EXPERIMENT NO. 1

AIM: Introduction to Data visualization and Data Visualization Tools

OBJECTIVE: Understand the concept of data visualization and its importance in the age of big data. Gain knowledge of different data visualization techniques and tools.

OUTCOMES: Identification of different types of data visualizations and their appropriate uses. We will be able to compare and contrast various data visualization tools.

PRE-REQUISITE:

1. Basic computer literacy and familiarity with data concepts are helpful.
2. No prior experience with data visualization tools is required.

THEORY:

Data visualization is the graphical representation of information and data. It is a technique used to communicate complex ideas or trends in a way that is easy to understand.

Introduction to Data Visualization:

Data visualization is crucial in today's data-rich world, allowing for effective communication of insights through charts, graphs, and maps. It simplifies complex data analysis by presenting information visually, making trends and patterns more apparent to the human mind.

Data Visualization Tools:

There are many different data visualization tools available, each with its own strengths and weaknesses. Some of the most popular data visualization tools include:

1. **Matplotlib:** Matplotlib, on the other hand, is a versatile data visualization library for Python that allows users to create static, interactive, and animated plots. It provides extensive control over visualization aspects and is based on the Matlab programming language, adapted for Python usage. Matplotlib is known for its versatility and the ability to visualize virtually everything from scratch, offering control over various visualization parameters like colours, line styles, legends, titles, and labels

2. **Seaborn:** Seaborn is a Python data visualization library built on top of Matplotlib, offering a high-level interface for creating attractive and informative statistical graphics. It simplifies the process of visualization tasks and enhances aesthetics, making it easier to create various plot types useful for statistical analysis and model fitting Seaborn provides an API on top of Matplotlib that offers sane choices for plot style and colour defaults, defines simple high-level functions for common statistical plot types, and integrates seamlessly with Pandas DataFrames
3. **Dash:**
   Description: Dash is a Python framework that allows you to create web applications with complex interactive visualizations. It provides a high-level interface for building dashboards, making it easy to create interactive components like dropdowns, sliders, and graphs.
   Advantages: Customizable, suitable for building interactive web applications, integrates well with Plotly for creating visualizations.
   Use Case: Ideal for developing interactive dashboards with complex data visualizations.
4. **Plotly:**
   Description: Plotly is a versatile library for creating interactive visualizations in Python. It offers a wide range of chart types, including scatter plots, bar charts, and heatmaps, that can be customized and embedded in web applications.
   Advantages: Interactive, supports a variety of chart types, easy to use for creating dynamic visualizations**.**
   Use Case: Perfect for creating visually appealing and interactive plots for data analysis and presentation.
5. **Tableau:**
   Description: Tableau offers various options like desktop, server, online versions, and a free public version. It supports multiple data import formats and output options including mapping capabilities.
   Pros: Hundreds of data import options, mapping capability, free public version available.
   Cons: Non-free versions are expensive.
   Use Case: Ideal for creating maps and other types of charts.
6. **Microsoft Power BI**: It is another popular data visualization tool that is integrated with Microsoft Office. Power BI allows you to create a wide variety of visualizations, and it provides a number of features for sharing and collaborating on visualizations.

CONCLUSION: Data visualization is a powerful tool for transforming data into insights. This course will equip you with the knowledge and skills to create effective data visualizations that can inform decision-making, improve communication, and reveal hidden patterns in data.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 2

AIM: Create a diverse range of plots using Python (Matplotlib and Seaborn) and R Programming.

- Area Plots
- Histograms
- Bar Charts
- Pie Charts
- Box Plots
- Scatter Plots

OBJECTIVE:

To understand various plots using Python and R programming, including area plots, histograms, bar charts, pie charts, box plots, and scatter plots. These plots will help visualize data and identify patterns, trends, and outliers.

OUTCOMES:

- Import necessary data visualization libraries in Python (Matplotlib, Seaborn) and R.
- Simulate or load real-world datasets for visualization.

