**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Department of Informatics**



# Master's Thesis

**Data Visualization of impact of Demonetization on Indian Stock Exchange using Tableau Software**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

# DIPLOMA THESIS ASSIGNMENT

Amarkishan Ponmalithazham, B.Tech.

Informatics

Thesis title

**Data Visualization of impact of Demonetization on Indian Stock Exchange using Tableau Software**

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**Objectives of thesis**

The main objective of the thesis is assess the impact of demonetization on Indian Stock Exchange using visualization tool. The partial objectives can be classified as below: (i) To comprehend the many data visualization technologies available, (ii) To evaluate the suggested visualization tool and make suggestions, (iii) To make a comparison between Tableau and Microsoft Excel, (iv) To analyse the five sectorial indices to calculate the yearly returns using Microsoft Excel software and after that compare those data in the Tableau software.

**Methodology**

This thesis is composed mostly of two sections: theoretical and practical. The theoretical section is based on a literature study that explains several data visualization techniques. It also gives a study of the present market for visualization tools and knowledge about the most popular applications. The practical portion focuses on applying the learnt material in the most effective manner. Moving average method in MS Excel software is used to analyse the data of 5 years for yearly returns and Tableau is the tool used for visualization and analytical purposes. The analysis gives information on the benefits and challenges of utilizing the apps. In addition, it outlines the procedures for generating the dashboard design and interactive representations of the particular data using Tableau software.

**The proposed extent of the thesis**

60 – 80 pages

**Keywords**

Data Visualization, Tableau Software, Demonetization, Indian Stock Exchange, Bombay Stock Exchange.

**Recommended information sources**

FROYEN, R T. *Macroeconomics : theories and policies.* New York: Pearson/Prntice Hall, 2004. ISBN 0-13-143582-5.

KAUFMAN, R T. *Student guide and workbook for use with N. Gregory Mankiw: Macroeconomics.* New York: Worth Publishers, 2013. ISBN 978-1-4641-0493-0.

LARSON, R. – FARBER, E. *Elementary statistics : picturing the world.* Boston: Pearson Prentice Hall, 2015. ISBN 9780321693624.

LUKE, J. *Stock market intelligence : investing made easy.* [New York]: Amazon, 2019. ISBN 978-1976928345.

SAMUELSON, P A. – NORDHAUS, W D. *Economics.* Boston: McGraw-Hill Irwin, 2010. ISBN 9780073511290.

TSAY, R S. *Analysis of financial time series.* Hoboken: John Wiley & Sons, 2010. ISBN 978-0-470-41435-4.

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Prague on 29. 03. 2023

**Declaration**

I declare that I have worked on my diploma thesis titled "Data Visualization of impact of Demonetization on Indian Stock Exchange using Tableau Software" by myself, and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that it does not break the copyrights of any person.

In Prague on 30/03/2023                 _____

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I would like to thank professor Ing. Tomas Hlavsa Ph.D for his help in preparing the thesis and invaluable recommendations. I want to thank all professors at the Czech University of Life Sciences for gaining knowledge in economics and management.

# Data Visualization of impact of Demonetization on Indian Stock Exchange using Tableau Software

**Abstract**

Data visualisation is the process of representing information and data graphically. Data styles, outliers and trends can be easily observed and analysed with data visualisation tools which include visual aids like charts, graphs, and maps. Data visualization is a useful tool for transforming unprocessed data into compelling visual representations of any business or project and it facilitates the decision-making process for upcoming business actions. The purpose of this thesis is to identify various visualization methods, comprehend various tools, compare Tableau, and Excel tools. It also aims to explain data using visualisation tools that can present the information in a better way efficiently as well as effectively, instead of explaining the return values of the chosen Bombay Stock Exchange sectoral indices to an individual or managers of a company. The data used for the purpose of analysis includes daily historical stock prices of selected BSE sectoral indices. The data is collected from the year 2016 to 2021. The returns are calculated for each chosen indices in Excel using the historical stock prices. Further, the results of calculated returns have been presented through different visualisation methods in Tableau. The results suggests that demonetization has impacted the Indian stock exchange, the returns for few indices were in negative and other indices were able to give minimal returns. It can be also seen that; stock exchange is slowly getting out of the sudden impact due to the trust by their investors.

**Keywords:** Data Visualization, Tableau Software, Demonetization, Indian Stock Exchange, Bombay Stock Exchange

**Abstrakt**

Vizualizace dat je proces grafického znázornění informací a dat. Datové styly, odlehlé hodnoty a trendy lze snadno pozorovat a analyzovat pomocí nástrojů pro vizualizaci dat, které zahrnují vizuální pomůcky, jako jsou tabulky, grafy a mapy. Vizualizace dat je užitečný nástroj pro transformaci nezpracovaných dat do působivých vizuálních reprezentací jakéhokoli podnikání nebo projektu a usnadňuje rozhodovací proces pro nadcházející obchodní akce. Cílem této práce je identifikovat různé způsoby vizualizace, pochopit různé nástroje, porovnat nástroje Tableau a Excel. Jeho cílem je také vysvětlit data pomocí vizualizačních nástrojů, které mohou prezentovat informace lepším způsobem efektivněji a efektivněji, namísto vysvětlování návratových hodnot vybraných sektorových indexů Bombay Stock Exchange jednotlivci nebo manažerům společnosti. Data použitá pro účely analýzy zahrnují denní historické ceny akcií vybraných sektorových indexů BSE. Data jsou shromažďována od roku 2016 do roku 2021. Výnosy jsou počítány pro každý vybraný index v Excelu pomocí historických cen akcií. Dále byly výsledky vypočtených výnosů prezentovány prostřednictvím různých metod vizualizace v Tableau. Výsledky naznačují, že demonetizace ovlivnila indickou burzu, že výnosy několika indexů byly záporné a ostatní indexy byly schopny poskytnout minimální výnosy. Je také vidět, že; burza se pomalu dostává z náhlého dopadu díky důvěře svých investorů.

**Klíčová slova:** Vizualizace dat, Software Tableau, Demonetizace, Indická burza, Bombajská burza

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# 1 Introduction

As the "Big Data Age" kicks into overdrive Data collecting has been easier and less expensive in the big data era, and visualisation and related technologies are now more crucial than ever for making sense of the daily billions of lines of data collected. By presenting data in an understandable manner, emphasising patterns, and highlighting other significant aspects, data visualisation aids in the telling of stories. A good visualisation highlights valuable information, cleans out data noise, and tells a story. A graphic depiction of information and data is known as data visualisation. (Sadiku et. al. 2016)

Data visualisation tools offer an accessible approach to examine and analyse styles, outliers, and patterns in data by using visual aids like charts, graphs, and maps. Data viewing tools and technologies are crucial in the realm of big data for analysing massive amounts of information and making data-driven decisions. A great graph can utterly fail to communicate the proper information or can say too much, making it incredibly laborious to record any notice or make a powerful point. Data and graphics demand interaction, and the trick is to weave a compelling narrative into sound analysis. (Waskom 2021)

Simple graphs or charts may come to mind when one first thinks of data visualisation. While this can be a key component of data visualisation and a common foundation for many data drawings, effective visualisation requires the correct set of data. Simple graphs are only the very beginning. There is a wide range of useful and appealing ways to visualise and convey data. Dashboards, charts, tables, graphs, maps, and info graphics are examples of common data visualisations. There are numerous tools for data visualisation. Microsoft Excel is a spreadsheet programme, not a data visualisation tool, in the purest sense. Nevertheless, it provides practical skills for data visualisation. Aparicio & Costa 2015)

Given the widespread use of Microsoft products in businesses, one frequently has access to them. To help professionals display data linked to business intelligence, Zoho Analytics is a data visualisation application. As a result, it is frequently used to visualise data linked to sales, marketing, profit, revenues, costs, and pipelines using comprehensible dashboards. For good reason, Tableau is frequently referred to be the Master of Data visualisation tools. Due to its ease of use and capacity to create interactive representations beyond those offered by typical BI solutions, Tableau has an overly broad customer base of 57,000+ accounts across several sectors. (Midway 2020)

The second significant participant in this market and Tableau's biggest rival is Qlik, which offers the QlikView product. Over 40,000 client account nets for the vendor exist in more than one hundred countries, and those who frequently use it highlight its highly flexible configuration and extensive feature set as a crucial advantage. Tableau is currently the most used tool for data analysis and visualisation. By producing interactive images, Tableau is a piece of software that may assist users in exploring and understanding their data.

Tableau is a platform for reducing complex data and supporting sophisticated visualisation techniques. The goal of this study is to better understand the difficulties associated with data visualisation. By examining data on the effects of demonetization, which took place in India in 2016, on sectorial indexes at Bombay Stock Exchange Ltd., the difficulties are made clear. For this study, the return in the five years following demonetization was used to assess the calculation of a few selected indices. MS Excel was used for the calculations, while Tableau was used for the display.

# 2  Objectives and Methodology

## 2.1  Objectives

The primary objective of the thesis is to understand the impact of demonetization on Indian stock exchange through data visualization using Tableau software. The thesis also aims to analyse the five sectorial indices to calculate the yearly returns using Microsoft Excel software and after that compare those data in the Tableau software. The secondary objectives can be classified as below:

✓ To learn about various visualization techniques.

✓ To comprehend the many data visualization technologies available.

✓ To evaluate the suggested visualization tool and make suggestions.

✓ To make a comparison between Tableau and Microsoft Excel.

## 2.2  Methodology

This thesis is composed mostly of two sections: theoretical and practical. The theoretical section is based on a literature study that explains several data visualization techniques. It also gives a study of the present market for visualization tools and knowledge about the most popular applications. The practical portion focuses on applying the learnt material in the most effective manner. Tableau is the tool used for analytical purposes. The analysis gives information on the benefits and challenges of utilizing the apps. In addition, it outlines the procedures for generating the dashboard design and interactive representations of the particular data using Tableau software. The data used for the analysis includes daily historical stock prices of chosen BSE indices for the period of past five years i.e. from the year of 2016 to 2021. A simple moving average is a type of technical indicator that can help you figure out if an asset's price will continue a bull or bear trend or if it will change direction. It does this by taking the average of a range of prices over a certain number of periods. The daily stock prices are calculated using 3 days simple moving average method.

## 2.3 Data Description

Prime Minister Narendra Modi said on national television few years ago that all Rs 500 and Rs 1,000 banknotes will become worthless at midnight. Eighty-six percent of the cash in circulation became worthless by midnight because of the statement made at 8 p.m. to flush out black money, or money concealed from the taxman. As expected, chaos ensued. The act, known as demonetization, created a great deal of difficulty for a large number of individuals, who were compelled to form serpentine lines in front of banks to exchange currency. a number of cash-dependent small enterprises suffered severe losses. Demonetization has three primary economic goals: combating black money and counterfeit currency and creating a cashless economy by promoting digital transactions.

In 2016, the year when demonetization was implemented, 632 million counterfeit banknotes were recovered across the nation. According to RBI (Reserve Bank of India) figures, a total of 18,87,000 counterfeit notes of varying denominations would be confiscated throughout the country during the next four years (including the year 2020). Nifty 50 Index and industry indices like 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 revealed a strong negative impact of demonetization on stock market performance.

The Bombay Stock Exchange Ltd. (BSE), founded in 1875, is the world's quickest stock exchange with a median trading speed of six microseconds. It provides an efficient, integrated, transparent, and secure market for equities, currency, debt instruments, derivatives, and mutual fund trading. It offers many services, including clearing, settlement, and risk management, education, and market data services. It has an international consumer base and a nationwide presence. It offers depository services through its subsidiary Central Depository Services Ltd. The S&P BSE SENSEX is the most widely followed benchmark index for India's stock market. It is traded worldwide on the EUREX as well as the main BRICS exchanges (Brazil, Russia, China, South Africa, and India).

A stock market index is a statistical metric that depicts stock market fluctuations. To build an index, a few equities of the same type that are already listed on the market are selected and put together. The selection of stocks might be based on industry type, market capitalization, or business size. Utilizing the values of the underlying equities, the value of the stock market index is determined. Any change in the underlying stock values affects the value of the index.

## 2.4 Analysis Description

The analysis's data set comprises daily historical stock prices for a few BSE indices during the monitored five-year period, from 2016 to 2021 in this case. It consists of:

**Date**: Dates are displayed beneath this column. For instance: from 1/1/2016 until 3/31/2021.

**Closing price**: Rupees are used to indicate the closing prices for BSE oil and gas equities. For instance: Rs. 9047.79 as of April 1st, 2016.

**Simple Moving Average using monthly price**: To determine the average return value for the year 2016, the three-month simple moving average is computed using monthly stock prices. Using the annual prices of the indices that were obtained using the simple moving average approach, the return provided by selected BSE indices over the previous five years was estimated after the simple moving average.

$$SMA = nA1 + A2 + ... + An / n$$

**where:** $An$=the price of an asset at period, $n$=the number of total periods

**Sector**: The various sectors' names, for as "BSE Auto Index."

**Year**: The years are included under the word "year," for example, 2015–16.

**Closing price**: The sum of the stock price calculated over the past five years using the simple moving average approach is given in rupees, for example, 18001.75 rupees in the year 2015–16. In an analogous manner, the closing prices for the other years are given in rupees under the heading of closing price.

**Return (Ri):** It is indicated what percentage return the BSE Auto Index provided during the previous five years, which was 18.03 percent. The return for the remaining years is computed in an analogous manner. Following the annual return computation, the mean is determined using the five-year return figures to determine the average return provided by BSE Auto in the five years prior, from 2016 to 2021, following the introduction of demonetization.

**Mean**: The average of the return values

$$\bar{x} = (x_1 + x_2 + x_3 + \ldots + x_n ) / n$$

**where: $x_n$**=sum of observations, n=total number of observations

**Standard Deviation**: The variation in the return values

$$\sigma = \sqrt{(\sum(x - \bar{x})^2 / n)}$$

**where:** σ=population standard deviation, n=total number of observations

# 3  Literature Review

## 3.1  Business Analytics

Business analytics is the process through which organisations analyse historical data using a variety of technologies and competencies to discover added information and enhance strategic decision-making. Business analytics uses techniques like data mining, statistical analysis, and forecasting statistics to turn data into meaningful information, spot trends and outcomes early on, and eventually make data-driven business decisions. (Power 2018)

**In the typical business analytics dashboard, important components include:**

**Data Aggregation**: It is the process of gathering, organising, and sorting data in preparation for analysis.

**Data Mining**: It is the process of analysing copious amounts of data for business statistics utilising statistics, machine learning, and big data sets to find patterns and establish connections.

**Association & Sequence Identification**: Identification of unexpected actions performed in connection with other actions or sequences is known as association and sequence identification.

**Text Mining**: Large-scale, unstructured data sets are scanned and organised using text mining for quality and quantity analysis.

**Forecasting**: Forecasting is the process of periodically analysing previous data to provide accurate predictions of future actions or events.

**Optimization**: After patterns have been discovered and forecasts have been made, companies can use simulation techniques to determine the ideal circumstances.

**Data Visualization**: The visual presentation of data in the form of graphs and charts allows for quick and simple data interpretation.

Modern, innovative platforms and software for data analytics have been created to capture and manage the massive amounts of data that businesses face and to be used for effective business operations. Systems for business users to analyse fixed, structured data include business analytics and data mining software. The accessibility of visual and analytical data tools for numerous users is one of these systems' benefits. (Delen 2018)

Business Analytics is the process by which businesses use different technologies and skills to analyse historical data 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 make wise business decisions driven by data. (Vidgen et. al. 2017)

## 3.2   Data Analytics

Data analysis is the science of analysing raw data to draw inferences from that information. Numerous methods and strategies for data analysis are built automatically into computer programmes and algorithms that use unprocessed data for human usage. Data analysis aids in a company's performance improvement. The phrase "data analytics" is wide and includes a variety of data analysis techniques. With the help of data analysis tools, any kind of information can be examined to gain knowledge that can be applied to make things better. Techniques for data analysis can make styles and metrics visible that would otherwise be obscured by the volume of data. The efficacy of a company or programme can be increased by adding processes using the information. (Hariri et. al. 2019)

For instance, to boost productivity, manufacturing companies frequently track the uptime, downtime, and lines of operation of numerous machineries. Data statistics are crucial because they enable firms to operate better. By applying it to a company model, organisations can increase income while reducing costs by identifying more effective business practises. Additionally, the business can use data analytics to improve business decisions and assist in analysing client behaviour and satisfaction, which may result in the development of fresh and improved goods and services. (Duan & Da 2021)

Data analysis is a process that involves several different processes. Identifying the type of data that is required and the best method for gathering it is the first step. The process of gathering data is the second phase in data analytics. This can be done using a range of tools, including computers, the internet, cameras, other sensors, environmental sources, and staff. After it has been gathered, the data must be altered (pre-processed) before analysis. A spreadsheet or other piece of software that can record statistical data may be edited. Before analysis, the data is then cleansed to remove any duplicates. (Gupta & George 2016)

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. (Rajaraman 2016)

**Types of Data Analytics**

Four fundamental categories can be used to group data statistics.

**Descriptive Analytics**: It explain what transpired over time. Has the quantity of ideas risen? Are sales this month better than last?

**Diagnostic Analytics**: It concentrate on the causes of events. This entails a variety of data entry and some guesswork. Has the weather had an impact on beer sales? Has the most recent marketing initiative increased sales?

**Predictive Analytics**: Soon, predictive analytics are going to happen. Using previous data, predictive analytics forecasts result for the future.

**Data Analytics**: It is an arduous process that involves many different data formats, format adjustments, tools, and mathematical models.

Information presented graphically makes patterns and trends easier to understand and aids firms in determining the proper priorities and concentrating on them (Beer 2018).

## 3.3 Visual Representation

To portray the key points of the data, graphs and charts covering enormous amounts of information efficiently and simply can be edited into simple formats. Consider the objective of the graph or chart and the information you want to provide before deciding how to present the data in the best viable way. (Cole et. al. 2022)

Figure 1: Visual Perception's Degree of Precision
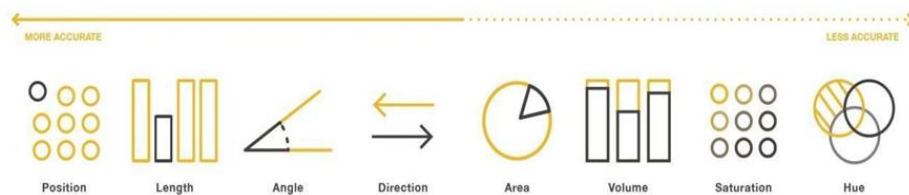


Source: Isenman, L. (2018)

The accuracy of visual perception is shown in Figure 1 above. The line shows which types of charts are more accurate on the left and which types of charts are less accurate on the right side of a picture. For instance, visual acuity improves vision and is quantified by one's capacity to distinguish between characters or numbers at a certain distance using a standard eye chart. Categorical information such as year, salary range, product, and country are represented by a dimension. (Yuan et. al. 2021)

**The chart is made less congested by following a few effortless steps:**

- ✓ Clarity is improved with value labels (% printed above bars).
- ✓ Internal smoking control seminars are less comprehensible than "Workplace smoking prohibitions" because the title employs straightforward language.
- ✓ Readers can better understand the distinctions between each data bar thanks to the depth and scale that grid lines add.
- ✓ The y-axis data label may appear unnecessary, but it ensures that readers understand what the figures represent.

1. **Line Chart**

A series of data points connected by a straight line are shown in line charts. Each of these data points explains how the graph's horizontal and vertical axes relate to one another. The X-axis displays the important measurements or temporal dimensions, such as month, quarter, or year, while the Y-axis displays the numerical value. Typically, temporal patterns and correlation, as well as data over a specific time, are represented using line and area charts. (Sohn et. al. 2021)

**A line chart's typical characteristics include:**
   ✓ Its assistance in analysing data trends over time.
   ✓ Simple to plot and read.
   ✓ It can be applied to both short-term and long-term data visualisation.

Figure 2: Illustration of Line Chart



Source: Hasunuma, T. (2015)

## 2. Area Chart

By colouring the region between the line segment and the x-axis, area charts are used to collectively measure data patterns across time. A line chart is simply a continuation of an area chart. (Bruns 2016)

**Features of Area Chart:**
- ✓ Its visual attractiveness is appealing.
- ✓ It offers a precise comparison of various data sets.
- ✓ Comparing it to other data types may make it more challenging to read.

Figure 3: Example of Area Diagram
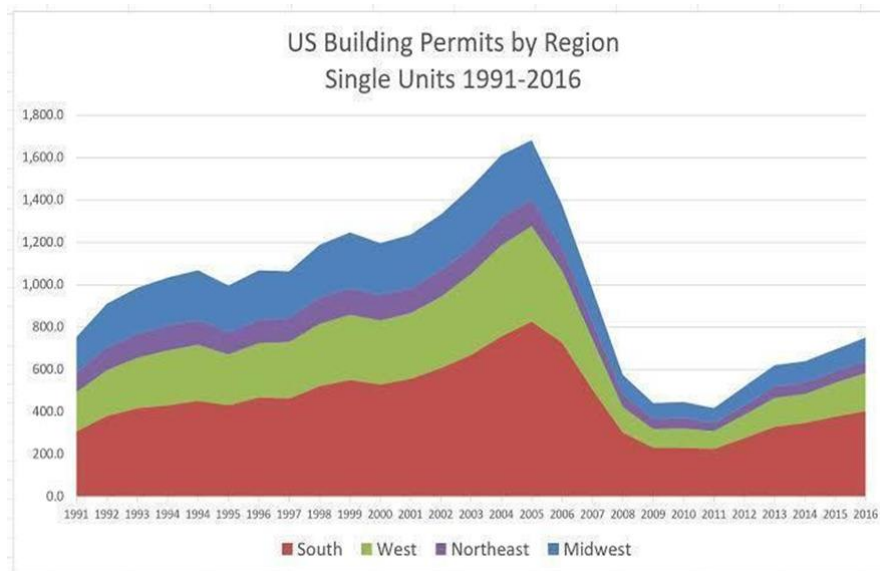


Source: Xie, F. et al. (2015)

### 3. Column Line Chart

A combination of a line chart and a column chart is a column line chart. One measure is shown as a column and another as a line in this sort of chart. These two metrics are displayed under several time units, including months, quarters, and years. This graph works better to show the relationship between two measurements over time. Gross margin, net income, and sales revenue are a few examples. (Sohn 2021)

The number of units sold, and the total number of transactions are shown in a chart in Figure 4. The column line charts are frequently used to display groupings of the same sort of data that have extremely broad ranges between them as well as to describe trends, data through time, temporal pattern, and correlation. (Moritz & Fisher 2018)

Implementation suggestions:
- ✓ Use a column line chart to compare two trends over time that are of different sorts. For instance, sales and repeat customers.
- ✓ This kind of chart can also be used to show changes over a specific amount of time.

