

Data Visualization

Prepared by Dr. Mohamed Sleem

Subject code : FNT 631
Data Analysis

Lecture 2



Data Visualization

Lecture 2

Subject code : FNT 631

Data Analysis

Prepared by
Dr. Mohamed Sleem

What is the difference between quantitative data and qualitative data?

- **Quantitative Data:** Numerical data that can be measured and quantified (e.g., height, weight, age).
- **Qualitative Data:** Descriptive data that cannot be measured but categorized (e.g., colors, names, labels).

What are the four strategies of data analysis?

1. **Descriptive Analysis:** Summarizes data to show patterns.
2. **Diagnostic Analysis:** Explains why something happened.
3. **Predictive Analysis:** Predicts future trends based on data.
4. **Prescriptive Analysis:** Suggests actions to achieve desired outcomes.

Data analysis is a cyclical process “explain”.

- Data analysis is iterative, involving repeated cycles of collecting data, analyzing it, interpreting results, and refining the approach based on insights, leading to continuous improvement and deeper understanding.

Objectives

- 
- 1) **Understanding Data Visualization Essentials:** Learn the fundamentals of data visualization, including its importance, types, and best practices.
 - 2) **Effective Visualization Techniques:** Explore techniques for choosing the right charts, preparing data, and enhancing visual appeal to communicate insights effectively.
 - 3) **Case Studies and Practical Applications:** Gain insights from real-world case studies across various industries, demonstrating how data visualization drives decision-making and improves business outcomes.
 - 4) **Emerging Trends and Future Directions:** Discover the latest trends in data visualization, including advancements in technology, ethics considerations, and the future integration with AI and machine learning.

■ Introduction to Data Visualization

- 1. Enhancing Data Understanding:** Data visualization offers a visual representation of data, making complex datasets easier to comprehend and analyze.
- 2. Facilitating Insight Discovery:** By presenting data visually, patterns, trends, and relationships become more apparent, enabling deeper insights and informed decision-making.
- 3. Improving Communication:** Visualizations provide a clear and concise way to communicate findings to stakeholders, facilitating better understanding and alignment across teams.

■ Introduction to Data Visualization

4. Data-Driven Decision Making: Leveraging intuitive visualizations enables organizations to make data-driven decisions more effectively. By identifying opportunities, mitigating risks, and optimizing strategies based on visualized data, organizations can drive better outcomes and achieve their objectives more efficiently.

5. Enhancing Forecasting Accuracy: Data visualization allows organizations to analyze historical trends and patterns, enabling them to make more accurate predictions and forecasts for the future.

📊 Importance of Data Visualization 📊



Analyzing the Data
in a Better Way



Faster Decision
Making



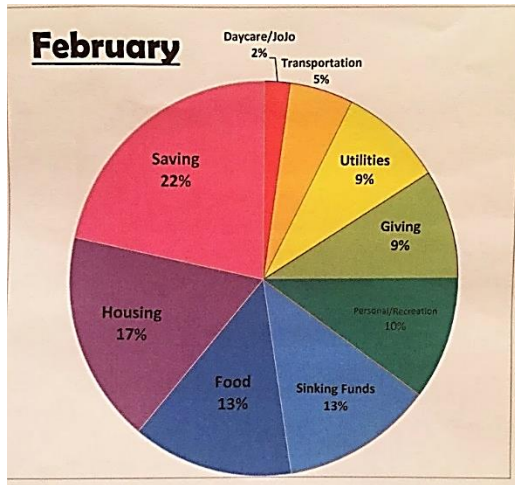
Making Sense of
Complicated Data

Types of Data Visualizations:

