TABLEAU

Data analytics and visualization using Tableau utilitarian for COVID-19 (Coronavirus)

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Abstract

In 2020 the world has generating 52 times the amount of data as in 2010, and 76 times the number of information sources. Being able to use this data provides huge opportunities and to turn these opportunities into reality, people need to use data to solve problems. Unfortunately in the midst of a global pandemic, when people throughout the world are looking for reliable, trustworthy information about COVID-19(Coronavirus). In this scenario tableau play the vital role, because Tableau is an extremely powerful tool for visualizing massive sets of data very easily. It has an easy to use drag and drop interface. You can build beautiful visualizations easily and in a short amount of time. Tableau supports a wide array of data sources. COVID-19(Coronavirus) analytics with Tableau, you will create dashboards that help you identify the story within our data, and we will better understand the impact of COVID-19 (Coronavirus). In this paper comprehensive review about Tableau. The Tableau are the tools which deals with the big data analytics also it generates the output in visualization technique i.e., more understandable and presentable. Its features include data blending, real-time reporting and collaboration of data. In the end, this paper gives the clear picture of growing COVID-19(Coronavirus) data and the tools which can help more effectively, accurately and efficiently.

Keywords: COVID-19 (Coronavirus); Data Analytics; Tableau; Visualization; Dashboards; Visual Analytics

1. Introduction

At present the data is been generated everywhere like YouTube, Tumblr, Reddit, Facebook, WhatsApp, Twitter, Instagram Gmail, LinkedIn and Academia. Understanding this data is very important as this is crucial and very important entity of an Organization, Nations, and Institutions. Big data is a collection of large [1] and complex data which are difficult to be handled with traditional data processing application software. Analyzing and visualizations [2] the data sets can give a new business trends, prevent diseases, and model to forecast future paradigms and combat crime and so on. At this time, the most used tools for data analytics and visualizations, data discovery are tableau [3]. Tableau is one of the fastest upcoming business intelligence (BI) tool. It is fast to deploy, easy to learn and very useful for a user. Tableau is a software [4] that can help users explore and understand their data by creating interactive visualizations. The software has the advantages that it can be used in conjunction with almost any database, and it is easy to use by dragging and dropping to create an interactive visualization [5] expressing the desired format. The COVID-19(Coronavirus) has proven to be a truly global pandemic, impacting people in just about every corner of the world. The usefulness of Tableau in COVID-19(Coronavirus) [6] data analytics can be measured by its performance, user friendly environment, and speed. A tableau, a tool use for complex visualization and simplification of complex data. It was designed to help the user to create visuals and graphics without the help of any programmer or any prior knowledge of programming. Data visualization is an intuitive way for users to easily read and understand data, especially in big data analyses [7]. It helps to improve the quality of governance [8] policies or services by presenting an integrated view and evidence for making

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better decisions [9]. Tableau connects users with a variety of data sources and enables them to create data visualizations by making charts, maps, dashboards, and stories through a simple drag and drop interface.

This paper presents a procedure for the interactive visualization and analysis of COVID-19(Coronavirus) data using Tableau as a intelligence tool. Tableau can connect to files, relational and Big Data [1] sources to acquire and process data. The software allows data blending and real-time collaboration, which makes it very unique.Data analysis [10] is very fast with Tableau [11] and the visualizations created are in visual form with dashboards and worksheets. A Tableau dashboard allows for multiple visualizations to be seen within a single view. It's often used to show only the most important data and is sometimes personalized. It works by connecting to data stored in various places. It can pull data from any source imaginable. From a simple excel sheet to PDF to complex database like Oracle to the next level of cloud such as Amazon webs services[12], Microsoft Azure SQL database [13], Google Cloud SQL, can be extracted by Tableau.Therefore,we are introduces Tableau and presents the procedure ofusing Tableau for the interactive visualization and analysis of COVID-19(Coronavirus) [14] data to encourage its widespread use.Tableau is a new age data analytics and visualizations tool [15] that provides flexibility and ease-of-use with a smooth experience to the users.

2. Data Visualization

Data visualization is the use of human natural skills to enhance data processing and organization efficiency. Data visualization is the representation of data or information in a graph, chart, or other visual format. Visualization can help us deal with more complex information and enhance memory [16]. It communicates relationships of the data with images. This is important because it allows trends and patterns to be more easily seen. With the rise of big data upon us, we need to be able to interpret increasingly larger batches of data. Machine learning makes it easier to conduct analyses such as predictive analysis, which can then serve as helpful visualizations to present [17]. But data visualization is not only important for data scientists and data analysts, it is necessary to understand data visualization in any career. Whether you work in finance, marketing, tech, design, or anything else, we need to visualize data. That fact showcases the importance of data visualization. Its main goal is to distill large datasets into visual graphics to allow for easy understanding of complex relationships within the data [18]. It is often used interchangeably with terms such as information graphics, statistical graphics, and information visualization. Data visualization is a huge field with many disciplines. It is precisely because of this interdisciplinary nature that the visualization field is full of vitality and opportunities.

2.1. Necessity of Data Visualization

According to the World Economic Forum, the world produces 2.6 quintillion bytes of data every day [19], and 90% of all data has been created in the last two years [20]. With so much data, it's become increasingly difficult to manage and make sense of it all. It would be impossible for any single person to wade through data line-by-line and see distinct patterns and make observations. Data proliferation can be managed as part of the data science process, which includes data visualization. We need data visualization because a visual summary of information makes it easier to identify patterns and trends than looking through thousands of rows on a spreadsheet. It's the way the human brain works. Since the purpose of data analysis is to gain insights, data is much more valuable when it is visualized. Even if a data analyst can pull insights from data without visualization, it will be more difficult to communicate the meaning without visualization [21]. The charts and graphs make communicating data findings easier even if we are identify the patterns without them. The numerous types of data visualizations for example Line charts, Box plots, Area charts, Sankey diagram, Scatter plots, Bar charts. Population pyramids, Pie charts, Heat maps, Bar chart (actual vs. expected), Tree maps, Histograms, Bubble charts, Chloropleth, Network diagram etc.

2.2. Subfields of Data Visualization

Data visualization is the presentation of quantitative information in a graphical form. In other words, data visualizations turn large and small datasets into visuals that are easier for the human brain to understand and process. Data visualizations are surprisingly common in our everyday life, but they often appear in the form of well-known charts and graphs [22]. In terms of business intelligence (BI), these visualizations help users make better data-based decisions. Data visualization transforms raw data into information. The data visualization has three significant subfields.

2.2.1. Scientific Visualization

Scientific visualization is the representation of data graphically to gain understanding and insight into the data. This allows the researcher to gain insight into the system that studied information in ways previously impossible. It is also referred to as visual data analysis [23]. The purpose is to convey the scientific data accurately, reveal underlying

structures in data and encourage the exploration of the data. Scientific visualization is an interdisciplinary research and application field in science, focusing on the visualization of three-dimensional phenomena, such as architecture, meteorology, medicine or biological systems. Its purpose is to graphically illustrate scientific data, enabling scientists to understand, explain, and collect patterns from the data.

2.2.2. Visual Analytics

Visual Analytics can be perceived as an integrated approach that combines visualization, human factors, and data analysis. Visual analytics is a new field that has evolved with the development of scientific visualization and information visualization, with an emphasis on analytical reasoning through an interactive visual interface. Visual analytics methods allow decision makers to combine their human flexibility, creativity, and background knowledge with the enormous storage and processing capacities of today's computers to gain insight into complex problems [24]. Visual analytics in the context of visualization relates to the areas of information visualization and computer graphics, and with respect to data analysis, it benefits largely from methodologies of information retrieval, data management & knowledge representation as well as data mining.

2.2.3. Information Visualization

Information visualization refers to the use of computer-supported, interactive visual representations of numerical and non-numerical abstract data sets in order to amplify human cognition. Information visualization, the art of representing data in a way that it is easy to understand and to manipulate, can help us make sense of information and thus make it useful in our lives [25]. Information visualization is the communication of abstract data through interactive visual interfaces. Graphics such as histograms, trend graphs, flow charts, and tree diagrams all belong to information visualization and the design of these graphics transforms abstract concepts into visual information.