Figure 4: Illustration of Column Line Graph
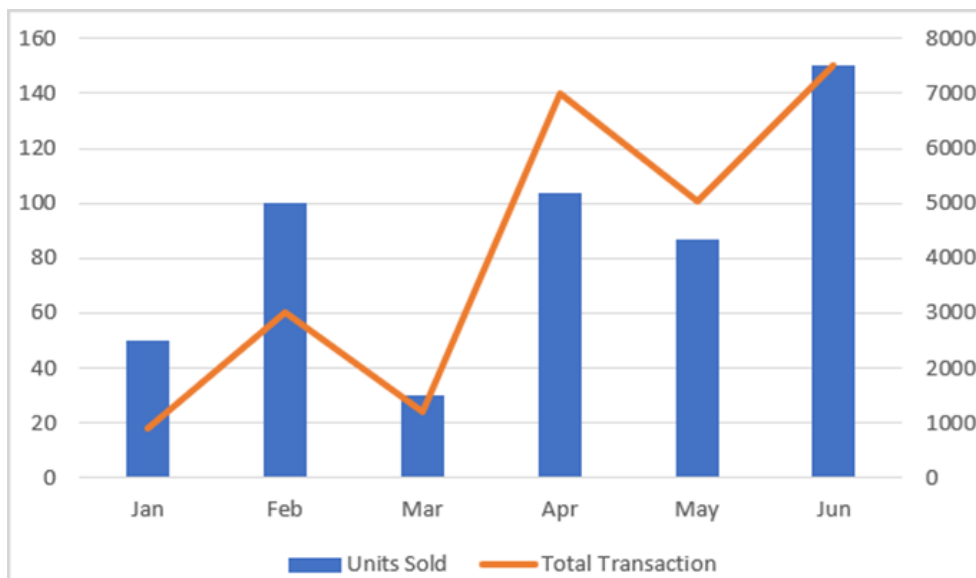


Source: Harvey & Wood (2018)

## 4. Bar Chart

Bar charts are used for comparing two things and are simple to make. The findings could not be compared since the footnotes in Figure 5 are defined the same way in both research, making the findings equivalent in the youth population. The bar chart in Figure 5 is only one example. (Taher 2016)

A bar chart is typically used to compare several categorical data values, which includes grouping the data by fusing numbers together in a chart. The less important categorical data should be placed into another group if there are multiple categories available. Among all chart kinds, the bar chart is the one that is used the most. The following are common applications for bar charts: (Wei et. al. 2018)

✓ Arranging the data in reverse, from largest to smallest.

✓ Removing information that is not necessary for the message.

✓ For dividing up data.

Figure 5: Example of Bar Graph
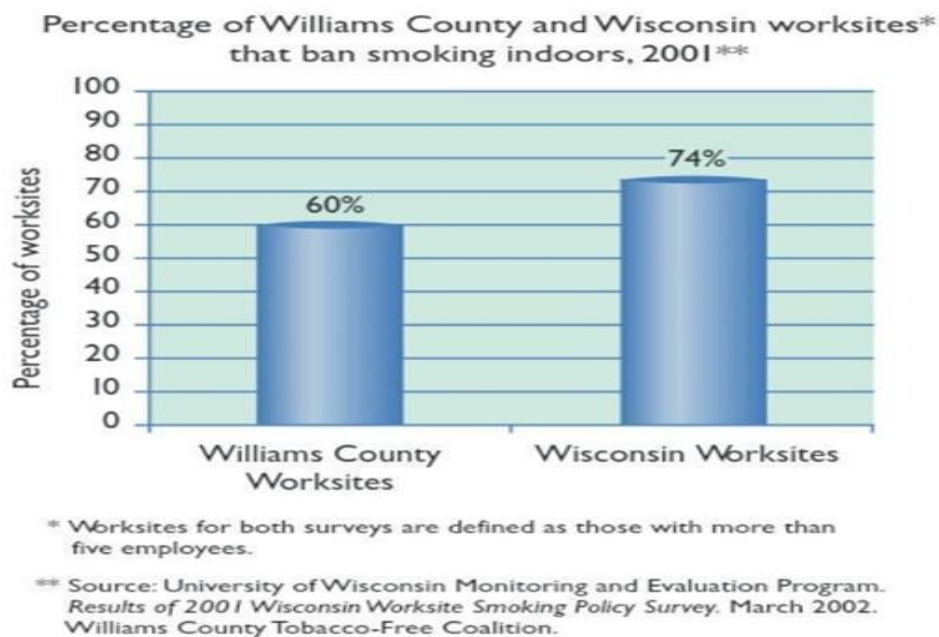


Source: Elzer et. al. (2011)

**5. Stacked Area Chart**

The base area chart is expanded upon in the stacked area chart. Because the values of each group are placed on top of one another, it is possible to see both the sum of a numerical variable and the importance of each group from the same image. For example, the lines can be made to show how the population of different states has changed through time. A graph representing population trends and showing data for each state in order from least to most populous can be created by colouring the region beneath each line to symbolise the state it represents. The development of baby names in the US between 1880 and 2015 is depicted in Figure 6. (Bostack 2020)

Figure 6: Example of Stacked Chart
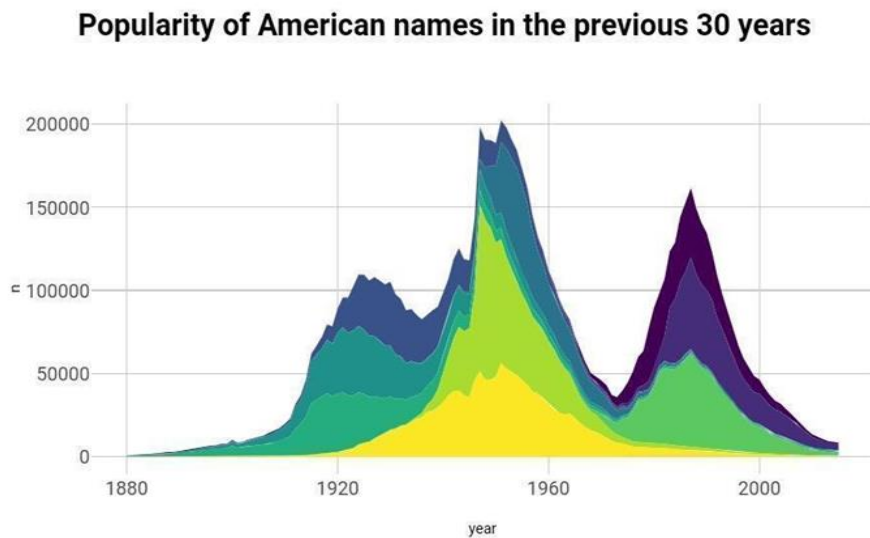


Source: Indratmo et al. (2018)

## 6. Horizontal Chart

The most effective graphical tool for showing comparisons between data categories is frequently a horizontal bar chart. With the use of a horizontal bar chart, the presenter can easily exhibit huge data labels because the horizontal rectangles offer space for text display. The sample displays the income figures for several companies' apparel, accessories, and equipment. (Pan 2017)

Figure 7: Example of Horizontal Bar Chart
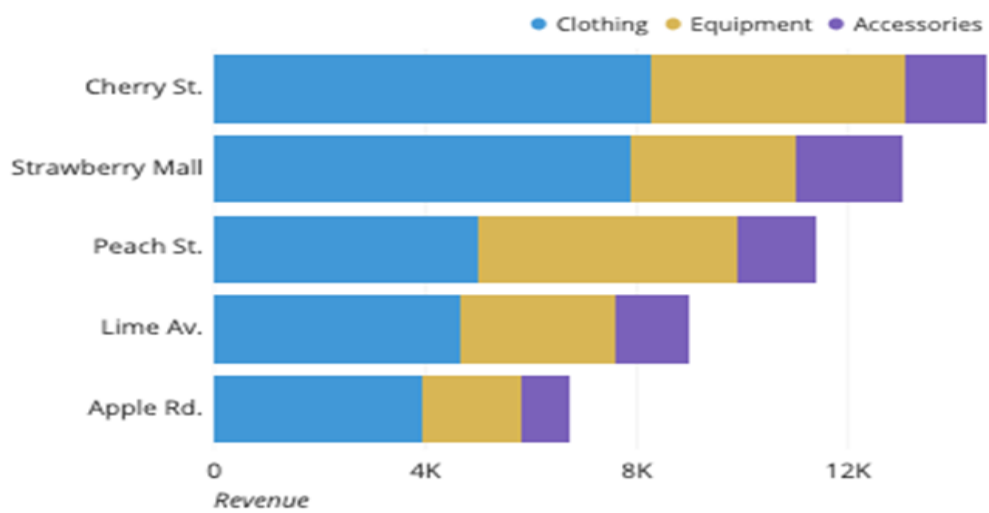


Source: Hibbert (2009)

**7. Waterfall Chart**

A waterfall chart is a visual representation of data that makes it easier to comprehend the impact of adding up positive or negative values. These intermediary values may be based on phase or on time. Due to a formation of columns (bricks) during the air, the waterfall chart is also known as the flying brick chart or Mario chart. It is typically referred to as a bridge in finance. The value fluctuation in terms of positive and negative values can be visualised using this style of chart. (Fairbanks & Buchko 2018)

The waterfall charts can be enhanced with additional information by adding numerous complete columns and axis crossing values. The accumulated value may fall above and below the axis in various places because of additions and decreases in large enough amounts. The graph can be expanded with middle footnotes that are displayed as full columns in between floating columns. Each month's net cash flow is shown in Figure 8 together with it. Typically, waterfall diagrams are used to show how a series of intermediate values rise and decrease a starting value to get an outcome. (Mendes 2020)

Figure 8: Example of Waterfall Chart
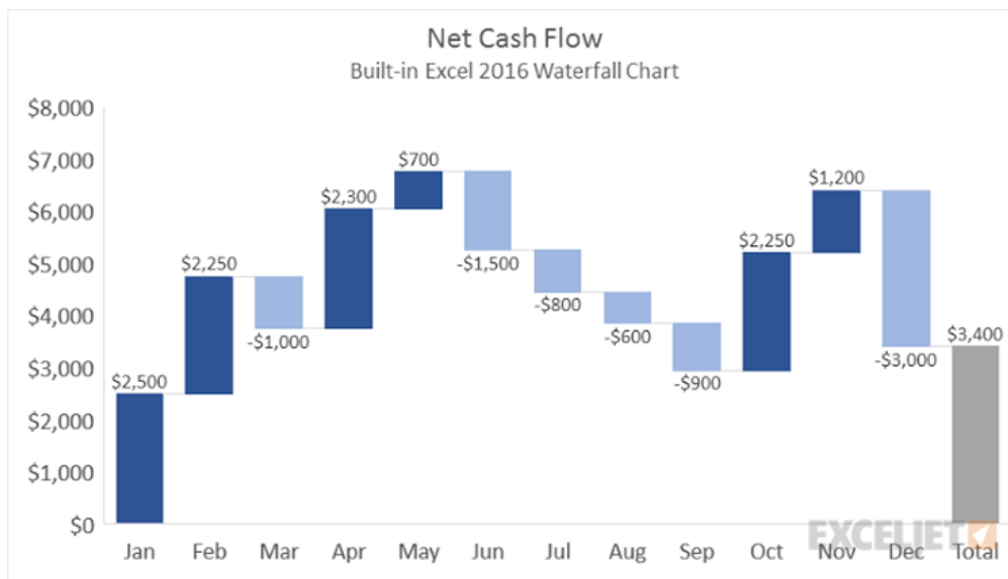


Source: Raikar & Adamson (2020)

## 8. Trellis Layout of Multiple Charts

A Trellis chart, also known as numerous tiny charts, is a collection of comparable graphs or charts that share the same scale and axes to make comparisons between them simple. This graph compares metrics for several data groups by displaying the same chart grid of numbers in many sizes. (Gusarov & Noskov 2015)

**These charts are employed for:**
- ✓ Identifying trends among various category variables.
- ✓ For contrasting metrics inside a category. To show the sales figures for each category, for instance, on a distinct or separate chart.

Figure 9: Multiple Charts Trellis Layout
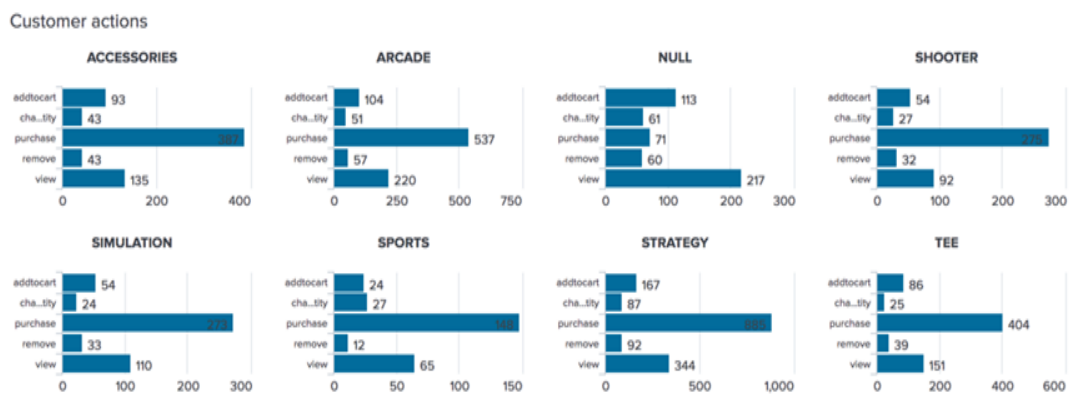


Source: Szafaryn *et al.* (2013)

**9. Part-to-whole Chart**

For a Part-to-Whole relationship, this sort of chart is used to show how to quantify the values that make up the entirety of anything. For instance, how many containers were sold in comparison to one another and how each container compared to the total. (Kosara 2019)

Figure 10: Sample of Part-to-Whole Chart
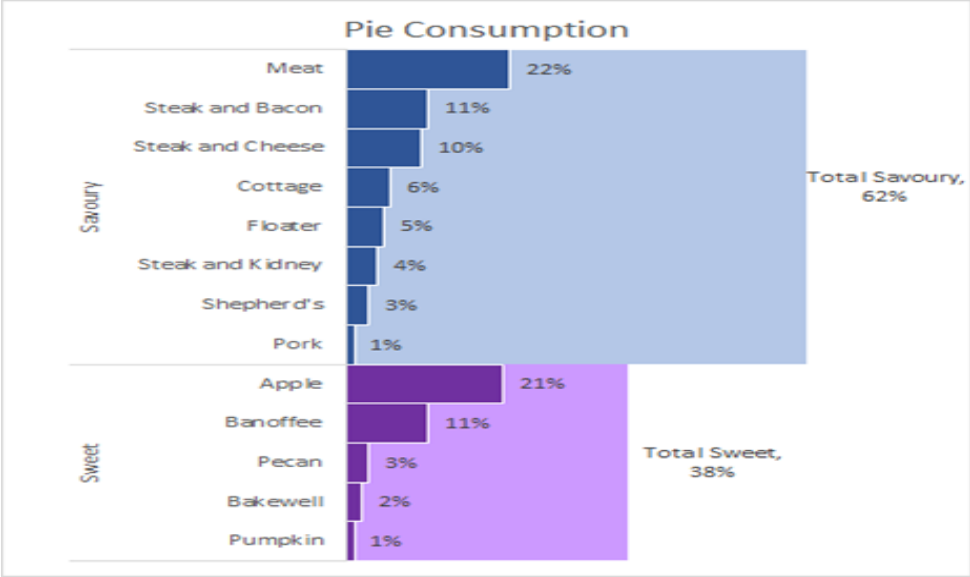


Source: Grady (2016)

**10. The Pie or Ring chart**

    The Pie chart is frequently the first sort of chart that comes to mind when attempting to determine the value's percentage structure. These diagrams represent the entire structure as a circle (100%) and its individual components as "pieces" based on their size. Pie, Ring, and Funnel Charts (shown next) are used for comparisons to either emphasise a certain subset of the data or look at values for categorical categories. It is advised not to include a lot of segments in this kind of charts because the observer might have trouble telling apart objects from a variety of assorted colours. Figure 11 shows a channel-by-channel example of sales. In comparison to ring and funnel charts, the pie chart can forecast a variety of population groupings easily, swiftly, and efficiently. It can also provide answers to market-research-related problems. (Bertini et. al. 2016)

Figure 11: Example of Pie Chart
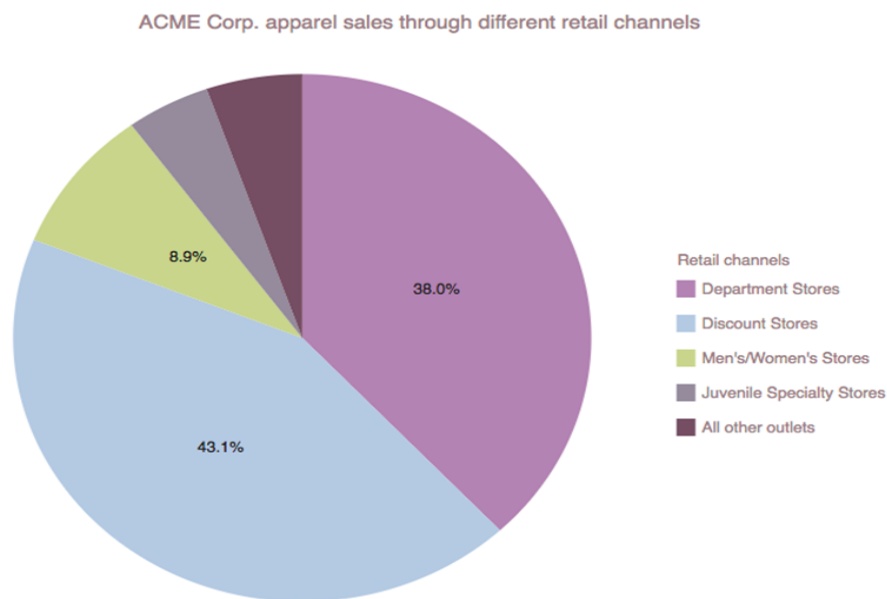


Source: Golumbic (2004)

## 11. Funnel Chart

The funnel chart style may be preferred when examining process phases that begin at 100% and end with a lower percentage to identify the steps and highlight the issues (the drop in which the stages occur and how much). The conversion of website visitors into paying consumers is depicted in Figure 12. (Hai-Jew 2019)

Figure 12: Example of Funnel Chart



Website Visits - 528756
Downloads - 164052
Valid Contacts - 112167
Interested to Buy - 79128
Purchased - 79128
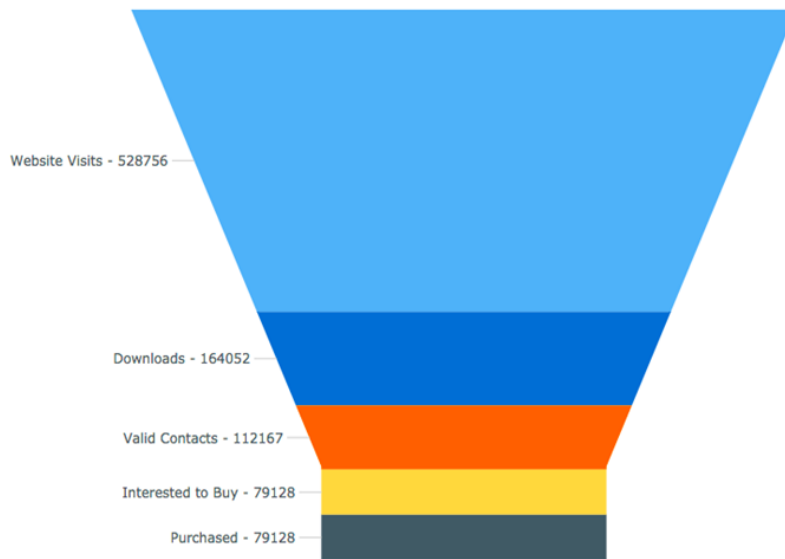
Source: Hoffman (2015)

**12. Box Plot Chart**

The design of a box or boxplot in descriptive statistics is a means to categorically display groups of numerical data by their quartiles. The terms "box-and-whisker box" and "box-beard drawing" refer to the ability of box sites to have lines from boxes (beards) that distinguish between groups other than the upper and lower quartiles. Individual points can be used to generate outliers. Figure 13 is an example of a box plot graphic. In addition, each sample is given an x-tick (x-axis) label using the label parameters.

**Most frequently, the box plot chart is used for:**

✓ Comparison: Box plot comparisons show the data distribution for a variety of categorical values.

✓ Value Distribution: The box plot chart shows how the values in the data are distributed.

