

# A Comprehensive Review of Data Visualization Tools: Features, Strengths, and Weaknesses

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**Abstract:** Data visualization tools have revolutionized processing, analysing, and communicating data. With the increasing amount of data available, it has become increasingly important to present data in an easily understandable and visually appealing way. As such, data visualization tools have become essential to data analysis and decision-making processes in various fields, including business, healthcare, social sciences, and engineering. This review paper aims to provide an overview of the various data visualization tools available and their features, strengths, and weaknesses. We begin by introducing the concept of data visualization and its importance in the data analysis process. We then provide a brief history of data visualization, highlighting its evolution over time from static charts to interactive and dynamic visualizations. We then discuss the available data visualization tools, including bar charts, line graphs, scatter plots, heat maps, tree maps, and network diagrams. For each type of visualization, we provide examples of when and how they can be used to present and analyse data effectively. Next, we examine the features and functionalities of popular data visualization tools, such as Tableau, Power BI, Google Data Studio, D3.js, and Python libraries like Matplotlib, Seaborn, and Plotly. We discuss the strengths and weaknesses of each tool and provide examples of real-world applications. In addition, we highlight the importance of choosing the right visualization tool based on the data type, audience, and purpose. We also discuss best practices for creating effective data visualizations, such as choosing the right colour scheme, designing for accessibility, and avoiding common pitfalls. Finally, we discuss future trends and developments in data visualization, such as using augmented and virtual reality for data visualization and incorporating machine learning and artificial intelligence in data visualization tools. In conclusion, data visualization tools have become an essential part of the data analysis process. This review paper overviews the available data visualization tools and their features, strengths, and weaknesses. By understanding the strengths and limitations of different visualization tools, researchers and analysts can effectively present and analyse data, leading to better decision-making and insights.

**Keywords:** Data Analysis; Data Visualization; Information design; Visualization tools; Types of visualizations

## 1. Introduction

Data visualization tools play a crucial role in data analysis, as they help convert complex and vast amounts of data into a visual format that is easily understandable and interpretable. There are several reasons why data visualization tools are essential for data analysis. Firstly, they allow analysts to quickly identify data trends and patterns that would be difficult to recognize otherwise [1, 2]. With the help of pictorial representations, such as charts, graphs, maps, and dashboards, analysts can better understand the underlying data and spot potential anomalies or

outliers. Moreover, data visualization tools can help communicate complex information to a broader audience, regardless of their level of expertise [3]. This is especially crucial in business, where data-driven decision-making is becoming increasingly important. By using data visualization tools, businesses can easily share insights and analysis with stakeholders, allowing them to make informed decisions based on data rather than intuition. Another benefit of data visualization tools is that they can help in exploratory data analysis, allowing analysts to quickly identify areas of interest and dive deeper into the data [4]. This can be

especially helpful when working with large data sets, where it is easy to get lost in the data without a clear focus. Analysts can quickly identify areas of interest and perform further analysis using data visualization tools, leading to faster and more efficient decision-making. Lastly, data visualization tools can also help in unifying data from different sources and applying AI-driven analytics to reveal relationships between different data sets [5]. This can help businesses gain insights that would be difficult to obtain by looking at individual data sets separately. In summary, data visualization tools are essential for data analysis as they allow analysts to quickly identify data trends, communicate insights to a broader audience, perform exploratory data analysis, and gain new insights by unifying data from different sources. Businesses can use data visualization tools to make more informed decisions based on data rather than intuition, leading to better outcomes and increased efficiency.

The paper's structure begins with an introduction that provides background information and context for the research. The second section is the literature review that surveys previous research on data visualization and related topics. Section three discusses the review of the tools that outline the visualization tools technically and their applications; the summary section presents the study findings; a discussion section interprets the results and discusses their implications; and a conclusion summarizes the key findings and contributions of the research.

## 2. Background

Data visualization tools have come a long way from their origins as static counts to interactive displays composed of multiple data sources [6]. While data visualization is a relatively new discipline, many currently used techniques were developed during the industrial revolution, and the field advanced significantly by the middle of the nineteenth century [7]. However, to truly understand the impact and evolution of data visualization, it's important to look further into history. Visualizations have been used by mankind since the dawn of time to instruct, convey meaning, and tell stories [8]. Maps, in particular, have a long history and were used by ancient civilizations to navigate and communicate important information. Over time, visualizations have become increasingly sophisticated and specialized, with cartography, statistics, and science practitioners using them to understand complex information better.