3. Tableau

The COVID-19 pandemic has impacted nearly every aspect of life around the globe, and data analytics vendors are mobilizing to help individuals, scientists, governments, and businesses understand the shape and scope of the crisis. In this scenario, Tableau is very advantageously tool. Because Tableau is a data analysis and visualization tool which can connect with many data sources comfortably. The big advantage with Tableau is its ability to create interactive dashboards. These dashboards can be created without much coding knowledge, through visual intuitive drag and drop interface. Tableau has been very popular among organizations due to its ability to translate data into insightful visual dashboard [26]. The Tableau utilizes application integration innovations like JavaScript APIs and single sign-on application to include Tableau analytics into basic business applications consistently. Tableau can create an ample range of visualization to interactively present the data and showcase insights. It comes with tools that allow to drilldown data and see the impact in a visual format that can be easily understood by any individual. Tableau also comes with real-time data analytics capacity and cloud support. Here we discuss the various versions of tableau, it benefits and implementation. We will see how tableau is various from ms excel and other spreadsheet tools. Tableau is the most strong, safe and flexible end-to-end analytical platform for our information from connection via cooperation. It also enhances data power for people [27]. Tableau is the only business intelligence platform designed for the individual but scaled for business that turns information into an insight which drives action. Tableau can manage millions of rows of data with ease. Different types of visualization can be created by the large amount of data without having another performance of the dashboards. Also, there is an option in Tableau where user can make live two connections to different data sources like SQL etc. There are, any different types of visualization options available in tableau which egregious the user experience [28]. Lastly, Tableau is very easy to learn, anyone without having any knowledge of coding can easily learn Tableau.

4. Versions of Tableau

Tableau makes it easy to share data, no matter what your requirements are. Tableau Online is an easy-to-use, cloud based BI tool that can enable any organization to share visualizations created in Tableau Desktop with other people [29]. Tableau Server enables the same sharing capabilities through a similar interface, but it is installed on our own network servers and managed by yourself. As we would expect, all visualizations on Tableau Server and Tableau online are fully interactive and can be embedded in any webpage. Additionally, the Tableau engine can connect to live data for up-to-date visualizations or warehoused data for many smoother-moving visualizations. In this section, we are discussing the different type of Tableau versions.

4.1. Tableau Public

This is a free version of Tableau software which can be used to make visualizations. It is an economical version which is very good for people wanting to learn and share their data with people. The files are published on Tableau Public and cannot be stored in the system. Tableau Public is not secured one and anyone can access the data and download.

4.2. Tableau Desktop

Tableau Desktop is similar to Tableau Public with the difference being you can load the worksheet in our system. It is a licensed version with two weeks of trail. We are enjoy real-time data analytics by directly connecting to data from your data warehouse. We are easily import our data into Tableau's data engine from multiple sources and integrate them by combining multiple views in an interactive dashboard. Tableau desktop produces files with extensions twb and twbx. Tableau desktop users can make use of server & online for a high-performance data repository.

4.3. Tableau Server

In Tableau Server Users can interact with the dashboards on the server without any installation on their machines. Tableau Online is Tableau Server hosted by Tableau on a cloud platform. Tableau Online is a fully hosted solution, organizations don't have to spend resources on configuring hardware, scalability or maintenance [30]. Tableau server also provides robust security to the dashboards. Tableau Server web-edit feature allows authorized users to download and edit the dashboards. Tableau server allows users to publish and share their data sources as live connections or extracts. Tableau Server is highly secured for visualizing data. It leverages fast databases through live connections.

4.4. Tableau Reader

Tableau Reader is a free desktop application to view and interacts with Tableau visualizations. Users can view dashboards saved as twbx. This means that we can filter and drill down the data but cannot edit or perform any kind of interactions or edits.

4.5. Tableau Online

This is a hosted version of Tableau server. It is usually powered with the help of cloud computing to make the software available to everyone [31]. This enables faster and easier access to business intelligence on the go. It is a sharing tool that is hosted in Sass (Software as a Service) cloud version, maintained outside the system firewall and supports SQL based sources hosted on a cloud platform as well as live data connections to Amazon Redshift, Google BigQuery, etc. Tableau Online is a fully hosted solution, organizations don't have to spend resources on configuring hardware, scalability or maintenance and it is highly secured for data visualizing.

5. Tableau Architecture

Tableau server is designed in a way to connect many data tiers shown in figure 1. It can connect clients from desktop, mobile, and web. Tableau desktop is a robust data visualization tool. It is highly available and secure. It can run on both virtual and physical machines. It is a multi-user, multi-process and multi-threaded system [32]. It can makes COVID-19 data analytics easy and helps you perform a variety of tasks, including accessing databases, collaborate on projects, generate reports, and so on. The best thing about Tableau is it can connect with multiple sources at once. It blends the data it receives from those sources to give you accurate results.

5.1. Tableau Data Server Process

The primary component of Tableau Architecture is the data sources it can connect to it. It stores data in the repository, keeps the user's data secure, and performs many similar essential tasks. Tableau can connect to multiple data sources. These data sources can be on-premise or remotely located. It can connect to a database, excel file, and a web application all at the same time. Tableau can connect data from heterogeneous environments. Tableau can work with all these at the simultaneously. Tableau gives simple alternatives to update your data to be quick and responsive with our quick in-memory data engine [29]. It can blend the data from multiple data sources. It can also make the relationship between various types of data sources.
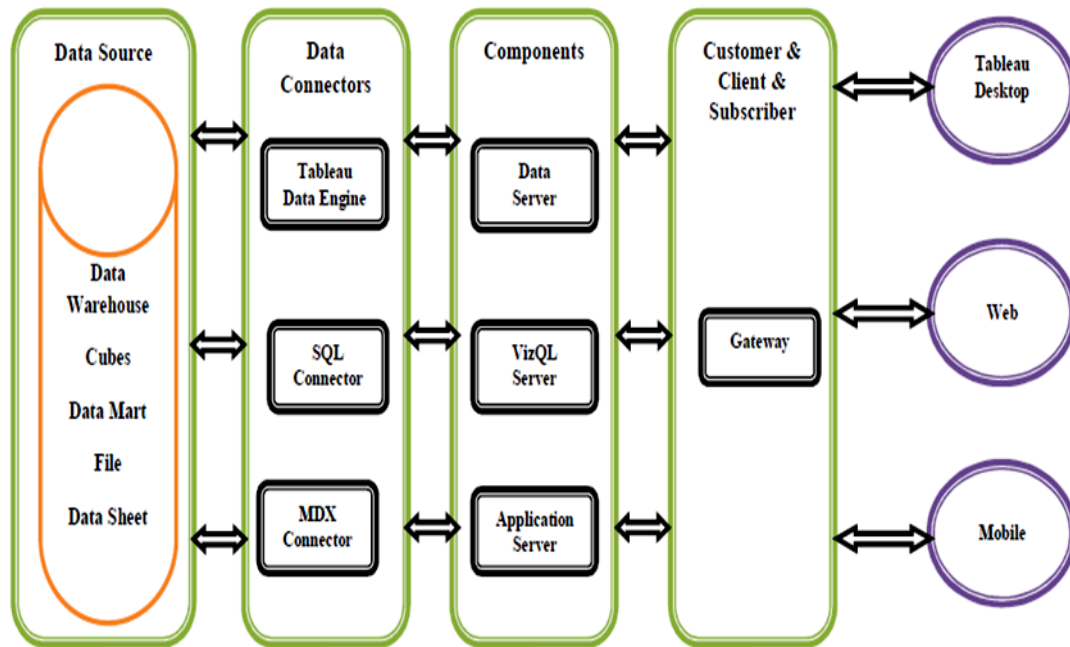
Figure 1 The Tableau Architecture

5.2. Tableau Data Connectors Process

The data connectors provide an interface to connect external data sources to Tableau Data Server. Tableau has in-built ODBC/SQL connector. This ODBC connector can connect to any databases without using their native connector. Tableau has an option to select both live and extract data. Tableau includes various connectors for databases, for example, Microsoft Excel, SQL Server, Oracle, Teradata, Vertica, Cloudera Hadoop, and significantly more. Tableau provides you with two options for storing this transferred data. Firstly, the real time data in this method we are transfer data directly from an external source in this method. Tableau sends SQL statements and multi-dimensional expressions for transferring data. The secondly option extracted data in this method apart from relying on a live data source, we can retrieve data from a particular source as well. Tableau enables you to create a local copy of the data as an extract file. Tableau's data extraction is capable of extracting millions of records from a data source. The straightforward interface ensures that data extraction doesn't remain complicated for you.

5.3. Tableau Application Server Process

The application server is used to provide the authentications and authorizations. It handles the administration and permission for web and mobile interfaces. It assures security by recording each session id on Tableau server. The administrator can configure the default timeout of the session in the server [30]. The application server handles the web application and REST API calls. The application server also supports browsing and searching. To ensure high availability of application server, configure instances on each node in the Tableau server cluster. It also handles processes related to the VizQL server that isn't concerned with data visualization.

5.4. Tableau VizQL Server Process

The VizQL server is used to convert the queries from the data source into visualizations. Once the client request is forwarded to VizQL process, it sends the query directly to data source and retrieves information in the form of images [33]. This image or visualization is presented to the user. Tableau server creates a cache of visualization to reduce the load time. The cache can be shared across many users who have the permission to view the visualization. To achieve high availability for the VizQL server process, configure one or more instances to run on multiple nodes.

