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Data Visualization Using Tableau

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PREFACE

This is one of the most important articles I've ever written in my amazing college life. My education at Metropolia University of Applied Science will come to an end with this piece of paper and a Master of Engineering degree in Information Technology.

First and foremost, I want to thank my coach (Ville Jääskeläinen) at Metropolia UAS for his encouragement, talks, comments, and guidance in the writing of this thesis. Unfortunately, owing to the COVID-19 virus, I was not always able to attend college, but he was very generous in helping me write my thesis and gain experience for my first thesis.

Second, I want to express my gratitude to my Indian friends and fellow Master of Engineering students for the stimulating discussions, as well as all of the hours spent on online and different discussions. More particularly, after the remarkable COVID-19 virus, for all the fun we've had in the last year.

Finally, I'd like to express my gratitude to my parents (Manilal and Maya) and grandparents for allowing me to participate in this incredible educational and social journey. Finally, I want to express my gratitude for my sister's unwavering support (Vandana).

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Abstract

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A graphical depiction of information and data is known as data visualization. Data visualization tools, which include visual aids such as charts, graphs, and maps, give an easy method to observe and analyze data styles, outliers, and trends.

The goal of this thesis was to study different visualization methods, understand the various tools, and compare Tableau and Excel tools.

The data given contains information about daily historical stock prices. The dataset contains index values of different business segments from the years 2016 to 2021. Using this historical data, this study found out the returns based on calculations in Excel sheet and then using these returns, it showed the results with different visualisation methods in Tableau.

At the end of the study, main differences between Excel and Tableau are listed.

Keywords: visualization, charts, Tableau, Excel

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List of Abbreviations

BI	Business intelligence
BRICS	Brazil, Russia, China and South Africa
BSE	Bombay Stock Exchange
BW	Business Warehouse
CDSL	Central Depository Services Ltd
ERP	Enterprise Resource Planning
FMCG	Fast-moving consumer goods
INX	International Exchange Limited
IT	Information Technology
PDF	Portable Document Format
RBI	Reserve Bank of India
SaaS	Software as a service
SAP	Systems Applications and Products in Data Processing.
XML	Extensible Markup Language

1 Introduction

As the "Big Data Age" begins in high gear, in the big data era the collection of data has become simple and cost-effective, and visualization and related tools have become increasingly important for making sense of the billions of lines of data generated on a daily basis. Data visualization helps to tell stories by presenting data in an easy-to-understand way, highlighting trends and other important properties. Good visualization tells a story, removes noise from data, and highlights useful details.

Data visualization is a graphical representation of information and data. By using visual aids such as charts, graphs, and maps, data visualization tools provide an accessible way to see and understand styles, outliers, and patterns in data. In the Big Data world, data viewing tools and technologies are essential for analysing large amounts of information and making data-driven decisions. A simple graph can be very tedious to capture any notification or make a strong point and excellent vision can completely fail to convey the right message or can say too much. Data and visuals require interaction, and the art is to combine good analysis with a story.

When one thinks about data visualization, one may first think just simple graphs or charts. While this can be an important part of visualizing data and a common basis for many data drawings, good visualization should be paired with the right set of information. Simple graphs are simply the tip of the iceberg. There is a complete selection of ways to visualize and present data in an effective and attractive way. Common types of data visualization are charts, tables, graphs, maps, info graphics, and dashboards.

There are multiple data visualization tools available. In the strictest sense, Microsoft Excel is a spreadsheet software, not a data visualization tool. Even so, it has useful data visualization capabilities. Given that Microsoft products are widely used at the enterprise level, one typically have access to it. Zoho Analytics is a data visualization tool specifically designed for professionals looking to visualize business intelligence related data. As such, it's most commonly used to visualize information related to sales, marketing, profit, revenues, costs, and pipelines with user-friendly dashboards.

Tableau is often regarded as the grand master of data visualization software and for a good reason. Tableau has a very large customer base of 57,000+ accounts across many industries due to its simplicity of use and ability to produce interactive visualizations far beyond those provided by general BI solutions. Qlik with their QlikView tool is the other major player in this space and Tableau's biggest competitor. The vendor has over 40,000 customer accounts across over 100 countries, and those that use it frequently cite its highly customizable setup and includes a wide feature range as a key advantage.

At this time, the most widely used tool for data analysis and visualization is Tableau. Tableau is software that can help users to explore and comprehend their data by creating interactive visuals. The software has advantages that can be used in conjunction with almost any database, and is easy to use by dragging and dropping to create interactive visuals that display the format one needs. Tableau is a tool supporting complex visualization methods and simplifying complex data.

The research problem of this study is to understand challenges related to data visualization. The challenges are demonstrated by analyzing data of the impact of demonetization, made at 2016 in India, on sectorial indices at Bombay Stock Exchange Ltd. For this study, the calculation of selected indices were analyzed

based on the return in the last 5 years that is after demonetization. For the calculations, MS Excel was used and for the visualization Tableau was be used.

Objectives

The main aim of the thesis is to identify an effective visualization method for representing the unstructured data into meaningful information.

- The study is conducted to know about different visualization methods.
- To understand the various tools used for data visualization.
- To assess the proposed visualization tool & provide recommendations.
- Do a comparison of Tableau and MS Excel.

The thesis has been divided into 6 sections. The first section introduces the problem statement and information about the overall data visualization tools. The second section gives ideas about method and material. The third section includes data analytics, business analytics and charts. The fourth section is about theory information related to the visualization tools. The fifth section gives ideas about visualization of calculated data of the selected indices using Tableau software. The last section will be focused on the output of implementation.

2 Method and Material

This thesis mainly consists of two parts: theoretical and practical. The theoretical part is based on literature review that provides understanding about numerous data visualization methods. It also includes analysis of the current market of visualization tools and provides understanding about widely used top applications. The practical part is about utilizing the learned topics and implementing them in the best possible manner. The tool used for the purpose of analysis is Tableau.

The analysis provides information about the advantages of applications and difficulties in using them. It also describes the steps for creating the design of the dashboard as well as the suitable interactive visualizations of the specific data using Tableau.

Data Used for Visualization Analysis

Five years ago, Prime Minister Narendra Modi appeared on national television and said that all Rs 500, Rs 1,000 high value notes will turn invalid by midnight. The announcement at 8 pm, aimed at flushing out money hidden from the taxman, known as black money, led to nearly 86 percent of the currency in circulation becoming invalid by midnight.

Expectedly, mayhem followed. The move, known as demonetization, caused a lot of hardship for many people who were forced to form serpentine queues in front of banks to exchange notes. Several small businesses that were dependent on cash took hard knocks. There were three main economic objectives of demonetization: fighting against black money, fake notes and creating a cashless economy by pushing digital transactions.

In 2016, the year when demonetisation was launched, 6,32,000 counterfeit notes were seized across the country. In the next four years (including the year 2020 so far), a total of 18,87,000 fake notes have been seized across the country in various denominations, according to the RBI (Reserve Bank of India) data.

A significant negative impact of demonetization on stock market returns was evidenced from Nifty 50 Index and sectoral indices such as Nifty Auto Index, Nifty Financial Services Index, Nifty FMCG Index, Nifty IT Index, Nifty Media Index, Nifty Private Bank Index, and Nifty Realty Index.

Founded in 1875, Bombay Stock Exchange Ltd. (BSE), is the fastest stock exchange in the world which has a median trade speed of 6 microseconds. It provides an efficient, integrated, transparent and secure market for trading in equity, currencies, debt instruments, derivatives, and mutual funds. It provides an array of services such clearing, settlement, risk management, education and market data services. It has a global reach with overseas customers and a nation-wide presence. It provides depository services through its Central Depository Services Ltd. (CDSL) arm. The S&P BSE SENSEX is India's most widely tracked stock market benchmark index. It is traded internationally on the EUREX as well as leading exchanges of the BRICS nations (Brazil, Russia, China and South Africa).

A stock market index is a statistical measure which shows changes taking place in the stock market. To create an index, a few similar kinds of stocks are chosen from amongst the securities already listed on the exchange and grouped together. The criteria of stock selection could be the type of industry, market capitalization or the size of the company. The value of the stock market index is computed using values of the underlying stocks. Any change taking place in the underlying stock prices impact the overall value of the index. If the prices of most of the underlying securities rise, then the index will rise and vice-versa. The data required for the analysis is available on the stock exchange portal as

open source to be accessed by anyone globally. The more details about the data is mentioned in section 5.

3 Data Visualization

This section gives first an overview of data analytics and business analytics and then different charts and graph used for the data analysis are presented.

3.1 Overview of Data Analytics

Data analysis is the science of raw data analysis to make conclusions about that information. Many data analysis techniques and processes are automatically developed into machine processes and algorithms that work with raw data for human use. Data analysis helps a business to improve its performance.

Data analytics is a broad term that encompasses many different types of data analysis. Any type of information can be viewed with data analysis techniques to gain insight that can be used to improve things. Data analysis techniques can reveal styles and metrics that would be lost in the bulk of the information. This information can be used to add processes to increase the effectiveness of a business or program.

For example, manufacturing companies often record the operating time, downtime, and lines of operation of various machines and then analyze the data to increase the productivity. Data statistics is important because it helps businesses increase their performance. Applying it to a business model means that companies can help to reduce costs by identifying more efficient ways of doing business and generate more revenue. The company can also use data analytics to make better business decisions and help to analyze customer behaviour and satisfaction, which can lead to new and better products and services.

The process involved in data analysis includes several different steps. The first step is to determine what kind of data is needed and how the data can be collected. The second step in data analytics is the process of collecting it. This can be done through a variety of sources such as computers, online sources, cameras and various other sensors, environmental sources, or by staff. Once the data has been collected, it needs to be edited (preprocessed) for analysis. Editing may take place in a spreadsheet or other type of software that can capture statistical data. The data is then cleaned before analysis to ensure that there is no duplications or other errors

Types of Data Analytics

Data statistics can be divided into four basic categories.

Descriptive analytics describe what happened over a period of time. Has the number of ideas increased? Are sales stronger this month than last?

Diagnostic analytics focus on why something happened. This includes a variety of data entry and a bit of speculation. Has the weather affected the sales of beer? Has that recent marketing campaign contributed to sales?

Predictive analytics are likely to occur in the near future. Predictive analytics makes predictions about future outcomes using historical data.

Data analysis is a complicated process which includes various data formats and modifications of the formats, tools and mathematical models.

The patterns and trends become more understandable when information is presented graphically and it helps businesses to identify the right priorities and focus on them (The Data Visualization Catalogue, 2020).

3.2 Overview of Business Analytics

Business Analytics is the process by which businesses use different technologies and skills to analyse historical data in order to gain new insights and to improve strategic decision-making. Business analytics uses methods such as data mining, forecasting statistics, and statistical analysis to convert data into useful information, identify and anticipate trends and results, and ultimately make wise business decisions driven by data.

Key elements in the standard business analytics dashboard include:

Data aggregation: prior to analysis, data must first be collected, organized, and sorted.

Data mining: digging data for business statistics using big data sets, statistics, and machine learning to identify trends and build relationships.

Association and Sequence Identification: identification of unexpected actions performed in conjunction with other actions or sequences.

Text Mining: scans and organizes large, informal data sets for quality and quantity analysis.

Forecasting: analyzes historical data from time to time to make informed predictable estimates of future events or behaviour.

Optimization: once trends have been identified and forecasts have been created, businesses can engage in simulation strategies to test the best conditions.

Data Visualization: provides visual presentations such as charts and graphs for easy and fast data analysis.

Modern, state-of-the-art software analytics software and platforms have been developed to capture and process large data sets that businesses encounter and can be used for efficient business operations. Business analytics and data mining systems are software applications that provide business users tools for analyzing fixed, structured data. One of the main advantages of such programs are the availability of visual and analytical data tools for multiple users [1].

3.3 Types of Graphs and Charts

Graphs and charts covering large amounts of data can be edited into easy-to-understand formats to present clearly and effectively the main points of the data. When choosing the best way to present the data, one should think about the purpose of the graph or chart and what one wants to introduce, and then decide how it should be presented.

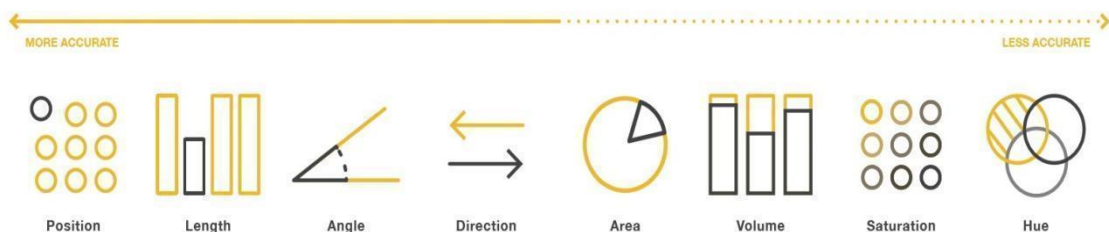


Figure 1: Visual perception in terms of accuracy.

In above Figure 1, visual perception in terms of accuracy is presented. The line indicates the less accurate types of charts at the right side of a picture and more accurate types of charts at the left side of the picture. For example, visual acuity clarifies eyesight and can be measured by the ability to recognize letters or number based on standard eye chart from a specific distance. A dimension represents categorical data such as year, salary range, product and country.

A few simple steps make the chart less congested:

- Value labels (percent written above bars) add clarity.
- The title uses direct language; "Internal smoking control workshops" are less understandable than "Workplace smoking restrictions."
- Grid lines add depth and size, which helps readers to see the differences between each data bar.
- Although the y-axis data label may seem unwanted, it ensures that readers know what the values mean.

Line chart

Line charts represent a group of data points joined together by a straight line. Each of these data points describes the relationship between the horizontal and the vertical axis on the graph. The Y-axis shows the numeric value and X-axis shows the key measurements or time dimensions such as month, quarter or year [2]. Line and area charts are typically used for representing the trends such as data over a certain time period or temporal patterns and correlation.



Figure 2: Sample of line chart (Source: www.excel-easy.com)

Typical features of a line chart:

- It helps studying data trends over a period of time.
- Easy to read and plot.
- It can be used to visualize data over both short and long period of time.

Area chart

Area charts are used to collectively measure data trends over a period of time by colouring the area between the line segment and the x-axis. In simpler terms, an area chart is an extension of the line chart.

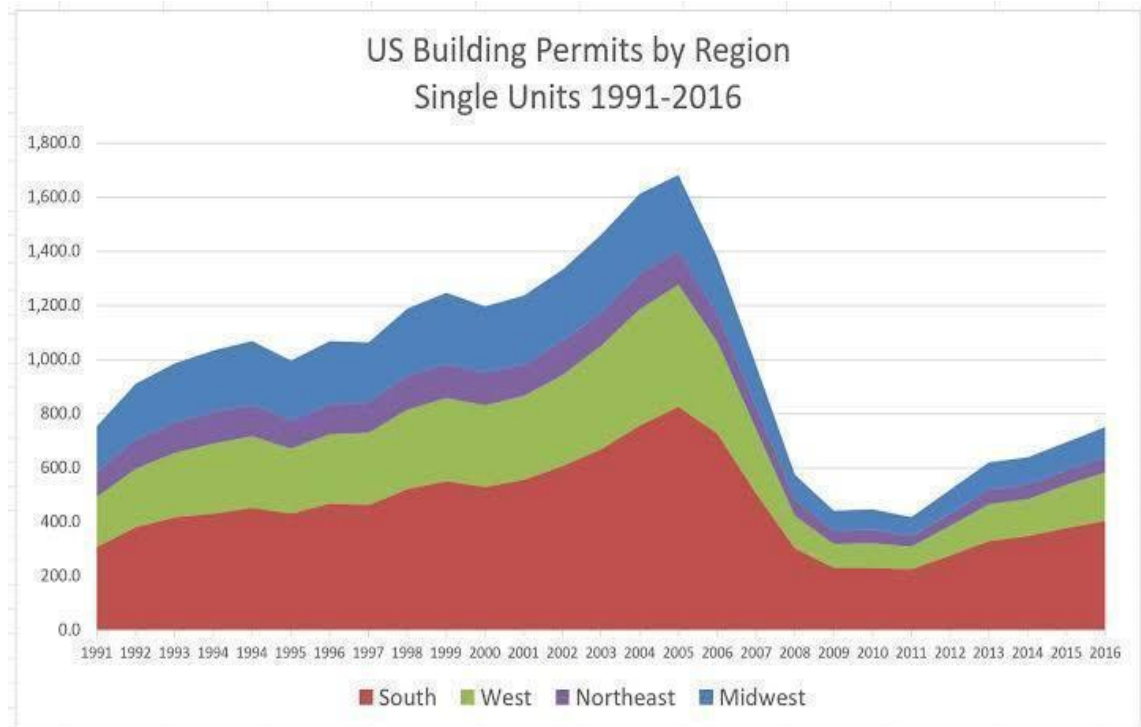


Figure 3: Sample of Area chart (Source: www.displayr.com)

Typical features of Area Chart:

- It is visually appealing.
- It gives a clear comparison of different groups of data.
- It may be difficult to read when compared to other data types.

Column line chart

The column line chart is a combination of line chart as well as column chart. This type of chart indicates one measure as a column and another as a line. These two measures are showed under the time dimensions such as months, quarters and years. This chart is more suitable for indicating relationship between two measures over a period of time. For example, gross margin, net income, and sales revenue [3].

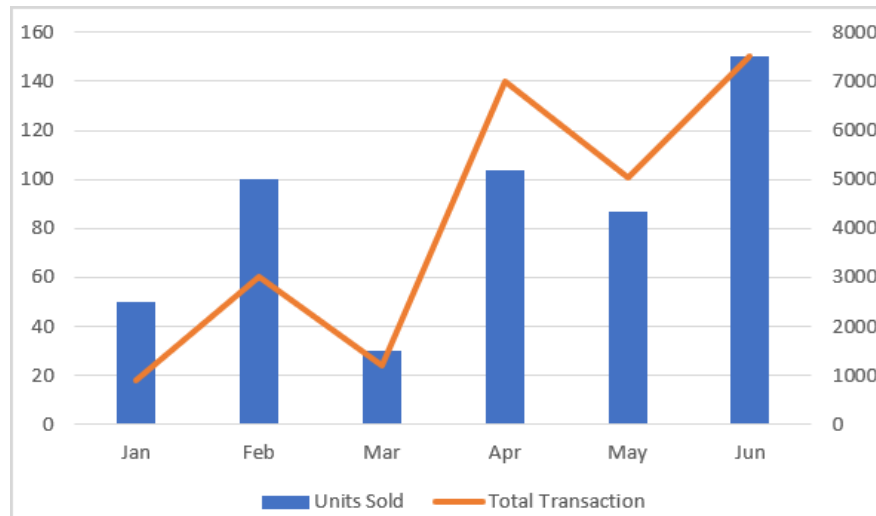


Figure 4: Sample of the column line chart (Source: www.microsoft.com)

In Figure 4, there is a chart that represents the number of units sold along with the total transactions line.

