

# Impact of Business Intelligence Tool Integrated with Statistical Development Environment on Forecasting Process of Textile Firm in Retail Business

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## ABSTRACT

Demand Planning is a key function to business, single-view dashboards play a vital role enabled by business intelligence tools to visualize forecasting trends in businesses. Many software tools enable businesses to create dashboards in order to organize data for executing informed business decisions and actions. This analysis anchors on a textile firm's sales data that is being utilized by exploring and implementing Microsoft's Business Intelligence tool (MS Power BI) for performing data processing and forecasting. Use of Microsoft Power BI tool, leveraging its inbuilt functionality of incorporating R programming scripts assisted in adding significant flexibility i.e. Plethora of Visualizations and lightning fast computations. Drastic improvements in terms of simplicity, speed and convenience are demonstrated by shifting the forecasting process on to this platform in Textile Firm Scenario, this paper also discusses the current known limitations and future scope of this integrated service. This analysis falls under the scope of knowledge management.

## Keywords

Microsoft Power BI; Forecasting; R scripts; Business Intelligence; Time Series Analysis

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## 1. Introduction

A prime facet of planning and forecasting activity is the necessity to possess a futuristic vision of domain areas where the resources of the business should be assigned, leading towards business success. Leveraging available tools is crucial to those who aspire to work in the current business environment. Students inducted in business school are often introduced to some embodiment of statistical and data analysis tool, due to the increasing number of employment opportunities which expect these niche skills beforehand. Such tools are also vividly researched and sustain a huge scope of relevance in academia.

Evolution of forecasting process over the years with proliferation of business intelligence tools has been faster than ever. Forecasting process involves significant number of steps to arrive at the final valueable output. The speed and convenience at which businesses arrive at this output is setting benchmarks with each incremental enhancement made in the already existing business intelligence tools.

Many business intelligence tools offer inbuilt forecasting models visualizations and results with flexible parameters selection. However, the depth and width desired by the analysts solely depends on the Business Intelligence (BI) tool backend

development which at times imposes constraints on the level of details required.

SAP BI, QlikSense, Tableau, SAS BI are among the top list of BI tools to name a few but it is Microsoft Power BI which has offered a feature over and above the ones existing across all BI platforms. The feature is incorporating R/Python scripts as visualization windows at par with other graphical representations. This feature has extended the scope of visualization to another level of flexibility, as it is now feasible to project the visualizations available via R/Python packages (libraries) directly onto the live running dashboards.

This research study will elaborate how Microsoft Power BI as a tool, in addition with integrated R scripts can work in synchronization, even when the sources of data are scattered in different storage locations to provide analysis and visualize dynamic data reports.

Materials, references or any other information that can disclose the organization's sensitive information have been taken off. Company's SCM Head was the single point of contact throughout the analysis.

The paper has following sections: Section one provides the introduction to available Business Intelligence tools and explain why Microsoft Power BI has an edge over others by discussing

it's application in the forecasting process of a textile firm operating in retail business. Section two covers the literature review of Business Intelligence. Section three explains the problem scenario in forecasting process of a textile firm in retail environment. Section four covers the structure of the analysis. Section five focuses on the conclusion and discussions around the impact of choosing a Business Intelligence tool over conventional mode of forecasting. Section six is about acknowledgement. Section seven describes the current known limitations with the proposed forecasting solution. Section eight covers the future scope.

## 2. Literature Review of Business Intelligence

Prevailing BI channels/metrics like Sales/Marketing and key performance indicators (KPIs) are supposed conventional BI forms, in which the framework is utilized to do repetitive analysis from explicit information. Ordinarily these Business Intelligence tools use marketing data, inspect the business stream, gauge the exhibition of advertising efforts and investigate monetary key performance metrics. In the beginning phases, key performance gauging tools were restricted and couldn't be modified by the necessities of the organization. Right now, these tools have additionally evolved which empowers the user to choose, channel, look at, envision and examine information in various ways. It likewise empowers the client to introduce the information outwardly as per their necessities. Swift analysing and reporting Business Intelligence tools need a group to work in collaboration to make desired applications for ultimate users. The BI tools then utilize self-administration to show data desired, for example single-view reports, tables or visualizations. Frameworks like these likewise demand support from an IT team to keep up the backend structure with the user base who leads the analysis and reporting (Sherman 2018.) Microsoft Power BI is an excellent case of the sort of BI tool that permits clients to pick/stack information, channelize and project the information. Be that as it may, the association will even now require a team to deal with the sources of data for it to work accurately.