Businesses and people benefit greatly from data visualization because it makes it possible to quickly identify and comprehend important data characteristics such as trends, outliers, and patterns [3]. A good data visualization strikes a fine balance between aesthetics and utility, presenting data in a way that is accessible to

a wide audience while yet drawing attention to the most important findings [9]. Data visualization tools enable fast decision-making and provide access to understanding patterns and trends [10]. Many data visualization tools are available today, each with unique strengths and weaknesses. Some of the top tools include Microsoft Power BI, which is best for business intelligence [11]; Tableau, which is best for interactive charts; and Qlik Sense, which is best for artificial intelligence. However, it's important to choose the right tool for your specific needs and to keep in mind that the field of data visualization is constantly evolving and changing. In conclusion, data visualization tools have a long and fascinating history, evolving from simple maps and charts to sophisticated, interactive displays. Today, these tools are essential for understanding complex information and making data-driven decisions, and there are many different options available for those looking to dive into the field of data visualization.

## 3. Data Visualization Tools

### 3.1 Tableau

Tableau is frequently used in data analytics due to its usefulness in visualizing data. Several academic papers and articles have been written about the benefits of using Tableau for data visualization. The authors of one such study present an activity that shows students how to use Tableau to make charts, put up a dashboard, and describe the patterns they see in the data [12]. In another study, the benefits of Tableau are outlined, and it is concluded that Tableau is software that can help users explore and understand their data by producing interactive visuals [13]. Additionally, an article discusses using Tableau as a data visualization tool and its importance in learning data analytics [14]. Another research paper discusses the importance of data visualization in business and highlights the role of dashboards and visualizations in decision-making. It mentions Tableau as a tool for creating data visualizations and dashboards [15]. Finally, an article briefly mentions Tableau as one of the tools used for data visualization, alongside Python libraries and other tools [16]. In conclusion, the literature reveals that Tableau is widely used in the data analytics industry as a tool for data visualization. Several research papers and articles discuss its advantages, uses, and importance in data analytics.

Using Tableau, a popular data visualization tool has benefits and drawbacks. Tableau's ability to effectively manage massive datasets and generate eye-catching representations that reveal insights that can't be gleaned simply by gazing at a spreadsheet is a major selling point [17]. Tableau is also highly rated for its overall performance, making it easy to create different types of visualizations and easily handle millions of

rows of data [18]. Moreover, Tableau's quick drag-and-drop functions help users to create interactive reports and dashboards within minutes, making it easy to implement [19]. On the other hand, one strong disadvantage of Tableau is its cost, which is considered high for small to medium-sized businesses, making it an expensive investment [20]. Tableau's license cost is higher than other data visualization tools, such as open-source software like R or Python, which can be used at no cost [17].

### 3.2 Power BI

Power BI, a set of corporate analytics tools, makes self-service data analysis and knowledge dissemination possible. Tools in the suite work together to transform disparate data sets into unified, interactive visualizations and insights [21]. The platform is scalable for enterprise-level use and user-friendly for self-service BI, enabling users to connect to any data source and seamlessly visualize it into their everyday apps [5]. In Power BI Desktop, users can manage relationships between data tables and create histograms [22]. The platform also offers features for documentation, such as documenting Power BI models [5]. Power BI Service, also known as Power BI Workspace, Power BI Web Portal, or Power BI Site, is an on-cloud service with a web-based platform to share and publish reports created on Power BI Desktop. It allows users to collaborate with others and create dashboards [22]. In addition to its core features, Power BI can be customized to fit specific needs. For example, users can build Power Apps to enable users to enter notes for specific data points and use the Power Apps custom visual on the Power BI report [23]. Power BI is a powerful and versatile platform for data analytics and visualization. It offers a range of self-service and enterprise BI features, allowing users to connect to any data source and share insights with others. Comprehensive guides are available for those interested in learning more, such as an end-to-end introduction guide on Power BI [24] and tools for documenting Power BI files and reports [25].

