

CASE STUDY – TIME SERIES

Sales Forecast for Global Mart

Group Name:

1. Atul Agarwal
2. Anurodh Kumar
3. Amit Kumar Verma
4. Debashish Bhattacharya

Contents

- Introduction & Problem Statement
- Data Cleaning
- Data Preparation
- Building the Model
- End to End model (EU) - Classical Decomposition
- End to End Model (EU) - Auto Arima
- Evaluating the model/Result
- Business implication of Forecasting

Problem Statement

- **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
- We want to forecast the sales and the demand for the next 6 months, that would help you manage the revenue and inventory accordingly
- This forecasting has to be done for the 2 most profitable segments

Data Cleaning

- NA Values Treatment: Checking the records having 'NA' and replacing them with 'Not Applicable'
- Duplicate Check: Checking for duplicate records
- Data type settings: Setting the data type for the Order date column as Date

Data Preparation

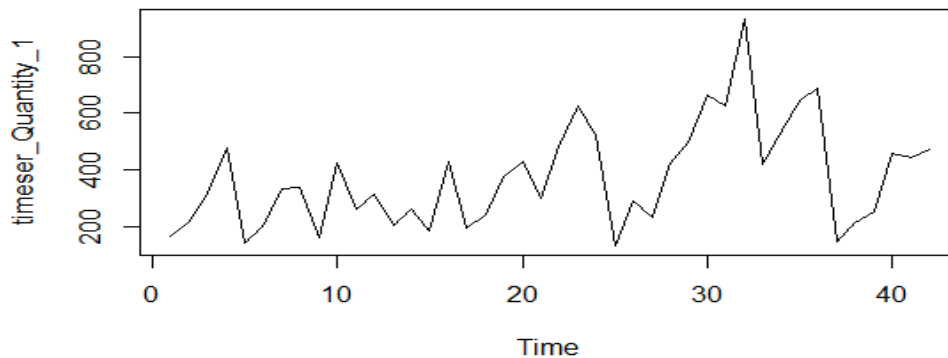
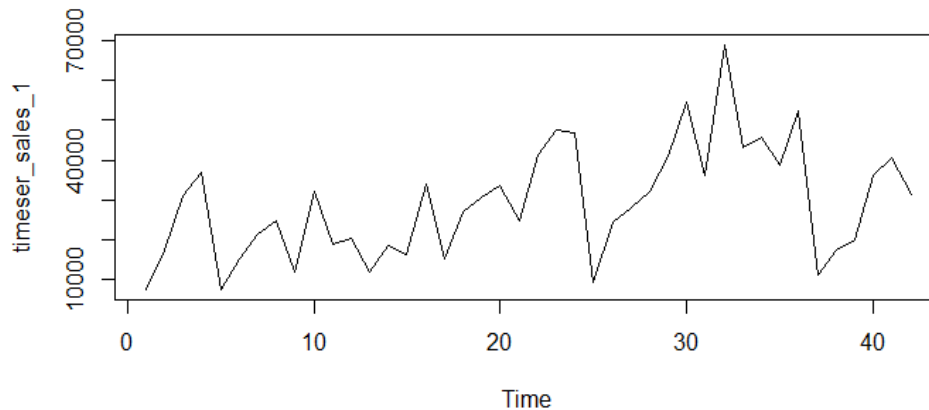
- Creating Data frames for different buckets: Dividing the data into 21 buckets for Global Mart across 3 segments (**Consumer, Corporate, Home Office**) and 7 markets(**US APAC EU Africa EMEA LATAM Canada**)
- Aggregating data: Aggregating the data from transaction level to Month level for each of the buckets
- Finding the most Profitable: Based on the CV (coefficient of variation), we obtain the 2 most profitable bucket:
 - Consumer Segment EU Market
 - Consumer Segment APAC market
- Separating train and test data: Separating the 1st 42 month data for training (model building) and last 6 month to be used for testing

Building the model

- Creating Timeseries: Creating 4 time series for Sales and Quantity for each bucket
- Auto Arima fitting:
 - Fitting the time series' using Auto Arima
 - Removing the fitted component from the original time series to get residue
 - Plotting the residual series and also performing KPSS and ADF tests to ensure that the residue is stationary
 - Forecasting for the test data and calculating accuracy using MAPE
- Classical Decompostion modelling:
 - Smoothening the Time Series' created
 - Fitting a sinusoidal model to model the trend and seasonality
 - Handling residual series and calculating accuracy same way as AUTO ARIMA