A self-administration BI framework utilizes and performs impromptu examination of the information, which is onetime-only or consolidation of a repetitive analysis. Such

analysis will likewise be imparted to other stakeholders within the company. In a self-administration BI structure, clients are free to include data without assistance from an IT group to keep up the framework. Be that as it may, the IT group is as yet required as there exists three necessities for a self-administration Business Intelligence framework to perform effectively. The IT group must deal with the access of the data sources dependent on need, safety and protection rights for the framework clients to acquire legitimate benefits. The information which is utilized by the Business Intelligence tool should be interpretable, as there might be access constraints in the system or server. In conclusion, the client information sources must be reasonable by the client domain, which as a rule works together with the IT group to improve comprehension of the constructions and data elaborations, expected to conduct analysis (Sherman 2018.) The last BI classification is progressive analysis. In such classification the BI tools utilize and manage how to lead predictive and prescriptive analytical models that incorporate data mining, predictive analytics and statistical modelling applications. The distinction to conventional analytical frameworks is that it stresses on forecasting occasions/situations, permitting organizations to make a re-enactment of what-if scenarios, which are utilized to foresee changes in business development and strategies. Most commonly advanced analytics is used in marketing, healthcare, risk management, and economics (Preslar 2013.) An example of this type of program is Yellowfin Software that offers to predict the future tools for the company. Its tools allow forecasting which can help the company to predict sales by identifying a consistent pattern in the data (Yellowfin 2018.) In the wake of picking a Business Intelligence framework, it is imperative to find out how the user base will get to the Business Intelligence framework (front end) and the place where BI itself is found and worked (backend). At present, a widely recognized approach to get to a BI framework is to utilize a program based customer interface. Another issue to mull over is the place the BI application is deployed. It can be accessed from servers on-site, in data centers or private cloud services (Sherman 2018.)

### 3. Problem Scenario

This research is based on the data and information of a textile firm - Welspun Global Brands Limited, a group company of Welspun India Limited, for the domestic retail business situated in India. Welspun's information will be blue-pencilled to ensure the security of the business. Welspun likewise chooses what information can be shown and utilized for the data analysis. The forecasting complexity related to retail business is challenging because of the location of push-pull boundary in the retail scenario which resembles make to order environment. The spread of efforts required to perform forecasting in such environment is magnanimous owing to wide varieties of Stock Keeping Units (SKUs), consumption rate, Minimum Order Quantities (MOQs), seasonality etc. To gauge significance of Business Intelligence tool for forecasting in such situation, a live data connection was utilized to gather the as-is available data from the Welspun's sales administration hub. The proposition of this analysis centers on the objective of how actualizing Microsoft's BI tool (MS Power BI) improves an organization's forecasting process.

The SCM (Supply Chain Management) Head of Welspun Global Brands Limited had actualized this business insight program - MS Power BI. With this program, he could quickly observe the most recent dashboards without sifting the data and manually making a visual representation which was a laborious task. Microsoft Power BI service is an online/locally accessible help from Microsoft that permits extraction of data from different locations without influencing the parent source. This tool gives an organization the freedom to access, slice, present, publish and monitor data conveniently yet effectively. The live feed information can likewise be refreshed consequently, which means all available presentations, dashboards and reports will likewise be refreshed to project the most recent data unaccompanied by manual work. The Business Intelligence tool associates data from numerous assorted sources and programs, into one spot and it is accessible from anywhere. The software can be installed onto a computer or be accessed online from any location by using different browsers (Microsoft 2018.)

### 4. Structure of the Analysis

The analysis is led by putting forth a subjective study to discover what changed in Welspun's forecasting process once the BI tool was put to use. The crucial elements for the research attempt that will be broken down, are to comprehend the Welspun's earlier circumstance by taking a look at their sales and forecasting data. To gauge the Welspun's own viewpoint and assessments, the SCM Head shall be conferred to extract crucial and significant thoughts why Microsoft Power BI was actualized in any case, also in which way utilizing this BI service has helped Welspun, was it to all the more likely use authentic data and information or to improve the focus of the business, key areas to channelize attention and subsequently the business performance.