✓ Identify outliers: Box plots add a reference line to the data's general median for the purpose of identifying outliers. (Etienne et. al. 2016)

Figure 13: Example of Box Plot of the Michelson–Morley experiment's data
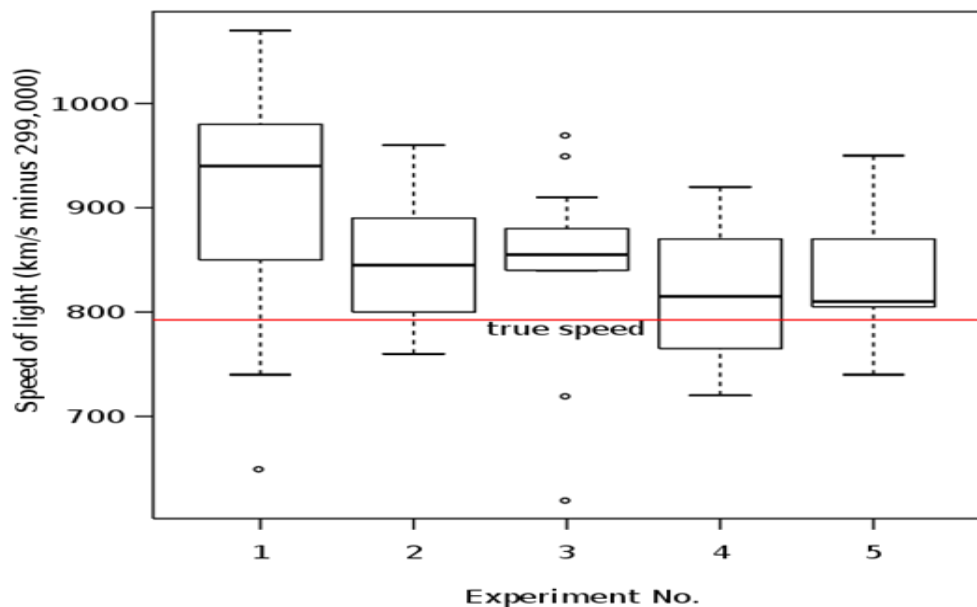


Source: Wilcox (2017)

## 13. Scatter Chart

Dots are used in the scatter plot (also known as a scatter chart or scatter graph) to show the numbers of various numerical variables. The values of each data point are shown by the location of each dot. Scatter plots are used to see how different variables relate to one another. A scatter plot illustration Figure 14 displays the sample of downed trees' width and length. Each dot symbolises a single tree, and its horizontal position corresponds to its width (in inches), while its vertical position corresponds to its height (in meters). We may deduce from the structure that there is, in general, a strong positive correlation between the width of the tree and its height. The outside point, which is a tree that is bigger than the others, is also visible. The fact that the tree seems undersized for its height may warrant additional research. To compare several scatter plots in a single chart, a scatter plot chart shows scatter plots in a Trellis pattern. For various data categories, assorted colours and/or symbols might be used for the dots. It is best to avoid include too many categories in a single chart because it could make it harder to distinguish between them. Drilling up to greater degrees of geographic detail is possible because to the establishment of a Geo hierarchy on top of location data, such as states, cities, etc. (Zhang et. al. 2018)

Figure 14: Example of Scatter Plot Chart



Source: Carr (2003)

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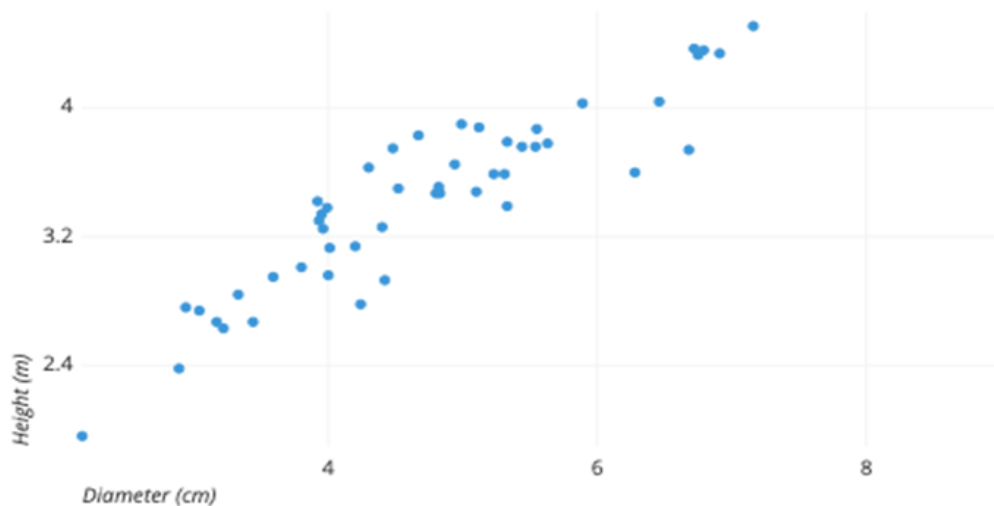
**14. Choropleth Map Chart**

A choropleth map is a map chart that is used to display geographically distinct areas, such as nations, regions, or other geographic divisions, which are collared, patterned, or added in relation to the displayed data. This makes it possible to see data values in a specific area and understand how they vary across the region depicted on the map. To effectively display the data while creating a huge data map in Choropleth Maps, a specific degree of colour continuity must be employed. To display measured values in designated zones, choropleth maps make use of various shading, colouring, and symbol placement. For supporting location-based comparisons of standardised data, such as rates, densities, and percentages, choropleth maps are used. Since the size of the region coloured may overemphasise larger areas, this sort of map is typically used for sites that are similar in size. For instance, while having a smaller population, Canada's overall area is greater than Japan's. The viewer may be provided with information utilising assorted colours and forms in a choropleth map that is visually appealing. (Mayhua et. al. 2018)

Figure 15: Example of Choropleth Map
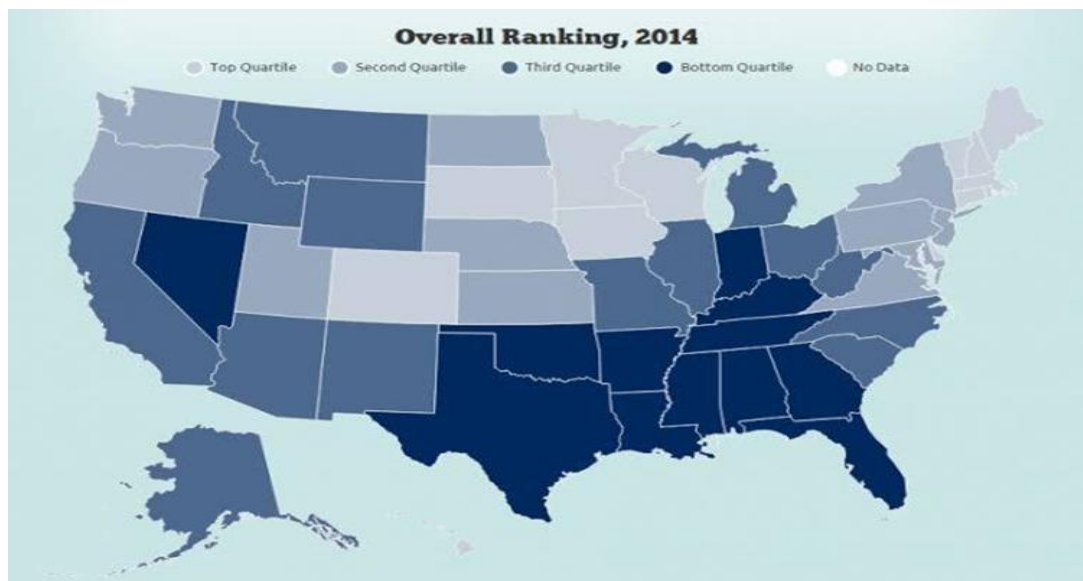


Source: Cahoon & Cutting (2009)

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**15. Geo Bubble Chart**

Geo charts display location-specific map data. Geo, Geo Bubble, and Geo Heatmap charts are what they are. This kind of graph displays measured values as bubbles on a map. The size of the map's bubble will increase as the measured values increase. The average value for a relative bubble size is displayed on geo bubble charts, such as bubble charts. Geo bubble charts are an effective use for zip code data. The bubble chart in Figure 16 shows an increase in sales, and the larger the bubble, the greater the number of sales, and the smaller the bubble, the less sales. (Onorati et. al. 2018)

Figure 16: Example of Geo Bubble Chart



Source: Latif & Beck (2019)

**16. Treemap Chart**

The Treemap chart is an excellent choice when dealing with sequence data because of its intricate design and tree-based organisation. This sort of chart makes it simpler to comprehend the structure and compare the shares because the entire ("tree") is viewed as a rectangular diagram with smaller rectangles showing branches. Treemap charts are best for huge data sets, whereas Pie charts function with fewer data points. Figure 18 is an illustration of export by destination country. (Scheibel et. al. 2020)

Figure 17: Example of Treemap Chart
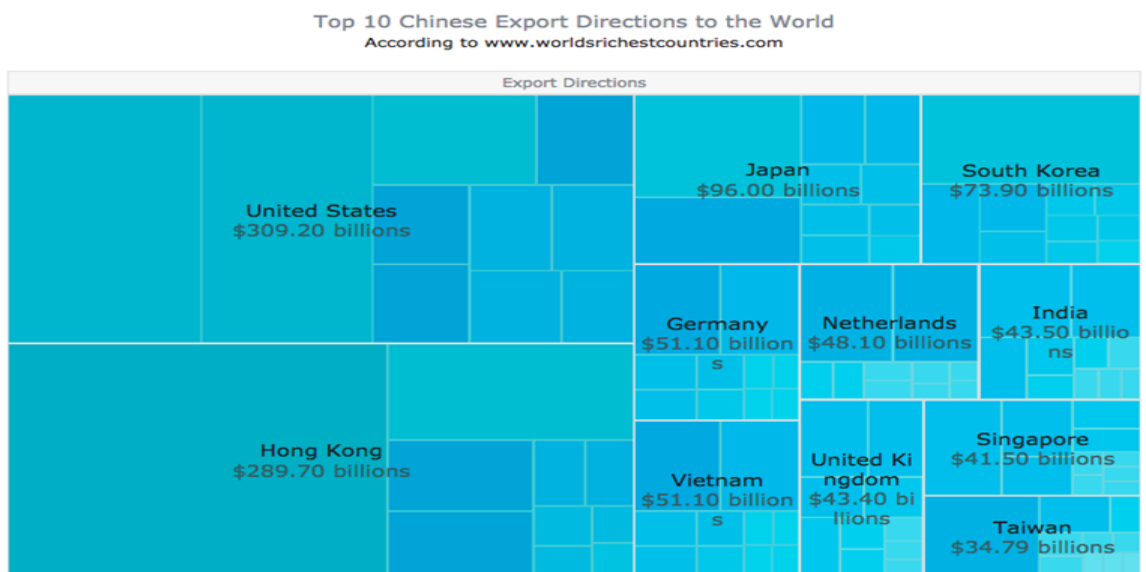


Source: Long *et al.* (2017)

## 3.4  Stock Market

The stock market is an essential part of the global economy because it offers firms with access to cash and investors with possibilities to earn profits on their investments. Many studies and research have been conducted on the stock market throughout the years, with a special emphasis on its performance, trends, and influence on the broader economy. The necessity of knowing the different elements that affect the performance of the stock market is a recurring subject in the literature on the stock market. (Shah et. al. 2019)

There have been studies examining the effect of macroeconomic factors, such as interest rates, inflation, and currency rates, on the performance of the stock market. Several studies have investigated the impact of investor emotion and behavioural characteristics, such as risk aversion and overconfidence, on stock market patterns. The creation of investing methods that can assist investors in achieving their financial goals is an additional important area of stock market research. Fundamental analysis, technical analysis, and passive index investing are examples of well-liked investment techniques. These methods have been proved to be effective in generating returns, but they also have limits and need careful consideration of market circumstances and risk tolerance. (Adam et. al. 2016)

The growth of digital technology has had a tremendous influence on the stock market in recent years. For investors and traders, the rise of internet trading platforms and the application of artificial intelligence and machine learning algorithms for stock market research have created new options. Yet, they have also expressed worry on the possible hazards and difficulties linked with the growing use of technology in the stock market. Many studies and research have been conducted on the Indian stock market, with an emphasis on its performance, volatility, and efficiency. (Ferreira et. al. 2021)

The Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) are the two major stock markets in India, and research has been undertaken on each of them. The behaviour of investors and traders on the Indian stock exchange has also been the topic of study. The influence of behavioural biases such as herding and overconfidence on stock market patterns and volatility has been studied. Several studies have examined the role of institutional investors, including mutual funds and foreign institutional investors, in the Indian stock market. (Yadav 2017)

## 3.5 Data Visualization

This section provides a summary of visualisation tools, describing the many types of tools on the market as well as their features. To analyse vast volumes of data and make data-driven decisions in the world of big data, you need effective tools with lots of features.

### 3.5.1 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 figure 18 depicts the numerous products that Tableau produces. (Battle & Heer 2019)

Figure 18: Example of Tableau Product



Source: Hoelscher & Mortimer (2018)

**Tableau Desktop**

Tableau Desktop is a data recognition programme that can quickly create stunning dashboards, highly interactive graphs, and reports from any structured data. After installation, any data source, such as spreadsheets or data repositories, can be linked to display details in a few clicks. One can work much more quickly than before thanks to the ease of use.

**Tableau Server**

It is a business espionage tool that offers open-source browser-based analytics. In the sluggish world of conventional BI software, it is the quickest method to start a fire. It is a web tool built for the interaction, sharing, and dissemination of Tableau-generated material. What sets Tableau apart? Everyone is advised. No script is necessary; therefore, anyone can become a mathematician when they grow up. Postage can be raised if necessary. Online training is free. Receive responses in seconds, not years.

**Tableau Online**

Sharing, distributing, and working together on Tableau views and dashboards is made possible by Tableau Online, a safe cloud-based service. Without servers, server software, or IT support, Tableau Online gives us the flexibility and simplicity of a potent cloud-based data recognition solution. Tableau Online may be used anywhere and can measure as much as is necessary. No infrastructure needs to be purchased, installed, or managed.

**Tableau Public**

Anyone can connect to a spreadsheet or file and create interactive online visibility using Tableau Public, which is free software. It is offered as a service to enable users to get up and work all night long. Without the use of a computer programme or IT, users of Tableau Public may rapidly publish beautiful interactive views.

**Tableau Aspects**

- ✓ Utilizing it is simple.
- ✓ No programming experience is necessary; all that is required to create aesthetically appealing reports and convey a tale that the user may share with their superiors or wow their professor in class is a little data and tables.
- ✓ It offers a drag and drop capability that allows users to create tales or reports with just a few simple movements and ideas.
- ✓ This might be because of VizQL, a visual query language that converts drag-and-drop operations into data queries and visually presents the resulting data. analysis and research.
- ✓ To collaborate or develop any feature using such a tool, no specialised organisational or technical abilities are needed. There is a shared interest in it among numerous businesses, researchers, or industries.

- ✓ Business customers can discover, analyse, and show the outcomes of their data using Tableau Software's straightforward, user-friendly interface, all without the use of technical or system capabilities.
- ✓ Advanced features offered by Tableau include forecasting, integration, automatic geocoding, and a visual formula editor.
- ✓ Compared to other competing systems, it enables customers to conduct more research, use their data faster and more effectively, and reduce data distribution.

Figure 19: Tableau Desktop Example
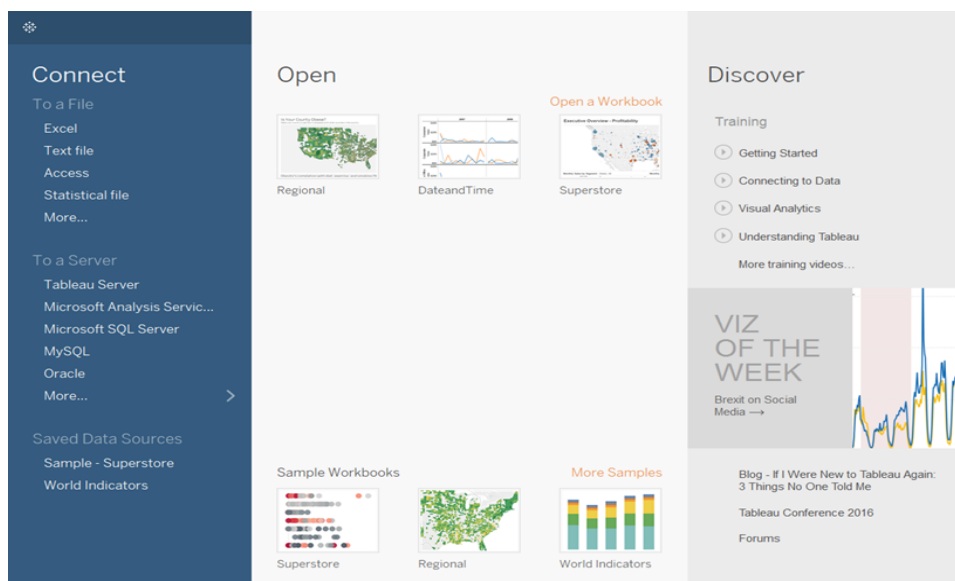


Source: Based on own Tableau screen picture

Tableau Public is another online community for development training and assistance. High product costs, modelling challenges when merging data from many sources, deficient performance, and enormous data sets are a few of the disadvantages. As a static file, dashboards can be distributed to other people. Data connectors are available upon starting Tableau and let users connect to any database they require. In conclusion, Tableau is a business platform created for automated features, distribution, management, and collaboration. File access for end users is improved across all platforms, including desktop, mobile, and email.

**Derived Chart**

Based on the list of the most popular chart types provided in the literature review, it is crucial to specify which types of charts Tableau supports.

Figure 20: Tableau Chart Types



Source: Based on own Tableau screen picture

- ✓ Charts with stacked bars and columns
- ✓ Clustered Bar and Column charts in their entirety
- ✓ Line and Area Charts with Clustered Bar and Column Diagrams
- ✓ Column charts with stacked or clustered lines

**Waterfall Chart**

- ✓ Charts for Scatter and Funnels
- ✓ Donut and pie charts
- ✓ Diagram of a tree
- ✓ Map and filled 3-D map.
- ✓ To illustrate the visualisations, additional features like gauges, cards, multi-row cards, KPI11, slicers, and interactive tables are used.

**Data Importing**

Start the desktop programme or online Tableau software as the initial step in the data import process. The Tableau application's desktop is displayed in Figure 22 below. Tableau Desktop is a free application that can connect to, alter, and visualise data on a local computer.

Figure 21: The Tableau Desktop



Source: Based on own Tableau screen picture

One can connect to multiple data sources using Tableau Desktop and incorporate that data (known as modelling) into a data model. With the use of this data model, a person can produce visuals as well as collections of visuals that can be distributed to others inside an organisation as reports. The Tableau programme is frequently used by users creating reports for business intelligence initiatives to share their reports with others. When the desktop has finished running, the home menu will appear. Figure 23 depicts the Tableau application's connect component. The Tableau software's connect component enables users to insert data to produce graphics. The Connect section can be used to insert the data.

Figure 22: Import Data Sources
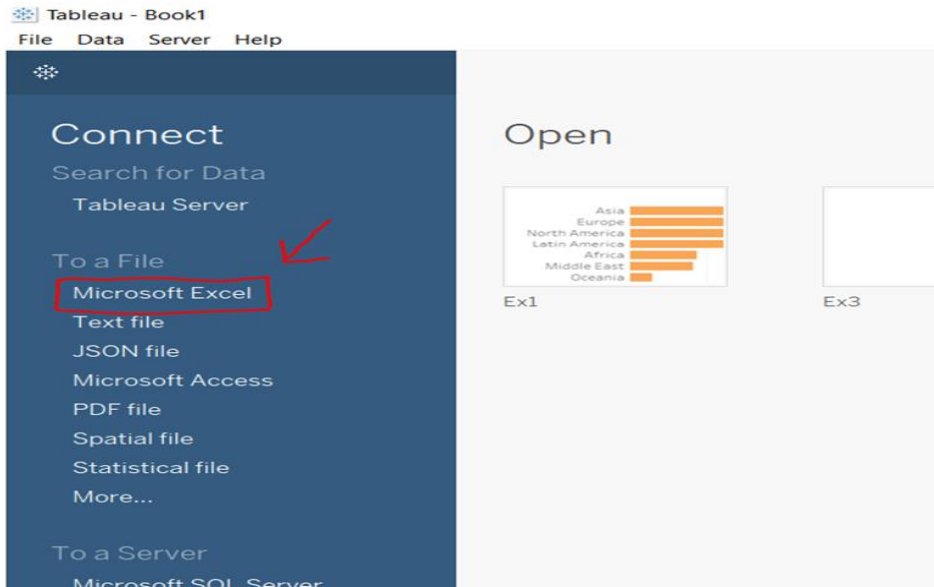


Source: Based on own Tableau screen picture

The Connect area offers several possibilities, including data search, file, and server connections, among others. It contains many visuals that can be used to present the data in original ways. Additionally, it gives users the option to filter the data used to create reports. The sources for importing data are shown in Figure 23. The data can be imported into Tableau software from a variety of sources. The connect part of the website offers a variety of choices for importing data, including searching for data, uploading to a file, and uploading to a server.

Figure 23: Data Insertion Procedure
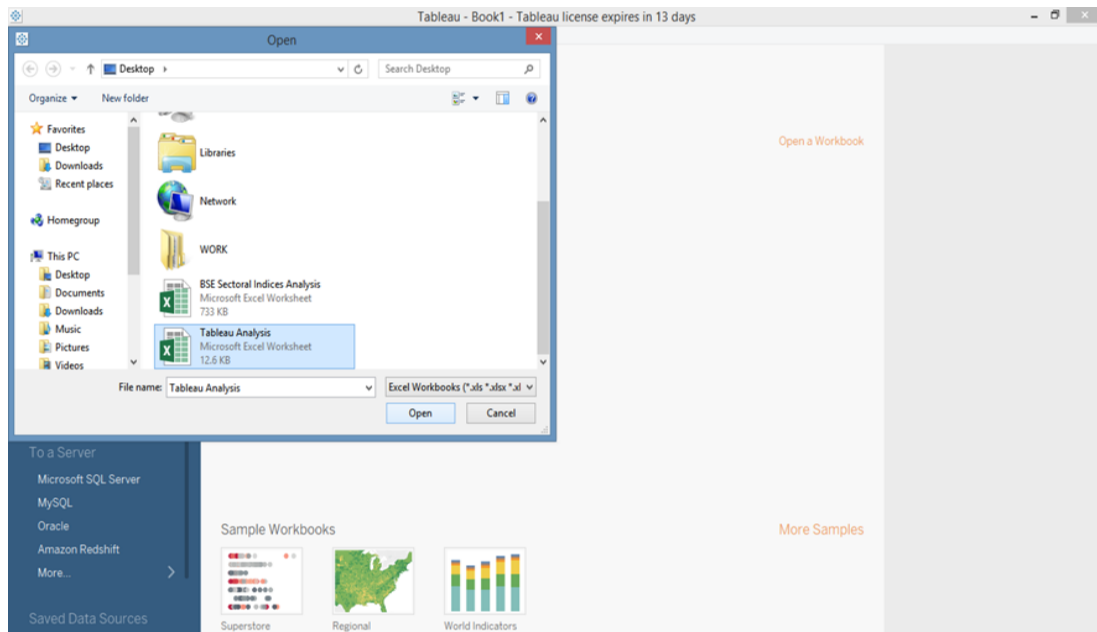


Source: Based on own Tableau screen picture

Figure 24 illustrates the data insertion method. Click on any data import option listed in the connect section. Numerous sources, including Excel, Text/CSV, JSON file, PDF file, spatial file, statistical file, and many more, can be used to import data. In addition, Tableau desktop supports the import of data from a variety of sources, including Oracle, Microsoft SQL Server, My SQL, Amazon Redshift, and many others.

