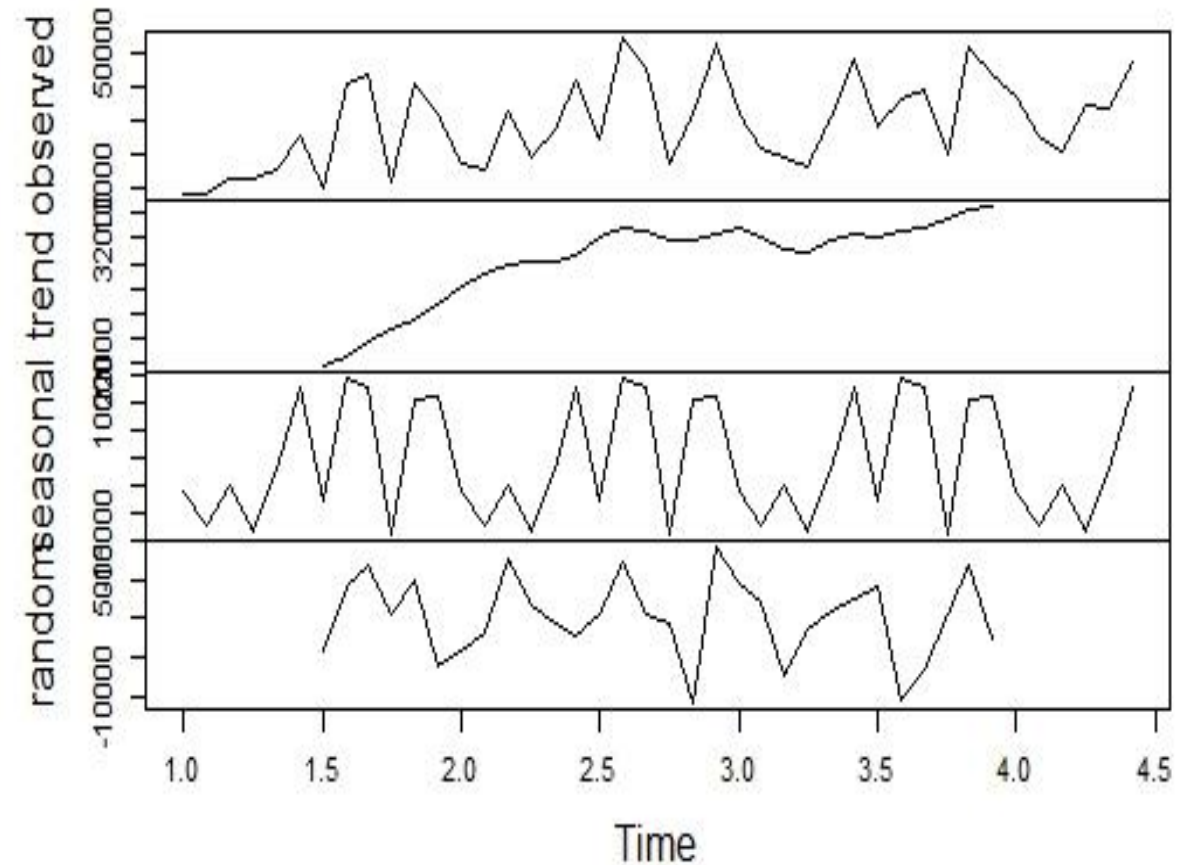


ARIMA ON SMOOTHENED SERIES

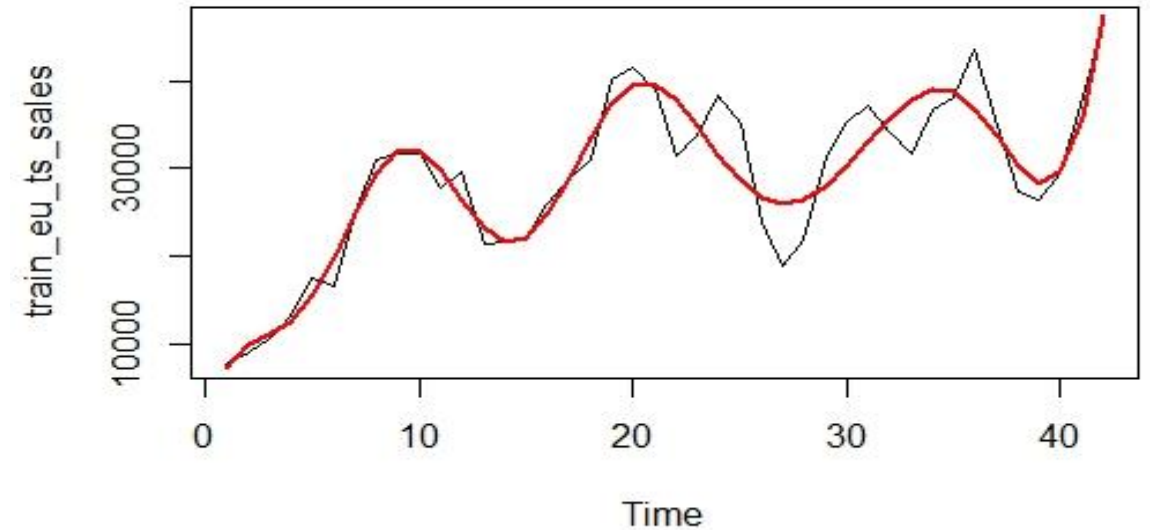
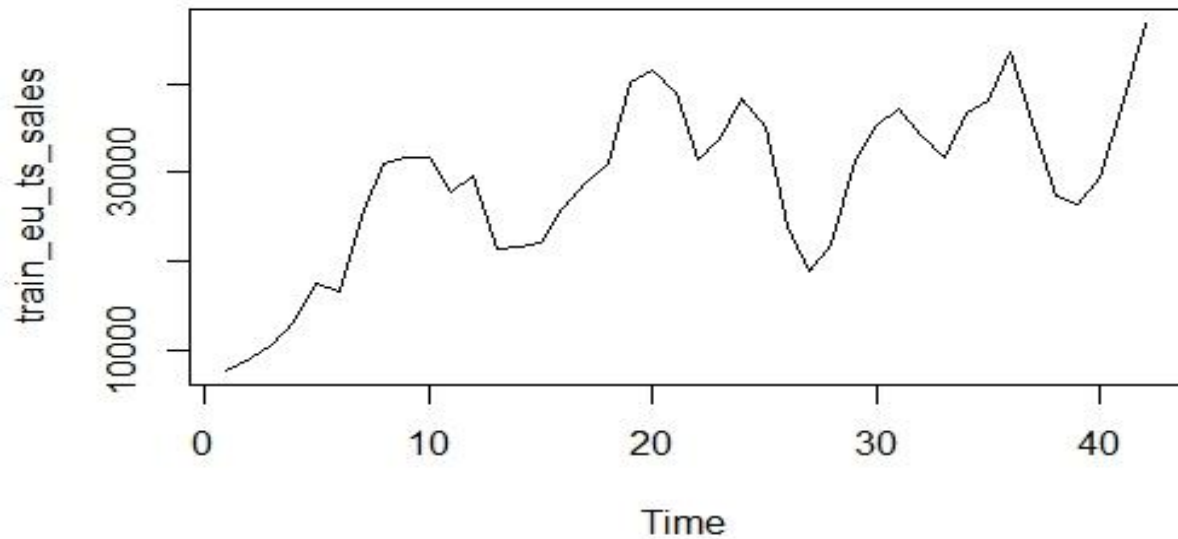
EU CONSUMER SALES TIME SERIES