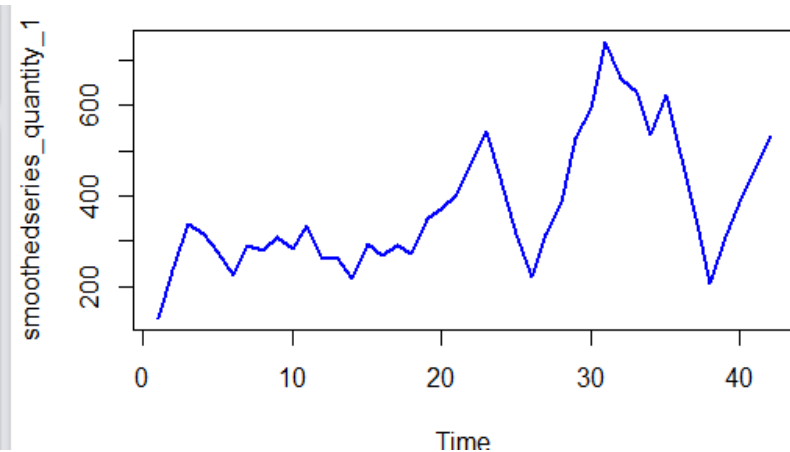
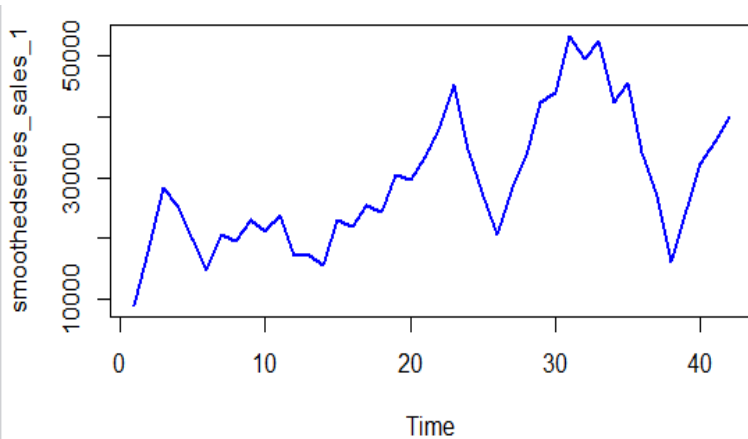
End to End Model - EU

- Creating Timeseries: After creating the Time Series for Sales and Quantity, we plot the Time series for the training data



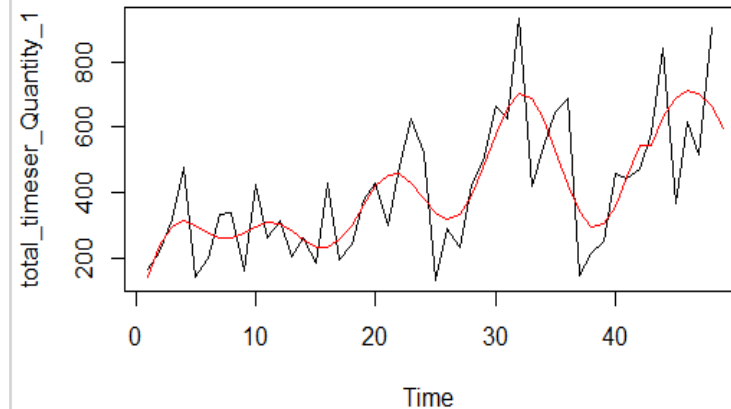
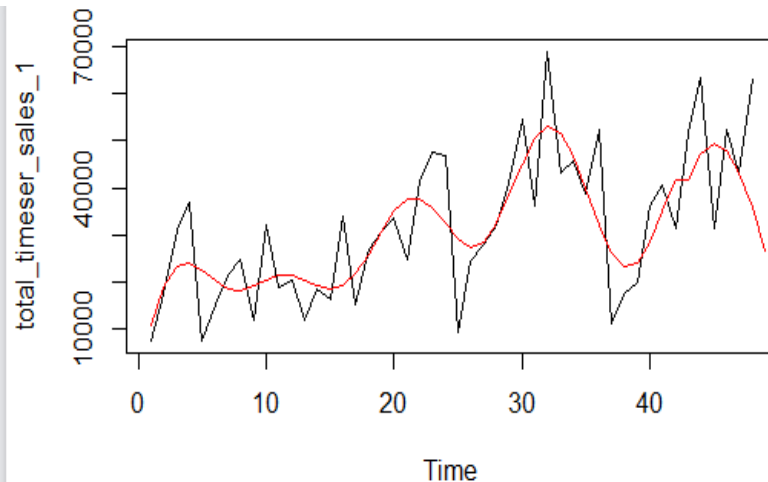
End to End Model - EU

- Creating Timeseries: Smoothing the Time series for Sales and Quantity. We use the moving average smoothing. (Exponential smoothing (Holtswinter) also gives same accuracy)