5.5. Tableau Gateway Process

Gateway is a kind of web server that helps clients communicates to the server via HTTP or https. The gateway channelizes the requests from users to Tableau components. When the client makes a request, it is forwarded to external load balancer for processing. The gateway works as a distributor of processes to various components. In case of absence of external load balancer, gateway also works as a load balancer. For single server configuration, one primary server or gateway manages all the processes. For multiple server configurations, one physical system works as primary server

while others are used as worker servers [32]. The Tableau server gateway process is an Apache web server component (httpd.exe). Its role is to handle requests to the server from all clients from Tableau desktop, mobile devices, a proxy, a load balancer, etc. The gateway can also act as a load balancer if the system lacks one.

5.6. Tableau Data Engine Process

The data engine optimizes the speed of analytical processes for better efficiency. It creates refreshes or queries extracts. It can also help you with cross-database joins when you use data sources having several connections. Data engine technology optimized for fast data ingests and analytical query processing on large or complex data sets. The data engine is used when creating, refreshing or querying extracts. It is also used for cross database joins to support federated data sources with multiple connections. The data engine is designed to leverage all available CPU and memory on the machine to provide the fastest response times.

5.7. Tableau Backgrounder Process

Backgrounder is an essential multi-process, a multi-process element that manages schedules for information refreshing and ensures proper functioning of the Tableau server and data engine. The backgrounder process runs server jobs, including extract refreshes, subscriptions, flow runs, and data driven alerts. Jobs are initiated both from scheduled tasks and when started manually using 'Run Now', REST API, or tabcmd commands [30]. it also helps in rebuilding search indexes, checking available disk space, and synchronizing directory groups.

5.8. Tableau Repository Process

The repositories in Tableau server stores server metadata related to users, permissions, assignments, groups, and projects, data sources, and extract metadata and refresh information. Along with the metadata, it stores visualizations in flat files (TWS, TDS), and performance data for auditing. Whenever a server service or component demands for metadata, it is provided from the repository. It also stores the visualizations in the form of flat files. It can also store performance data for future audits. It works with the active directory to send information to the application server for login verification.

5.9. Tableau Search and License Process

The license component, as the name suggests, handles the licensing tasks of the server [32]. On the other hand, the search section lets you search the index in the repository for our requirements. While these components might seem simple, they are essential for the proper functioning of the server. Both these services run on the primary server of the Tableau's server cluster.

5.10. Tableau Server File Store Process

The Tableau server file store process controls the storage of extracts. When file store is installed, an instance of the data engine is also installed unless the node already has an instance of the data engine. However, file store can be run locally as well as external to Tableau server. In highly available environments, the file store ensures that extracts are synchronized to other file store nodes so they are available if one file store node stops running.

5.11. Tableau Server Administration Controller Process

The Administration Controller process hosts the TSM REST API for configuring and managing your Tableau server deployment. There can only be a single instance of the administration controller in the entire cluster.

5.12. Tableau Clients

The clients are the end users using Tableau through a web, mobile devices, on-cloud, on-premise, or on a command-line interface for development. These end users interact mainly with Tableau server for accessing workbooks or visualizations[33]. Web browsers such as Safari, Google Chrome, and Mozilla Firefox can let you edit the contents of your visualization through the dashboards of Tableau online. Tableau desktop helps you in creating the dashboard, workbooks, and visualizations by using the data you received from sources. We are also publishing the results into the server for future use. This tool also lets you create custom designs for your dashboards according to tablets, phones, and PCs.

6. Tableau is Significant for Covid-19 (Coronavirus) Data Visualization

The continued spread of COVID-19 (coronavirus) disease is rapidly changing our daily life, we need data analysis and visualizations. In this scenario Tableau is frequently used as a tool that helps to analyze data quickly and creates visualizations for worksheets and dashboards. Tableau enables us to make dashboards that give actionable insights and spreads the business faster. Tableau products are always operated in virtualized environments if they are configured with proper hardware and operating system. With Tableau, you can work with more unordered COVID-19 (coronavirus) data [34] and create varieties of visualizations with the help of the in-built features offering by Tableau. Moreover, we will be able to achieve great context, several ways of drilling the COVID-19 (coronavirus) data and exploring the data within minutes. Tableau helps organizations in analyzing future data without any future goals in mind. We are exploring visualizations and observe COVID-19 (coronavirus) data from different approaches. With hypothetical visualizations and a feature of adding components for comparison and analysis, we are frame 'what-if' queries and work on the data accordingly. The user-friendly feature is the major strength of Tableau.

This feature demonstrates the ability of an individual to work without any technical or coding knowledge. Since Tableau offers most of its features in a drag-and-drop form and each visualization [35] is built-in and self depicting. The reason behind must-add Tableau to the process by various enterprises is that COVID-19 (coronavirus) data can come from any source in today's data-driven world. This tool allows you connecting different data sources, data warehouses, cloud files, big data, spreadsheet data, non-relational, and several other types of data. Tableau can blend every kind of data to help COVID-19 researcher, organizations for producing attractive visualizations. Tableau can add new data sets easily which can be automatically blended with Tableau using common fields. Tableau allows you to work with more unordered data and develop stunning visualization. We can do that while observing data from several angles and approaches.

7. How to Connect Our Data in Tableau

When open Tableau you are taken to the home page where you can easily select from previous workbooks, sample workbooks (Tableau Workbook files [twb] are the main file type created by Tableau to save your entire workbook.), and saved data sources. We are also connecting to new data sources by selecting connect to data shown in figure 2. The option in a file is for connecting to locally stored data or file based data. If your database isn't listed try the other database connector (ODBC) that utilizes the Open Database Connectivity standard. We are seeing a list of saved data sources on the right. Saved data source files (.tds) are found on your computer's hard disk in the data sources directory under the My Tableau repository.
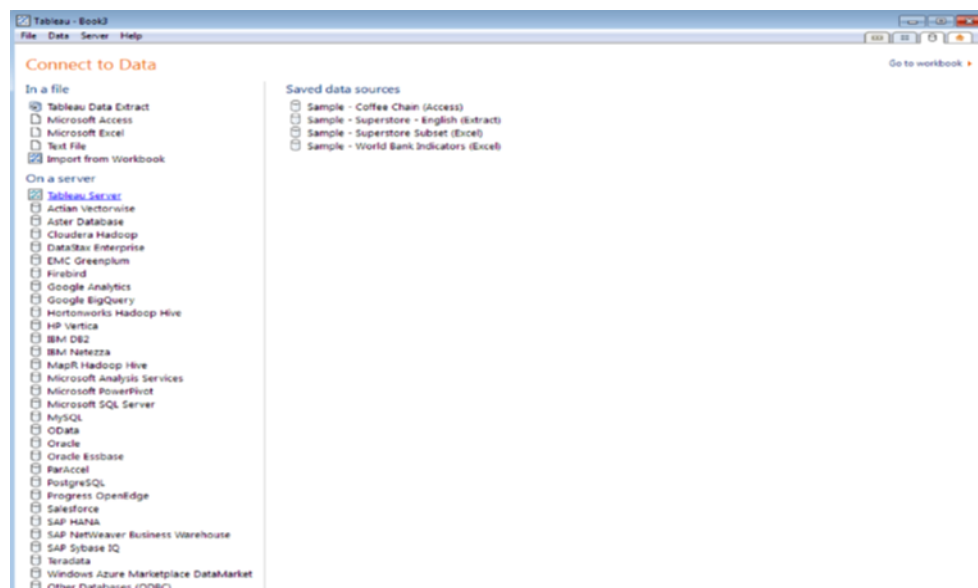

Figure 2 TheConnect to Data

If we are logged into Tableau server you may also see saved data sources on your server's repository. The figure 3 shows the connection window with the datasorce being the file that is being accessed [36]. There are three tabs in the spreadsheet file. Tableau interprets these tabs the same way it views different tables in a database. Once you have selected and customized your data connection, you will be taken to the second data connection window where you must

decide whether or not to create an extract. There are advantages to extracting the data into Tableau data engine, particularly when you are using Excel, Access, or text files as your data source.
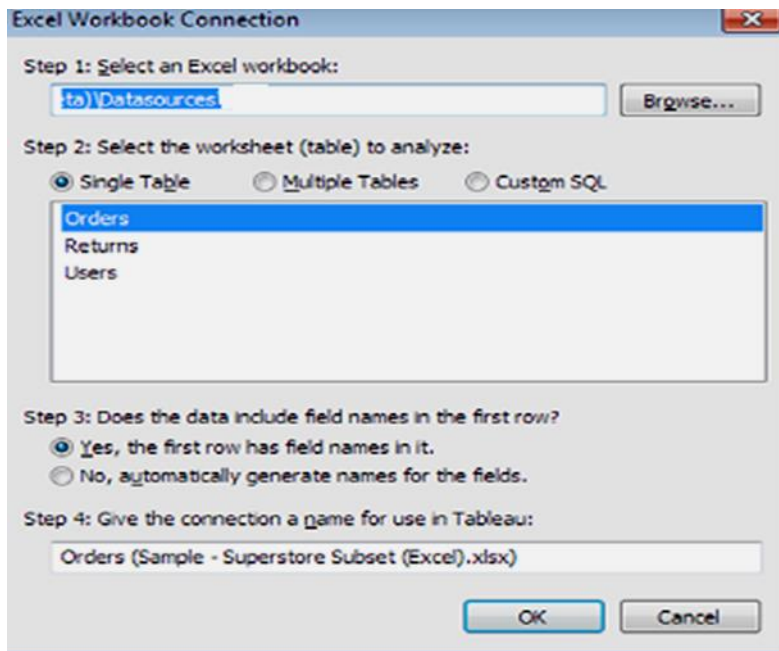

