

CSI 5112 Software Engineering

Identifying Business Intelligence Tools for fulfilling Business Sales Potential

Group 6

Ahmed Farooqui 300334347

Feier Zhang 8589976

Executive Summary

We were engaged by a retail company to conduct a comprehensive evaluation of various Business Intelligence (BI) tools to identify the most suitable option for their needs. After applying our initial filtering process, we have narrowed down the options to two leading BI tools: Tableau and PowerBI. We have established a set of evaluation criteria, and each tool will be scored accordingly. Based on the evaluation, we will recommend the BI tool with the higher score to be used by the employees of the company, enabling them to make data-driven decisions effectively.

Finally, we evaluated both tools and received a score for each of them. The results show PowerBI is 5 scores higher than Tableau. Therefore, we decided to recommend PowerBI to the retail company, and we also showed many details in graphs of important parts in PowerBI, to give an instruction for the company when they start to use it.

Table of Contents

| | |
|--|-----------|
| Executive Summary..... | 1 |
| List of Figures..... | 3 |
| List of Tables..... | 4 |
| 1. Introduction..... | 6 |
| 1.1 Business Context..... | 6 |
| 1.2 Evaluation Goals..... | 6 |
| 1.3 Evaluation Scope..... | 7 |
| 2. Evaluation Criteria..... | 8 |
| 2.1 Overview..... | 8 |
| 2.2 Installation Evaluation Criteria..... | 9 |
| 2.3 Data Sources Evaluation Criteria..... | 9 |
| 2.4 Charts Evaluation Criteria..... | 10 |
| 2.5 Data Modeling Evaluation Criteria..... | 10 |
| 2.6 Data Analytics Evaluation Criteria..... | 11 |
| 2.7 Reports Evaluation Criteria..... | 11 |
| 2.8 Usability & Other Evaluation Criteria..... | 12 |
| 3. Methodology..... | 13 |
| 4. Presentation and Evaluation of Tableau..... | 15 |
| 4.1 Overview..... | 15 |
| 4.2 Installation Evaluation..... | 17 |
| 4.3 Data Sources Evaluation..... | 18 |
| 4.4 Charts Evaluation..... | 19 |
| 4.5 Data Modeling Evaluation..... | 22 |
| 4.6 Data Analytics Evaluation..... | 25 |
| 4.7 Reports Evaluation..... | 27 |
| 4.8 Usability Evaluation..... | 29 |
| 4.9 Conclusion..... | 30 |
| 5. Presentation and Evaluation of Power BI..... | 31 |
| 5.1 Overview..... | 31 |
| 5.2 Installation Evaluation..... | 32 |
| 5.3 Data Sources Evaluation..... | 32 |
| 5.4 Charts Evaluation..... | 34 |
| 5.5 Data Modeling Evaluation..... | 40 |
| 5.6 Data Analytics Evaluation..... | 42 |
| 5.7 Reports Evaluation..... | 44 |
| 5.8 Usability Evaluation..... | 45 |
| 5.10 Conclusion..... | 46 |
| 6. Conclusions and Recommendations..... | 47 |

List of Figures

| | |
|--|----|
| Figure 3-1 Field names of Global Superstore Dataset..... | 13 |
| Figure 4-1 The overview of the Tableau welcome page..... | 15 |
| Figure 4-2 An example report on Global Superstore Dataset in Tableau..... | 17 |
| Figure 4-3 Database connectors in Tableau..... | 19 |
| Figure 4-4 Types of Charts in Tableau..... | 20 |
| Figure 4-5 Include/Exclude Customizations in Tableau..... | 21 |
| Figure 4-6 Tooltip feature in Tableau..... | 21 |
| Figure 4-7 Remove a column in Tableau..... | 23 |
| Figure 4-8 Add a column in Tableau..... | 24 |
| Figure 4-9 An Example of Drill-Down in Tableau on Global Superstore Dataset..... | 25 |
| Figure 4-10 An Example of Grouping in Tableau..... | 26 |
| Figure 4-11 Exporting Tableau Report as PowerPoint Presentation..... | 27 |
| Figure 4-12 Publishing Report to Tableau Cloud..... | 28 |
| Figure 5-1 The overview of the Power-BI welcome page..... | 31 |
| Figure 5-2 Database connectors in Power BI..... | 33 |
| Figure 5-3 Databases in Power BI..... | 33 |
| Figure 5-4 Charts in Power BI..... | 35 |
| Figure 5-5-1 UI Customizations in Power BI (Visual)..... | 35 |
| Figure 5-5-2 UI Customizations in Power BI (General)..... | 36 |
| Figure 5-6 Include/Exclude Customizations in Power BI..... | 36 |
| Figure 5-7 Tooltip feature in Power BI..... | 37 |
| Figure 5-8 Third-party charts in Power BI..... | 37 |
| Figure 5-9-1 Static Parameter Selection in Power BI..... | 38 |
| Figure 5-9-2 Dynamic Parameter Selection in Power BI..... | 38 |
| Figure 5-10-1 Adding a column in Power BI..... | 40 |
| Figure 5-10-2 Deleting a column in Power BI..... | 40 |
| Figure 5-11 Handling missing values using Fill Up/Down in Power BI..... | 41 |
| Figure 5-12 Aggregations in Power BI..... | 42 |
| Figure 5-13 Drill Down in Power BI..... | 43 |
| Figure 5-14-1 DAX Expression for Rolling Sales 90 Days..... | 43 |
| Figure 5-14-2 DAX Expression for Rolling Sales 90 Days Chart..... | 43 |
| Figure 5-15 Publishing Report to Power BI..... | 44 |
| Figure 5-16 Exporting Power BI Report as PowerPoint Presentation..... | 45 |

List of Tables

| | |
|---|----|
| Table 2-1 Evaluation Criteria Categories..... | 8 |
| Table 2-2 Criteria Impact Level..... | 8 |
| Table 2-3 Installation Criteria..... | 9 |
| Table 2-4 Data Sources Criteria..... | 9 |
| Table 2-5 Charts Criteria..... | 10 |
| Table 2-6 Data Modeling Criteria..... | 10 |
| Table 2-7 Data Analytics Criteria..... | 11 |
| Table 2-8 Reports Criteria..... | 11 |
| Table 2-9 Usability Criteria..... | 12 |
| Table 3-1 Methodology Scores and Descriptions..... | 14 |
| Table 4-1 The scores and results of Installation Evaluation for Tableau..... | 17 |
| Table 4-2 The scores and results of Data Sources Evaluation for Tableau..... | 19 |
| Table 4-3 The scores and results of Charts Evaluation for Tableau..... | 22 |
| Table 4-4 The scores and results of Data Modeling Evaluation for Tableau..... | 23 |
| Table 4-6 The scores and results of Reports Evaluation for Tableau..... | 28 |
| Table 4-7 The scores and results of Usability Evaluation for Tableau..... | 29 |
| Table 5-1 The scores and results of Installation Evaluation for Power BI..... | 32 |
| Table 5-2 The scores and results of Data Sources Evaluation for Power BI..... | 34 |
| Table 5-3 The scores and results of Charts Evaluation for Power BI..... | 39 |
| Table 5-4 The scores and results of Data Modeling Evaluation for Power BI..... | 41 |
| Table 5-5 The scores and results of Data Analytics Evaluation for Power BI..... | 43 |
| Table 5-6 The scores and results of Reports Evaluation for Power BI..... | 45 |
| Table 5-7 The scores and results of Usability Evaluation for Power BI..... | 46 |
| Table 6-1 Comparison of scores of Power BI v/s Tableau..... | 47 |

Glossary

| | |
|-------------------|--|
| BI | Business Intelligence, the use of data and analytics to help businesses make better decisions. |
| Dashboard | A visual display of key performance indicators (KPIs) and other important metrics that provide a quick overview of the current status of a business or organization. |
| UI | User Interface |
| Drill Down | Refers to the process of navigating from a summary view of data to a more detailed view |
| Drill Up | Refers to the process of navigating from a detailed view of data to a more summary view |
| Filter | A functionality or feature that allows users to selectively narrow down or limit the data displayed or analyzed based on specific criteria or conditions. Filters are used to refine data sets and focus on specific subsets of data that are relevant to a particular analysis or report. |
| Std. Dev | The standard deviation of all values in the given expression. |
| Include | Ability to include certain data points from the visualization |
| Exclude | Ability to exclude certain data points from the visualization |
| Tooltip | Ability to interact when certain action performed on a GUI component |
| DAX | Data Analysis Expressions (DAX) is a library of functions and operators that can be combined to build formulas and expressions in Power BI, Analysis Services, and Power Pivot in Excel data models |

1. Introduction

1.1 Business Context

The retail industry is highly competitive, and companies need to stay ahead by making data-driven decisions to improve their business operations and gain a competitive advantage. In this context, a retail company with approximately 200 employees has recognized the need to leverage BI tools to enhance their decision-making process and drive business success.

BI tools are software applications and technologies that enable organizations to collect, analyze, and present business data in a way that helps them make informed decisions. These tools typically include reporting, data visualization, and data analysis capabilities that enable users to explore data, identify patterns, and gain insights into business operations and performance.

Currently, the company does not have any BI tools in place, and there is a clear understanding that leveraging BI tools can provide valuable insights from the vast amount of data generated in their operations. The company seeks to identify a suitable BI tool that aligns with their business requirements and can empower their employees with the necessary data analysis capabilities. Additionally, the company is keen on providing training to their existing employees to effectively utilize the chosen BI tool and make data-driven decisions as part of their daily business operations.

1.2 Evaluation Goals

The purpose of this evaluation is to conduct a comprehensive and objective study of various Business Intelligence (BI) tools to determine which one, if any, meets the specific business requirements of the retail company. The evaluation process will involve analyzing and comparing different BI tools based on a set of predefined requirements.

Here are the requirements we concluded for the company:

1. User-friendly UI: The BI tool should have an intuitive and easy-to-use interface that enables employees to navigate and interact with the tool efficiently.
2. Have various common chart types: This allows the company and its employees to visually present and analyze data in different ways.
3. Support multiple data sources: This ensures that the retail company can integrate and analyze data from different sources.
4. Support multiple data modeling and analytics capabilities: These capabilities allow employees to manipulate and analyze data in meaningful ways, uncover patterns, trends, and insights, and derive actionable intelligence from the data.
5. Low cost: The retail company seeks a cost-effective BI tool that offers good value for money.

1.3 Evaluation Scope

After doing some research, we found that there are actually many open source BI tools on the Internet, such as Tableau, Power BI, Looker and Data Studio. We did an initial filter based on the company's requirements and the type of the dataset, and finally selected Tableau and PowerBI. We will use these two BI softwares to conduct experiments and evaluations on the dataset, and compare them in the form of scoring to select the most suitable BI tool for this company.

2. Evaluation Criteria

In this section, we evaluate the criteria defined by us which we feel is relevant to the business context set by us. These criteria were compiled keeping certain factors in mind such as ease of use, learning curve required, the ability to achieve the tasks, community support offered to name a few. The list of criteria mentioned here is not exhaustive but subjective based on what we feel are required for the purpose of our research.

2.1 Overview

There are 7 categories listed in Table 2-1 that we would analyze on the two tools - Tableau and PowerBI. Some of the criteria were tested out on the free version available to students, while for the rest a research was conducted.

Table 2-1 Evaluation Criteria Categories

| Category | Description |
|----------------|---|
| Installation | Focuses on the different operating systems of the tool. |
| Data Sources | Focuses on the data sources available to integrate with the BI tool and if there is a workaround to connect data sources not present to connect directly. |
| Charts | Focuses on the list of charts that are available to be utilized for different visualizations. |
| Data Modeling | Focuses on the capacity to modify the raw data for certain key tasks. |
| Data Analytics | Focuses on the capacity to perform common analytical operations and use it for developing chart visualization logic |
| Reports | Focuses on the options available to publish reports and any customizations offered for different devices. |
| Usability | Focuses on the overall intuitiveness of the software and considers the learning curve and ease of use. |

The scale that we use for each criteria within the category is shown in Table 2-2.

Table 2-2 Criteria Impact Level

| Criteria Impact Level | Impact Level | Description |
|-----------------------|--------------|--|
| Must Have | 5 | Essential to meet the business requirements. |

| | | |
|--------------|---|---|
| Should Have | 3 | Not essential absolutely but severely impacts the quality of solution produced if not present. |
| Good to Have | 1 | Having this feature is not essential currently but improves the scope of the solution for the future. |

2.2 Installation Evaluation Criteria

We want to analyze which operating systems can the given tools run on and the criteria is shown in Table 2-3.

Table 2-3 Installation Criteria

| Installation Criteria | Impact Level | Description |
|--|--------------|---|
| Supported on Common Operating System Platforms | 5-Must Have | Focuses on the different operating systems the tool is compatible on, most importantly should be supported on MacOS, Linux and Windows operating systems. |

2.3 Data Sources Evaluation Criteria

This criteria is important according to the company's requirements in Section 1, we want to compare and list the supported data sources for each BI tool, and also let the company have an idea to choose their appropriate data source to store data. Table 2-4 shows the details of the data sources criteria.