Decomposition of additive time series



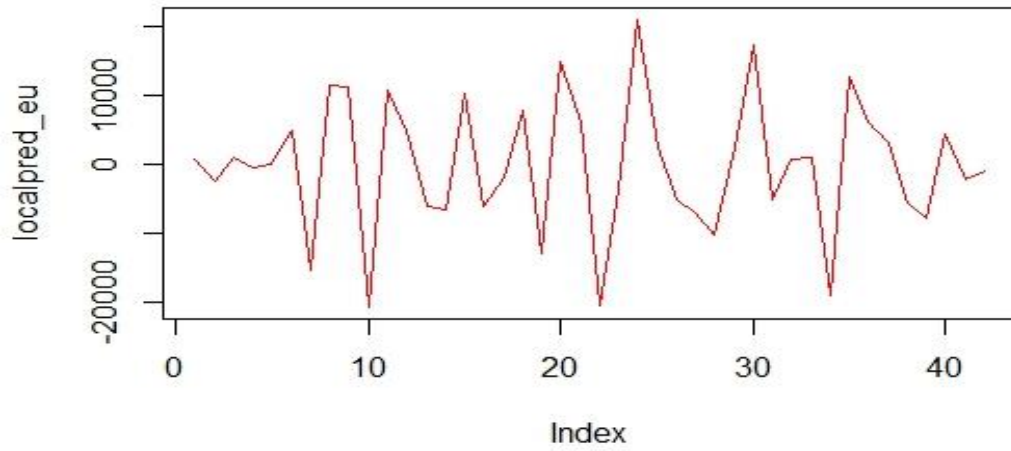
EU CONSUMER SALES - SMOOTHING



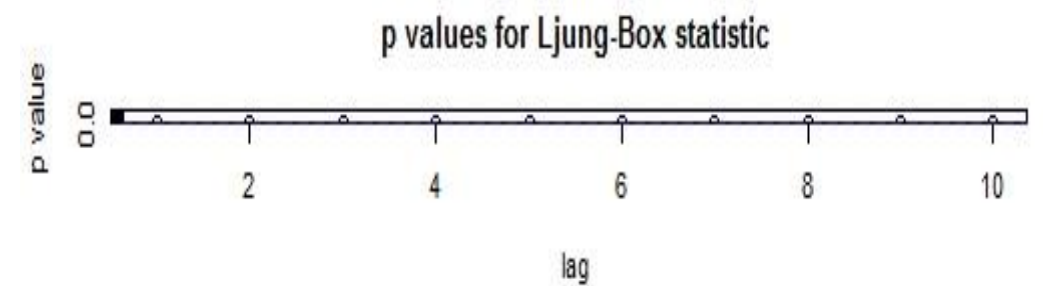
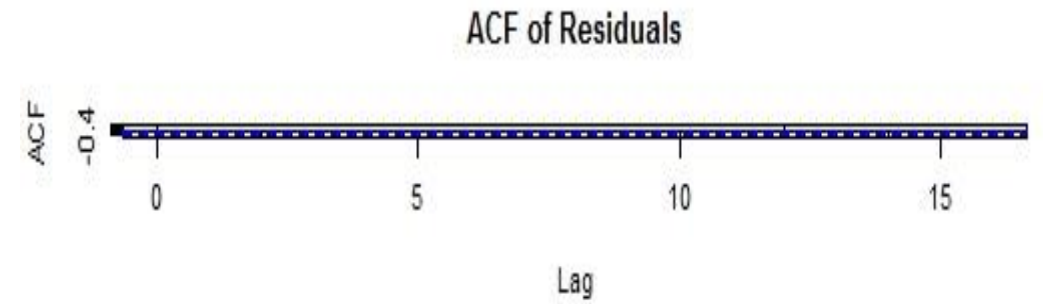
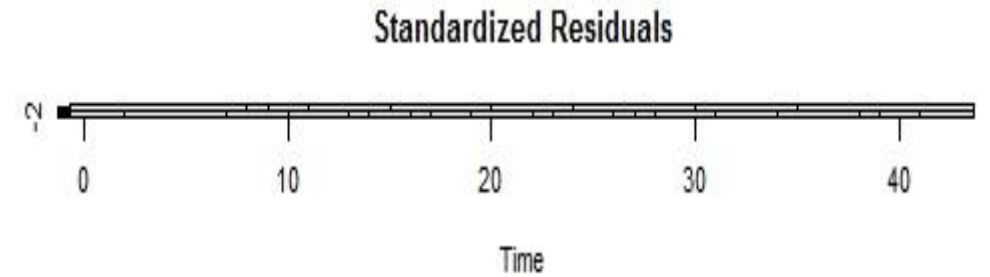
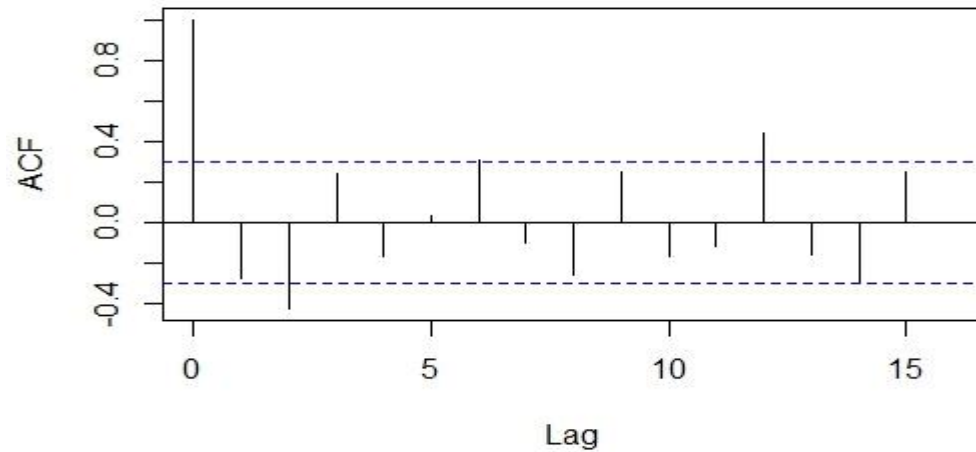
SMOOTHENED SERIES AND LINEAR FIT