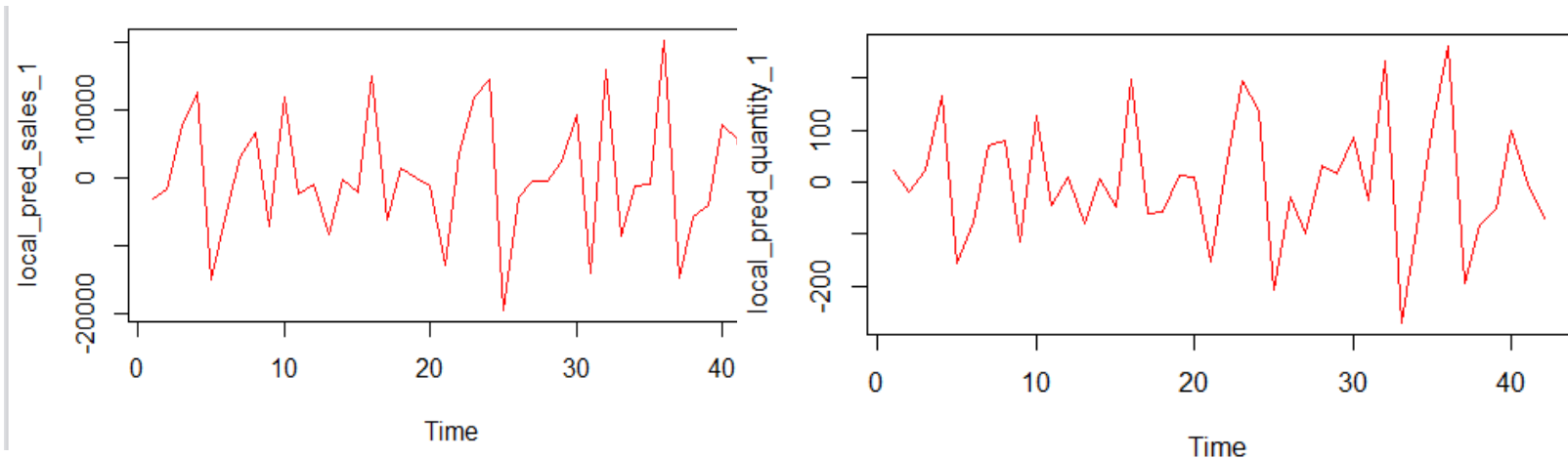
End to End Model - EU

- Building Model: Based on the plot of the model, we build a multiplicative model using sinusoidal function and plot the forecast models and original time series together for full 48 months



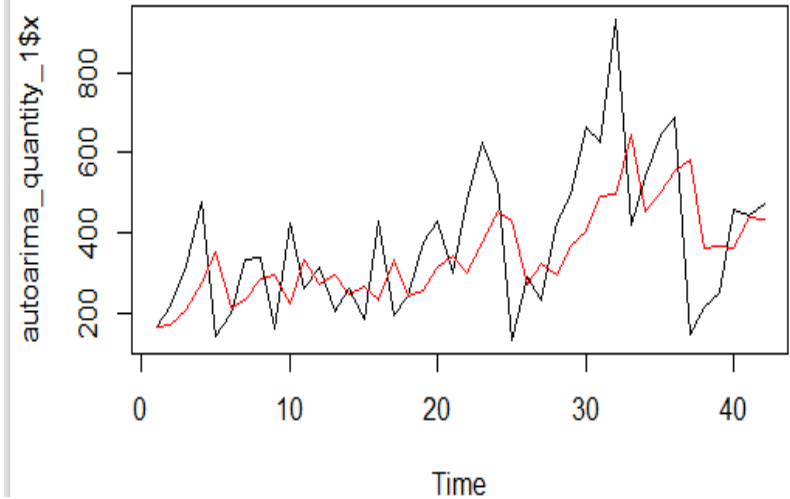
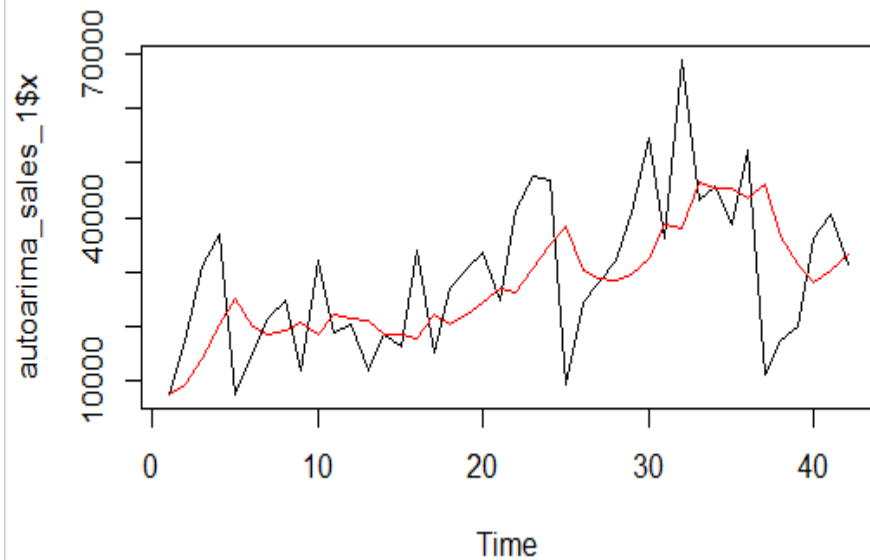
End to End Model - EU