Figure 3 The Connection Window

7.1. Tableau Geocoding Process

Suppose our data contains standard geographic fields like country, state, province, city, or postal codes denoted by a small globe icon Tableau will automatically generate the longitude and latitude values for the centre points of each geographic entity displayed in your visualization.
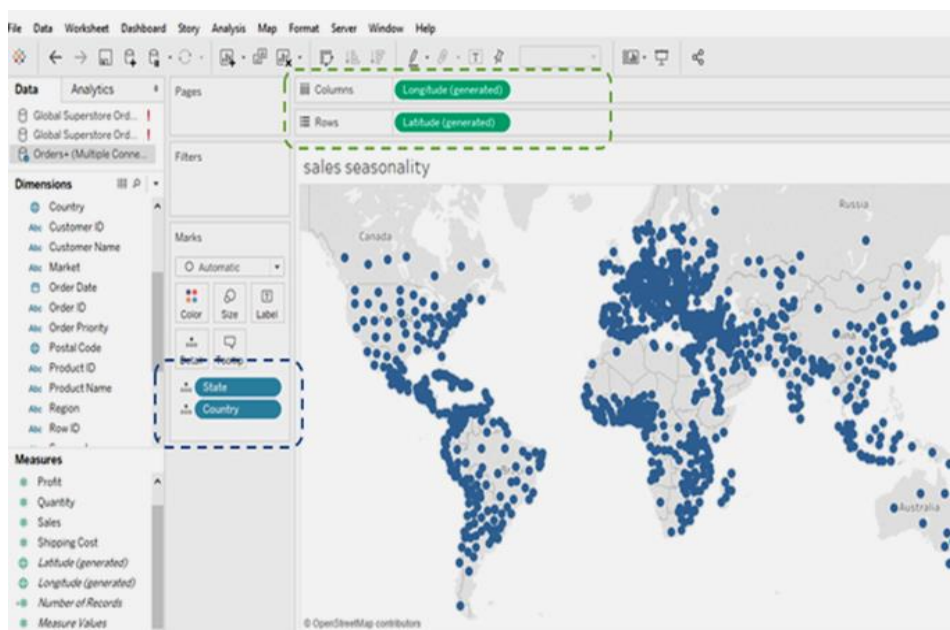
Figure 4 The Longitude & Latitude Generated Measures in Tableau

If for some reason Tableau doesn't recognize a [11] geographic dimension, you can change the geographic role of the field by right-clicking on the field and selecting the appropriate geographic role. Figure 4 shows a map created using country, state, and city, then using show me to display the symbol map. The map option menu seen on the left was exposed from the map menu, map option selection. If Tableau failed to recognize any location, a small gray pill would

appear in the lower right of the map. Clicking on that pill would expose a menu that would help you identify and correct the geocoding.

7.2. Tableau Blending Process

Suppose data isn't in one place, blending provides a viable way to quickly create a left-join-like connection between our primary and secondary datasources. The creating data blends require a little planning. If w are going to bring data that doesn't reside in your primary datasource you have to think about what field(s) you may need in order to achieve the desired result [26]. There are many ways first we are creating a blend the automatic method or manually defining the blend. They persist only on the worksheet page on which they are created. But blends offer a different kind of flexibility the ability to alter the primary datasource for each worksheet page.

8. Visualization in Tableau

In this section, we are discussing add trend lines, reference lines, and control the way your data is sorted and filtered. Tableau's mission statement is to help you see and understand your data by enabling self-service visual analytics. The software is designed to facilitate analysis for non-technical information consumers.
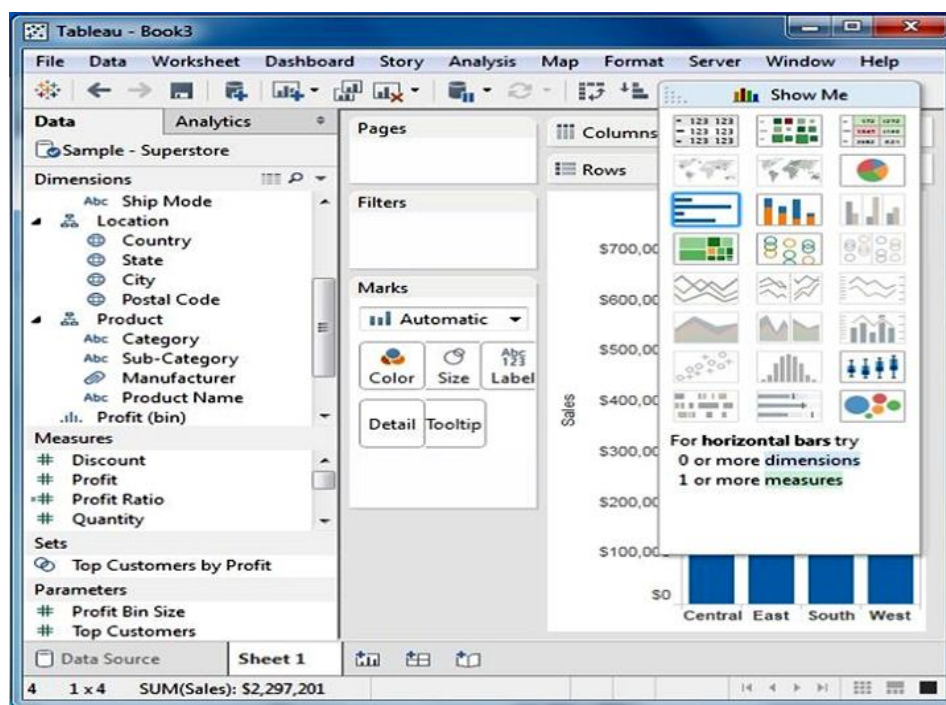

Figure 5 Show Me Displays Chart Options

This is the concept behind Tableau's show me button shown in figure 5. Show me to be your expert helper. Show me tells you what chart to use and why. It will also help we create complicated visualizations [35] faster and with less effort. Show me looks at the combination of measures and dimensions we are selected and interprets what chart types display the data most effectively. At the bottom of the show me area you also see additional details regarding requirements needed for building any available chart. The time series chart requires one date, one measure, and zero or more dimensions. Pointing at other chart options in the Show Me menu changes the text at the bottom of the menu. This text provides guidance on the combination of data elements required for the chart being considered. Clicking on any of the highlighted show me icons alters the visualization in the worksheet.

8.1. Trend Lines and Reference Lines in Tableau

Trend lines are considered to be of great use in data visualization and analysis. In Tableau, we get a lot of options to create different types of trend lines which helps in inferring important patterns and trends in our data. In visualizing granular data sometimes results in random-looking plots shown in figure 6. Trend lines help you interpret the data by fitting a straight or curved line that best represents the pattern contained within detailed data plots. Reference lines provide visual comparisons to benchmark figures, constants, or calculated values that provide insight into marks that

don't conform to expected or desired values [28]. Trend lines help you see patterns in data that are not apparent when looking at your chart of the source data by drawing a line that best fits the values in view. Reference lines allow you to compare the actual plot against targets or to create statistical analyses of the deviation contained in the plot; or the range of values based on fixed or calculated numbers.
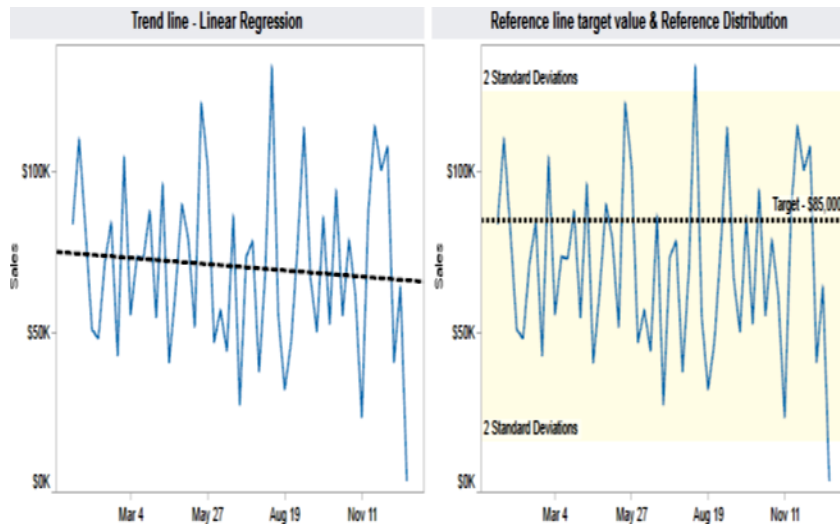