Microsoft Power BI is a popular data visualization and analytics tool that offers a wide range of features to help users make sense of their data. Here is a summary of what reviewers have to say about using Power BI for data visualization:

Power BI is a robust data visualization solution that efficiently generates business insights. Power BI facilitates clear and simple data communication by providing real-time data dashboards, interactive reports, charts, and graphs [22].

To properly convey data through visualizations, users must choose the proper tool. Power BI's tools are just what you need to connect the dots between your narrative and your data. Users are aided in their quests to find useful information, unearth vital business

knowledge, and efficiently exchange and collaborate on data [22].

Power BI combines powerful analytics with a user-friendly interface and excellent data visualization capabilities. Customers can use Power BI's pre-built visuals or create their own to meet their needs [23].

Power BI offers many visuals, including stacked, line, pie, doughnut, map, and scatter charts. Users can easily create and manipulate data visualizations using the user-friendly interface [26].

With Power BI, users can collaborate on interactive dashboards and reports, visualize data, and share their findings throughout the company, all without leaving the programme [27].

The number of visuals in Power BI is vast, and it has the potential to create most of the visual's users may need. Power BI provides an accessible fast way to create data visualizations [5].

Power BI can process large amounts of data efficiently, allowing users to run big data through it seamlessly. This tool allows users to drill down into the granular details, providing them with better insights and strategic decision-making abilities [23].

Power BI enables businesses to reach strategic decision-making by providing visibility on the broader context and actual scenario. It manipulates the system's transactional, interaction, and behavioural data and external sources, such as API.

Overall, the consensus from the search results is that Power BI is a powerful data visualization and analytics tool with a user-friendly interface and vast visualization capabilities. It allows users to process large amounts of data efficiently and make strategic decisions based on the insights gained from their data.

### 3.3 Google Data Studio

Google Data Studio (GDS) is a web-based data visualization tool allowing users to create interactive and visually appealing reports and dashboards easily. It was first introduced in 2016 as a beta version and has become a popular data analysis and visualization tool. This literature review will discuss GDS's key features and benefits for data visualization. One of the core functions of GDS is the interpretation of social media and web analytics data; however, it also supports data sources like MySQL and spreadsheets, which suggests it can be used for various data sources [28]. GDS offers various visualization types, such as bar charts, line charts, scatter plots, Google Maps visuals, and more, allowing users to create customized reports and dashboards according to their needs [29]. One of the most significant advantages of GDS is its sub-second performance, thanks to the BI Engine from the Google Cloud BigQuery team. The BI Engine is an in-memory data access and analysis service that integrates with in-house BigQuery data warehouses, allowing live data from hundreds of sources to be presented in one

dashboard that updates and loads instantaneously. Another advantage of GDS is its user-friendly interface, making it easy for beginners. GDS is also compatible with multiple data sources such as MySQL, Google Analytics, Google BigQuery, PostgreSQL, YouTube, Excel files, and more, making it a versatile tool for data analysis and visualization. Furthermore, data is automatically updated when linked to another platform, ensuring that reports and dashboards remain current [30].

Finally, GDS has community visualizations that enable users to display complex patterns easily, funnels, and flows in reports and dashboards [28]. This feature makes GDS an even more versatile and customizable tool for data visualization. In conclusion, Google Data Studio is an effective data visualization tool since it supports several visualization kinds, works with various data sources, runs in milliseconds, and is easy to learn and use. Its community visualizations feature further enhances its versatility and customization options. These features make GDS a popular data analysis and visualization tool, especially for those looking for an easy-to-use and customizable platform.

### 3.4 D3.js

D3.js, short for "Data-Driven Documents," is a robust and widely used open-source JavaScript toolkit for building browser dynamic and interactive data visualizations. D3.js, created by Mike Bostock in 2011, is frequently used to portray massive data sets in a digestible and interactive manner [31]. It uses web standards, such as HTML, SVG, and CSS, to create visual representations of data that bring it to life [32]. D3.js provides various visualization options beyond simple bar charts, including maps, tables, and interactive visualizations. D3.js leverage the Power of web technologies to create stunning, scalable, responsive visualizations, making it a popular choice for data visualization on the web [33].