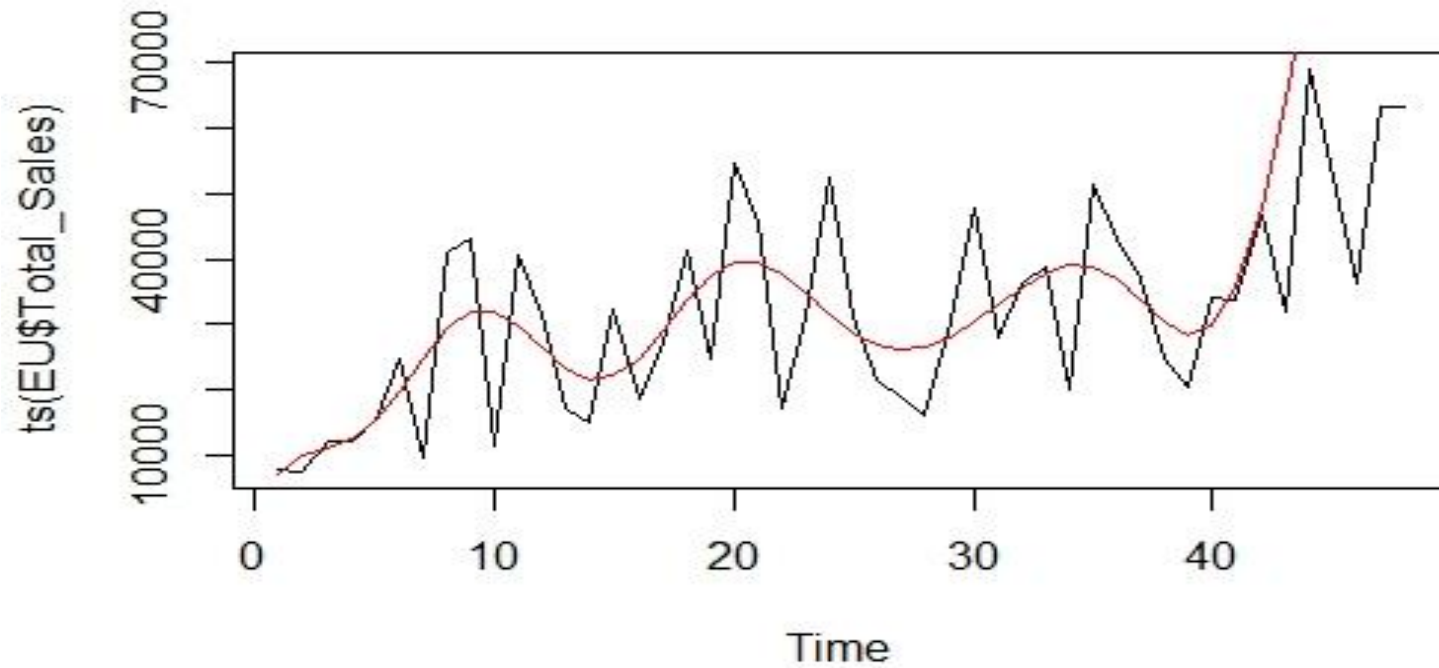
LOCAL PREDICTION EU CONSUMER SALES



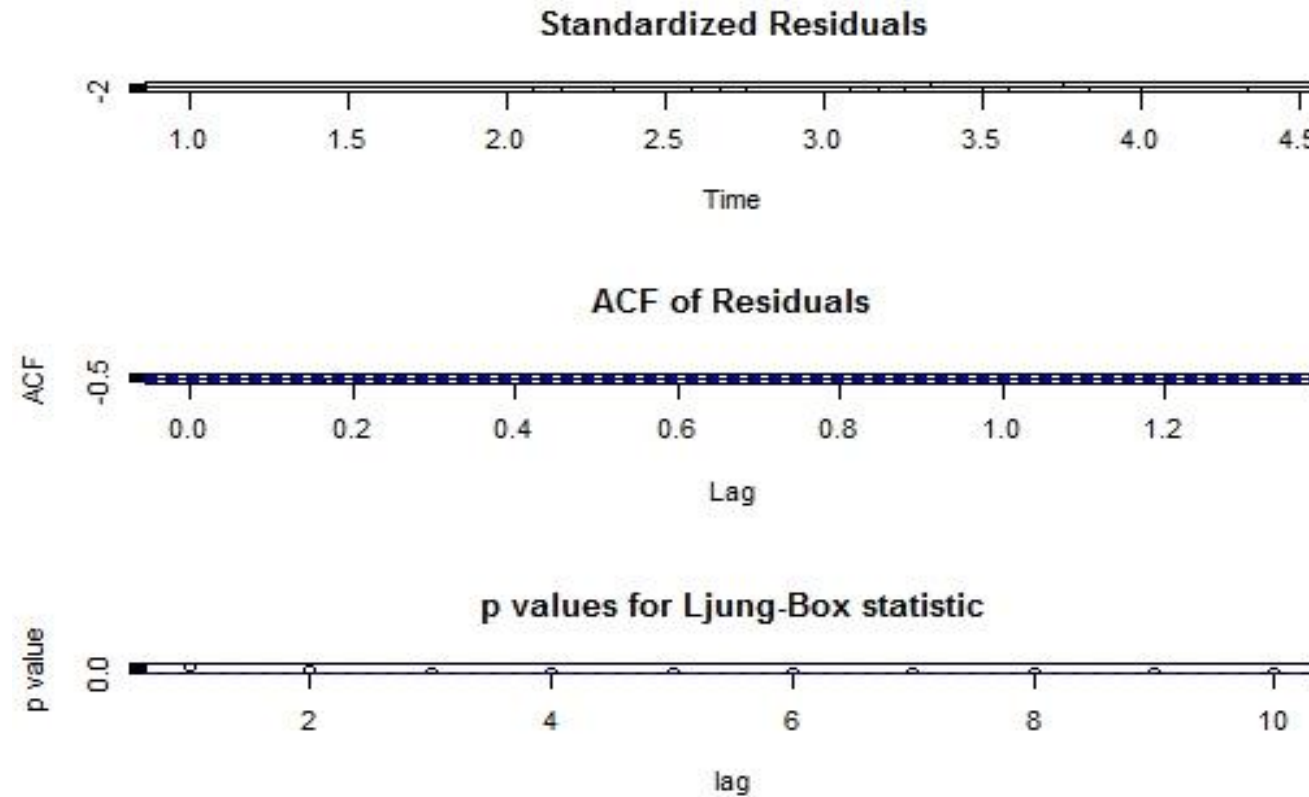
Series localpred_eu



GLOBAL AND LOCAL PREDICTION FOR LAST 6 MONTHS

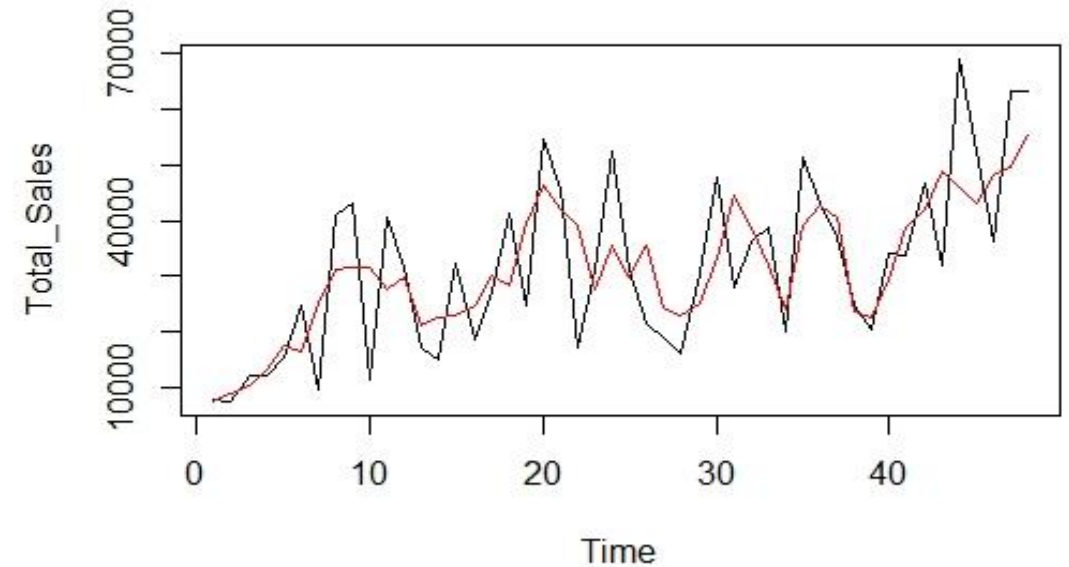
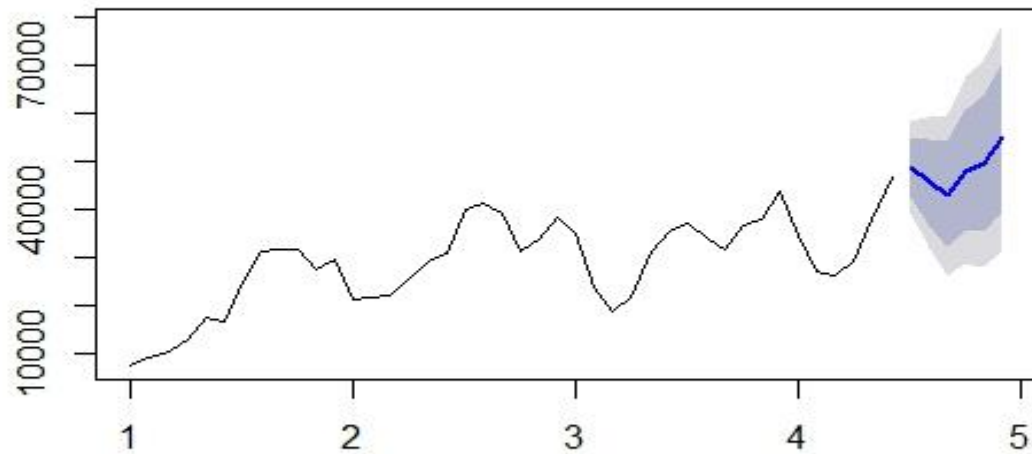