Note: For instance, the aggregate data is prepared in table form with the intention of importing Excel data so that Tableau can identify the data and divide it into specific sections for visualisation. By choosing the Microsoft Excel check box under the connect sections to a file category, the data needed for analysis is imported. The window for choosing the file that needs to be imported for analysis will open after choosing the Excel option. Select the Tableau analysis file from the window, then click the open button to view it. To enter the data into the Tableau programme, the Tableau analysis file is chosen.

The blank white colour window that will be used to create charts is shown in Figure 25. Once the data file intended for analysis has been chosen, the window depicted in Figure 25 will appear, requiring the user to drag the categories for chart creation.

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Figure 24: Import Data Transformation
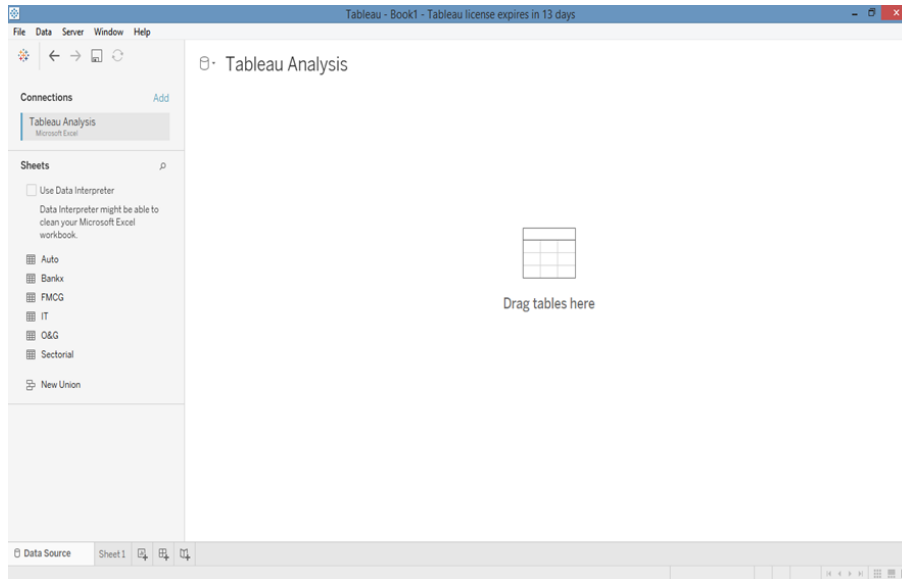


Source: Based on own Tableau screen picture

**Dashboard Development**

The next crucial step is to assist Tableau programme in locating fields that are connected to the stock values of BSE indices. As a result, the data must be categorised and separated into certain fields.

**The steps involved in creating the dashboard.**

Report view is together with a workspace in Tableau Software. The picture also shows the crucial components that must be highlighted when conducting analysis. The Tableau workspace is shown in the figure as being made up of menus, a toolbar, the Data pane, cards and shelves, and sheets. Worksheets, dashboards, and narrative are all types of sheets.

**Workbook Name**: There are sheets in the workbook. Sheet might refer to a tale, dashboard, or spreadsheet.

**Cards and Shelves**: In the workspace, drag fields to cards and shelves to add data for viewing.

**Toolbar**: Access navigation, analytics, and command tools with the toolbar.

**View**: View is a workspace canvas where one can build visibility (also called "viz").

**Sidebar**: The Data window and the Analytics window are in the worksheet's sidebar

**Status Bar**: Shows details about the active view.

**Sheet Tabs**: Each sheet in a workbook is represented by a tab. Worksheets, dashboards, and stories may be included.

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On the right side of the window, there is a Show Me tab. There are many different sorts of charts, including bar charts, pie charts, map charts, Treemap charts, and more, under the show me option. The presenter can choose any kind of chart to display the data. The "show me" icon comes with a variety of graphs that can graphically and interactively depict data.

In the left-hand side of the figure, there are fields. Select a chart from the list of charts in the show me area, click on it to make a chart, then drag a category into the column box and a different category into the row field to connect the data and display it as a chart. In the various charts discussed in the literature review, such as bar charts, maps, pie charts, and many more, the data is represented in a variety of ways.

### 3.5.2   Power BI

Microsoft's Power BI is a collection of business analytics tools for data analysis and information sharing in the form of reports and dashboards. Spreadsheets, text files, databases, and other types of data storage can all be used to insert user data. The conversion of user-provided data produces data sets. Users control the conversion of data. In this step, errors and unnecessary data are removed, formatting is fixed, and subsequent data analysis is prepared by sorting the data into proper standard forms, among other things. Filtering data to include just relevant elements allows one to concentrate solely on the most crucial data, depending on the report and dashboard being prepared. (Becker & Gould 2019)

Reports can be generated from the database once it is ready by selecting items from the multi-item selection option. The Power BI visual elements span from the top display to the gradient colour map. These mirrors aid in presenting facts in a way that fosters comprehension and context. Reports can employ filters to direct pertinent data to people who are interested in data analysis. Report items or the full report can be added to the dashboard after the reports have been published or they can be made manually.

Power BI dashboards allow users to keep their most crucial KPIs in one location while displaying 360-degree data viewing. Users can also assist in filtering or querying reports, and native language inquiries are supported. To make it simpler for consumers to understand, it is only available on one page and only opens the pertinent portions of the data. Data and dashboard information can also be continuously updated in real-time and made accessible on all gadgets, including PCs and mobiles.

Most users that work on business intelligence projects report, provide, and analyse data using Power BI Desktop, and then use the Power BI app to share their reports with others. The following are the main characteristics of the Power BI Desktop:

Connect the data.

- ✓ Modify the data and create a data model.
- ✓ Create illustrations (charts or graphs) for data presentations.
- ✓ On one or more of the report pages, create graphic reports.
- ✓ Utilize the Power BI service to distribute reports to others.

Power BI is a free programme that allows users to see different sorts of data, analyse and retrieve stored information, and intelligently arrange chapters using a group table that is intricately connected into one category. It can produce intricate, aesthetically appealing reports using data from several sources and instantly share them with others using the Power BI service. Figure 27 shows the home page from the Power BI Desktop report as the report's initial page. It marks the start of a visual tool.

Power BI has various capabilities that make it easy to connect to other programmes and devices. There are three methods for using Power BI, including:

- ✓ Power BI online
- ✓ Power Desktop
- ✓ Power BI Mobile

### 3.5.3 Cognos

IBM An online reporting and analytics solution for business intelligence is called Cognos. This business software provides a number of capabilities that allow for data integration and the easy creation of comprehensive reports. Additionally, Cognos provides the option to examine reports in XML format and deliver reports in either PDF or XML format. (Mihova et. al. 2016)

**Characteristics of IBM Cognos**

The primary characteristics of Cognos are listed below.

- ✓ Provides memory-based streaming statistics.
- ✓ Provides events, notifications, and notifications in real time.
- ✓ Logical and lovely Web 2.0 user interface
- ✓ Personal and ongoing cooperation

- ✓ Drag and drop, integration of free forms, and authorisation with search
- ✓ The wizard operates external data.
- ✓ Access to SAP BW queries is automatic.
- ✓ Permits capabilities like building status models, monitoring in real time, and forecasting
- ✓ Users can edit current data.
- ✓ Power to Drill Through.
- ✓ Including Potential Image Documents.
- ✓ It is a trustworthy, impartial, and independent platform.
- ✓ Secure data that is firewall-protected is provided.

**Cognos Components**

The Cognos software's salient characteristics are listed below.

**Cognos connection**

Users can access Cognos 10 and studios through the website Cognos Connect. Depending on the position they have been given, users can find, view, publish, manage, and amend corporate reports, scoreboards, and agents using this section. The administrator also uses Cognos Connection to manage Cognos Connection material and assign user roles and permissions.

**Business Insight from Cognos**

With Cognos Business Insight, users can design their own dashboards and incorporate any material. The user will see every piece of content they are permitted to view as an object. You can use this at work to create a dashboard that is entirely unique.

**Query Studio by Cognos**

Business users can discover rapid answers to inquiries about their businesses using Cognos Query Studio. Organizations benefit from having a deeper understanding of the product, customers, and internal requirements. Additionally, it enables companies to react quicker and keep a step ahead of the competition.

**Analysis Studio by Cognos**

Business priorities can be identified and focused on with the use of Cognos Analysis Studio. Understanding current trends, contrasting data, and assessing business performance using various analyses are also beneficial.

**Advanced Cognos Business Insight**

Cognos Business Intelligence enhanced by a fresh module put in by Cognos 10. It includes Cognos Analysis Studio and Cognos Questionnaire. It offers a strong setting for businesspeople to be authorised.

**Report Studio by Cognos**

Complete pixel reports for organisation can be made using the Cognos reporting tool. It enables the creation of every available report type, including charts, maps, lists, and reports leveraging multiple distribution or affiliate data sources.

**Event Studio by Cognos**

With the use of this tool, someone can specify a specific event that notifies a stakeholder in an organisation. Agents that empower anyone at occasions and frontiers can be created by someone. As a result, the agent who sends the message will do so if an event or limit is achieved.

**Metric Studio by Cognos**

By establishing a scorecard environment, Cognos Metric Studio enables users to see and analyse an organization's business metrics. It is also beneficial for someone to start the process and keep an eye on an organisation to watch how it reacts as the process is modified.

**Types of Cognos**

Here are the main Cognos reporting tool categories.

**Content Store**

Data tables from the Content Store Set are used by the Content Manager to store data from Cognos applications.

**Content Manager**

Cognos Manager aids in storage management and retrieves published packages, reported data, and configuration data from the content store database.

**Content Database for Cognos**

In demo locations without access to DBMS business, the Cognos Content Database is a standalone database server that hosts a content store database.

### 3.5.4 Qlik View

A platform for business statistics is offered by Qlik (formerly known as QlikTech Inc.). The SaaS Software Company was established in 1993 in Lund, Sweden, and is presently headquartered in King of Prussia, Pennsylvania. Qlik Sense and Qlik Replicate are two cloud-based tools for data integration and business intelligence. (Shukla & Dhir 2016)

A business intelligence tool called QlikView can integrate data, track conversation activity, and turn unstructured data into a knowledge base. With the use of QlikView's ad query tools, it is simple to make judgments based on readily available information. This programme uses the integration approach and may be used in several ways to conduct a search for information.

**Here are some advantages and noteworthy advantages of utilising QlikView.**
- ✓ The platform is incredibly easy to use and straightforward.
- ✓ Offers data visibility in a transparent and expert manner.
- ✓ Rapid reaction times without data volume restrictions
- ✓ Enables direct and indirect data searches on all information.
- ✓ Dynamic applications, dashboards, analysis, etc. are supported by QlikView.
- ✓ It makes it easier to quickly combine data from various sources into a single application.
- ✓ To make new judgments, it is helpful to recognise styles and information.
- ✓ Enables access to, analysis of, and data retrieval from mobile devices.
- ✓ Due to the speedy start-up, it offers a quick return on investment.
- ✓ Change management and rapid development.
- ✓ End-user self-service business intelligence.

**Key features of QlikView**
- ✓ **Data Integration Model**: The in-memory integration model used by QlikView is one of its main characteristics. Therefore, if someone can construct SQL select questions and comprehend data, they do not need "IT pros."
- ✓ **Platform**: Although QlikView is only available for Windows, it is set up to work with 64-bit computers.
- ✓ **Cost-effective**: Since QlikView is a memory software, organising data with it is cheap.
- ✓ **Economical**: Because memory usage is based on the amount of data a user requires for each programme, QlikView saves a significant amount of disc space.

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**Applications of QlikView**

- ✓ It is beneficial to examine revenue data from a major international business using different filters.

- ✓ Allows for the creation of thorough watch reports based on comments made by users worldwide on social media.

- ✓ Using historical data and drawings to depict cause and effect, the QlikView application enables users to make decisions.

- ✓ With the goal of enhancing performance, QlikView enables users to assess already-existing goods, activity orders, sales, and staff usage.

- ✓ Tools make it possible to examine data on product performance, sales, production, and delivery.

- ✓ It will be simple and quick for someone to produce strategic, efficient, and strategic reports and analyses.

- ✓ Some well-known organisations that use QuickvView in their operations include Canon, Panasonic, Shell, FILA, and ING LEASE.

### 3.5.5 SAP Analytics

A tool for visualising cloud data from SAP is called SAP Analytics Cloud. (Gole & Shiralkar 2020)

**SAP Analytics Cloud Features**

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

For business intelligence, SAP offers a comprehensive solution. SAC, which is accessible online in SaaS mode, is playing a bigger role in SAP's environmental system. And lastly, it aims to be a trustworthy BI tool for the SAP Cloud suite.

To address the needs of viewing data in the cloud, SAP Analytics Cloud is a new tool in the SAP portfolio. It is provided as a SaaS-based integrated package. includes specifications for budget planning, forecasting analytics, and data identification. Its primary duty is to produce data reports.

The sources of this data can range from hundreds of data lines formatted as an MS Excel table to real-time data gathered from business activities, budget status information,

and more. The answer is precise and simple to apply. Enables the user to independently produce reports of varying complexity levels. SAC is a component of a Power BI-like data analytics product from Microsoft.

**SAC Analytics Cloud Characteristics**

**Business Intelligence**

Data can be accessed using SAP Analytics Cloud in two diverse ways: by importing data and by directly reading from databases or ERP systems. When using direct reading, only by connecting to the SAP system is real-time data updated.

**Modelling Data**

By adding more features like indexing, formulae, and converting values for obtained attributes, this enables data modification.

**Data Visualisation**

Using graphs, tables, or other graphic objects, one can view and highlight data with this feature.

**Statistical Analysis**

SAP has employed artificial intelligence to highlight pertinent metrics or forecast future outcomes. These new features can be used for a variety of things, such as rigorous record capture, powerful feature recognition, and automated content generation using smart detection.

**Planning**

To get a thorough picture of one's status, one can use the SAC planning process to combine financial and operating statements using the same platform. Financial statements already in existence can be used to construct and modify various budget planning models. The given machine learning techniques and predictive tools can assist someone in making future financial predictions. There is also the well-liked "What If" simulation mode available.

**Future Hold**

SAP is committed to advancing SAC continually. It is regularly updated and accessible at no additional expense, much like a cloud tool. The adoption of the BI allocation and planning solution will determine SAP's future SAC strategy.

**By Offer**

The synchronisation of the reporting style and its use across tools is advanced by the integration of the SAC data recognition component into other SAP Cloud products. Examples include the new cloud-based data storage tool SAP Data Warehouse Cloud and SAP S / 4HANA Cloud Integrated Analytics. SAP Business Objects is still the go-to option for SAP On-Premises solutions, despite the availability of increased hybrid systems that combine On-Premises ERP with cloud-based solutions.

**By Organising**

SAP strategy to provide cloud-based editing tool solutions top priority. Without the necessity for legal consolidation, using SAP Analytics Cloud is advised for scheduling. Additionally, its integrated SAP S / 4HANA enables for simple data integration, and its collaborative planning tools offer value for revising projections in each company category. However, the extension is available with SAC for customers using the On-Premises solution through SAP BPC. Even better data utilisation is advised. To put it simply, SAP produces SAP Analytics Cloud for all the categories it offers, whether it reports on its newest solutions or plans with other tools in its category. SAC has a promising future because SAP is committed to making the tool better.

### 3.5.6   MS Excel

Excel is the Microsoft office programme that is used the most frequently. A spreadsheet programme called Excel is used to store and examine numerical data. A group of columns and rows that together make up an Excel spreadsheet can be compared to a table. Cells are places where rows and columns cross. A through Z and other alphabetical letters are often assigned to columns, whereas digits are typically assigned to rows. A single item of data, such as a number value, text, or formula, can only be stored in a cell at a time.

Spreadsheet software like Microsoft Excel is used to collect and examine numerical and statistical data. For conducting various activities, such as mathematical computation, graph tools, pivot tables, micro programming, and others, Microsoft Excel provides a number of capabilities. Numerous operating systems, including as Windows, Android, and others, are compatible with it. (Katoch 2020)

# 4 Practical Part

This part provides an overview of the data and uses Tableau to visualise several indexes.

## 4.1 Case Description

In this section of the thesis, two well-liked and commonly applied BI platform methodologies are contrasted. Microsoft Excel and Tableau are two of the techniques that are contrasted in the thesis. Additionally, the thesis contrasts the following crucial factors: features for feature recognition, dashboard designs that differ, accessibility, usability, and visibility.

The comparison is based on a case study and seeks to provide answers to the following: Which programme is ideal for creating visual dashboards? What are the main distinctions between Microsoft Excel and Tableau? Both the Office 365 Enterprise E5 version and the cloud-based business analytics tool suites Microsoft Excel and Tableau are available.

These two programmes are each beneficial in their own ways. Therefore, it is interesting to consider the advantages and disadvantages of using case studies for research. This case study aims to give an evaluation of return for a few selected BSE Indices in India while taking significant decisions for businesses, investors, and researchers into consideration.

The creation and production of a visualisation dashboard to aid researchers, investors, and firm managers in making investment decisions and better understanding the return generated by BSE indexes over the prior five years following India's demonetization. The researcher must offer the chosen BSE indexes stock prices data over the last five years, from 2016 to 2021, in an original manner that allows research scholars, managers, investors, and anyone else to grasp it. The researcher must also include data on how particular BSE indexes are faring in terms of return generation since India's adoption of demonetization.

Researchers, investors, and management of well-known companies demand data that has been processed to meet their needs and expectations. Therefore, it is necessary to develop original ideas for presenting the raw data and to create a report based on information obtained on the website of the Bombay Stock Exchange about foreign investors, researchers, and businesses that have already made investments abroad. As international investors or companies frequently do not comprehend the data of BSE Indices available on the BSE website, where the data is released by Bombay Stock Exchange of India, the data report

should be helpful and intelligible for a speedy study of the data. These investors frequently base their investments on reports or other paperwork that seeks to provide a person a better grasp of the returns provided by BSE indices during the five years following India's demonetization.

How can we assist these investors, managers, and researchers? A contemporary and sophisticated technique is used to produce an interactive dashboard that analyses the vast data and explains it to the end user in a straightforward and understandable manner. To conduct further research or to make predictions about the performance of BSE indices and which indices will perform better in the future and provide investors with higher returns in India, it is crucial for investors and researchers to have access to easily understandable stock price data of selected BSE indices. In addition to investors and scholars, managers of multinational corporations will be interested in learning about the performance of BSE indices to make judgments on investments in India. The most widely used technology on the market for visualising big data, as well as the types, uses, and techniques for creating these graphics, are detailed in literature reviews.

The end-user should be quickly informed about the most crucial indications overall by the dashboards. For instance, the stock prices of BSE indices, the number of industries that performed well following demonetization, the better returns produced by indices among BSE indices, and other relevant data. The analysis's findings should outline the benefits and drawbacks of investing in India and whether the Indian stock market is doing well following demonetization for managers, researchers, and investors. For instance, if a foreign company or foreign investor plans to invest in India for business purposes or to increase their wealth, they should confirm that the investment has potential for growth and will be able to produce favourable returns with minimal risk.

This thesis will primarily compare Tableau and Microsoft Excel dashboards, which analyse data from verified database sources and offer suggestions for future advancements in visual dashboard creation. Dashboards' output will provide visual differences and point out the advantages of these tools when used for analysis.

## 4.2 Data Sources

Bombay Stock Market (BSE), often known as BSE Limited, is an Indian stock exchange situated on Dalal Street in Mumbai (Bombay). The Rajasthan Stock Market, the oldest stock exchange in Asia and the tenth largest in the world, was established in 1875 by cotton merchant Premchand Roychand, a Rajasthani Jain businessperson. With a total market value of more than R255.003 trillion as of October 2021, BSE is the ninth-largest stock exchange.

To gauge the total success of a trade, BSE created the S&P BSE SENSEX index in 1986. In 2000, BSE opened the exit market by trading future S&P BSE SENSEX contracts using this index. The BSE trading platform was broadened with the introduction of S&P BSE SENSEX options and the equity exit that followed in 2001 and 2002.

India INX was introduced by BSE on December 30, 2016. India's first international exchange is called India INX. BSE introduces a gold and silver export contract. With a speed of six seconds, BSE is the first stock exchange in Asia and the fastest in the world. It is also one of the major trade organisations in India.

**Indices of BSE -** Real-time market movements are quantitatively summarised by the stock market index. The same types of stocks are chosen from the market or trade and then combined to generate the stock market index. A stock market indicator for the Bombay Stock Exchange, Sensex stands for "Stock Exchange Sensitive Index". calculates BSE movement.

**Classification of Stock Market Indices** - There are many stock market indicators for India. Some of the BSE indices are given below.

**Benchmark Index -** The most important metrics for analysing market changes since they show how the overall market is performing. Showing the difference between the amount the central fund made in the market and the amount it should have made is known as a comparative statistical rate. BSE Sensex, NSE Nifty, etc (Nifty 50).

**Broad Market Index** - They are signs of stagnation, yet they frequently make many index stocks stronger. e.g.: BSE 100. The movement of thirty financially sound Indian companies listed on BSE is represented by the BSE Sensex. Over one hundred significant corporations on the BSE 100 perform the same.

**Market Capitalization Index** - An indication of how shares of firms are valued in terms of the market value of all their remaining shares (capitalization). BSE Small cap, BSE Midcap, etc.

**Sector or industry-based index** - Offer benchmarks and summaries of stock market activity in particular sectors, such as the medical field, energy, the manufacturing sector, the technology sector, etc. Nifty FMCG Index, CNX IT. Market capitalization indexes, broad market indices, industry and sector indices, thematic indices, strategy indices, sustainability indices, volatility indices, and fixed income indices are all included in the BSE. The five sectoral indices used in this thesis were chosen at random for analysis. S&P BSE Auto, S&P BSE Bankex, S&P BSE Information Technology, S&P BSE Oil & Gas, and S&P BSE FMCG are the five sectoral indexes that were chosen.

**Overview of Demonetization -** Extraction of money from a common use or distribution is known as demonetization. Demonetization, then, is the process of robbing a monetary unit of its status as legal money. Every time the national currency is changed, it occurs. Current currencies are withdrawn from use and abandoned, and new notes or coins are frequently introduced in their place. India's Prime Minister Narendra Modi made the surprise live broadcast announcement of demonetization on November 8, 2016. In his address to the nation at 20:15 IST, Modi declared that the distribution of all 2500 and 1000-series banknotes will be prohibited as of midnight on the same day, and he also announced the issue of the new 500 and 2000 series to replace the old ones.

The goal was to get rid of both personal black money and terrorism funding. There is no doubt that the average person was significantly impacted, particularly those who make less money and lack wealth (lower middle-class family and poor family). Even their meagre money resources are worthless, and they struggle to meet their daily necessities. Because they lacked the funds to make purchases in the market, the category of workers who earn and save their income in 500/1000 notes was defeated.

