# Business Intelligence Visual Analytics Tools

Gabriela Ožegović, Mauro Jurada, Elliot Koh, and Sven Celin

18 May 2020

## Abstract

This survey paper compares four different Business Intelligence (BI) tools: Tableau, Qlik, Power BI, and Spotfire. Each tool will be explored and scored on its various features. The tools will also be used on sample datasets. A recommendation will be made at the end based on the results of the study.

# Contents

# List of Figures

# List of Tables

# Chapter 1

# Introduction

With the amount of data businesses can collect, data analytics and business intelligence are becoming increasingly important. Business intelligence (BI) tools allow businesses to monitor and view data in ways that allow them to identify trends. This survey paper will look at four different popular business intelligence tools. The capabilities and core features of each tool will be explored, and a comparison will be made between them.

# Chapter 2

# Datasets Used

Choosing the right dataset is important when deciding to showcase a tool's visualization capabilities. First dataset (Figure 2.1) used is a simple dataset of the change in world population [JohnSnowLabs 2018] between the years 2000-2016 was selected. In the data columns, "Country", "Country code", "Year", and "Population" are shown.

Another more complex dataset was chosen (Figure 2.2). A dataset of cereals [Chris Craford 2017] along with nutritional information was used. This dataset was used due to its higher dimensionality which allowed for a more interesting correlation analysis.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Country | Country_Code | year | Population |
| 2 | Aruba | ABW | 2000 | 90853 |
| 3 | Afghanistan | AFG | 2000 | 20093756 |
| 4 | Angola | AGO | 2000 | 16440924 |
| 5 | Albania | ALB | 2000 | 3089027 |
| 6 | Andorra | AND | 2000 | 65390 |
| 7 | United Arab Emirates | ARE | 2000 | 3154925 |
| 8 | Argentina | ARG | 2000 | 37057452 |
| 9 | Armenia | ARM | 2000 | 3069588 |
| 10 | American Samoa | ASM | 2000 | 57521 |
| 11 | Antigua and Barbuda | ATG | 2000 | 83584 |
| 12 | Australia | AUS | 2000 | 19153000 |
| 13 | Austria | AUT | 2000 | 8011566 |
| 14 | Azerbaijan | AZE | 2000 | 8048600 |
| 15 | Burundi | BDI | 2000 | 6400706 |
| 16 | Belgium | BEL | 2000 | 10251250 |

**Figure 2.1:** World population from 2000-2016 dataset

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | name | mfr | type | calories | protein | fat | sodium | fiber | carbo | sugars | potass | vitamins | shelf | weight | cups | rating |
| 2 | 100% Bran | N | C | 70 | 4 | 1 | 130 | 10 | 5 | 6 | 280 | 25 | 3 | 1 | 0.33 | 68.40297 |
| 3 | 100% Natural Bran | Q | C | 120 | 3 | 5 | 15 | 2 | 8 | 8 | 135 | 0 | 3 | 1 | 1 | 33.98368 |
| 4 | All-Bran | K | C | 70 | 4 | 1 | 260 | 9 | 7 | 5 | 320 | 25 | 3 | 1 | 0.33 | 59.42551 |
| 5 | All-Bran with Extra Fiber | K | C | 50 | 4 | 0 | 140 | 14 | 8 | 0 | 330 | 25 | 3 | 1 | 0.5 | 93.70491 |
| 6 | Almond Delight | R | C | 110 | 2 | 2 | 200 | 1 | 14 | 8 | -1 | 25 | 3 | 1 | 0.75 | 34.38484 |
| 7 | Apple Cinnamon Cheerios | G | C | 110 | 2 | 2 | 180 | 1.5 | 10.5 | 10 | 70 | 25 | 1 | 1 | 0.75 | 29.50954 |
| 8 | Apple Jacks | K | C | 110 | 2 | 0 | 125 | 1 | 11 | 14 | 30 | 25 | 2 | 1 | 1 | 33.17409 |
| 9 | Basic 4 | G | C | 130 | 3 | 2 | 210 | 2 | 18 | 8 | 100 | 25 | 3 | 1.33 | 0.75 | 37.03856 |
| 10 | Bran Chex | R | C | 90 | 2 | 1 | 200 | 4 | 15 | 6 | 125 | 25 | 1 | 1 | 0.67 | 49.12025 |
| 11 | Bran Flakes | P | C | 90 | 3 | 0 | 210 | 5 | 13 | 5 | 190 | 25 | 3 | 1 | 0.67 | 53.31381 |
| 12 | Cap'n'Crunch | Q | C | 120 | 1 | 2 | 220 | 0 | 12 | 12 | 35 | 25 | 2 | 1 | 0.75 | 18.04285 |

**Figure 2.2:** Cereal dataset

# Chapter 3

# Tableau

Tableau is used for interactive data visualization, data management and data analysis. It helps with simplifying the data and showing it in understandable format. It is able to import data of all sizes and ranges, and can be really helpful for people without technical background, since it offers "no code" data queries. Visualizations are created as worksheets and dashboards.

It offers several products which all serve different purposes. Tableau Desktop is used for coding and customizing reports. Here a user can create reports and charts, and combine them in a dashboard. A worksheet is, like its name says, a sheet where user works, and it consists of all charts and dashboard created for the dataset. Tableau Reader is used to view visualizations and workbooks which were created using Tableau Public or Tableau Desktop. Tableau Prep is used for data preparation before the visualization and analysis. Tableau gives out few pricing ranges [Tableau 2020b], with the goal to fit people and organisations with different needs. For individuals, there is only one option, and that is Tableau Creator for 70 USD per month, billed annually. Older customers had the ability to purchase Tableau Desktop on it's own, but that is not available any more for new customers.

For organisations, there are two groups of pricing categories, depending on where the deployment of visualizations is. Products deployed with Tableau Server are cheaper than the ones deployed with Tableau Online. The reason behind the cost difference is that additional cost accounts for the infrastructure Tableau uses to host the service. For the deploy with Tableau server the offers are: Tableau Creator for 70 USD per month per user, Tableau Explorer for 35 USD per month per user, and Tableau Viewer for 12 USD per month per user. Deploying with Tableau Online gives the offers: Tableau Creator for 70 USD per month per user, Tableau Explorer for 42 USD per month per user, and Tableau Viewer for 15 USD per month per user. Every deployment requires at least one Creator. In addition to that, a minimum of 5 Explorers and 100 Viewers are required. Since Tableau's target market is companies, there are also enterprise prices available. Tableau's subscription offerings make it easy to plan and scale analytics across the organization, including volume discounts where applicable. Those are specific for each company, so they are made after a direct contact and meeting with the Tableau sales team.

It also has a free version for everybody, Tableau Public. Students are eligible for a student license which lasts for a year. Other than that, there is a two week free trial for Tableau Desktop. These free options are a great way to start working with Tableau before purchasing it. Potential user can get familiar with the software and see how it works for themself. It is fairly easy to do the most basic things in Tableau, with the help of tutorials. Learning it on its own is a much harder path. It takes a lot of practice to master Tableau, and it needs to be done continuously. For a beginner, it is not hard to grasp the basics and do simple charts with some help, but doing complex operations is hard.

When it comes to deployment, it can be done either via Tableau Server or Tableau Online. Tableau Server means the deployment is on-premises or with a public cloud of user's choice. This gives the users certainty that their data is secure, governed and accurate. It gives the ability to explore the data in a trusted environment. It can also connect to any data source securely, whether on-premises or in the cloud.

Users can publish and share their data sources as live connections or encrypted extracts for everyone to use. In addition to that, users can see the usage so they could optimize their environment. Tableau can also integrate with any of the existing security protocols that users have. For the deployment itself, users can integrate the software into their existing data infrastructure. Tableau Online means the deployment is fully hosted by Tableau. With that, multiple people can work on the same dashboard. Users can also share their dashboard to anyone to explore it. Since it is fully in the cloud, it saves users from setting up and maintaining a server infrastructure, and configurations, everything is done by Tableau itself. There are no virtual private networks required, analytics can be accessed from everywhere (given the fact that it is shared to that person who wants to see it).

## 3.1  Import and Export Formats

There are a lot of different import options, which is also the case with other tools. On the welcome street, there is a sidebar on the left just for connecting the data. The first option is to search for data on the Tableau Server. Here a user can write the URL of the dataset, and open it in the worksheet. Then a user can choose a file stored locally on the computer. There are few file formats listed here, and with clicking on "More..." a user can select a file which is not listed immediately, like .csv, Tableau Desktop really shows its import capabilities with selection of options to connect data to a server. Lastly, a user can open one of the saved data sources, which is some sample data from Tableau or specific data user saved.

As mentioned previously, Tableau has a Tableau Prep product which is used for working on datasets and preparing them for the visualization. There a user can see a complete picture of their data. It is really interactive, for example, a user can just click on a shown value and change it immediately. Data can also be connected to more data, and merged. Other than that, there is a data management page in Tableau Desktop. After connecting to the data, the user is taken to the page which is for managing data sources. Here the user can work with their dataset. The user can add more datasets and connect all their data. The user can add more columns, based on their data. For example, the user can split a column (write each word of a string in a new column) or perform some type of calculation to edit the strings. For the columns which have values stored, mathematical operations can be performed on them and the result can be saved in a new column, or put the values into bins. The user can't edit or delete values in the dataset. This data management is used primarily to see thr data, perform some basic operations which do not change original data values, and add new values. While this is not ideal for personal use, organisations which buy Tableau Creator (since there is no possibility to buy just Tableau Desktop) also get Tableau Prep builder included, so that might be the reason data management is so limited here and weaker than the other tools.

It does not have a lot of export options. The user can export the whole workbook, or just a single worksheet (chart). Exporting as a Tableau version means the user can select a specific version of Tableau from all the existing ones. The workbook can also be export as PowerPoint or PDF. A single worksheet can be exported as an image, data or crosstab to excel. Data export exports just the parts of data which were used in the worksheet.

While these exports seem good at first, there are two key elements missing. There is no SVG export, which should be available in the tool as powerful as Tableau. In addition to that, Tableau gives the ability to create easy and good looking animations, but there is no official way to export that animation. Their focus seems to be on keeping people using Tableau and seeing the charts in their own Tableau Viewer.