The column line charts are typically used for describing trends, data over time, temporal pattern and correlation, for displaying two different data sets together and for displaying the sets of same type of data which have very wide ranges between them.

Implementation suggestions:

1. Use column line chart to display two trends of different types over a certain period of time. For example, returning customers and sold items.
2. This type of chart can also be used to indicate the changes over a certain time period.

Bar chart

Bar charts are often used to show comparisons and are easy to create. Note that footnotes shown in Figure 5 are defined in the same way in these two studies, making the findings similar in the youth population, the findings could not be compared. The Figure 5 below just an example of bar chart.

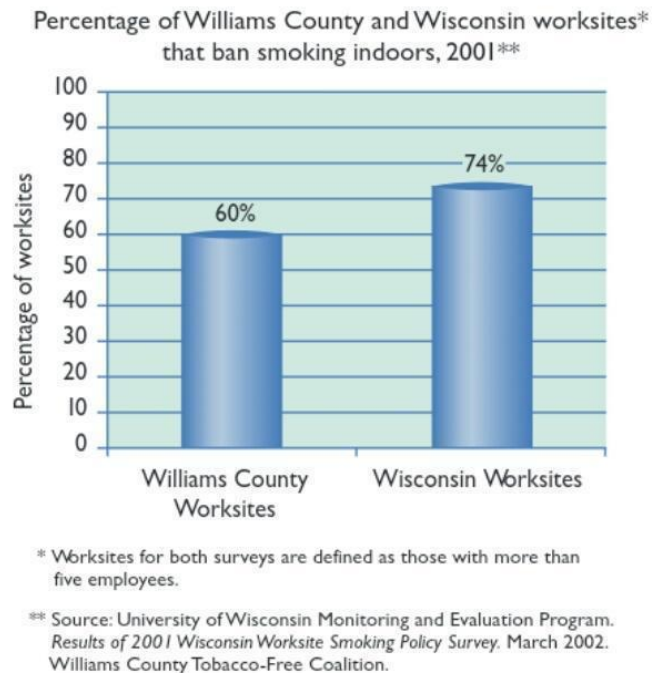


Figure 5: Sample of Bar chart (Source: www.istockphoto.com)

Bar chart is the most frequently used chart among other chart types. Bar charts are majorly used for following [4]:

- Positioning the data from largest to smallest and vice versa.
- Filtering the data which is not important for the message.
- For grouping data.

Bar chart is usually used for comparing different values of categorical data which includes grouping the data by combining values in a chart. If there are

various categories available, then the less relevant categorical values should be grouped into another group.

Stacked area chart

Stacked area chart is an extension of the base area chart. The values of each group are displayed on top of each other, which allows one to see from the same picture both the total of a numeric variable and the significance of each group.

The lines can be drawn, for instance, to track the change in population of various states across a particular time period. The area below each line can be coloured with different colours in order to represent the state it depicts, resulting in a graph which represents trends of population and shows data of each state in order from least to most populous state [5].

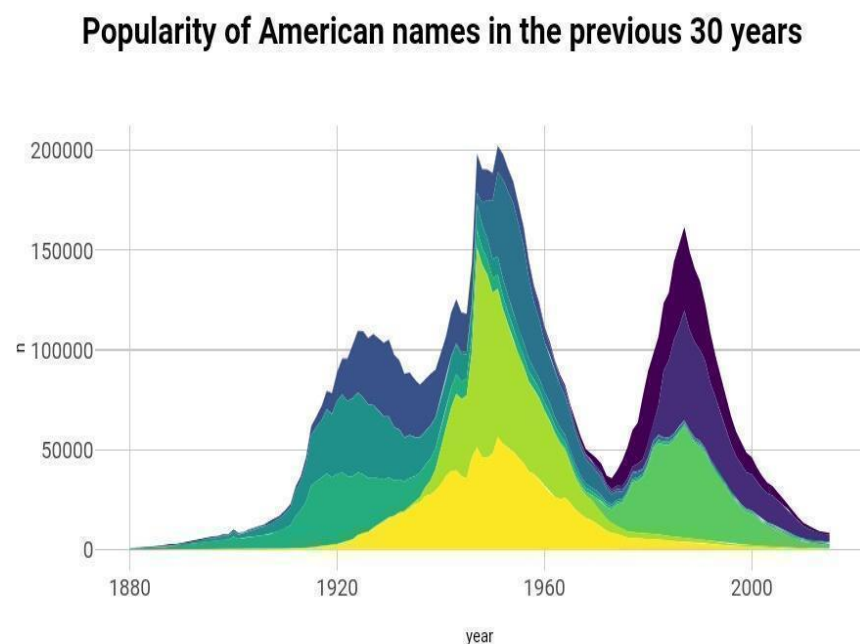


Figure 6: Sample of Stacked chart (Source: www.data-to-viz.com)

The Figure 6 illustrates the emergence of baby names in the US between 1880 and 2015.

Horizontal chart

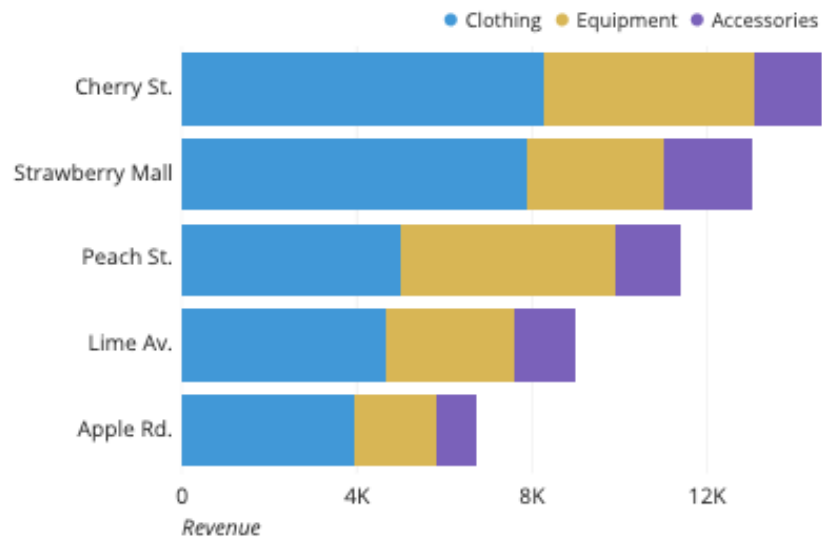


Figure 7: Sample of Horizontal bar chart (Source: www.alamy.com)

Horizontal bar chart is often the best graphical tool for representing comparisons between categories of data. The presenter can show large data labels easily with the help of horizontal bar chart as the horizontal rectangles have enough room for displaying textual information. The example above shows the revenue data of clothing, equipment, and accessories of different companies.

Waterfall chart

A waterfall chart is a way of seeing data that helps to understand the effect of aggregation of positive or negative values. These intermediate values can be time-based or phase-based. The waterfall chart is also known as the flying brick chart or Mario chart due to the apparent formation of columns (bricks) in the

middle of the air. Usually in finance, it is called a bridge. This type of a chart is useful for visualizing the fluctuation in values in terms of positive and negative values [6].

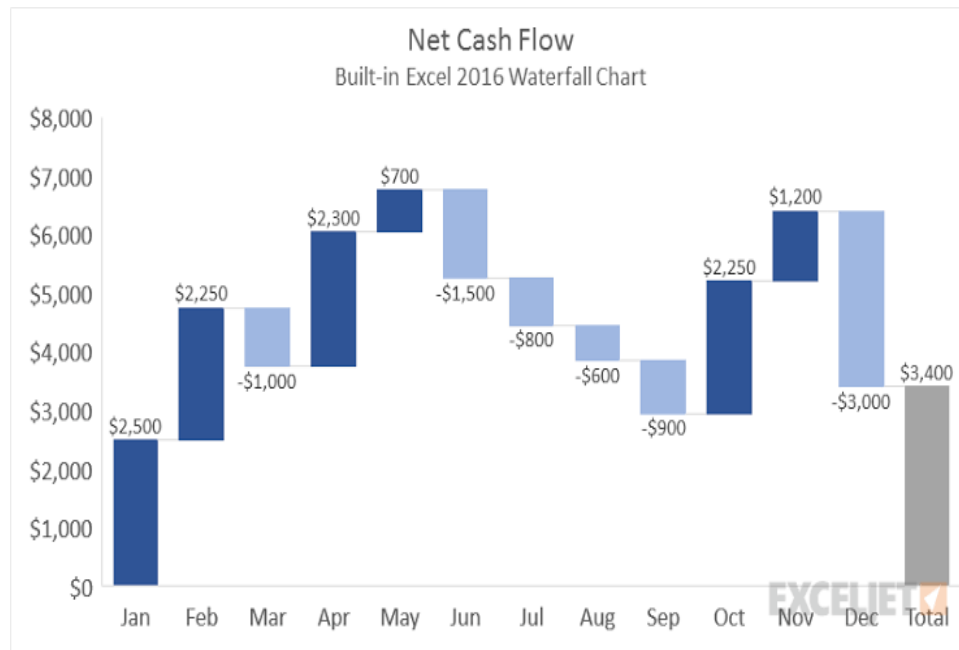


Figure 8: Sample of Waterfall chart (Source: en.m.wikipedia.org)

More information can be added to the waterfall charts by including many complete columns and axis crossing values. Additions and decreases in sufficient quantities may cause the accumulated value to fall above and below the axis in various locations. Middle footnotes, shown in full columns, can be added to the graph between floating columns. In Figure 8, the net cash flow is indicated along with each month. Waterfall charts are typically used for demonstrate how an initial value is increased and lowered by a sequence of intermediate values to yield a final result.

Trellis Layout of Multiple Charts

A Trellis chart (also called multiple small charts) is a series of similar graphs or charts that use the same scale and axes, allowing them to be easily compared.

This chart shows the same chart grid of values of different sizes and can be used to compare metrics for different data groups.

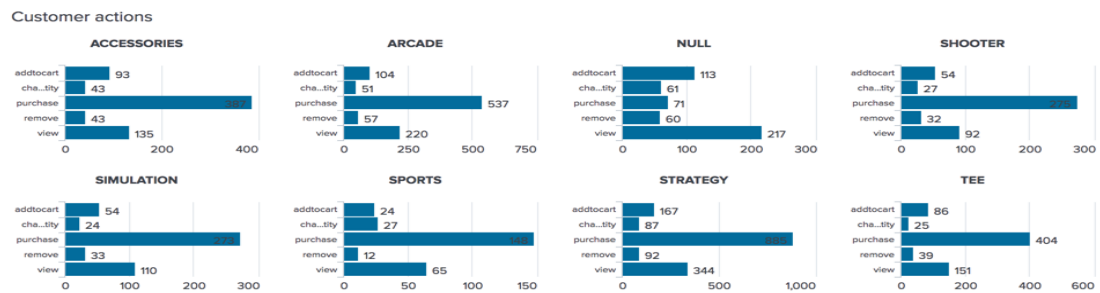


Figure 9: Trellis layout of Multiple Charts sample (Source: www.linkedin.com)

These types of charts are used for:

- Finding out patterns across multiple categorical values.
- For comparing values within a category. For example, to display the sales values for each category in a different or separate chart.

Part-to-whole chart

This type of chart is used for a Part-to-Whole relationship which indicates how to measure values that form the whole of something. For example, number of containers sold as compared to one another and how the each container compare itself with the whole.

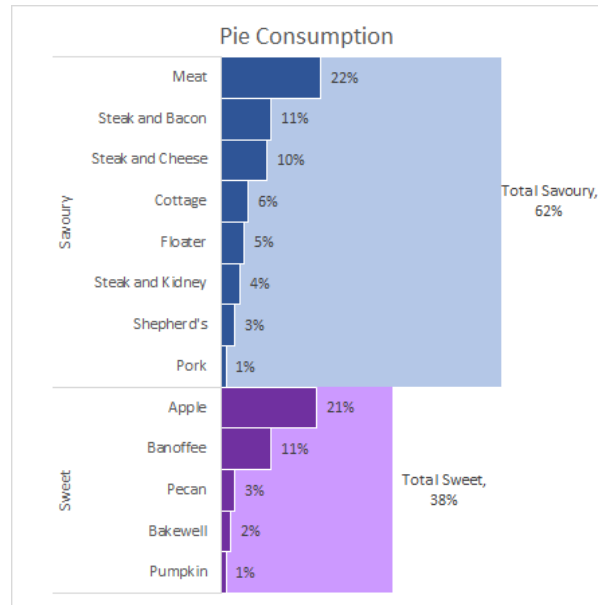


Figure 10: Part-to-whole chart sample (Source: www.anychart.com)

The Pie or Ring chart

If one tries to figure out the percentage structure of the value, the first type of chart that often comes to mind is the Pie chart. These charts visualize the whole structure as a circle (100%) and its parts as "pieces" related to their size.

Pie, Ring and Funnel Charts (presented next) are used for comparisons to either give importance to a certain portion of the data or to examine values of certain categorical values. It is suggested to not include many segments in this type of charts because the viewer may face problem while distinguishing objects between numerous different colours [7].

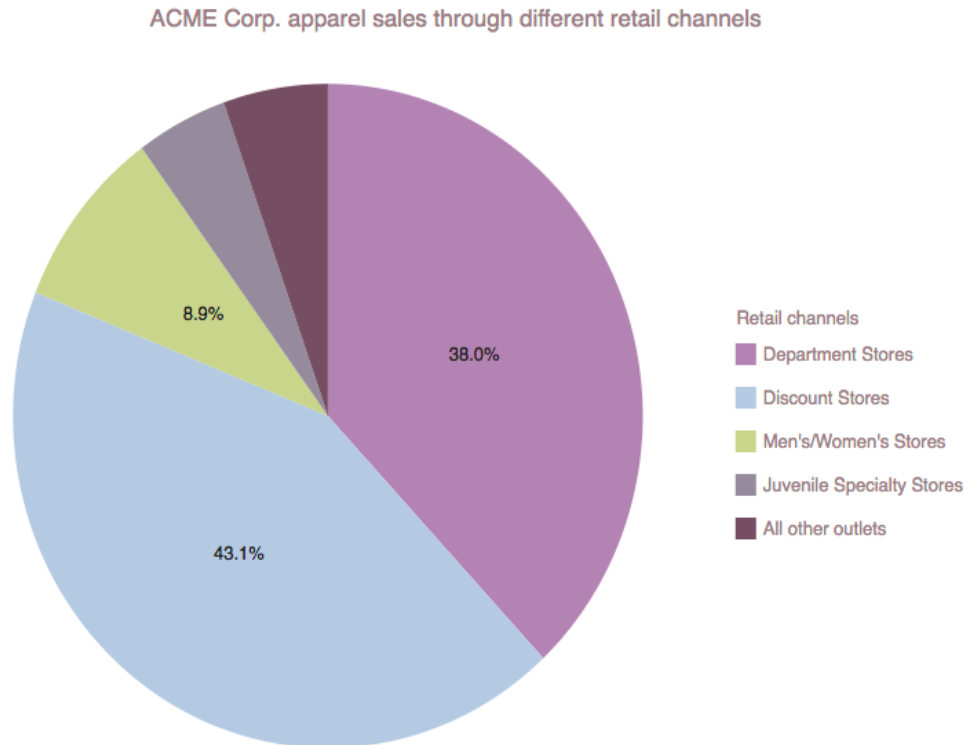


Figure 11: Sample of the Pie chart (Source: www.statisticshowto.com)

Figure 11 indicates the example of sales by channel. The pie chart can easily, quickly, and effectively forecast numerous population segments and It can also provide responses to questions related to market-research as compared to ring and funnel charts [8].

Funnel chart

When one checks out a process stages that start at 100% and end with a smaller percentage, to see the steps, and to point out the problems (the decline in which the stages occur and how much), one may like the Funnel chart type.

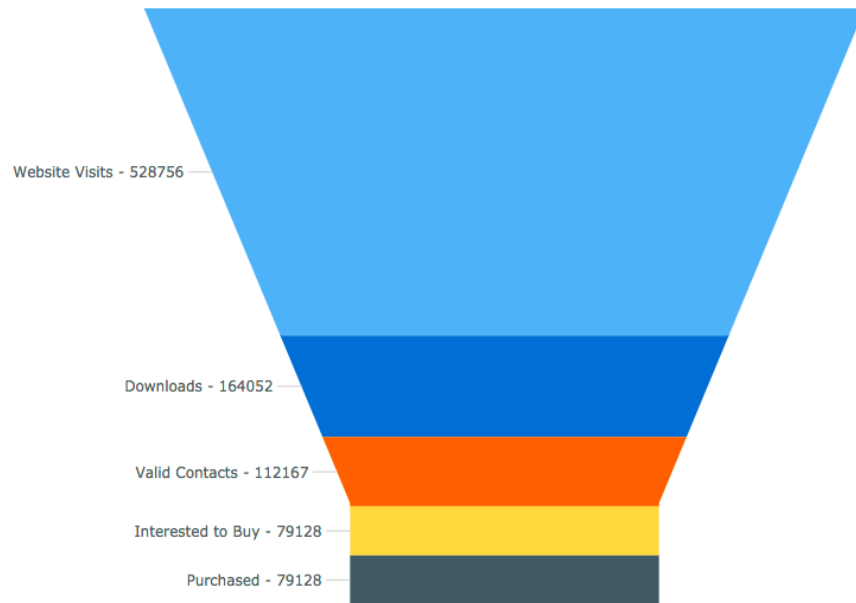


Figure 12: Sample of Funnel chart (Source: <https://charito.com>)

The Figure 12 shows conversion of website visitors into paying customers.

Box plot chart

In descriptive statistics, the structure of a box or boxplot is a way of clearly showing groups of numerical data by their quartiles. Box sites can have lines from boxes (beards) showing distinction except for the upper and lower quartiles, hence the names of the box-and-whisker box and the box-beard drawing. Outliers can be constructed as individual points.

The Figure 13 illustrates how to create box plot chart. Apart from this, the parameters of labels are used to give x-tick (x-axis) labels for every sample [9].

