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Data Visualization Tools: A Comparative Analysis

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Abstract: ***The advancement of computer hardware and big data processing technologies has shifted the challenge of intelligent analysis of large datasets from analyse each data in a dataset to effectively visualise the data and easily extract the needed data only. Data visualization is the process of representing information and data in graphical way through various means such as charts, graphs, maps, and other visual instruments. These visual representations facilitate the comprehension of patterns, trends, and anomalies within a data set. Numerous options exist for data visualization and analysis, varying from straightforward to intricate, and from user-friendly to more complex. It is important to note that not every tool is suitable for every individual seeking to master visualization techniques, and not all tools are capable of accommodating industry or enterprise-level needs. This research paper introduces different data visualization tools and techniques available in various domains and identifies each tool represent the data suitable for what.***

Keywords: data visualization, data set, graphs, tool

1. Introduction

Analyzing extensive data sets can often be a complex task. In certain instances, the sheer volume of data can render it nearly impossible to extract meaningful insights. This is where the utility of data visualizations becomes evident. When managing data sets that encompass hundreds of thousands or even millions of data points, the automation of data visualization processes greatly simplifies the tasks of a designer. Traditional visualization analysis relies heavily on the continuous active involvement of the user throughout the entire visualization analysis process. This encompasses various stages such as data preparation, data conversion, visualization mapping, visual rendering, user interaction, and visual analysis. Such a process demands a high level of professional expertise from users while the system itself exhibits limited intelligence.

The recent advancements in data visualization techniques necessitate the development of improved methods for analysing, processing, and presenting data. In contemporary times, technological progress has enabled the creation of more effective visual representations, facilitating both rapid and intricate data visualization. The visualization can be done by using the dashboards, where the undetected text, patterns and correlations can be easily visualized by using the visualization software.

Data Visualization Tools are software applications designed to present information in a visual format, such as graphs and charts, to enhance comprehension and usability. These tools have gained significant popularity as they enable analysts and statisticians to effortlessly create visual data models tailored to their requirements. They offer a user-friendly interface, facilitate database connections, and integrate Machine Learning capabilities, all within a single platform. The main uses of data visualization are:

- It makes a difference to examine patterns and designs in information .
- It viably points out the complex data.
- It offers assistance us to take choice making.
- It gives the experiences and connections in information.
- It screens execution and changes over time.

We have access to a variety of data visualization tools that enable the creation of charts, graphs, maps, dashboards, and infographics. Microsoft Excel serves as a valuable data visualization tool, Features such as PivotTables, charts, and slicers enhance its functionality. However, advanced tools like Power BI, Tableau, Infogram, ChartBlocks, Google Charts, Datawrapper, Plotly, Sisense, D3.js, and Looker are available for more complex representations.

The most vital factors to consider when choosing a data visualization instrument incorporate how simple it is to learn and utilize, if it offers get to to a few diverse chart and chart types ―and that they're simple to get it, indeed to tenderfoots, that the apparatus permits you to send out your information into diverse designs, that it can handle a number of different formats, is interactive, offers plugins and underpins numerous distinctive devices.

1.1 Steps for Data Analysis Process

1) Recognize the problem
2) Collection of data
3) Information preprocessing
4) Analysis of Data
5) Data visualization
6) Displaying the data

1) Recognize the problem
To begin with step of the information investigation is given a issue. The investigator needs to carefully consider the issue and distinguish the information needs to unravel the issue. He needs to distinguish the information requirements.

2) Collection of data
This step includes collection of data and storing it for further processing. The analyst needs to collect the data based on the requirement of the problem from different resources like survey, online

3) Data preprocessing
The collected data may contain unwanted details; thus, the data need to be preprocessed. In preprocessing step , the data cleaning should be performed. After the data is collected from multiple sources, it is time to clean the data. Clean and

preprocess the data to handle missing values, outliers, and inconsistencies. This step might involve:

- Removing duplicates or irrelevant data points.
- Correcting errors in the dataset (e.g., fixing typos, standardizing units).
- Handling missing or incomplete data (e.g., imputation, removal).