Table 2-4 Data Sources Criteria

| Data Sources Criteria | Impact Level | Description |
|---|----------------|--|
| Supports connectivity to Relational Database Management Systems | 5-Must Have | Focuses on the support to import data from commonly and widely used relational databases MySQL, PostgreSQL, MariaDB. |
| Supports non-relational databases | 1-Good to Have | Focuses on the support to other types of databases not directly supported through an alternative means. |

2.4 Charts Evaluation Criteria

Chart Criteria is also important in our evaluation, because a BI tool with a diverse set of chart types can provide advantages in terms of data visualization flexibility and enhanced data analysis. It empowers the company to create effective and impactful visualization that can drive better decision-making and insights from data. Table 2-5 shows the details of charts criteria.

Table 2-5 Charts Criteria

| Charts Criteria | Impact Level | Description |
|-----------------------------|----------------|---|
| Support for Common Charts | 5-Must Have | Focuses on the options available to create the most common charts - bar chart, pie chart, line chart, area chart. |
| UI Customizations of Charts | 5-Must Have | Focuses on the options to create aesthetically beautiful charts which enhance user experience. |
| Charts Interactiveness | 5-Must Have | Focuses on certain features such as include/exclude, tool tips, mouse-over, etc. |
| Advanced Charts | 3-Good to Have | Focuses on the less standard charts available such as Waterfall, Gantt, Funnel, Ribbon Charts. |
| Third-party Charts | 1-Good to Have | Focuses on the ability to add lesser known charts through installation. |
| Parameter Selection | 5-Must Have | Focuses on the ability to alter the visualizations in charts based on predefined and dynamic user constraints. |

2.5 Data Modeling Evaluation Criteria

Data modeling is a preprocessing step before data visualization, Table 2-6 shows the details of data modeling criteria.

Table 2-6 Data Modeling Criteria

| Data Modeling Criteria | Impact Level | Description |
|----------------------------------|--------------|---|
| Supports Adding/Deleting Columns | 5-Must Have | Focuses on allowing users to create columns based on common |

| | | |
|--|-------------|---|
| | | mathematical formulas |
| Supports Handling Missing Values | 5-Must Have | Focuses on allowing missing values to be filled in using user-defined functions or standard functions such as mean, variance, etc |
| Identifying and Mapping Relationships between the tables | 5-Must Have | Focuses on identifying or letting users create relationships between different columns of the table |

2.6 Data Analytics Evaluation Criteria

Data analytics is also important for the company, it can improve data quality and accuracy, increase data exploration and discovery, and customized data analysis. Table 2-7 shows the details of data analytics criteria.

Table 2-7 Data Analytics Criteria

| Data Analytics Criteria | Impact Level | Description |
|-----------------------------------|--------------|---|
| Supports Data Aggregation | 5-Must Have | Focuses on allowing users to aggregate data and define their own aggregations based on common scalar functions such as sum, mean, etc |
| Drill-Down | 5-Must Have | Focuses on allowing users to drill down into the different sections of the data for visualization purposes |
| User Defined Analytical Functions | 5-Must Have | Focuses on allowing users to create analytical functions whose logic can be integrated to produce the visualizations in the charts |

2.7 Reports Evaluation Criteria

Table 2-8 shows the details of reports criteria.

Table 2-8 Reports Criteria

| Reports Criteria | Impact Level | Description |
|---------------------------------------|----------------|--|
| Supports Multiple Formats for Reports | 1-Good to Have | Focuses on allowing users to export the reports generate in many formats |

| | | |
|-----------------|-------------|---|
| Publish Reports | 5-Must Have | Focuses on a user being able to publish a report which can be collaborated and run by other users |
|-----------------|-------------|---|

2.8 Usability & Other Evaluation Criteria

Table 2-9 shows the details of usability criteria.

Table 2-9 Usability Criteria

| Usability Criteria | Impact Level | Description |
|------------------------|----------------|--|
| Ease of Learning | 5-Must Have | Focus on whether the user feels that the user interface is clear and user-friendly when using the software, especially for beginner-users. The learning curve should be clear and intuitive. |
| AI and ML capabilities | 1-Good to have | Focuses on determining what capabilities the tool has to offer. |
| Cost of the tool | 5- Must Have | Focuses on the costs involved in using the software on the commercial scale. |

3. Methodology

This company provides us with a sample of their dataset, named “Global Superstore Dataset[1]”. It is the consumer and product analytics on global superstore data, has over 50,000 rows of data spanning a four-year period. Figure 1-1 shows the field names of this dataset, it contains information about orders, shippings, customers, products and sales.

| Type | Field Name | Physical Table | Remote Field Name |
|------|----------------|-------------------|-------------------|
| Abc | Order Id | global_superstore | order_id |
| 📅 | Order Date | global_superstore | order_date |
| 📅 | Ship Date | global_superstore | ship_date |
| Abc | Ship Mode | global_superstore | ship_mode |
| Abc | Customer Id | global_superstore | customer_id |
| Abc | Customer Name | global_superstore | customer_name |
| Abc | Segment | global_superstore | segment |
| 🌐 | City | global_superstore | city |
| 🌐 | State | global_superstore | state |
| 🌐 | Country | global_superstore | country |
| # | Postal Code | global_superstore | postal_code |
| Abc | Market | global_superstore | market |
| Abc | Region | global_superstore | region |
| Abc | Product Id | global_superstore | product_id |
| Abc | Category | global_superstore | category |
| Abc | Sub Category | global_superstore | sub_category |
| Abc | Product Name | global_superstore | product_name |
| # | Sales | global_superstore | sales |
| # | Quantity | global_superstore | quantity |
| # | Discount | global_superstore | discount |
| # | Profit | global_superstore | profit |
| # | Shipping Cost | global_superstore | shipping_cost |
| Abc | Order Priority | global_superstore | order_priority |

Figure 3-1 Field names of Global Superstore Dataset

According to the requirements of the retail company, we designed the evaluation criteria in section 2, and in this section, we introduce our evaluation score table shown in Table 3-1. The two BI tools will be compared and evaluated by the evaluation criteria with some experiments on the dataset, and scored by this score table based on 0-absent, 1-weakly satisfied and 2-strongly satisfied. Finally, the BI tool with a higher total score will be recommended to the retail company.

Table 3-1 Methodology Scores and Descriptions

| Result | Score | Description |
|--------------------|-------|---|
| Absent | 0 | The criteria is unavailable or can be availed at a premium cost only. |
| Weakly Satisfied | 1 | The criteria is present in some capacity but not in the desired capacity. |
| Strongly Satisfied | 2 | The criteria is completely satisfied and meets the requirement. |

The overall score for each evaluation criteria is computed as:

$$\Sigma \text{Impact Level of Criteria}(i) * \text{Score}(i)$$

where Criteria(i) are all the subcriteria for a given evaluation criteria and score(i) is the score assigned to it.

4. Presentation and Evaluation of Tableau

The functions and features of Tableau will be evaluated according to the evaluation criteria of section 2 and the methodology of section 3.

4.1 Overview

Tableau is a data visualization application to facilitate people to examine many kinds of structured data and generate highly interactive and beautiful graphs, dashboards, and reports within minutes. This evaluation will focus on Tableau Desktop and it is an open software, and the most basic and main functions are free.

Figure 4-1 shows the welcome page of the Tableau Desktop. From the figure, we can clearly understand some functions of Tableau. In the left column, you can quickly import local data according to the type of data file, or you can choose the server of the database to import data. Furthermore, the right column offers tutorial links to assist beginners in getting acquainted with the software and mastering fundamental operations. The middle section is where workbooks are created, providing a central space for data visualization and analysis.

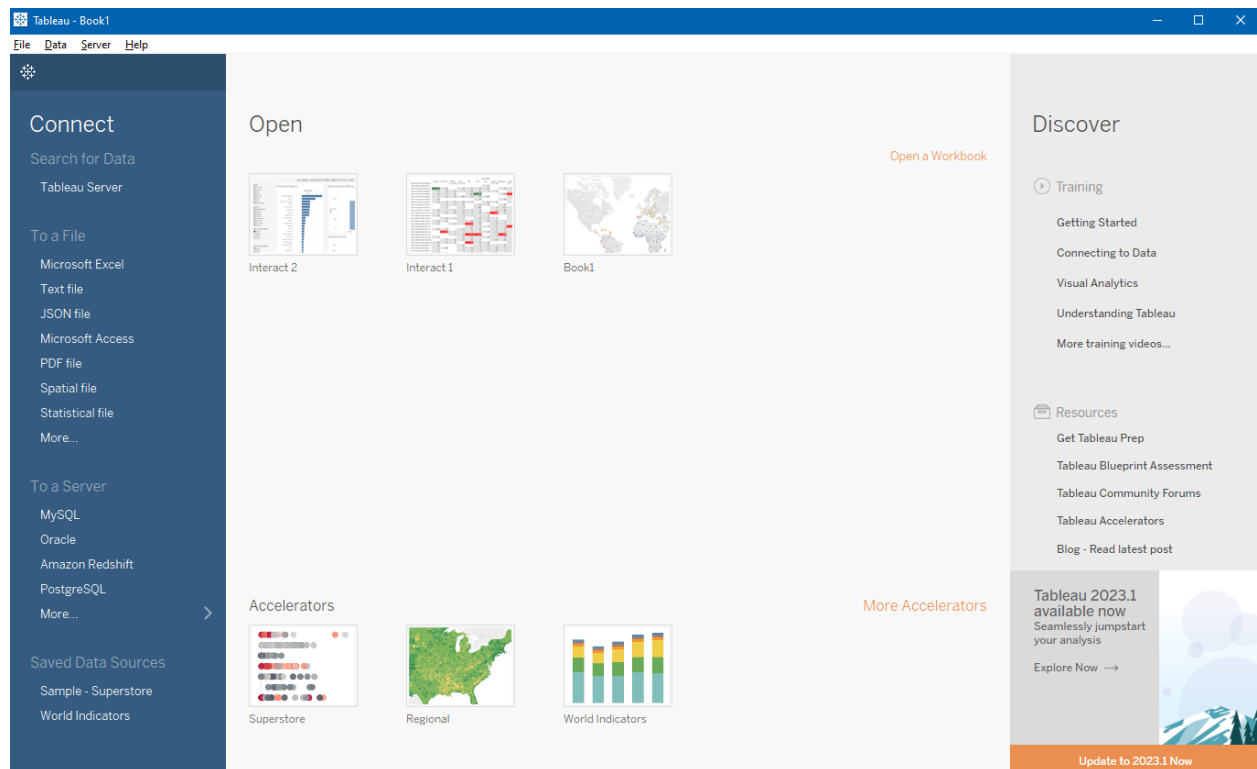


Figure 4-1 The overview of the Tableau welcome page

The process of creating a report in Tableau generally involves the following steps[2]:

1. **Connect to a data source:** Tableau allows people to connect to various data sources such as spreadsheets, databases, and online data. You can import your data into Tableau to create a data source that you can work with.
2. **Create a view/worksheet:** Once you have connected to your data, you can create a worksheet in Tableau. A worksheet is a canvas where you can create visualizations and arrange them to build a report. You can drag and drop fields from your data source onto the Rows and Columns shelves, and use the Marks shelf to define the type of visualizations such as bar charts, line charts, or maps.
3. **Emphasizing the Results/Customize Visualizations:** You can format the visualizations, apply filters, add calculations, and define parameters to create interactive and dynamic reports. You can also add multiple visualizations on a single worksheet and use actions to create interactive links between them.
4. **Create a dashboard:** Dashboards in Tableau are used to bring together multiple worksheets into a single view. You can create a dashboard by dragging and dropping worksheets onto a blank dashboard canvas. You can arrange the worksheets, add titles, and apply formatting to create a cohesive and visually appealing dashboard.
5. **Add interactiviness:** You can use filters, parameters, and actions to allow users to interact with the data and explore different perspectives. This helps in creating dynamic and interactive reports that can provide insights and facilitate data-driven decision-making.
6. **Publish and share:** Once you have created your report or dashboard in Tableau, you can publish it to Tableau Server or Tableau Online to share it with others. You can also export your reports as images, PDFs, or interactive web pages for distribution.

Figure 4-2 shows a report on the Global Superstore Dataset. This report is dynamic, we can get different results by checking the content in the filter on the left. The horizontal bar chart demonstrates the profit for each country for a year and the countries are sorted by profit, and you can select different countries, states and years on the filter. The area chart represents the rolling sales for 3 months for this company, and you also can select the month and year in the filter to show different results. The line chart illustrates the quantity sold depending on years.