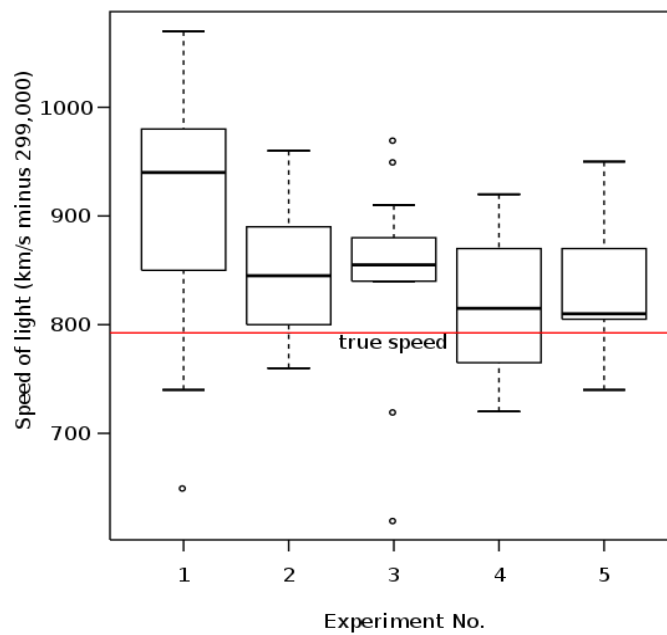


Figure 13: Sample of Box Plot of data from the Michelson–Morley experiment (Source: en.m.wikipedia.org)

The box plot chart is mostly used for:

- Comparison - Box plot chart compares data distribution for numerous categorical values.
- Distribution of values - The box plot chart indicates the distribution of values in data.
- Identifying outliers - Box plot adds a reference line to the overall median in data.

Scatter chart

The scatter plot (scatter chart, scatter graph) uses dots to represent the numbers of different numeric variables. The position of each dot indicates the values of each data point. Scatter plots are used to view relationships between variables.

An example of scatter plot Figure 14 shows the width and length of the sample of the felled trees. Each dot represents one tree; the horizontal position of each point indicates the width of the tree (in inches) and the vertical position indicates the height of the tree (in meters). From the structure, we can see a good solid positive connection generally between the width of the tree and its height. We can also see the outlier point, a tree that is much larger than the others. The tree appears to be too short for its height, which may ensure further investigation. Scatter plot chart indicates scatter plots in a Trellis layout with a view to compare various scatter plots in a single chart.

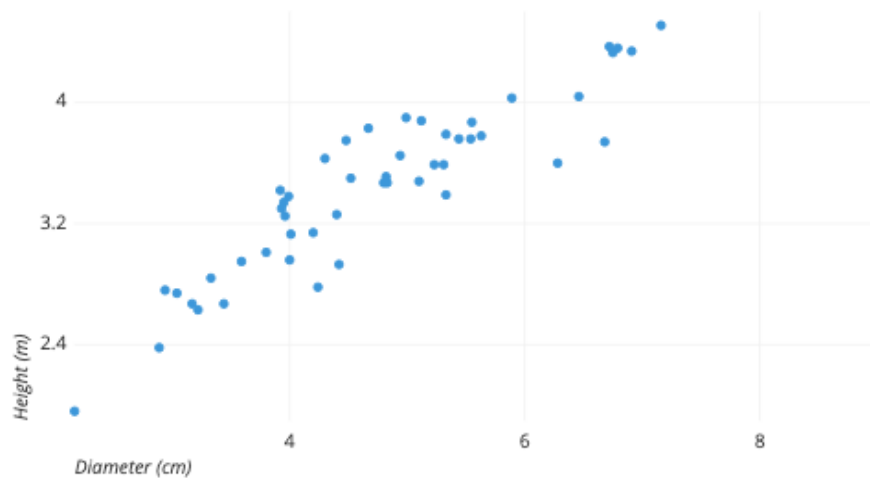


Figure 14: Sample of Scatter plot chart (Source: <https://chartio.com>)

Different colours and or different symbols for the dots can be used for different categories of the data. However, one should not show too many categories in one chart, as it may become difficult to separate those categories. The creation of geo hierarchy on top of location data for example: states, cities etc. allows drilling up to higher levels of details of geography [10].

Choropleth map chart

Choropleth Map is a type of map chart used to show geographically segregated areas such as countries, regions, etc. That are collared, patterned, or inserted in relation to shown data. In this way, it allows one to visualize data values in a particular area, giving an understanding of how they differ throughout the area shown on such a map.

When one creates a large data map in Choropleth Maps, a certain colour continuity should be used to display the data properly. Choropleth Map uses different shading, colouring and the placing of symbols within defined regions to show measured values in those areas [11].

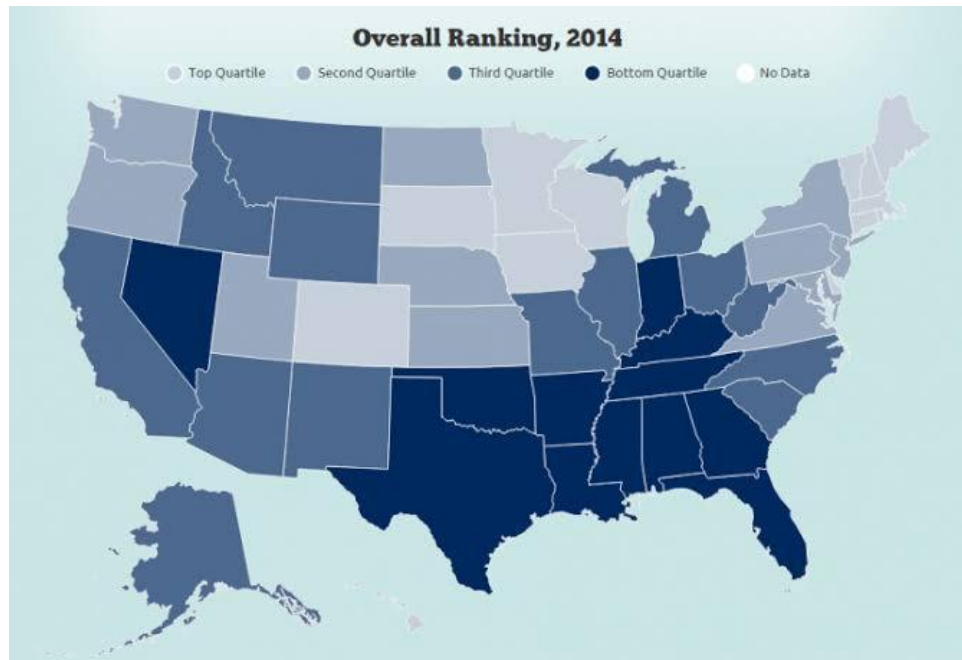


Figure 15: Sample of Choropleth map (Source: www.anychart.com)

Choropleth Map is used for supporting location based comparisons of standardized data such as rates, densities, percentages.

This type of map is usually used for similar size of locations as the size of the area coloured may overemphasize larger areas. For example, the total area of Canada is larger than Japan despite being smaller in context of population. Choropleth Map may present visually clear information using various colours and shapes for the viewer.

Geo Bubble chart

Geo charts show map data by location. They are geo, geo bubble, and geo heatmap charts. This type of chart indicates measured values in the form of bubbles on a map. The more the measured values are, the larger bubble will be formed on the map. Geo bubble charts, such as bubble charts, show the average value for a relative bubble size. Zip code data is a good choice for geo bubble charts. [12]



Figure 16: Sample of Geo Bubble chart (Source: <https://docs.thoughtspot.com>)

In Figure 16, the bubble chart indicates increase in sales, where it can be observed that the bigger the bubble, the larger the number of sales and the lower the bubble, the smaller the number of sales.

Treemap chart



Figure 17: Sample of Treemap chart (Source: developers.google.com)

Looking at the sequence data, where the design is complex and organized by tree, the Treemap chart is a great solution. With this type of chart, the whole (“tree”) is seen as a rectangular diagram with smaller rectangles showing branches, making it easier to understand the structure and compare the shares. In fact, while Pie chart works with a small number of points, Treemap charts are ideal for large data sets. The Figure 17 indicates an example of export by country of destinations.

4 Visualization Tools

This section gives first an overview of visualization tools and what kind of tools are available in the market and their features.

In the Big Data world, efficient and feature-rich tools are essential for analysing large amounts of information and making data-driven decisions.

4.1 Tableau

Tableau Software is an American computer software company based in Seattle and it offers BI-based data consulting products. The company was established in the Department of Computer Technology at Stanford University between 1997 and 2002.

The various products made by the Tableau are shown in the Figure 18.

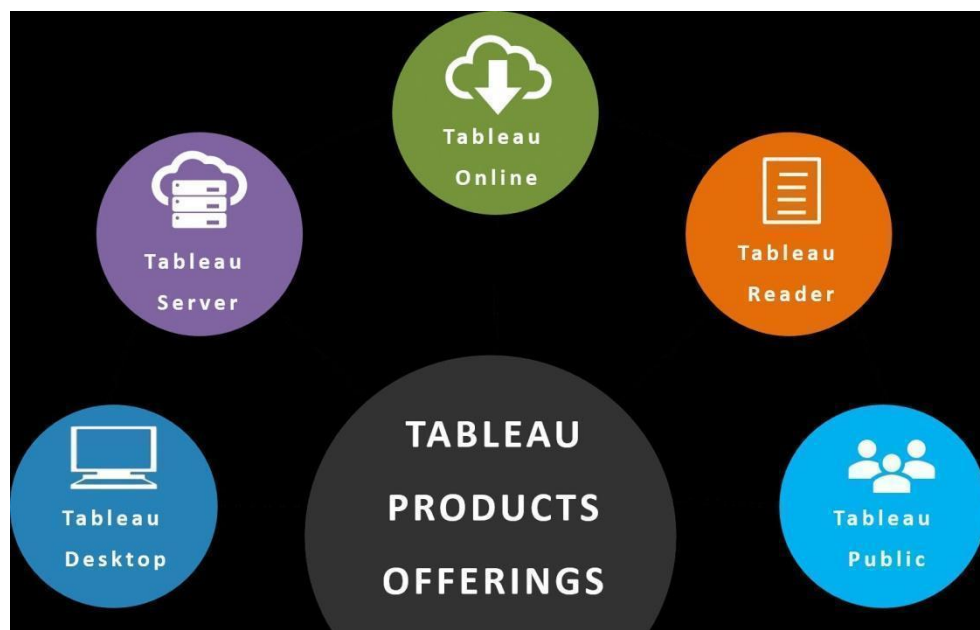


Figure 18: Image of Tableau products offerings (Source: <https://intellipaat.com>)

Tableau Desktop

Tableau Desktop is a data recognition application to help to scan almost any type of structured data and generate highly interactive graphs, beautiful dashboards, and reports within minutes. Once installed, someone can link to almost any data source from spreadsheets to data repositories and display details in several clicks. Designed for easy use, one can work much faster than before.

Tableau Server

It is a business spy app that provides browser-based analytics that anyone can use. It is the fastest way to fire in the slow pace of traditional BI software. It is an online solution designed for the sharing, distribution, and interaction of content created in Tableau. What makes Tableau different? Everyone is recommended. No script is required, so everyone can grow up to be a mathematician. Someone can increase postage, as per need. Train online for free. Get answers in minutes, not months.

Tableau Online

Tableau Online is a secure, cloud-based solution used to share, distribute, and collaborate on Tableau views and dashboards. Tableau online puts the flexibility and simplicity of a powerful cloud-based data recognition solution for us - without servers, server software, or IT support. Tableau Online can measure as much as someone needs and someone can use it wherever need. Someone does not need to purchase, set up or manage any infrastructure.

Tableau Public

Tableau Public is free software to help anyone connect to a spreadsheet or file and build interactive web visibility. It is provided as a service that allows the user to get up and work through the night. With Tableau Public users they can create amazing interactive views and publish them instantly, without the help of program or IT.

Features of Tableau

- It is very easy to use.
- Someone doesn't have to be familiar with programs of any kind, someone needs a few data and tables to produce visually appealing reports and tell a story which user should tell their supervisors or please their professor in class.
- It has a drag and drop feature where the user can simply generate stories or reports with drag and drop and a few thoughts.
- This may be due to VizQL (VizQL is a visual query language that translates the action of drag and drop to data queries and renders that data visually Query and analysis.

Such a tool does not require any special technical or organizational skills to collaborate or create any feature. It has a collective interest among people from a variety of business, researchers or industries. Tableau Software has an intuitive, easy-to-use interface, which allows business users to discover, analyze and display the results of their data without technical and system capabilities. Tableau's capabilities include advanced features such as forecasting, integration, default geocoding, and a visual formula editor. It allows users to do more research and use their data faster and more efficiently than most competing platforms, as well as the ability to downgrade data distribution.

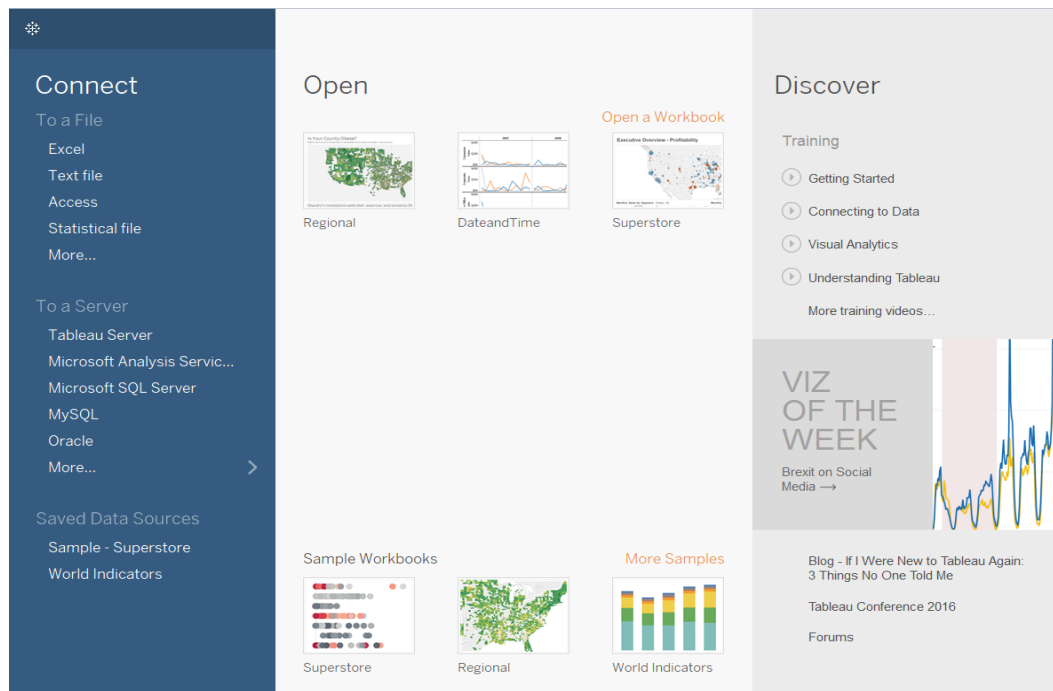


Figure 19: Sample of Tableau Desktop (Source: <https://intellipaat.com>)

There is also an online community called Tableau Public for development training and support. Some of the weaknesses are high product costs, difficulty modeling when combining data from different sources, low performance and large amounts of data.

Dashboards can be shared with others as a static file. While launching the Tableau, data connectors are available, and allow someone to connect to any database needed.

In summary, Tableau is a business platform designed for collaboration, distribution, management, security model and automated features. End customers are better experienced accessing files stored in all locations such as desktop, mobile phone or email. [13]

Derived Chart

It is important to define what types of charts are supported by Tableau based on the list of mostly used ones listed in the literature review. [14]



Figure 20: The possible chart types supported by Tableau

- Stacked Bar and Column Charts
- 100% Clustered Bar and Column charts
- Clustered Bar and Column Chart
- Line and Area Charts
- Line and Stacked / Clustered column charts
- Waterfall chart
- Scatter and Funnel Charts
- Pie and Donut charts
- Tree map chart
- Map and 3-D filled map
- Other items such as Gauge, Card, Multi-Row card, KPI11, Slicers and Interactive Tables to describe the visuals effectively.

Importing Data

The first step for importing the data is to run the desktop application or online Tableau software. In the following Figure 21, the desktop of Tableau application is showed. Tableau Desktop is a free program that install on a local computer that allows to connect, modify and visualize data.

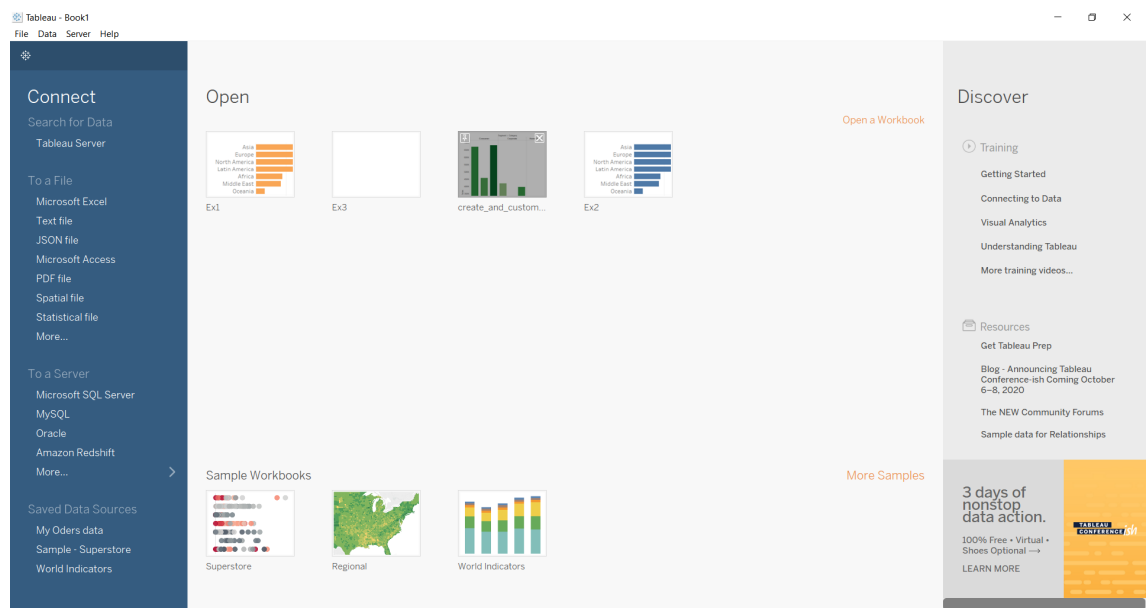


Figure 21: Tableau desktop

With Tableau Desktop, someone can connect to various data sources, and integrate it (commonly called modeling) into a data model. This data model allows someone to create visuals, as well as collections of visuals that someone can share as reports, with other people within organization. Many users working on business intelligence projects use the Tableau Desktop to create reports and then use the Tableau application to share their reports with others.