AUTO ARIMA FITS RESIDUALS — EU CONSUMER SALES



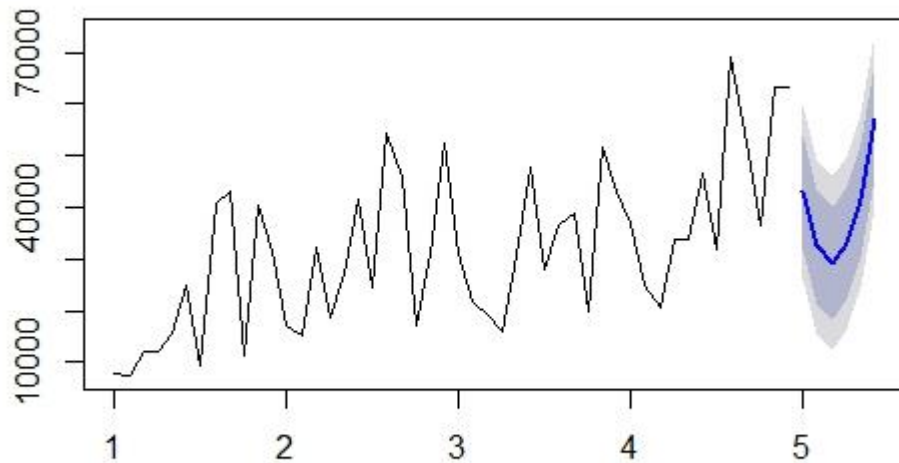
AUTO ARIMA FITS — FORECAST TESTING AND MAPE — EU CONSUMER SALES

Forecasts from ARIMA(0,1,0)(0,1,0)[12]