Figure 6 Trend Line and Reference Line

8.2. Sorting Data in Tableau

Tableau provides basic and advanced sorting methods that are easily accessed through icons or menus. The most basic way to sort is via the icons that appear in the toolbar menu. The toolbar menu sort icons provide ascending and descending sorts. In figure 7 shows a bar chart in which a manual sort was applied from the toolbar icon. Tableau also provides sorting icons near the headings and mark axis. If we don't see an icon, hover your mouse near the area and it will appear. The clicking on the sort icon floating over the right side of the sub-category heading provides ascending and descending sorts using the text of the product category headings. The sort icons that appear over and under the mark (bar) axis provide ascending and descending sorts based on the values displayed by the marks, and also add datasource order sorting.
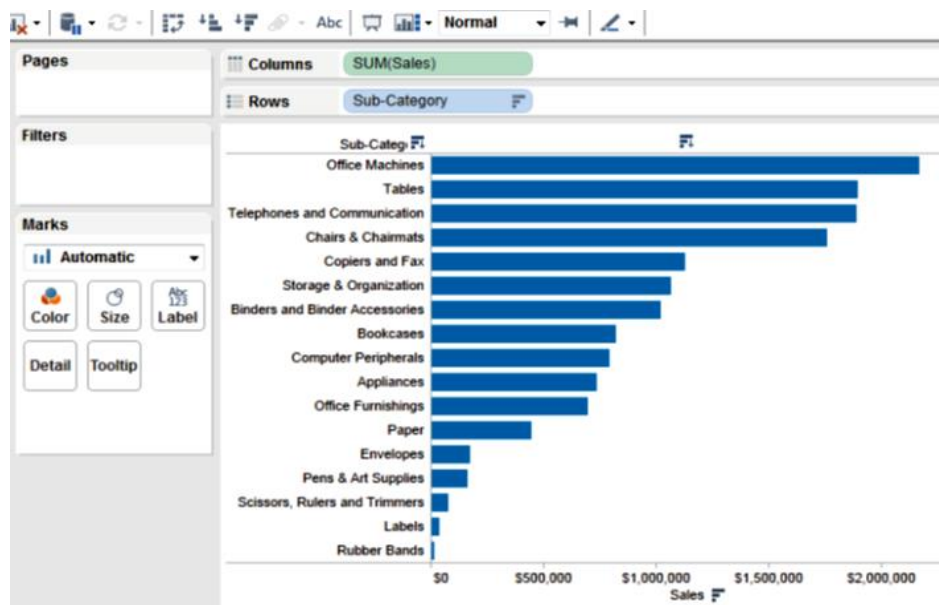

Figure 7 Sorting Data in Tableau

9. Dashboard and Stories in Tableau

First of all question arises why use a dashboard in tableau because dashboard helps one to show several worksheets in a single space. In addition to this, one can provide supporting information, compare and monitor varieties of data simultaneously [36]. A dashboard is a visual display of the most important information needed to achieve one or more objectives that fits entirely on a single computer screen, so that it can be viewed, monitored and managed at a glance. In other words, we can say that a dashboard is a user interface that organizes and presents information in a way that is easy to read.
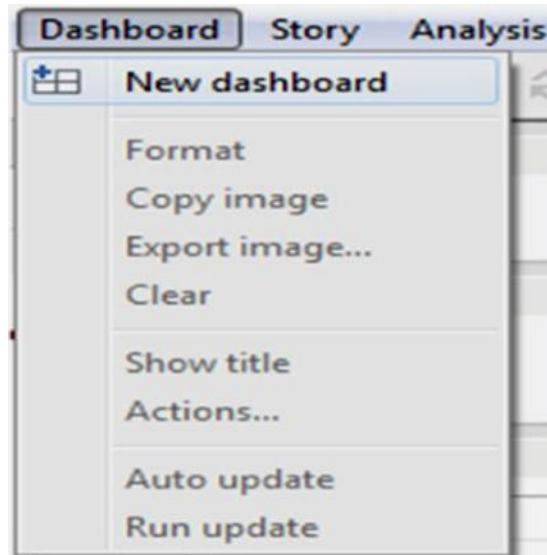
Figure 8 The New Dashboard in Tableau

It consolidates and arranges numbers, metrics and sometimes performance scorecards on a single screen. We are seeing the dashboard tab at the bottom of the workbook similar to the worksheet tab. We are adding views from your workbook to the dashboard. You can add web pages, images and text areas to our dashboard as well. A dashboard allows you to format, edit, drill-down, and edit axes on our view. When add a view to the dashboard [37], it automatically connects to the corresponding worksheet. When modify the worksheet, the dashboard is updated automatically and vice-versa. One or more views & worksheets can be pulled into a dashboard. We are add interactivity to the dashboard and can do much more. We are creating a dashboard in the same way you create a new worksheet. After creating a new dashboard sheet, we are adding one or more views and objects to the dashboard. Firstly select dashboard for new dashboard figure 8 shows. Alternatively, we are click on the "New dashboard" tab at the bottom of the workbook and click on "Dashboard" to open the dashboard in figure 9.

Figure 9 The Dashboard in Tableau

All the worksheets currently present in the workbook are displayed. If we create a new worksheet, that worksheet is added to the dashboard window automatically.
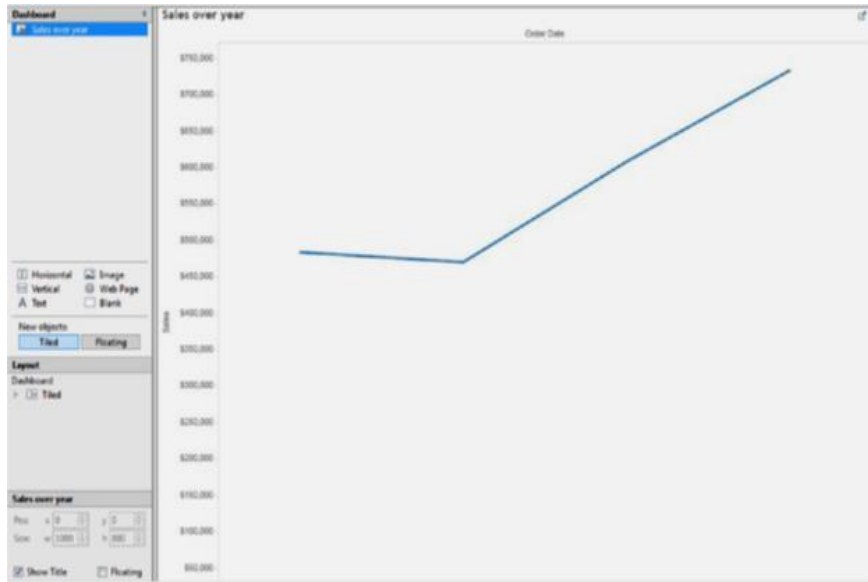
Figure 10 Dashboard Sheet in Tableau

This feature helps you to view all the worksheets available in the workbook. To add a view to the dashboard, click the view and drag it to your dashboard sheet on the right figure 10 shows.
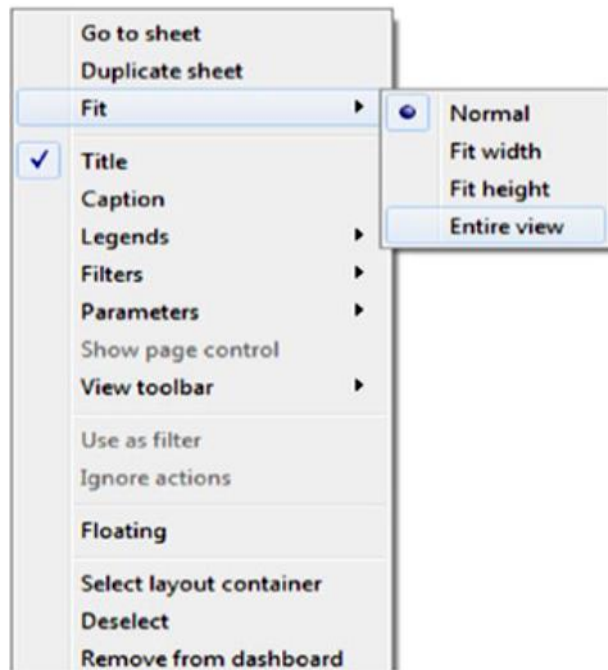