After running the desktop, the home menu will get open. In Figure 22, the connect section of Tableau application is showed. The connect section of

Tableau software allows someone to create visuals by inserting data. The data can be inserted using Connect section.

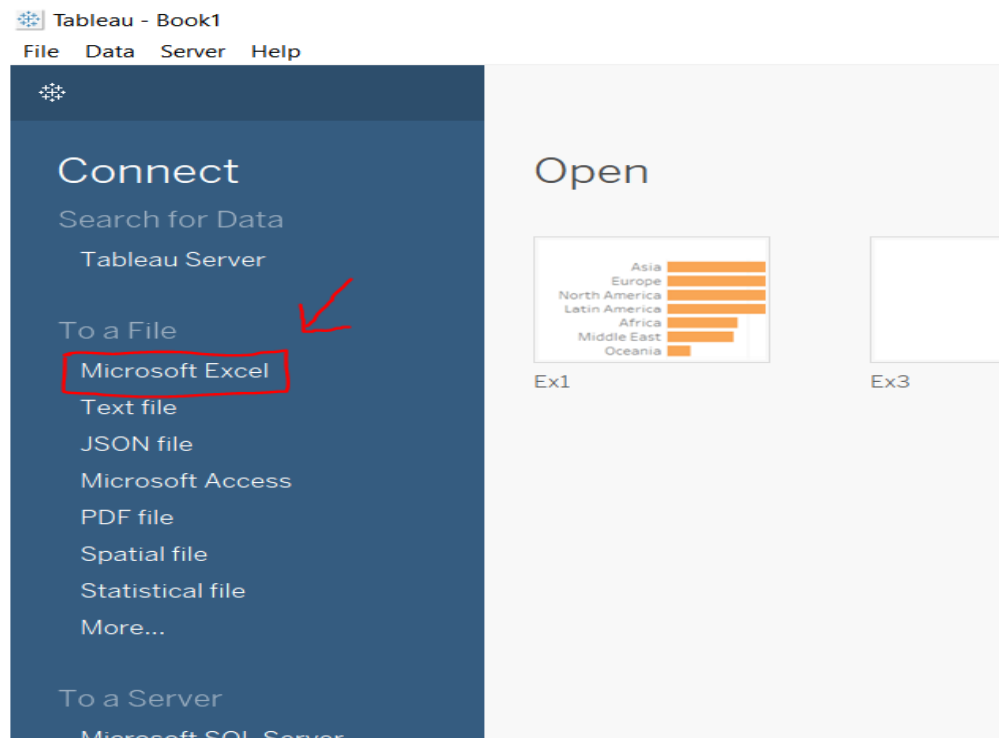


Figure 22: The Sources of importing the data

Connect section includes various options such as search for data, to a file, to a server and many more. It includes different visualizations which can be used for presenting the data in unique manner. It also enables user to filter the data used for preparing report.

In Figure 22, the sources for importing data are mentioned. There are many sources for inserting the data into Tableau software. There are many options available in the connect section for importing the data such as search for data, to a file and to a sever.

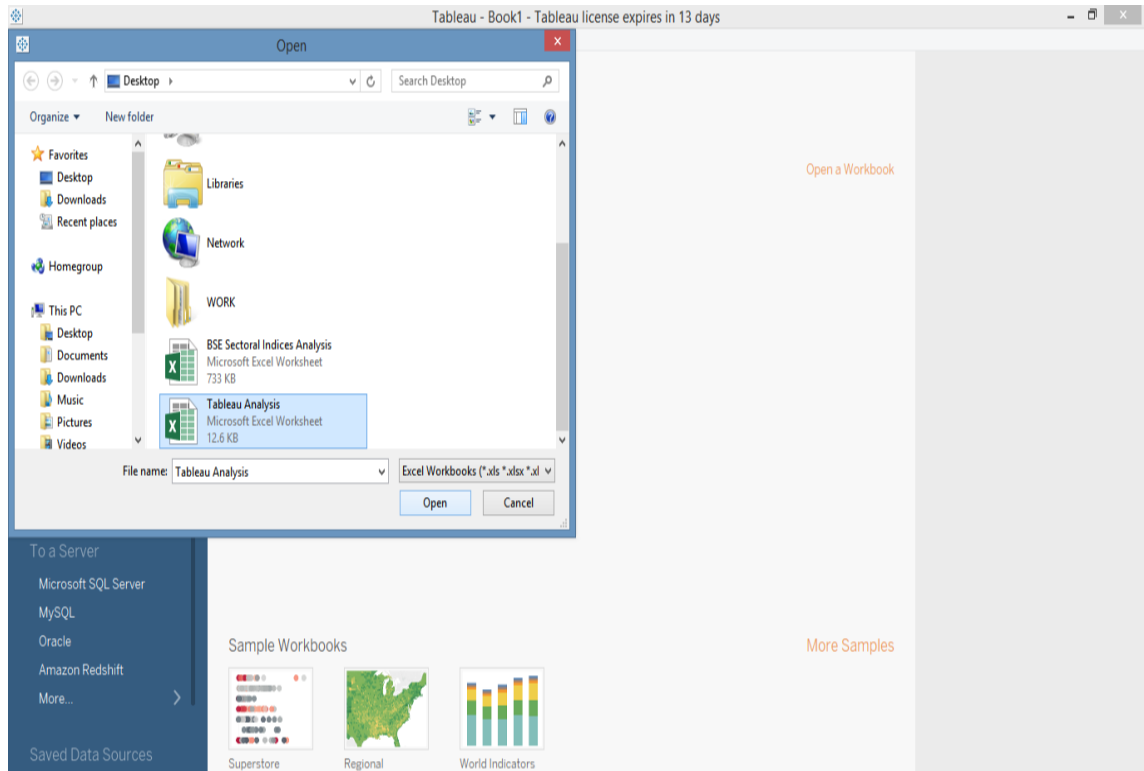


Figure 23: The Process of inserting the data

In Figure 23, the process of inserting the data is shown. In connect section, click on any options available for importing the data. The data can be imported from number of sources like Excel, Text/CSV, JSON file, PDF file, Spatial file, Statistical file and many more. Beside this, it is also possible to import data through Tableau desktop using Microsoft SQL server, My SQL, Oracle, Amazon Redshift and many more.

Note:

For example, with a view to import Excel data, the aggregate data is formatted in table form for Tableau to identify the data and bifurcate it into particular sections for providing visualizations. The data for analysis is imported by selecting Microsoft Excel option in the to a file category under connect section. After selecting the option of Excel, the window will appear for selecting the file which is required to be imported for the purpose of analysis. From the window,

select Tableau analysis file and click on open button in order to open it. The Tableau analysis file is selected for inserting the data into Tableau application.

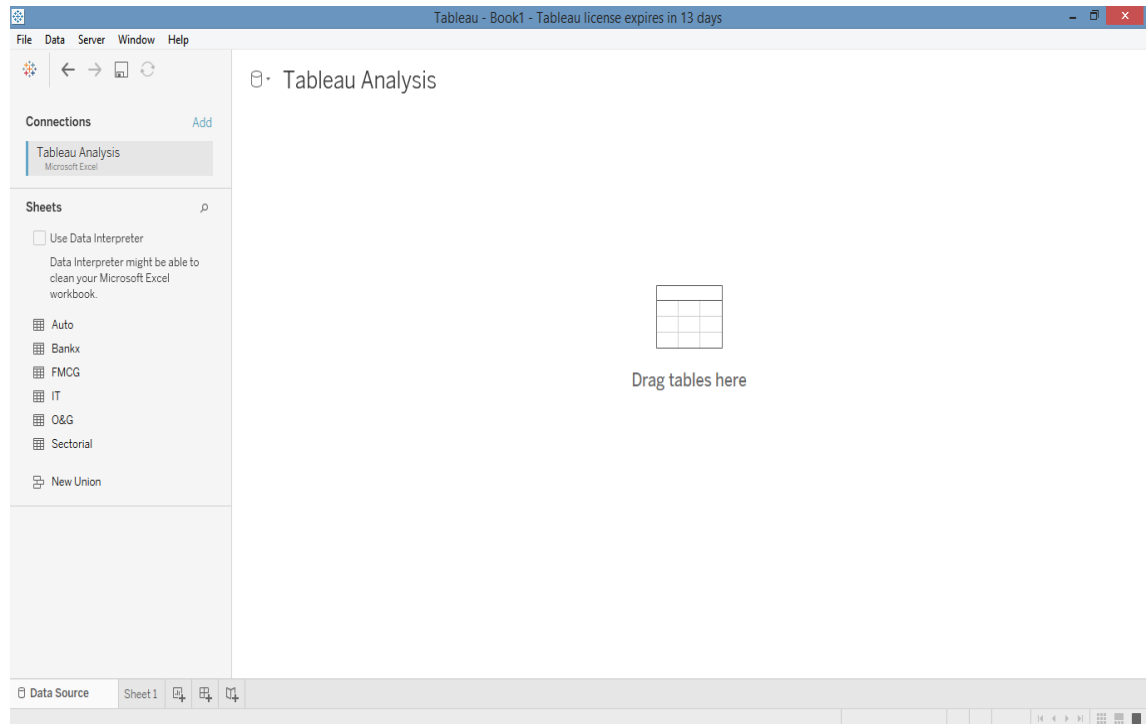


Figure 24: The transformation of importing data

Figure 24 indicates the empty white colour window which is going to be used for creating charts. Once the data file which is to be used for the purpose of analysis is selected, the window shown in the Figure 24 will appear where an individual needs to drag the categories for creating charts.

Dashboard Creation

The next important thing is to help Tableau application in identifying fields which are related to stock prices of selected BSE indices. Therefore, the data is required to be categorized and divided into particular fields.

The process of designing the dashboard

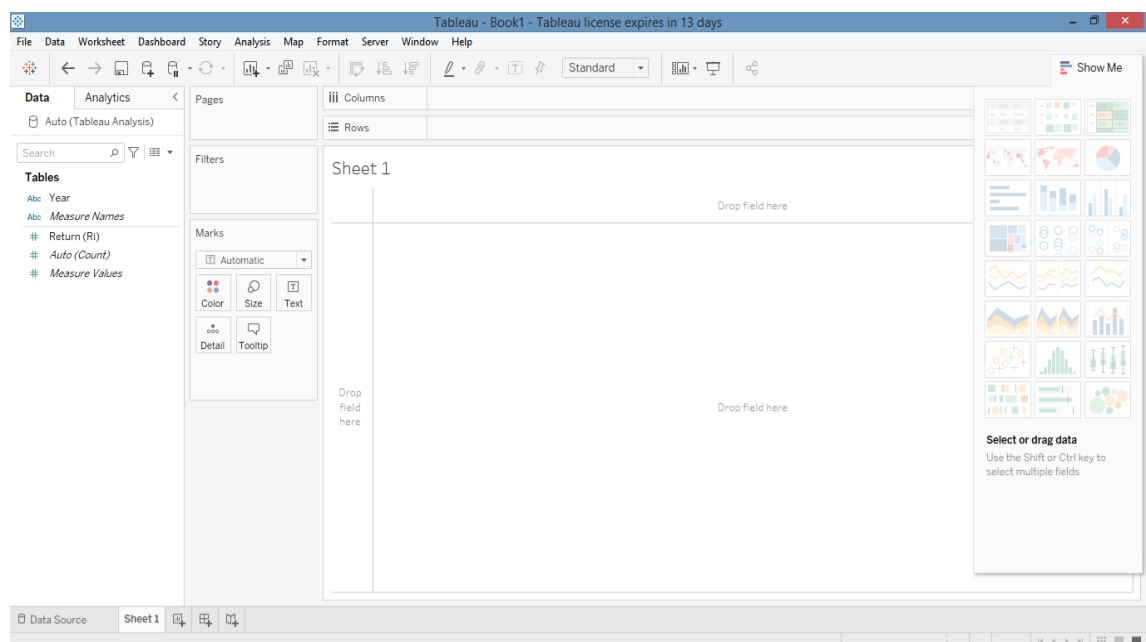


Figure 25: Tableau workspace desktop

The Figure 25 includes report view and there is a workspace in Tableau Software. Moreover, the figure also indicates the essential parts to be emphasized for performing analysis. The figure indicates that the Tableau workspace consists of menus, a toolbar, the Data pane, cards and shelves and sheets. Sheets can be worksheets, dashboards, or stories.

Workbook Name - The workbook contains sheets. Sheet can be a worksheet, dashboard, or story.

Cards & Shelves - Drag fields to cards and shelves in the workspace to add data to view.

Toolbar - Use the toolbar to access commands and analytics and navigation tools.

View - This is a canvas in the workspace where someone create visibility (also called "viz").

Sidebar - In the worksheet, the sidebar area contains the Data window and the Analytics window.

Status bar - Displays information about the current view.

Sheet Tabs - Tabs represent each sheet in workbook. This may include worksheets, dashboards and stories.

There is Show Me tab on the right side of the window. Under the show me tab, various types of charts are available like bar chart, pie chart, map chart, treemap chart and many more. An individual can select any type of chart for presenting the data.

The show me icon includes different types of charts which can represent the data graphically in an interactive way.

There are fields situated in the left-hand side of the figure. Under the show me section, choose any chart and click on that chart in order to create a chart and then drag one category into the column field and drag another category into the row field for running the connection between data and present it through a chart. Different charts represent the data differently in respective charts that are mentioned in the literature review like bar charts, maps, pie charts and many more.

4.2 Power BI

Power BI, Microsoft, is an organization of business analytics tools used to analyse data and share information in the form of reports and dashboards. User data can be inserted in a variety of ways - spreadsheets, text files, databases, etc. Data sets are created by converting data provided by users. Data conversion is determined by users. This step is used to remove errors and unwanted data, correct formatting, and to prepare additional analysis of data by sorting them into standard appropriate forms, and so on. Depending on the report and the dashboard being created, filtering data to include only relevant pieces makes one focus only on important data.

Once the database is ready, reports can be created from them by adding from the multi-item selection option. The visual objects in the Power BI range from the number one display to the gradient colour map. These mirrors help to present data in a way that provides context and understanding. Filters can be used in reports so that relevant data is directed to users who are interested in data analysis. Such reports can be created manually or once the reports have been published, report items or the entire report can be added to the dashboard.

Power BI dashboards display 360 degree data viewing by enabling users to keep their most important metrics in one place. They also allow users to participate in filtering or query reports, and allow native language queries. However it is limited to one page, thus only opening the relevant parts of the data to make it easier for users to gain insight. It is also possible to regularly update data and dashboard data, in real time, and make it available on all devices such as PCs and smartphones. [15]

Most users working on business intelligence projects use the Power BI Desktop to report, provide and analyse data and then use the Power BI app to share

their reports with others. [16] The key features of the Power BI Desktop are as follows:

- Connect to data
- Change data and build a data model
- Create visuals (charts or graphs) that provide visual data presentations
- Create visual reports, on one or more of the report pages
- Share reports with others via the Power BI service

Power BI is free to use app to visualize various types of data that analyze and retrieve filed information, intelligently organizing chapters with a closely related group table into one category. [17] It can create a complex and visually rich reports, uses data from multiple sources and immediately shares it with others through the Power BI service thinking. [18]

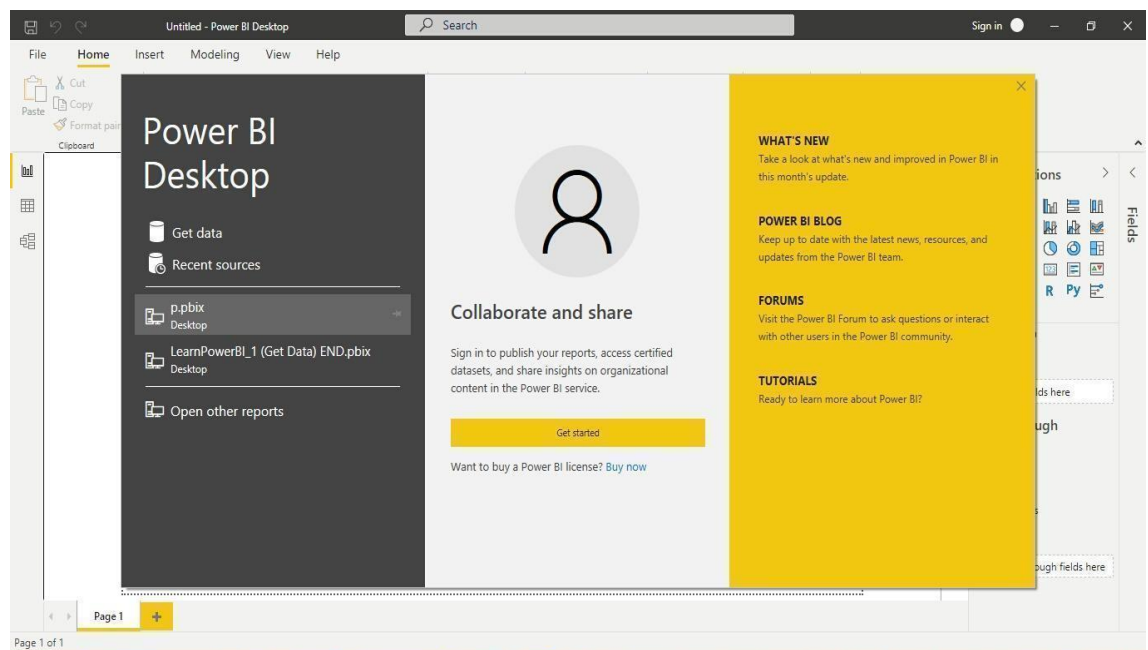


Figure 26: Power BI desktop

In Figure 26, the first page of the Power BI Desktop report is represented as Home. It is the beginning of a visual tool. There are many features that Power

BI offers to connect to other apps and tools. There are three ways to use Power BI, such as:

- Power BI online
- Power desktop
- Power BI Cell Phone

4.3 Cognos

IBM Cognos is a business intelligence tool for web-based reporting and analytics. This business software offers a variety of features to enable data integration and to create detailed reports that are easy to use. Cognos also offers the option to send reports in XML or PDF format and view reports in XML format.

Features of IBM Cognos

The following are the key features of Cognos.