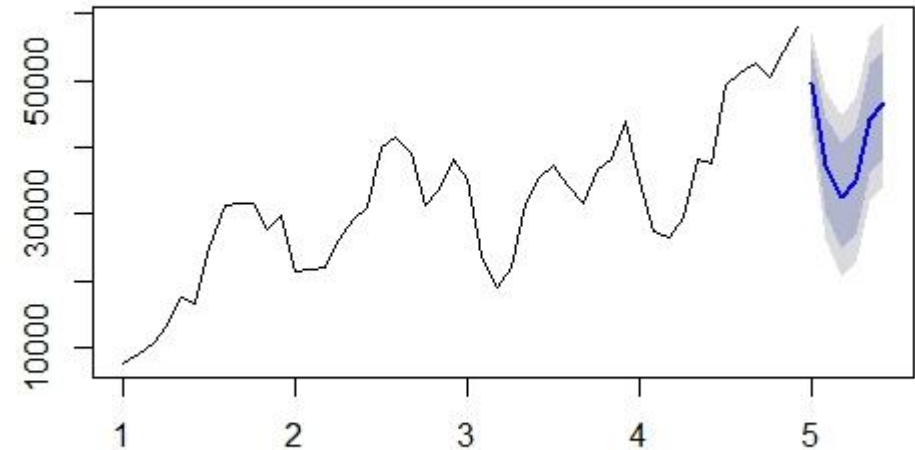
AUTO ARIMA FORECAST — EU CONSUMER SALES

Forecasts from ARIMA(0,0,0)(1,1,0)[12] with drift



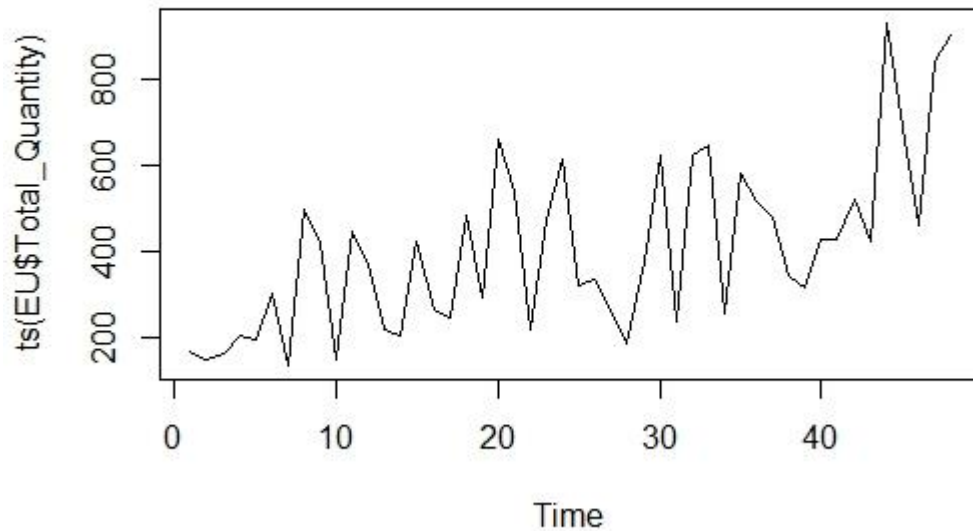
ARIMA ON ORIGINAL SERIES WITH FORECAST

Forecasts from ARIMA(2,0,0)(1,1,0)[12] with drift

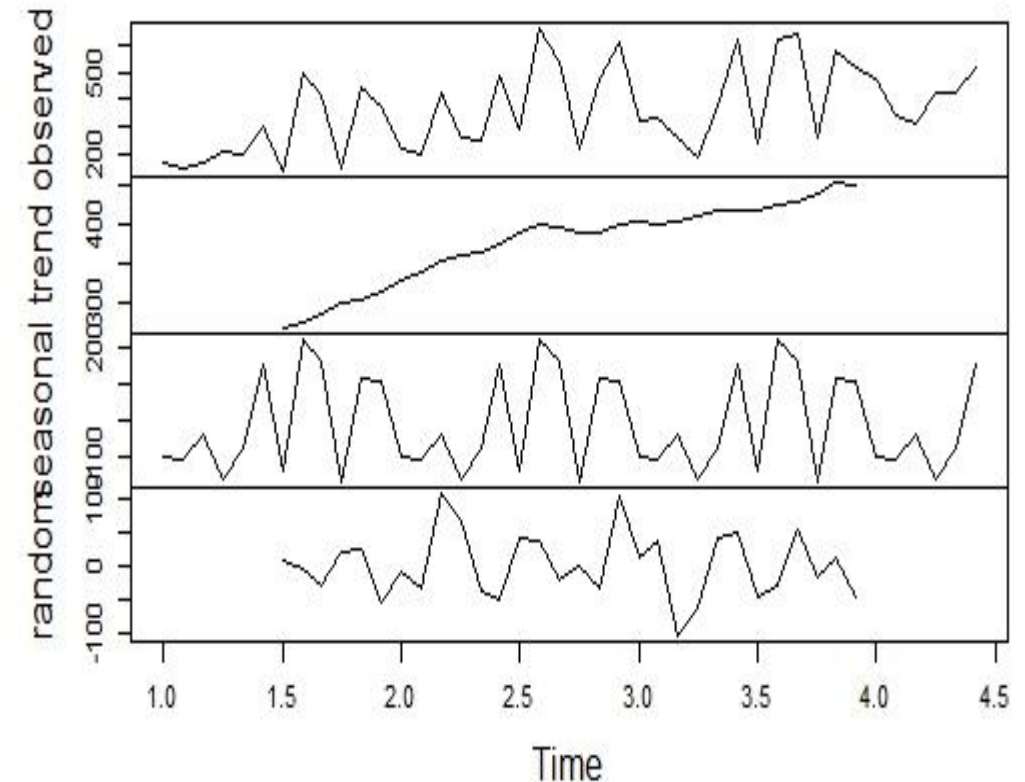


ARIMA ON SMOOTHENED SERIES WITH FORECAST

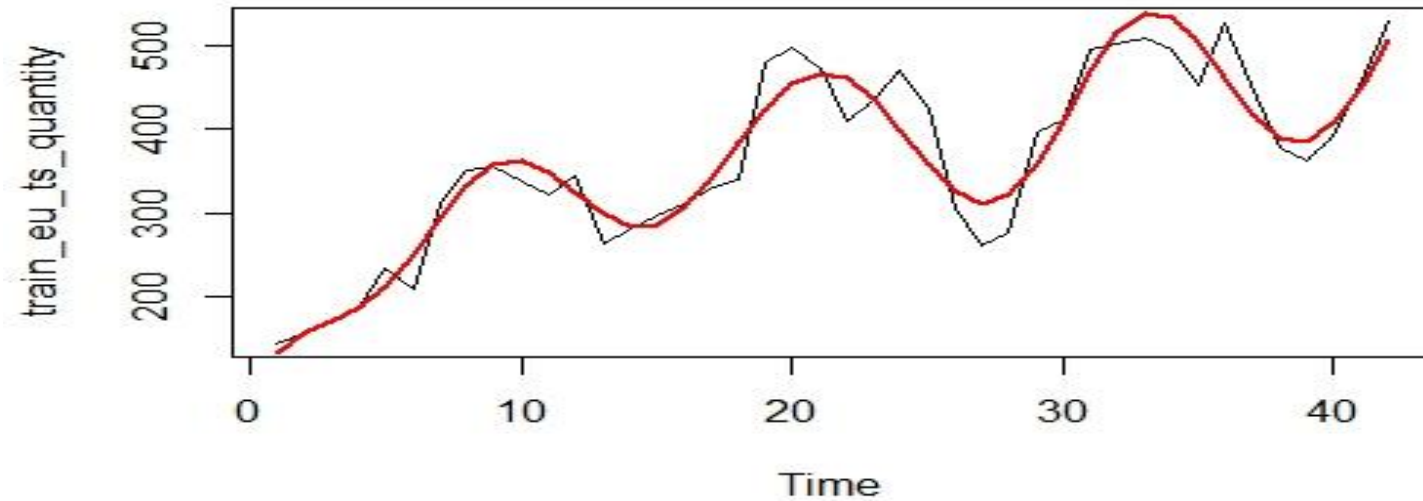
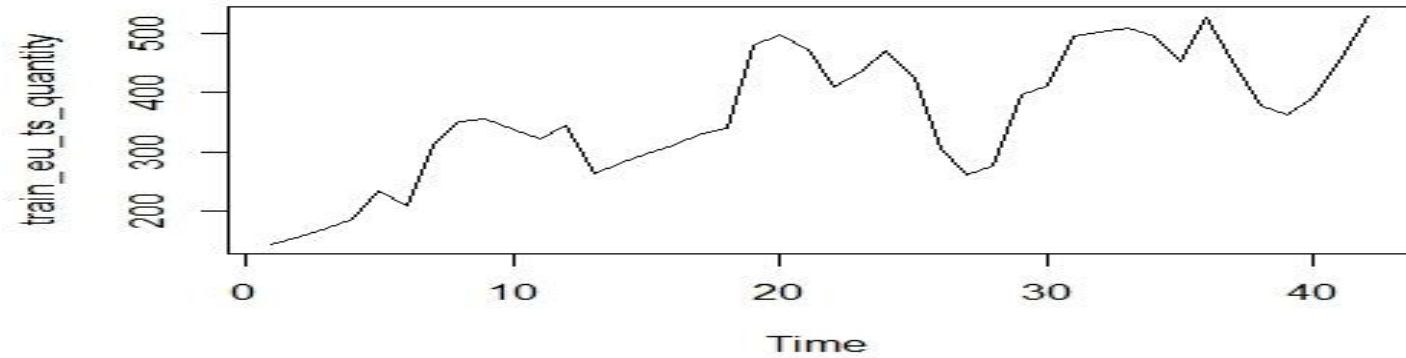
EU CONSUMER — TIME SERIES OF QUANTITY