**Information based on Selected BSE Indices -** Both directly by BSE via lease lines and indirectly by data suppliers, BSE real-time information products are supplied. All listed and traded instruments in the Equity, Equity Derivatives, Currency Derivatives, Commodity Derivatives, and Credit Segments, as well as S&P BSE Real Time Indices, are covered by data products.

**Covered data segments:** S&P Real-time BSE Indices, Equity, Equity Derivatives, and Debt at BSE Real Time Level 1, Equity, Equity Derivatives, and Debt at BSE Real Time Level 2, Real-time currency derivatives on the BSE, Real-time commodity derivatives on the BSE.

S&P BSE Auto, S&P BSE Bankex, S&P BSE Information Technology, S&P BSE Oil & Gas, and S&P BSE FMCG sector stock prices for the thesis were gathered from the BSE website. The information was gathered throughout the course of the previous five years, from 1 April 2016 to 31 March 2021. Daily, BSE provides monthly, and annual historical stock prices. However, the daily stock prices of all chosen BSE indexes have been examined in this thesis to calculate returns. On the BSE website, in addition to historical stock price information, are annual report data for numerous companies. The website also offers details on numerous financial ratios for businesses that are listed on the BSE stock exchange, as well as details on businesses that are listed on stock exchanges.

## 4.3 Data Visualization

The most important element, the data, is examined throughout the entire dash board in order to generate a chart. In this instance, Figure 25 displays the stock prices of particular BSE sectoral indices for a certain year. The raw data that is analysed in order to determine return is shown in Figure 25.

Figure 25: Tableau Dashboard Information



Source: Based on own analysis in Excel software

Stock prices from a few BSE indices are used in the analysis. The information on stock prices is taken from the BSE's website. After stock price information has been gathered, it is analysed over a period of three days using the simple moving average method to get the average monthly stock prices indicated by a certain index. Additionally, the year stock values are computed using the simple moving average approach utilising the monthly stock prices.

Table 1: Raw Data of BSE Auto Index

| BSE AUTO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 18381.26 | | | | | | |
| **May** | 18268.67 | | | Moving Average | | | |
| **June** | 19299.78 | 18649.90 | | | | | |
| **July** | 20401.15 | 19323.20 | | Moving Average | | | |
| **August** | 21372.88 | 20357.93 | 19443.68 | | | | |
| **September** | 22424.28 | 21399.43 | 20360.19 | | Moving Average | | |
| **October** | 22348.79 | 22048.65 | 21268.67 | 20357.51 | | | |
| **November** | 20082.23 | 21618.43 | 21688.84 | 21105.90 | | | |
| **December** | 20141.41 | 20857.47 | 21508.19 | 21488.57 | 20983.99 | | |
| **January** | 21351.57 | 20525.07 | 21000.33 | 21399.12 | 21331.19 | | |
| **February** | 21862.37 | 21118.45 | 20833.66 | 21114.06 | 21333.91 | 21216.37 | |
| **March** | 22134.19 | 21782.71 | 21142.08 | 20992.02 | 21168.40 | 21277.84 | 21247.10 |

Source: Based on own analysis in Excel software

The raw data utilised for BSE Auto is shown in Figure 26. The image also shows how to compute the annual prices for the BSE Auto index using the Simple Moving Average Method on a three-day basis.

Table 2: Returns of BSE Auto Index

| BSE AUTO | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 18001.75 | |
| **2016-17** | 21247.10 | 0.18 |
| **2017-18** | 24672.24 | 0.16 |
| **2018-19** | 22245.12 | -0.10 |
| **2019-20** | 17137.83 | -0.23 |
| **2020-21** | 18264.28 | 0.07 |
| **Mean** | | 0.02 |
| **Standard Deviation** | | 0.16 |

21247.10-18001.75=3245.35/18001.75

24672.24-21247.10=3425.14/21247.10

22245.12-24672.24=(2427.1)/24672.24

Mean = 0.18+0.16+(0.10)+(0.23)+0.07/5

SD = Excel Calculation

Source: Based on own analysis in Excel software

The return provided by BSE Auto throughout the five years following the implementation of demonetization is shown in Figure 27. The following formula is used to determine the return:

Return = (Closing Price - Opening Price) / Opening Price * 100%

To compare several BSE sectoral indexes and determine which sector is performing best by generating the highest returns, the average return generated by the BSE Auto index over the last five years is first computed, followed by the yearly returns.

Figure 26: Tableau Interactive Visualisation (Heat Map Chart)
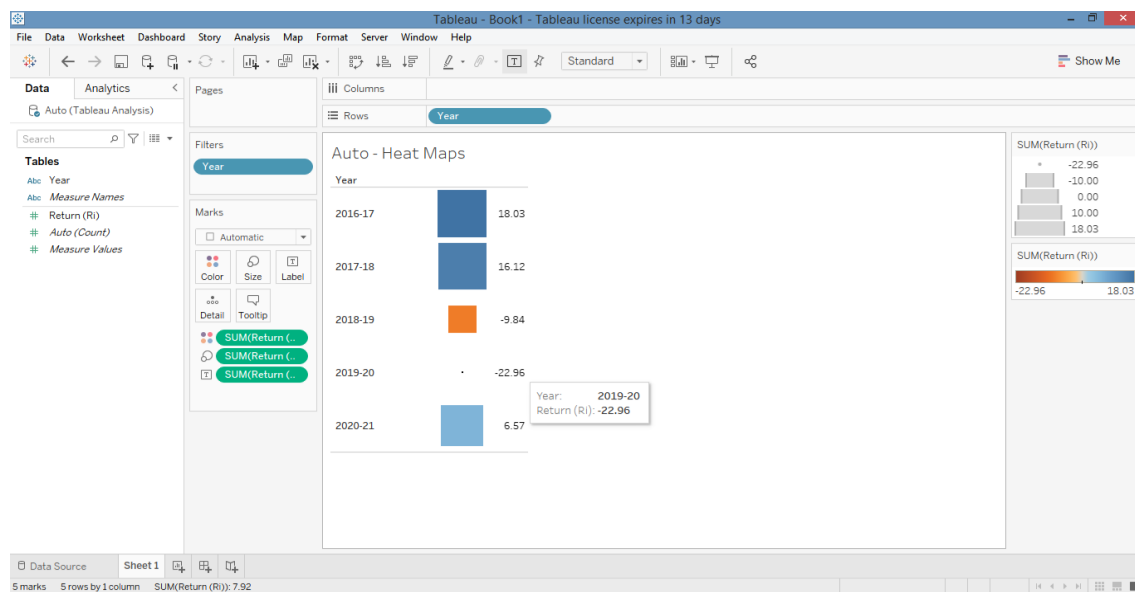


Source: Based on own analysis in Tableau software

Heat Map charts in Tableau are helpful for comparing various dimensions to a single metric (dimensions and measure are features provided by Tableau). The next step must be completed in order to create an interactive chart that shows the return provided by particular BSE sectoral indexes each year. Drag and drop the return category into the column box and the year category into the row field in Tableau in order to create a Heat Maps chart. After that, a bar chart will be generated automatically.

The bar chart will then immediately change to a heat map chart when you click on it in the Show Me section. In Figure 31, the Auto-heat maps on the right show the overall return in percentage given by the BSE Auto Index over the previous five years (with square colour coding), while the Auto-heat maps on the left show the various years.

Figure 27: Tableau Dynamic Visualisation (Text Table Charts)
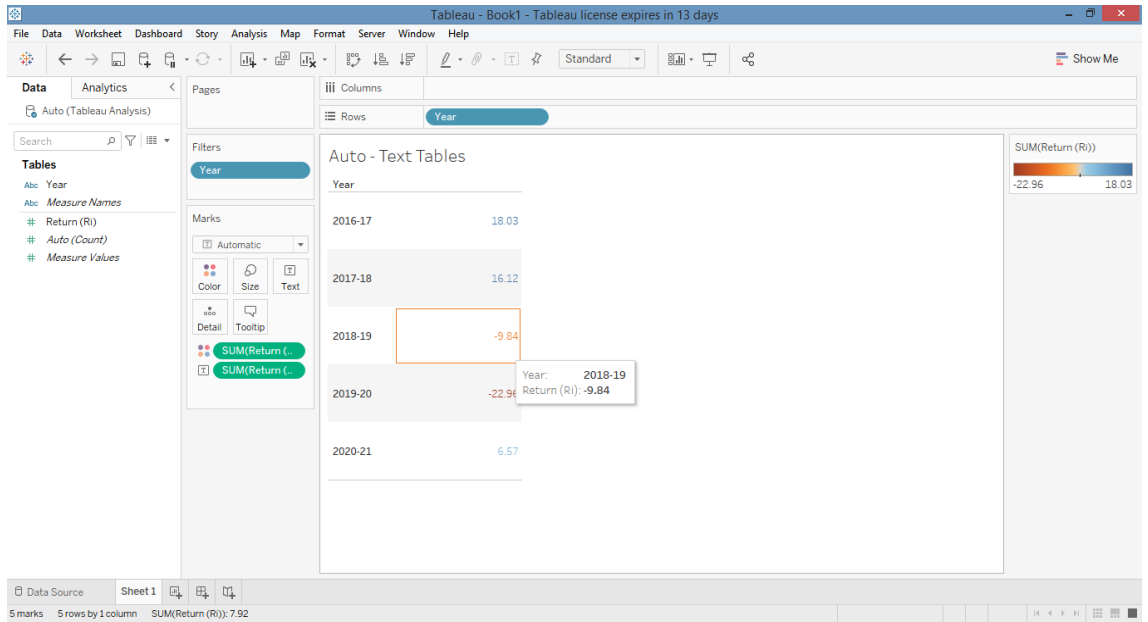


Source: Based on own analysis in Tableau software

Following the creation of the Heat Map, a text table chart is made to display the returns made by the BSE Auto Index throughout the course of the five years following the introduction of demonetization. Drag and drop the return category into the column box and the year category into the row field to start constructing a text tables chart. It will instantly produce a bar chart.

The bar chart will instantly change to the text table's chart when you click on it in the Show Me section. In Figure 29, the right sight of the auto-text tables displays the cumulative % return provided by the BSE Auto Index over the previous five years, while the left sight of the auto-text tables displays the various years.

The next stage is to construct an interactive vertical bars chart that shows data regarding the % return provided by BSE Bankex over the previous five years post demonetization.

Table 3: Raw Data of BSE Bankex Index

| BSE BANKEX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 18423.94 | | | | | | |
| **May** | 18963.91 | | | | | | |
| **June** | 20300.82 | 19229.56 | | | | | |
| **July** | 21567.62 | 20277.45 | | | | | |
| **August** | 21864.81 | 21244.42 | 20250.47 | | | | |
| **September** | 22798.27 | 22076.90 | 21199.59 | | | | |
| **October** | 22173.85 | 22278.98 | 21866.76 | 21105.61 | | | |
| **November** | 21980.80 | 22317.64 | 22224.51 | 21763.62 | | | |
| **December** | 20953.79 | 21702.81 | 22099.81 | 22063.69 | 21644.31 | | |
| **January** | 21692.24 | 21542.28 | 21854.24 | 22059.52 | 21962.28 | | |
| **February** | 23228.91 | 21958.32 | 21734.47 | 21896.17 | 22006.46 | 21871.02 | |
| **March** | 23987.51 | 22969.56 | 22156.72 | 21915.14 | 21956.95 | 21975.23 | 21923.12 |

Source: Based on own analysis in Excel software

The raw data utilised for BSE Bankex is seen in Figure 30. The image also shows how the Simple Moving Average Method on a 3-day basis is used to derive the annual pricing for BSE Bankex.

Table 4: Return of BSE Bankex Index

| BSE BANKEX | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 18391.96 | |
| **2016-17** | 21923.12 | 0.19 |
| **2017-18** | 27886.24 | 0.27 |
| **2018-19** | 29816.19 | 0.07 |
| **2019-20** | 33303.39 | 0.12 |
| **2020-21** | 28207.49 | -0.15 |
| **Mean** | | 0.10 |
| **Standard Deviation** | | 0.14 |

Source: Based on own analysis in Excel software

The return provided by BSE Bankex throughout the five years following the adoption of demonetization is shown in Figure 31. In order to compare several BSE sectoral indexes and determine which sector is performing best and generating the highest returns, the yearly returns are first computed, followed by the average return provided by the BSE Bankex index over the previous five years.

Figure 28: Tableau Interactive Visualisation (Vertical Bar Chart)
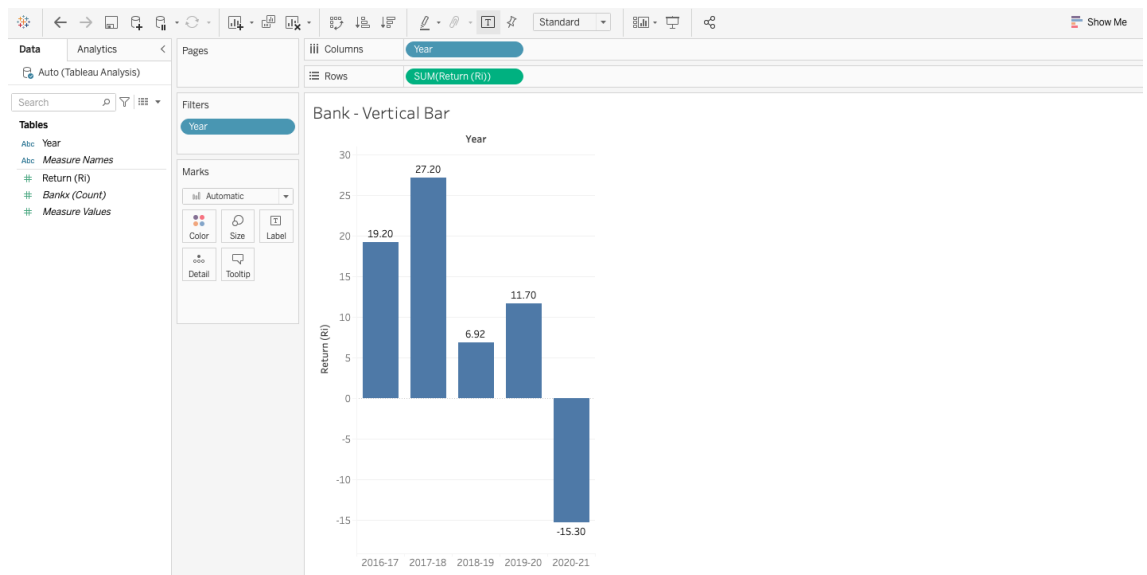


Source: Based on own analysis in Tableau software

The vertical bar chart is the following chart on the dashboard. Let's attempt to create a chart that has comprehensive data regarding the % return provided by BSE Bankex during the previous five years.

The vertical bar chart in Figure 32 displays the % return provided by BSE Bankex during the previous five years, from 2016 to 2021. The y-axis of this sort of chart shows the total return, expressed as a percentage, provided by the BSE Bank Index over the last five years, while the x-axis shows the years.

The return provided by BSE Bankex is shown in this instance by the vertical bar chart. BSE Bankex achieved a return of 27.20 percent in 2017–18, which is the greatest compared to past years. However, the banking industry is not doing well in 2020–2021 as it has a negative return of -15.30 percent.

Figure 29: Tableau Interactive Visualisation (Table Chart)
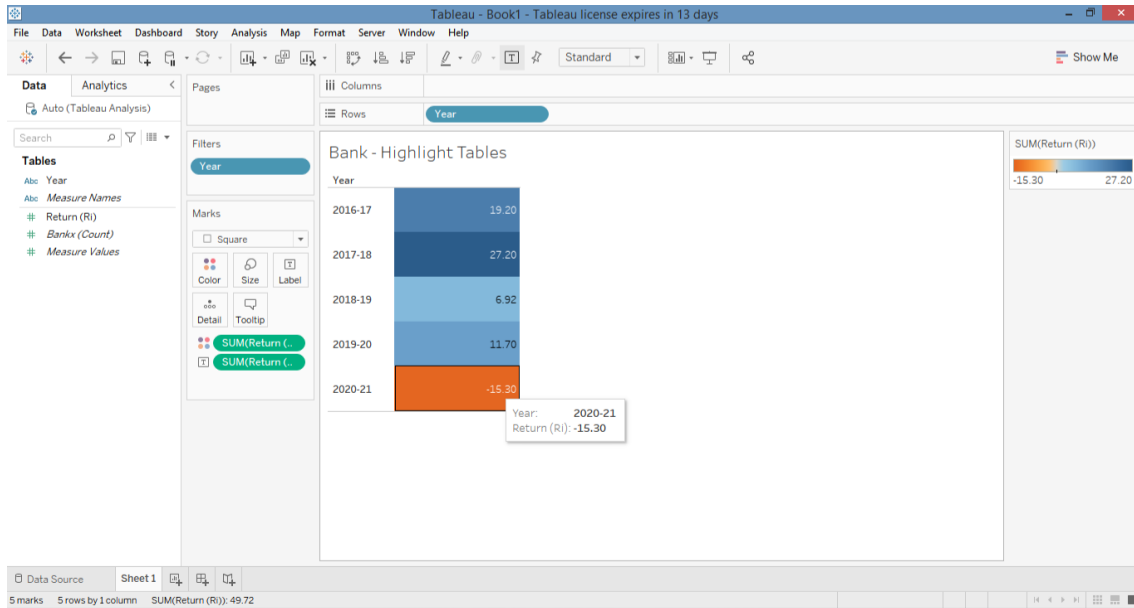


Source: Based on own analysis in Tableau software

The previous vertical bar chart used to illustrate the results obtained by BSE Bankex. Here, the same data is displayed using a different form of chart called a highlight table to better visualize the data. To create a highlight table chart, choose the chart from the "Show Me" section and drag the categories into the required row and column fields for the chart. The percentage return provided by BSE Bankex between the years of 2016 and 2021 is shown in the figure of the highlight table chart.

Table 5: Raw Data of BSE FMCG Index

| BSE FMCG | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 7779.74 | | | | | | |
| **May** | 7814.43 | | | | | | |
| **June** | 8210.01 | 7934.73 | | | | | |
| **July** | 8596.53 | 8206.99 | | | | | |
| **August** | 8702.36 | 8502.96 | 8214.89 | | | | |
| **September** | 8789.84 | 8696.24 | 8468.73 | | | | |
| **October** | 8492.70 | 8661.63 | 8620.28 | 8434.63 | | | |
| **November** | 8020.66 | 8434.40 | 8597.42 | 8562.14 | | | |
| **December** | 7923.25 | 8145.53 | 8413.85 | 8543.85 | 8513.54 | | |
| **January** | 8374.28 | 8106.06 | 8228.66 | 8413.31 | 8506.44 | | |
| **February** | 8881.58 | 8393.04 | 8214.88 | 8285.80 | 8414.32 | 8478.10 | |
| **March** | 9161.60 | 8805.82 | 8434.97 | 8292.84 | 8330.65 | 8417.14 | 8447.62 |

Source: Based on own analysis in Excel software

The raw data utilised to create the BSE FMCG Index is displayed in Figure 37. The data also shows how the BSE FMCG Index's annual prices were determined using the Simple Moving Average Method on a basis of three days.

Table 6: Returns of BSE FMCG Index

| BSE FMCG | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 7692.32 | |
| **2016-17** | 8447.62 | 0.10 |
| **2017-18** | 10233.32 | 0.21 |
| **2018-19** | 11616.88 | 0.14 |
| **2019-20** | 11401.71 | -0.02 |
| **2020-21** | 11520.63 | 0.01 |
| **Mean** | | 0.09 |
| **Standard Deviation** | | 0.08 |

Source: Based on own analysis in Excel software

The graph shows the performance of the BSE FMCG Index over the five years following the introduction of demonetization. The average return provided by the BSE FMCG index over the previous five years is then calculated in addition to the yearly returns.

Figure 30: Tableau Interactive Visualisation (Vertical Bars)
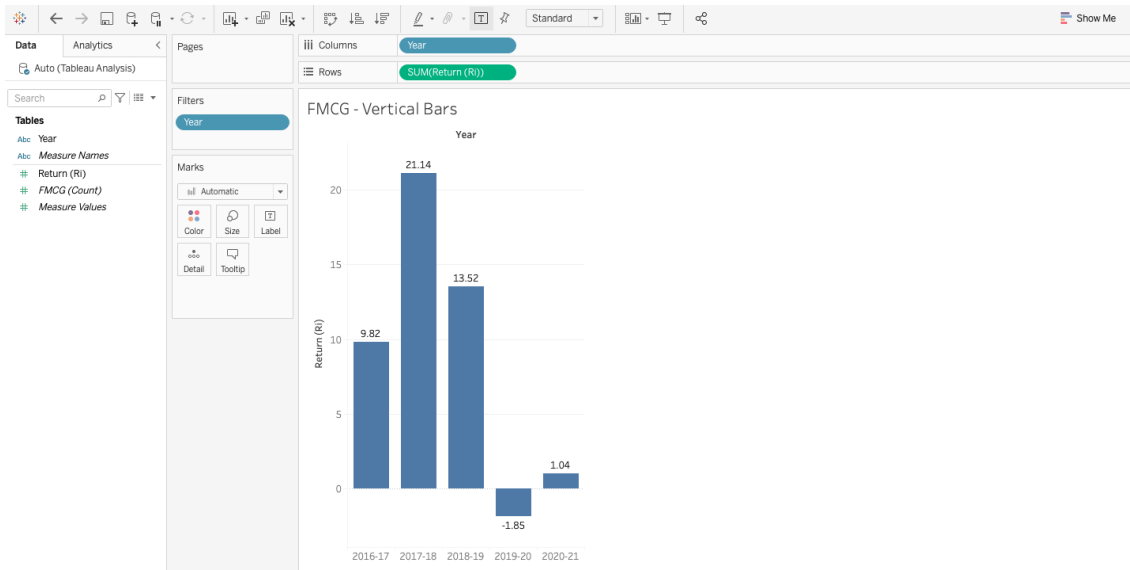


Source: Based on own analysis in Tableau software

The vertical bar chart is the following chart on the dashboard. Let's attempt to create a graph that has comprehensive data regarding the percentage of return offered by BSE Fast Moving Consumer Goods over the previous five years. The vertical bars chart in Figure 39 shows the overall percentage return that the BSE FMCG sector obtained following demonetization.