- Checking the Local part: Subtracting the global part of forecast from the original time series, we get the local part. Plotting the local part we see that it is a white noise, that we wont model



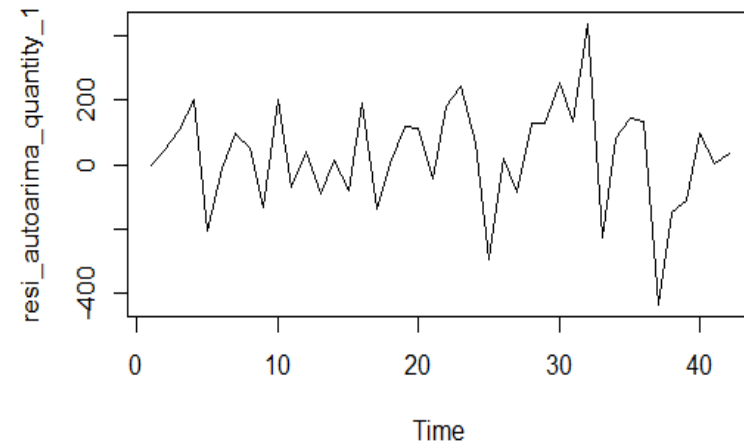
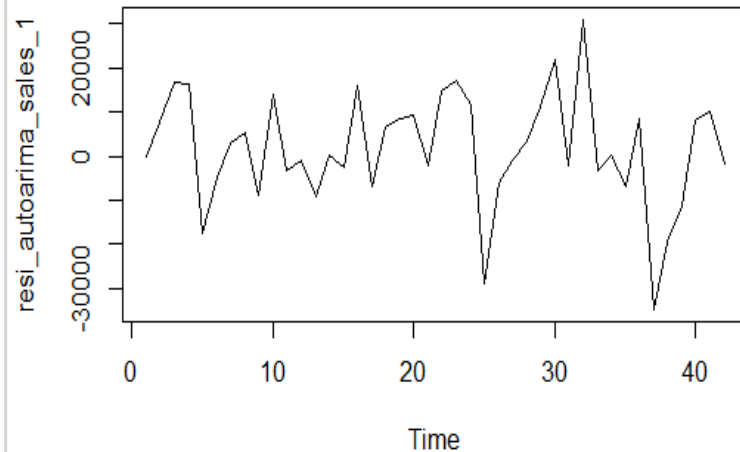
End to End Model – EU (Auto Arima)

- Creating the Auto Arima Model: Creating the model using Auto Arima and also plotting the forecast and the original train data



End to End Model – EU (Auto Arima)

- Checking the Local part: Subtracting the global part from the original time series and checking that the residual part is white noise



Evaluating the model

- For each time series, we select any 1 of the 2 models – either Auto Arima or the Classical Decomposition, whichever gives us the lower MAPE value (better accuracy)
- Based on the above criteria, we obtain the below result:
 - The best model for EU-Consumer quantity is Auto Arima model with 30% MAPE
 - Best models are for EU-Consumer sales is Classical Decomposition model with 25.1% MAPE
 - Best Model for APAC-Consumer quantity is Auto Arima with MAPE of 23.4%
 - Best Model for APAC-Consumer sales is Auto Arima with MAPE of 17.8%

Business Implications of Forecasting

- Efficient Supply Chain Scheduling: If you can forecast not only the amount of sales you'll have but also when they are likely to occur, you can better schedule your production, warehousing and shipping
- Better Labor Management: Having too few workers to handle a spike in sales orders can lead to slow order fulfillment. Accurate forecasting helps to overcome this problem
- Adequate Cash Flow: Knowing the peaks and valleys of demand helps you better manage your cash flow, ensuring you have enough money on hand to pay bills
- More Accurate Budgeting: If you have a flexible budget, such as tying marketing spending to sales, you can shift paid marketing efforts such as advertising and free marketing efforts such as a social media campaign between slow and busy periods