Decomposition of additive time series



SMOOTHENED SERIES AND LINEAR FIT – EU CONSUMER QUANTITY

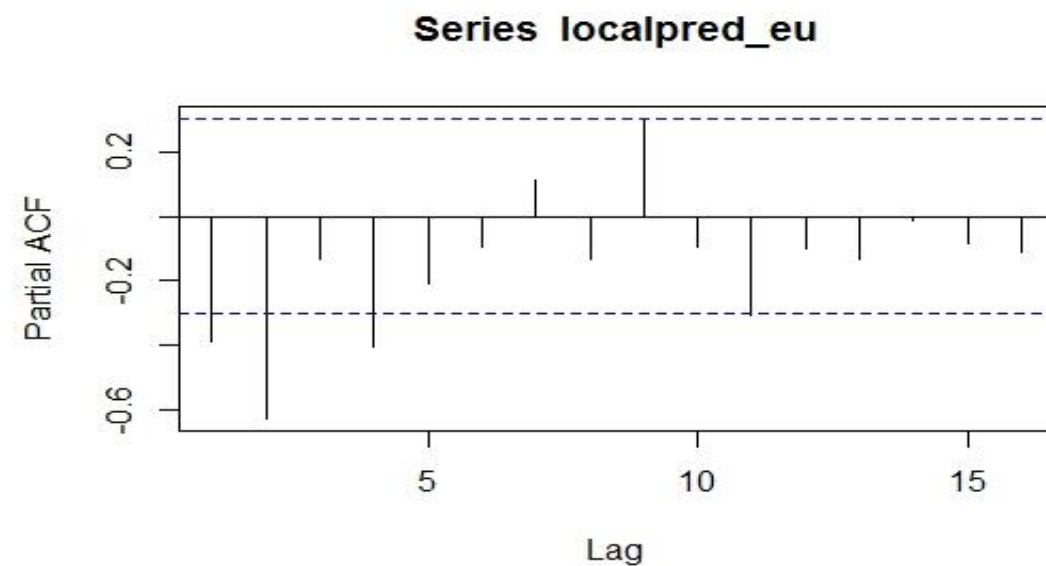
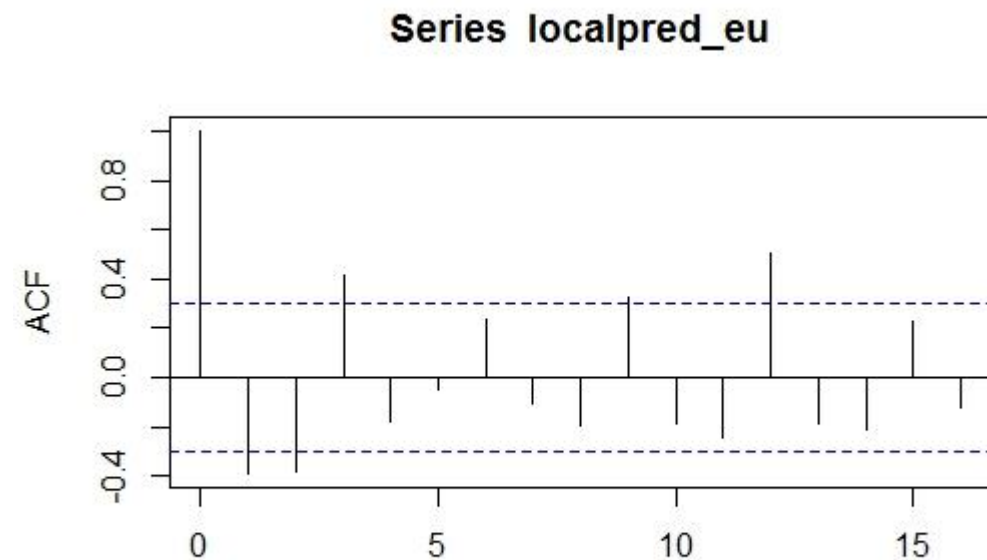
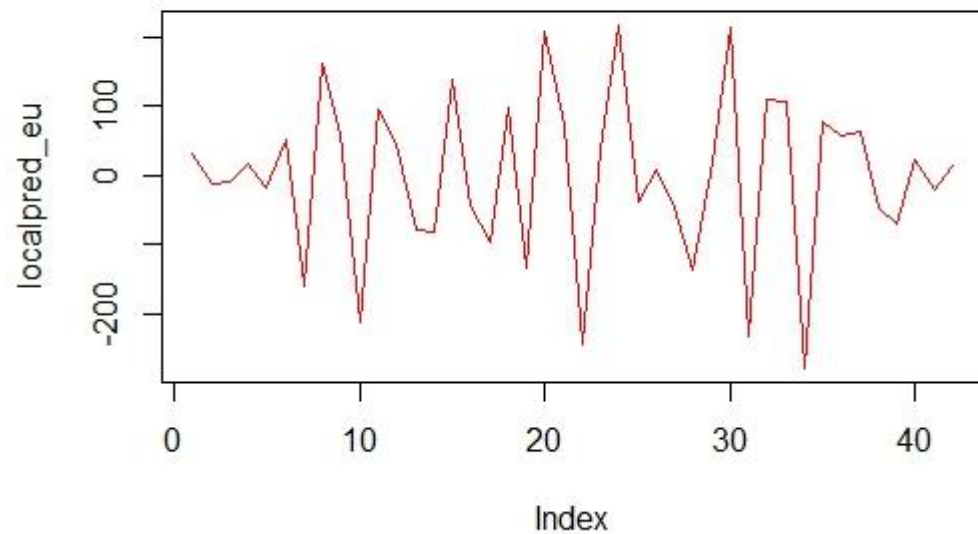