## 3.2  UI and Usability

To start working with Tableau, a user should look at a few tutorials to understand some basics. It, of course, depends on the experience the user has when it comes to similar information visualization softwares. For a first-time user, drag and dropping desired field of data might not be the most natural
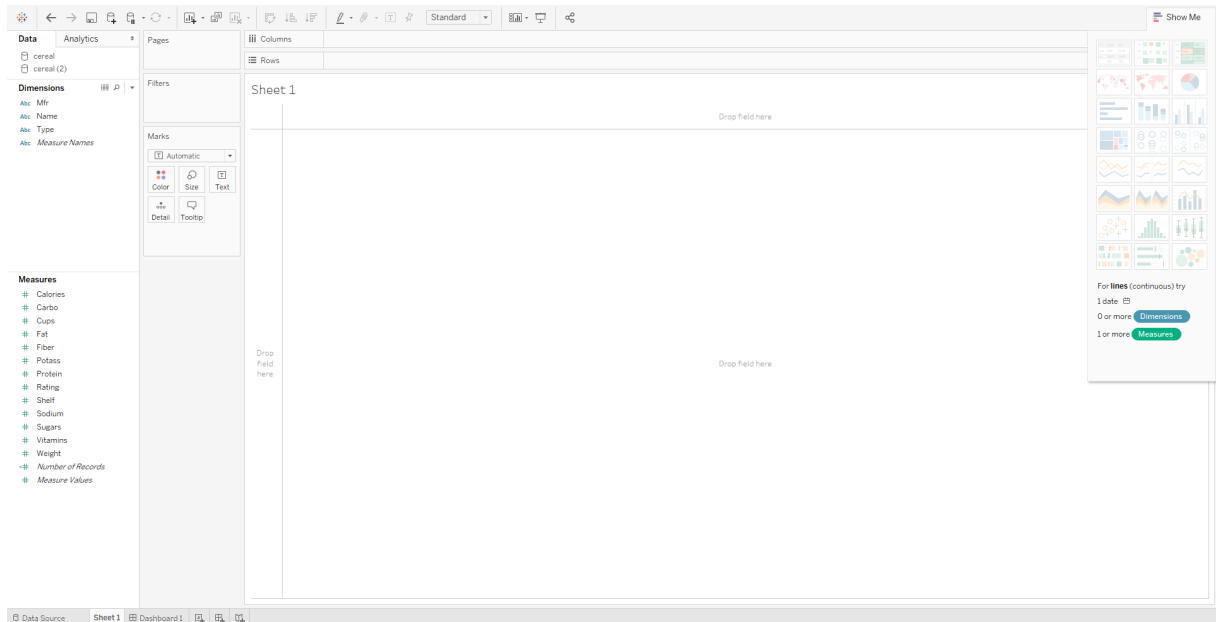
**Figure 3.1:** Tableau empty worksheet. [Screenshot made by Gabriela Ožegović using Tableau [Tableau 2020a].]

and intuitive thing. It is not recommended for a first-time user to try to learn the software by themselves, since it would be quite hard.

Figure 3.1 shows how the empty worksheet looks like. To visualize the data, the user simply has to drag the desired fields from the sidebar and drop them into "Columns" or "Rows" in the upper middle part of the screen, or just to the empty canvas. This puts the data on the worksheet so user can work with it. It makes creating charts easier, since the user can select the specific data they can work with. Similar to that, to do analytics the user can just drag and drop pieces of the analytics from the sidebar to the sheet. On the right side, there is a "Show me" tab. This tab shows which charts can be created with selected fields of data. The charts that can be created are colored, and the ones for which there is no enough information are grayed out. One helpful feature is that, if a grayed out chart is hovered over, it is written which data is missing to be able to create that chart. Charts can be created only with GUI, there is no scripting available itself. But, there is scripting available in other Tableau products, which companies get while buying Tableau. In 2019, custom support for R and Python scripts is introduced to Tableau Prep. That gives users the ability to use R or Python language to transform the data, look up additional information or run machine learning pipelines on their data. For Tableau Server and Tableau Online, there is an "Ask data" feature. This gives users the ability to ask questions in natural language about the data. It also has an AI-driven explanation of the data, which is accessed by just clicking on the data point a user is interested in. Those features really make it easy to people without technical background. While Tableau Desktop does not have those features itself, they come with purchasing the software altogether, so it is assumed that each company that uses Tableau uses them.

The unique feature that Tableau Desktop has is an ability to create animations. The animation can be created in a few simple steps, and it is easy and intuitive. This is a really powerful feature for representing certain types of data. The user can easily and in an understandable way show time series, or any data that changes over time or according to some condition. Animated visualizations can give the viewer in the end a better understanding of data. Like mentioned before, there is no export of these animations, but that might be changed in the future.
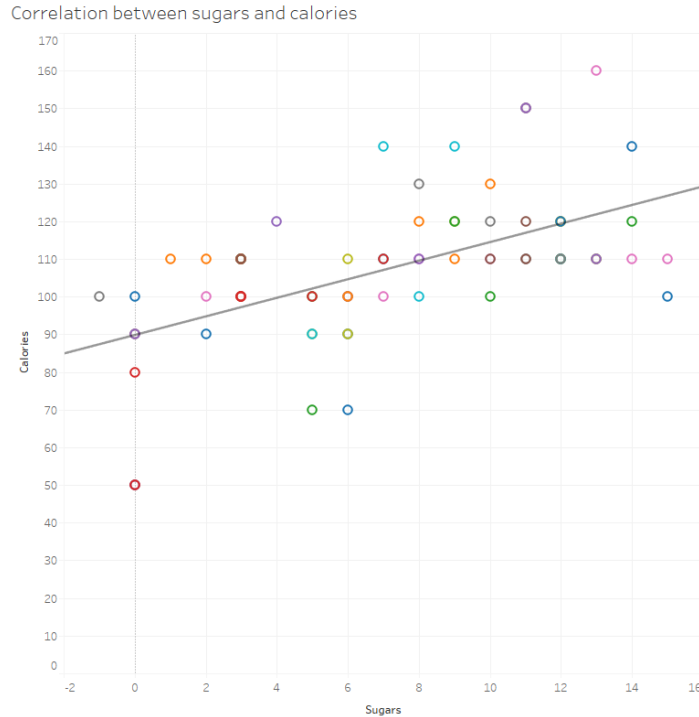
**Figure 3.2:** Tableau:  Scatter plot to see correlation between sugars and calories for each cereal.
[Screenshot made by Gabriela Ožegović using Tableau [Tableau 2020a].]

## 3.3  Support and Community

Being the most popular BI tool on the market, it has a very active online forum.  There are more than 150,000 active users, which help each other at all times.  This makes it easier to work with Tableau, since if a user has a specific issue, they have a dedicated space to ask other users.  This also makes learning easier since people share resources with each other or give each other advice.  In addition to that, there are quite a few tutorials available, directly from Tableau.  Tableau also offers classes and conferences for people with interest in it.  There are a lot of different resources to learn it, it is just a matter of how persistent a person is.  In addition to that, there are several low-cost courses on Udemy and Lynda with focus on Tableau.  There are also many books available that help with learning Tableau, since some people prefer that way of learning.  One could argue that having an active forum or a place to discuss with other users is better than the software support itself, and luckily Tableau provides both.

Tableau Desktop provides Extensions API, which is used by developers to create dashboard extensions that enable customers to integrate and interact with data from other applications directly in Tableau, and create unique features.  But, a user does not have to be a developer to use the extensions.  Extension Gallery is publicly available, where users can see what other developers have built, and can use them freely. Extensions are used on dashboards, and not on single sheets. The Extension object on the sidebar of the dashboard can be just dragged and dropped to the dashboard, and there user chooses between his extensions and extension library to choose an extension.

## 3.4  Examples

For this testing of the Tableau Desktop, a version which was being used is 2020.1, with a student licence, on Windows 10 OS.
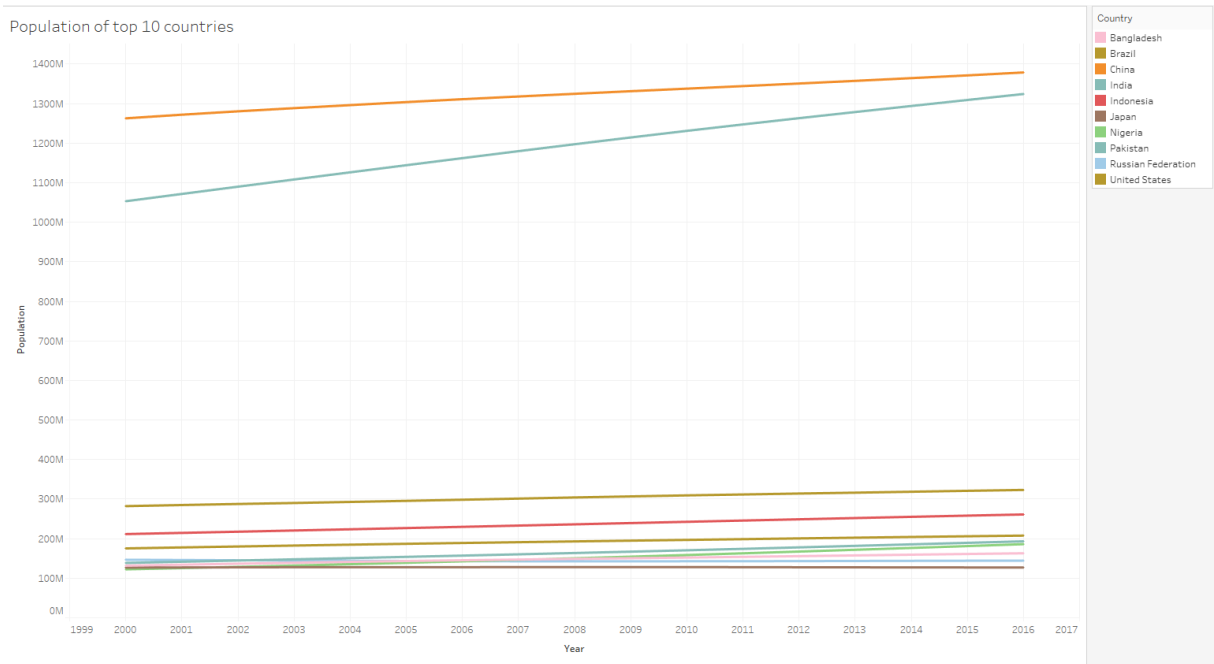
**Figure 3.3:** Tableau: Line graph which shows how the population in 10 most populated countries in the world changed over the years. [Screenshot made by Gabriela Ožegović using Tableau [Tableau 2020a].]
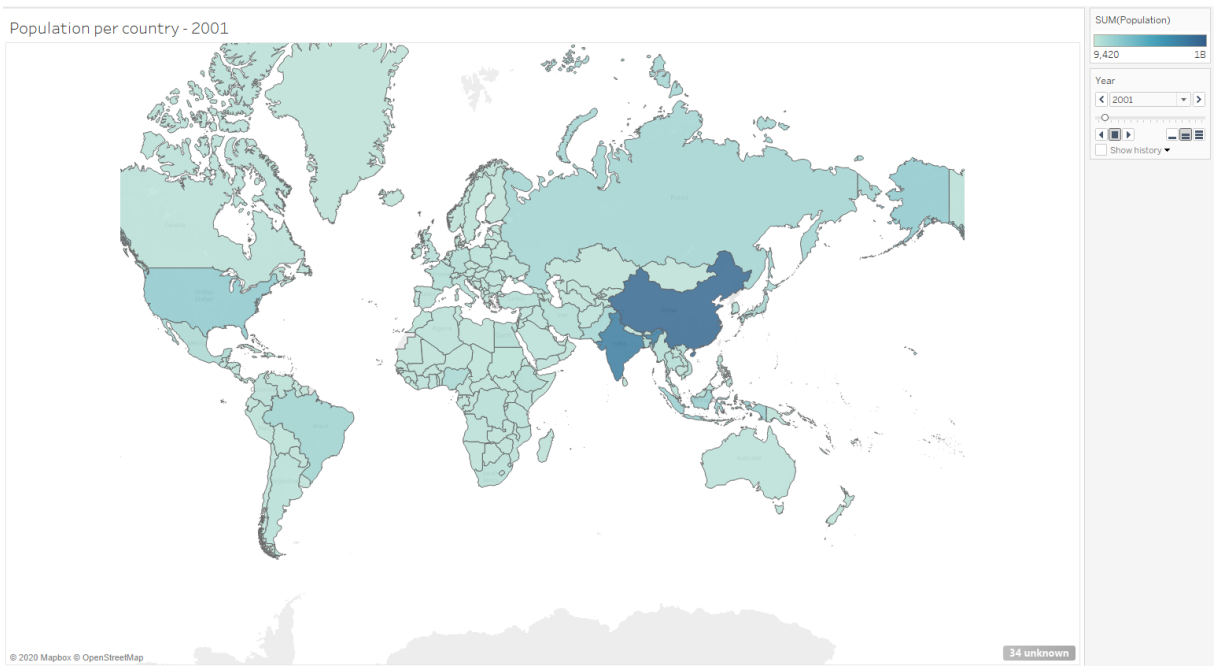


**Figure 3.4:** Tableau: Map graph which colors each country in a color which is proportional to the population (dark color = higher population) for a specific year. [Screenshot made by Gabriela Ožegović using Tableau [Tableau 2020a].]