4) Analysis of data

The **analysis of data** is a key step in turning raw data into valuable insights. It involves exploring the data, cleaning and preparing it, performing statistical analyses, identifying patterns, and making sense of the findings. Once insights are derived, they can be communicated through visualizations that support decision-making.

5) Data visualization

Data visualization s the pictorial representation of information or data by means of a charts, graphs maps etc

6) Presenting the data

It is the process of visualising the data to the authority

Data Visualization Techniques

Data visualization is achieved by computer supported tools to represent the visuals. Visualized data supports interactive data visualization which allows users to choose the format of their choice to display data.

Visualization and visual analysis, based on the fundamentals of human visual perception, combine data analysis with human-computer interaction technologies to use visual representations for clarifying the insights and patterns found in intricate datasets.

Step-by-step approach to data visualizations in presentations:
Step 1: Establish your objective
Step 2: Identify your target audience
Step 3: Select the type of visualization
Step 4: Opt for a suitable chart
Step 5: Choose the best visualization tool
Step 6: Adhere to design best practices

2. Data Visualization Tools

Microsoft Power BI

Microsoft Power BI is a collection of tools designed to assist organizations in examining data, visualizing data, and sharing findings with others. Your data could be contained in an Excel file or a mixture of hybrid data warehouses that are both cloud-based and on-premises. Power BI enables you to effortlessly link to your data sources, highlight and uncover what matters, and distribute that information with whoever you choose.

Pros	Cons
• Power BI is simple to understand and intuitive for Excel Office 365 users. • It has a free version and is incredibly reasonably priced. • Easy adaptation for users familiar with Excel.	• It is not appropriate for beginners • Individual problems that can take a lot of time. • Large data sets don't work well with it.

Tableau

One of the top data visualization tools for business intelligence and data analysis is Tableau. Tableau enables users to format, clean, and prepare their data before producing data visualizations that yield actionable insights that can be disseminated to other users. Tableau can be used at scale by business teams and organizations, or it can be used by individual data analysts.

Pros	Cons
• outstanding visualisation skills. • High performance and simplicity of usage. • Accommodates a variety of data sources. • Responsive to mobile devices.	• costly. • lacks options for report scheduling and auto-refresh.

Looker

Looker is a data visualization tool that can examine and analyze data in detail to produce insightful findings. It offers real-time dashboards of the data, enabling organizations to make decisions instantly based on the visualized data. In order to easily connect to numerous databases, Looker also offers connections with Redshift, Snowflake, and BigQuery in addition to more than 50 SQL dialects.

Pros	Cons
• Investigating and visualizing. • There are drag-and-drop options available.	• Overuse of visualization can cause the tool to lag. • They are not highly customizable.

Infogram

Infogram is an online platform for infographics and data visualization that was developed in Riga, Latvia.It enables users to create and distribute digital maps, infographics, and charts. Infogram provides a user-friendly editor for creating infographics from user data that can be shared, published, or embedded. This application can be used by newsrooms, marketing teams, governments, educators, and students without the requirement for coding knowledge.

Pros	Cons
• User-Friendly • Numerous choices for logos, colors, and styles. • A vast collection of images, GIFs, and icons.	• There are just 20 pre-made design templates available. • Only common picture and document formats are available for export.

ChartBlocks

ChartBlocks handles the entire import procedure and chooses the relevant data segment to produce a chart. Information can be imported from almost any source. It improves a number of sharing options that allow you to instantly share the chart on the website. There are hundreds of design and customization options that affect different parts of the chart. Data can be quickly imported from any source with ChartBlocks' data import features. It facilitates the creation of the chart and the import of accurate data from the target source. And in just a few minutes, all of this takes place. No code is required to create a chart.

Pros	Cons
• No coding required -can create charts and graphs without coding. • Easy to use -can build charts in minutes using the chart designer. • Built-in social media sharing tool	• They may not be suitable for complex data sets. • If the scale is not set correctly, they might not adequately depict the data.

QlikView

Qlikview's data visualization tool offers a number of useful features, such as analytics, enterprise reporting, and business intelligence tools. It can create colorful visualizations.It processes data in-memory and saves the results in the report it generates. It has the ability to read data from relational databases and files, among other sources. Businesses use it to perform advanced analytics on their data in order to gain a deeper understanding. By merging data from multiple sources into a single QlikView analysis document, it even performs data integration.