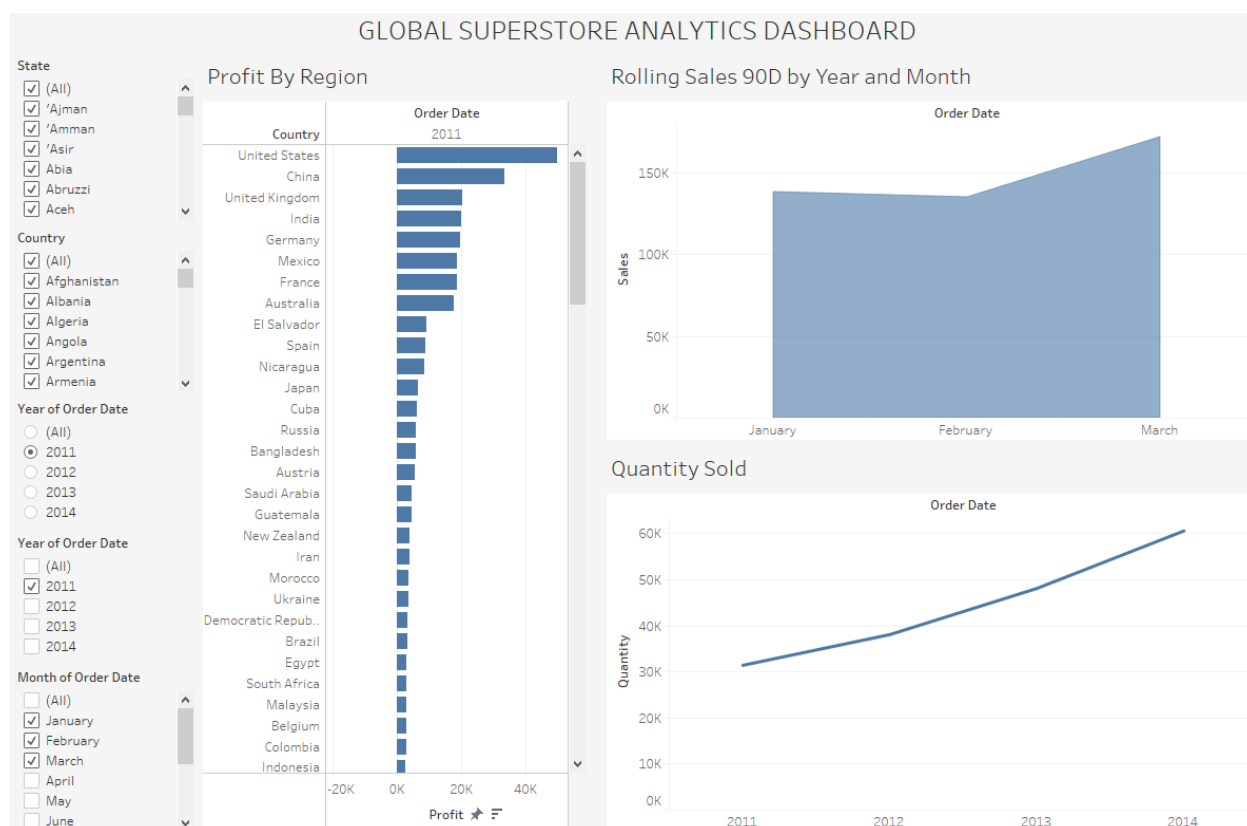


Figure 4-2 An example report on Global Superstore Dataset in Tableau

4.2 Installation Evaluation

Table 4-1 shows the scores and results of installation criteria for Tableau. The final score of this criteria is **5/10**.

Table 4-1 The scores and results of Installation Evaluation for Tableau

| Installation Criteria | Evaluation Score | Descriptions and Results |
|--|--------------------|---|
| Supported on Common Operating System Platforms | 1-Weakly Satisfied | <p>Tableau can be installed on the[3]:</p> <ul style="list-style-type: none"> - Operating Systems: Windows (Windows 8/8.1/10(x64)) and Mac (macOSCatalina 10.15, macOS Big Sur 11.4+, and macOS Monterey 12.6+); - Virtual Environments: Citrix environments, Microsoft Hyper-V, Parallels and VMware. <p>Tableau Desktop doesn't support</p> |

| | | |
|--|--|--|
| | | Windows 11 and Linux, but Tableau Server can run on Linux. |
|--|--|--|

4.3 Data Sources Evaluation

Connecting to a database is the mandatory and important step of creating the report. There are two types of database[4]:

1. **Relational Database:** It is a type of database that uses a structured approach to organizing and storing data. In a relational database, data is organized into tables with rows and columns, where each row represents a record and each column represents a field or attribute. The relationships between tables are established through keys, such as primary keys and foreign keys, which help to link related data across tables.
2. **Non-relational database:** It is also known as NoSQL databases, differ from traditional relational databases as they store data in a non-tabular format. Instead, they may use data structures like documents, which can contain diverse types of information in various formats, making them highly detailed and versatile. This flexibility allows non-relational databases to efficiently organize and manage different types of data side by side, setting them apart from relational databases.

Figure 4-3 shows the database connectors in Tableau. We need to choose the connector which we store our data in and set up with tableau.

| Installed Connectors (73) | Google Drive | Presto | Agiloft by Agiloft | Yellowbrick by Yellowbrick Data |
|------------------------------|-----------------------------------|----------------------------------|---|---------------------------------|
| Action Vector | Hortonworks Hadoop Hive | Progress OpenEdge | Altinity Connector for ClickHouse by Altinity Inc | |
| Alibaba AnalyticDB for MySQL | IBM BigInsights (deprecated) | Qubole Presto | Amazon DocumentDB by Amazon | |
| Alibaba Data Lake Analytics | IBM DB2 | Salesforce | BI Connector by Guidanz Inc | |
| Alibaba MaxCompute | IBM PDA (Netezza) | Salesforce CDP | Couchbase Analytics by Couchbase Analytics | |
| Amazon Athena | Impala | SAP HANA | Data Virtuality JDBC by Data Virtuality | |
| Amazon Aurora for MySQL | Intuit QuickBooks Online | SAP NetWeaver Business Warehouse | Denodo JDBC by Denodo Technologies | |
| Amazon EMR Hadoop Hive | Kognitio | SAP Sybase ASE | Exasol JDBC by Exasol | |
| Amazon Redshift | Kyvos | SAP Sybase IQ | Firebolt by Firebolt Analytics Inc | |
| Anaplan | LinkedIn Sales Navigator | ServiceNow ITSM | Incorta by Incorta | |
| Apache Drill | MariaDB | SharePoint Lists | Jethro ODBC by Jethro Data | |
| Azure Data Lake Storage Gen2 | Marketo | SingleStore | Kyligence Connector by Kyligence | |
| Azure SQL Database | MarkLogic | Snowflake | MarkLogic by MarkLogic | |
| Azure Synapse Analytics | Microsoft Analysis Services | Spark SQL | Ocient JDBC by Ocient | |
| Box | Microsoft PowerPivot (deprecated) | Splunk | Oracle NetSuite by Tableau | |
| Cloudera Hadoop | Microsoft SQL Server | Teradata | Palantir Foundry by Palantir | |
| Databricks | MonetDB | Teradata OLAP Connector | Qubole Hive by Qubole | |
| Datorama | MongoDB BI Connector | TIBCO Data Virtualization | Salesforce Marketing Cloud by Tableau | |
| Denodo | MySQL | Vertica | SAP SuccessFactors by Tableau | |
| Dremio | OData | Web Data Connector | ServiceNow by Tableau | |
| Dropbox | OneDrive (deprecated) | | Sharepoint Lists (JDBC) by Tableau | |
| Esri | OneDrive and SharePoint Online | Other Databases (JDBC) | SQream DB by SQream Technologies | |
| Exasol | Oracle | Other Databases (ODBC) | Starburst Enterprise by Starburst | |
| Firebird 3 | Oracle Eloqua | | Stratio Crossdata by Stratio BD | |
| Google Analytics | Oracle Essbase | | | |
| Google BigQuery | Pivotal Greenplum Database | Additional Connectors (26) ⓘ | | |
| Google Cloud SQL | PostgreSQL | Action ODBC by Actian | | |

Figure 4-3 Database connectors in Tableau

Table 4-2 demonstrates the scores and results of Data Sources Evaluation for Tableau, the final score of this criteria is **12/12**.

Table 4-2 The scores and results of Data Sources Evaluation for Tableau

| Data Sources Criteria | Evaluation Score | Descriptions and Results |
|---|----------------------|---|
| Supports connectivity to Relational Database Management Systems | 2-Strongly Satisfied | Tableau can connect with the commonly and widely used relational database server, such as MySQL, PostgreSQL, MariaDB, and the Figure 4-3 shows the list of the other servers. |
| Supports non-relational databases | 2-Strongly Satisfied | Tableau can import database on the following file types: <ul style="list-style-type: none">- Microsoft Excel- Text file- JSON file- Microsoft Access- PDF file- Spatial file- Statisal file- MongoDB |

4.4 Charts Evaluation

Selecting a suitable chart for data visualization is crucial as it greatly impacts the effectiveness of conveying information and insights from data. Figure 4-4 displays different types of charts and graphs in Tableau, and we will go through the names of these charts from left to right and top to bottom: text tables, heat maps, highlight tables, symbol maps, maps, pie charts, horizontal bars, stacked bars, side-by-side bars, treemaps, circle views, side-by-side circles, lines (continuous), lines (discrete), dual lines, area charts (continuous), area charts (discrete), dual combination, scatter plots, histogram, box-and-whisker plots, Gantt, bullet graphs, packed bubbles.



Figure 4-4 Types of Charts in Tableau

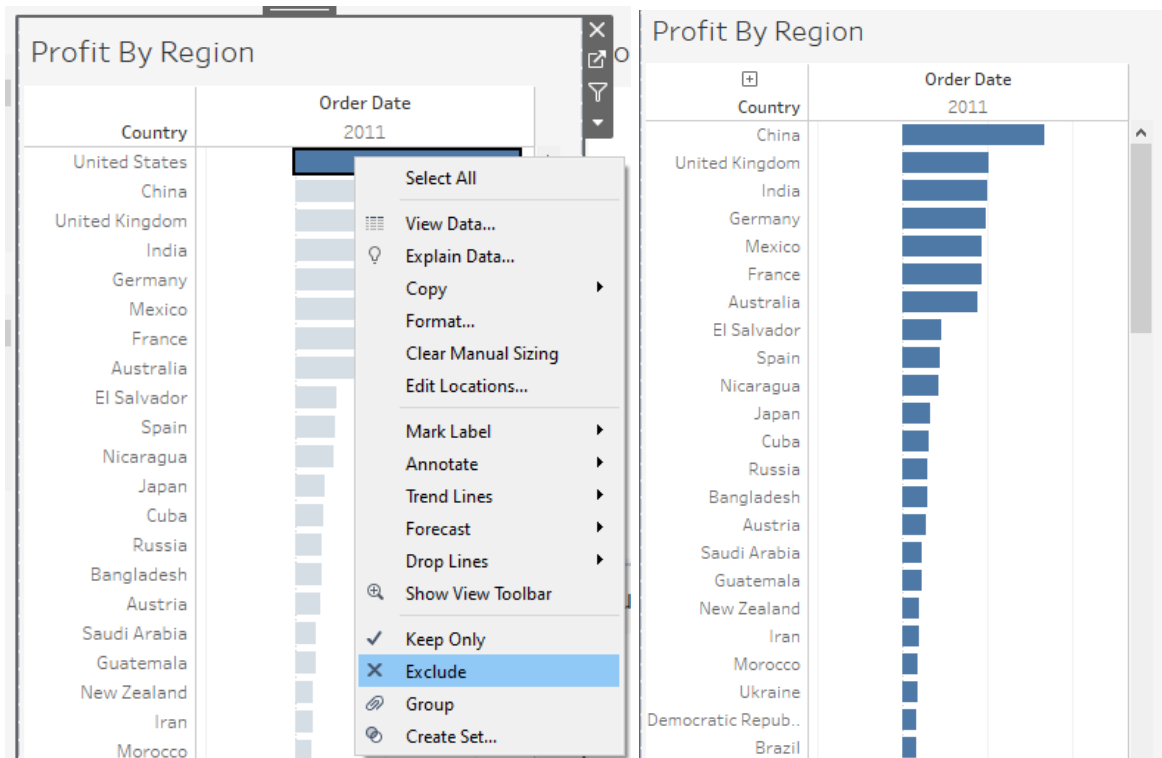


Figure 4-5 Include/Exclude Customizations in Tableau

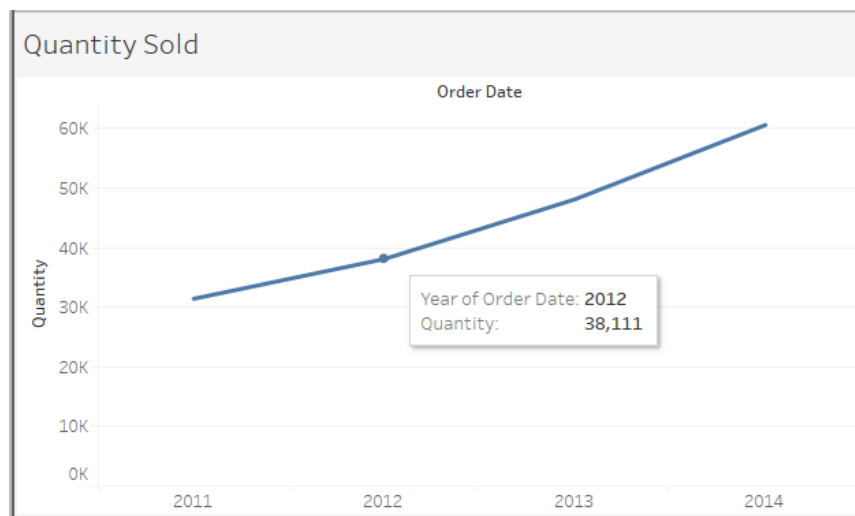


Figure 4-6 Tooltip feature in Tableau

Table 4-3 shows the scores and results of Charts Evaluation for Tableau, the final score of this criteria is **43/48**.