Figure 11 Entire View in Tableau

If you have a complex data source, it is difficult to review, monitor and manage the views. We are creating an interactive dashboard to limit the data that is displayed on the dashboard. If you want entire view our data first of all right click on dashboard sheet and select fit entire view shown in figure 11. We are organizing our dashboard in several ways to tell a story or highlight and emphasize information. Tableau provides two types of layouts tiled and floating by default, dashboard uses tiled layout. In tiled layout, all views and objects are arranged on a single layer. In a floating layout, views or objects can be layered on other objects. To change default layout, click on floating button in the middle of the dashboard pane as shown in figure 12.
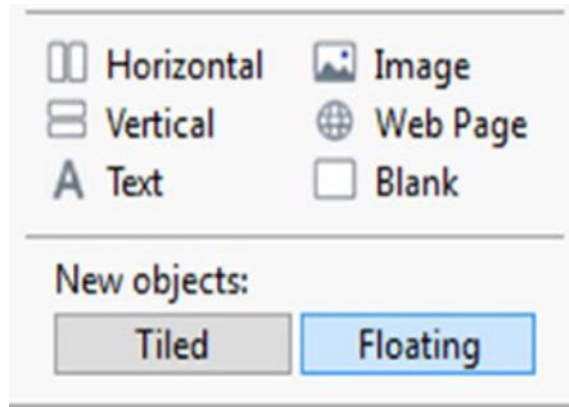
Figure 12 Tiled and Floating Layout Button in Tableau

9.1. Dashboard Actions in Tableau

Tableau allows you to add interactivity to the dashboard using actions. With the help of actions, we can use data in one view to filter data in another view, to link external web pages, to highlight specific results. There are three types of actions in Tableau. Firstly, filter actions are defined by a source sheet that passes one or more dimensional values as filters to target sheets upon an action [37]. Secondly, highlight actions allow you to call attention to marks of interest by coloring specific marks and dimming all others. Thirdly, URL actions allow you to generate dynamically a URL based on an action and open it within a web object in the dashboard or in a new browser window or a tab.

9.2. Creating a Story in Tableau

A story is a sheet or a collection of worksheets arranged in sequence shown in figure 13. Each individual sheet in a story is known as story point. In Tableau, stories are not just a collection of static sheets [38]. We are making your story points remain connected to the underlying data to reflect data changes. We are use stories in different ways. Firstly, we can assemble the sequence sheet to perform what-if analysis. Secondly, we can use stories to present history of views or dashboards to audience.

Figure 13 The New Story Tab in Tableau

We are choosing "Size" for your story from the lower-left corner of the dashboards and worksheets pane [38]. Click on the story title to edit the title of the story as shown in figure 14.
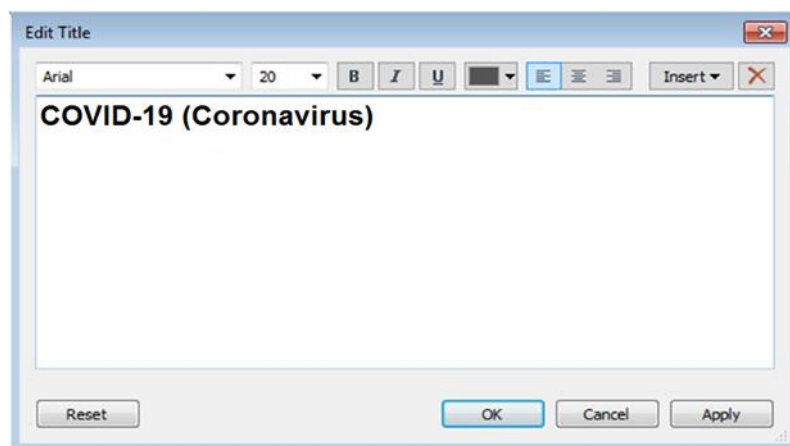

Figure 14 The Story "Edit Title" Dialog Box in Tableau

Figure 15 COVID-19 (Coronavirus) in the Centre of the View in Tableau

Drag the "COVID-19 (Coronavirus)" view under dashboards and worksheets pane to the centre of the view shown in figure 15. We are creating stories to tell how facts are connected, to provide context and to tell compelling COVID-19 (Coronavirus) cases.

10. Using Dashboards to get Outcomes in Tableau

The dashboards are more than visual tools to display data and dashboards are used as decision making tools to obtain outcomes quickly. We are helping our COVID-19 researcher to make decisions fast by producing dashboards that are in line with the current research and thinking about dashboard structure. We are also help researcher get results from their dashboard by improving the availability of COVID-19 data. Using dashboards [38] facilitating the researcher to explore and understand the data speedily and sharing information with COVID-19 team members and beyond. Providing adaptability in the dashboard and allowing flexibility for COVID-19 researcher to add notes to their dashboard. On the initial Tableau page, select connect to data and navigate to the location where you stored the data files, as shown in figure 16.
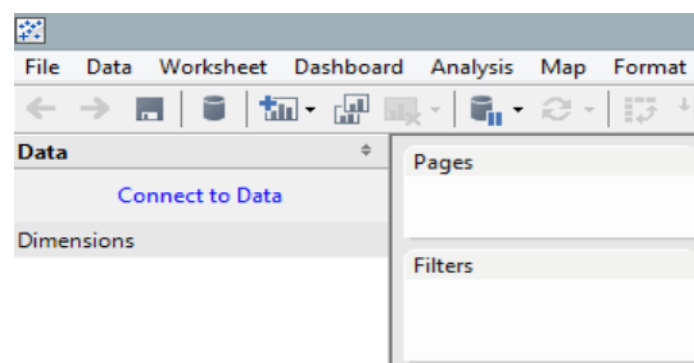

Figure 16 Connect to Data and Navigate in Tableau

Navigate to the file and select it. Next, select the option to load multiple tables shown in figure(17).
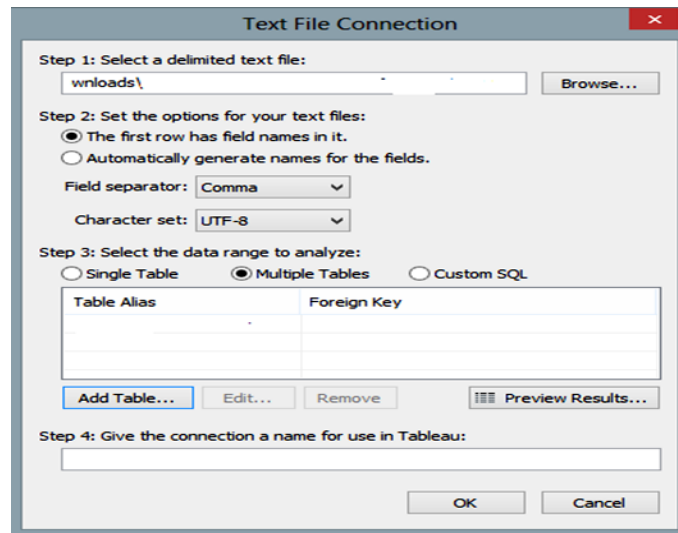
Figure 17 Text File Connection in Tableau

We will add the date dimension first. The connection to the table is called DimDate#csv shown in figure 18.
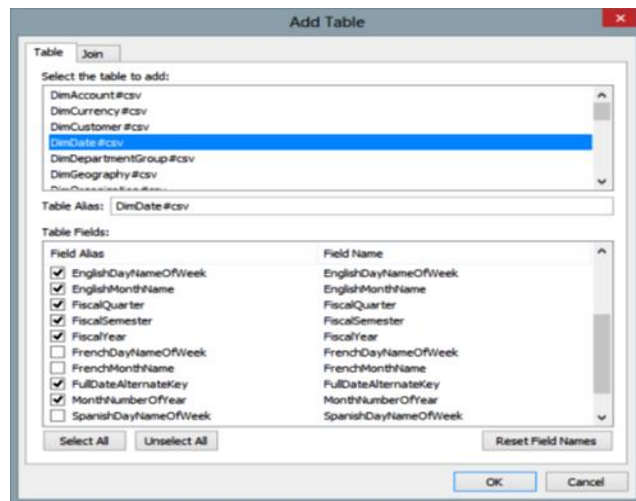

Figure 18 Add Table Connection in Tableau

Once we have added all of the tables. Once you have clicked on ok, we are importing all the data or just some of it. We will import all of the data into Tableau's data engine. A list of the options is shown in the figure 19.
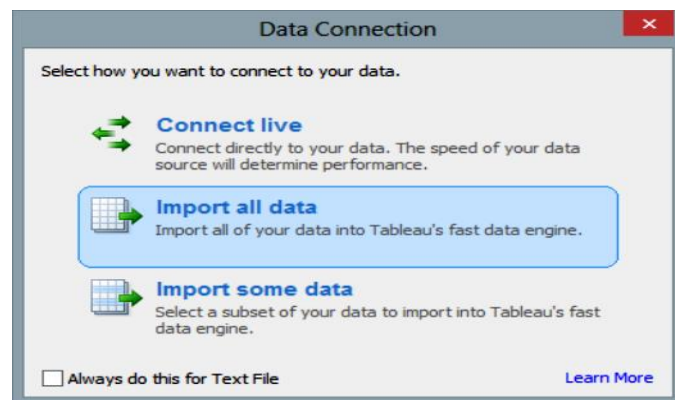

Figure 19 Import Data Connection in Tableau

Once we have imported our appropriate data, our Tableau worksheet will show all of the tables [38] on the left-hand side. We are seeing that the tables are located in the data pane on the left-hand side.