One of the advantages of D3.js is its flexibility and the ability to create custom visualizations tailored to specific data sets. While working with HTML, SVG, and CSS, D3.js enables data-driven transformations, allowing users complete freedom over visualization components and a data-driven perspective on DOM modification. The library's commitment to web standards means it can use all that current browsers offer without forcing its users into any proprietary ecosystem [34].

In conclusion, D3.js is a powerful and flexible JavaScript library for creating dynamic and interactive data visualizations on the web. Its use of web standards and data-driven transformations allows for customized visualizations tailored to specific data sets. Its popularity and wide range of visualization options make it a valuable tool for data visualization.

### 3.5 Matplotlib

Matplotlib is a widely used open-source data visualization library in Python, primarily for generating 2D plots and graphs for scientific, engineering, and financial data. In this literature review, we will explore the available resources on Matplotlib, including its features, advantages, disadvantages, and use cases. According to [35], A literature review summarises the available research on a certain issue that may be used to determine what theories, methodologies, and gaps in the knowledge base need to be filled. The steps involved in writing a literature review include defining the research question, searching for and selecting relevant sources, evaluating and analyzing the sources, synthesizing the information, and writing the review. Several sources [36, 37, 38] discuss Matplotlib's features, including its versatility in generating various types of plots and graphs, its customization options for plot aesthetics, and its compatibility with other libraries and frameworks in Python. One of the advantages of Matplotlib is its ability to provide interactive and dynamic visualizations, making it suitable for exploratory data analysis. However, its default plots may not be aesthetically pleasing, requiring further customization to enhance its visual appeal.

Additionally, while Matplotlib is widely used, some sources suggest it may not be the most efficient library for generating complex and large-scale visualizations. Regarding use cases, Matplotlib suits various fields, including scientific research, engineering, finance, and social sciences. Sources [36] provide examples of how Matplotlib has been used in different applications, such as visualizing geographic data, time series data, and statistical analyses. In conclusion, Matplotlib is a powerful and versatile library for data visualization in Python, with its strengths lying in its flexibility and customization options. However, its efficiency in generating complex and large-scale visualizations may be a concern. Matplotlib has various use cases in various fields, making it a popular choice for researchers and practitioners.

### 3.6 Seaborn

The Seaborn Python library is a data visualization tool that creates beautiful and useful charts and graphs with a simple-to-use interface. Seaborn relies heavily on Matplotlib and incorporates the pandas' package for data analysis. With its declarative, dataset-focused API, it's a breeze to turn data inquiries into visually informative charts. This response will provide a comprehensive literature review of Seaborn Data Visualization. One research paper provides a detailed overview of Seaborn's capabilities and features. The

paper "Seaborn: Statistical Data Visualization" was written by Michael Waskom and published on ResearchGate [40]. The paper describes the library's history, strengths and weaknesses and provides an in-depth look at its functionality, syntax, and available plot types. The paper also includes several figures demonstrating the library's capabilities, including histograms, bar plots, and heat maps. Another research paper, "seaborn: statistical data visualization. Python," is published in The Journal of Open Source Software [41]. This paper presents Seaborn as a statistical visualization library and comprehensively overviews its functionalities. The paper discusses the library's architecture, the available plot types, the integration with Pandas, and its customization options. A third resource on Semantic Scholar also provides a detailed overview of Seaborn [42]. The resource describes the library's functionality, syntax, and plot types and explains how it integrates with Pandas data structures. The paper provides an in-depth look at Seaborn's different plot types, including scatterplots, line plots, and boxplots, and examples of using the library to visualize real-world data. In addition to research papers, several articles and tutorials are available online that provide an introduction to Seaborn and its capabilities. For example, one article on DataGy.io overviews Seaborn's functionality and explains how to use the library to visualize data [43]. The article discusses the different plots in Seaborn and provides examples of using the library to create complex visualizations. Another article on TowardsDataScience.com describes Seaborn as a powerful data storytelling tool [44]. The article provides a comprehensive overview of the library's capabilities and features, including its built-in styles and customization options. The article also includes examples of how to use Seaborn to create beautiful and informative visualizations. The Seaborn documentation on the library's official website provides a detailed overview of the library and its capabilities [37]. The documentation includes a getting started guide, tutorials, and API reference, providing a comprehensive overview of the library's functionalities, syntax, and plot types. The documentation also includes examples of how to use Seaborn to visualize different types of data, including categorical data, time series data, and distribution data.