## 3.5 Conclusion

As mentioned before, Tableau is the most popular Business Intelligence tool on the market. It holds 15.87% of the market share [[Enlyft 2020c]]. For this reason, it has a thriving community, which can often be of significant importance for people working with it. Tableau Desktop is great visualization tool, and for other things which need to be done with the data, there are other Tableau products which are included. Since it is fairly expensive, it might not be the best option for the companies which are just starting out and do not have a huge income, because the can get, as can be seen, equally good tools for cheaper price.

# Chapter 4

# Qlik Sense

Qlik Sense is a complete data analytics platform that aims to set the benchmark for a new generation of analytics. It advertises its one-of-a-kind associative analytics engine, sophisticated AI, and high performance cloud native architecture aiming for organizations of any size. It was built upon the first iteration of the tool - QlikView, a simpler tool which is still heavily supported to this day (Figure 4.1). While very easy to get started with and create a valid, useful report from clean data, more in-depth functions require tool-specific knowledge.

Qlik Sense provides support for mobile sharing, online or offline with fully interactive mobile analytics. It also indexes and promises to understand every relationship in data so users can explore freely in any direction.

Currently there is a 30 day free trial as well as a student version lasting for a year. Normally it would set the company back for $30 per user per month, up to $70 [Qlik 2020b]. Cheapest options is a SaaS solution to operationalize analytics across groups and teams while higher tears offer multi-cloud solutions.

In terms of deployment, it is offered as a Software as a service (SaaS). Depending on the subscription tier, users or organizations can use the full power of the Qlik Cloud or set up an on-premise deployment. It is even possible to combine the clouds through Qlik multi-cloud architecture.

## 4.1  Import and Export formats

Importing into Qlik Sense is as easy as drag and drop or connecting to a data source through already established connectors (Figure 4.2). Besides the standard input formats (CSV, XML, etc.), Qlik Sense supports DIF and even manual entry. It is possible to load almost anything through scripting and preproces it into a readable format (e.g. JSON files are loaded either through a REST connector or by scripting).

Merging and formatting datasets is usually done with scripting in a SQL fashion. But besides that, Qlik offers an intuitive GUI that shows the tables, associations, connections, etc. It can be simpler for users to manage data through a visual representation. Qlik will automatically merge tables with the same headers and is able to recommend associations between data tables.

Through the Data model viewer (Figure 4.3) users can see a nice overview and inspect all the fields. Seeing the density, duplicates, distinct and null values, it becomes very easy to fast check the integrity of data. Creating a preset of specific dimensions and measures can be done here.

Appearing somewhat limited in its export options, Qlik Sense focuses on sharing between collaborators. It can statically export to an PNG image, PDF and iframe HTML embedding. Users can directly connect to their secure email server for such sharing. The strength is, ofcourse, in the live, intractable reports called sheets. These can be accessed by other Qlik users simply by following an URL. These reports are automatically updated if the datasets change or when users specify what data they want shown. Specific to the Qlik Sense is the Storytelling option that works much like the popular Microsoft PowerPoint.

**Figure 4.1:** Features & functions of Qlik Sense and QlikView.
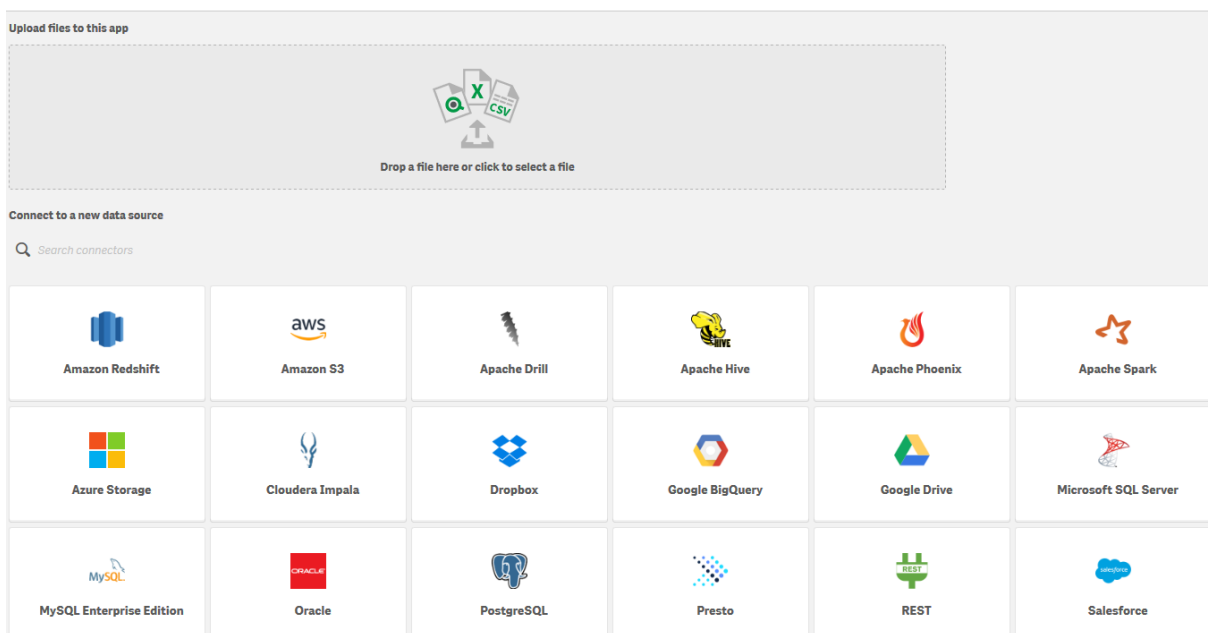[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]



**Figure 4.2:** Qlik Sense import UI
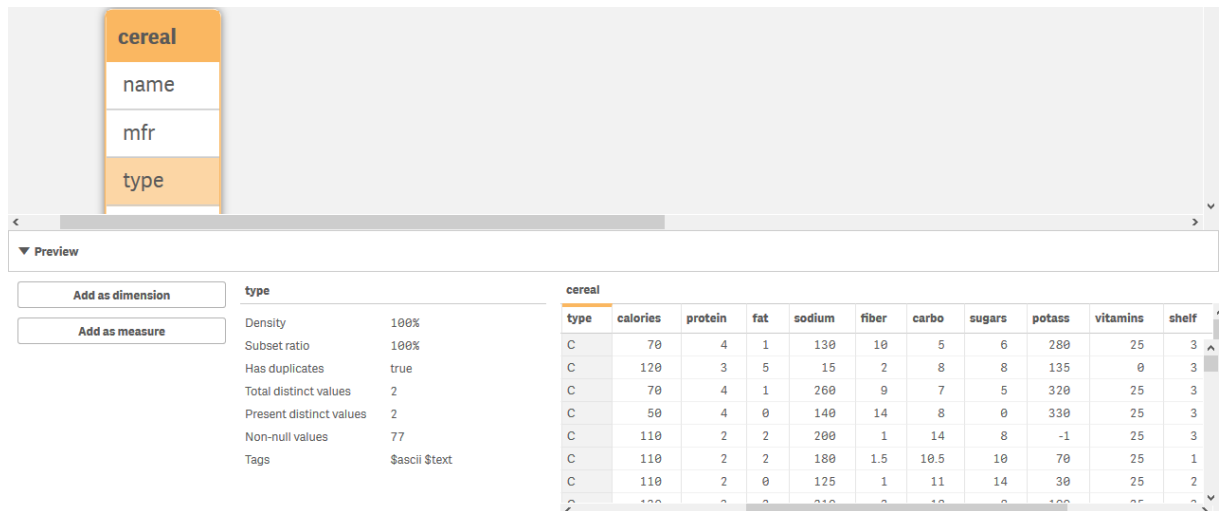[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]

**Figure 4.3:** Data model viewer with the cereal dataset.
[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]

## 4.2 UI Overview and Usability

UI follows the three-click rule. After getting used to where everything is, it is very fast. Not only that, but the AI assistant provides automatic findings of insights in the data. Users are also able to use natural language to ask questions such as "What was our revenue last year?"

Workflow in Qlik Sense can be separated into three distinct areas with clear left-to-right order. Firstly is the *Prepare* side that encomapses everything about importing, merging and referencing datasets. From scripting that helps import and format tricky data, to interactive visualisations of the tables which tremendously helps with proper referencing and finding connections. Secondly, the *Analyze* portion with the current worksheet containing the desired charts etc. Here users can literally ask the AI assistant to find insights into the data and recommend visualisations. In figure 4.4 part of the worksheet is shown from where users can simply drag and drop the desired chart into the worksheet.

Finally, in the third section, *Narrate*, users can show gathered snapshots of the charts in a presentation format. Usually though, sharing worksheets is the way to go since they are fully interactable.

Everything in Qlik Sense is intended to be possible through GUI, apart from specific importing, visual representations (e.g. changing nomenclatures) and writing formulas. Further customizing the charts through formulas can be scripted but heavy emphasis still lies on GUI.

A close to perfect view of the dataset tables and their visual representations of datasets can be of immense help to connect and find relationships. While looking at a worksheet, selecting only part of the data highlights how that changes other shown data before even the charts are updated.

## 4.3 Support and Community

Through thorough documentation and available tutorial videos, users can find an answer to any problem reasonably fast. Qlik Training, as part of Qlik subscription, offers proper certified courses.

Ability to develop extensions directly on the Qlik's Associative Engine Lots of extensions (e.g. SVG reader that can read data from SVG maps) With the developer platform you can explore the tools and resources you need to build, extend and deploy custom data-driven applications and analytics. Users can add and create extensions taking advantage of the qlik engine through Qlik branch - a marketplace for partnered up developers.
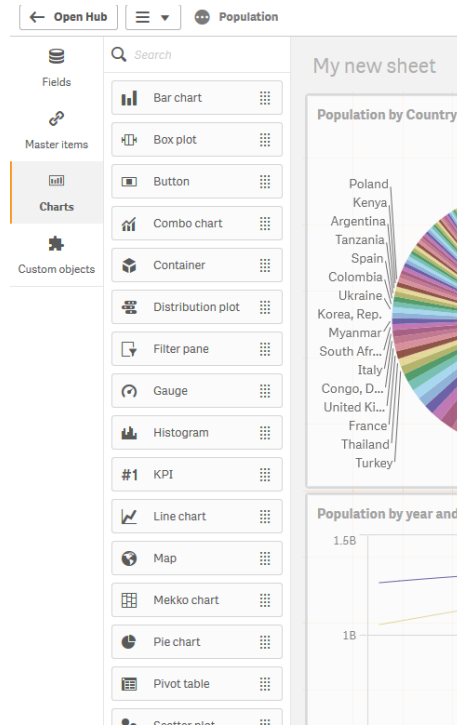
**Figure 4.4:** Part of Qlik Sense worksheet
[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]

## 4.4  Examples

A trial version of Qlik Sense Business edition 2020 on Windows 10 Pro v 1909 was used, along with the same datasets and same desired charts for comparison purposes.

First chart (Figure 4.5) is a Scatter plot to see correlation between sugars and calories for each cereal. Unlike other tools, in Qlik Sense the trend line showed to be quite difficult to create. Knowledge of tool specific formulating was needed. In figure 4.6 and figure 4.7 a line chart and a map are shown.