11. Data Items and Calculated Fields in Tableau

The item names are based on the names in your selected data source. Within Tableau, We are renaming items to make them relevant for our audience. Tableau offers five types of data items Number, Date & time, Date, String, and Boolean. By default, when Tableau connects to our data, it determines which type is the best match for a data item using the data source information and rules around data types [39]. It is important to note that items will behave differently in our views based on the data type. Usually, we only will need to modify data types when using Access, Excel, or text files as data sources. Relational and multidimensional databases are usually preformatted so that Tableau can select the correct data types when we open them.

11.1. Dimensions and Measures in Tableau

In Tableau, dimensions and measures are the primary means of grouping data items in the data Items pane. Tableau treats any field containing qualitative or categorical information as a dimension. In general, dimensions are items used to create row or column headers in a view. Thereunto, Tableau treats any field containing numeric information as a measure. Measures typically produce axes when added to the rows or columns shelves. Measures are computed using the specified aggregation for each unique combination of row and column dimensions used in the view.

11.2. Continuous vs Discrete Data Items in Tableau

In Tableau, all data items are classified as either continuous or discrete. In the Data Items pane, the icons located to the left of all data items are color coded as green (continuous) or blue (discrete). Additionally, when we select a particular data item, discrete items will be framed with a blue oval and continuous item by a green one. When added to the rows or columns shelves, continuous items always create axes and discrete items always create headers. We are converting both measures and dimensions that are continuous items to discrete and discrete items to continuous, although more often you will convert continuous to discrete due to the Tableau defaults.

11.3. Geographic Roles in Tableau

Tableau offers exciting mapping capabilities to overlay our data onto relevant maps. Tableau automatically assigns a geographic role to data items that have certain name and data types assigned to them shown in the figure 20. All other items have a default geographic role of none. Additionally, we are adding our own geographic roles to extend the capabilities of Tableau, such as the location of our stores based on store identifier. If Tableau does not properly identify our geographic item, we are changing this role by right-clicking the item, selecting Geographic Role, and choosing the proper geographic role from the list. Once our data item is assigned a geographic role, it is distinguished with a small globe icon. Our dataset may have some miscoded items that Tableau cannot map.
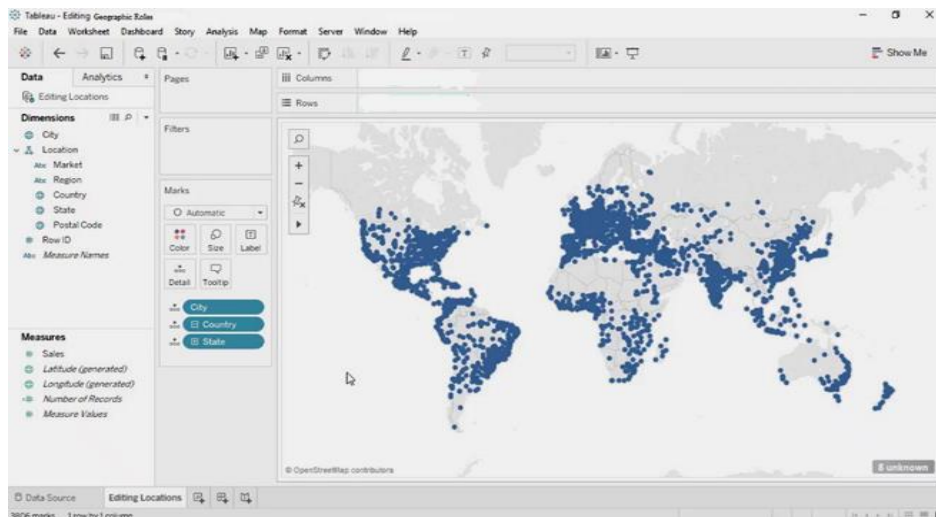

Figure 20 Geographic Roles in Tableau

11.4. Calculated Fields in Tableau

In Tableau the many functions available organized in a table for easy lookup, and parameters that allow you to quickly fine tune the data we use in our analyses. Sometimes ours analysis needs a data item that our original data source does not include but that oneself could calculate using the current data items [39]. This is called a calculated field. For example, you might need a new data item called COVID-19 recovered cases ratio, the ratio of the COVID-19 recovered cases to the total confirmed cases. To create a new calculated field, right-click an existing data item that you want to include in the calculation and select create calculated field. The calculated field dialog will appear as shown below. This dialog also was shown earlier in the custom table calculation section shown in figure 21.
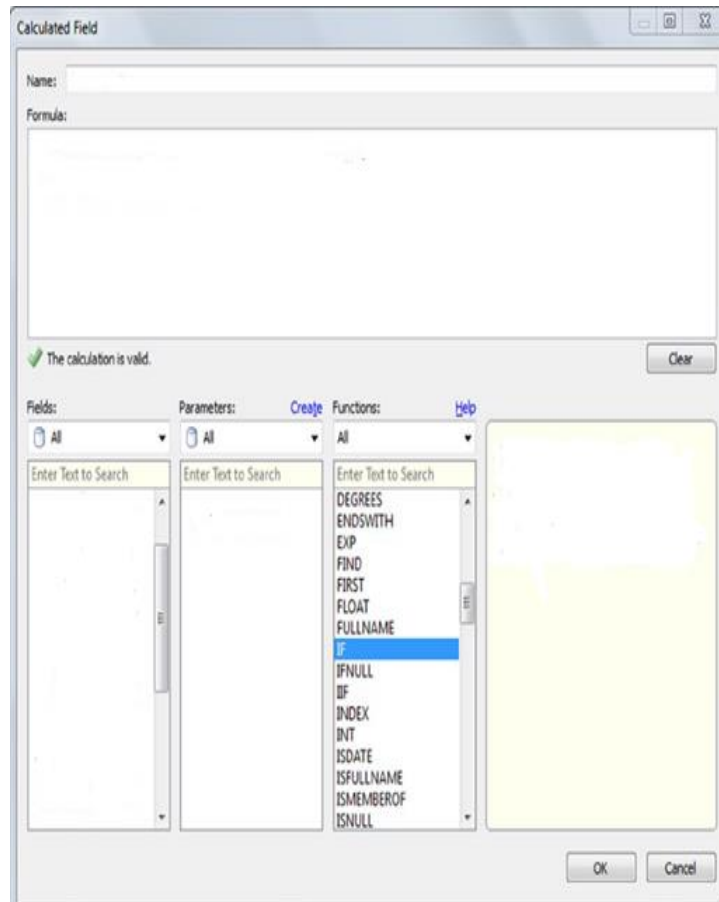

Figure 21 Calculated Field dialog in Tableau

From the calculated field dialog, we can name the new calculated field, enter the formula for the new field, and add data items from the field's pane, create and use parameters, and find functions by category and add them to the formula. We are covert the outcome of any calculation to a specific data type. The conversion functions are DATE, DATETIME, INT, STR, and FLOAT.

12. Forecasting in Tableau

Forecasting in Tableau uses a technique known as exponential smoothing. Forecast algorithms try to find a regular pattern in measures that can be continued into the future shown in figure 22. Tableau automatically selects the best of up to eight models, the best being the one that generates the highest quality forecast.
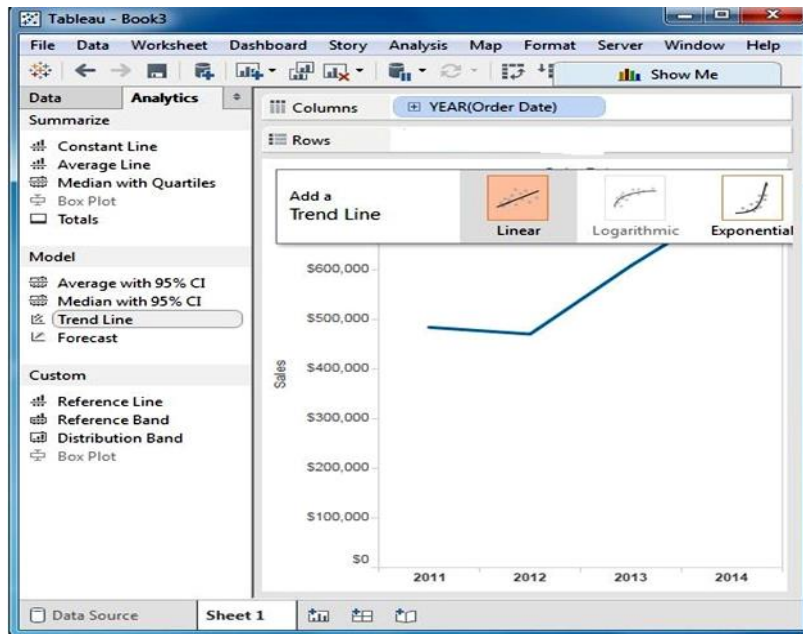
Figure 22 Forecasting in Tableau