Finally, an article on TowardsDataScience.com provides a tutorial on using Seaborn for data visualization [44]. The tutorial provides step-by-step instructions on creating plots using Seaborn, including scatterplots, bar plots, and heat maps. The article also includes an example of how to use Seaborn to visualize a real-world dataset. To sum up, Seaborn is a robust data visualization framework that offers a convenient API for creating engaging and instructive statistical visuals. The library has been extensively studied and well-documented in research papers and online

resources. Seaborn's capabilities, syntax, and available plot types are thoroughly described in these resources, providing a comprehensive literature review for Seaborn Data Visualization.

### 3.7 Plotly

Plotly is a popular data visualization tool professionals use in various fields, including data science, engineering, and the sciences. It is a cloud-based or on-premises application that allows data scientists to structure and display their findings without custom programming. Using Python, R, and Julia, Plotly's Plotly Dash seeks to put data science and machine learning in the hands of business customers [45]. Plotly is a free and open-source Python module that can generate several graphs, including line plots, scatter plots, bar graphs, histograms, area plots, and many more. No prior knowledge of JavaScript is necessary to utilize it alongside languages like R, Python, Java, and others [46]. Additionally, it supports dynamic charts and animations as a first principle, which is a key difference between other visualization libraries like matplotlib or seaborn [47].

Users have found Plotly to be applicable for data visualization across various disciplines. It has been used for data from buildings, building occupancy, public health, and statistics. Plotly is also used in online courses, such as Coursera's guided project on Data Visualization using Plotly and the project-based course on Data Visualization with Plotly Express [48]. In conclusion, Plotly is a versatile and user-friendly data visualization tool that can be used in various disciplines and programming languages. It offers advanced visualization features and does not require extensive coding knowledge, making it accessible to users with varying levels of expertise.

### 3.8 QlikView

QlikView is a data analysis system developed by Qlik that enables users of all skill levels to aggregate data-reporting capabilities and make informed business decisions [49]. QlikView's proprietary Associative Engine sets it apart, allowing users to create and deploy interactive guided analytics apps and dashboards in record time [50]. Here are some of the benefits and drawbacks of QlikView as reported by real users:

#### Pros:

- QlikView allows users to find new relations within the different data points, answer questions more intuitively and contains many different visualizations [51].
- The documentation presented by QlikView is very clear and exact, making the implementation process easy. Accessing the QlikView documents online is

easy if any questions arise while creating the reports. QlikView has a Qlik Community with different questions and answers [51].

- QlikView provides a regulated analytics environment, which is useful for discovering and acting upon critical business insights [51].
- QlikView is a cloud platform that integrates and analyses real-time data, helping companies bridge the gap between information and action [51].

**Cons:**

- The export process to PDF or PowerPoint could work better for bigger documents [51].
- The solution is not as easy to configure and program data import [51].

Overall, QlikView serves organizations of every size in accounting, IT, pharmaceuticals, retail, logistics, and insurance, enabling users to optimize data discovery and reporting capabilities [52]. According to Gartner Peer Insights, QlikView has received 1696 in-depth reviews from real users, and users have praised its ease of use and high performance [52].

### 3.9 SAS Visual Analytics

SAS Visual Analytics is an all-inclusive analytics visualization tool that aids in the discovery of previously hidden linkages and patterns in data. With its out-of-the-box sophisticated analytics and self-service BI and reporting features, anybody can gain insights from data of any scale [53]. The solution comes with a built-in processing engine similar to CAS that allows users to load data directly into servers without needing extra pipelines, making it an excellent tool for those working in the insurance industry and requiring a single-screen depiction of revenue growth [54].

Data handling, analysis, and insight into the past and present are all possible with the help of SAS Visual Analytics' data preparation and quality tools [55]. A non-technical user may design, collaborate, and run BI and Analytics processes for interactive reporting and experimental purposes. Users have praised the software's ability to quickly gain insights about their data and the ability to plug seamlessly with other SAS products. They have also appreciated the dashboard canvas for easy navigation and the easy-to-find tutorials that teach advanced features [56]. Individual end-users rated SAS Visual Analytics well in their Gartner Peer Insights assessments. User reviews below are individual opinions, not those of Gartner or any of its partners. Overall, SAS Visual Analytics is a powerful tool providing a complete visualization platform with self-service BI, advanced analytics, and governance features. It offers scalability and easy-to-use analytics in a single in-memory environment, making it a great choice for businesses of all sizes [57].