#### 4.1 Overview of Research Structure

The meeting is done online via an engaged (semi-organized) manner, out of which data regarding the matter is expected from the individual to be interviewed. The objective is to understand the respondent's point of view with open-ended questions (Jamshed 2014). This implies the company's SCM Head will express his opinions why MS Power BI was actualized explicitly. The appropriate responses therefore might not be pertinent to different organizations as it is a particular and one-sided view. The inquiries of the interview for the SCM Head were the following: (i) For what reason was Microsoft Power BI actualized? (ii) How Microsoft Power BI has altered/modified the forecasting information introduced to the organization? (iii) How was the forecasting information sifted and introduced to the organization before the actualization of Microsoft Power BI? (iv) How would you think Microsoft Power BI has been valuable to the organization?

Such inquiries will enable the SCM Head to comprehend the present worth as well as the need/purpose behind the use of MS Power BI and see how gainful will it be for the forecasting process of the business. To accomplish significant outcomes, data must be acquired using Power BI and contrasted against the previous way in which the raw data was retrieved. The attempt assumes that there would be chances of errors throughout the information gathering, processing, and visualization, for instance, the information can be

sifted using irrelevant filtering or shown in the incorrect configuration/format.

#### 4.1.1 Scenario of the company

To comprehend the current situation of Welspun Global Brands Limited, company's SCM Head is interviewed to see how Welspun has dealt with the forecasting process before the utilization of a Business Intelligence tool and looking forward into the future leveraging the same. The replies to the interview questions are recorded by means of audio-video call so that meeting procedure could be effortlessly followed and alluded to, without asking the company's SCM Head to rehash replies to the interview questions.

#### 4.1.2 Existing data collection

Two distinct scenarios of data gathering are used from Welspun, the latest method is using Microsoft Power BI and the former method, that would ask for information assortment and sifting with no Business Intelligence tools. Data collection is begun by acquainting with MS Power BI tool followed by retrieving dynamic data from Welspun's data warehousing systems. The advantages/the edge of incorporating Microsoft Power BI tool is that it gathers information and channels it rapidly, not affecting the already linked parent data. It is this powerful feature of the framework that assists the users to reproduce reports and dashboards without any constraint, to highlight the principle business problems that the team should concentrate on.

#### 4.1.3 Methodology

Once the data is collected, it is analysed, previous methodology included various computations in the excel before arriving at the final forecasting dashboard - charts, filters and slicers. One of the finest methods to assess is to establish a comparison at the way of gathering, filtering, computing and visualizing data. Steps to arrive at the forecasting dashboard without the use of BI Tool:

Data dump in an excel file is taken from the SAP data server.

Smoothened data is compiled after outlier treatment exercise.

Worksheet to identify initial Level and Trend for each product is compiled using Excel solver and VBA Macros to avoid repititive steps.

Data is bifurcated on the basis of data availability(Monthly Buckets in separate Worksheets).

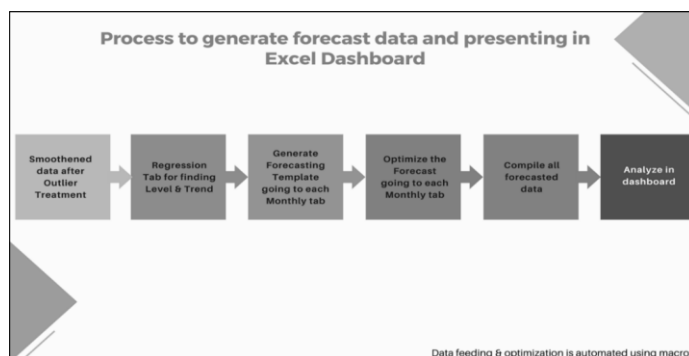
For each monthly bucket worksheet, formulae are used for different forecasting methods output as desired and computed using VBA Macros to avoid repititive steps.

All the forecasting data is compiled back in one worksheet using VBA macros.

This compiled worksheet is used as a source sheet for visualization(Dashboard,Slicers as per columns etc.)

Best fit models for each product are stored with optimized parameters for future reference.