The smoothing parameters of each model are optimized before Tableau assesses forecast quality [29]. The optimization method is global. Therefore, choosing locally optimal smoothing parameters that are not also globally optimal is not impossible. There are two important concepts on which the process of forecasting is based trends and seasonality. The trend is the increase or decrease in data over time and seasonality [30] is a repeating variation in values over a determined period of time (such as weekly, quarterly, yearly, etc) known as seasons.
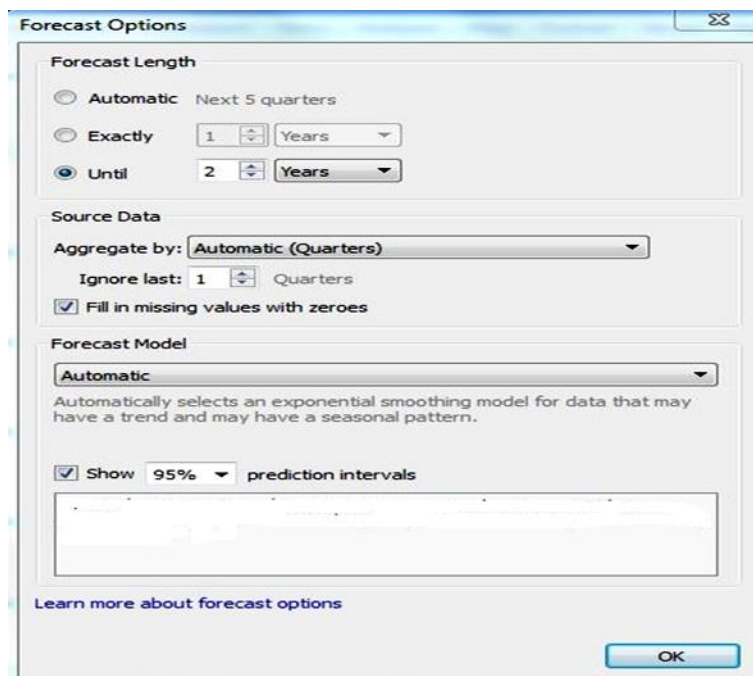

Figure 23 Forecasting Options in Tableau

Usually, Tableau considers variations occurring in a 12-months cycle to predict a forecast as the time values are in a yearly manner. If the data values are given on a 6-months basis, a 12-month trend is determined with two sub-trends underlying it. Tableau calculates seasonality and trends for different periods using different methods and models suiting the requirements of the data set. Before we start with creating a forecast, we must have a line chart as an extension of which, our forecast will be made. The forecast models will use data from this line chart to calculate and give an accurate

forecast [39]. The first step, add a date dimension in the columns section and a measure field in the rows section. This will give us a simple line chart. Now, go to the analytics pane and select forecast from the available model list. To explore more options related to forecasting shown in figure 23, right-click on the forecasting section and go to Forecast option and select forecast options [30]. We are view a detailed description of the forecast by right-clicking on the forecast section and then go to Forecast and select the option describe forecast. We are also adding another measure on the same line chart. We have a split view where we are compare the line charts and forecast of two fields with respect to the same time interval.

13. The Features of Tableau

A Tableau is a tool use for complex visualization and simplification of complex data. It is a highly scalable easily deployable [38]. In this section, we are discussing the some unique features which enable Tableau to handle diverse scenarios.

13.1. Blend Diverse Data Sets in Tableau

Tableau allows to blend different relational, semi structured and raw data sources in real time, without expensive up-front integration costs [30]. The users don't need to know the details of how data is stored.

13.2. Internet of Things (IoT) in Tableau

Presently, there is an increase in the number of industries leveraging the Internet of Things (IoT) to be able to collect large volumes of data for various forms of analytics [40]. Data visualization is a hot topic for IoT right now. As more companies incorporate data-driven initiatives and innovation into their overall strategy and operations, the central importance of data visualization [41] is growing. Service providers and end-users alike are beginning to recognize the distinctive value of data visualization tools for IoT applications. Tableau play the important role in data visualization in IoT [42] and Tableau helps magnify our view of IoT networks [43].

13.3. Mapping Enhancements in Tableau

Tableau introduced vector maps and began using Mapbox as its map provider. These enhancements provided better clarity of maps when zooming [44] and allowed for the display of satellite images and densit and heatmaps.

13.4. Real-Time Collaboration in Tableau

Tableau can filter, sort, and discuss data on the fly and embed a live dashboard in portals like SharePoint site or Salesforce [39]. We are save our view of data and allow colleagues to subscribe to our interactive dashboards so they see the very latest data just by refreshing their web browser.

13.5. Time Series Analysis in Tableau

The solution has built-in date and time functions that allow users to drag-and-drop and drill down with a click to analyze time trends and execute comparisons over time like year-over-year growth or get insights based on days of the week.

13.6. Encryption for Extracts in Tableau

Tableau's new encryption at rest feature encrypts Tableau extracts on Tableau server. Tableau extracts are persistent data files (stored on disk) and may contain sensitive data.

13.7. View Recommendations in Tableau

Tableau server now uses machine learning algorithms to help determine what views you might find best suited to display our data. It suggests views based on the data we are pulling and data used by others with similar preferences.

13.8. Ubiquitous in Tableau

Increasingly, users are no longer creating documents for a single delivery platform. Users need to view and interact with data on their desktops, over the web, on mobile devices, embedded in other applications and documents, and more. Tableau allows a single document to be published and then used across all these platforms without any porting or redesign.

13.9. Blockchain in Tableau

It is a well-known fact that Tableau is one of the most powerful, reliable, and flexible end-to-end analytics platform for data. It is all about visualizing the secrets hidden within big data [45]. Blockchain platforms are the next big wave in transforming our business [46]. Technically Blockchain is one variety of multi node data processing technique, specifically using inter-node communication technique. Blockchain data records [47] are not unalterable, but considered secured by design. They are fundamentally a data platform and currently do not have an easy way to visualize data in it. In general majority of Blockchain applications are using open source [48] visualization techniques instead of Tableau. In spite of that, somebody is REALLY looking for a FANCY integration with Tableau. They should work hard to integrate using a component called the Web Data Connector (WDC) [49].

13.10. Centralized Data in Tableau

Tableau server provides a centralized location to manage all of the organization's published data sources. We are delete, change permissions, add tags, and manage schedules in one convenient location [50]. It's easy to schedule extract refreshes and manage them in the data server.

13.11. Visual Discovery in Tableau

The user explores and analyzes the data by using visual tools like colors, trend lines, charts, and graphs [51]. There is very little script to be written as nearly everything is done by drag and drop.

13.12. Simplicity in Tableau

In many cases, users need the assistance of IT or a power user to help create the queries and documents they want. Tableau provides an intuitive interface for non-technical users to query and analyze complex data without needing them to become database or spreadsheet experts.

13.13. Iterative in Tableau

Discovery is an inherently cyclical process. Tableau is designed to speed the cycle from question [52] to insight to question so that users can quickly develop a hypothesis, test it with available data, revise that hypothesis, and test it again, and so on.

13.14. Mobile Support and Responsive Dashboard in Tableau

Tableau dashboard has a great reporting feature that allows you to customize dashboard specifically for a certain device such as a mobile phone or laptop [53]. Tableau automatically understands which device is the users are viewing the report on and make adjustments to ensure that the right report is served to the right device.

14. Conclusion

Currently data is at the heart of most breakthrough technologies in the 21st century. At the present time, spread of COVID-19 (Coronavirus) around the world has set off a spike of interest in data analytics and visualizations. Everyone wants to see and understand how case counts are rising, what kind of impact the virus might have on themselves and their community, and what role they can play in slowing the spread. We are use Tableau to create high-impact visualizations of common data analyses to help us see and understand our data. We are applying predictive analytics to improve preferable decision making for spread of COVID-19 (Coronavirus). Using Tableau people, scientist, and researcher can quickly access reliable information, and even analyze the data for themselves. With Tableau define discrete and continuous dates, and examine when to use each one to explain our data and also introduce mapping and explore how Tableau can use different types of geographic data, how to connect to multiple data sources and how to create custom maps. Tableau is a used for data visualizations which we can use to connect with almost any database, plot our data and get insights to understand the data properly. Using Tableau we are create dashboards, models, interactive visualizations as well as analyze our data thoroughly as well as to create story out of the data and view results, Tableau provide opportunities for yourselves or key decision-makers to discover COVID-19 data patterns such as COVID-19 pandemic behavior, match the results obtained through machine learning algorithms and Tableau visualizations. In this paper, we are review the background and state-of-the-art of Tableau. Eventually, Tableau's main task is connecting and extracting the stored information in different locations. It can collect information from any platform. Tableau can obtain information from any Excel, PDF, Oracle or Amazon Web Services database.

Compliance with ethical standards

Disclosure of conflict of interest

All authors declare that there is no conflict of interest regarding the publication of this paper.

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