### 3.10 IBM Cognos Analytics

The business intelligence package IBM Cognos Analytics is ideal for widespread implementation. Enhanced self-service features make it easy to find relevant information and take decisive action [58]. Includes Cognos Administration, Microsoft Office integration, full-text search, dashboards, Query Studio, Reports Studio, Analytic Studio, and Event Studio. The package also features an AI Assistant that responds to inquiries in plain language and recommends new data visualizations and joins to help users find associations they had not considered before. Users have reported that IBM Cognos Analytics is a comprehensive reporting tool that can help enterprises derive hidden patterns of customer behaviour, market trends, and business performance over a period, region, and business line. Data visualization helps to understand these insights effortlessly [59]. However, some users have reported that the security (authorization) concept is not detailed enough for their purpose. IBM Cognos Analytics is a robust and scalable solution that can be deployed locally or in the cloud, and it provides business users with the freedom to design and modify their dashboards and reports. Many companies prefer this suite because it meets their needs at a reasonable price and is well-supported by many experts [60]. Overall, IBM Cognos Analytics is a comprehensive reporting tool that offers self-service capabilities and an AI assistant to empower business users to make confident decisions based on data. While some users have reported security concerns, the suite remains a popular choice for businesses due to its affordability and availability in the market [61].

Forbes [62], Qlik [51], and FounderJar [63], it is evident that Tableau, Power BI, and QlikView are among the top data visualization tools in 2023. Tableau offers a variety of ways to access the software, including desktop, server, online, prep, and a free public option. Tableau is ideal for creating maps and public-facing visualizations, and it provides an extensive collection of data connectors and visualizations. According to Forbes, Tableau is the best option for interactive charts [62]. Power BI is another popular data visualization tool, particularly for business intelligence. It is ideal for analyzing large datasets and generating reports and offers real-time data insights. Power BI provides a range of visualization options and can be used with other Microsoft products. Forbes names Power BI as the best option for business intelligence [62].

QlikView, on the other hand, is ideal for artificial intelligence and machine learning. It provides a suite of supporting capabilities required for interactive data visualization at scale. QlikView also offers a range of visualization options and can handle large datasets. According to Gartner's 2022 Magic Quadrant Analytics

BI report, QlikView is one of the three vendors named as leaders in data visualization tools [51]. Other data visualization tools mentioned in the sources include FusionCharts, Highcharts, Datawrapper, Plotly, and Sisense. Each tool has strengths and weaknesses, making it important to carefully evaluate the user's needs before choosing a tool. Summarizing that data visualization tools such as Tableau, Power BI, and QlikView offer various visualization options and provide different features to suit specific needs. The choice of tool will ultimately depend on the user's requirements, such as the size and complexity of the data, the level of interactivity needed, and the desired output format. Careful evaluation and consideration of the strengths and weaknesses of each tool will ensure

the selection of the most appropriate tool for the task at hand.

## 4. Summary Metrics

Data visualization tools are becoming increasingly important in today's data-driven world. With so many available tools, choosing the best one for your needs can be challenging. This comparison provides an overview of the most popular data visualization tools, their features, strengths, and weaknesses. By understanding the differences between these tools, users can decide which tool to use for their data visualization needs.

Table 1: Summary metrics about the Advantages and Disadvantages of Data Visualization Tools