Table 4-3 The scores and results of Charts Evaluation for Tableau

| Charts Criteria | Evaluation Score | Descriptions and Results |
|-----------------------------|----------------------|---|
| Support for Common Charts | 2-Strongly Satisfied | Tableau supports 8 key types of charts: <ul style="list-style-type: none"> - Bar Chart - Line Chart - Pie Chart - Maps - Density Maps - Scatter Plot - Bubble Chart - Treemap |
| UI Customizations of Charts | 2-Strongly Satisfied | Tableau provides UI customizations on chart choice, layout, color, titles & subtitles, tooltips, fonts, dashboard size, dashboard interactivity and design for performance. [5] |
| Charts Interactiveness | 2-Strongly Satisfied | Charts can interact with users by include/exclude (Figure 4-5), highlighting & highlighting actions, filtering & filter actions, parameters, sets & set Actions, Tooltips (Figure 4-6), URL Actions, Dashboard Navigation. |
| Advanced Charts | 1-Weakly Satisfied | Tableau only has the Gantt chart. And other advanced charts are not included, such as Waterfall, Funnel, Ribbon Charts. |
| Third-party Charts | 0-Absent | Tableau doesn't have third-party charts. |
| Parameter Selection | 2-Strongly Satisfied | Tableau supports the parameter actions to let your audience change a parameter value through direct interaction with a viz, such as clicking or selecting a mark. |

4.5 Data Modeling Evaluation

Data modeling is performed before you start your visualization in Tableau, it is a critical step in designing efficient and effective databases. It helps ensure data integrity, consistency, and accuracy, and provides more accurate assistance for subsequent data analysis and reporting.

Table 4-4 shows the scores and results of Data Modeling Evaluation for Tableau, the final score is **25/30**.

Table 4-4 The scores and results of Data Modeling Evaluation for Tableau

| Data Modeling Criteria | Evaluation Score | Descriptions and Results |
|--|--------------------|--|
| Supports Adding/Deleting Columns | 2-Strong Satisfied | Tableau is able to remove and add columns easily as shown in Figure 4-7 and 4-8 below. For removing the unnecessary columns, just right click on that column and hide it. For adding a column, we can customize the calculation of the new column. |
| Supports Handling Missing Values | 1-Weakly Satisfied | Tableau provides a choice on hiding and showing missing values. |
| Identifying and Mapping Relationships between the tables | 2-Strong Satisfied | Tableau supports the model view to show all of the tables, columns, and relationships in the model. |

The screenshot shows the Tableau interface with a data table titled 'global_superstore' containing 23 fields and 51,290 rows. The table has columns: Ship Mode, Customer Id, Customer Name, Segment, City, State, Country, Postal Code, and Product. A right-click context menu is open over the 'Postal Code' column, showing options: Rename, Reset Name, Copy Values, Hide (highlighted in red), Aliases..., Create Calculated Field..., Create Group..., Create Bins..., and Describe... The table data includes rows for various ship modes like 'Same Day', 'Second Class', 'First Class', and 'Standard Class' across different countries and segments.

Figure 4-7 Remove a column in Tableau

The screenshot shows the Tableau interface with the 'Analysis' menu open, highlighting 'Create Calculated Field...'. A dialog box titled 'cost_price' displays the formula $[(Sales)/(1-[Discount]))]/[Quantity]$. Below the dialog, a data table is shown with the new calculated field 'cost_price' added as a column.

| Category | Sub Category | Product Name | Sales | Quantity | Discount | Profit | Shipping Cost | Order Priority | cost_price |
|-----------------|--------------|-----------------------------------|----------|----------|----------|-----------|---------------|----------------|------------|
| Technology | Copiers | Sharp Wireless Fax, High-Spe... | 2,832.96 | 8 | 0.000000 | 311.52 | 903.040 | Critical | 354.12 |
| Technology | Accessories | Plantronics CS510 - Over-the... | 2,309.65 | 7 | 0.000000 | 762.18 | 933.570 | Critical | 329.95 |
| Furniture | Chairs | Novimex Executive Leather A... | 3,709.40 | 9 | 0.100000 | -288.77 | 923.630 | Critical | 457.95 |
| Technology | Phones | Nokia Smart Phone, with Call... | 5,175.17 | 9 | 0.100000 | 919.97 | 915.490 | Medium | 638.91 |
| Technology | Phones | Motorola Smart Phone, Cordl... | 2,892.51 | 5 | 0.100000 | -96.54 | 910.160 | Medium | 642.78 |
| Technology | Phones | Samsung Smart Phone, with ... | 2,862.68 | 5 | 0.100000 | 763.28 | 897.350 | Critical | 636.15 |
| Furniture | Chairs | Novimex Executive Leather A... | 1,822.08 | 4 | 0.000000 | 564.84 | 894.770 | Critical | 455.52 |
| Furniture | Tables | Chromcraft Conference Tabl... | 5,244.84 | 6 | 0.000000 | 996.48 | 878.380 | High | 874.14 |
| Office Supplies | Binders | Fellowes PB500 Electric Pun... | 5,083.96 | 5 | 0.200000 | 1,906.49 | 867.690 | Low | 1,270.99 |
| Furniture | Tables | Chromcraft Bull-Nose Wood ... | 4,297.64 | 13 | 0.400000 | -1,862.31 | 865.740 | Critical | 550.98 |
| Office Supplies | Supplies | Martin Yale Chadless Opener ... | 4,164.05 | 5 | 0.000000 | 83.28 | 846.540 | High | 832.81 |
| Furniture | Tables | Bevis Conference Table, Fully ... | 4,626.15 | 5 | 0.000000 | 647.55 | 835.570 | High | 925.23 |

Figure 4-8 Add a column in Tableau

4.6 Data Analytics Evaluation

Figure 4-9 shows an example of Drill Down/Up on our dataset, the left side indicates only the country, and the right side also displays the states of each country.

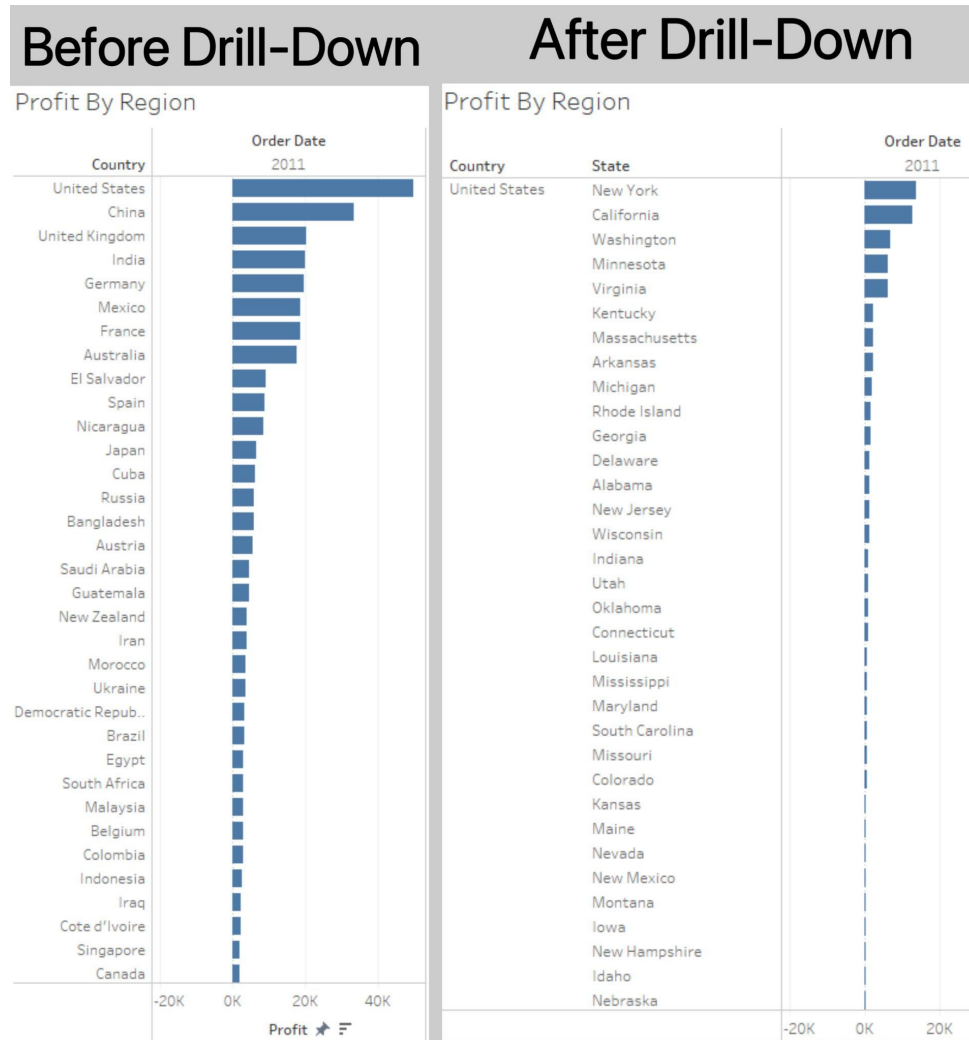


Figure 4-9 An Example of Drill-Down in Tableau on Global Superstore Dataset

Figure 4-10 shows the Grouping functionality on our data source.

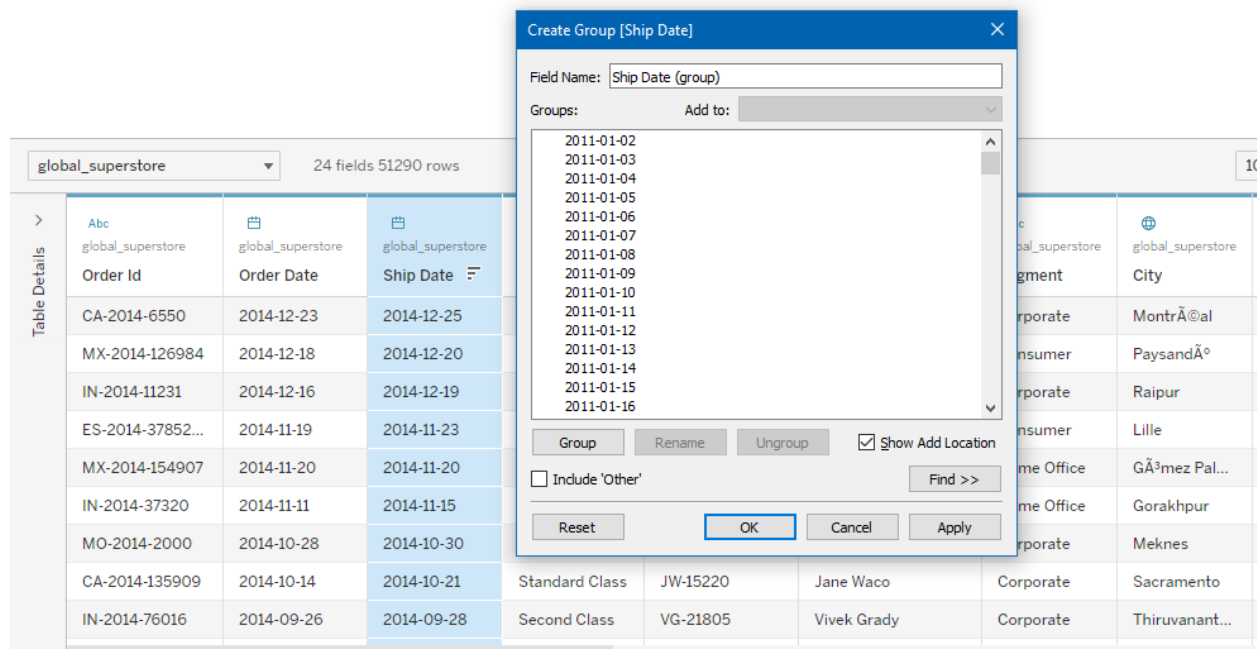


Figure 4-10 An Example of Grouping in Tableau

Table 4-5 shows the scores and results of Data Analytics Evaluation for Tableau, the final score is **30/30**.