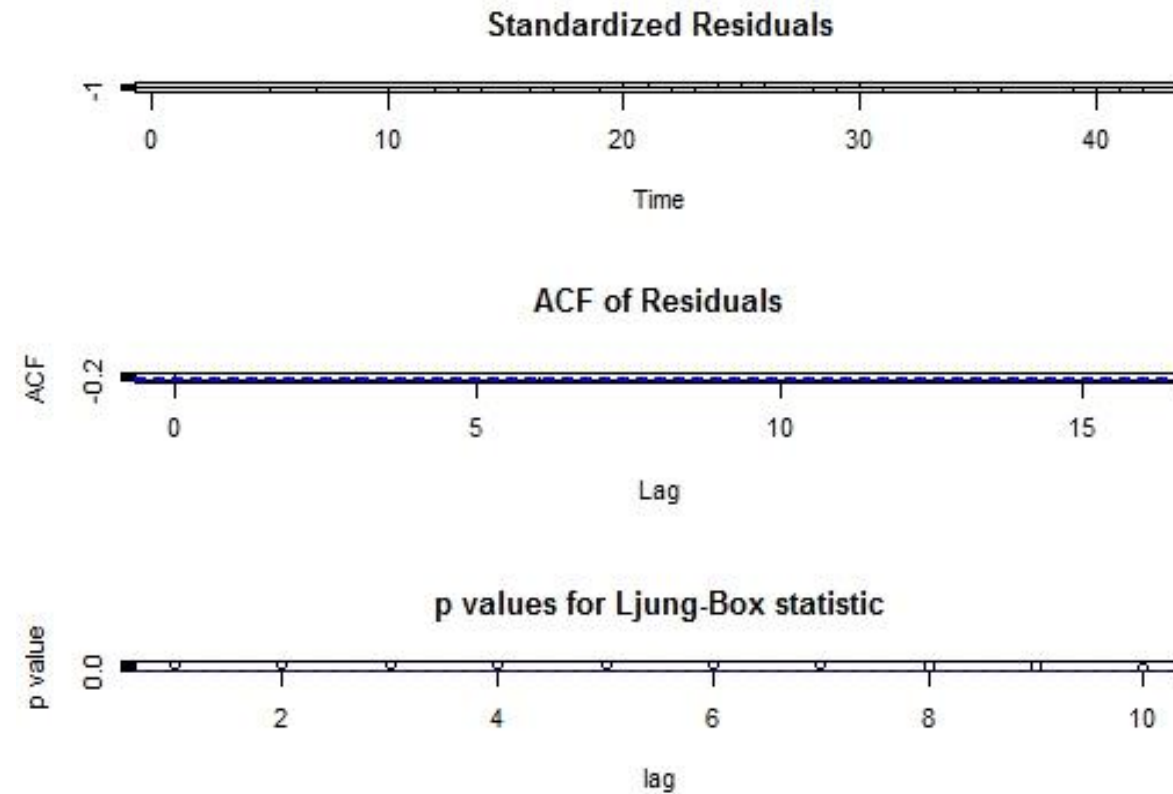
MIT

LOCAL PREDICTION — EU CONSUMER QUANTITY

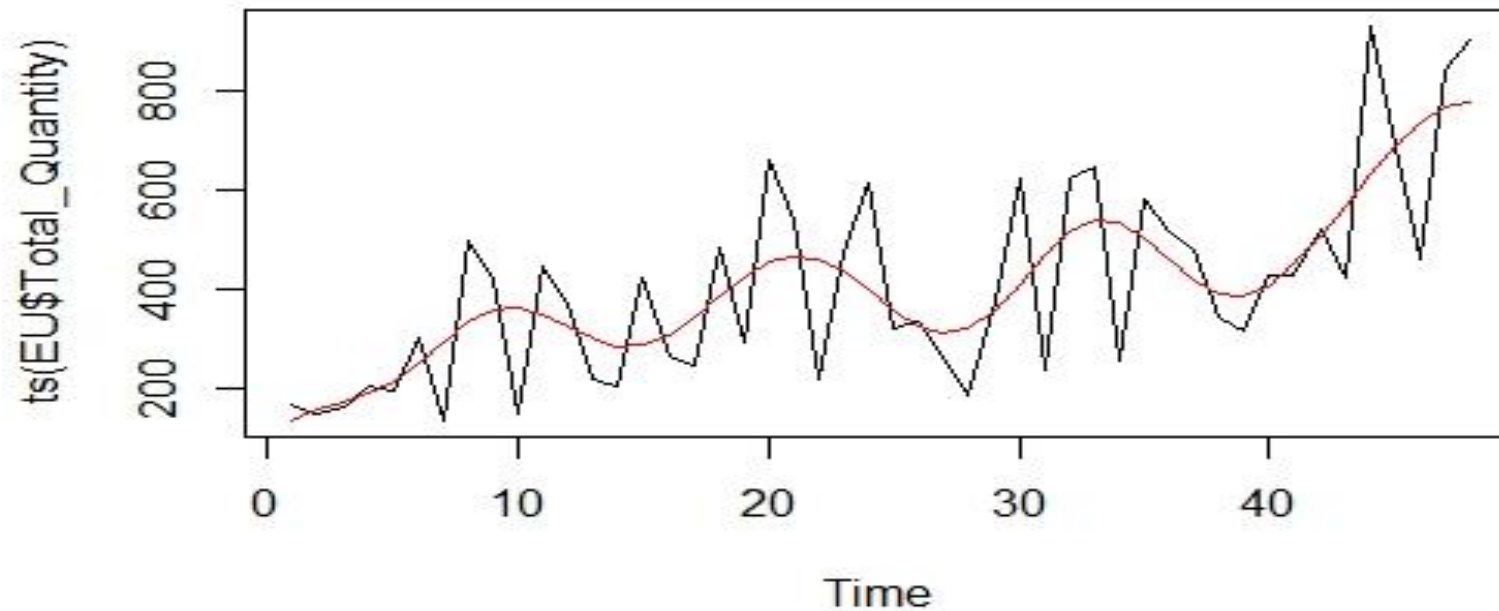
UpGrad



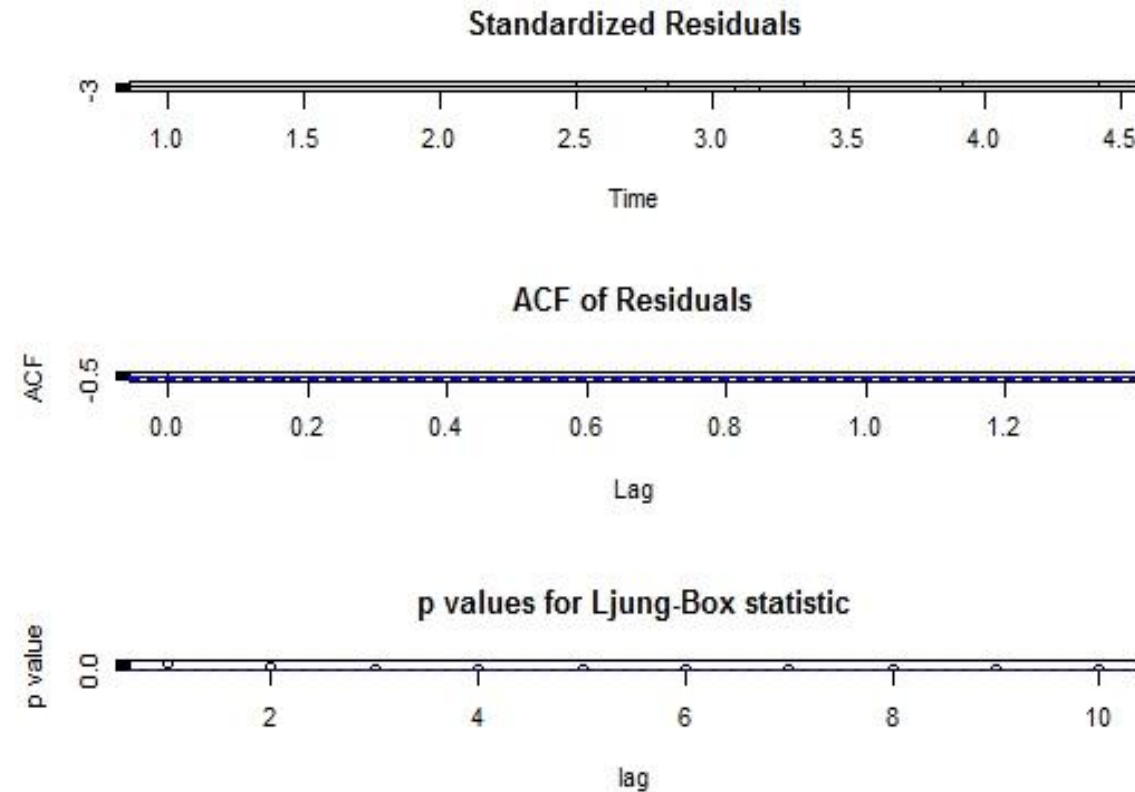
ARIMA RESIDUALS — EU CONSUMER QUANTITY



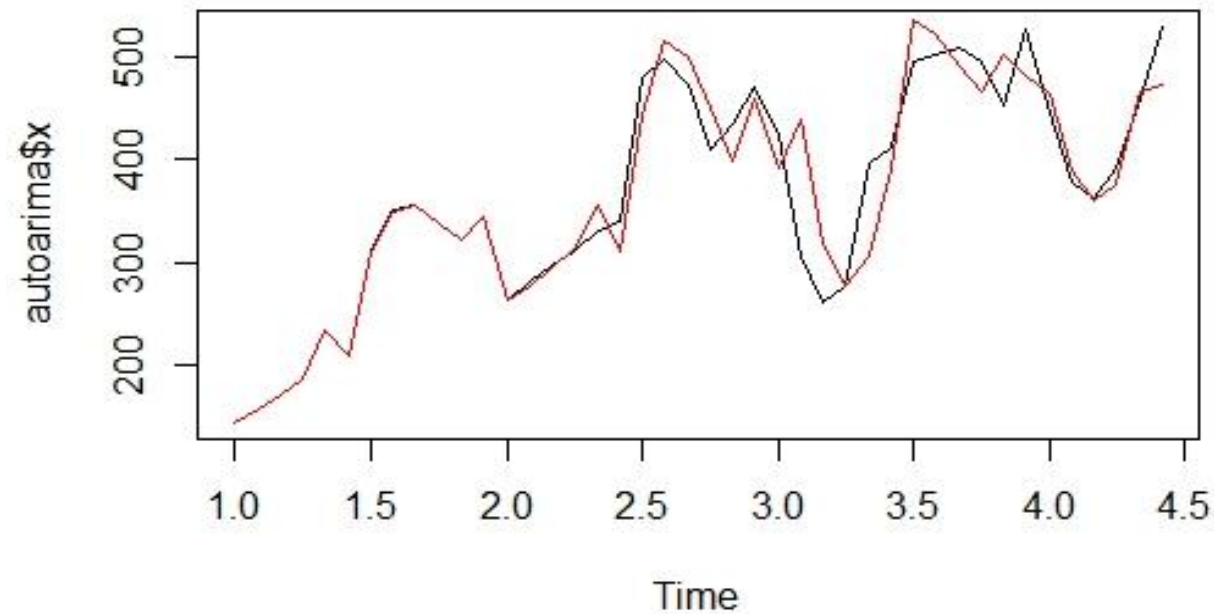
GLOBAL AND LOCAL PREDICTION FOR THE LAST 6 MONTHS – EU CONSUMER QUANTITY



AUTO ARIMA FITS RESIDUALS — EU CONSUMER QUANTITY

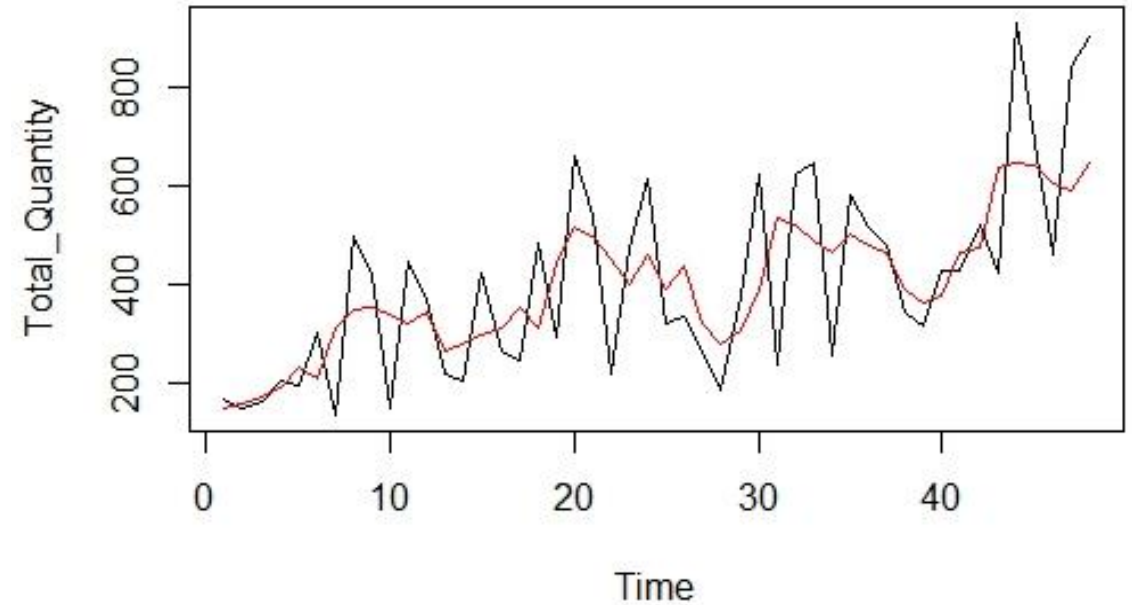
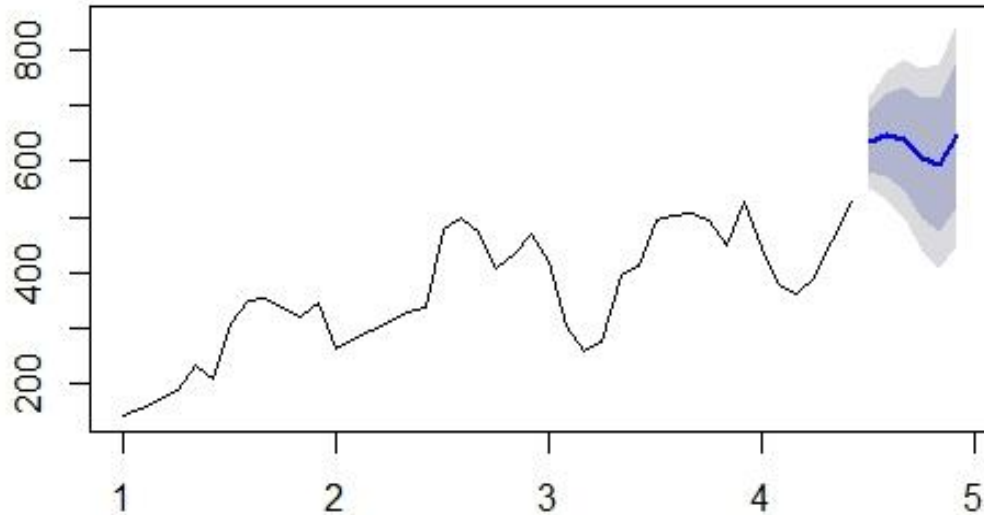


AUTO ARIMA FITS SEASONALITY – EU CONSUMER QUANTITY



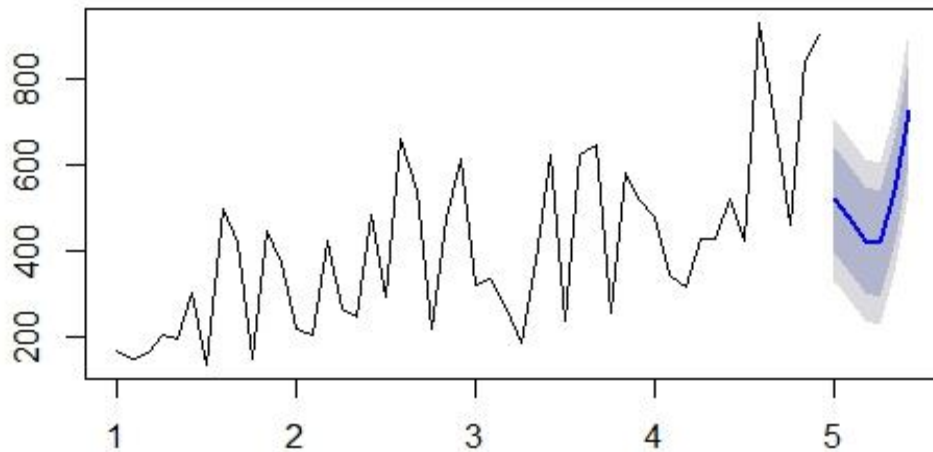
AUTO ARIMA FITS — FORECAST TESTING AND MAPE — EU CONSUMER QUANTITY

Forecasts from ARIMA(0,1,0)(1,1,0)[12]



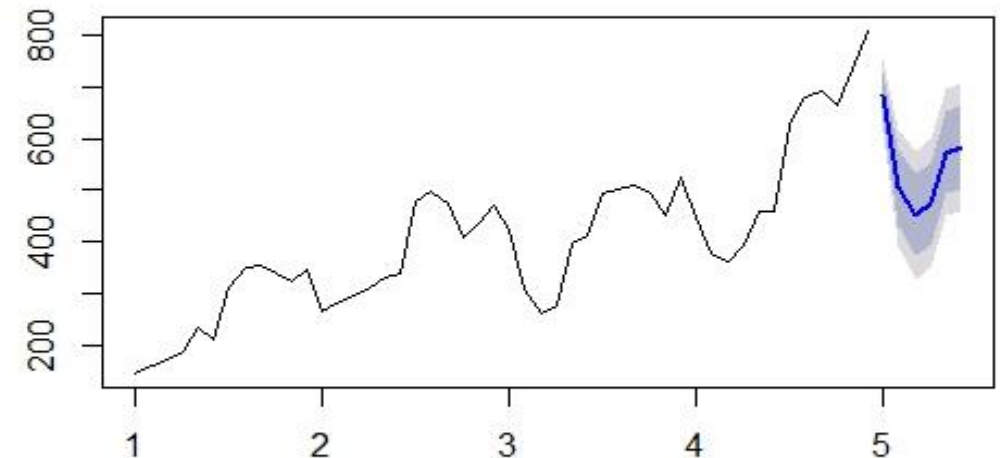
AUTO ARIMA FORECAST — EU CONSUMER QUANTITY

Forecasts from ARIMA(0,0,0)(1,1,0)[12] with drift



ARIMA ON ORIGINAL SERIES WITH FORECAST

Forecasts from ARIMA(0,0,2)(1,1,0)[12] with drift



ARIMA ON SMOOTHENED SERIES WITH FORECAST

CONCLUSIONS

Sales across both analysed market segments have shown seasonal behaviour.

The two most profitable and consistent market segments are; APAC Consumer and EU Consumer.

Segments have shown linear increasing trend in quantity sold along with seasonal trend.

We have used Auto ARIMA method and classical decomposition techniques for both APAC Consumer and EU Consumer (Sales and Quantity).

Looking at the EU forecasted graph; there is a immediate downward trend in sales & quantity followed by a slight increment in both at later stage. The inventory has to be managed accordingly.

Looking at APAC forecast, we find a upward trend though their a chance of immediate low sales and quantity. A pullback or bull run is anticipated when the opposite takes place.

Forecasted EU consumer quantity hovers around 600 to 650 and EU sales is forecasted in between 30000 to 45000.

Forecasted APAC consumer quantity hovers between 600 to 800 and APAC sales is forecasted between 48000 to 62000.