## 4.5  Conclusion

There are at least 3,712 companies that use Qlik Sense [Enlyft 2020b]. The companies using Qlik Sense are most often found in the United States and in the Computer Software industry. It is most often used by companies with 50-200 employees and 10M-50M dollars in revenue.
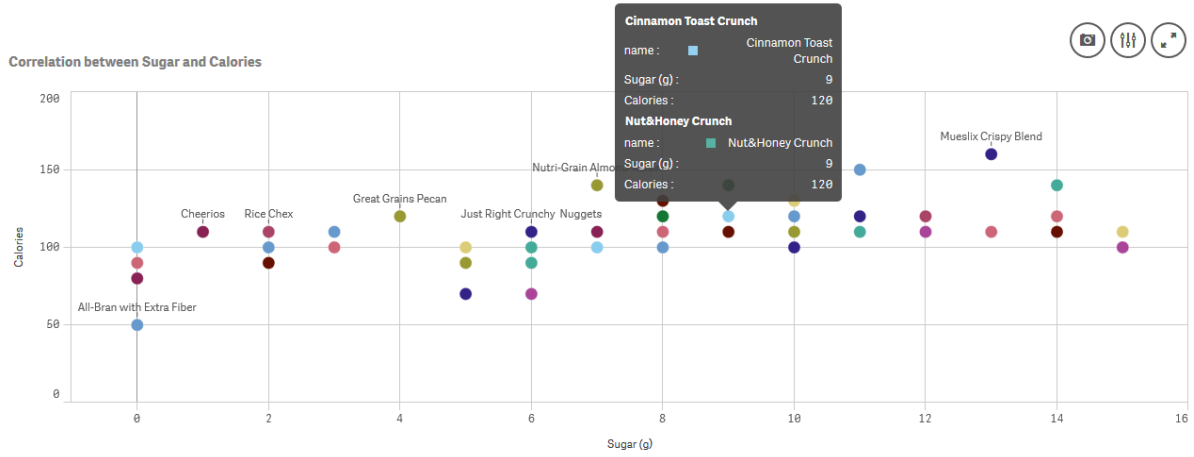
**Figure 4.5:** Qlik Sense scatter plot showing the correlation between sugar and calories.
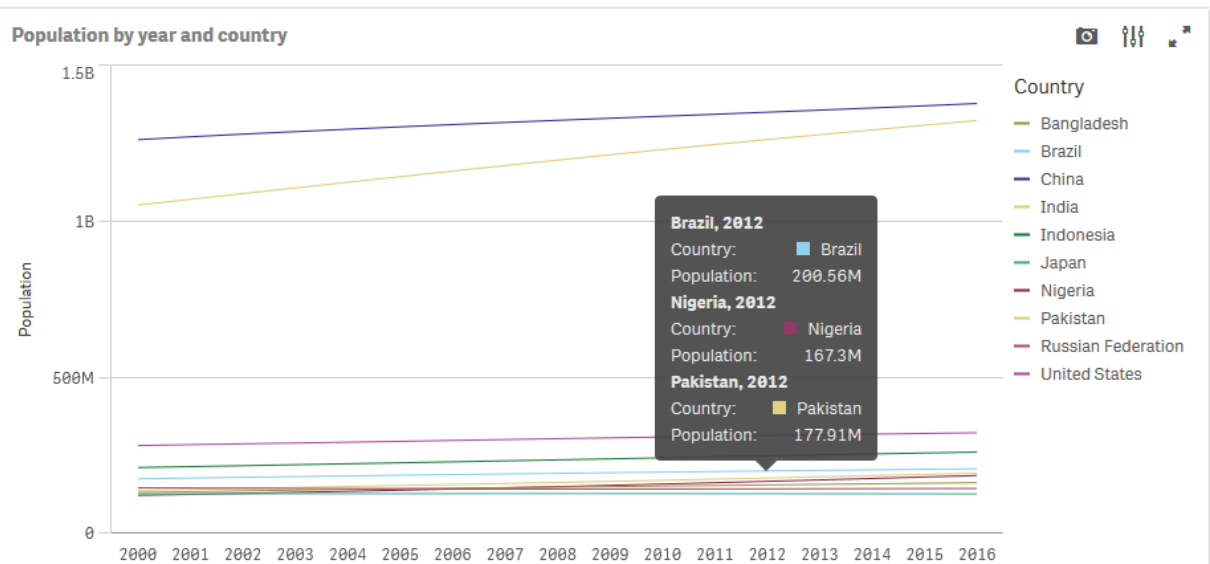[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]



**Figure 4.6:** Qlik Sense growth in population for the top 10 most populous countries.
[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]
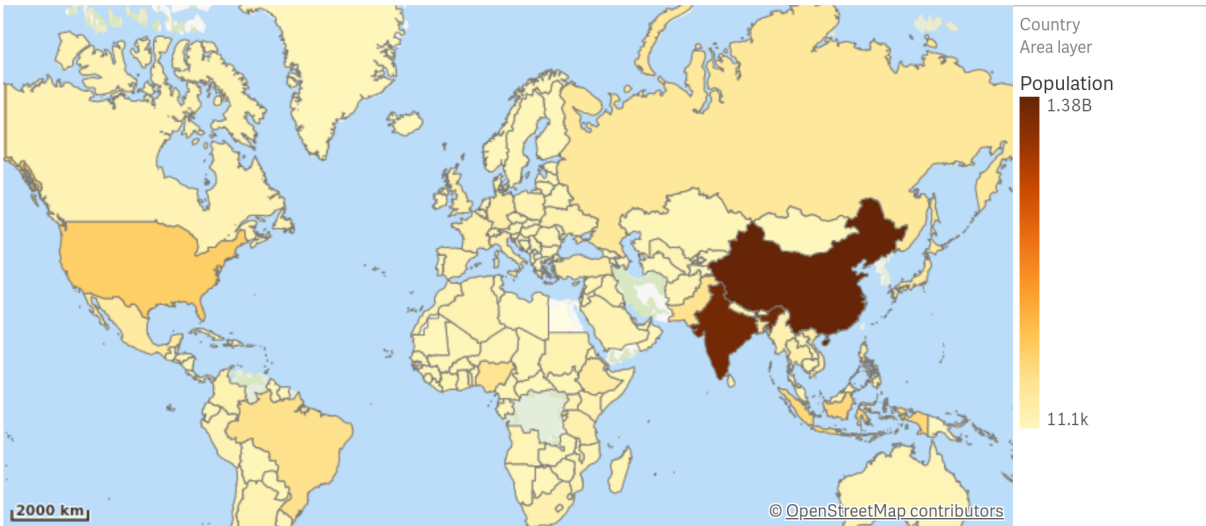
**Distribution of Population across countries**



**Figure 4.7:** Qlik Sense map of population by country.
[Screenshot made by Mauro Jurada using Qlik Sense [Qlik 2020a]]

# Chapter 5

# Power BI

Power BI is a business intelligence and analytics service developed by Microsoft. It aims to provide users with an affordable but simple, easy-to-use tool to create visualizations, dashboards, and reports with their data. Power BI is available both free and as a paid version. The free version is called Power BI Desktop. This offering is meant for single users and includes basic functionality such as data import, basic and custom visualizations and the ability to publish to the Power BI service.

The paid versions come in two variants; Power BI Pro and Power BI Premium. Power BI Pro includes data collaboration, data governance, building dashboards and allows users to share and publish reports. Power BI Premium does everything the Pro version can do and comes with dedicated cloud computing and storage. Power BI Pro is licensed per user and is priced at $9.99/user/month [Microsoft 2020b]. A 60-day free trial is available for users who wish to try Power BI Pro. Power BI Premium is licensed by dedicated cloud compute and storage resources and is priced at $4,995/month/per dedicated cloud compute and Storage.

Upon opening Power BI for the first time, users are greeted with links to video tutorials. Even without using the tutorials, Power BI is intuitive and has a shallow learning curve. Users can start creating simple charts and graphs in Power BI with little to no training.

Power BI can be run both locally and on the cloud. The local version of the application is available for Windows only. While both versions have the same core functionality, the local version is more limited in report sharing and publishing. That being said, users can easily export their work done locally to the cloud for more sharing and publishing options.

## 5.1  Import and Export Formats

Power BI supports a large range of import formats. The standard formats such as CSV, XML, and Excel are supported. Power BI is also able to connect to databases.

Power BI can export to the usual formats such as PDF. Power BI users can also create shareable links and also have the option to embed reports in HTML. However, Power BI is limited in its image export options. It cannot export to SVG or other image formats.

The Power Query Editor (Figure 5.1) in Power BI allows users to clean and edit their data upon import. This tool allows users to pre-process their data before use. Users can add, remove and filter data, and view it in table format before they begin to use it.

## 5.2  UI and Usability

Power BI is intuitive and easy-to-use for the average user. As a Microsoft product, the Power BI UI is reminiscent of other Microsoft office products. Power BI uses the same menu bar and ribbon (Figure 5.2)
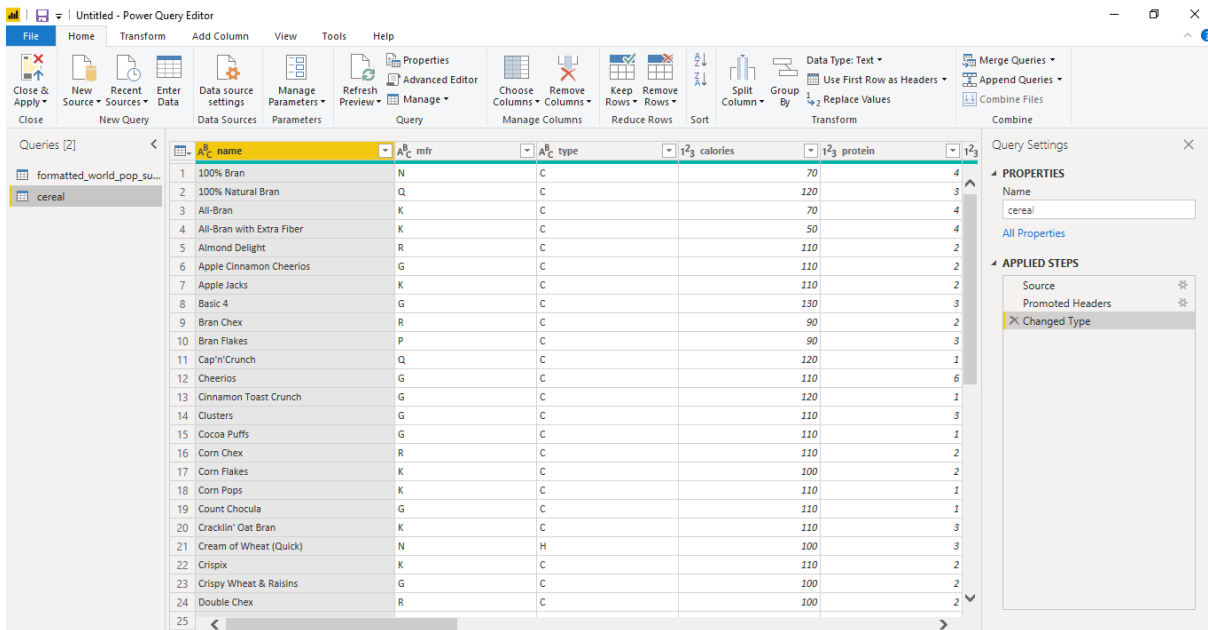
**Figure 5.1:** Power Query Editor in action. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]
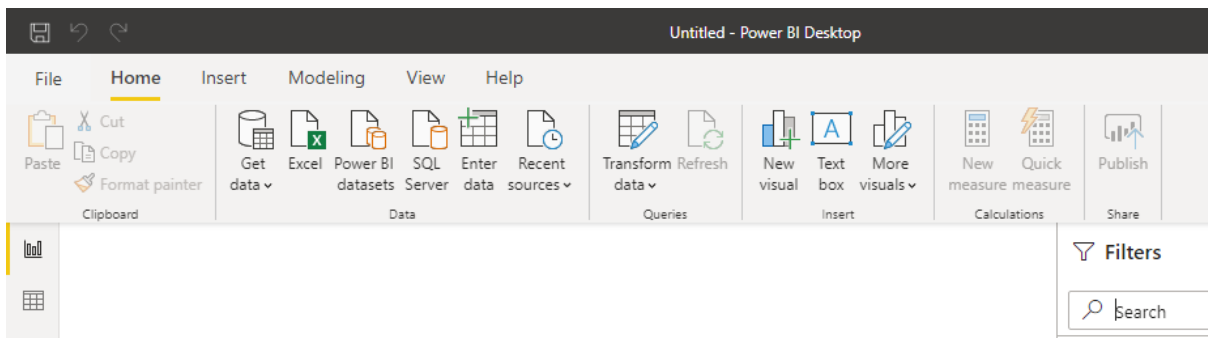


**Figure 5.2:** Power BI's menu bar and ribbon. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]

as applications such as Word and Excel. Users familiar with those products should have little trouble finding their way around Power BI.