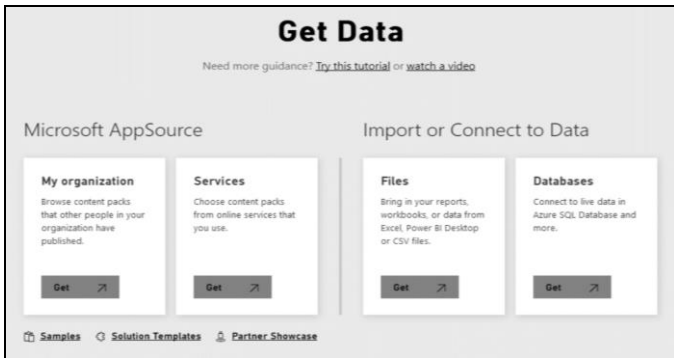
This whole process is time consuming. The same sequence of steps is being represented in the image below [see Img.1].



Img.1: Process Flow of Forecasting in MS Excel

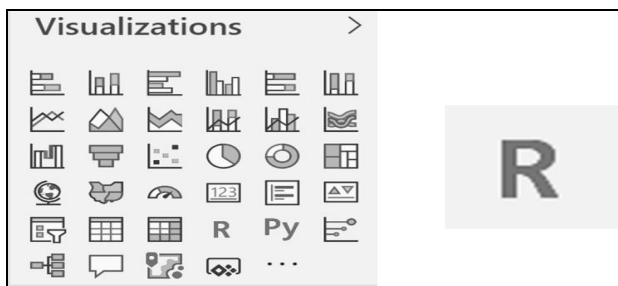
Now to explore the structure of the data, dense details about the products in columns like Product description column, Product Unique Number column etc. followed by month-wise sales data is available. The backend computations for each product by desired forecasting models makes the process quite exhaustive and the penultimate compilation of the results with optimized individual solutions using Excel solver tool makes the workbook quite heavy.

Moving ahead to the execution of the same forecasting process with the new method i.e. using Microsoft Power BI. First and foremost step of data sourcing in Power BI offers plethora of options– from local storage, online services(Direct Query/Import mode), and from network drives[see Img.2].



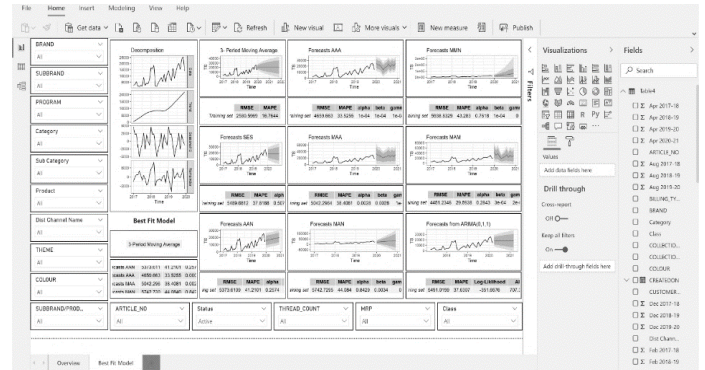
Img.2: Data import options in Microsoft Power BI

After the data is imported into the Power BI tool, provision for data transformation is available using Power Query which without changing the sourced data, processing it as per the desired formats and settings. Now the dashboard window has many options to incorporate inbuilt forecasting visualizations from the visuals pane of Power BI. However the unique feasibility is explored by using R Script visuals to do the job [see Img.3].



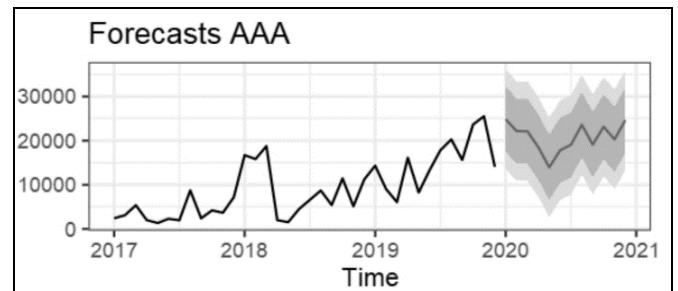
Img.3: R Script visual in visualization pane

It is this decision of incorporating R script visuals that opened the door for enormous possibilities. Basically what one could visualize in R using diverse packages (libraries), the same is now possible to visualize in MS Power BI with added functionality of dynamic data selection using synced slicers. Once R script visual is selected, an optional pop up appears to link it with the locally installed R Integrated Development Environment (same directory). After this step, for each R script visualization, data is selected from the transformed data field as input. Optimized solutions of various desired forecasting models is made feasible with the same. The end result (Forecasting Dashboard) looks like this [see Img.4].