Table 4-5 The scores and results of Data Analytics Evaluation for Tableau

| Data Analytics Criteria | Evaluation Score | Descriptions and Results |
|---------------------------|----------------------|---|
| Supports Data Aggregation | 2-Strongly Satisfied | <p>In Tableau, you can aggregate measures or dimensions[6].</p> <p>You can change the aggregation for a measure based on:</p> <ul style="list-style-type: none"> - Sum - Average - Median - Count & Count(distinct) - Minimum & Maximum - Percentile - Std. Dev & Std. Dev (Pop.) - Variance & Variance (Pop.) <p>You also can aggregate a dimension in the view as:</p> <ul style="list-style-type: none"> - Minimum - Maximum - Count & Count(distinct). |

| | | |
|-----------------------------------|----------------------|---|
| Drill-Down | 2-Strongly Satisfied | Tableau has Drill-Down and Drill-Up, and Figure 4-9 shows an example of drill-down on regions of Global Superstore Dataset. The left graph displays the county on the y-axis, and after Drill-Down, the right graph also demonstrates all states of a country on the y-axis. |
| User Defined Analytical Functions | 2-Strongly Satisfied | Analytical Functions in Tableau include: <ul style="list-style-type: none"> - Aggregation - Grouping (Figure 4-10) - Sorting - Numerical filters - Numerical limits - Categorical filters for text values - Time filtering |

4.7 Reports Evaluation

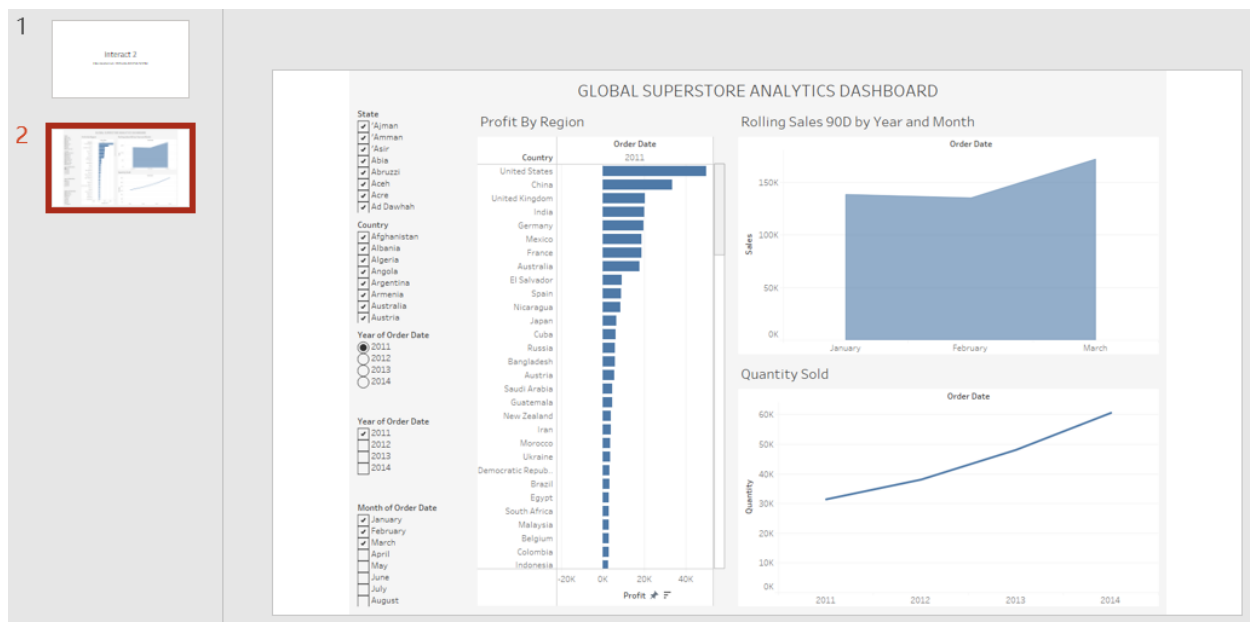


Figure 4-11 Exporting Tableau Report as PowerPoint Presentation

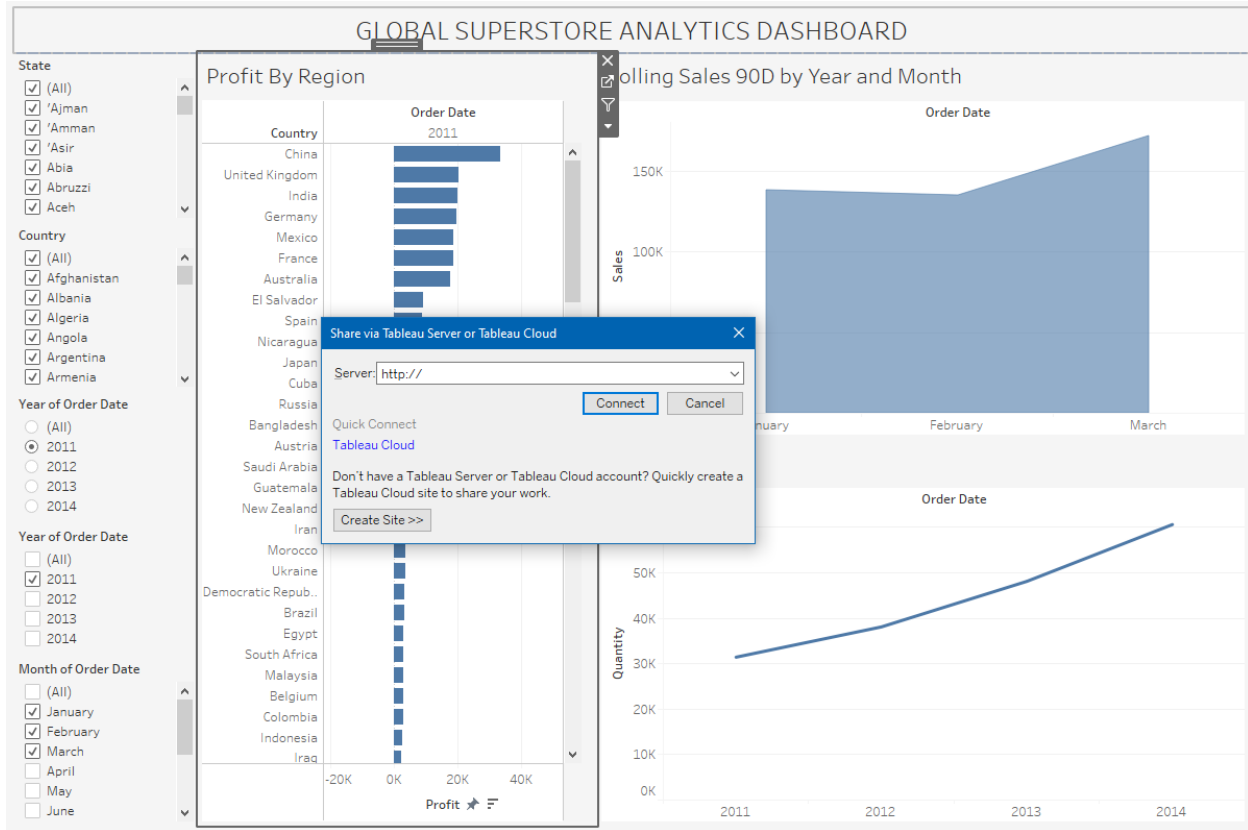


Figure 4-12 Publishing Report to Tableau Cloud

Table 4-6 shows the scores and results of Reports Evaluation for Tableau, the final score is **2/12**.

Table 4-6 The scores and results of Reports Evaluation for Tableau

| Reports Criteria | Evaluation Score | Descriptions and Results |
|---------------------------------------|--------------------|--|
| Supports Multiple Formats for Reports | 2-Weakly Satisfied | Tableau can export reports as PowerPoint (Figure 11) and PDF documents. |
| Publish Reports | 0-Absent | To share workbooks with people, Tableau has 4 ways: <ul style="list-style-type: none"> - <u>Publish the workbook to Tableau Server</u> (Figure 4-12): Tableau Server provides browser-based analytics. After publishing your workbook to Tableau Server, others with a Tableau Server account can sign in to see your workbook. |

| | | |
|--|--|--|
| | | <ul style="list-style-type: none"> - <u>Email the workbook and open it in Tableau Reader</u>: Email a workbook and its data source to others saved as a .twbx, and they can open and see its contents using Tableau Reader. - <u>Save the workbook to Tableau Public</u>: After publishing a workbook to Tableau Public, anyone with a link to the workbook can see its contents. - <u>Publish the workbook to Tableau Cloud</u>: Tableau Cloud lets you view and share dashboards from the office, at home or on the road. Native mobile apps, from the Web or a tablet. Only authorized users can interact with data and dashboards. <p>But it's not free for publishing and sharing the report in the above four ways.</p> |
|--|--|--|

4.8 Usability Evaluation

Table 5-8 shows the scores and results of Usability Evaluation for Tableau, the final score is **10/23**.

Table 4-7 The scores and results of Usability Evaluation for Tableau

| Usability Criteria | Evaluation Score | Descriptions and Results |
|------------------------|--------------------|---|
| Ease of Learning | 1-Weakly Satisfied | The dashboard design is not easy to use, but the icon for UI is easy to understand. |
| AI and ML capabilities | 0-Absent | Tableau supports AI Analytics including Augmented Analytics, Business Science and Data Science, but it costs \$70/month individually. |
| Cost of the tool | 1-Weakly Satisfied | Tableau has 3 levels of options (from highest to lowest): Tableau Creator, |

| | | |
|--|--|---|
| | | Tableau Explorer and Tableau Viewer. - Tableau Creator: \$70/month - Tableau Explorer: \$42/month - Tableau Viewer: \$15/month |
|--|--|---|

4.9 Conclusion

In summary, the final score of Tableau is **127/165**.

Tableau as a visualization tool, offers many capabilities and functionality for users. It supports both Windows and Mac platforms, and provides multiple data sources. It also has various charts, but it doesn't provide so many advanced charts and third-party charts. The data modeling is not so strong, and it cannot publish and share reports with others for free.

5. Presentation and Evaluation of Power BI

In section 5, we will evaluate the functionalities and features for PowerBI based on the evaluation criteria in section 2 and methodology in section 3.

5.1 Overview

Power BI is a business analytics service provided by Microsoft that enables users to create interactive visualizations and reports from their data. With a range of data connectors, users can easily import data from various sources such as Excel spreadsheets, databases, and cloud-based services. Power BI offers a variety of visualization options, including charts, maps, and tables, as well as the ability to create custom visuals using the Power BI Developer Tools. Users can also create interactive dashboards and reports, which can be shared with others within their organization or published publicly on the web. Available as both a cloud-based service and a desktop application, Power BI provides users with flexibility in terms of where and how they work with their data.

Figure 5-1 shows the homepage of Power BI. From the home tab, we can import data through the available options provided by Power BI. On the right, we have the visualizations that we can have for the data we import.

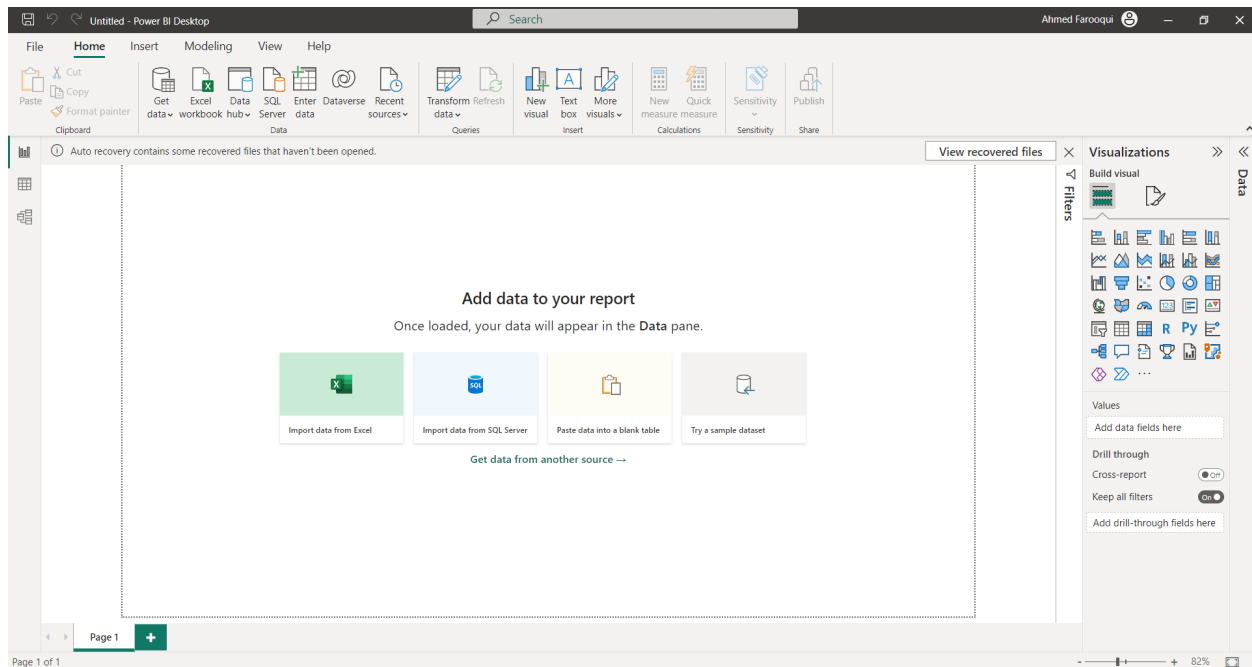


Figure 5-1 The overview of the Power-BI welcome page

5.2 Installation Evaluation

Table 5-1 shows the scores and results of installation criteria for Power BI.

Microsoft restricts the access of Power BI to Windows Operating systems only. This makes it impossible to use on MacOS or Linux other than through Virtual Machines.

Table 5-1 shows the scores and results of Installation Evaluation for Power BI. The final score is **5/10**.

Table 5-1 The scores and results of Installation Evaluation for Power BI

| Installation Criteria | Evaluation Score | Descriptions and Results |
|--|--------------------|--|
| Supported on Common Operating System Platforms | 1-Weakly Satisfied | Power BI can be installed on the[2]: <ul style="list-style-type: none">- Windows 10, Windows Server 2012 R2, Windows Server 2012, Windows 8, Windows 8.1, Windows Server 2016, Windows Server 2019, Windows 11- Virtual Environments: Citrix environments, Microsoft Hyper-V, Parallels and VMware. |

5.3 Data Sources Evaluation

Figure 5-2 shows the data imports have been divided into File, Databases, Power Platforms, Azure, Online Services and other. Notably, the data imports from Azure and Power Platforms are not supported by Tableau.

Figure 5-3 shows the relational databases supported in Power BI. Notably, the non relational databases such as MongoDB can be connected using ODBC which is present in Power BI.