PRE-REQUISITE:

- Basic familiarity with Python and R programming environments (installation, running code).
- A fundamental understanding of data structures (lists, dictionaries, Data Frames) in either language.
- Knowledge of essential data types (numerical, categorical) is beneficial.

THEORY:

Data visualization is a crucial aspect of data analysis, helping to uncover patterns, trends, and relationships that might be difficult to discern from raw data. Different plot types are suited for

different purposes, so it's essential to choose the right one to effectively communicate your findings.

- **Area Plots:** Illustrate trends or changes in a quantity over time. Useful for visualizing cumulative effects or flows.
- **Histograms:** Capture the distribution of continuous data, providing insight into data spread and skewness.
- **Bar Charts:** Effective for comparing categories and their associated quantities. Stacked bar charts can reveal proportions within categories.
- **Pie Charts:** Best used to show proportions of a whole, but avoid overloading with too many slices.
- **Box Plots:** Represent the spread of numerical data, including median, quartiles, and outliers.
- **Scatter Plots:** Explore relationships between two numerical variables, helping to identify correlations and potential trends.

ALGORITHM:

1. Area Plot
Algorithm:

1. **Define data points:** Specify x-axis values (categories or time points) and corresponding y-axis values (quantities).
2. **Sort data (optional):** Sorting data points in ascending or descending order of x-axis values can be helpful for some datasets, especially when visualizing trends over time.
3. **Connect data points:** Use a line or curve to connect the data points in the order they appear in the sorted or unsorted list.
4. **Fill area (optional):** To emphasize the cumulative effect or flow over time/space, fill the area below the line or curve with a color or pattern.

2. Histogram
Algorithm:

1. **Define data:** Specify a list or array of numerical values.

2. **Choose bin size:** Determine the width of each bin (interval) in the histogram. A common technique is using the Freedman-Diaconis rule to estimate an appropriate bin size based on the data's quartiles (interquartile range).
3. **Count data points in bins:** Iterate through the data values, assigning each value to the corresponding bin based on its range. Keep track of the number of data points that fall into each bin.
4. **Plot the histogram:** Create a bar chart where the x-axis represents bin ranges or centres, and the y-axis represents the count of data points in each bin.

3. Bar Chart

Algorithm:

1. **Define data:** Specify a list of categories (x-axis labels) and a corresponding list of numerical values (y-axis values) for each category.
2. **Sort data (optional):** Sorting categories in ascending or descending order of numerical values can be helpful for emphasizing comparisons.
3. **Create bars:** For each category, create a rectangular bar with its width representing the category and its height proportional to the corresponding numerical value.
4. **Position bars:** Place the bars side-by-side on the x-axis, with some spacing between them for better visualization.

4. Pie Chart

Algorithm:

1. **Define data:** Specify a list of categories (pie chart slice labels) and a corresponding list of numerical values (slice sizes) for each category.
2. **Calculate slice angles:** Convert each numerical value into a percentage of the total sum of all values. These percentages will determine the relative sizes of the pie chart slices.
3. **Create pie chart:** Use a pie chart library function to create a circular chart with slices sized according to the calculated percentages, and labeled with the corresponding categories.

5. Box Plot

Algorithm:

1. **Define data:** Specify a list or array of numerical values.
2. **Calculate summary statistics:** Find the minimum, maximum, median (50th percentile), first quartile (25th percentile), and third quartile (75th percentile) of the data.

3. **Draw box:** The box represents the interquartile range (IQR) between the first and third quartiles. The bottom and top edges of the box correspond to the first and third quartiles, respectively.
4. **Draw median line:** Draw a horizontal line inside the box at the median value.
5. **Draw whiskers:** The whiskers extend from the box to the minimum and maximum values, but are limited to a certain distance (e.g., 1.5 times the IQR) from the quartiles to avoid including outliers too far away.
6. **Plot outliers (optional):** If any data points fall outside the whisker range, they can be plotted as individual points beyond the whiskers.