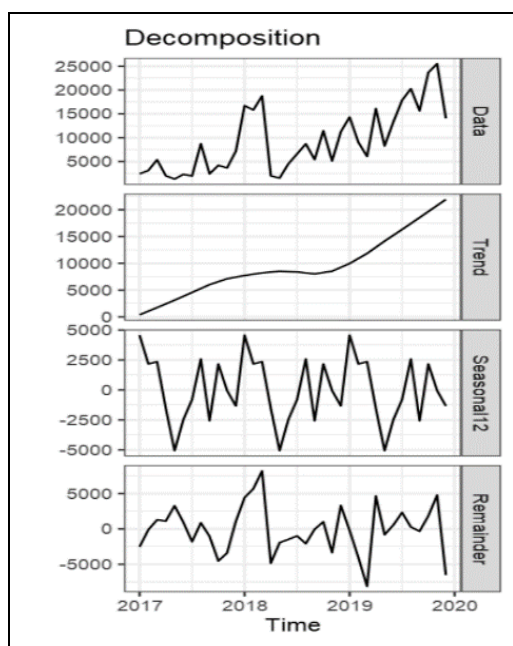
Img.4: Forecasting Dashboard (Microsoft Power BI 2020)

From here onwards we shall look at the sample scripting details of one of the Forecasting Models, visual for decomposition of time series and ultimately consolidated report visual with best fit model recommendation. As and when the data is loaded in R script visual, it gets allocated in a data frame by default and user initiated scripts are written later. The comprehensive details of the scripts are mentioned in Appendix 1, Appendix 2 & Appendix 3. Plots for distinct forecasting models (image below shows an example of Holtz Winters Model with additive error, trend and seasonal components) are obtained with changes in R scripts associated with the respective visualizations [see Img.5].



Img.5: Holtz Winters Forecasting Model Visual

Alongside these forecasting models plots, a plot for decomposition of time series of the selected data is also made feasible using R script, sample depiction [see Img.6]. It gives fruitful insights at any level of product classification in terms of trend, seasonality and randomness. Summary of all the selected forecasting models with their performance metrics is also readily available with best-fit model recommendation for the selected data by the user [see Img.7].



Img.6: Time Series Decomposition

Best Fit Model					
3-Period Moving Average					
Model	RMSE	MAPE	alpha	beta	gamma
Forecasts 3-MA	2580.597	16.7644	0.0000	0.0000	0e+00
Forecasts SES	5489.681	37.8188	0.5073	0.0000	0e+00
Forecasts AAN	5373.611	41.2101	0.2574	0.0001	0e+00
Forecasts AAA	4659.663	33.5255	0.0001	0.0001	1e-04
Forecasts MAA	5042.296	38.4081	0.0028	0.0028	1e-04
Forecasts MAN	5742.730	44.0840	0.8429	0.0034	0e+00
Forecasts MMN	5938.833	43.2830	0.7618	0.0001	0e+00
Forecasts MAM	4451.235	29.5938	0.2843	0.0003	2e-04
Forecasts ARIMA	5491.016	37.6307	0.0000	0.0000	0e+00

Img.7: All Forecasting Models - Performance

## 5. Conclusion & Discussions

After the comparison, the conclusion was in favor of the use of BI tool with integrated R Scripts for forecasting since the valuable output yield was way faster and readily available for all to access and analyze. It is ascertain that the analysis & research was effective and it serves as a preferable solution over the existing practice. It is also crucial to identify if the findings can be put to use by other organizations in the future when pondering over the need to adapt and use the business intelligence tools. Crosschecking and validation, in case the data collected and analyzed

consists of errors, Null values and outliers can be done using various methods of data wrangling in R scripts.

## 6 Acknowledgement

This work would not have been possible without the immense support of the co-authors, the company –Welspun Global Brands Limited and its highly supportive employees.