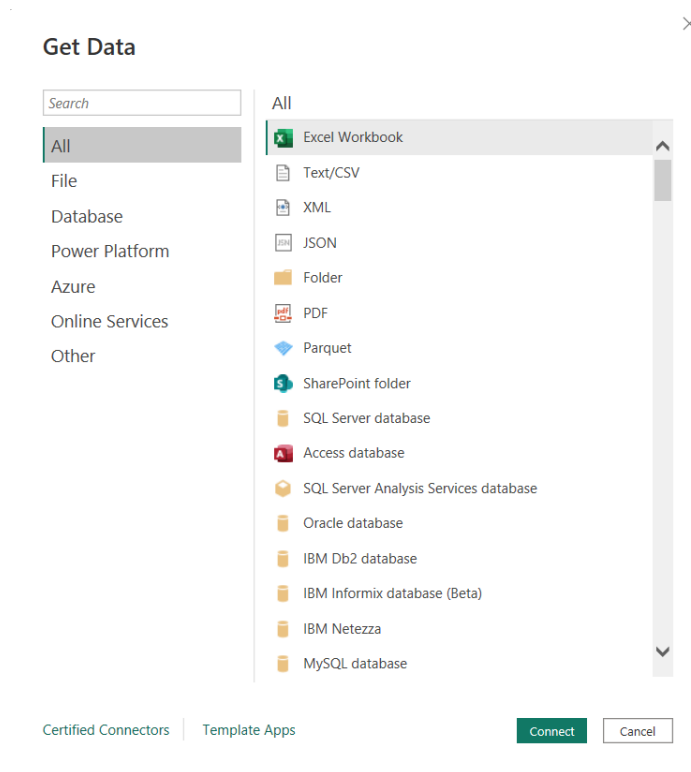


Figure 5-2 Database connectors in Power BI

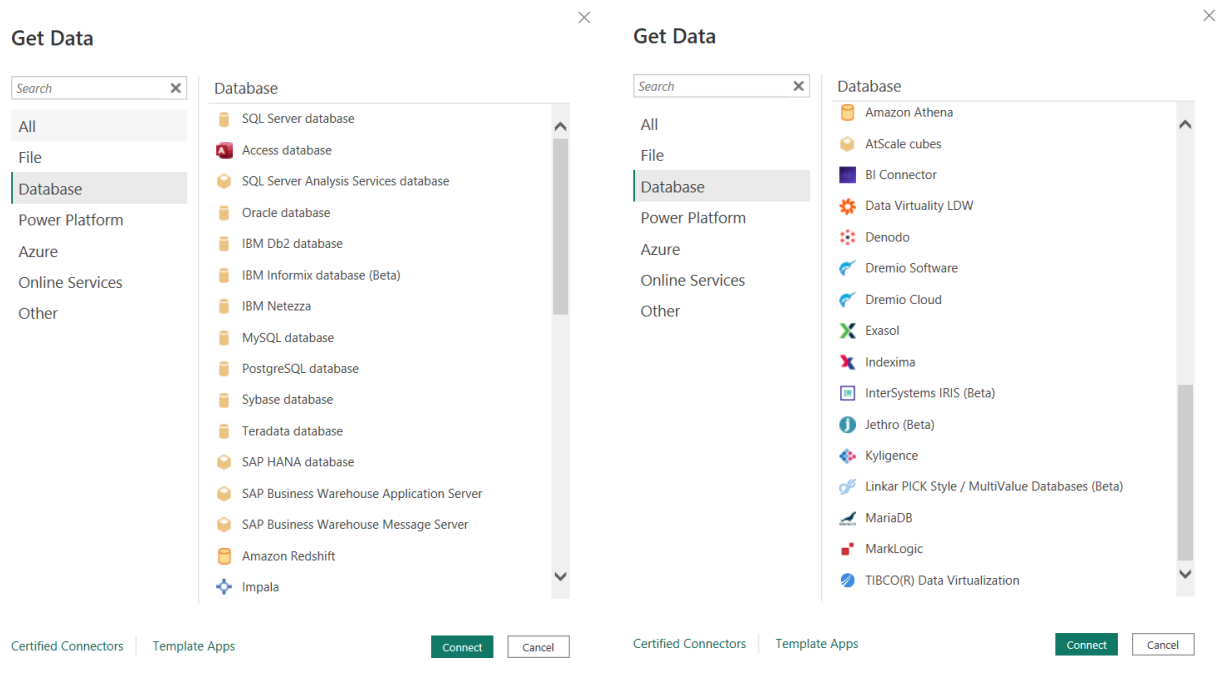


Figure 5-3 Databases in Power BI

Table 5-2 shows the scores and results of Data Sources Evaluation for Power BI. The final score is **12/12**.

Table 5-2 The scores and results of Data Sources Evaluation for Power BI

| Data Sources Criteria | Evaluation Score | Descriptions and Results |
|---|----------------------|---|
| Supports connectivity to Relational Database Management Systems | 2-Strongly satisfied | Power BI can connect with the commonly and widely used relational database server, such as MySQL, PostgreSQL, MariaDB and other servers. |
| Supports non-relational databases | 2-Strongly satisfied | Power BI can import (but not limited to) database on the following file types: <ul style="list-style-type: none">- Microsoft Excel- Text file- JSON file- Microsoft Access- PDF file- Spatial file- Statisal file- MongoDB- Cassandra |

5.4 Charts Evaluation

Figures 5-4 shows the available charts available in Power BI.

Figures 5-5-1 and 5-5-2 show the UI customizations available in Power BI. Some of these customizations have been applied to generate the UI for the visualizations displayed in these figures.

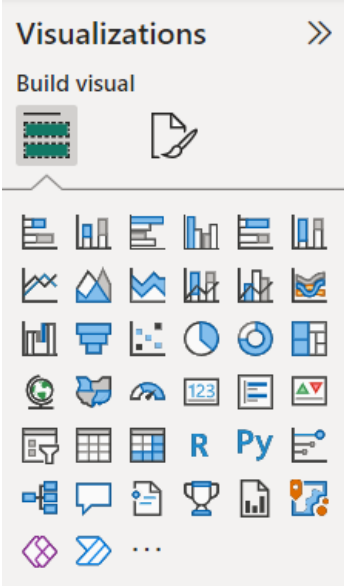


Figure 5-4 Charts in Power BI



Figure 5-5-1 UI Customizations in Power BI (Visual)



Figure 5-5-2 UI Customizations in Power BI (General)

Figures 5-6 shows the include/exclude feature where all the data points with location Ontario were removed and the visualization was updated.



Figure 5-6 Include/Exclude Customizations in Power BI

Figure 5-7 shows when the tooltip quantity has been added to the visual, then the quantity is displayed for the duration specified in the visualization.

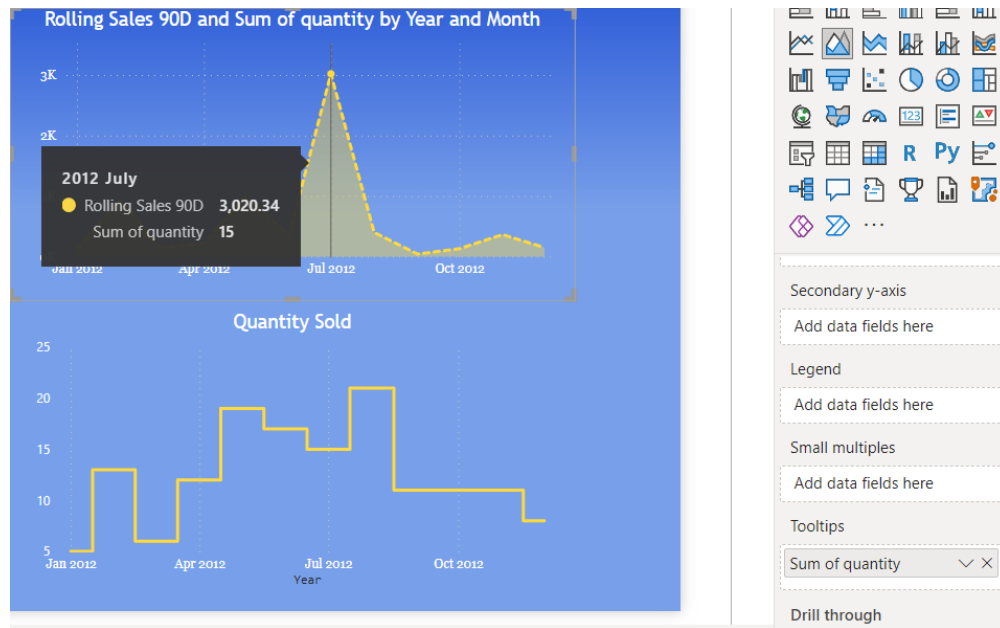


Figure 5-7 Tooltips feature in Power BI

Figure 5-8 shows the third-party charts which can be used in Power BI. The crucial thing to note here is that these charts need to be certified by Power BI before being utilized.

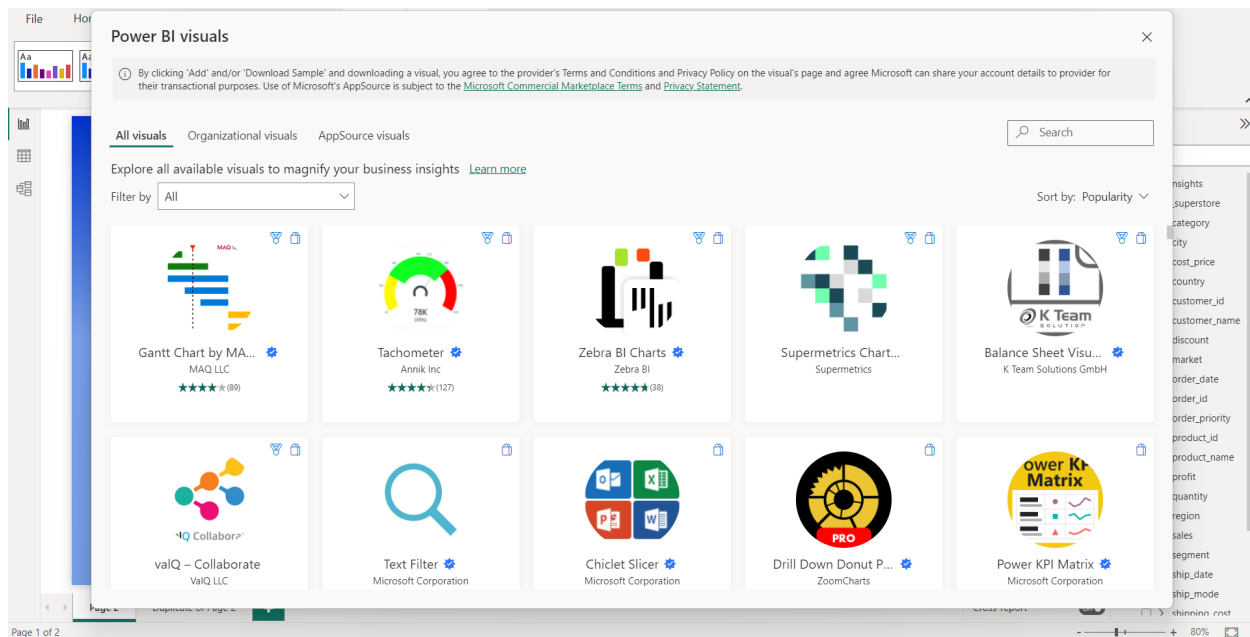


Figure 5-8 Third-party charts in Power BI

Figures 5-9-1 and 5-9-2 show the ability to add filters using static and dynamic parameters. Dynamic parameters are added in Power BI in multiple ways. One way is using bookmarks. In

our example, we have used slicers to allow users to toggle between different Time Period, Product Name and Location.



Figure 5-9-1 Static Parameter Selection in Power BI

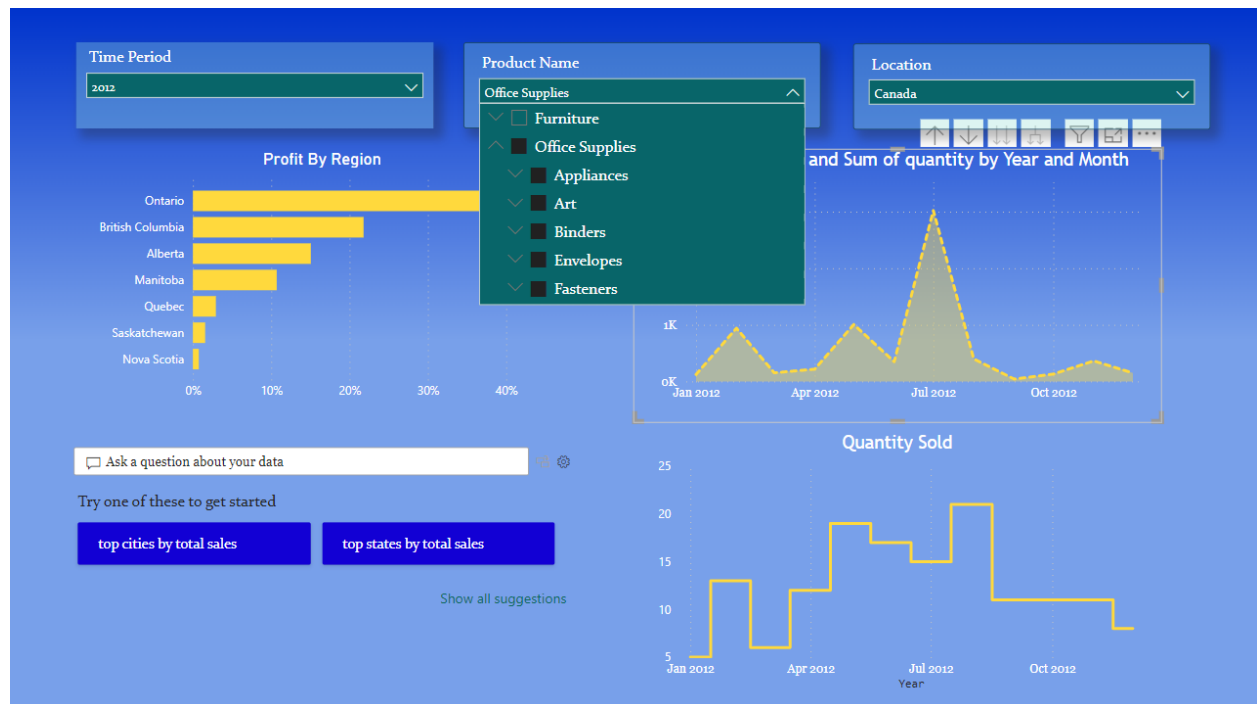


Figure 5-9-2 Dynamic Parameter Selection in Power BI

Table 5-3 shows the scores for the charts evaluation in Power BI. The final evaluation score for Power BI for charts evaluation is **48/48**.