Pros	Cons
• interface that is easy to use. • Beautiful visuals. • Easy to maintenance	• RAM capacity is the limiting factor. • Inadequate customer service.

Dundas BI

With interactive scorecards, maps, gauges, and charts, Dundas BI provides highly customisable data visualizations that maximize the production of multi-page, ad hoc reports. Dundas BI makes it easier to clean, analyze, convert, and model large datasets by giving users complete control over visual components.

Pros	Cons
• it is possible for users to create specially designed graphs and charts. • It uses the open architecture methodology	• higher cost • require training or technical assistance.

Sisense

Sisense is a platform for data analytics and business intelligence (BI) that helps to collect, examine, and display data from several sources. Its user-friendly interface for data exploration and reporting is intended to assist organizations in making well-informed decisions. Sisense turns complicated data into robust analytical tools that you can embed or share anywhere. Utilize, evaluate, and visualize all of your data to influence company choices and promote change. Sisense offers a range of visualization options, including charts, graphs, and interactive dashboards.

Pros	Cons
• uses in-memory analytics, which will help in the fast examination of large datasets • user can access and analyse data in just about wherever they are.	• It can be pricey for corporate use • reduced number of features are available for the cloud system

Plotly

Complex visualizations are made possible using Plotly. It is an open-source data visualization tool that fully integrates with analytics-focused computer languages like Matlab, Python. Plotly is a popular tool for teamwork, sharing, editing, and producing interactive, graphical data. It can be installed on-site or in the cloud.

Pros	Cons
• Users can interact with graphs by zooming, panning, and hovering • Plotly is fast when creating complex visualizations.	• Some customization options require complex and technical solutions • Setting up Plotly without an online account can be challenging.

Data Wrapper

One of the very few free data visualization tools available on the market is Data Wrapper. Because of its built-in capability to generate charts and display graphical information on Big Data rapidly, it is well-liked by media companies. Data Wrapper's user-friendly interface makes it easy for users to construct charts and maps that they can incorporate into reports.

Pros	Cons
• Customize for media use. • Ideal for tiny locations. • Integrated checker for color blindness.	• lacks direct data source integration. • Time-consuming. • Other challenges include staff training.

D3.js

A JavaScript library called D3.js (Data-Driven Documents) is used to create dynamic, interactive data visualizations in web browsers. It utilizes the Cascading Style Sheets (CSS), HTML5, and Scalable Vector Graphics (SVG) standards. It replaces the previous Protovis framework. D3.js is easy to use.

Pros	Cons
• Users can customize every aspect of their visualization • It is free to use for commercial or non-commercial purposes	• Requires a lot of time • difficult to learn, especially for new programmers • doesn't have a default presentation for data

3. Useful for what?

- **Tableau:** Suitable for both individuals and large organizations, it provides interactive dashboards.
- **Microsoft Power BI:** A reasonably priced tool with an easy-to-use interface that supports real-time data updates and integrates well with Excel
- **Looker:** Drag and drop features are available, object-oriented code, making it a strong tool for data modeling.
- **QlikView:** A strong tool that employs a no-query analytics methodology and gathers data using its own Qlik Associated engine Business professionals can visualize data like sales, marketing, and profit with Zoho Analytics, an easy-to-use tool.
- **Datawrapper:** An easy-to-use interface that benefits businesses as well as journalists and publishers
- **Google Charts:** is a free online tool with limited customization options.
- **Infogram:** A user-friendly interface that works well for producing brief, interesting reports
- **D3.js:** Able to create custom chart types by integrating with Power BI

- **ChartBlocks:** Hundreds of customization options with a focus on simplicity and ease of use

4. Conclusion

Choosing the right data visualization tool is essential to turning data into insights. Although Tableau is pricey, it offers complex, interactive dashboards. Microsoft Power BI provides good Excel connectivity and is affordably priced. Despite its strength, QlikView is challenging to learn. Datawrapper's simple designs make it ideal for the media. You base your choice on a number of criteria, including price, usability, and integration. Understanding the features of each tool is necessary to make an informed decision for effective data visualization.

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