6. Scatter Plot
Algorithm:

1. **Define data:** Specify two lists or arrays of numerical values representing the x-axis and y-axis coordinates of data points.
2. **Plot points:** Create a scatter plot where each data point is represented by a marker (circle, square, etc.) at its corresponding x-axis and y-axis coordinates.

CONCLUSION: Data visualization is an essential tool for analyzing and interpreting data. Different types of plots are used for different purposes, such as comparing data, visualizing distributions, and identifying relationships. Python and R programming languages provide powerful libraries for creating data visualizations. Understanding the theory and algorithm behind each type of plot is essential for creating effective visualizations.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 3

AIM: Creating Dashboards with Plotly and Dash

- Introduction to Plotly
- Introduction to Dash

Make Dashboards Interactive

OBJECTIVE:

The objective of creating dashboards with Plotly and Dash is to build interactive data visualization tools that allow users to explore and analyze data dynamically. By combining the capabilities of Plotly for creating interactive plots and Dash for building web-based dashboards, you aim to provide a user-friendly and engaging way to interact with data.

OUTCOMES:

1. Create interactive dashboards using Plotly and Dash that allow users to interact with data visually.
2. Customize the layout and design of the dashboard to present data effectively.
3. Deploy the dashboard for others to access and explore the data interactively.

PREREQUISITE:

- Proficiency in Python programming.
- Understanding of data visualization concepts.
- Familiarity with Plotly for creating interactive plots.
- Basic knowledge of web development concepts (HTML, CSS) for working with Dash.

THEORY:

- Plotly is a Python graphig library that makes interactive, publication-quality graphs online. It provides a wide range of chart types and customization options for creating visually appealing plots.

- Dash is a productive Python framework for building web applications. It allows you to create interactive, web-based dashboards with Python code. Dash abstracts away the complexities of web development, making it easier to create interactive data visualizations.
- Interactive dashboards combine the power of Plotly's interactive plots with Dash's web application framework to create dynamic and engaging data visualization tools.
- Elements such as dropdowns, sliders, and buttons can be added to the dashboard to allow users to interact with the data and customize their viewing experience.

ALGORITHM:

1. Install Plotly and Dash libraries in Python.
2. Create interactive plots using Plotly.
3. Use Dash to build a layout for the dashboard, including components like graphs, dropdowns, sliders, and buttons.
4. Define callbacks in Dash to update the dashboard based on user interactions.
5. Customize the design and layout of the dashboard to enhance user experience.
6. Deploy the dashboard using Dash to make it accessible online.

CONCLUSION: Interactive dashboards created with Plotly and Dash provide a powerful way to visualize and explore data interactively. By combining Plotly's interactive plots with Dash's web application framework, you can create dynamic and engaging data visualization tools.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 4

AIM: Data Visualization and Dashboards with Excel

- Create basic visualizations such as line graphs, bar graphs, and pie charts using Excel spreadsheets.
- Explain the important role charts play in telling a data-driven story.
- Construct advanced charts and visualizations such as Treemaps, Sparklines, Histogram, Scatter Plots, and Filled Map Charts.
- Build and share interactive dashboards using Excel

OBJECTIVE:

The objective is to create basic and advanced visualizations such as line graphs, bar graphs, pie charts, Tree-maps, Sparklines, Histogram, Scatter Plots, and Filled Map Charts using Excel spreadsheets. Additionally, building and sharing interactive dashboards using Excel will be covered.

OUTCOMES:

1. To Create basic and advanced visualizations using Excel and to understand the importance of charts in telling a data-driven story.
2. Construct interactive dashboards using Excel.
3. Apply various Excel features to create charts and pivot charts.
4. Utilize tools such as Cognos Analytics for creating interactive and informative dashboards.