Power BI is drag and drop based and offers over 20 default visualizations out of the box. To create a chart, users simply need to select the chart they want to create and drag the data they wish to plot to the corresponding field of the chart (Figure 5.3).

Icons in Power BI are also well labelled so modifying charts and adding additional elements to a graph such as trends lines are straightforward to do. Charts are interactive and users can mouse over different areas and elements of a chart to get more detailed information about it.

Custom visualizations are possible in Power BI. Users can create their own custom visualizations using JavaScript. Power BI provides a visualization framework along with a test suite and tools to help the community build custom visuals easily.

Mobile Integration: Power BI has mobile apps for iOS, Android, and Windows devices. The mobile apps let users view and interact with reports and data they have created. Reports can also be designed with mobile views in mind (Figure 5.4). Natural Language Processing: The Q&A feature in Power BI lets users explore their data using natural language (Figure 5.5).
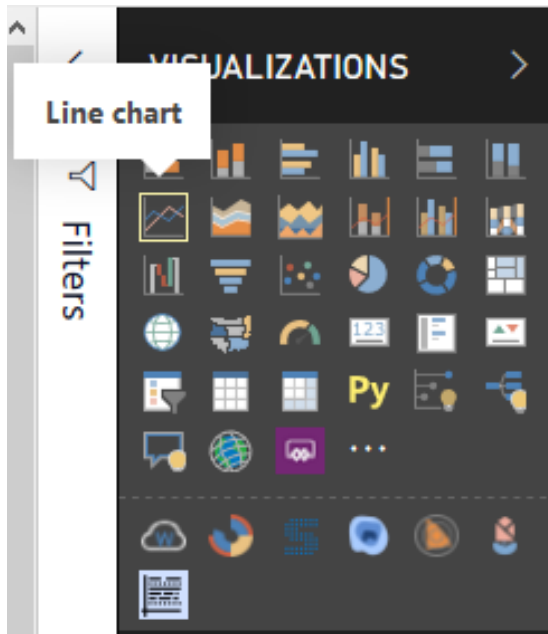
**(a)** Power BI provides over 20 default visualizations out of the box
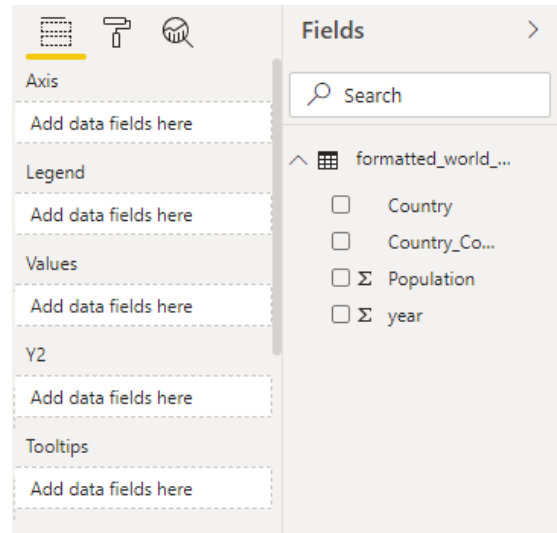


**(b)** Power BI's drag and drop interface.

**Figure 5.3:** Elements of the Power BI UI. (a) shows visualization options. (b) shows Power BI's drag and drop interface. [Both screenshots made by Elliot Koh using Power BI [Microsoft 2020a]]
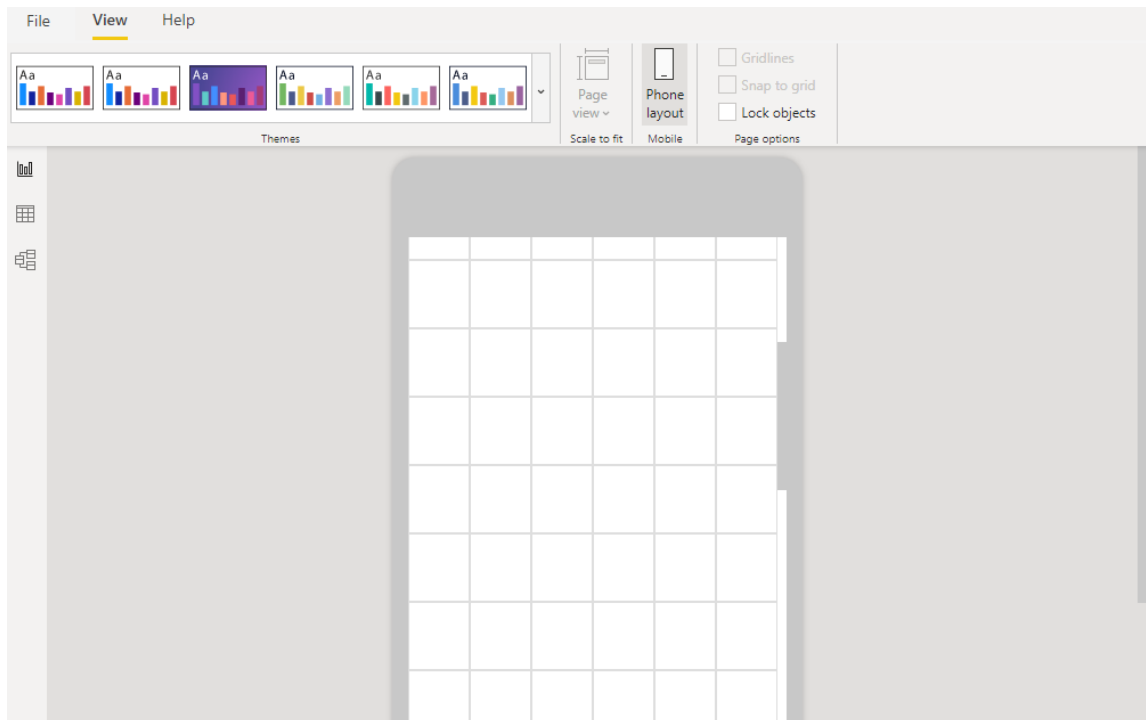


**Figure 5.4:** Power BI allows users to design reports with mobile users in mind. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]
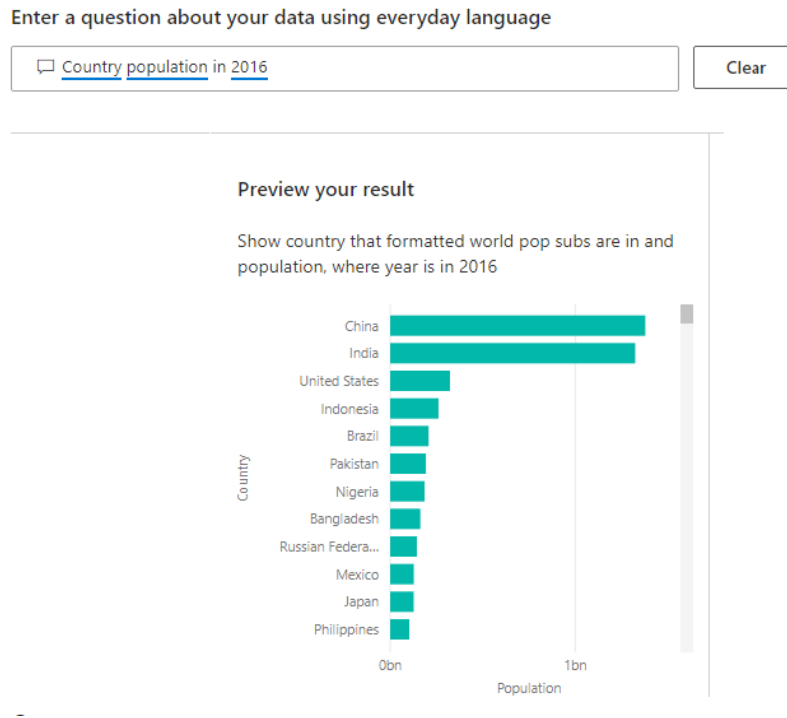
**Figure 5.5:** Power BI's Q&A feature. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]

## 5.3  Support and Community

Power BI has an excellent support ecosystem and active community. Links to official documentation and video tutorials are directly accessible from the Power BI application. Many user-created tutorials can also be found all over the web. Power BI also has an active online community forum, with over 500 thousand forum posts, where people can ask and answer questions. Power BI also has a community marketplace (Figure 5.6) where users can download custom visualizations that other people have created.

## 5.4  Examples

The trial version of Power BI Pro 2.79 on Windows 10 was used to create the following images. Scatter plots (Figure 5.7) are easy to create in Power BI. Simply drag data to the corresponding x and y axis fields. Trend lines can also be easily added via checkbox. Reports in Power BI are interactive. Users can hover over elements in their graphs (Figure 5.8) to get more detailed information. Unlike Qlik and Tableau, Power BI does not have the ability to shade countries . Instead, Power BI visualizes the data using a geo bubble chart (Figure 5.9).