- Provides streaming statistics within the memory
- Provides real-time events, notifications, and notifications.
- Intuitive, attractive Web 2.0 interface
- Personal and progressive collaboration
- Drag and drop, free form integration, and search-assisted authorization
- External data operated by the wizard
- Automatic access to SAP BW queries
- Allows features such as status model creation, real-time monitoring, and forecasting
- Users can edit existing data.
- Drill-Through Power.
- Integration of Possible Image Documents.
- It is an independent, reliable, and dependable platform.

- Provides secure data as protected by firewall.

Components in Cognos

Below is a list of key features of the Cognos software.

Cognos connections

Cognos Connect is a web site that allows users to access Cognos 10 and studios. Depending on the role someone have been assigned, someone may use this section to locate, view, publish, manage, and edit company reports, scoreboards, and agents. Administrator also uses Cognos Connection to establish user roles and permissions and manage Cognos Connection content.

Cognos Business Insight

The offer of Cognos Business Insight allows users to create their own dashboard and use anything. All content that the user is allowed to view will be presented as an object. This can be used in your workplace to create a completely personalized dashboard.

Cognos Query Studio

Cognos Query Studio helps business users find quick answers to business-related questions. It helps organizations better understand the product, customers and organizational needs. It also helps them to respond faster and stay ahead of the competition.

Cognos Analysis Studio

Cognos Analysis Studio helps businesses find and focus on business priorities. It is also helpful to understand the latest trends, compare data, and evaluate business performance with several analyzes.

Cognos Business Insight Advanced

Cognos Business Understanding Improved by a new module installed in Cognos 10. Includes Cognos Questionnaire and Cognos Analysis Studio. It provides a powerful environment for authorizing business people.

Cognos Report Studio

Using the Cognos reporting tool, someone can create complete pixel reports for organization. Allows someone to create charts, maps, lists, or any other type of report available using affiliate or multi-distribution data sources.

Cognos Event Studio

This tool allows someone to provide a specific event that sends a notification to a stakeholder in an organization. Someone can create agents that empower anyone at events and borders. Therefore, in the event that an event or limit is reached by the agent who sends the notification.

Cognos Metric Studio

Cognos Metric Studio lets someone's view and analyze an organization's business metrics by creating a scorecard environment. It also helps someone to initiate the process and monitor an organization to see how it responds as changes are made to the process.

Types of Cognos

Here are the key types of Cognos reporting tool.

Content Store

Set with data tables used by the Content Manager to store Cognos application data.

Content Manager

Cognos Manager helps someone to manage storage and retrieve reported data, configuration data, and published packages, from the content store database.

Cognos Content Database

The Cognos Content Database is a self-contained database server used to host a content store database in demo's locations where DBMS business is not available.

4.4 Qlik view

Qlik (formerly known as QlikTech Inc. provides a business statistics platform. SaaS Software Company was founded in 1993 in Lund, Sweden and is now based in King of Prussia, Pennsylvania, United States. Qlik Sense and Qlik Replicate, Both cloud-based software for business intelligence and data integration.

QlikView is a business intelligence tool for data integration, chat statistics, and converting raw data into a knowledge base. QlikView provides ad query features and makes it easy to make decisions based on easily accessible information. This software works on the integration model and can be accessed in any way to search for answers.

Here are the benefits / great benefits of using QlikView.

- It is very simple and intuitive to use the platform.
- Provides data visibility in a clear and professional way
- Quick response time without limit to the amount of data
- Allows to search for all data directly and indirectly
- QlikView provides support for dynamic applications, dashboards, and analysis, etc.
- It facilitates the rapid integration of data from multiple sources into a single application.
- It helps to identify styles and information to make new decisions.
- Allows someone to access, analyze, and retrieve data from mobile devices.
- It provides a quick return on investment, due to the short start time.
- Rapid Development and Change Management.
- Self Service Business Intelligence for end users.

Key features of QlikView

Data Integration Model: QlikView works on in-memory integration model. So someone doesn't need "IT professionals" If someone can write SQL select Questions and understand data.

Platform: QlikView is a windows-only product, but is actually configured for 64 bit and many processors.

Costs effective: QlikView is a memory app, so it's an inexpensive way for organization.

Economical: QlikView saves a lot of disk space as the amount of memory depends on the amount of data someone wants for each program.

QlikView Applications

- It helps to analyze revenue data based on various filters of a large international organization.
- Allows someone to create a detailed watch report based on social media feedback from customers around the world.
- The Qlikview tool lets someone make decisions based on predicting cause and effect with drawings using its historical data.
- QlikView lets someone analyze existing items, activity orders, sales, and staff usage - all focused on improving performance.
- Tools allow someone to analyze information about sales, production, shipping, and product performance.
- Someone will be able to easily and quickly create reports and analysis at the strategic, effective, and strategic level.
- Canon, Panasonic, Shell, FILA, ING LEASE are some of the well-known companies that use Quickview in their businesses.

4.5 SAP Analytics

SAP Analytics Cloud, commonly referred to as SAC, is a tool for viewing cloud data from SAP.

SAP Analytics Cloud combines the following functionality into one tool:

- Business Intelligence (BI);
- Predictability Analysis;
- Planning.

SAP provides a complete solution when it comes to business intelligence. Available online in SaaS mode, SAC is becoming increasingly important in

SAP's environmental system. Finally, it is intended to be a reliable BI tool for the SAP Cloud suite.

SAP Analytics Cloud is a new tool in the SAP portfolio to meet the needs of viewing data in the cloud. It is delivered as an all-in-one product, based on SaaS. Includes requirements for data identification, budget planning, and forecasting analytics.

Its main function is to create data reports.

This data can come from a variety of sources: real-time data taken from business operations, budget status data or thousands of data lines formatted as an MS Excel table.

The solution is accurate and easy to use. Allows the user to generate reports of various complexities with complete independence.

SAC is part of a data analytics tool, similar to Microsoft's tool, Power BI.

The key features of SAC

- Business Intelligence
- Data Access
- SAP Analytics Cloud allows data to be available in two ways: Importing Data and Direct reading from database / ERP.
- In the case of direct reading, real-time data is updated, only by connecting to the SAP system (HANA, BW, BPC or another).

Data Modelling

This allows for data modification with additional features such as indexing, formulas and converting values for acquired features.

Data visualization

This feature allows someone to view and highlight data with graphs, tables or other graphic objects.

Predictive Analysis

In order to highlight relevant metrics or predict future results, SAP has introduced artificial intelligence. A few examples of use of these new features include automated content creation with smart detection, powerful feature identification, and uncompromising record acquisition, and much more.

Planning

The SAC planning process enables someone to consolidate financial and operating statements with the same tool so that someone has a complete and clear view of someone's current situation.

Types of budget planning can be developed and modified from existing financial statements. The machine learning tools provided and predictive tools can help someone anticipate money in the future. Also available is the popular "What If" mode of simulation.

What does the future hold for SAC?

SAP is focused on constantly improving SAC. Like a cloud tool, it is constantly updated and visible, at no additional cost. SAP's future strategy for SAC can be defined by the implementation of the solution: BI allocation and planning.

BI offer

The integration of the SAC data recognition component into other SAP Cloud solutions furthers the synchronization of the reporting style and simplifies its use

from one tool to another. Examples include SAP S / 4HANA Cloud Integrated Analytics and a new cloud-based data storage tool, SAP Data Warehouse Cloud.

In terms of SAP On-Premise solutions, SAP Business Objects remains the preferred option, although hybrid solutions with On-Premise ERP and cloud-based solutions are becoming increasingly available.

By planning

SAP strategy to prioritize cloud solutions for editing tools. The use of SAP Analytics Cloud is recommended for scheduling without the need for legal consolidation.

In addition, its collaborative planning tools provide an additional value for updating forecasts in each company category and its integration with SAP S / 4HANA allows for easy data integration.

However, for customers using the On-Premise solution via SAP BPC, the extension is possible with SAC. Even improved data usage is recommended.

In short, SAP develops SAP Analytics Cloud across all segments offered; whether it reports on its new solutions or planning in conjunction with other tools in its category. With SAP's focus on continuing to improve the tool, SAC has a bright future ahead of it.

4.6 Excel

The most widely used Microsoft office program is Ms Excel. Excel is a spreadsheet tool used to store and analyze numerical data.

An Excel spreadsheet may be thought of as a collection of columns and rows that together form a table. Rows and columns intersect in an area known as a cell.

Normally, alphabetical letters are assigned to columns (A to Z and so on), whereas numerals are assigned to rows (1 to 1,048,576). Each cell can only hold a single piece of data, such as a number value, text, or formula.

Microsoft Excel is a spreadsheet tool used to capture and analyze numerical and statistical data. Microsoft Excel has a variety of functions for performing different tasks such as mathematical computation, graph tools, pivot tables, macro programming, and so on. It is compatible with a variety of operating systems, including Windows, Android, and others.

Microsoft Excel uses terms such as cell, workbook (which refers to an Excel spreadsheet record), worksheet, workspace, formula bar, tool bar (which is used to save, undo, redo, and so on), chart, data validation, and ribbon.

The default format for storing a Microsoft Excel workbook is .xlsx. The extension for Excel workbooks (deprecated) is .xls. The extension for an Excel macro-enabled workbook is .xlsm. The extension for an Excel binary workbook is .xlsb. The extension for Excel templates is .xltx.

5 Results and Analysis

This section gives an overview of data and visualisation of different indices using Tableau.

5.1 Case Study Description

In this part of the thesis, two popular and widely used methods of BI platforms are compared. The methods compared in the thesis include Microsoft Excel and Tableau. Further, the thesis also compares their key parameters: Accessibility, Usability and visibility, Differences in dashboard design, Features form recognition and their strategies.

The comparison is based on a case study, and it tries to answer following questions:

- What is the best tool for building visual dashboards?
- What are the major differences between Tableau and Microsoft Excel?

Microsoft Excel and Tableau are cloud-based suites of business analytics tools, both below Office 365 Enterprise E5 version. Both of these programs are good programs in their own way. It is therefore interesting to note the pros and cons being used in studying case study.

This case study is aimed at presenting an assessment of return for selected BSE Indices in India considering important decisions for companies, investors and researchers.

The development and preparation of the visualization dashboard for research scholars, investors and managers of the company regarding investment decisions and having better understanding about return provided by selected

BSE indices in preceding five years after demonetization in India. The researcher is required to present the selected BSE indices stock prices data of past five years i.e. from 2016 to 2021 in such an innovative way that it can be easily and clearly understood by research scholars, managers, investors and any individual. The researcher is also required to present the information regarding how selected BSE indices are performing in terms of return generation after the implementation of demonetization in India.

Research scholars, investors and managers of the well established companies need well-processed data that match to their requirements and expectations. Therefore, it is required to formulate creative ideas for presenting the raw data and prepare a report based on data received from the website of Bombay Stock Exchange concerning to international investors, researchers, companies that already invested their money abroad. The data report should be informative and understandable for a rapid analysis of the data, as international investors or companies often do not understand the data of selected BSE Indices available on BSE's website where the data is published by Bombay Stock Exchange of India. These investors often invest based on the reports or documentation that aims to help an individual to get better understanding about return given by selected BSE indices in last five years after demonetization in India.

How to help these research scholars, investors and managers? To interpret the data intelligently, a modern and sophisticated process to create an interactive dashboard that explains the broad data in a simple and clear way to the end viewer for analysis is used. The critical interest of the investors or researcher is obvious to get an easily understandable stock prices data of selected BSE indices which can be used in conducting further research or for making predictions about future performance of selected BSE indices and which indices will be going to perform better and results into higher returns for investors in future in India. Apart from investors and researchers, the managers of international companies will also have an interest in knowing about performance

of selected BSE indices for making investment related decisions in India. Many viewing tools can visualize big data, the most popular tool on the market described in literature reviews and the types, purposes and methods of building such visuals.

The dashboards should rapidly explain to end-user about the most important indicators in general. For example, the stock prices of selected BSE indices, the number of sectors performing well after the implementation of demonetization and higher returns generated by selected indices among selected BSE indices and other related information. The result of the analysis should provide pros and cons to the investors, researchers and managers that whether it is good to invest in India or whether Indian stock market is performing well after demonetization or not. For example, if any foreign company or foreign investor is planning to invest in India for business and for increasing their wealth then they should make sure that it has potential growth opportunities and will be able to generate good returns with lower risk.

This thesis will mostly focus on the comparison of Microsoft Excel and Tableau dashboards which will analyse the data from authenticated database sources and it will also give suggestions for further improvements in creating visual dashboards. The result of dashboards will give visual differences and indicate benefits of these used tools for the purpose of analysis.

5.2 Sources of Data

BSE Limited, also known as Bombay Stock Exchange (BSE), is an Indian stock exchange located on Dalal Street in Mumbai (Bombay). Founded in 1875 by Cotton Merchant Premchand Roychand, A Rajasthani Jain Businessman, it is the oldest stock exchange in Asia, [6] and the tenth largest in the world. BSE is the 9th largest stock exchange with a total market capitalization of more than R255.003 trillion, as of October 2021.

In 1986, BSE developed the S&P BSE SENSEX index, giving BSE a way to measure the overall performance of a trade. In 2000, BSE used this index to open the exit market, trading in future S&P BSE SENSEX contracts. The development of the S&P BSE SENSEX options and the equity exit followed in 2001 and 2002 expanded the BSE trading platform.

BSE launched India INX on December 30, 2016. India INX is India's first international exchange. BSE introduces an export contract for gold, silver. BSE is the first in Asia and the Fastest Stock Exchange in the world with a speed of 6 seconds and is one of the leading trading groups in India.

BSE Indices

The stock market index statistically summarizes market movements in real time. The stock market index is created by selecting the same types of stock in the market or trading and then merging them together. Sensex, representing the 'Stock Exchange Sensitive Index', is a stock market indicator for the Bombay Stock Exchange. Calculates movement on BSE.

Types of Stock Market Indices

There are various indicators of the stock market in India. Here are listed some of the indices found in BSE.

Benchmark Index

The key metrics for viewing market movements as they reflect the performance of the entire market. Comparative statistical rate which means showing the amount earned by the central fund in the market compared to the amount that should have been gained. eg: BSE Sensex, NSE Nifty (Nifty 50).

Broad Market Index

They are indicators of stagnation, but they often strengthen many stocks in the index. eg: BSE 100. BSE Sensex includes the movement of 30 financially strong Indian companies listed on BSE. The BSE 100 does the same for over 100 large companies.

Market Capitalization Index

An indication of how companies' shares are measured in terms of total market value (capitalization) of their remaining shares. eg: BSE Smallcap, BSE Midcap

Sector or industry-based index

Provide benchmarks and summaries of stock operations in specific industries such as health care, energy, industrial goods, technology, etc. CNX IT, Nifty FMCG Index.

BSE includes market capitalization index, broad market index, sector and industry index, thematic index, strategy index, sustainability index, volatility index and fixed income index.

In this thesis, the five sectoral indices were selected randomly for the purpose of analysis. The selected five sectoral indices are S&P BSE Auto, S&P BSE Bankex, S&P BSE Information Technology, S&P BSE Oil & Gas and S&P BSE FMCG.

Introduction of Demonetization

Demonetization is the process of extracting money from a common use or distribution. In other words, demonetization is the act of depriving a currency unit of its status as a legal tender. It happens whenever there is a change in the national currency. Current currencies are taken out of circulation and discontinued which is often replaced with new notes or coins.

On November 8, 2016, the Prime Minister of India Narendra Modi announced the demonetization in an unscheduled live televised.

Speech to the nation at 20:15 IST., in a proclamation, Modi announced that the distribution of all 2500 and 1000 banknotes of the Mahatma Gandhi series was illegal from midnight on the same day, and announced the release of the new 500 and 2000 series to replace the old ones.

The purpose was to eradicate people's black money, as well as money from terrorism. There is no doubt that ordinary people were greatly affected, especially those who earn less money and who do not have wealth (lower middle class family and poor family). Even their small financial assets do not work and they face problems meeting their basic daily needs.

The category of employees who earn and save their income by 500/1000 notes, were beaten because they had no money to buy in the market.

5.2.1 Data Based On Selected BSE Indices

BSE real-time information products are distributed directly by BSE vide lease lines and indirectly by data vendors. Data products provide information on all listed and traded instruments in Equity, Equity Derivatives, Currency Derivatives, Commodity Derivatives and Credit Segment as well as S&P BSE Real Time Indices.

Data Segments covered:

- S&P BSE Real Time Indices.
- BSE Real time Level 1 – Equity, Equity Derivatives & Debt.
- BSE Real time Level 2 – Equity & Equity Derivatives & Debt.
- BSE Real time Currency Derivatives.

- BSE Real time Commodity Derivatives.

The stock prices of selected BSE indices for thesis namely S&P BSE Auto, S&P BSE Bankex, S&P BSE Information Technology, S&P BSE Oil & Gas and S&P BSE FMCG sector was collected from the website of BSE. The data was collected for a period of past five years from 1st April, 2016 to 31st March, 2021. BSE provides historical stock prices on a daily, monthly and yearly basis. However, in this thesis, the daily stock prices of all selected BSE indices have been analysed for the purpose of return calculation. Apart from historical stock prices data, the annual reports data of various companies are also available on BSE's website. The website also provides information about various financial ratios for companies listed on BSE stock exchange and it also provides information about listed companies on stock exchange.

5.2.2 Description of Data

The data used for the analysis includes daily historical stock prices of selected BSE indices for the monitored period of preceding five years such as from the year of 2016 to 2021.

It includes:

Date : The dates are showed under this column. For example: 1/4/2016 to 31/3/2021.

Closing price: The closing prices for BSE oil and gas stocks are mentioned in rupees. For example: 9047.79 Rs. As on 1st April, 2016.

Simple Moving Average using daily price: The simple moving average is calculated for 3 days using daily stock prices of BSE oil and gas index, i.e. 9033.308 Rs.

Simple Moving Average using monthly price: The simple moving average is calculated for 3 months using monthly stock prices for deriving the average return value for the year 2016.

After simple moving average, the return provided by selected BSE indices are calculated for past five years using yearly prices of indices which are derived using simple moving average method.

Sector: The name of the various sectors, e.g. "BSE Auto Index".

Year: The years are stated under the heading of year, i. e. 2015-16.

Closing price: The amount of stock price which is derived using simple moving average method in the past five years is mentioned in rupees, e.g. 18001.75 rupees in the year 2015-16 and similarly the closing prices for remaining years are mentioned in rupees under the head of closing price.

Return (R_i): The percentage of return given by BSE Auto Index in past five years is stated, i.e. 18.03% return was given by BSE Auto Index. Similarly, the return for remaining years is calculated. After calculation of return on yearly basis, the mean is calculated using five years return values for identifying the average return given by BSE Auto in preceding five years i.e. from 2016 to 2021 after the implementation of demonetization.