## 7. Limitations of the analysis

R visuals script extension in Microsoft Power BI service has following known limitations:

R visuals script extension offers zero support currently for customized packages

Size limit for data in R visuals script for plotting is limited to 150 thousand rows. If it exceeds 150 thousand rows, then only the top 150 thousand rows are considered by the extension with a message display on the screen.

R visuals are not interactive since the output is an image only and they keep refreshing upon filtering, highlighting and data updates.

## 8. Future Scope

Over and above the limitations which are being resolved by the development team of Microsoft Power BI, Forecasting analysis is a huge domain, elements of which can also be incorporated in the researched solution by introducing more reports to the dashboard which would enable detecting auto-correlations(ACF,PACF Plots), Differencing results, desired data transformations(Log Transformation etc.), and grouping products with similar demand patterns via clustering algorithms all using R script visuals.

Conflict of Interest: Authors don't have any conflict of interest

Ethical Approval: Not applicable

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Appendix 1 - Format shown below(input sales data for 3 years – from Jan 2017-18 to Dec 2019-20)

Default Loaded Data Frame in R script Visual:

```
dataset <- data.frame(Jan 2017-18, Feb 2017-18,
Mar 2017-18, Apr 2017-18, May 2017-18, Jun
2017-18, Jul 2017-18, Aug 2017-18, Sep 2017-18,
Oct 2017-18, Nov 2017-18, Dec 2017-18, Jan
2018-19, Feb 2018-19, Mar 2018-19, Apr 2018-
```

```
19, May 2018-19, Jun 2018-19, Jul 2018-19, Aug
2018-19, Sep 2018-19, Oct 2018-19, Nov 2018-
19, Dec 2018-19, Jan 2019-20, Feb 2019-20, Mar
2019-20, Apr 2019-20, May 2019-20, Jun 2019-
20, Jul 2019-20, Aug 2019-20, Sep 2019-20, Oct
2019-20, Nov 2019-20, Dec 2019-20)
```

Appendix 2 - User Initiated Scripts  
(Packages & Forecasting Results):

```
library('ggplot2')
To enable plotting in R with lattice methodology
(Data,Aesthetic mapping and Geometrical
Objects)
```

```
library('ggthemes')
To customize visual themes for plots
```

```
library('gridExtra')
To print summary reports as images
```

```
library('forecast')
For forecasting results
```

```
dataset[is.na(dataset)] =0
Replacing NA values with zero
```

```
Sample = as.data.frame(dataset,stringsAsFactors =
FALSE)
Loading the processed data in a new data frame
```

```
Sample = t(Sample)
Transposing the data frame
```

```
Sample$Sum = rowSums(Sample[,c(-1)])
Aggregating data for each month
```

```
TS = ts(Sample$Sum, frequency =12, start =
c(2017,1))
Conversion of data into time series format
```

```
Fit = ets(TS,model = 'AAA')
Fitting Forecasting Model(Holts Winters) to the
time series
```

```
Forecast = forecast(Fit,method = 'ets',h=12)
Forecasting for next 12 periods with same
Forecasting model
```

```
autoplot(Forecast)+theme_bw()
ggtitle("Forecasts AAA")
Plot rendering on dashboard
```

```
DF = as.data.frame(accuracy(Forecast))  
Putting forecast summary in a data frame(DF)  
grid.table(DF)  
Rendering summary report on dashboard  
Appendix 3 - R Script for decomposing time  
series data
```

```
library('ggplot2')  
To enable plotting in R with lattice methodology  
(Data,Aesthetic mapping and Geometrical  
Objects)
```

```
library('ggthemes')  
To customize visual themes for plots
```

```
library('forecast')  
For forecasting results
```

```
Sample = as.data.frame(dataset,stringsAsFactors =  
FALSE)  
Loading the processed data in a new data frame
```

```
Sample[is.na(Sample)] = 0  
Replacing NA values with zero
```

```
Sample = t(Sample)  
Transposing the data frame
```

```
Sample$Sum = rowSums(Sample[,c(-1)])  
Aggregating data for each month
```

```
TS = ts(Sample$Sum, frequency = 12, start =  
c(2017,1))  
Conversion of data into time series format
```

```
Decomp = mstl(TS,s.window = "periodic")  
Decomposing time series into 04 components -  
Level, Trend, Season and Randomness
```

```
autoplot(Decomp) + ggtitle("Decomposition") +  
theme_bw()  
Plot rendering on dashboard
```