The vertical bars graph displays the percentage return that the BSE FMCG Index provided over the previous five years. Different bars are used to symbolise each year. A longer bar is used to indicate the year with the highest return; as the return decreases, the bar gets smaller or negative. For instance, the BSE FMCG Index saw its best return of 21.14 percent in the year 2017–18, which is denoted by a longer bar, and saw its lowest return of 13.52 percent in the year 2018–19, which is in comparison to the year 2017–18. As a result, the bar is smaller than the highest return bar. The vertical bars chart's negative bar indicates the BSE FMCG Index's lowest return for 2019–20, which is around -1.85 percent.

Figure 31: Tableau Interactive Visualisation (Circle Chart)
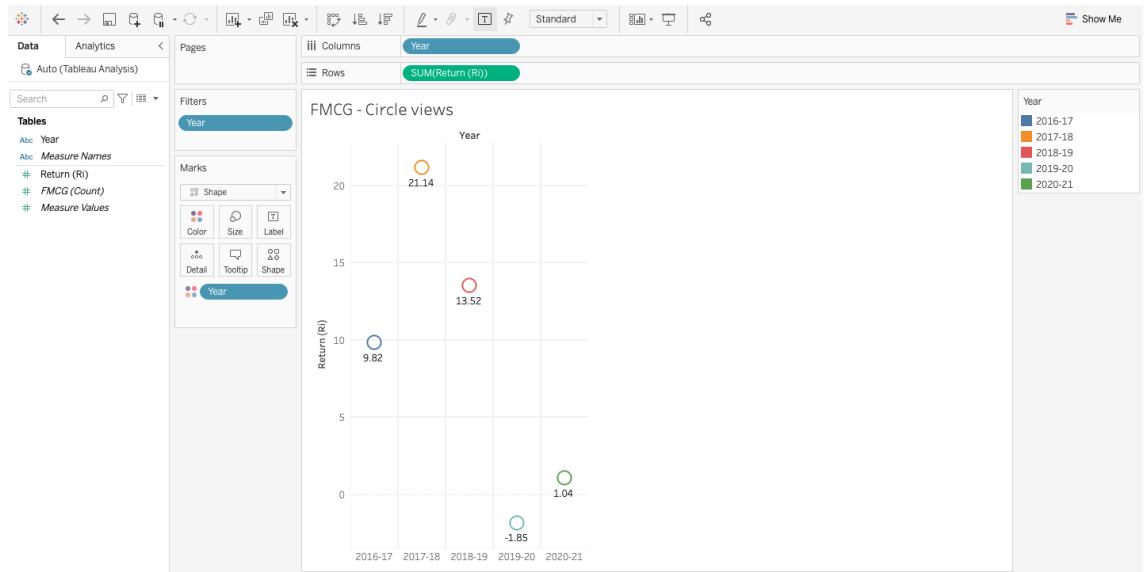


Source: Based on own analysis in Tableau software

A circle view chart is also used to display the data from the BSE FMCG Index. Drag and drop the year into the column box and then the return key into the row field to create a circle view chart. It will instantly produce a bar chart.

The bar chart will automatically change to a circle view chart when you select the circle view chart option in the Show me section. The y-axis in the figure shows the total return, expressed as a percentage, provided by the BSE FMCG Index during the last five years, while the x-axis shows the number of years.

The next stage is to develop a circle views chart that shows data on the rate of return provided by BSE Information Technology throughout the course of the five years following demonetization.

Table 7: Raw Data of BSE IT Index

| BSE IT | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 11386.29 | | | | | | |
| **May** | 11243.47 | | | | | | |
| **June** | 11353.21 | 11327.66 | | | | | |
| **July** | 10836.45 | 11144.38 | | | | | |
| **August** | 10743.48 | 10977.71 | 11149.91 | | | | |
| **September** | 10306.04 | 10628.66 | 10916.92 | | | | |
| **October** | 10228.00 | 10425.84 | 10677.40 | 10914.74 | | | |
| **November** | 9353.22 | 9962.42 | 10338.97 | 10644.43 | | | |
| **December** | 9962.75 | 9847.99 | 10078.75 | 10365.04 | 10641.41 | | |
| **January** | 9930.88 | 9748.95 | 9853.12 | 10090.28 | 10366.58 | | |
| **February** | 10130.49 | 10008.04 | 9868.33 | 9933.40 | 10129.58 | 10379.19 | |
| **March** | 10466.19 | 10175.85 | 9977.62 | 9899.69 | 9974.46 | 10156.87 | 10268.03 |

Source: Based on own analysis in Excel software

The raw data for the BSE Information Technology Index is mentioned in Figure 38. The picture also shows how the BSE Information Technology Index's annual prices were determined using the Simple Moving Average Method on a basis of three days.

Table 8: Return of BSE IT Index

| BSE IT | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 11387.95 | |
| **2016-17** | 10268.03 | -0.10 |
| **2017-18** | 10430.60 | 0.02 |
| **2018-19** | 14666.28 | 0.41 |
| **2019-20** | 15487.83 | 0.06 |
| **2020-21** | 20266.33 | 0.31 |
| **Mean** | | 0.14 |
| **Standard Deviation** | | 0.19 |

Source: Based on own analysis in Excel software

The return produced by the BSE Information Technology Index throughout the five years following the adoption of demonetization is shown in Figure 39.

Figure 32: Tableau Interactive Visualisation (Circle Chart)
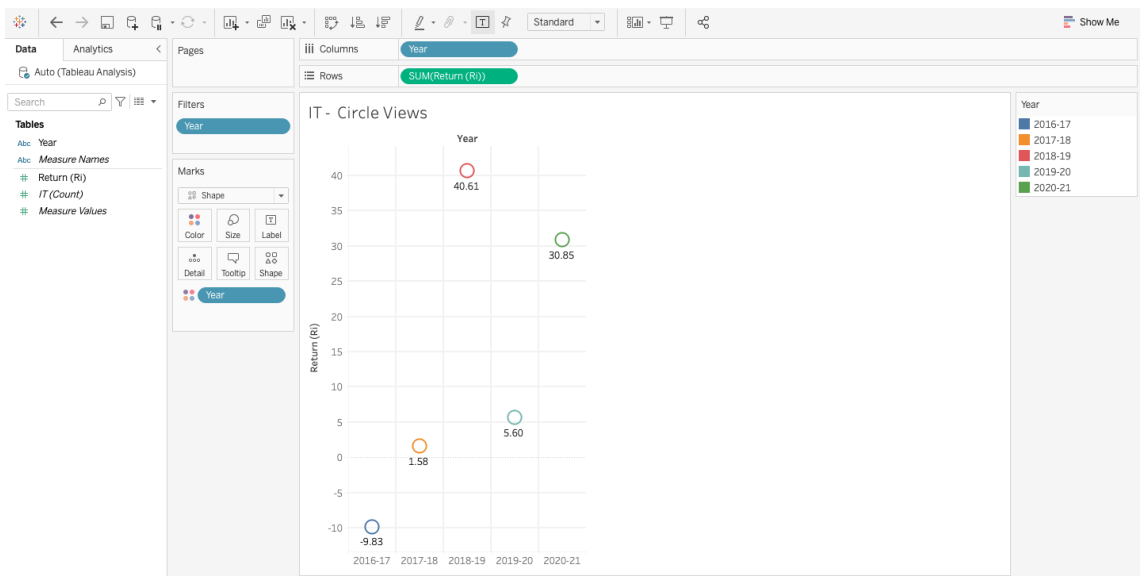


Source: Based on own analysis in Tableau software

Choose the chart from the "Show Me" area and drag the categories into the required row and column fields to display the chart in circle views. The circle views chart's figure displays the return percentage that BSE IT provided from 2016 to 2021. Different years are shown on the X-axis, and return is shown on the Y-axis.

Figure 33: Tableau Interactive Visualisation (Vertical Bar Chart)
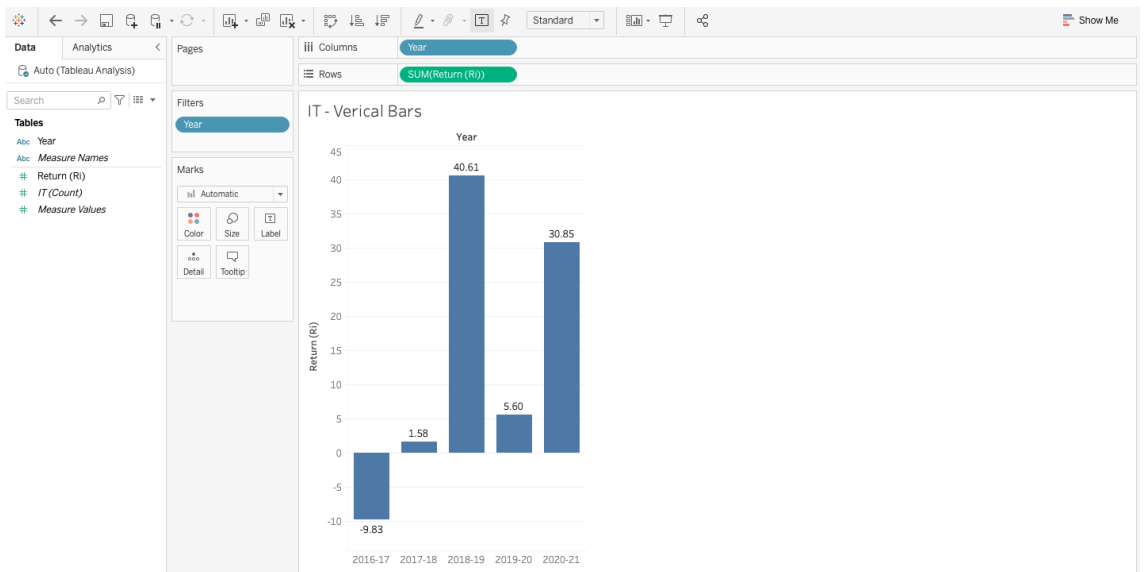


Source: Based on own analysis in Tableau software

In a prior chart utilising a circle view, the returns obtained by the BSE IT Index are shown. Here, the same data is displayed using a different form of chart called a vertical bar chart to better visualise the data. Choose the vertical bar chart from the "Show Me" area, then drag the categories into the "Row and Column" fields that the vertical bar chart needs to represent. The % return provided by BSE IT from 2016 to 2021 is shown in the figure of the vertical bar graph. Different years are shown on the X-axis, and return is shown on the Y-axis.

Table 9: Raw Data of BSE Oil & Gas Index

| BSE OIL & GAS | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2016 | Closing | Simple Moving Average (3 Years Interval) | | | | | |
| April | 9338.06 | | | | | | |
| May | 9135.08 | | | | | | |
| June | 9432.38 | 9301.84 | | | | | |
| July | 10201.40 | 9589.62 | | | | | |
| August | 10717.67 | 10117.15 | 9669.54 | | | | |
| September | 11129.40 | 10682.83 | 10129.87 | | | | |
| October | 12163.24 | 11336.77 | 10712.25 | 10170.55 | | | |
| November | 11711.84 | 11668.16 | 11229.25 | 10690.46 | | | |
| December | 11985.35 | 11953.47 | 11652.80 | 11198.10 | 10686.37 | | |
| January | 12572.26 | 12089.82 | 11903.82 | 11595.29 | 11161.28 | | |
| February | 13084.83 | 12547.48 | 12196.92 | 11917.85 | 11570.41 | 11139.36 | |
| March | 13370.15 | 13009.08 | 12548.79 | 12216.51 | 11909.88 | 11547.19 | 11343.27 |

Source: Based on own analysis in Excel software

The raw data for the BSE Oil & Gas Index is shown in Figure 45. The image also shows how to calculate the BSE Oil & Gas index's annual prices using the Simple Moving Average Method on a three-day basis.

Table 10: Return of BSE Oil & Gas Index

| BSE OIL & GAS | | |
|---|---|---|
| Year | Closing price | Return (Ri) |
| 2015-16 | 9161.61 | |
| 2016-17 | 11343.27 | 0.24 |
| 2017-18 | 15263.51 | 0.35 |
| 2018-19 | 14020.30 | -0.08 |
| 2019-20 | 14287.04 | 0.02 |
| 2020-21 | 13060.29 | -0.09 |
| Mean | | 0.09 |
| Standard Deviation | | 0.17 |

Source: Based on own analysis in Excel software

The return provided by BSE Oil & Gas in the five years following the implementation of demonetization is shown in Figure 43.

Figure 34: Tableau Interactive Visualisation (Vertical Bar Chart)
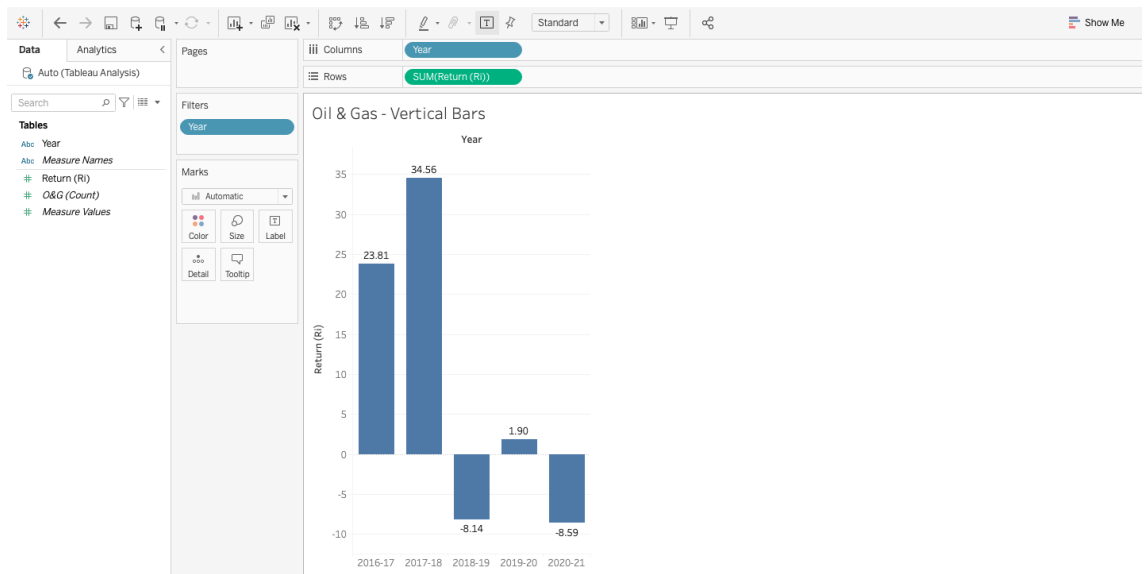


Source: Based on own analysis in Tableau software

The next step must be completed in order to create an interactive chart that shows the return provided by particular BSE sectoral indexes each year. Therefore, drag and drop the year category into the column field first before dropping the return category into the row area to create a vertical bar chart in Tableau. It will instantly produce a bar chart.

The bar chart will then automatically change to a vertical bar chart when you click on it in the Show Me section. The BSE Oil & Gas Index vertical bar chart is shown in figure. Returns determine the vertical bar display with various bar sizes.

Figure 35: Tableau Interactive Visualisation (Circle Chart)
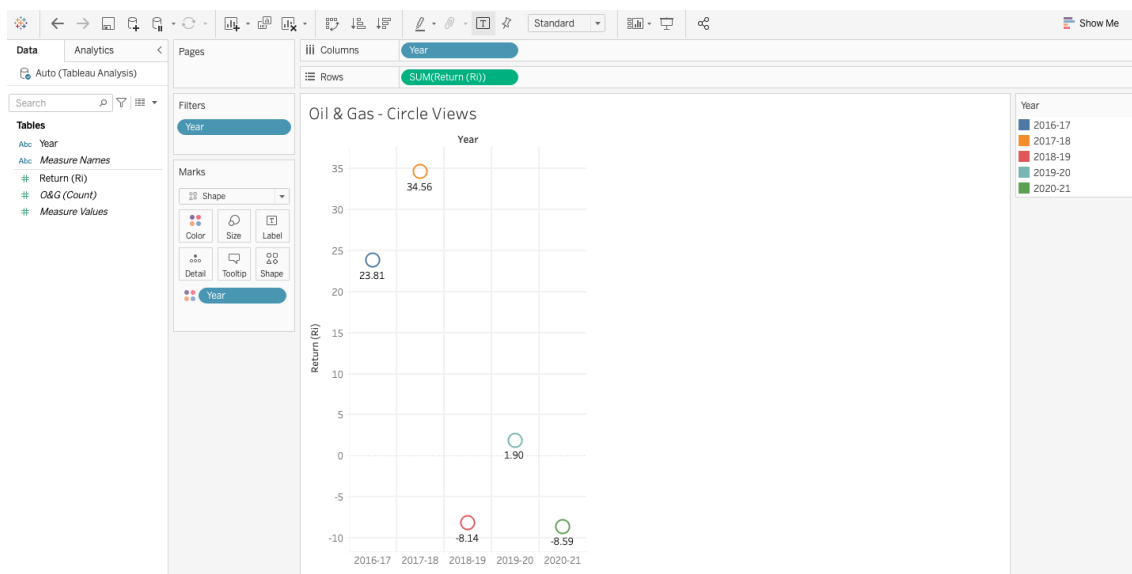


Source: Based on own analysis in Tableau software

Following the creation of the verticle bar chart, a circle view chart is made to show the returns made by the BSE Oil & Gas Index over the course of the five years following the adoption of demonetization. Drag and drop the year category into the column box and the return category into the row field to create a circleviews chart. It will instantly produce a bar chart.

The circle views chart will immediately change from a bar chart to a circle views chart when you select it from the Show me section. The y-axis in the graphic shows the total return, expressed as a percentage, provided by the BSE Auto Index during the last five years, and the x-axis shows the years.

Table 11: Microsoft Excel & Tableau Differences

| Point | Parameters | Microsoft Excel | Tableau |
|-------|-----------|-----------------|---------|
| 1. | Definition | The data organisation and formatting are done using a spreadsheet programme. | It is a visualisation tool for in-depth research. |
| 2. | Usage | suitable for statistical analysis and data storage. | Perfect for displaying data quickly and simply. |
| 3. | Security | In comparison to Tableau, the built-in security protections are inadequate. | There are other alternatives to scripting to secure the data. |
| 4. | User Experience | Excel's full power can only be realised with an understanding of VBA and simple programming. | We don't need to know how to code in order to use Tableau. |
| 5. | Business Objectives | Quick on-off reports. | Best while working with a large amount of data. |
| 6. | Integration | Excel can interface with around sixty different apps. | Tableau can integrate with over 250 other programmes. |

Source: Based on own results

# 5 Results and Discussion

Data visualization is an effective tool for gaining insights from large data sets. In recent years, there has been a significant increase in the use of data visualization tools for analyzing and presenting data. In this thesis, the author explored the impact of demonetization on the Indian Stock Exchange using Tableau software.

Demonetization is a significant economic policy change that has affected the Indian economy in many ways. It refers to the act of withdrawing the legal tender status of certain currency notes or coins from circulation. In November 2016, the Indian government announced the demonetization of Rs 500 and Rs 1,000 currency notes, which accounted for 86% of the country's currency in circulation.

The demonetization policy had a significant impact on the Indian Stock Exchange, with many stocks experiencing large fluctuations in value. To analyze this impact, author used Tableau software to create a data visualization dashboard. The dashboard provides a general overview of the impact of demonetization on the Indian Stock Exchange. The study gives an overview of five selected indicies namely as BSE AUTO, BSE BANKEX, BSE IT, BSE OIL & GAS, and BSE FMCG. The data was compared for five years starting from 2016 to 2021 to identify any significant changes.

The analysis showed that the demonetization policy had a mixed impact on the Indian Stock Exchange. While some companies experienced a significant drop in stock prices, others saw an increase in their stock values. Overall, the Indian Stock Exchange recovered quickly from the initial shock of the policy change and continued to perform well in the following months.

To compare this  results with the results of other authors on the same topic, author analyzed several scholary articles and research papers on the impact of demonetization on the Indian Stock Exchange. It was found that the study results were consistent with the findings of other studies. Here is the comparision of multiple studies:

Table 12 - Findings Comparision

| Study | Key Findings |
|---|---|
| Acharya et al. (2017) | Negative impact on the stock prices of firms that were more dependent on cash transactions. |
| Bhattacharya et al. (2019) | Negative impact on the market in the short run, but the impact was less severe for larger firms. |
| Kaur and Singh (2019) | Negative impact on the market in the short run, but the impact was less severe for firms with higher liquidity. |
| Reddy (2017) | Negative impact on the market in the short run, but the impact was not significant in the long run. |
| Gupta et al. (2018) | Mixed impact on stock prices, some companies saw a decline while others saw an increase. |
| Kumar and Chandra (2019) | Short-term negative impact, but the market recovered quickly in the following months. |
| Lobo and Sampath (2018) | Negative impact on the stock market in the short run, but the market recovered in the long run. |
| Gupta and Manoj (2018) | Negative impact on the banking sector in the short term, but the stock market remained relatively stable. |
| Jena (2017) | Negative impact on the stock market, with a significant decline in the stock prices of select companies. |

| Goyal and Singh (2019) | Significant negative impact on the stock market in the short term, but the market recovered quickly in the following months. |
|---|---|
| Our analysis using Tableau | Mixed impact on stock prices, with the Indian Stock Exchange recovering quickly. |

Though the results from the other studies are quite similar for the current study of BSE Indicies, there are a few points which makes this thesis significant than others:

- ✓ **Visual representation**: The study uses Tableau software to create visual representations of the data, making it easier for readers to understand the impact of demonetization on the Indian Stock Exchange. This approach can help in better comprehend complex data sets, and potentially make this study more accessible to a wider audience.

- ✓ **In-depth analysis**: The study provides an in-depth analysis of the impact of demonetization on the Indian Stock Exchange, exploring multiple factors and trends, such as changes in stock prices and retun volumes across different industries. This level of analysis can help gaining more nuanced understanding of the impact of demonetization on the stock market.

- ✓ **Interactivity**: Tableau software allows for interactive dashboards and data exploration, which can engage others and allow them to explore the data on their own terms. This can help make the study more engaging and may improve retention of key findings.

- ✓ **Flexibility**: Tableau software allows for flexibility in data analysis and visualization, allowing you to easily modify charts and graphs as needed. This can be especially useful if author needs to update their findings as new data becomes available.

- ✓ **Timeliness**: The study was likely conducted more recently than some of the other studies, as Tableau software was first released in 2003 and since then no other author has used this software to demonstrate the stock market data analysis. This means that your study may incorporate more recent data, and may therefore provide a more up-to-date picture.