5.3 Data Analysis

In order to create a chart the most significant thing, the data, is analysed in the entire dash board. In this case, it is the stock prices of selected BSE sectoral indices for a particular year which is showed in Figure 27. The Figure 27 indicates the raw data which is analysed for the purpose of calculating return.

BSE OIL AND GAS INDEX										2016						
Date	Close	Simple Moving average using daily price								Month	Simple Moving average using monthly price					
1-Apr-16	9047.79									April	9338.056					
4-Apr-16	9056.51									May	9135.079					
5-Apr-16	8996.29	9033.53								June	9432.384	9301.84				
6-Apr-16	9052.23	9035.01								July	10201.4	9589.622				
7-Apr-16	9063.63	9037.383	9035.308							August	10717.67	10117.15	9669.538			
8-Apr-16	9099.69	9071.85	9048.081							September	11129.4	10682.83	10129.87			
11-Apr-16	9191.31	9118.21	9075.814	9053.068						October	12163.24	11336.77	10712.25	10170.55		
12-Apr-16	9302.8	9197.933	9129.331	9084.409						November	11711.84	11668.16	11229.25	10690.46		
13-Apr-16	9396.82	9296.977	9204.373	9136.506	9091.328					December	11985.35	11953.47	11652.8	11198.1	10686.37	
18-Apr-16	9430.73	9376.783	9290.564	9208.09	9143.002					January	12572.26	12089.82	11903.82	11595.29	11161.28	
20-Apr-16	9361.81	9396.453	9356.738	9283.892	9209.496	9147.942				February	13084.83	12547.48	12196.92	11917.85	11570.41	11139.36
21-Apr-16	9424.98	9405.84	9393.026	9346.776	9279.586	9210.694				March	13370.15	13009.08	12548.79	12216.51	11909.88	11343.27
22-Apr-16	9458.66	9415.15	9405.814	9385.193	9338.62	9275.901	9211.512									
25-Apr-16	9369.11	9417.583	9412.858	9403.899	9378.623	9332.276	9272.957									
26-Apr-16	9411.69	9413.153	9415.296	9411.323	9400.138	9372.46	9326.879	9270.449								
27-Apr-16	9527.48	9436.093	9422.277	9416.81	9410.677	9396.479	9367.072	9322.303								
28-Apr-16	9319.54	9419.57	9422.939	9420.17	9416.101	9408.972	9392.637	9362.196	9318.316							
29-Apr-16	9356.16	9401.06	9418.908	9421.374	9419.452	9415.41	9406.954	9388.888	9357.795	9338.056						
2-May-16	9379.84															
3-May-16	9282.22															
4-May-16	9188.61	9283.557														
5-May-16	9173.53	9214.787														

Figure 27: The data used for creating the Tableau dashboard

The analysis is done by using stock prices of selected BSE indices. The stock prices data is obtained from the BSE's website. After the data of stock prices have been collected, it is analysed using Simple Moving Average Method for 3 days using daily stock prices for calculating the average monthly stock prices given by particular index. Further, the monthly stock prices are used for calculating yearly stock values using simple moving average method.

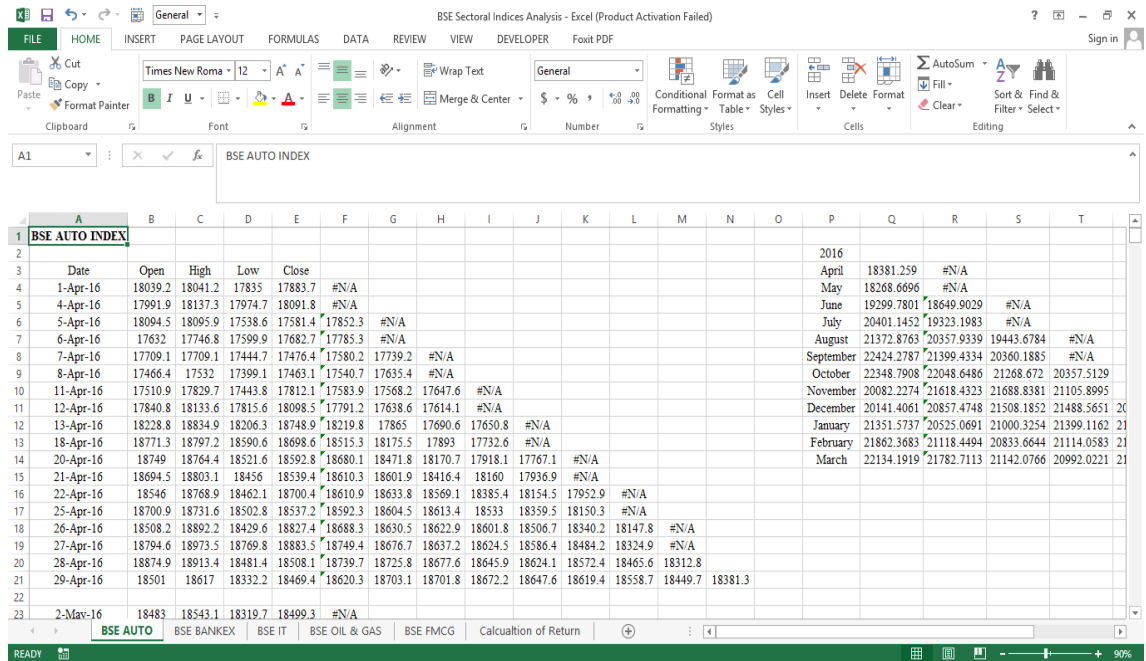


Figure 28: Raw data of BSE Auto Index

In Figure 28, the raw data used for BSE Auto is stated. The figure also indicates the calculation for deriving the yearly prices for BSE Auto index using Simple Moving Average Method on a 3 days basis.

Year	Return (Ri)
2016-17	18.03%
2017-18	16.12%
2018-19	-9.84%
2019-20	-22.96%
2020-21	6.57%
Total return	1.58%

Figure 29: Return calculation for BSE Auto Index

The Figure 29 indicates the return given by BSE Auto in last five years after the implementation of demonetization. The return is calculated by using the following formula:

$$\text{Return} = (\text{Closing Price} - \text{Opening Price}) / \text{Opening Price} * 100\%$$

Firstly, the yearly returns are calculated and then average return given by BSE Auto index in past five year is also calculated for comparative analysis of selected BSE sectoral indices in order to know about which sector is performing well by obtaining highest returns.

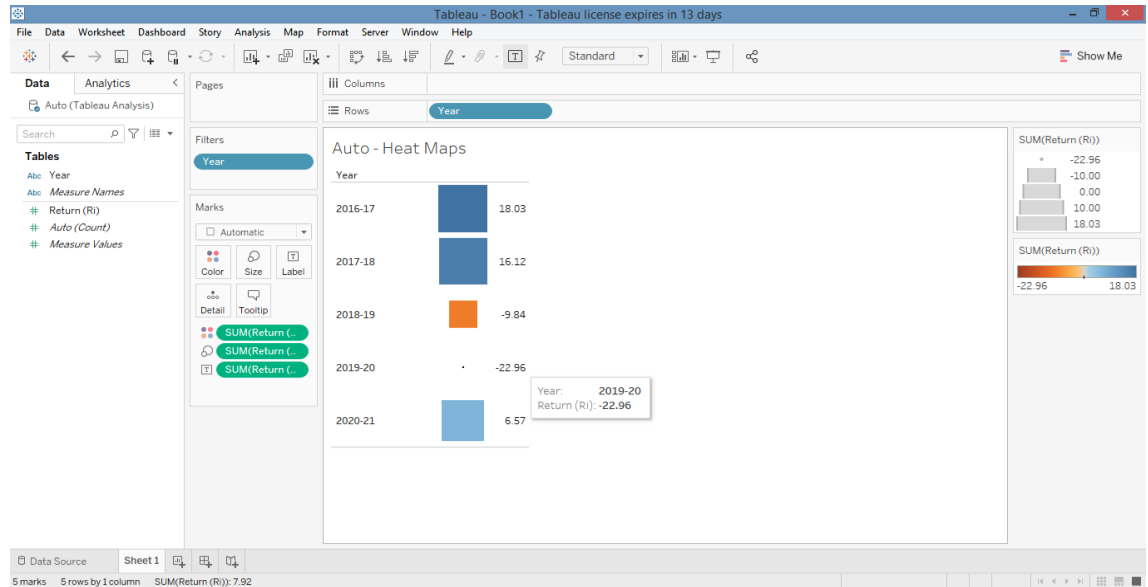


Figure 30: Interactive visualization Heat Map Chart in Tableau.

In Tableau Heat Map chart is useful for comparing a number of dimensions against a single measure (dimensions and measure are features provided by Tableau). The following step is to be followed for creating an interactive chart to know about the return given by selected BSE sectoral indices in each year. Therefore, for creating Heat Maps chart in Tableau, first drag and drop the return category into the column field and the year category into the row field. It will then automatically create a bar chart.

After that, click on the Heat Map chart under the Show Me section which will automatically convert the bar chart into Heat Map chart. In Figure 30, the right sight of Auto- heat maps indicates the total amount of return in percentage given (with square colour code) by BSE Auto Index in past five years and the left sight of Auto- heat maps indicates the different years.

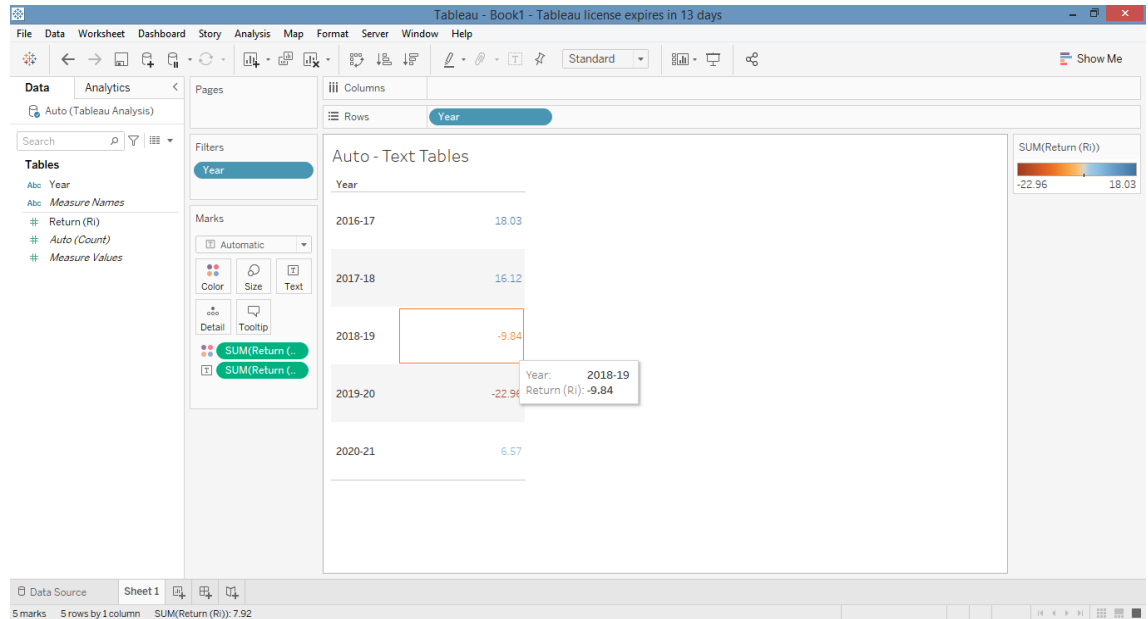


Figure 31: Interactive visualization Text Tables Chart in Tableau.

After the Heat Map, text tables chart is created for representing the returns obtained by BSE Auto Index in past five years after the implementation of demonetization. For creating text tables chart, first drag and drop the return category into the column field and the year category into the row field. It will automatically create a bar chart.

Click on text table's chart under the Show Me section which will automatically convert the bar chart into text table's chart. In Figure 31, the right sight of Auto-text tables indicates the total amount of return in percentage given by BSE Auto Index in the past five years and the left sight of Auto- text tables indicates the different years.

The following step is to create an interactive vertical bars chart that provides information about the percentage of return given by BSE Bankex in the past five years after demonetization.

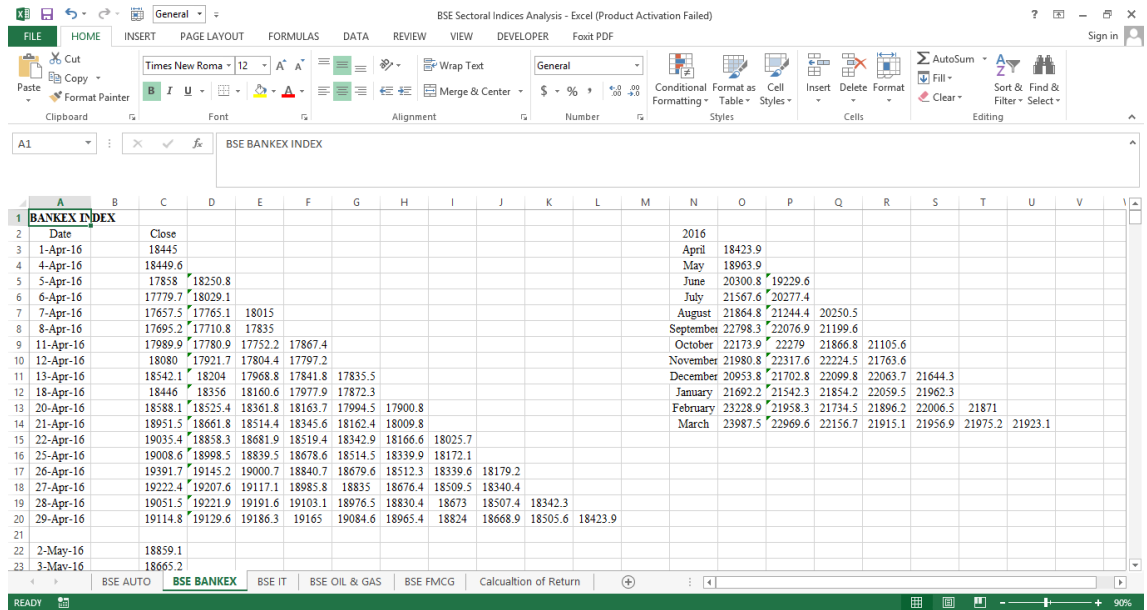


Figure 32: Raw data of BSE Bankex Index

In Figure 32, the raw data used for BSE Bankex is shown. The figure also indicates the calculation for deriving the yearly prices for BSE Bankex using Simple Moving Average Method on a 3 days basis.

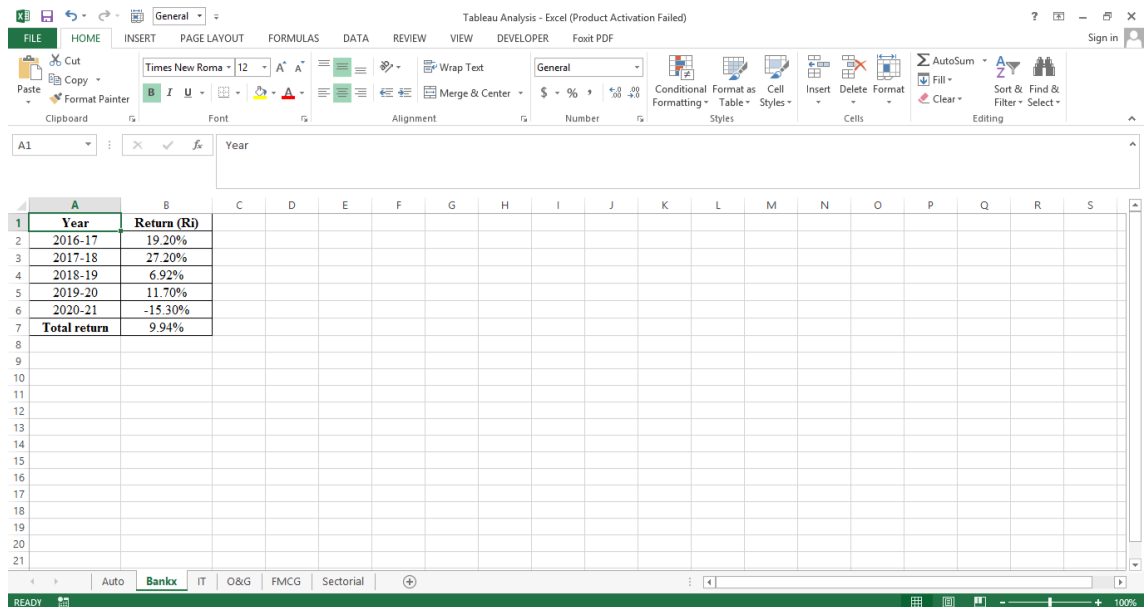


Figure 33: Return calculation for BSE Bankex Index

The Figure 33 indicates the return given by BSE Bankex in last five years after the implementation of demonetization.

Firstly, the yearly returns are calculated and then average return given by BSE Bankex index in past five year is also calculated for comparative analysis of selected BSE sectoral indices in order to know about which sector is performing well with obtaining highest returns.

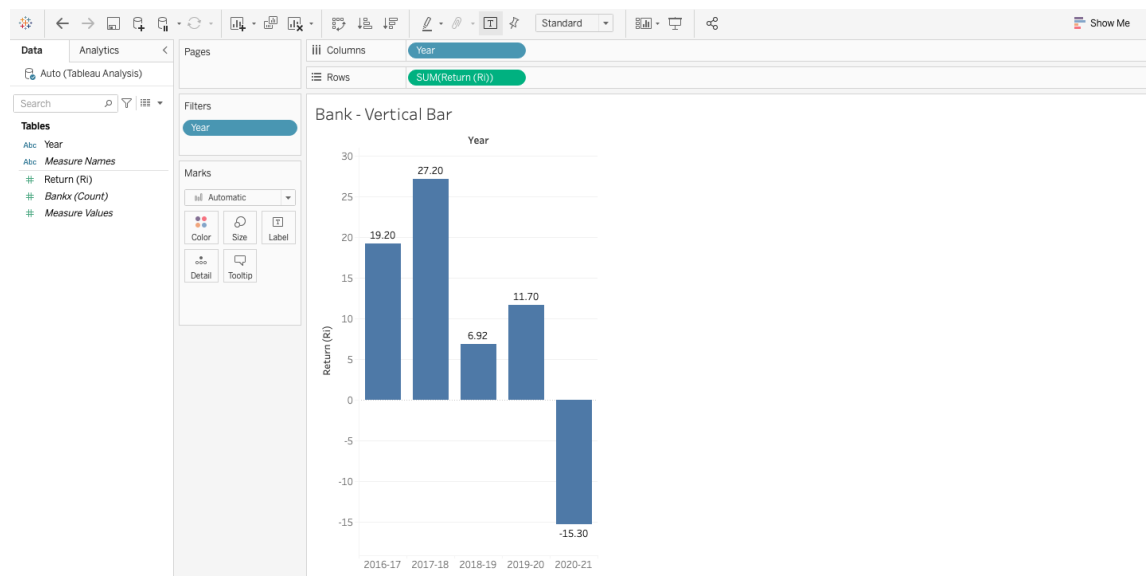


Figure 34: Interactive visualization vertical bar chart in Tableau

The next chart in the dashboard is the vertical bar chart. Let's try to develop a chart that includes detailed information about the percentage of return given by BSE Bankex in preceding five years.