Table 5-3 The scores and results of Charts Evaluation for Power BI

| Charts Criteria | Evaluation Score | Descriptions and Results |
|-----------------------------|-----------------------|--|
| Support for Common Charts | 2-Strongly satisfied | Power BI supports 8 key types of charts: <ul style="list-style-type: none"> - Bar Chart - Line Chart - Pie Chart - Maps - Column Chart - Area - Scatter Chart - Gauge - Cards |
| UI Customizations of Charts | 2-Strongly satisfied | Power BI provides UI customizations on chart choice, layout, color, titles & subtitles. fonts, dashboard size, dashboard interactivity and design for performance. |
| Charts Interactiveness | 2- Strongly Satisfied | Charts can interact with users through tooltips, mouse-overs and include/exclude. |
| Advanced Charts | 2-Strongly Satisfied | Power BI only has other advanced charts such as Waterfall, Funnel, Ribbon and Gantt Charts available. |
| Third-party Charts | 2-Strongly Satisfied | Power BI can import a wide number of third-party charts. |
| Parameter Selection | 2-Strongly Satisfied | Power BI provides dynamic and Static parameter selection |

5.5 Data Modeling Evaluation

Figure 5-10-1 and 5-10-2 show the adding and deleting a column in Power BI respectively. Custom columns can be added with DAX expressions.

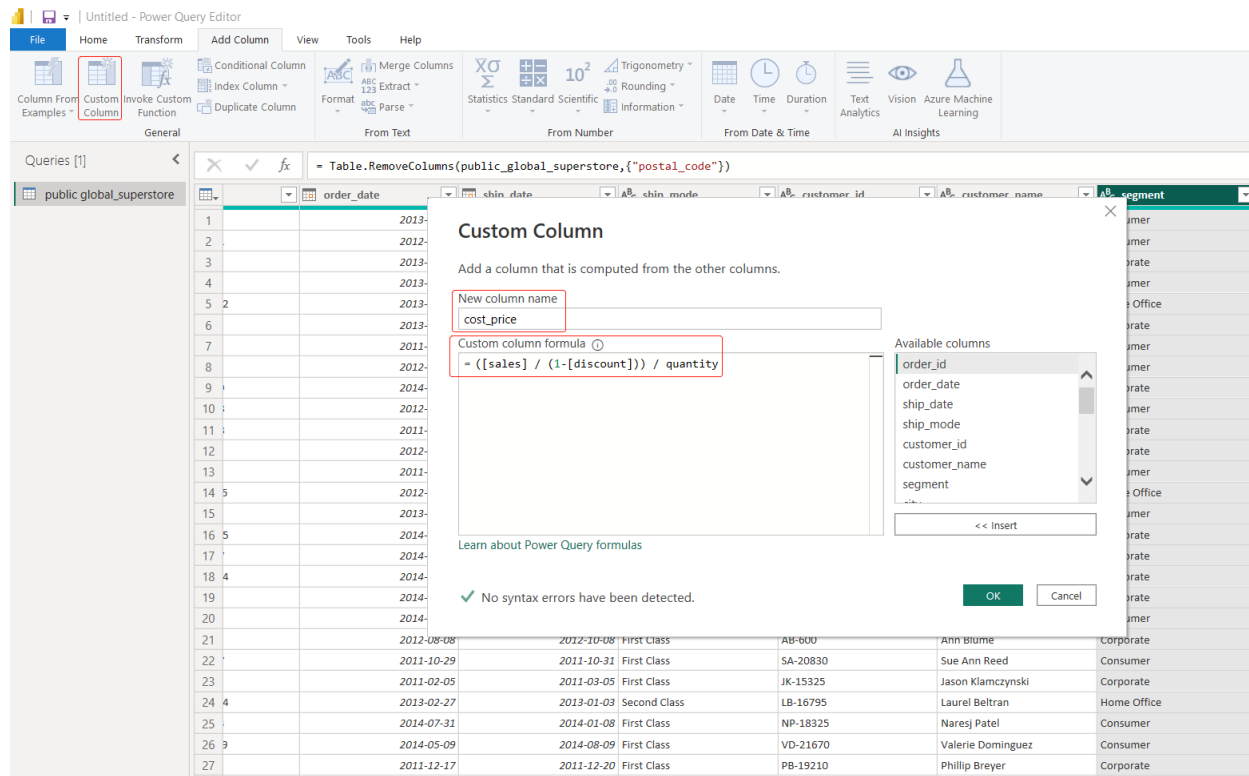


Figure 5-10-1 Adding a column in Power BI

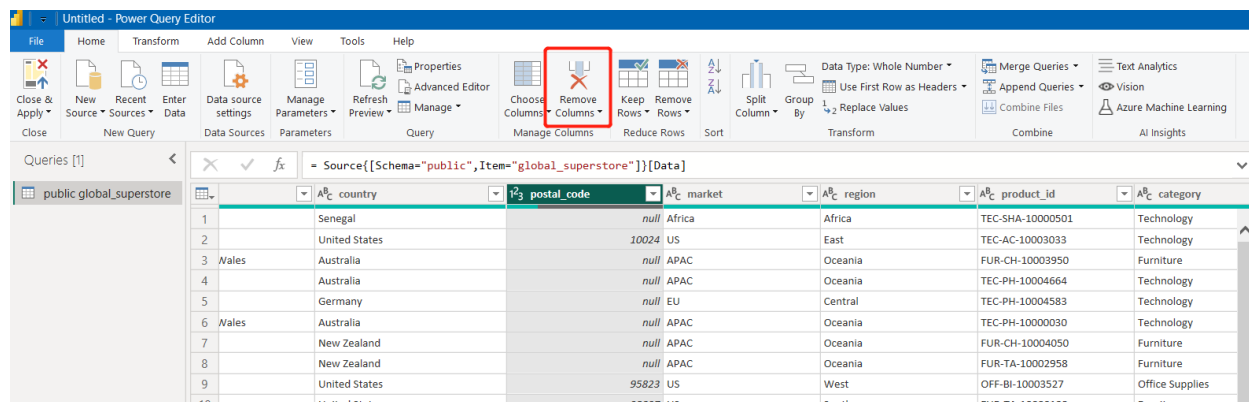


Figure 5-10-2 Deleting a column in Power BI

Figure 5-11 shows that missing values can be handled using Fill up or Fill down in Power BI. Fill up means to fill missing values with the value above it until a new value is found and fill

down means to fill the missing values with the one below it. However, to fill missing values using the UI is not available and a DAX query needs to be written for it which is inconvenient.

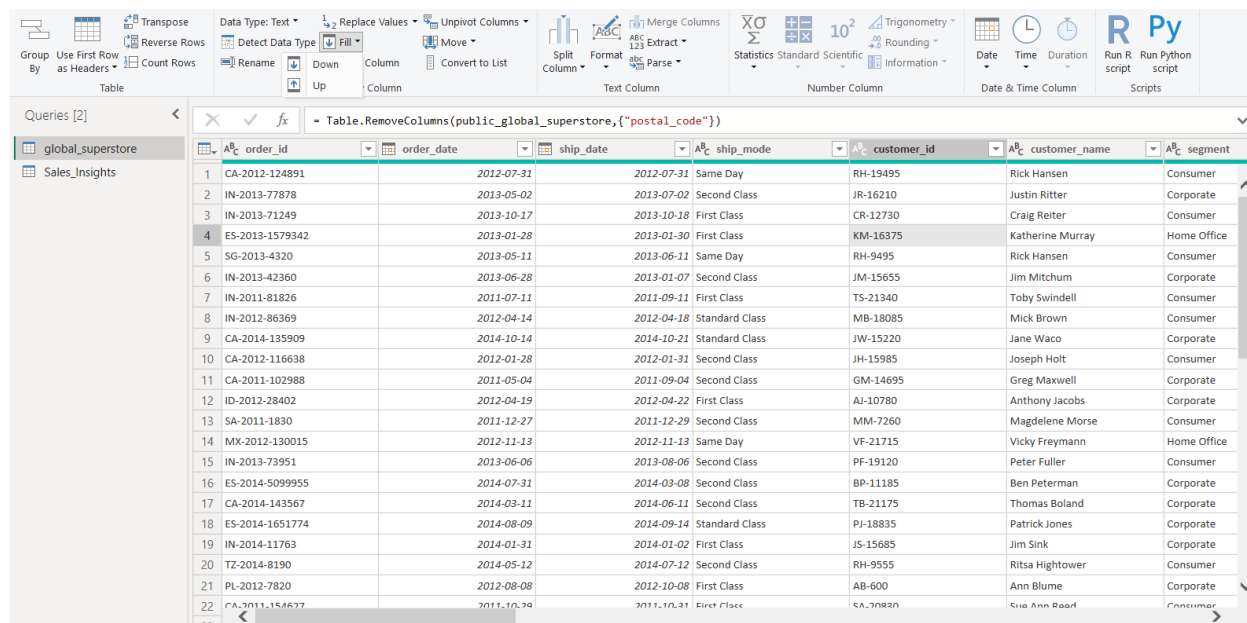


Figure 5-11 Handling missing values using Fill Up/Down in Power BI

Power BI has 3 views - report view (for the reports), table view (for the values in the tables) and model view (for the relationships between the tables). Power BI allows us to map the different columns in different tables and identifies the relationship between them (one-to-one, one-to-many, many-to-many).

Table 5-4 shows the scores and results of Data Analytics Evaluation for Power BI, the final score is **25/30**.

Table 5-4 The scores and results of Data Modeling Evaluation for Power BI

| Data Modeling Criteria | Evaluation Score | Descriptions and Results |
|----------------------------------|--------------------|--|
| Supports Adding/Deleting Columns | 2-Strong Satisfied | Power BI can add or delete columns. Custom columns can be added based on user provided DAX expressions |
| Supports Handling Missing Values | 1-Weakly Satisfied | Power BI provides limited options to fill missing values from the user interface. More complex ways to fill missing values requires knowledge of DAX queries |
| Identifying and Mapping | 2-Strong Satisfied | Power BI model view identifies the |

| | | |
|----------------------------------|--|--|
| Relationships between the tables | | relationships between different columns within the table and also allows users to map columns. |
|----------------------------------|--|--|

5.6 Data Analytics Evaluation

Figure 5-12 shows the abilities to create data aggregations in Power BI. These aggregations can create a new table. The functionality of these aggregations is similar to GROUP BY in SQL. These can be incorporated in visualizations as well using DAX queries.

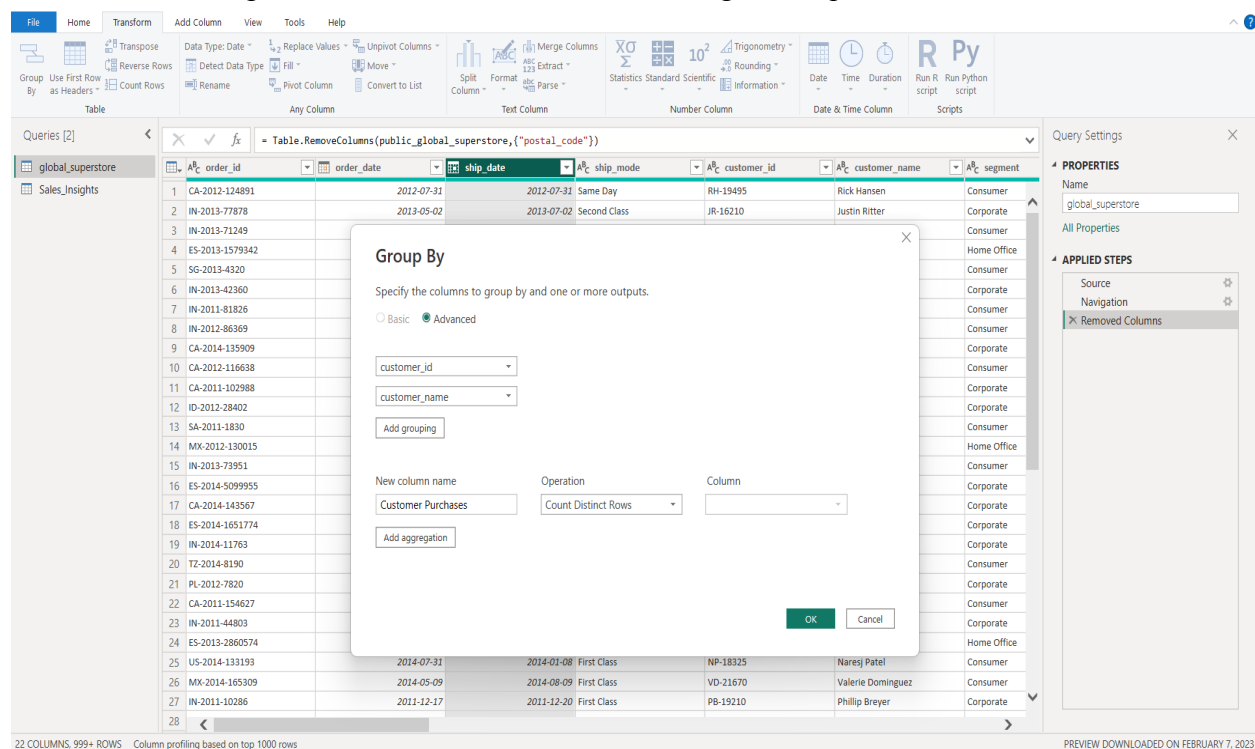


Figure 5-12 Aggregations in Power BI

Figure 5-13 shows the drilling down of the profits from the state of Ontario to the cities within Ontario. Similarly, the data can be drilled up as well.