PREREQUISITES:

- Basic computer literacy and High-school level math.
- A device with a modern web browser.
- The ability to use (or create) a Microsoft account to access Excel online at no-cost

THEORY:

- Data visualization plays a crucial role in conveying insights and trends from data.
- Excel provides a range of chart types to represent data visually, including line graphs, bar graphs, pie charts, Tree-maps, Sparklines, Histogram, Scatter Plots, and Filled Map Charts.

- Interactive dashboards allow users to explore and analyze data dynamically, providing a more engaging and informative experience.
- Excel features such as pivot tables and pivot charts can be used to create advanced visualizations and interactive dashboards.
- Cognos Analytics is a popular tool for data visualization and analytics, which can be used to create interactive and informative dashboards.

ALGORITHM:

1. Prepare the data in Excel spreadsheets.
2. Create basic visualizations such as line graphs, bar graphs, and pie charts using Excel features.
3. Construct advanced visualizations such as Treemaps, Sparklines, Histogram, Scatter Plots, and Filled Map Charts.
4. Build interactive dashboards using Excel features such as pivot tables and pivot charts.
5. Utilize tools such as Cognos Analytics to create interactive and informative dashboards.

CONCLUSION: Excel provides a powerful platform for creating basic and advanced visualizations and interactive dashboards. Understanding the various chart types and Excel features can help convey insights and trends from data more effectively. Utilizing tools such as Cognos Analytics can enhance the capabilities of Excel for data visualization and analytics.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 5

AIM: Fundamentals of Visualization with Tableau

- Install Tableau Public Software and create a visualization
- Examine and navigate the Tableau Public workspace

Practice and connect to different data sources

OBJECTIVE:

The practical aims to provide hands-on experience with Tableau Public software and create visualizations by examining and navigating the Tableau Public workspace, practicing and connecting to different data sources.

OUTCOMES:

Upon completion, the learner will be able to:

1. Install Tableau Public Software and create a visualization.
2. Examine and navigate the Tableau Public workspace.
3. Practice and connect to different data sources.

PREREQUISITES:

- Basic computer literacy.
- A device with a modern web browser.
- The ability to use (or create) a Tableau Public account.
- Familiarity with data sources and data management.

THEORY:

Data visualization is a crucial aspect of data analysis. It helps transform raw data into clear and visually appealing charts and graphs that effectively communicate insights, trends, and patterns. Tableau Public provides a user-friendly platform specifically designed for creating interactive visualizations.

- **Data Sources:** Tableau allows you to connect to various data sources, including spreadsheets, databases, and cloud storage.

- **Data Pane:** This pane displays the structure of your data, with rows and columns representing data points and variables.
- **Worksheet:** This is the main workspace where you build your visualizations by dragging and dropping data fields onto the shelves.
- **Marks Card:** This card determines the visual representation of your data points (circles, squares, bars, lines, etc.).
- **Shelves:** Shelves (Rows, Columns, Marks, Color, Size, Detail, etc.) allow you to organize and customize your visualization.
- **Filters:** You can use filters to focus on specific subsets of data within your visualizations.

STEPS:

1. **Install Tableau Public:** Download and install Tableau Public from the official website (https://www.tableau.com/products/public).
2. **Connect to Data:** Open Tableau Public and explore connecting to a sample dataset provided within the software or connect to your own data file (CSV, Excel, etc.).
3. **Explore the Workspace:** Familiarize yourself with the Tableau interface.
4. **Create a Visualization:** Drag and drop data fields onto the shelves to build a basic chart (e.g., bar chart, line chart).
5. **Customize Your Visualization:** Use the marks card, formatting options, and filters to personalize the appearance and focus of your visualization.