# 6 Conclusion

Based on the analysis of the case study, the analysis of the thesis shows that it is possible to transform unprocessed data into informative data. Based on the investigation, it was found that dashboard development using programmes like Tableau produced satisfactory results. Comparing Microsoft Excel to Tableau, the advantages are less clear. Applications from Tableau and Microsoft Excel are used for various tasks. Tableau and Microsoft Excel are both priced, and anyone can readily purchase and install both. Comparing Tableau to Microsoft Excel, it has been discovered that Tableau is superior to Microsoft Excel for managing copious amounts of data. Tableau has everything you need to create a dashboard that secures business analytics and looks beautiful in terms of visualisation. It also has everything you need to create reports and dashboards. As it processes enormous amounts of data very quickly, Tableau outperforms Microsoft Excel in terms of scalability. The literature study and application section outline the key distinctions when using these apps. According to the analysis, Tableau is appropriate for any user and can design any special dashboard because it has numerous advantages over Microsoft Excel. The data is presented using Tableau to grab the interest of viewers as well as their eyes. Microsoft Excel can be used to create simple, plain visualisations that are easy to use but lack much originality in the report or dashboard. The spreadsheet programme Microsoft Excel is used to arrange and format the data. Additionally, the result of the analysis is what matters most since well-designed, well-defined visualisation aids in converting raw data into valuable information for straightforward understanding of the data. For instance, it is preferable to explain data using visualisation tools that can convey the information in a better way easily and effectively than giving an individual or management of some organisation the return values of the selected BSE sectoral indices. Data visualisation is a useful tool for transforming unprocessed data into compelling visual representations of any business or project, and it facilitates the decision-making process for upcoming business actions. Additionally, it aids investors in developing a thorough comprehension of financial facts to make wise investment choices. The thesis evaluated differences between currently popular visualisation tools on the market and highlighted their advantages. To develop a dashboard and produce an interactive representation using a specific set of data, it was essential to combine two of the most well-liked programmes on the market. The study made use of information on stock prices for a five-year period for a few BSE sectoral indexes that was gathered from the

Bombay Stock Exchange's annual report. With the use of Tableau, the study created a dashboard for the return values of specific BSE Sectoral indices. These days, tools like Microsoft Excel and Tableau are inexpensive and accessible to entrepreneurs and inexperienced users. Because they evaluate data rapidly and incorporate analysis that automatically delivers essential and key features of data, both technologies make it simple to use and develop dashboards. Due to the differences in objectives between Tableau and Microsoft Excel, selecting the ideal one might be challenging. One is a spreadsheet programme that can produce interactive graphics, and another seeks to design powerful graphics (like charts, tables, graphs, maps, Infographics). Overall, the findings demonstrated that Tableau is distinct and offers results that are pertinent and professional, which are especially important to businesses and companies around the world because they allow them to present the important data to investors and customers in a way that is simple to understand, effective and efficient.

# 7 References

Adam, K., Marcet, A. and Nicolini, J.P., 2016. Stock market volatility and learning. The Journal of finance, 71(1), pp.33-82.

Aparicio, M. and Costa, C.J., 2015. Data visualization. Communication design quarterly review, 3(1), pp.7-11.

Battle, L. and Heer, J., 2019, June. Characterizing exploratory visual analysis: A literature review and evaluation of analytic provenance in tableau. In Computer graphics forum (Vol. 38, No. 3, pp. 145-159).

Becker, L.T., and Gould, E.M., 2019. Microsoft power BI: extending excel to manipulate, analyze, and visualize diverse data. Serials Review, 45(3), pp.184-188.

Beer, D., 2018. Envisioning the power of data analytics. Information, Communication & Society, 21(3), pp.465-479.

Bertini, E., Elmqvist, N. and Wischgoll, T., 2016. Judgment error in pie chart variations. In Proceedings of the Euro graphics/IEEE VGTC conference on visualization: Short papers (pp. 91-95).

Bostack, M., 2020. Observable: Zoomable Area Chart.

Bruns, D., 2016. Stacked area chart. Retrieved February 22, 2021.

Cahoon, L.B. and Cutting, R.H. (2009) Forensic Water Quality Investigations. Available at: https://doi.org/10.1016/b978-0-12-374192-9.00006-6.

Carr, D.B. (2003) Graphics in the Physical Sciences. Elsevier BV. Available at: https://doi.org/10.1016/b0-12-227410-5/00297-0.

Cole, E., Yang, X., Wilber, K., Mac Aodha, O. and Belongie, S., 2022. When does contrastive visual representation learning work? In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 14755-14764).

Delen, D. and Ram, S., 2018. Research challenges and opportunities in business analytics. Journal of Business Analytics, 1(1), pp.2-12.

Duan, L. and Da Xu, L., 2021. Data analytics in industry 4.0: A survey. Information Systems Frontiers, pp.1-17.

Elzer, S., Carberry, S. and Zukerman, I. (2011) The automated understanding of simple bar charts. Elsevier BV. Available at: https://doi.org/10.1016/j.artint.2010.10.003.

Etienne, L., Devogele, T., Buchin, M. and McArdle, G., 2016. Trajectory Box Plot: A new pattern to summarize movements. International Journal of Geographical Information Science, 30(5), pp.835-853.

Fairbanks, S. and Buchko, A., 2018. The Visual Waterfall Chart Tool. In Performance-Based Strategy. Emerald Publishing Limited.

Ferreira, F.G., Gandomi, A.H. and Cardoso, R.T., 2021. Artificial intelligence applied to stock market trading: a review. IEEE Access, 9, pp.30898-30917.

Gole, V. and Shiralkar, S., 2020. Empower Decision Makers with SAP Analytics Cloud. Springer Books.

Golumbic, M.C. (2004) Not So Perfect Graphs. Elsevier BV. Available at: https://doi.org/10.1016/s0167-5060(04)80059-1.

Grady, J.O. (2016) Specification Section 4 Preparation. Available at: https://doi.org/10.1016/b978-0-12-804221-2.00004-8.

Gupta, M., and George, J.F., 2016. Toward the development of a big data analytics capability. Information & Management, 53(8), pp.1049-1064.

Gusarov, M.A. and Noskov, M.D., 2015. Application of single-row layout chart of periodic wells for uranium mining from narrow elongated orebody. In VI School-conference of young nuclear scientists of Siberia. Collection of abstracts.

Hai-Jew, S., 2019. The Humble "Funnel Chart." C2C Digital Magazine, 1(11), p.14.

Hariri, R.H., Fredericks, E.M. and Bowers, K.M., 2019. Uncertainty in big data analytics: survey, opportunities, and challenges. Journal of Big Data, 6(1), pp.1-16.

Harvey, D.F. and Wood, D.A. (2018) The treewidth of line graphs. Elsevier BV. Available at: https://doi.org/10.1016/j.jctb.2018.03.007.

Hasunuma, T. (2015) Structural properties of subdivided-line graphs. Elsevier BV. Available at: https://doi.org/10.1016/j.jda.2015.01.008.

Hibbert, D.B. (2009) Chemometric Analysis of Sensory Data. Elsevier BV. Available at: https://doi.org/10.1016/b978-044452701-1.00010-7.

Hoelscher, J. and Mortimer, A. (2018) Using Tableau to visualize data and drive decision-making. Elsevier BV. Available at: https://doi.org/10.1016/j.jaccedu.2018.05.002.

Hoffman, J.I.E. (2015) Meta-analysis. Available at: https://doi.org/10.1016/b978-0-12-802387-7.00036-6.

Indratmo et al. (2018) The efficacy of stacked bar charts in supporting single-attribute and overall-attribute comparisons. Elsevier BV. Available at: https://doi.org/10.1016/j.visinf.2018.09.002.

Isenman, L. (2018) A Feeling for the Truth. Available at: https://doi.org/10.1016/b978-0-12-814108-3.00008-7.

Katoch, S.K., 2020. MS-Excel Spreadsheet Applications in Introductory Under-Graduate Physics-A Review. Journal of Science and Technology, 5(3), pp.48-52.

Kosara, R., 2019. The Impact of Distribution and Chart Type on Part-to-Whole Comparisons. In EuroVis (Short Papers) (pp. 7-11).

Latif, S. and Beck, F. (2019) Interactive map reports summarizing bivariate geographic data. Elsevier BV. Available at: https://doi.org/10.1016/j.visinf.2019.03.004.

Long, L.Y. et al. (2017) A Study on the Effectiveness of Tree-Maps as Tree Visualization Techniques. Elsevier BV. Available at: https://doi.org/10.1016/j.procs.2017.12.136.

Mayhua, A., Gomez-Nieto, E., Heer, J. and Poco, J., 2018, October. Extracting visual encodings from map chart images with colour-encoded scalar values. In 2018 31st SIBGRAPI Conference on graphics, patterns, and images (SIBGRAPI) (pp. 142-149). IEEE.

Mendes, A.M., 2020. Time to Retire for DuPont Analysis. A Waterfall Chart Alternative. A Waterfall Chart Alternative (March 16, 2020).

Midway, S.R., 2020. Principles of effective data visualization. Patterns, 1(9), p.100141.

Mihova, V., Stefanov, G. and Marzovanova, M., 2016. Cognos Mobile-dashboards design and implementation technology. In Proceedings of International Conference on Application of Information and Communication Technology and Statistics in Economy and Education (ICAICTSEE) (pp. 514-519).

Moritz, D. and Fisher, D., 2018. Visualizing a million-time series with the density line chart. arXiv preprint arXiv:1808.06019.

Onorati, T., Díaz, P., Zarraonandia, T. and Aedo, I., 2018, October. The immersive bubble chart: a semantic and virtual reality visualization for big data. In Adjunct Proceedings of the 31st Annual ACM Symposium on User Interface Software and Technology (pp. 176-178).

Pan, X., 2017. Horizontal cumulative variance chart: A quality control scheme monitoring shifts in process variation. International Journal of Industrial and Systems Engineering, 25(2), pp.265-277.

Power, D.J., Heavin, C., McDermott, J. and Daly, M., 2018. Defining business analytics: An empirical approach. Journal of Business Analytics, 1(1), pp.40-53.

Raikar, S. and Adamson, S. (2020) Modeling project cash flows and debt service. Available at: https://doi.org/10.1016/b978-0-12-816441-9.00004-0.

Rajaraman, V., 2016. Big data analytics. Resonance, 21, pp.695-716.

Sadiku, M., Shadare, A.E., Musa, S.M., Akujuobi, C.M. and Perry, R., 2016. Data visualization. International Journal of Engineering Research And Advanced Technology (IJERAT), 2(12), pp.11-16.

Scheibel, W., Trapp, M., Limberger, D. and Döllner, J., 2020, February. A Taxonomy of Treemap Visualization Techniques. In VISIGRAPP (3: IVAPP) (pp. 273-280).

Shah, D., Isah, H. and Zulkernine, F., 2019. Stock market analysis: A review and taxonomy of prediction techniques. International Journal of Financial Studies, 7(2), p.26.

Shukla, A. and Dhir, S., 2016. Tools for data visualization in business intelligence: case study using the tool Qlikview. In Information Systems Design and Intelligent Applications: Proceedings of Third International Conference INDIA 2016, Volume 2 (pp. 319-326). Springer India.

Sohn, C., Choi, H., Kim, K., Park, J. and Noh, J., 2021. Line chart understanding with convolutional neural network. Electronics, 10(6), p.749.

Sohn, C., Choi, H., Kim, K., Park, J. and Noh, J., 2021. Line chart understanding with convolutional neural network. Electronics, 10(6), p.749.

Szafaryn, L.G. et al. (2013) Trellis: Portability across architectures with a high-level framework. Elsevier BV. Available at: https://doi.org/10.1016/j.jpdc.2013.07.001.

Taher, F., Jansen, Y., Woodruff, J., Hardy, J., Hornbæk, K. and Alexander, J., 2016. Investigating the use of a dynamic physical bar chart for data exploration and presentation. IEEE transactions on visualization and computer graphics, 23(1), pp.451-460.

Vidgen, R., Shaw, S., and Grant, D.B., 2017. Management challenges in creating value from business analytics. European Journal of Operational Research, 261(2), pp.626-639.

Waskom, M.L., 2021. Seaborn: statistical data visualization. Journal of Open-Source Software, 6(60), p.3021.

Wei, X., Zhou, W., Sanjay, S.T., Zhang, J., Jin, Q., Xu, F., Dominguez, D.C. and Li, X., 2018. Multiplexed instrument-free bar-chart spinchip integrated with nanoparticle-mediated magnetic aptasensors for visual quantitative detection of multiple pathogens. Analytical chemistry, 90(16), pp.9888-9896.

Wilcox, R.R. (2017) Confidence Intervals in the One-Sample Case. Available at: https://doi.org/10.1016/b978-0-12-804733-0.00004-4.

Xie, F. et al. (2015) Plotting and application of predominance area diagram of In–S–O system based on topological rules. Elsevier BV. Available at: https://doi.org/10.1016/s1003-6326(15)63685-8.

Yadav, S., 2017. Stock market volatility - a study of Indian stock market. Global Journal for Research Analysis, 6(4), pp.629-632.

Yuan, X., Lin, Z., Kuen, J., Zhang, J., Wang, Y., Maire, M., Kale, A. and Faieta, B., 2021. Multimodal contrastive training for visual representation learning. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 6995-7004).

Zhang, N., Ren, F. and Guo, C., 2018. Significance of hematology analyser scatter chart and alarm information in the diagnosis of haematological malignancies. Journal of Leukemia & Lymphoma, pp.517-520.

# 8 Appendix

The data analysis process was undertaken in Microsoft Excel software. For the analysis purpose, five indices were analysed such as BSE AUTO, BSE BANKEX, BSE IT, BSE OIL and GAS & BSE FMCG. The analysis has been done for five years, starting from 2016 to 2020. The primary analysis was focused on moving average for five indices and for five consecutive years, which resulted in closing price and finally return values as well as mean and standard deviation.

Table 13 - BSE AUTO (Year 2016)

| BSE AUTO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 18381.26 | | | | | | |
| **May** | 18268.67 | | | Moving Average | | | |
| **June** | 19299.78 | 18649.90 | | | | | |
| **July** | 20401.15 | 19323.20 | | Moving Average | | | |
| **August** | 21372.88 | 20357.93 | 19443.68 | | | | |
| **September** | 22424.28 | 21399.43 | 20360.19 | Moving Average | | | |
| **October** | 22348.79 | 22048.65 | 21268.67 | 20357.51 | | | |
| **November** | 20082.23 | 21618.43 | 21688.84 | 21105.90 | | | |
| **December** | 20141.41 | 20857.47 | 21508.19 | 21488.57 | 20983.99 | | |
| **January** | 21351.57 | 20525.07 | 21000.33 | 21399.12 | 21331.19 | | |
| **February** | 21862.37 | 21118.45 | 20833.66 | 21114.06 | 21333.91 | 21216.37 | |
| **March** | 22134.19 | 21782.71 | 21142.08 | 20992.02 | 21168.40 | 21277.84 | 21247.10 |

Source: Based on own analysis in Excel software

Table 14 - BSE AUTO (Year 2017)

| BSE AUTO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2017** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 22021.75 | | | | | | |
| **May** | 23332.38 | | | | | | |
| **June** | 24167.28 | 23173.80 | | | | | |
| **July** | 24301.13 | 23933.60 | | | | | |
| **August** | 23741.54 | 24069.98 | 23725.79 | | | | |
| **September** | 24553.06 | 24198.58 | 24067.39 | | | | |
| **October** | 24878.79 | 24391.13 | 24219.90 | 24004.36 | | | |
| **November** | 24968.29 | 24800.04 | 24463.25 | 24250.18 | | | |
| **December** | 25669.97 | 25172.35 | 24787.84 | 24490.33 | 24248.29 | | |
| **January** | 26199.79 | 25612.68 | 25195.03 | 24815.37 | 24518.63 | | |
| **February** | 24929.78 | 25599.85 | 25461.63 | 25148.16 | 24817.96 | 24528.29 | |
| **March** | 24376.71 | 25168.76 | 25460.43 | 25372.36 | 25111.97 | 24816.18 | 24672.24 |

Source: Based on own analysis in Excel software

Table 15 - BSE AUTO (Year 2018)

| BSE AUTO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2018** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 25446.75 | | | | | | |
| **May** | 24667.20 | | | | | | |
| **June** | 24868.29 | 24994.08 | | | | | |
| **July** | 24379.53 | 24638.34 | | | | | |
| **August** | 24336.43 | 24528.09 | 24720.17 | | | | |
| **September** | 23862.25 | 24192.74 | 24453.05 | | | | |
| **October** | 19979.69 | 22726.12 | 23815.65 | 24329.62 | | | |
| **November** | 20545.75 | 21462.56 | 22793.81 | 23687.50 | | | |
| **December** | 20894.03 | 20473.15 | 21553.95 | 22721.13 | 23579.42 | | |
| **January** | 19905.90 | 20448.56 | 20794.76 | 21714.17 | 22707.60 | | |
| **February** | 18402.27 | 19734.06 | 20218.59 | 20855.77 | 21763.69 | 22683.57 | |
| **March** | 19483.70 | 19263.95 | 19815.53 | 20276.29 | 20948.74 | 21806.68 | 22245.12 |

Source: Based on own analysis in Excel software

Table 16 - BSE AUTO (Year 2019)

| 2019 | Closing | Simple Moving Average (3 Years Interval) | | | | | |
|---|---|---|---|---|---|---|---|
| **BSE AUTO** | | | | | | | |
| April | 19780.66 | | | | | | |
| May | 18229.81 | | | | | | |
| June | 17985.28 | 18665.25 | | | | | |
| July | 17044.48 | 17753.19 | | | | | |
| August | 15689.10 | 16906.29 | 17774.91 | | | | |
| September | 16249.87 | 16327.82 | 16995.77 | | | | |
| October | 17419.95 | 16452.98 | 16562.36 | 17111.01 | | | |
| November | 18196.24 | 17288.69 | 16689.83 | 16749.32 | | | |
| December | 17951.38 | 17855.86 | 17199.17 | 16817.12 | 16892.48 | | |
| January | 18647.63 | 18265.08 | 17803.21 | 17230.74 | 16932.39 | | |
| February | 17627.93 | 18075.65 | 18065.53 | 17689.31 | 17245.72 | 17023.53 | |
| March | 12882.27 | 16385.94 | 17575.56 | 17814.77 | 17578.27 | 17252.13 | 17137.83 |

Source: Based on own analysis in Excel software

Table 17 - BSE AUTO (Year 2020)

| 2020 | Closing | Simple Moving Average (3 Years Interval) | | | | | |
|---|---|---|---|---|---|---|---|
| **BSE AUTO** | | | | | | | |
| April | 12418.44 | | | | | | |
| May | 12841.26 | | | | | | |
| June | 14752.50 | 13337.40 | | | | | |
| July | 16036.89 | 14543.55 | | | | | |
| August | 17688.31 | 16159.23 | 14680.06 | | | | |
| September | 18121.69 | 17282.30 | 15995.03 | | | | |
| October | 17992.57 | 17934.19 | 17125.24 | 15933.44 | | | |
| November | 18912.86 | 18342.38 | 17852.96 | 16991.07 | | | |
| December | 20662.19 | 19189.21 | 18488.59 | 17822.26 | 16915.59 | | |
| January | 22864.62 | 20813.22 | 19448.27 | 18596.61 | 17803.31 | | |
| February | 24644.57 | 22723.79 | 20908.74 | 19615.20 | 18678.02 | 17798.98 | |
| March | 23247.67 | 23585.62 | 22374.21 | 20910.41 | 19707.40 | 18729.58 | 18264.28 |

Source: Based on own analysis in Excel software

Table 18 - BSE AUTO Returns

| BSE AUTO | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 18001.75 | |
| **2016-17** | 21247.10 | 0.18 |
| **2017-18** | 24672.24 | 0.16 |
| **2018-19** | 22245.12 | -0.10 |
| **2019-20** | 17137.83 | -0.23 |
| **2020-21** | 18264.28 | 0.07 |
| **Mean** | | 0.02 |
| **Standard Deviation** | | 0.16 |

21247.10-18001.75=3245.35/18001.75

24672.24-21247.10=3425.14/21247.10

22245.12-24672.24=(2427.1)/24672.24

Mean = 0.18+0.16+(0.10)+(0.23)+0.07/5

SD = Excel Calculation

Source: Based on own analysis in Excel software

Table 19 - BSE BANKEX (Year 2016)

| BSE BANKEX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 18423.94 | | | | | | |
| **May** | 18963.91 | | | | | | |
| **June** | 20300.82 | 19229.56 | | | | | |
| **July** | 21567.62 | 20277.45 | | | | | |
| **August** | 21864.81 | 21244.42 | 20250.47 | | | | |
| **September** | 22798.27 | 22076.90 | 21199.59 | | | | |
| **October** | 22173.85 | 22278.98 | 21866.76 | 21105.61 | | | |
| **November** | 21980.80 | 22317.64 | 22224.51 | 21763.62 | | | |
| **December** | 20953.79 | 21702.81 | 22099.81 | 22063.69 | 21644.31 | | |
| **January** | 21692.24 | 21542.28 | 21854.24 | 22059.52 | 21962.28 | | |
| **February** | 23228.91 | 21958.32 | 21734.47 | 21896.17 | 22006.46 | 21871.02 | |
| **March** | 23987.51 | 22969.56 | 22156.72 | 21915.14 | 21956.95 | 21975.23 | 21923.12 |

Source: Based on own analysis in Excel software

Table 20 - BSE BANKEX (Year 2017)

| BSE BANKEX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2017** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 24656.48 | | | | | | |
| **May** | 25891.57 | | | | | | |
| **June** | 26632.87 | 25726.97 | | | | | |
| **July** | 27169.27 | 26564.57 | | | | | |
| **August** | 27318.70 | 27040.28 | 26443.94 | | | | |
| **September** | 27993.08 | 27493.69 | 27032.85 | | | | |
| **October** | 27413.53 | 27575.10 | 27369.69 | 26948.83 | | | |
| **November** | 28920.07 | 28108.89 | 27725.89 | 27376.14 | | | |
| **December** | 28674.67 | 28336.09 | 28006.70 | 27700.76 | 27341.91 | | |
| **January** | 29540.84 | 29045.20 | 28496.73 | 28076.44 | 27717.78 | | |
| **February** | 28609.74 | 28941.75 | 28774.35 | 28425.92 | 28067.71 | 27709.13 | |
| **March** | 27653.43 | 28601.33 | 28862.76 | 28711.28 | 28404.55 | 28063.35 | 27886.24 |