## 5.5  Conclusion

Released in 2015, Power BI is relatively new to the game but has already captured a sizable share of the BI tool market. Power BI is used by over 15,000 companies, with average revenue of around $10M - 100M and company size of 10-100 employees [Enlyft 2020a]. Due to its relatively low cost and inclusion with Office 365, it is not surprising that Power BI is more popular among small-medium companies. Companies that use Power BI include the Memphis Grizzlies, The Bartell Drug Company, and Fashion Nova. While Power BI is lacking in export format options, it is great for smaller companies due to its low cost. Power BI's intuitive user interface means new users can immediately start using it without having to watch tutorials. Power BI also has a great developer support and an active community that can help with problems when using the software. In conclusion, Power BI is a solid option for companies looking
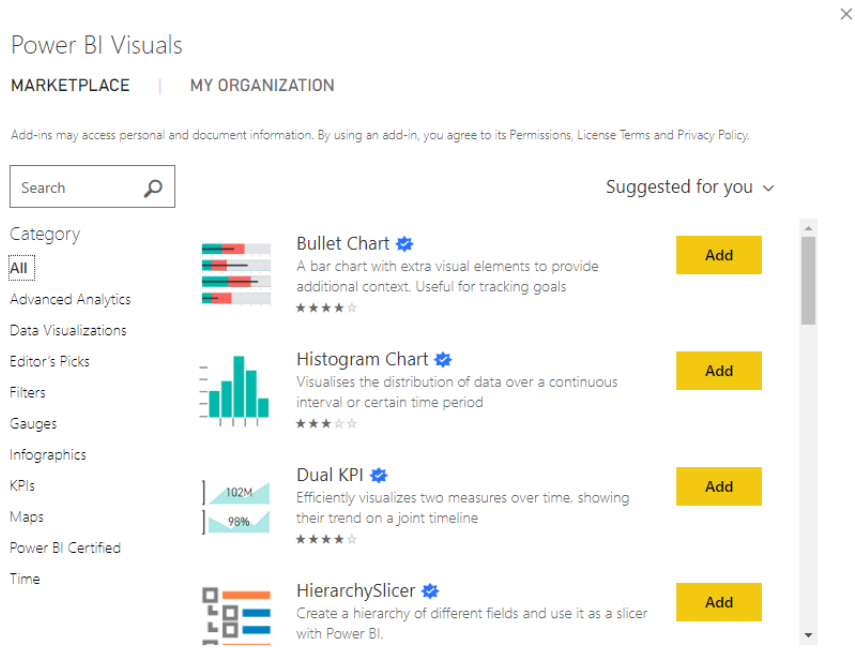
**Figure 5.6:** Power BI Marketplace. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a].]
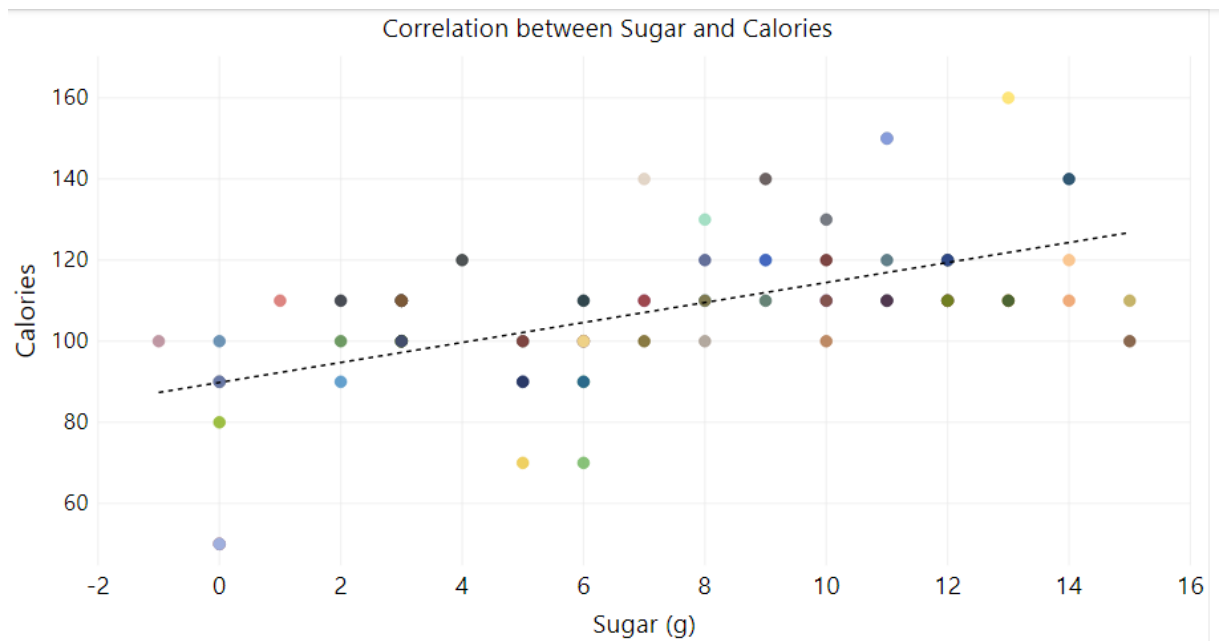


**Figure 5.7:** Power BI: Scatter plot showing the correlation between sugar and calories. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]

Population by Year and Country

Country ● Bangla... ● Brazil ● China ● India ● Indonesia ● Nigeria ● Pakistan ● United ...

| 2013 | |
|---|---|
| Bangladesh | 157571292 |
| Brazil | 202408632 |
| China | 1357380000 |
| India | 1278562207 |
| Indonesia | 252032263 |
| Nigeria | 171829303 |
| Pakistan | 181712595 |
| United States | 316204908 |

**Figure 5.8:** Power BI: Growth in population for the top 10 most populous countries. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]

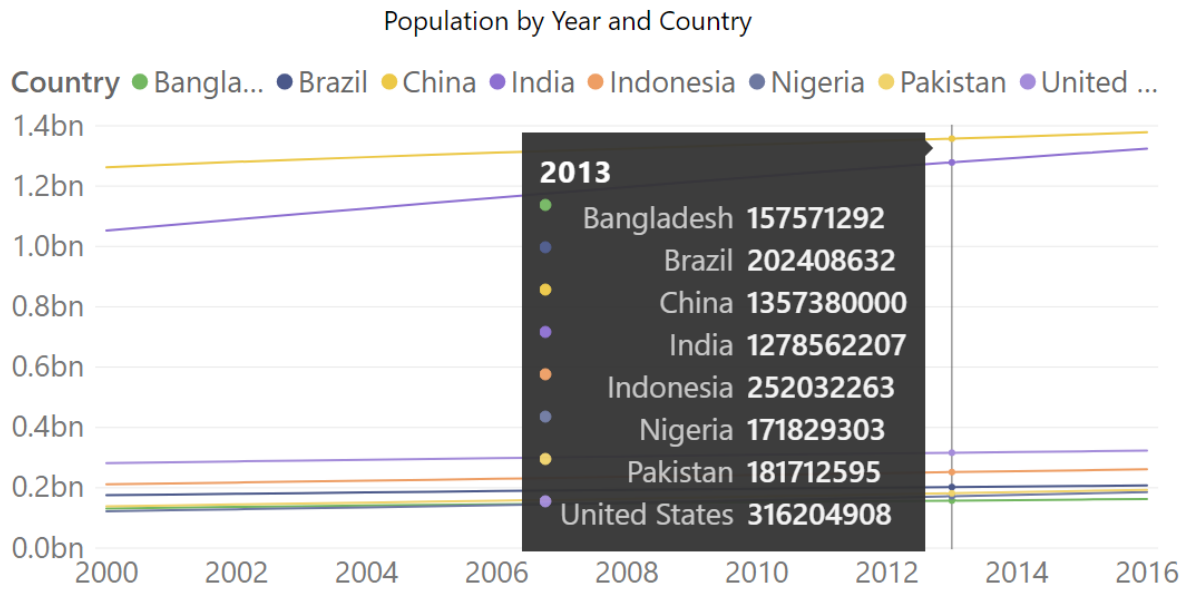Population by Country

| Country | **Russian Federation** |
|---|---|
| Population | 144342396 |

**Figure 5.9:** Power BI: Map of population by country. [Screenshot made by Elliot Koh using Power BI [Microsoft 2020a]]

for a affordable, straightforward BI tool.

# Chapter 6

# Spotfire

TIBCO Spotfire is a tool that provides its users tools needed to collect, analyze and visualize their data. Small businesses can use this tool as well as big ones, so with this tool you could expand and scale up as the business grows. Furthermore, it is made in a way that could blend in almost any software ecosystem to simplify business intelligence processes. Another important thing to say about this tool is that it could be run in all famous operating systems such as Windows, MacOS and Linux.

Price ranges from $1250 to $250 per year depending on features each customer needs [TIBCO 2020b]. Student version of this tool is available on the website. Tool that the student version enables is TIBCO Spotfire Desktop. Also every tool here has a 30day trial version of this tool. All these versions could be purchased through TIBCO website and/or contacting their sales department (Figure 6.1).

Ease of use of this tool is shown in start tutorials when you first open the tool. There are shown the possibilities of the tool and their respective video tutorials on YouTube. This tool is made with simplicity in mind and it reflects in the user interface. This tool for simple tasks doesn't seem so hard to learn but for more complicated datasets or multiple databases, I think, it would take time to master. Reason to that is that this tool has such a wide range of possibilities for customization we will touch on further text. We could see in the next table just a glimpse of industries that use this tool and for what it should be customized for.

This tool has a lot of possibilities depending on your workflow. For smaller companies you could use a simple local based Desktop version. On the other hand for bigger companies that have to share a lot of data between them TIBCO can offer Cloud support for easy sharing. For locally run Spotfire Desktop and also for Spotfire Cloud TIBCO guarantees that the data used in their tools won't be shared in any way with any third party or that their engineers won't be able to interact with your data. TIBCO Spotfire Desktop enables users to create dashboard and evaluate data locally on their computers. TIBCO Spotfire Cloud is made for teams of analysts that prefer to work with cloud based analytics. It could do the same things as Spotfire Desktop such as creating dashboards, evaluating data and on top of that it could do easy sharing with collaborators because it is all done in the cloud. TIBCO Spotfire Platform lets users create everything from dashboards to custom big data analytics applications for large companies and organizations.

## 6.1  Import and Export Formats

Spotfire programs are equipped with all tools that can handle all formats for importing the data into a tool like this. Some of the most famous formats are CSV, JSON, Excel etc. and they are all supported in this tool. There are also a lot of possibilities of connecting this tool to any kind of database imaginable and pulling data from it directly into this tool. Furthermore, TIBCO BA module allows users to run analysis on a query to query basis.

There is a popup tool that goes on when importing the data. In this tool the user could interact with
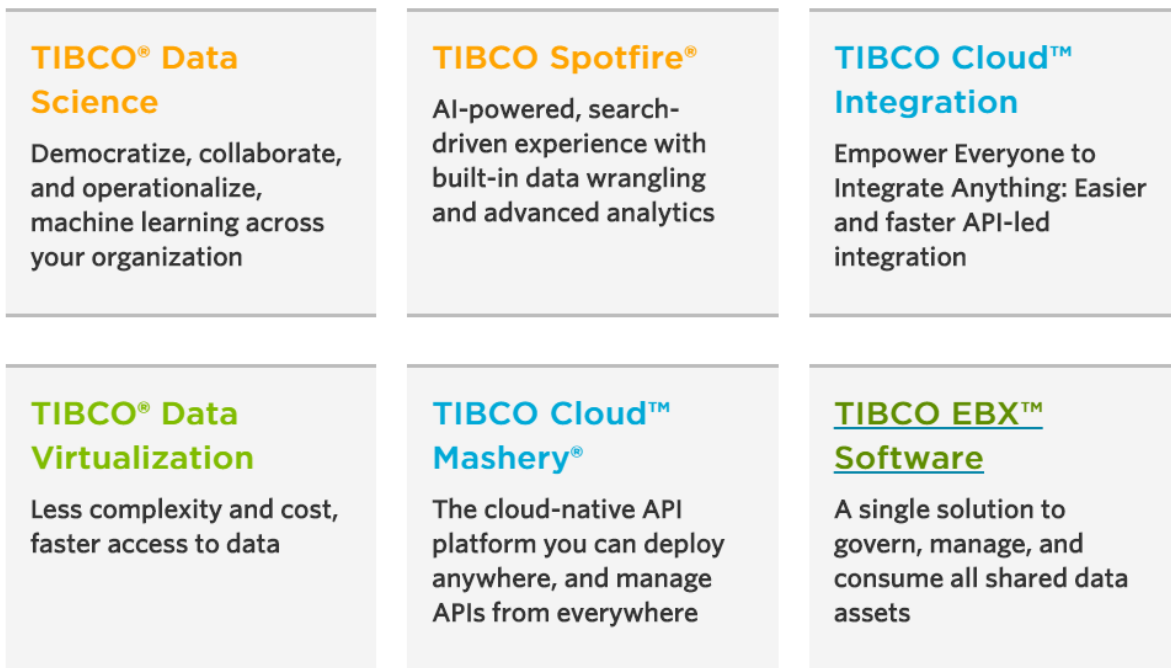
**Figure 6.1:** TIBCO flagship software. [Screenshot made by Sven Celin on official Spotfire website [TIBCO 2020a]]

data that he is importing.  If columns or rows are different types that they should have been user could here change that.  Also with this tool users could just remove rows or columns that they don't want to use in their report.