In Figure 34, the vertical bar chart indicates the percentage of return given by BSE Bankex in past five years from 2016 to 2021. In this type of chart, y-axis indicates the total amount of return in percentage given by BSE Bank Index in past five years and x-axis indicates the years.

Here, the vertical bar chart represents the return given by BSE Bankex. In 2017-18, 27.20% return is obtained by BSE Bankex which is the highest as compare to other years. However, in the year 2020-2021, the banking sector is not performing well as it has negative return of -15.30%.

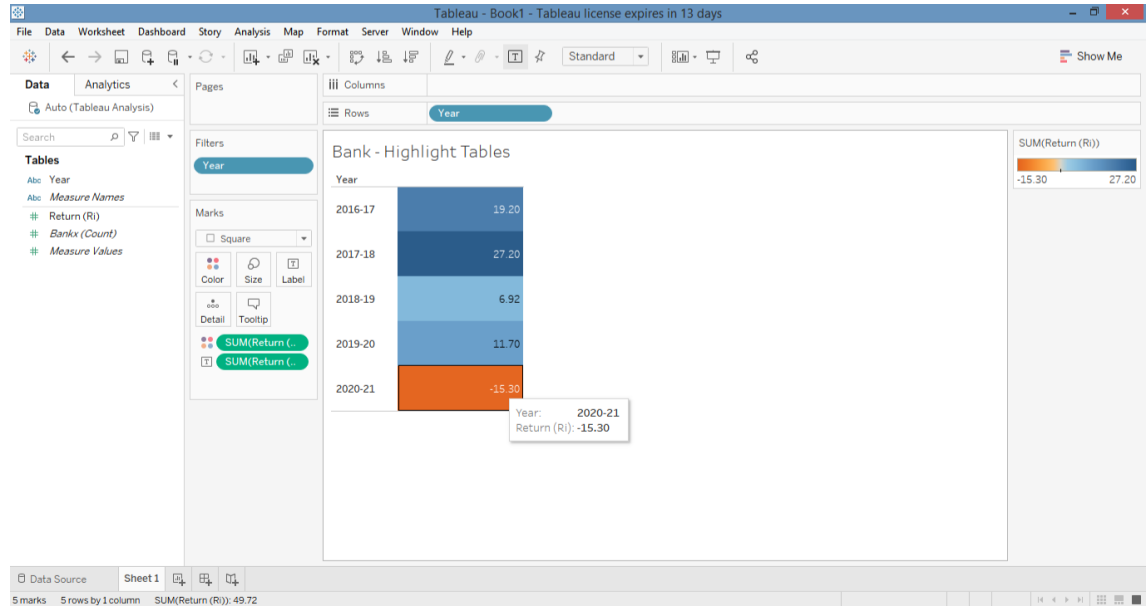


Figure 35: Highlight table chart in Tableau

The returns obtained by BSE Bankex are represented previously using vertical bar chart. Here, the same data is presented using different chart type called highlight table for presenting data in a better way of visualization. For creating a highlight table chart select the chart from show me section and move the categories in to row and column fields that are required to display in the highlight tables chart. The figure of highlight table chart indicates the percentage of return given by BSE Bankex from the year 2016 to 2021.

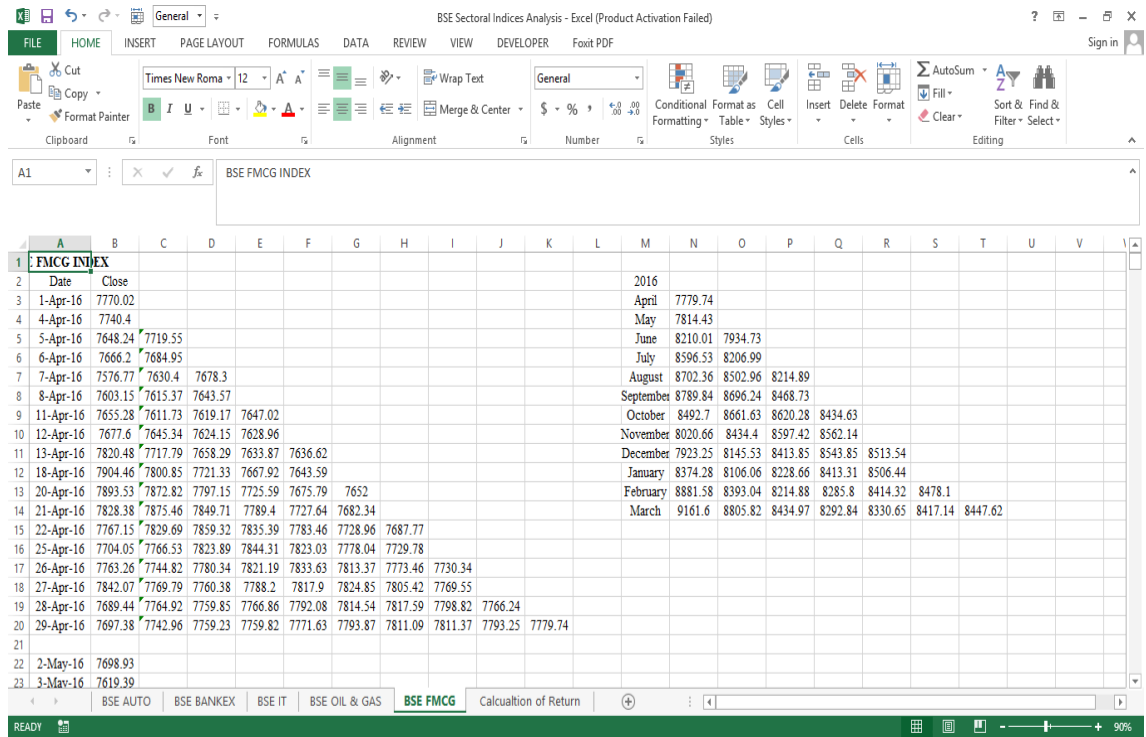


Figure 36: Raw data of BSE FMCG Index

In Figure 36, the raw data used for BSE FMCG Index is shown. The figure also indicates the calculation for deriving the yearly prices for BSE FMCG Index using Simple Moving Average Method on a 3 days basis.

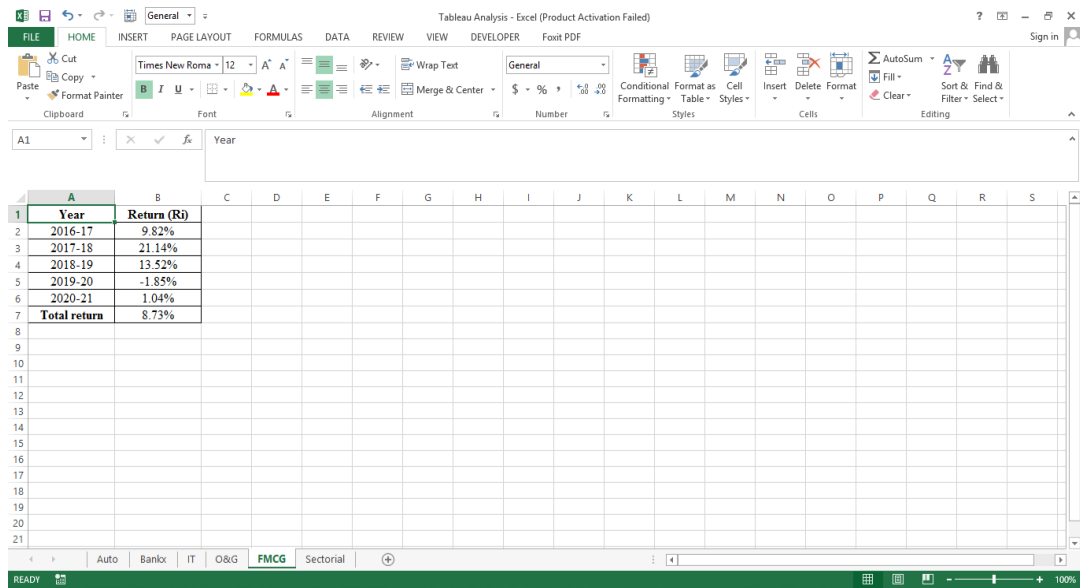


Figure 37: Return calculation for BSE FMCG Index

The figure indicates the return given by BSE FMCG Index in last five years after the implementation of demonetization. The yearly returns are calculated and then average return given by BSE FMCG index in past five year is also calculated.

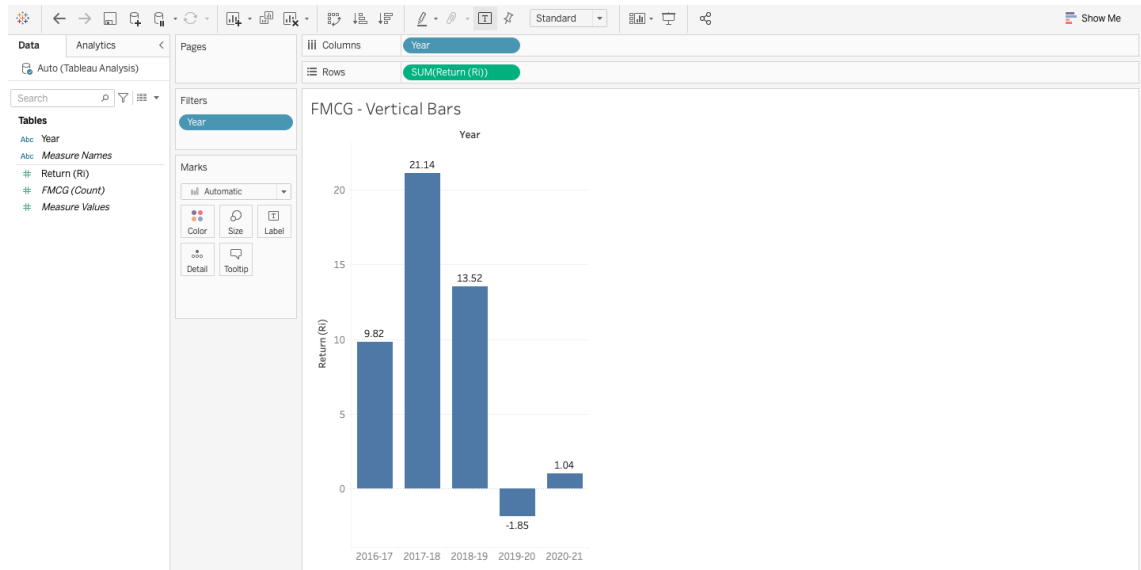


Figure 38: Interactive visualization vertical bar chart in Tableau.

The next chart in the dashboard is the vertical bar chart. Let's try to develop a chart that includes detailed information about the percentage of return provided by BSE Fast Moving Consumer Goods in preceding five years.

In Figure 38, the vertical bars chart indicates the total percentage of return achieved by BSE FMCG sector after demonetization.

The vertical bars chart shows the percentage of return given by BSE FMCG Index in past five years. Each year is represented using different bars. The year which has the highest return is highlighted with a longer bar and as the return reduces the bar will be smaller or negative. For example, in the year 2017-18 BSE FMCG Index has obtained highest return of 21.14% which is indicated with

a longer bar and the index has obtained return of 13.52% in the year 2018-19 which is lower as compare to year 2017-18. Therefore, it is indicated with smaller as compare to highest return bar. The BSE FMCG Index has witnessed lowest return in 2019-20 which is around -1.85% which is indicated with negative bar in the vertical bars chart.

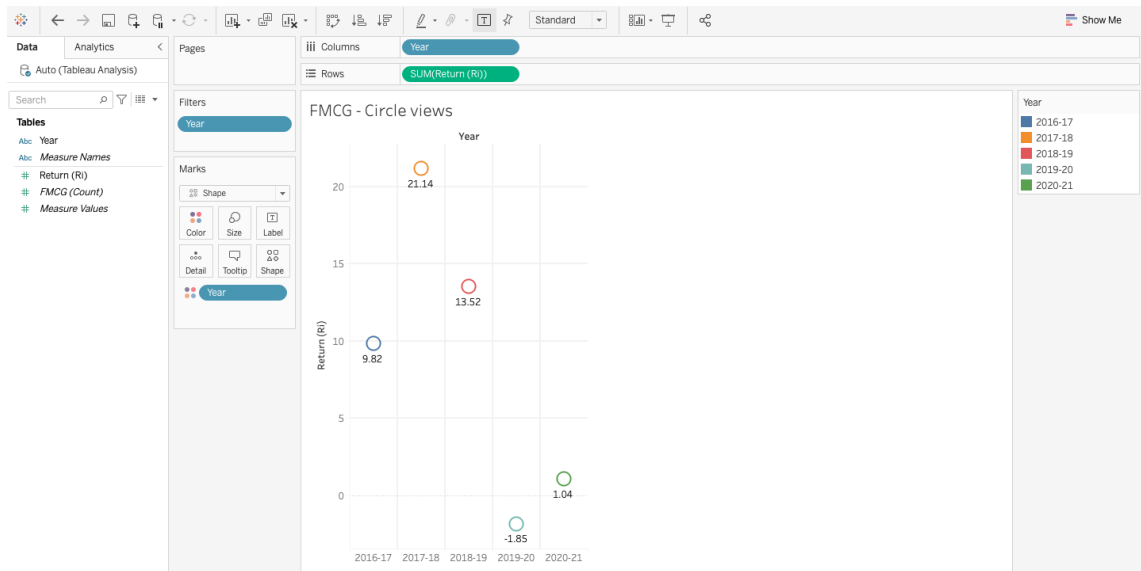


Figure 39: Interactive visualization circle view chart in Tableau.

The data of BSE FMCG Index is also represented using circle view chart. For creating circle view chart, first drag and drop the year into column field and return into row field. It will automatically create a bar chart.

Click on circle view chart under the Show me section which will automatically convert the bar chart into circle view chart. In figure, the y-axis indicates the total amount of return in percentage given by BSE FMCG Index in past five years and x-axis indicates the number of years.

The following step is to create a circle views chart that provides information about the percentage of return given by BSE Information Technology in past five years after demonetization.

Figure 41: Return calculation for BSE IT Index

The Figure 41 indicates the return given by BSE Information Technology Index in last five years after the implementation of demonetization.

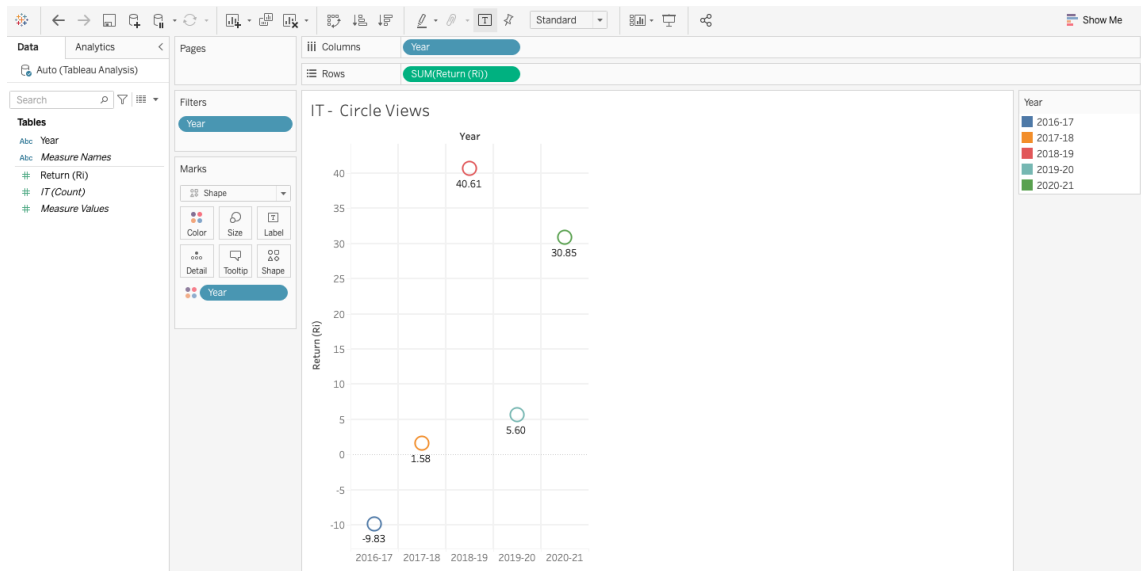


Figure 42: Interactive visualization circle views chart in Tableau.

For creating a circle views chart select the chart from Show Me section and move the categories into row and column fields that are required to display in the circle views chart. The figure of circle views chart indicates the percentage of return given by BSE IT from the year 2016 to 2021. X-axis indicates different years and y-axis indicates return.