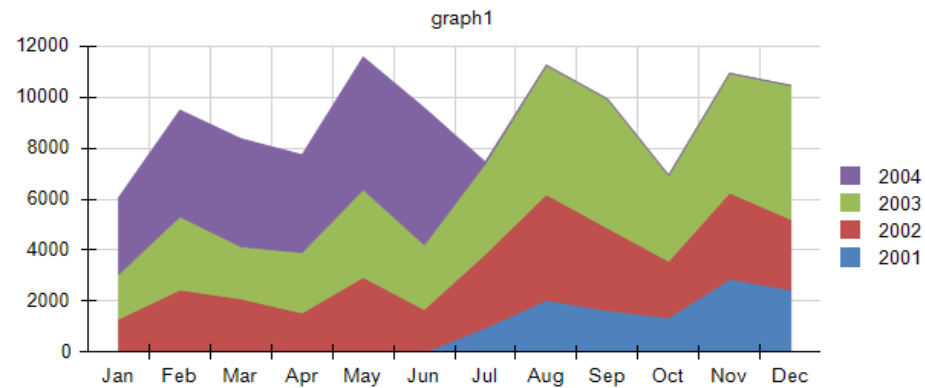
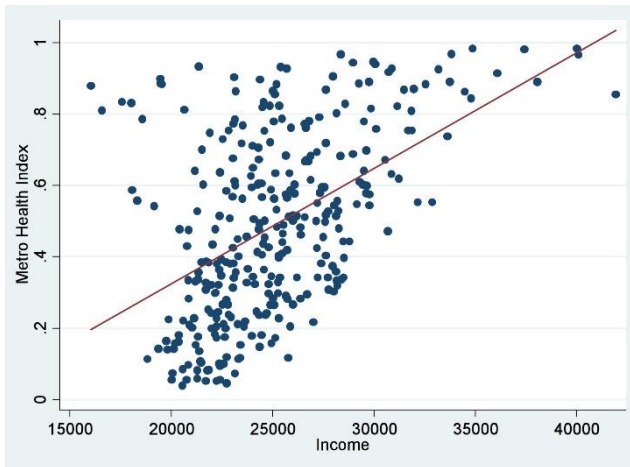
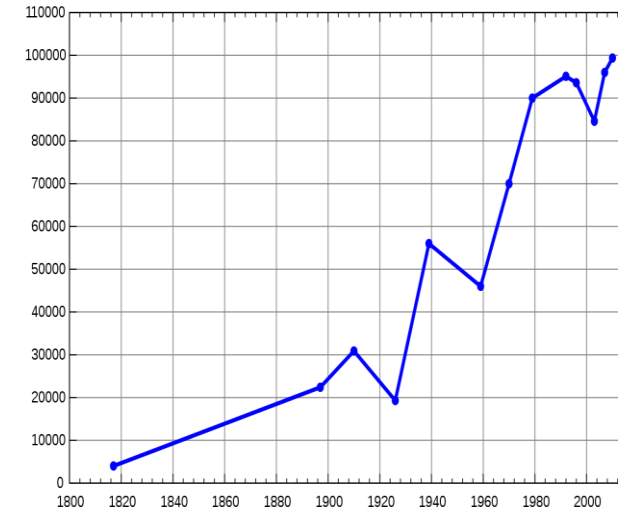
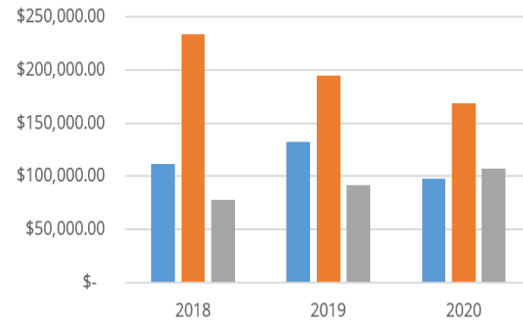
A. Charts and Graphs:

- 1.Bar charts:** Suitable for comparing values across different categories.
- 2.Line charts:** Ideal for showing trends and changes over time.
- 3.Pie charts:** Useful for displaying proportions or percentages of a whole.
- 4.Scatter plots:** Great for showing relationships between two variables.
- 5.Area charts:** Similar to line charts but emphasize the magnitude of change over time.

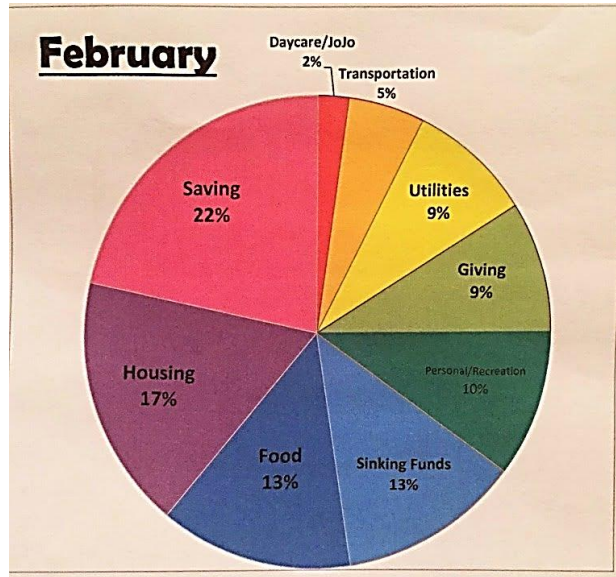
Types of Data Visualizations:



Bar Chart (Data Visualization)



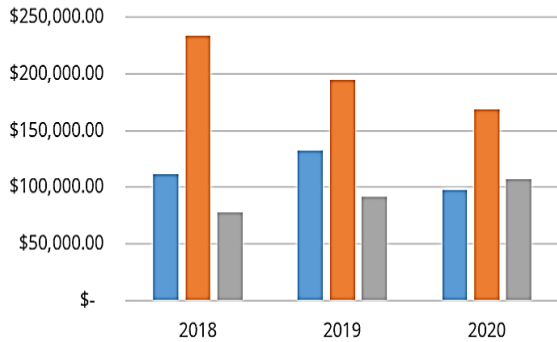
Types of Data Visualizations:



- A pie chart is a graph used for data visualization and analysis, representing the proportions of different categories within a dataset.
- It is useful for comparing the relative sizes of parts of a dataset and simplifies visualization. In the financial sector, pie charts can be used for budget allocation, expense tracking, and investment distribution.
- By analyzing pie charts, analysts can gain insights into spending habits and make informed decisions.

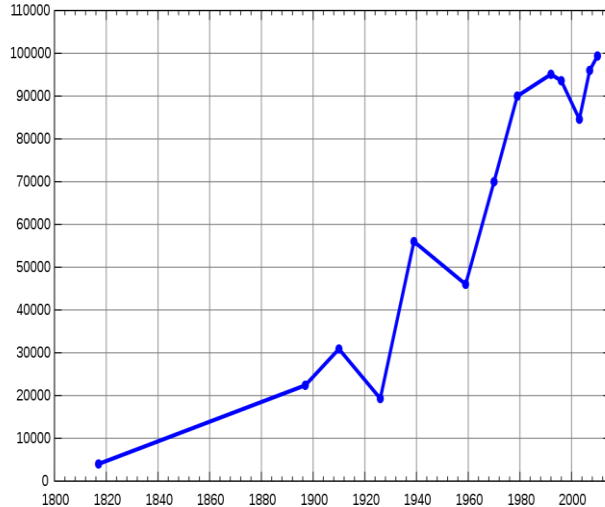
Types of Data Visualizations:

Bar Chart (Data Visualization)



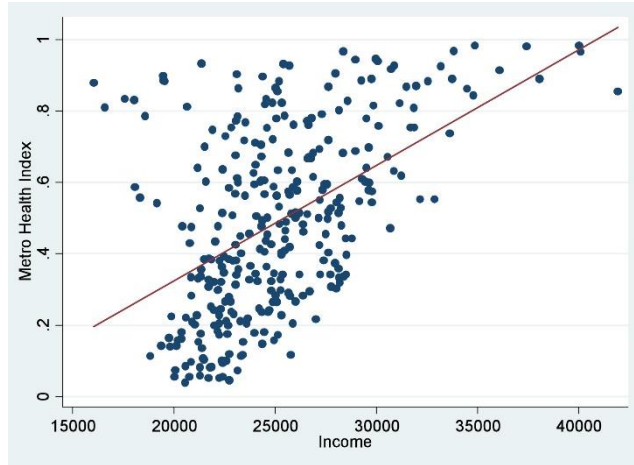
- A bar chart is a graph used for data visualization and analysis in the financial sector.
- It allows for comparative analysis, trend analysis, and distribution of data across different categories.
- Bar charts can be used to compare revenue, expense breakdown, and investment performance over different years.
- They can help identify growth trends, identify areas of cost increase or decrease, and illustrate investment returns.