In exporting part of the program, as previously stated, there are many options of exporting the data and could be used side by side with any script or program written in Python or R. Exporting the data is really simple.  Users just need to go to the tab file and then export and in this submenu (Figure 6.2) there are offered most often types of exporting this data.  Also if needed, users could import scripts that extend the range of possibilities for exporting for this application.

## 6.2  UI and Usability

User interface of TIBCO Spotfire is really simple and it is fully loaded with predictive, descriptive and prescriptive analysis to make the interface explorable.  It goes from left to right (Figure 6.3).  On the far left side you could see three icons.  First icon is here for importing the data from any source.  Second icon is to analyze the data, choose what columns the user wants to use.  And the third and final icon is for choosing the graphs that are offered in this tool.  This tool has more than 16 different types of visualization.  Some of them are: bar, line, map, pie charts, heat maps and network graphs.  The solutions are easy to interpret and see vital insights of the data, also they allow you to spot trends and patterns from vital and valuable datasets.

In this interface users can make an interface that has graphs and charts that interact with each other on a point and click basis.  Users can create a guided experience through their data and communicate complex concepts by adding images, descriptions and step-by-step navigation to narrate their findings. The solution provides guidance to the users by suggesting best possible representations of the data. TIBCO Spotfire's location analytics provides geospatial interaction.  Users can create and view instant maps establishing more comprehensive connections between data and location, helping users understand data, generate insights and predict future possible outcomes

The solution is embedded with an R engine and can run statistical language with an open source within
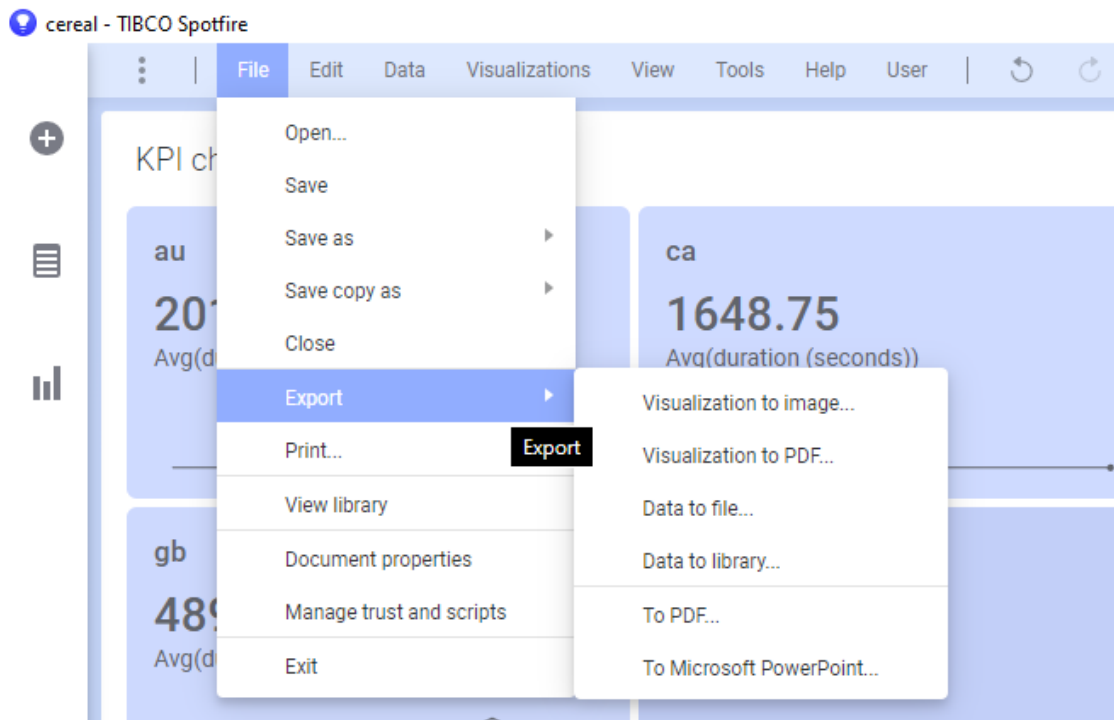
**Figure 6.2:** Spotfire Export options. [Screenshot made by Sven Celin on official Spotfire tool [TIBCO 2020a]]
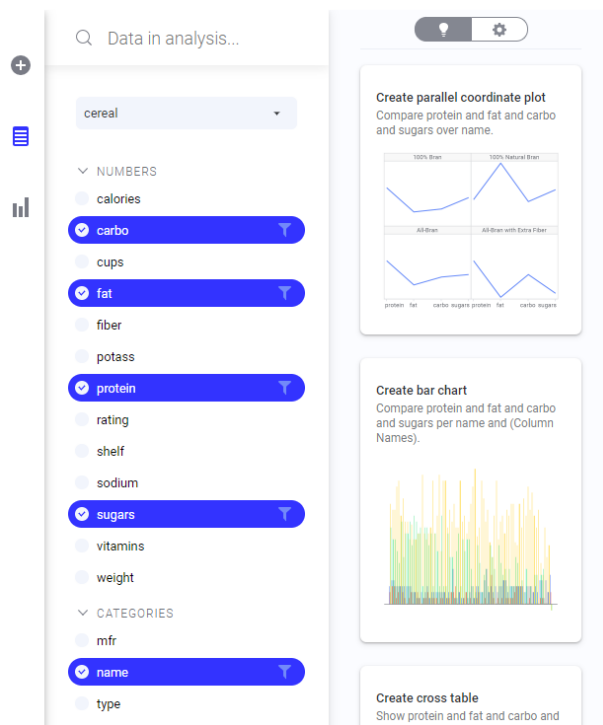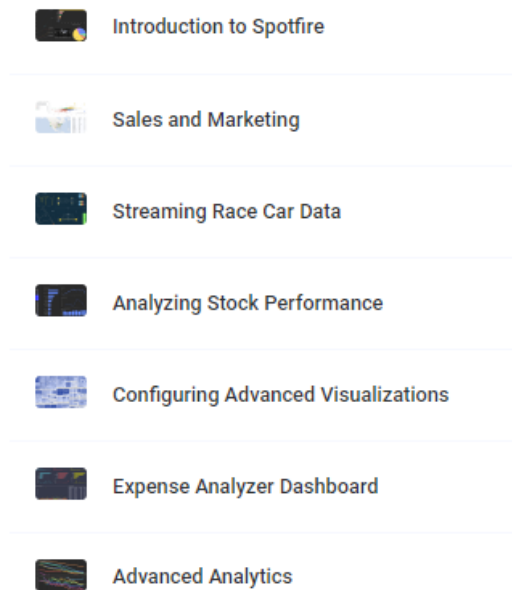


**Figure 6.3:** Simple overview of the UI. [Screenshot made by Sven Celin on official Spotfire tool [TIBCO 2020a]]

**(a)** TIBCO Tutorials                                        **(b)** TIBCO Community.

**Figure 6.4:** Spotfire Community (b) and Tutorials (a) shows how they are dedicated to their userbase.
[Both screenshots made by Sven Celin on official Spotfire tool [TIBCO 2020a]]

the software analysis. The R code provides point-and-click authoring for all levels of users and offers admins the ability to run custom R models in the analysis. The solution is also capable of drilling down to existing databases. Furthermore users can link their own scripts from R or Python directly into this BI tool and use the interface for displaying the data. Also this kind of integration expands possibilities of exports and imports and exchanging information between services. Performs various functions, including in-depth analysis and robust visual reporting, all powered by artificial intelligence.This program supports insights with AI, big data integration, integration with the Internet of Things (IoT) and more through its streaming technology.

Simple user interface is greatly improved with an AI submenu that recommends best graphs and charts for any kind of data that is imported in this tool .

## 6.3  Support and Community

Spotfire has a good and active community forum (Figure 6.4). There the user could go and search for any question he has. Most of the questions are already answered. If the user is totally new to this tool while opening the tool there are tutorials of example projects and also links to YouTube tutorials.

It has a great range of expansions with possibilities for scripting in python or R programming language. With that kind of possibilities programmers could connect many more tools with this BI tool.

## 6.4  Examples

Spotfire version that was used in this test was TIBCO Spotfire Analyst (student version) 10.8 on Windows 10 operating system.

On the first image is line graph that was made from population dataset (Figure 6.5).

On the second image is line graph that was made from cereals dataset (Figure 6.6).
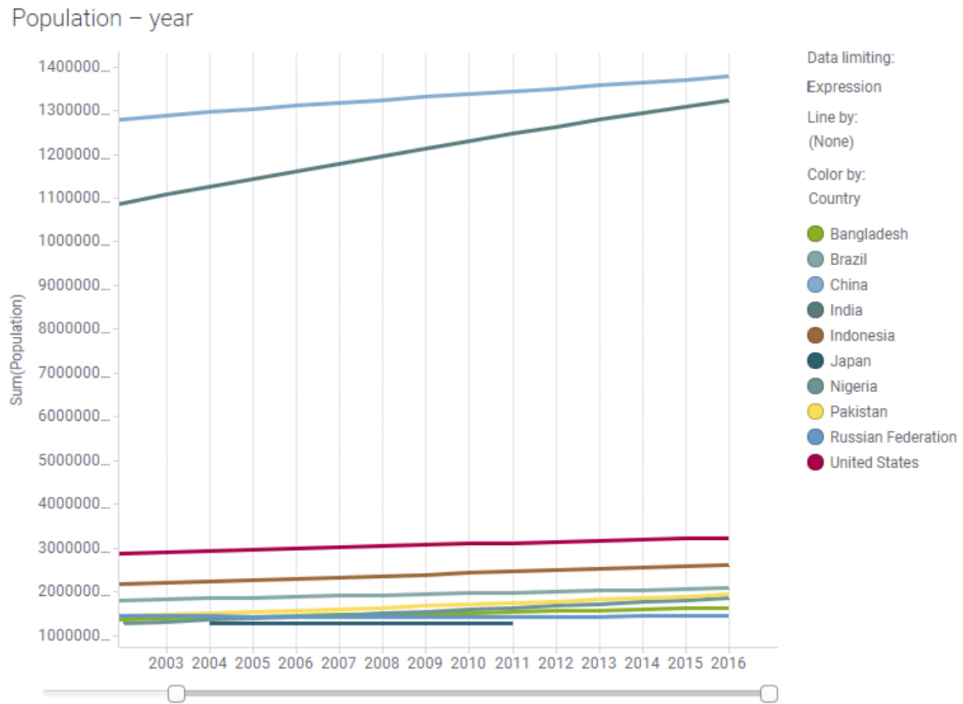
**Figure 6.5:** Spotfire Line Graph. [Screenshot made by Sven Celin on official Spotfire tool [TIBCO 2020a]]
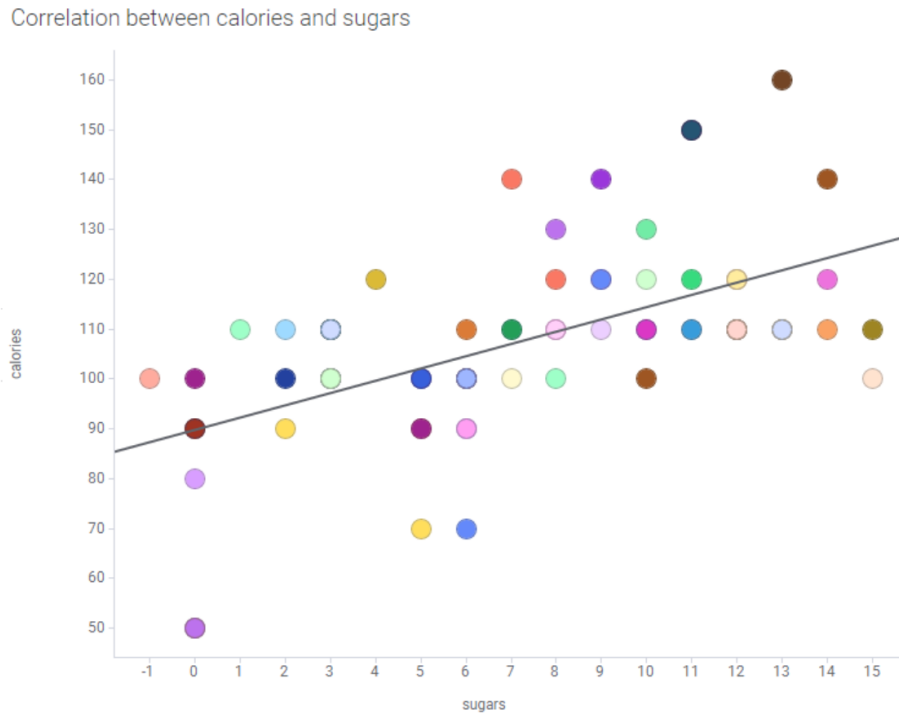