Name of Tool	Advantage	Disadvantage	Citation
Tableau	User-friendly with non-Tech requirements	Professional version Expensive for SMEs; Manual update of Data does not allow auto-scheduling	[17, 14, 12]
Power BI	Affordable for a Desktop version suitable for SMEs; Supportive for Non-Datawarehouse organizations; Automated data refresh and report generations; customized access keys for security	No data cleaning possible; higher difficulty levels for learning	[26, 24]
Google Data Studio	Easy integration with all Google Cloud Applications; Flexible Integration; Built-in data connectors; Dynamic Controls; real-time collaborations; Unlimited access to widgets; Fully Open Source	Difficult learning curve; Limited with functionalities; Data processing limitations;	[30, 28]
D3.js	Flexible and powerful; Variety of visualization; supports animation and data interactions; Active community support; compatible with customized datasets; versatile in visualization; built on JavaScript libraries	The difficult learning curve for non-programmers; Complex set up; tough for beginners needs detailed step-by-step learning before full application; uncertain performance issues;	[33, 32]
Matplotlib	Wide range of visualization packages; fully customizable; cross-platform support; interactive plotting; massive user community for support	Difficulty in learning curve; verbose syntax; Limited for 3D and animation plotting; Limited interactivity between other visualization python packages;	[4, 15]
Seaborn	Wide range of default multiple plotting; integrates strongly with Pandas and NumPy; inbuilt statistical tests;	Rus into out of memory often; not fully embedded into Python;	[37]
Plotly	Programmatically cost-effective; empowers visualization with back-end and front-end Machine learning support; Aesthetically pleasing;	No automation process at all; too many separate libraries; slow in speed and consumers high processes speed;	[47]
QlikView	Allows new relationship identification among data nodes; end-to-end solution;	Exporting plots gets challenging to a power point or PDF, tough program configurations;	[51]
SAS Visual Analytics	Self-Service BI tool; highly interactive; easy to learn; no need for programming skills; predictive modules; powerful data visualization; a variety of outputs provided for better visualization	Highly expensive; poor graphic presentations	[55]
IBM Cognos Analytics	Highly secured for corporate data visualizations; AL and ML-based data analytics modelling tools; greater flexibility; cell-by-cell analytics; easy to learn; seamless integrations with Cognos; easy file storages and report generations system;	Expensive; too many modelling tools creating confusion; missing simple and small plotting features;	[60]

Data visualization is an essential tool for businesses and organizations to make sense of their

data and make informed decisions. From the provided search results, it appears that Tableau is a popular choice for data visualization, with multiple sources ranking it as the best tool for enterprise-level data visualization [62, 64]. Tableau is known for its flexibility, powerful features, and an enormous collection of data connectors and visualizations [63]. Microsoft Power BI is also a highly recommended tool for business intelligence and data visualization, according to Forbes [11]. Qlik Sense is another top tool for data visualization, especially for artificial intelligence. Other tools like Infogram, Plecto, and Whatagraph are also recommended for specific use cases such as collaboration, sales teams, and visual data analytics for social media, PPC, SEO, and email campaigns, respectively [2]. Ultimately, the best data visualization tool depends on the user's needs and requirements.

## 5. Conclusion

In conclusion, this comprehensive review of data visualization tools has demonstrated that data visualization is essential for effective data analysis and communication. Analysts and decision-makers can easily understand complex data sets and identify patterns, trends, and relationships by presenting data visually. Throughout this review, we have provided an overview of the various data visualization tools available, including their features, strengths, and weaknesses. We have explored different types of visualizations, such as bar charts, line graphs, scatter plots, heat maps, tree maps, and network diagrams, and have shown how they can be effectively used in different situations. We have also evaluated popular data visualization tools like Tableau, Power BI, Google Data Studio, D3.js, and Python libraries like Matplotlib, Seaborn, and Plotly. Through our analysis, we have highlighted the strengths and weaknesses of each tool and provided real-world examples of how they have been used to present and analyze data. In addition, we have discussed best practices for creating effective data visualizations, including choosing the right colour scheme, designing for accessibility, and avoiding common pitfalls. By following these best practices, analysts and decision-makers can create clear, compelling visualizations that communicate data insights effectively. Finally, we have explored future trends and developments in data visualization, such as using augmented and virtual reality for data visualization and incorporating machine learning and artificial intelligence in data visualization tools. These trends promise to enhance the capabilities of data visualization tools further and make them even more valuable in data analysis and decision-making. This comprehensive review of data visualization tools has demonstrated the importance of data visualization in

data analysis and communication and provided valuable insights into the strengths and limitations of different visualization tools. By understanding the capabilities of different tools and following best practices for creating effective visualizations, analysts and decision-makers can effectively present and analyze data, leading to better decision-making and insights.

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