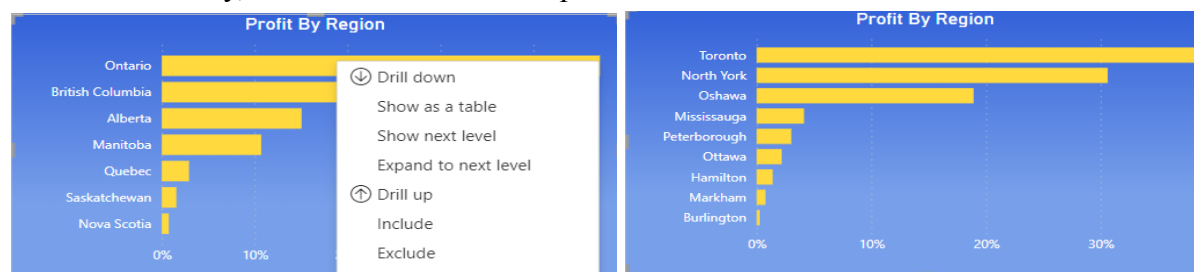


Figure 5-13 Drill Down in Power BI

Figures 5-14-1 and 5-14-2 show the user-defined analytical functions written for determining the rolling sales every 90 days beginning of each month. The more complex visualizations can be achieved with DAX queries.

```
1 Rolling Sales 90D = CALCULATE(global_superstore[Total Sales],
2 DATESBETWEEN(global_superstore[ship_date], MAX(global_superstore[ship_date]) - 90, MAX(global_superstore[ship_date])))
```

Figure 5-14-1 DAX Expression for Rolling Sales 90 Days

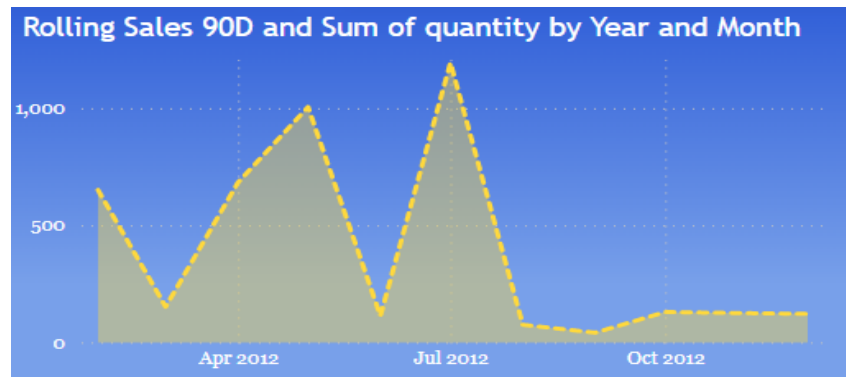


Figure 5-14-2 DAX Expression for Rolling Sales 90 Days Chart

Table 5-5 shows the results of the evaluation of Data Analysis in Power BI. The final score is **30/30**.

Table 5-5 The scores and results of Data Analytics Evaluation for Power BI

| Data Analytics Criteria | Evaluation Score | Descriptions and Results |
|---------------------------|----------------------|---|
| Supports Data Aggregation | 2-Strongly Satisfied | Power BI offers a wide range of options for data aggregation. These include <ul style="list-style-type: none"> - Sum - Average - Minimum - Maximum - Count Rows - Count Distinct Rows - All Rows |
| Drill-Down and Drill-Up | 2-Strongly Satisfied | Power BI offers Drill-down and Drill-up options to users on its visualizations. |

| | | |
|-----------------------------------|----------------------|--|
| User Defined Analytical Functions | 2-Strongly Satisfied | Power BI users can leverage DAX to write complex user defined functions that can be used to create visualizations. |
|-----------------------------------|----------------------|--|

5.7 Reports Evaluation

Figure 5-15 shows a report published on our workspace in Power BI. To publish a report on Power BI, a workspace needs to be created first. On the free version, a personal workspace can only be created. This version doesn't allow for the reports to be collaborated and shared with other users.

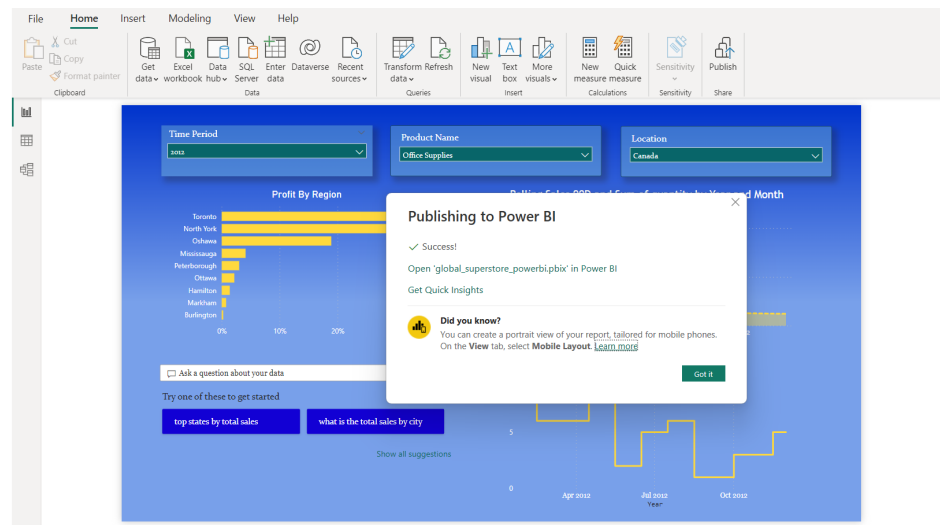


Figure 5-15 Publishing Report to Power BI

Figure 5-16 shows that Power BI reports can be exported as PowerPoint Presentations. A PDF operation is available if required.

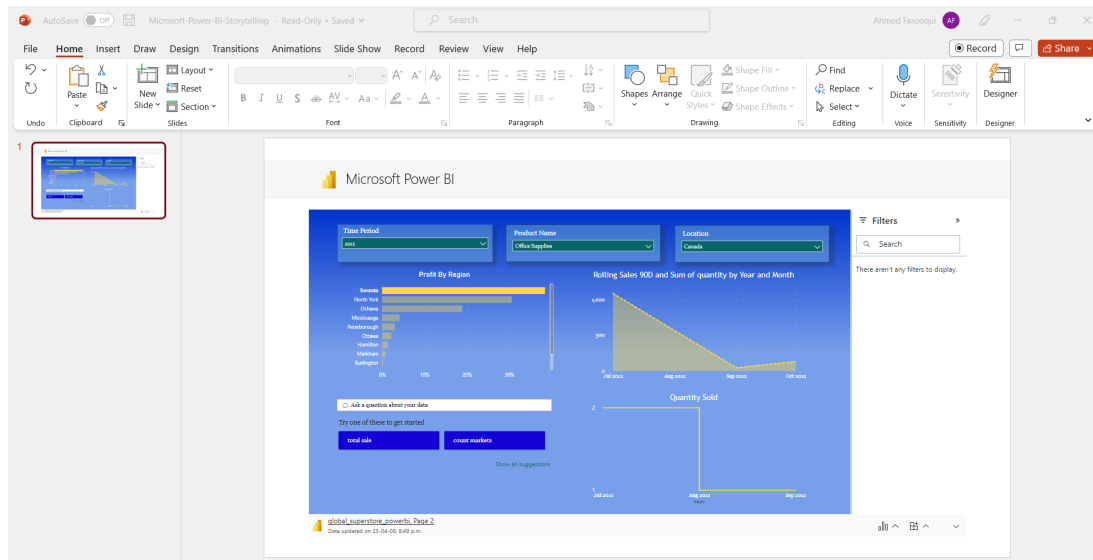


Figure 5-16 Exporting Power BI Report as PowerPoint Presentation

Table 5-6 shows the scores and results of Reports Evaluation for Power BI, the final score is **2/12**.

Table 5-6 The scores and results of Reports Evaluation for Power BI

| Reports Criteria | Evaluation Score | Descriptions and Results |
|---------------------------------------|----------------------|--|
| Supports Multiple Formats for Reports | 2-Strongly Satisfied | Power BI can export reports as PowerPoint and PDF documents. |
| Publish Reports | 0 - Absent | Power BI free version doesn't allow for the required level of publishing and collaboration of reports between users. |

5.8 Usability Evaluation

The most critical feature of Power BI which enables it to generate meaningful insights and reports is DAX. The learning curve of DAX for Microsoft Excel users can be easier, however, the learning curve can be quite challenging and time-consuming. It can take 40 hours per day spread over 1-2 months to gain mastery over it[7].

The AI & Machine Learning capabilities are linked with Azure. The tool has basic features that utilize NLP, but any significant algorithms cannot be run on the dataset in the free version.

The cost of the Power BI premium version is \$6,858.10 per month for an organization. The cost reduces to \$27.50 per month for an individual user which is more reasonable if the costs have to be restricted.

Table 5-7 shows the scores and results of the Usability Evaluation for Power BI. The final score is **10/23**.

Table 5-7 The scores and results of Usability Evaluation for Power BI

| Usability Criteria | Impact Level | Description |
|------------------------|----------------------|---|
| Ease of Learning | 1 - Weakly Satisfied | The Power BI DAX learning curve can be steep. The transition from an excel user is easier. |
| AI and ML capabilities | 0 - Absent | Power BI has advanced AI capabilities on Azure Machine Learning Studio but this is restricted to the premium users. |
| Cost of the tool | 1 - Weakly Satisfied | Power BI premium costs are high monthly for an organization, however, the costs per user are more affordable and viable if the number of users operating on it within the organization are lower. |

5.10 Conclusion

The final score of the evaluation for Power BI is **132/165**.

Power BI offers an excellent option for the organization to begin its data analytics journey. While a more cost-effective tool can be utilized in the beginning, the features which Power BI offers are numerous. The user experience and community support for the tool is suitable for users of all levels. The difficult part is navigating the cost and the learning curve of DAX, but with time, it is worth the resources in our opinion.

6. Conclusions and Recommendations

Both Tableau and Power BI offer excellent options for data visualization. Overall, Power BI has the edge purely from a commercial perspective, but for the case of our study, both offer excellent choices to choose from. However, Power BI outperforms Tableau in terms of the number of charts available, including third-party charts. The conclusion score shown in Table 6-1 favors Power BI by 5 points over Tableau. Thus, we recommend Power BI for the retail company's data visualization and analysis needs.

Table 6-1 Comparison of scores of Power BI v/s Tableau

| Evaluation Criteria | Score | |
|---------------------|----------|---------|
| | Power BI | Tableau |
| Installation | 5/10 | 5/10 |
| Data Sources | 12/12 | 12/12 |
| Charts | 48/48 | 43/48 |
| Data Modeling | 25/30 | 25/30 |
| Data Analytics | 30/30 | 30/30 |
| Reports | 2/12 | 2/12 |
| Usability | 10/23 | 10/23 |
| Total | 132/165 | 127/165 |

7. References

- [1] Apoorva Mahalingappa, 2020, Global SuperStore Dataset, *Kaggle*:
<https://www.kaggle.com/datasets/apoorvaappz/global-super-store-dataset>
- [2] Parul Pandey, Sept 2018, Data Visualization with Tableau, *Datacamp*:
<https://www.datacamp.com/tutorial/data-visualisation-tableau>
- [3] Installation of Tableau: <https://www.tableau.com/products/techspecs>
- [4] What is a Non-Relational Database, *MongoDB*:
<https://www.mongodb.com/databases/non-relational>
- [5] UI Customizations in Tableau:
https://help.tableau.com/current/blueprint/en-us/bp_visual_best_practices.htm
- [6] Data Aggregation in Tableau:
https://help.tableau.com/current/pro/desktop/en-us/calculations_aggregation.htm
- [7] Gaurang Bhatt, Nov 2022, DAX Learning Curve, *LabsMedia*
<https://www.labsmedia.com/blog/time-required-to-learn-power-bi/>