CONCLUSION: This practical session provided a foundational understanding of Tableau Public and its core functionalities for data visualization. As you continue exploring Tableau, you'll discover more advanced features for creating complex dashboards, interactive visualizations, and sharing your insights effectively.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

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DEPARTMENT: Emerging Science and Technology		LABORATORY: OCC Lab
Class: **T.Y.(AIDS) PART: II**	SUBJECT: **Visualization Tools Course Code: AID374**	YEAR: 2023-2024

EXPERIMENT NO. 6

AIM: Visual Analytics with Tableau

- Create a chart using Tableau
- Create dates using calculated fields
- Customize table calculations
- Customize and create dual layer maps

OBJECTIVE:

The objective of this practical is to enhance skills in visual analytics using Tableau by creating a chart, working with dates using calculated fields, customizing table calculations, and creating dual-layer maps. This will help in mastering advanced visualization techniques and data manipulation in Tableau.

OUTCOMES:

Upon completion of this practical, you will be able to:

1. Create a chart using Tableau to visualize data effectively.
2. Utilize calculated fields in Tableau to work with dates and perform advanced calculations.
3. Customize table calculations to gain deeper insights into data trends and patterns.
4. Create dual-layer maps in Tableau to visualize spatial data with multiple layers of information.

PREREQUISITES:

To successfully complete this practical, you should have:

1. Basic knowledge of Tableau software.
2. Understanding of data visualization principles.
3. Familiarity with data manipulation and calculations in Tableau.
4. Proficiency in working with data sets.

THEORY:

- Tableau is a powerful data visualization tool that allows users to create interactive and visually appealing charts and dashboards.

- Calculated fields in Tableau enable users to perform complex calculations, including working with dates and creating custom metrics.
- Table calculations in Tableau provide advanced options for analyzing and visualizing data, such as running totals, moving averages, and percent of total calculations.
- Dual-layer maps in Tableau allow users to overlay multiple layers of geographic data to create more informative and visually rich maps.

ALGORITHM:

1. Create a chart in Tableau by selecting the appropriate visualization type based on the data.
2. Use calculated fields in Tableau to manipulate and work with dates, such as creating date hierarchies or custom date calculations.
3. Customize table calculations in Tableau by adjusting settings like addressing and partitioning to control how calculations are computed.
4. Create dual-layer maps in Tableau by overlaying different map layers or data sets to visualize spatial data with multiple dimensions.

CONCLUSION: Mastering advanced visualization techniques in Tableau, such as working with dates, customizing table calculations, and creating dual-layer maps, enhances the ability to derive insights from data. Customizing visualizations and calculations in Tableau allows for more in-depth analysis and storytelling with data.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 7

AIM: Creating Dashboards and Storytelling with Tableau

- Combine the data and follow the best practices to present your story
- Create calculated fields for KPIs to build a figure that will be used to measure progress in the data

Assemble a dashboard

OBJECTIVE:

The objective is to create an effective and informative dashboard in Tableau that combines data from various sources and tells a story through data visualization. The dashboard should be easy to understand, visually appealing, and provide insights that can help in decision-making

PREREQUISITES:

- Basic understanding of data analysis concepts (e.g., data types, filtering, aggregation)
- Familiarity with a spreadsheet application like Microsoft Excel or Google Sheets
- Access to Tableau Desktop software (free trial or licensed version)

OUTCOMES:

1. The outcome of this task will be a dashboard that combines data from various sources and presents it in a way that is easy to understand and provides insights.
2. The dashboard should include visualizations that are relevant to the story being told and should include calculated fields for KPIs.
3. The dashboard should be visually appealing and easy to navigate.

THEORY:

The theory behind creating a dashboard in Tableau is to combine data from various sources and present it in a way that is easy to understand and provides insights. This is achieved by creating visualizations that are relevant to the story being told and by using calculated fields to measure progress. The dashboard should be designed with the end-user in mind and should be easy to navigate.