Source: Based on own analysis in Excel software

Table 21 - BSE BANKEX (Year 2018)

| BSE BANKEX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2018** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 28240.27 | | | | | | |
| **May** | 29284.84 | | | | | | |
| **June** | 29658.28 | 29061.13 | | | | | |
| **July** | 29748.30 | 29563.80 | | | | | |
| **August** | 31705.95 | 30370.84 | 29665.26 | | | | |
| **September** | 30069.57 | 30507.94 | 30147.53 | | | | |
| **October** | 28192.56 | 29989.36 | 30289.38 | 30034.06 | | | |
| **November** | 29377.45 | 29213.19 | 29903.50 | 30113.47 | | | |
| **December** | 30050.78 | 29206.93 | 29469.83 | 29887.57 | 30011.70 | | |
| **January** | 30750.70 | 30059.64 | 29493.26 | 29622.19 | 29874.41 | | |
| **February** | 30073.44 | 30291.64 | 29852.74 | 29605.27 | 29705.01 | 29863.71 | |
| **March** | 32718.53 | 31180.89 | 30510.72 | 29952.24 | 29726.57 | 29768.66 | 29816.19 |

Source: Based on own analysis in Excel software

Table 22 - BSE BANKEX (Year 2019)

| BSE BANKEX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2019** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 33745.46 | | | | | | |
| **May** | 33013.75 | | | | | | |
| **June** | 34378.42 | 33712.54 | | | | | |
| **July** | 34181.35 | 33857.84 | | | | | |
| **August** | 31581.80 | 33380.52 | 33650.30 | | | | |
| **September** | 31327.03 | 32363.39 | 33200.59 | | | | |
| **October** | 32539.80 | 31816.21 | 32520.04 | 33123.64 | | | |
| **November** | 35128.56 | 32998.46 | 32392.69 | 32704.44 | | | |
| **December** | 36418.67 | 34695.68 | 33170.12 | 32694.28 | 32840.79 | | |
| **January** | 35795.59 | 35780.94 | 34491.69 | 33351.50 | 32916.74 | | |
| **February** | 35545.67 | 35919.98 | 35465.53 | 34375.78 | 33473.85 | 33077.13 | |
| **March** | 25374.43 | 32238.56 | 34646.49 | 34867.91 | 34198.39 | 33529.66 | 33303.39 |

Source: Based on own analysis in Excel software

Table 23 - BSE BANKEX (Year 2020)

| BSE BANKEX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2020** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 22727.30 | | | | | | |
| **May** | 21169.81 | | | | | | |
| **June** | 23479.66 | 22458.92 | | | | | |
| **July** | 24936.75 | 23195.41 | | | | | |
| **August** | 25043.44 | 24486.62 | 23380.32 | | | | |
| **September** | 25234.83 | 25071.67 | 24251.23 | | | | |
| **October** | 27086.41 | 25788.22 | 25115.50 | 24249.02 | | | |
| **November** | 32973.86 | 28431.70 | 26430.53 | 25265.76 | | | |
| **December** | 34997.32 | 31685.86 | 28635.26 | 26727.10 | 25413.96 | | |
| **January** | 36616.24 | 34862.47 | 31660.01 | 28908.60 | 26967.15 | | |
| **February** | 41139.27 | 37584.28 | 34710.87 | 31668.71 | 29101.47 | 27160.86 | |
| **March** | 39171.43 | 38975.65 | 37140.80 | 34503.89 | 31693.74 | 29254.12 | 28207.49 |

Source: Based on own analysis in Excel software

Table 24 - BSE BANKEX Returns

| BSE BANKEX | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 18391.96 | |
| **2016-17** | 21923.12 | 0.19 |
| **2017-18** | 27886.24 | 0.27 |
| **2018-19** | 29816.19 | 0.07 |
| **2019-20** | 33303.39 | 0.12 |
| **2020-21** | 28207.49 | -0.15 |
| **Mean** | | 0.10 |
| **Standard Deviation** | | 0.14 |

Source: Based on own analysis in Excel software

Table 25 - BSE IT (Year 2016)

| BSE IT | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 11386.29 | | | | | | |
| **May** | 11243.47 | | | | | | |
| **June** | 11353.21 | 11327.66 | | | | | |
| **July** | 10836.45 | 11144.38 | | | | | |
| **August** | 10743.48 | 10977.71 | 11149.91 | | | | |
| **September** | 10306.04 | 10628.66 | 10916.92 | | | | |
| **October** | 10228.00 | 10425.84 | 10677.40 | 10914.74 | | | |
| **November** | 9353.22 | 9962.42 | 10338.97 | 10644.43 | | | |
| **December** | 9962.75 | 9847.99 | 10078.75 | 10365.04 | 10641.41 | | |
| **January** | 9930.88 | 9748.95 | 9853.12 | 10090.28 | 10366.58 | | |
| **February** | 10130.49 | 10008.04 | 9868.33 | 9933.40 | 10129.58 | 10379.19 | |
| **March** | 10466.19 | 10175.85 | 9977.62 | 9899.69 | 9974.46 | 10156.87 | 10268.03 |

Source: Based on own analysis in Excel software

Table 26 - BSE IT (Year 2017)

| BSE IT | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2017** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 9750.79 | | | | | | |
| **May** | 10065.32 | | | | | | |
| **June** | 9991.35 | 9935.82 | | | | | |
| **July** | 10160.01 | 10072.23 | | | | | |
| **August** | 10200.46 | 10117.27 | 10041.77 | | | | |
| **September** | 10035.73 | 10132.07 | 10107.19 | | | | |
| **October** | 10367.89 | 10201.36 | 10150.24 | 10099.73 | | | |
| **November** | 10735.77 | 10379.80 | 10237.74 | 10165.06 | | | |
| **December** | 10887.65 | 10663.77 | 10414.98 | 10267.65 | 10177.48 | | |
| **January** | 11911.99 | 11178.47 | 10740.68 | 10464.47 | 10299.06 | | |
| **February** | 12102.66 | 11634.10 | 11158.78 | 10771.48 | 10501.20 | 10325.91 | |
| **March** | 12337.11 | 12117.25 | 11643.27 | 11180.91 | 10805.62 | 10535.29 | 10430.60 |

Source: Based on own analysis in Excel software

Table 27 - BSE IT (Year 2018)

| BSE IT | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2018** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 12672.66 | | | | | | |
| **May** | 13228.63 | | | | | | |
| **June** | 13737.94 | 13213.08 | | | | | |
| **July** | 14410.45 | 13792.34 | | | | | |
| **August** | 14928.13 | 14358.84 | 13788.08 | | | | |
| **September** | 15695.61 | 15011.40 | 14387.53 | | | | |
| **October** | 14469.41 | 15031.05 | 14800.43 | 14325.35 | | | |
| **November** | 13997.62 | 14720.88 | 14921.11 | 14703.02 | | | |
| **December** | 14460.94 | 14309.32 | 14687.08 | 14802.87 | 14610.41 | | |
| **January** | 14466.62 | 14308.40 | 14446.20 | 14684.80 | 14730.23 | | |
| **February** | 15356.04 | 14761.20 | 14459.64 | 14530.97 | 14672.88 | 14671.18 | |
| **March** | 15055.24 | 14959.30 | 14676.30 | 14527.38 | 14581.05 | 14661.39 | 14666.28 |

Source: Based on own analysis in Excel software

Table 28 - BSE IT (Year 2019)

| | | BSE IT | | | | | |
|---|---|---|---|---|---|---|---|
| **2019** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 15572.04 | | | | | | |
| **May** | 15030.96 | | | | | | |
| **June** | 15960.54 | 15521.18 | | | | | |
| **July** | 15442.23 | 15477.91 | | | | | |
| **August** | 15665.75 | 15689.51 | 15562.86 | | | | |
| **September** | 15838.24 | 15648.74 | 15605.38 | | | | |
| **October** | 15151.02 | 15551.67 | 15629.97 | 15599.41 | | | |
| **November** | 15204.93 | 15398.06 | 15532.82 | 15589.39 | | | |
| **December** | 15226.79 | 15194.25 | 15381.33 | 15514.71 | 15567.84 | | |
| **January** | 16078.75 | 15503.49 | 15365.27 | 15426.47 | 15510.19 | | |
| **February** | 16302.54 | 15869.36 | 15522.37 | 15422.99 | 15454.72 | 15510.92 | |
| **March** | 12349.05 | 14910.11 | 15427.65 | 15438.43 | 15429.30 | 15464.74 | 15487.83 |

Source: Based on own analysis in Excel software

Table 29 - BSE IT (Year 2020)

| | | BSE IT | | | | | |
|---|---|---|---|---|---|---|---|
| **2020** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 12746.96 | | | | | | |
| **May** | 13588.96 | | | | | | |
| **June** | 14522.88 | 13619.60 | | | | | |
| **July** | 16740.22 | 14950.68 | | | | | |
| **August** | 18297.93 | 16520.34 | 15030.21 | | | | |
| **September** | 19500.94 | 18179.70 | 16550.24 | | | | |
| **October** | 21975.39 | 19924.76 | 18208.26 | 16596.24 | | | |
| **November** | 21583.81 | 21020.05 | 19708.17 | 18155.56 | | | |
| **December** | 22862.26 | 22140.49 | 21028.43 | 19648.29 | 18133.36 | | |
| **January** | 26456.70 | 23634.26 | 22264.93 | 21000.51 | 19601.45 | | |
| **February** | 25716.86 | 25011.94 | 23595.56 | 22296.31 | 20981.70 | 19572.17 | |
| **March** | 26292.98 | 26155.51 | 24933.90 | 23598.13 | 22298.32 | 20960.49 | 20266.33 |

Source: Based on own analysis in Excel software

Table 30 - BSE IT Returns

| BSE IT | | |
|---|---|---|
| Year | Closing price | Return (Ri) |
| 2015-16 | 11387.95 | |
| 2016-17 | 10268.03 | -0.10 |
| 2017-18 | 10430.60 | 0.02 |
| 2018-19 | 14666.28 | 0.41 |
| 2019-20 | 15487.83 | 0.06 |
| 2020-21 | 20266.33 | 0.31 |
| Mean | | 0.14 |
| Standard Deviation | | 0.19 |

Source: Based on own analysis in Excel software

Table 31 - BSE OIL & GAS (Year 2016)

| BSE OIL & GAS | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2016 | Closing | Simple Moving Average (3 Years Interval) | | | | | |
| April | 9338.06 | | | | | | |
| May | 9135.08 | | | | | | |
| June | 9432.38 | 9301.84 | | | | | |
| July | 10201.40 | 9589.62 | | | | | |
| August | 10717.67 | 10117.15 | 9669.54 | | | | |
| September | 11129.40 | 10682.83 | 10129.87 | | | | |
| October | 12163.24 | 11336.77 | 10712.25 | 10170.55 | | | |
| November | 11711.84 | 11668.16 | 11229.25 | 10690.46 | | | |
| December | 11985.35 | 11953.47 | 11652.80 | 11198.10 | 10686.37 | | |
| January | 12572.26 | 12089.82 | 11903.82 | 11595.29 | 11161.28 | | |
| February | 13084.83 | 12547.48 | 12196.92 | 11917.85 | 11570.41 | 11139.36 | |
| March | 13370.15 | 13009.08 | 12548.79 | 12216.51 | 11909.88 | 11547.19 | 11343.27 |

Source: Based on own analysis in Excel software

Table 32 - BSE OIL & GAS (Year 2017)

| BSE OIL & GAS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2017** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 9338.06 | | | | | | |
| **May** | 9135.08 | | | | | | |
| **June** | 9432.38 | 9301.84 | | | | | |
| **July** | 10201.40 | 9589.62 | | | | | |
| **August** | 10717.67 | 10117.15 | 9669.54 | | | | |
| **September** | 11129.40 | 10682.83 | 10129.87 | | | | |
| **October** | 12163.24 | 11336.77 | 10712.25 | 10170.55 | | | |
| **November** | 11711.84 | 11668.16 | 11229.25 | 10690.46 | | | |
| **December** | 11985.35 | 11953.47 | 11652.80 | 11198.10 | 10686.37 | | |
| **January** | 12572.26 | 12089.82 | 11903.82 | 11595.29 | 11161.28 | | |
| **February** | 13084.83 | 12547.48 | 12196.92 | 11917.85 | 11570.41 | 11139.36 | |
| **March** | 13370.15 | 13009.08 | 12548.79 | 12216.51 | 11909.88 | 11547.19 | 11343.27 |

Source: Based on own analysis in Excel software

Table 33 - BSE OIL & GAS (Year 2018)

| BSE OIL & GAS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2018** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 14658.57 | | | | | | |
| **May** | 14469.92 | | | | | | |
| **June** | 14508.71 | 14545.73 | | | | | |
| **July** | 14198.20 | 14392.28 | | | | | |
| **August** | 14907.77 | 14538.23 | 14492.08 | | | | |
| **September** | 14769.76 | 14625.24 | 14518.58 | | | | |
| **October** | 13138.19 | 14271.90 | 14478.46 | 14496.37 | | | |
| **November** | 13592.68 | 13833.54 | 14243.56 | 14413.53 | | | |
| **December** | 13421.83 | 13384.23 | 13829.89 | 14183.97 | 14364.63 | | |
| **January** | 13423.92 | 13479.47 | 13565.75 | 13879.73 | 14159.08 | | |
| **February** | 13199.62 | 13348.45 | 13404.05 | 13599.90 | 13887.87 | 14137.19 | |
| **March** | 14942.33 | 13855.29 | 13561.07 | 13510.29 | 13663.31 | 13903.42 | 14020.30 |

Source: Based on own analysis in Excel software

Table 34 - BSE OIL & GAS (Year 2019)

| BSE OIL & GAS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2019** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 14782.14 | | | | | | |
| **May** | 14873.15 | | | | | | |
| **June** | 14928.81 | 14861.37 | | | | | |
| **July** | 14122.78 | 14641.58 | | | | | |
| **August** | 12971.70 | 14007.76 | 14503.57 | | | | |
| **September** | 13471.57 | 13522.02 | 14057.12 | | | | |
| **October** | 15064.98 | 13836.08 | 13788.62 | 14116.44 | | | |
| **November** | 15199.82 | 14578.79 | 13978.96 | 13941.57 | | | |
| **December** | 14800.39 | 15021.73 | 14478.87 | 14082.15 | 14046.72 | | |
| **January** | 14625.93 | 14875.38 | 14825.30 | 14427.71 | 14150.48 | | |
| **February** | 14054.31 | 14493.54 | 14796.89 | 14700.35 | 14403.40 | 14200.20 | |
| **March** | 10143.93 | 12941.39 | 14103.44 | 14575.21 | 14567.76 | 14373.88 | 14287.04 |

Source: Based on own analysis in Excel software

Table 35 - BSE OIL & GAS (Year 2020)

| BSE OIL & GAS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2020** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 11109.46 | | | | | | |
| **May** | 11117.88 | | | | | | |
| **June** | 12557.78 | 11595.04 | | | | | |
| **July** | 13037.34 | 12237.67 | | | | | |
| **August** | 13295.31 | 12963.48 | 12265.40 | | | | |
| **September** | 13134.79 | 13155.81 | 12785.65 | | | | |
| **October** | 11983.56 | 12804.55 | 12974.62 | 12675.22 | | | |
| **November** | 12943.17 | 12687.18 | 12882.51 | 12880.93 | | | |
| **December** | 14399.46 | 13108.73 | 12866.82 | 12907.98 | 12821.38 | | |
| **January** | 14960.54 | 14101.06 | 13298.99 | 13016.11 | 12935.01 | | |
| **February** | 14942.69 | 14767.57 | 13992.45 | 13386.09 | 13103.39 | 12953.26 | |
| **March** | 15556.02 | 15153.09 | 14673.90 | 13988.45 | 13463.55 | 13167.32 | 13060.29 |

Source: Based on own analysis in Excel software

Table 36 - BSE OIL & GAS Returns

| BSE OIL & GAS | | |
|---|---|---|
| **Year** | **Closing price** | **Return (Ri)** |
| **2015-16** | 9161.61 | |
| **2016-17** | 11343.27 | 0.24 |
| **2017-18** | 15263.51 | 0.35 |
| **2018-19** | 14020.30 | -0.08 |
| **2019-20** | 14287.04 | 0.02 |
| **2020-21** | 13060.29 | -0.09 |
| **Mean** | | 0.09 |
| **Standard Deviation** | | 0.17 |

Source: Based on own analysis in Excel software

Table 37 - BSE FMCG (Year 2016)

| BSE FMCG | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2016** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 7779.74 | | | | | | |
| **May** | 7814.43 | | | | | | |
| **June** | 8210.01 | 7934.73 | | | | | |
| **July** | 8596.53 | 8206.99 | | | | | |
| **August** | 8702.36 | 8502.96 | 8214.89 | | | | |
| **September** | 8789.84 | 8696.24 | 8468.73 | | | | |
| **October** | 8492.70 | 8661.63 | 8620.28 | 8434.63 | | | |
| **November** | 8020.66 | 8434.40 | 8597.42 | 8562.14 | | | |
| **December** | 7923.25 | 8145.53 | 8413.85 | 8543.85 | 8513.54 | | |
| **January** | 8374.28 | 8106.06 | 8228.66 | 8413.31 | 8506.44 | | |
| **February** | 8881.58 | 8393.04 | 8214.88 | 8285.80 | 8414.32 | 8478.10 | |
| **March** | 9161.60 | 8805.82 | 8434.97 | 8292.84 | 8330.65 | 8417.14 | 8447.62 |

Source: Based on own analysis in Excel software

Table 38 - BSE FMCG (Year 2017)

| BSE FMCG | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2017** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 9283.99 | | | | | | |
| **May** | 9583.79 | | | | | | |
| **June** | 10141.77 | 9669.85 | | | | | |
| **July** | 10455.22 | 10060.26 | | | | | |
| **August** | 9933.30 | 10176.76 | 9968.96 | | | | |
| **September** | 10156.88 | 10181.80 | 10139.61 | | | | |
| **October** | 10215.00 | 10101.72 | 10153.43 | 10087.33 | | | |
| **November** | 10242.39 | 10204.75 | 10162.76 | 10151.93 | | | |
| **December** | 10551.46 | 10336.28 | 10214.25 | 10176.81 | 10138.69 | | |
| **January** | 10800.55 | 10531.46 | 10357.50 | 10244.84 | 10191.19 | | |
| **February** | 10536.52 | 10629.51 | 10499.08 | 10356.95 | 10259.53 | 10196.47 | |
| **March** | 10366.42 | 10567.83 | 10576.27 | 10477.62 | 10359.80 | 10270.18 | 10233.32 |

Source: Based on own analysis in Excel software

Table 39 - BSE FMCG (Year 2018)

| BSE FMCG | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2018** | **Closing** | **Simple Moving Average (3 Years Interval)** | | | | | |
| **April** | 10802.97 | | | | | | |
| **May** | 11241.00 | | | | | | |
| **June** | 11204.93 | 11082.96 | | | | | |
| **July** | 11437.60 | 11294.51 | | | | | |
| **August** | 12347.42 | 11663.31 | 11346.93 | | | | |
| **September** | 11940.10 | 11908.37 | 11622.07 | | | | |
| **October** | 11033.92 | 11773.82 | 11781.84 | 11583.61 | | | |
| **November** | 11325.75 | 11433.26 | 11705.15 | 11703.02 | | | |
| **December** | 11766.14 | 11375.27 | 11527.45 | 11671.48 | 11652.70 | | |
| **January** | 11917.77 | 11669.89 | 11492.81 | 11575.13 | 11649.88 | | |
| **February** | 11369.12 | 11684.34 | 11576.50 | 11532.25 | 11592.95 | 11631.84 | |
| **March** | 11725.53 | 11670.81 | 11675.01 | 11581.44 | 11562.94 | 11601.92 | 11616.88 |

Source: Based on own analysis in Excel software

Table 40 - BSE FMCG (Year 2019)

| 2019 | Closing | Simple Moving Average (3 Years Interval) | | | | | |
|---|---|---|---|---|---|---|---|
| April | 11790.36 | | | | | | |
| May | 11733.08 | | | | | | |
| June | 11478.07 | 11667.17 | | | | | |
| July | 11189.16 | 11466.77 | | | | | |
| August | 10915.73 | 11194.32 | 11442.76 | | | | |
| September | 11011.51 | 11038.80 | 11233.30 | | | | |
| October | 11784.78 | 11237.34 | 11156.82 | 11277.63 | | | |
| November | 11838.31 | 11544.87 | 11273.67 | 11221.26 | | | |
| December | 11446.84 | 11689.98 | 11490.73 | 11307.07 | 11268.65 | | |
| January | 11861.59 | 11715.58 | 11650.14 | 11471.51 | 11333.28 | | |
| February | 11536.39 | 11614.94 | 11673.50 | 11604.79 | 11461.12 | 11354.35 | |
| March | 9412.96 | 10936.98 | 11422.50 | 11582.04 | 11552.78 | 11449.06 | 11401.71 |

Source: Based on own analysis in Excel software

Table 41 - BSE FMCG (Year 2020)

| BSE FMCG | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2020 | Closing | Simple Moving Average (3 Years Interval) | | | | | |
| April | 10915.69 | | | | | | |
| May | 10076.07 | | | | | | |
| June | 10798.93 | 10596.90 | | | | | |
| July | 11521.93 | 10798.98 | | | | | |
| August | 11713.59 | 11344.82 | 10913.56 | | | | |
| September | 11313.76 | 11516.43 | 11220.07 | | | | |
| October | 11054.41 | 11360.59 | 11407.28 | 11180.30 | | | |
| November | 11475.17 | 11281.11 | 11386.04 | 11337.80 | | | |
| December | 12548.74 | 11692.77 | 11444.82 | 11412.71 | 11310.27 | | |
| January | 12731.57 | 12251.83 | 11741.90 | 11524.26 | 11424.92 | | |
| February | 12504.22 | 12594.84 | 12179.81 | 11788.85 | 11575.27 | 11436.82 | |
| March | 12338.50 | 12524.76 | 12457.14 | 12126.29 | 11813.13 | 11604.44 | 11520.63 |

Source: Based on own analysis in Excel software

Table 42 - BSE FMCG Returns

| BSE FMCG | | |
|---|---|---|
| Year | Closing price | Return (Ri) |
| 2015-16 | 7692.32 | |
| 2016-17 | 8447.62 | 0.10 |
| 2017-18 | 10233.32 | 0.21 |
| 2018-19 | 11616.88 | 0.14 |
| 2019-20 | 11401.71 | -0.02 |
| 2020-21 | 11520.63 | 0.01 |
| Mean | | 0.09 |
| Standard Deviation | | 0.08 |

Source: Based on own analysis in Excel software