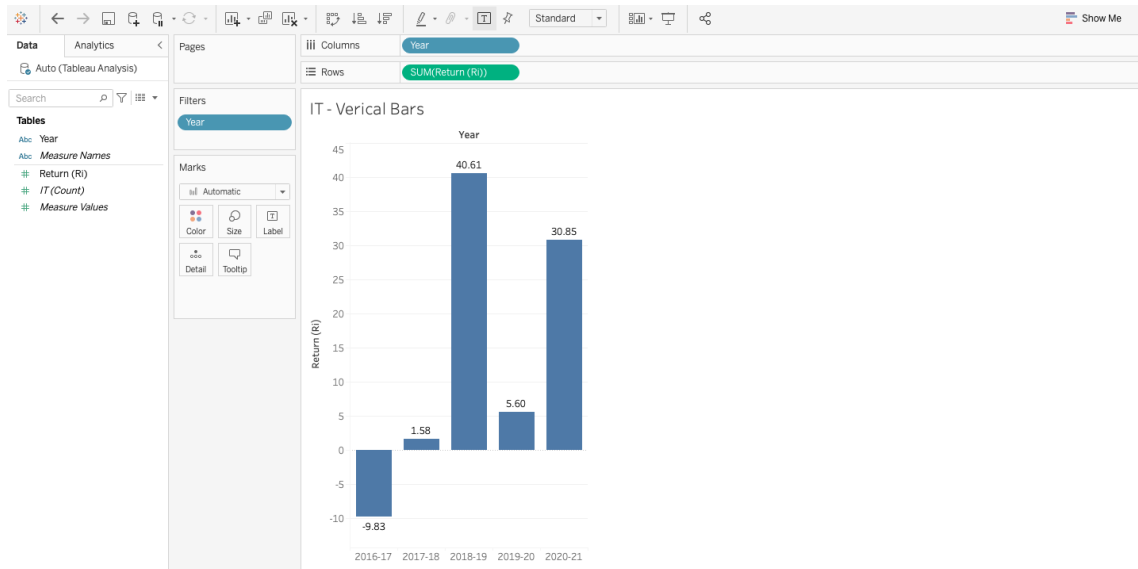


Figure 43: Interactive visualization vertical bar chart in Tableau

The returns obtained by BSE IT Index are represented previously using circle view chart. Here, the same data is presented using different chart type called vertical bar chart for presenting data in a better way of visualization. For creating a vertical bar chart select the chart from show me section and move the categories in to row and column fields that are required to display in the vertical bar chart. The figure of vertical bar chart indicates the percentage of return given by BSE IT from the year 2016 to 2021. X-axis indicates different years and y-axis indicates return.

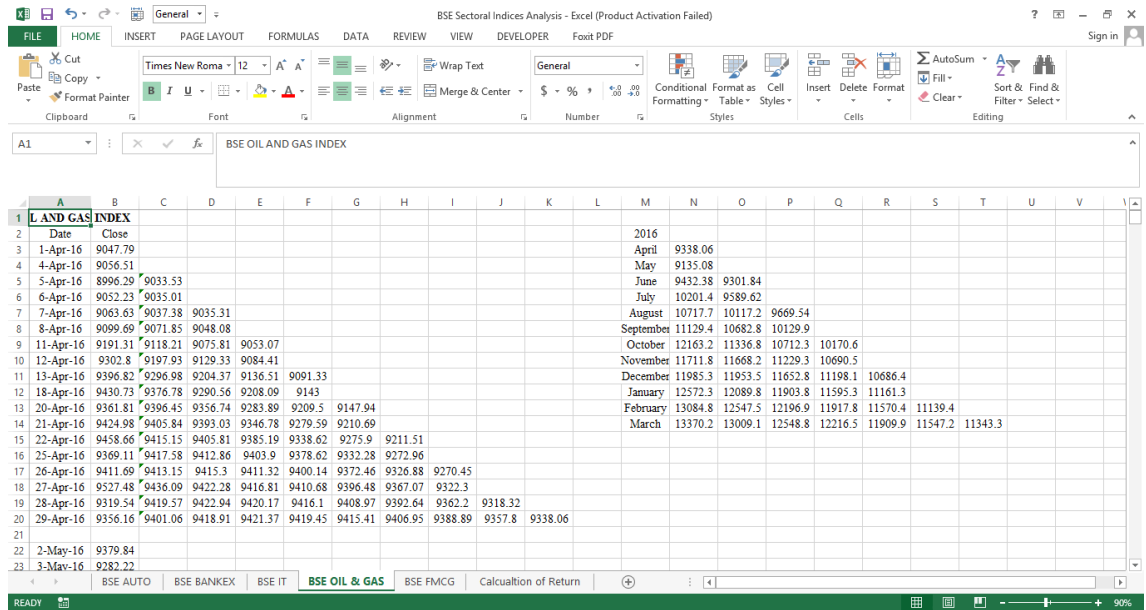


Figure 44: Raw data of BSE Oil & Gas Index

In Figure 44, the raw data used for BSE Oil & Gas Index is stated. The figure also indicates the calculation for deriving the yearly prices for BSE Oil & Gas index using Simple Moving Average Method on a 3 days basis.

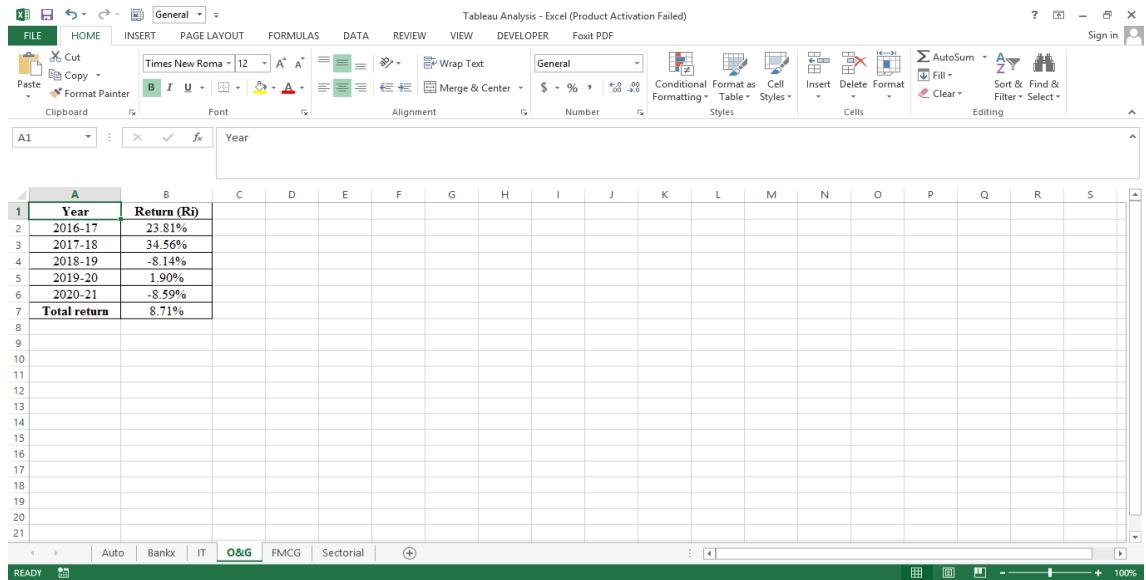


Figure 45: Return calculation for BSE Oil & Gas Index

The Figure 45 indicates the return given by BSE Oil & Gas in last five years after the implementation of demonetization.

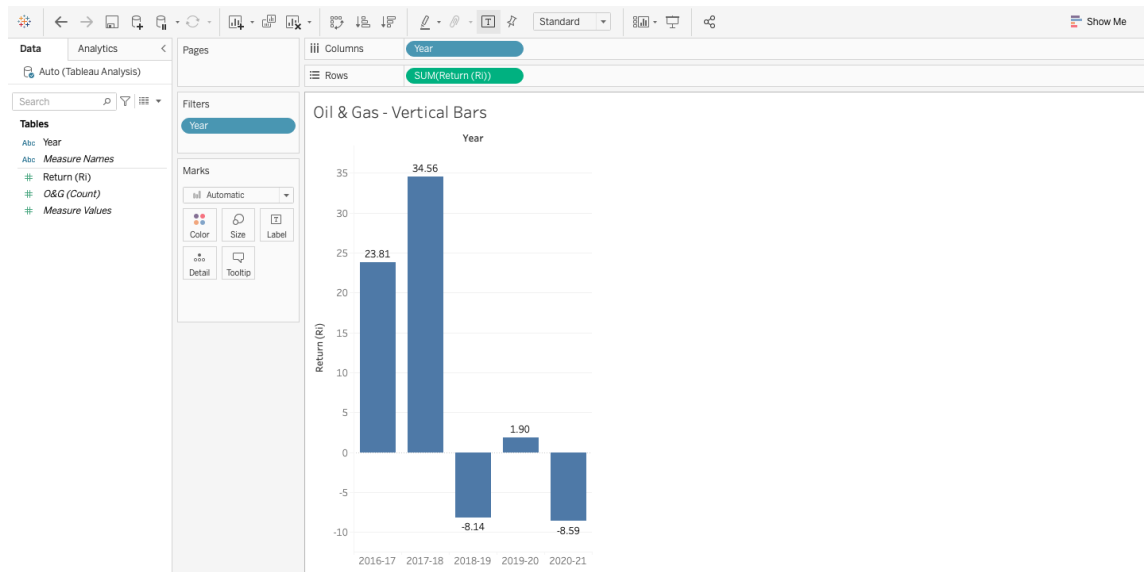


Figure 46: Interactive visualization vertical bar Chart in Tableau

The following step is to be followed for creating an interactive chart to know about the return given by selected BSE sectoral indices in each year. Therefore, for creating Vertical Bar chart in Tableau, first drag and drop the year category into column field and return category into row field. It will automatically create a bar chart.

After that, click on vertical bar chart under the Show me section which will automatically convert the bar chart into vertical bar chart. In figure, the vertical bar chart is displayed for BSE Oil & Gas Index. The vertical bar display with different bars sizes depends on returns.

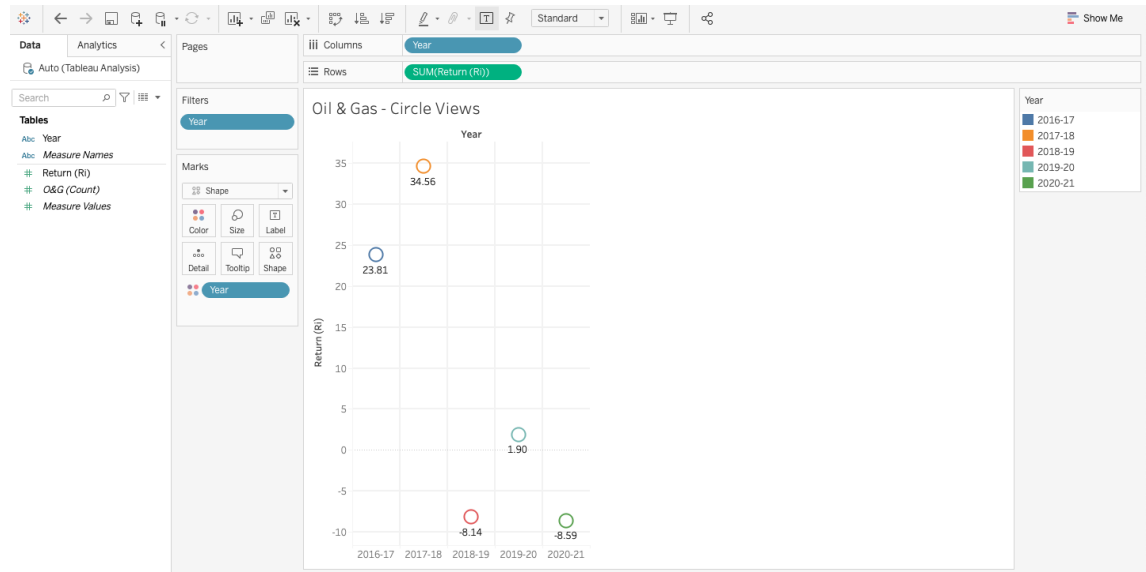


Figure 47: Interactive visualization circle view chart in Tableau

After the Vertical bar chart, circle view chart is created for representing the returns obtained by the BSE Oil & Gas Index in past five years after the implementation of demonetization. For creating circleviews chart, first drag and drop the year category into column field and return category into row field. It will automatically create a bar chart.

Click on the circle views chart under the Show me section which will automatically convert the bar chart into circle views chart. In figure, the y-axis indicates the total amount of return in percentage given by the BSE Auto Index in the past five years and x-axis indicates the years.

Table 1: Different between Tableau and Microsoft Excel (Source: <https://www.simplilearn.com/>)

S.R No.	Parameters	Microsoft Excel	Tableau
1.	Definition	It is a spreadsheet application used to organize and format the data.	It is a visualization tool used for detailed analysis.
2.	Usage	Suitable for storing data and statistical analysis.	Perfect for the quick and easy representation of data.
3.	Security	The inbuilt security features are weak as compared to the Tableau.	Several options to secure the data without scripting.
4.	User Interface	To unleash the full potential of Excel, knowledge of VBA and basic scripting is required.	We can use Tableau with no prior knowledge of coding.
5.	Business Purpose	Quick on-off reports.	Best while working with big data.
6.	Integration	Excel integrates with around 60 applications.	Tableau integrates with around 250 applications.

6 Recommendations and Conclusions

The analysis of the thesis indicates that it is possible to convert raw data into meaningful information based on the analysis of the case study. From the analysis, it was observed that applications such as Tableau provided a good result in terms of creation of a dashboard. Microsoft Excel has less distinct benefits as compared to Tableau.

Microsoft Excel and Tableau applications are used for serving different purposes. Not only Microsoft Excel but also Tableau are very affordable as anyone can easily buy and install the respective applications.

While comparing Tableau with Microsoft Excel, it has been found that Tableau is good when working with big data as compared to Microsoft Excel. Tableau includes all the necessary things required for creating an effective dashboard for securing business analytics as well as for creating reports and dashboards which goods look in terms of visualization. Tableau is performing well in terms of scalability in comparison to Microsoft Excel as it processes huge amounts of information very quickly. The literature review and practical part describes the major differences when using these the applications. As per the analysis, Tableau is suitable for any user and it can create any unique dashboard as it has many advantages and benefits compared to Microsoft Excel. Tableau is used to present the data in such a way that it catches both viewer's eyes as well as their attention. While Microsoft Excel is suitable for creating smooth, basic and straightforward visualizations without having much uniqueness in the report or in the dashboard. Microsoft Excel is a spreadsheet application used to organize and format the data.

Moreover, the most important thing is the end result of the analysis, because well-designed, well-defined visualization helps in transforming raw data into

useful information for easy understanding of the data. For example, instead of describing the return values of the selected BSE sectoral indices to an individual or managers of some company, it is better to explain data using visualization tools which can present the information in a better way effectively and effortlessly.

Data visualization is an efficient technique to convert the raw data into effective graphic representations of any business or a project and it helps making decisions related to future business actions. It also helps investors in getting proper understanding about financial data for making effective investment decision. The thesis analyzed current widely used visualization tools in the market, validate differences and emphasized their benefits. It was necessary to take two of the most popular applications of the market, design a dashboard and create an interactive visualization using a particular data. The study used the data of stock prices of selected BSE sectoral indices for a period of five years which was collected from Bombay Stock Exchange's annual report. The study developed a dashboard for return values of selected BSE Sectoral indices with the help of Tableau.

Tools such as Microsoft Excel and Tableau are inexpensive products today and are affordable for startups and first-time users. Both of these tools are easy to use and create dashboards because they analyze data quickly and include analysis that automatically provides valuable and important aspects of data. It is difficult to choose the best one because Microsoft Excel and Tableau have different goals. One is a spreadsheet application that can create interactive visuals, while another aims to design the effective visuals (like charts, tables, graphs, maps, infographics, dashboards). Overall, the results showed that Tableau is unique and provides seemingly relevant and professional looking results that are very important to businesses and companies around the world to present the significant data to investors and customers in an easily understandable, effective and efficient manner.

References

- 1 Waskom ML. Seaborn: statistical data visualization. *Journal of Open Source Software*. 2021 Apr 6;6(60):3021.
- 2 Sohn C, Choi H, Kim K, Park J, Noh J. Line Chart understanding with convolutional neural network. *Electronics*. 2021 Jan;10(6):749.
- 3 Zhang Q. A System of Visualizing Business Chart Using Text Mining Techniques. In 2019 4th IEEE International Conference on Cybernetics (Cybconf) 2019 Jul 5 (pp. 1-6). IEEE.
- 4 Wei X, Zhou W, Sanjay ST, Zhang J, Jin Q, Xu F, Dominguez DC, Li X. Multiplexed instrument-free bar-chart spinchip integrated with nanoparticle-mediated magnetic aptasensors for visual quantitative detection of multiple pathogens. *Analytical chemistry*. 2018 Jul 20;90(16):9888-96.
- 5 Lemenkova P. Processing oceanographic data by Python libraries NumPy, SciPy and Pandas. *Aquatic Research*. 2019 Apr 1;2(2):73-91.
- 6 Mendes AM. Time to Retire for DuPont Analysis. A Waterfall Chart Alternative. *A Waterfall Chart Alternative* (March 16, 2020). 2020 Mar 16.
- 7 De P. Automatic data extraction from 2D and 3D pie chart images. In 2018 IEEE 8th International Advance Computing Conference (IACC) 2018 Dec 14 (pp. 20-25). IEEE.
- 8 Daniel M, Rivière G, Couture N. Designing an expandable illuminated ring to build an actuated ring chart. In *Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interaction* 2018 Mar 18 (pp. 140-147).
- 9 Thirumalai C, Vignesh M, Balaji R. Data analysis using Box and Whisker plot for Lung Cancer. In 2017 Innovations in Power and Advanced Computing Technologies (i-PACT) 2017 Apr 21 (pp. 1-6). IEEE.

- 10 Thirumalai C, Vignesh M, Balaji R. Data analysis using Box and Whisker plot for Lung Cancer. In 2017 Innovations in Power and Advanced Computing Technologies (i-PACT) 2017 Apr 21 (pp. 1-6). IEEE.
- 11 Padala SA, Barsouk A, Thandra KC, Saginala K, Mohammed A, Vakiti A, Rawla P, Barsouk A. Epidemiology of renal cell carcinoma. World journal of oncology. 2020 Jun;11(3):79.
- 12 Bhandari G. A tale of two cloud analytics platforms for education. International Journal of Cloud Computing. 2018;7(3-4):237-47.
- 13 Battle L, Heer J. Characterizing exploratory visual analysis: A literature review and evaluation of analytic provenance in Tableau. In Computer Graphics Forum 2019 Jun (Vol. 38, No. 3, pp. 145-159).
- 14 Hoelscher J, Mortimer A. Using Tableau to visualize data and drive decision-making. Journal of Accounting Education. 2018 Sep 1;44:49-59.
- 15 Ferrari A, Russo M. Analyzing Data with Power BI and Power Pivot for Excel. Microsoft Press; 2017 Apr 28.
- 16 Power BI, Excel U, Desktop PB, Tiles P. Microsoft power bi. Available from: <https://powerbi.microsoft.com/en-us>. 2021 [Accessed 22th October 2021].
- 17 Clark D. Introducing Power BI Desktop. In Beginning Power BI 2017 (pp. 193-216). Apress, Berkeley, CA.
- 18 Rad R. Power BI Administrator Configuration. In Pro Power BI Architecture 2018 (pp. 349-366). Apress, Berkeley, CA.