ALGORITHM:

1. Connect to data sources and combine data as needed.
2. Identify the key performance indicators (KPIs) that will be used to measure progress.
3. Create calculated fields for KPIs.
4. Create visualizations that are relevant to the story being told.
5. Assemble the visualizations on a dashboard.
6. Format the dashboard to make it visually appealing and easy to navigate.
7. Test the dashboard to ensure that it is functioning properly.

CONCLUSION: Creating a dashboard in Tableau is a powerful way to combine data from various sources and present it in a way that is easy to understand and provides insights. By following best practices and using calculated fields for KPIs, you can create a dashboard that tells a story and helps in decision-making.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 8

AIM: Introduction to Power BI

OBJECTIVE:

The objective is to learn the fundamentals of Microsoft Power BI, a business intelligence tool that allows users to connect to various data sources, visualize data in reports and dashboards, and share them with others.

PREREQUISITES:

- Basic computer literacy
- Familiarity with data concepts (data types, filtering, aggregation) is helpful but not essential

OUTCOMES:

After completing the tutorial, users will be able to connect to data sources, create reports, and share them with others using Power BI.

THEORY:

Power BI is a business intelligence tool that enables professionals to process, analyze, and visualize vast volumes of data. It consists of three main elements: Power BI Desktop, Power BI Service, and Power BI mobile apps. Power BI Desktop is a free desktop application for building and designing reports, while Power BI Service is an online publishing service for viewing and sharing reports and dashboards. Power BI mobile apps are for viewing reports and dashboards on the go.

ALGORITHM:

1. **Introduction to Power BI:** Overview of the Power BI suite and its components (Power BI Desktop, Power BI Service, Mobile Apps).
2. **Connecting to Data Sources:** Learn how to import data from various sources and understand data types.
3. **Data Transformation and Cleaning:** Explore data views, clean and manipulate data using filtering, sorting, grouping, and creating calculated fields.

4. **Building Visualizations:** Discover different chart types in Power BI, understand their strengths and weaknesses, and learn how to create effective visualizations.
5. **Designing Dashboards:** Discover best practices for arranging visualizations on a dashboard to optimize clarity and user experience.
6. **Sharing Insights:** Publish reports and dashboards to the Power BI service for collaboration and sharing.

CONCLUSION: By gaining a solid foundation in Power BI, you'll be well-positioned to unlock the power of data visualization and business intelligence. You'll be able to transform raw data into meaningful insights that can inform better decision-making within your organization.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date

EXPERIMENT NO. 9

AIM: Data Visualization with Power BI.

OBJECTIVE:

The objective is to learn data visualization with Power BI, a cloud-based business analytics service from Microsoft that enables anyone to visualize and analyze data with better speed and efficiency.

PREREQUISITES:

- Familiarity with data analysis and business intelligence concepts
- Basic understanding of data visualization techniques
- Access to Power BI software or Power BI online

OUTCOMES:

1. Understand the fundamentals of Power BI and its components
2. Connect to various data sources and prepare data for visualization
3. Create interactive reports and visualizations using Power BI's drag-and-drop interface
4. Publish and share reports with others using Power BI Service

THEORY:

Power BI is a powerful and flexible BI tool for connecting with and analyzing a wide variety of data. It provides cloud-based and desktop interfaces for data warehousing, data discovery, and interactive dashboard creation. Power BI supports custom visualizations and is easily scalable across organizations.

ALGORITHM:

1. Install Power BI and connect to a data source
2. Prepare and clean the data using Power BI's visual tools
3. Analyze and build reports with custom visualizations
4. Publish the report to Power BI Service to share with others

CONCLUSION: Power BI is a powerful and flexible BI tool for data visualization and analysis. With its drag-and-drop interface and compatibility with multiple data sources, it is an excellent choice for data scientists and business analysts. By following the steps outlined in the

algorithm, users can create interactive reports and share them with others using Power BI Service.

Rubrics for Practical Assessment:

Cognitive (3)	Affective (3)	Psychomotor (3)	Total (9)

Sign of Course Teacher with Date