**Figure 6.6:** Spotfire Scatter Plot. [Screenshot made by Sven Celin on official Spotfire tool [TIBCO 2020a]]
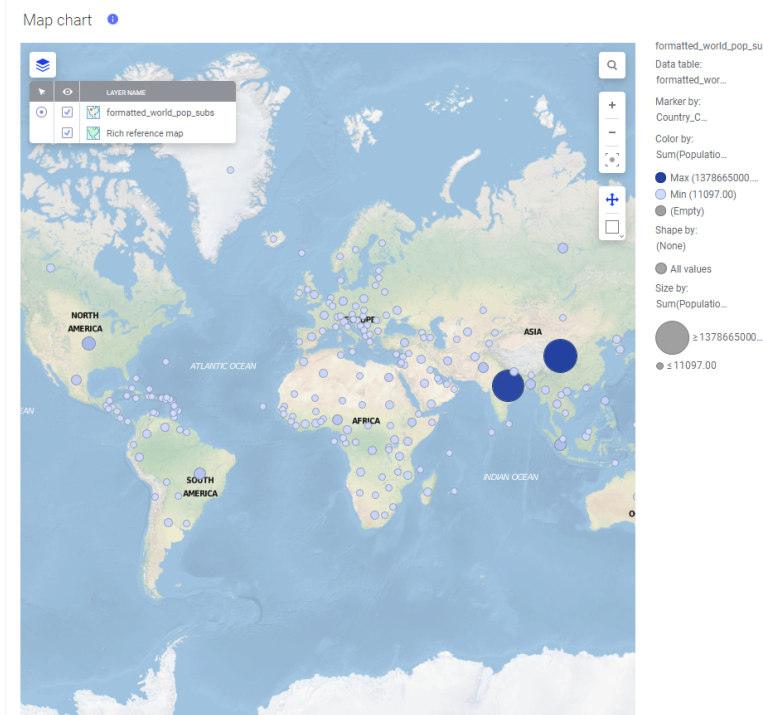
**Figure 6.7:** Spotfire Map Graph. [Screenshot made by Sven Celin on official Spotfire tool [TIBCO 2020a]]

On the third image is line graph that was made from population dataset (Figure 6.7).

## 6.5 Conclusion

This tool is one of the oldest and most widely used tools for big companies. This tool is used by around 4000 companies that have net profit of around $1B dollars and have 50 to 200 employees [Enlyft 2020d]. Furthermore, with this great backing of huge companies this tool should have a great forum, and it has, it is called TIBCO Community where all knowledge and tips and tricks are shared for this tool. Some of their customers are ABB, Airbus, Apple, bp, Cisco, Deloitte, NASA, NSA, T-mobile, WesterUnion and others.

# Chapter 7

# Comparison and Recommendation

In this chapter, a summary of each tool is presented and a comparison between them is made. A list of recommendations based on a user's requirements will be given.

## 7.1 Comparison

All the tools have similar import capabilities (Table 7.1).

| Import format: | CSV | Excel | JSON | XML | Text | Web | Databases |
|---|---|---|---|---|---|---|---|
| Tableau | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Qlik Sense | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Power BI | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Spotfire | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

**Table 7.1:** Import formats across tools.

While all the tools except for Spotfire are perhaps lacking in export options (Table 7.2), they all cater to the business intelligence needs by offering live, interactive reports.

| Export format: | Powerpoint | PDF | Embedded HTML | Shareable link | Image | SVG |
|---|---|---|---|---|---|---|
| Tableau | Yes | Yes | No | Yes (Tableau Public) | Yes | No |
| Qlik Sense | Special | Yes | Yes | Yes | Yes | No |
| Power BI | Yes | Yes | Yes | Yes | No | No |
| Spotfire | Yes | Yes | Yes | Yes | Yes | No |

**Table 7.2:** Export formats across tools.

Power BI is by far the cheapest tool and easiest option since it is included in Office 365 Enterprise. This makes it the best for the companies that are starting out, and may not have the budget for software

like Spotfire and Tableau, which are much more expensive. Tableau at the first glance seems not too expensive, but after realizing that quite a few products, on top of Tableau Desktop, are needed for the deployment, the price becomes much higher. For a complete beginner, all the tools, except Tableau, are easy enough to start working with, with little to no training. When it comes to Tableau, a new user should definitely watch some tutorials on the basics. For more complex use, in-depth knowledge of the tool is expected, but that is the case with software in general. There is a small chance that a user who has to do complex things in BI tools has no knowledge of the tool itself. Of course, for the best experience, a user should take some time and learn how a tool works.

All tools have the local and cloud based version. In all of them, the cloud based version has more options when it comes to exporting, sharing and publishing reports. When it comes to choosing between these two (local or cloud) options, it all depends on who is the customer. Each company works with different datasets in different situations, and so can choose what suits them best. The cloud based version is a good choice for companies who do not have the whole infrastructure themselves, or capabilities of hosting.

Qlik offers the best interface to preprocess the data before using it, since it has both the ability to edit the data via the GUI or with scripting in SQL. This makes it easy for users without technical experience, and technically experienced people have the option to write more powerful queries in SQL if necessary. Tableau offers separate software for data preprocessing, which is why Tableau Desktop does not offer much functionality in this regard. Spotfire and Power BI both have interactive GUIs which allows users to clean and edit their data according to their needs.

In table 7.3, each tool is ranked from best (1) to worst (4) in four different categories. An overall score is calculated based on how each tool performed in each area.

| Tool | Cost | Import/Export | Usability | Community and support | Overall |
|------|------|---------------|-----------|-----------------------|---------|
| Tableau | 3 | 2 | 4 | 1 | 3 |
| Qlik Sense | 2 | 3 | 2 | 2 | 2 |
| Power BI | 1 | 4 | 3 | 2 | 3 |
| Spotfire | 4 | 1 | 1 | 1 | 1 |

**Table 7.3:** Ranking of the tools.

## 7.2  Recommendation

It is most practical for small companies to use Power BI. For large amounts of data, Qlik Sense and Spotfire are the way to go. When the highest grossing companies are concerned, even with the great abilities of Qlik to handle huge amounts of data, Spotfire is recommended for its powerful export options (Table 7.4).

| Large companies/Enterprise | Spotfire |
|----------------------------|----------|
| Medium companies | Spotfire/Qlik Sense |
| Small companies | Power BI |
| Home businesses | Power BI |

**Table 7.4:** Recommendation.

# Chapter 8

# Conclusion

While all the tools are similar in many ways and provide many of the same core functionalities, there are two clear winners. Spotfire is the most feature-rich and provides the largest range of import and export formats. Despite its many features, Spotfire is intuitive to use and the most user-friendly of the four tools. New users can immediately start using the tool without any prior training. The downside of Spotfire is its high cost. Due to this, Spotfire is recommended for large companies with many users. Power BI is the recommendation for small to medium businesses. Power BI is priced at a per user basis making it more cost effective for smaller companies. As a Microsoft product, Power BI has a familiar user interface and smoother learning curve for users that already use other Office tools, such as Word and PowerPoint.

Not all software is created equally. Despite sharing the same set of core features, Tableau and Qlik are simply not as good as Power BI and Spotfire. Power BI has a familiar user interface and is the most cost effective of the four tools. Power BI's great value means it is perfect for smaller businesses. Spotfire is more expensive but makes up for it with its features and wide range of export formats. Spotfire is very user friendly and has great support. Spotfire is a great choice for larger companies where its higher price may not be as important a factor.

# Bibliography

Chris Craford [2017]. *80 Cereals | Kaggle*. 24 Oct 2017. `https://www.kaggle.com/crawford/80-cereals` (cited on page 3).

Enlyft [2020a]. *Companies using Microsoft power BI and its marketshare*. 20 May 2020. `https://enlyft.com/tech/products/microsoft-power-bi` (cited on page 20).

Enlyft [2020b]. *Companies using Qlik Sense and its marketshare*. 20 May 2020. `https://enlyft.com/tech/products/qlik-sense` (cited on page 14).

Enlyft [2020c]. *Companies using Tableau and its marketshare*. 20 May 2020. `https://enlyft.com/tech/products/tableau` (cited on page 10).

Enlyft [2020d]. *Companies using Tibco Spotfire and its marketshare*. 20 May 2020. `https://enlyft.com/tech/products/tibco-spotfire` (cited on page 30).

JohnSnowLabs [2018]. *Population Figures By Country*. 2018. `https://datahub.io/JohnSnowLabs/population-figures-by-country` (cited on page 3).

Microsoft [2020a]. *Data Visualization | Microsoft Power BI*. 20 May 2020. `https://powerbi.microsoft.com/` (cited on pages 18–22).

Microsoft [2020b]. *Pricing & Product comparison*. 20 May 2020. `https://powerbi.microsoft.com/en-us/pricing/` (cited on page 17).

Qlik [2020a]. *Qlik Business Intelligence: Data Analytics & Data Integration | Qlik*. 20 May 2020. `https://www.qlik.com/` (cited on pages 12–16).

Qlik [2020b]. *Qlik Pricing | Qlik Sense - Compare All Editions*. 20 May 2020. `https://www.qlik.com/us/pricing` (cited on page 11).

Tableau [2020a]. *Business Intelligence and Analytics Software*. 20 May 2020. `https://tableau.com/` (cited on pages 7–9).

Tableau [2020b]. *Tableau Pricing for Individuals and Personal Use*. 20 May 2020. `https://www.tableau.com/pricing/individual` (cited on page 5).

TIBCO [2020a]. *Global Leader in Integration and Analytics Software | TIBCO Software*. 20 May 2020. `https://www.tibco.com/` (cited on pages 26–30).

TIBCO [2020b]. *TIBCO Spotfire - Editions and Pricing*. 20 May 2020. `https://www.tibco.com/products/tibco-spotfire/editions-pricing%5C#pricing` (cited on page 25).