Types of Data Visualizations:



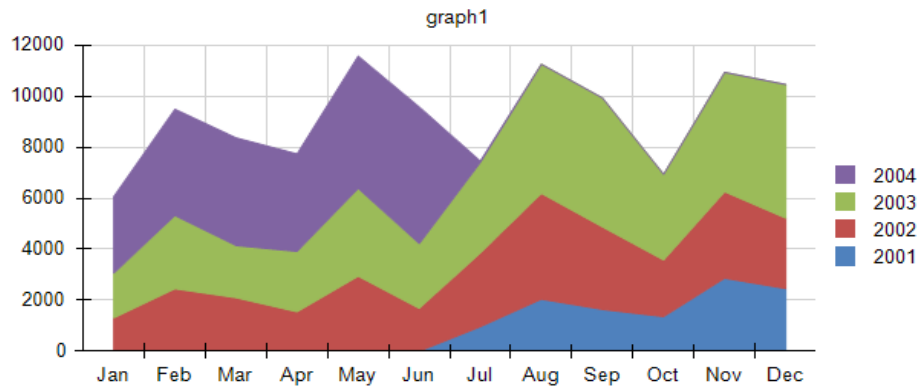
- A line chart is a graph used for trend analysis, continuous data visualization, and comparative analysis. It is commonly used in the financial sector to track stock prices, revenue growth, and interest rates.
- Interpretations include overall trend, fluctuations, and significant increases.
- Line charts are useful for stock market analysis, revenue tracking, and expense monitoring, allowing financial analysts to make data-driven decisions based on historical data patterns.

Types of Data Visualizations:



- Scatter plots are graphs used for data visualization and analysis in the financial sector.
- They help identify trends, outliers, and patterns in data. For example, they can be used to analyze the relationship between financial metrics, risk assessment, and customer data. For example, they can show the correlation between income and the Metro Health Index.
- Financial analysts can use scatter plots to understand stock performance, marketing strategies, and investment returns.

Types of Data Visualizations:



- Area charts are graphs used for trend visualization, comparative analysis, and cumulative data analysis. They are useful in the financial sector for analyzing revenue growth, expense breakdown, and investment portfolio performance.
- The chart shows seasonal trends, year comparisons, and cumulative growth over time. Applications include annual revenue analysis, expense monitoring, and sales performance visualization.
- By analyzing area charts, financial analysts can make informed decisions based on historical data patterns.

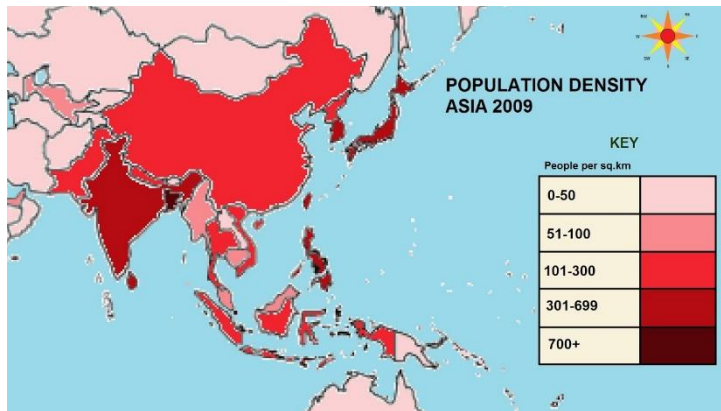
Types of Data Visualizations:

B. Maps and Geospatial Visualizations:

- 1. Choropleth maps:** Display data by shading or coloring geographic areas.
- 2. Bubble maps:** Use bubble size or color to represent data points on a map.
- 3. Heatmaps:** Show data density or distribution using color gradients on a map.

Types of Data Visualizations:

Choropleth Map:



- Choropleth maps are useful tools for data visualization and analysis, allowing comparisons between regions, identifying patterns, and making informed decisions.
- They are particularly useful in spatial analysis, public policy, and business, providing insights into population distribution, resource allocation, and market stratification.

Types of Data Visualizations:

Color-Coded Heat Map:

Example of a color-coded heat map

A risk map offers a visualized, comprehensive view of the likelihood and impact of an organization's risks. Risks that fall into the green areas of the map require no action or monitoring. Yellow and orange risks require action. Risks that fall into red portions of the map need urgent action.

IMPACT	Catastrophic (5)	5	10	15	20	25
	Significant (4)	4	8	12	16	20
	Moderate (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Negligible (1)	1	2	3	4	5
		Improbable (1)	Remote (2)	Occasional (3)	Probable (4)	Frequent (5)
		LIKELIHOOD				

- Heat maps are color-coded risk matrixes used in data visualization for risk assessment, pattern recognition, prioritization, and resource allocation.
- They are useful in risk management, performance metrics, and credit risk analysis in the financial sector.
- They help identify high-risk investments, monitor asset portfolios, and assess operational risks across functions like compliance, fraud, and technology.

Types of Data Visualizations:

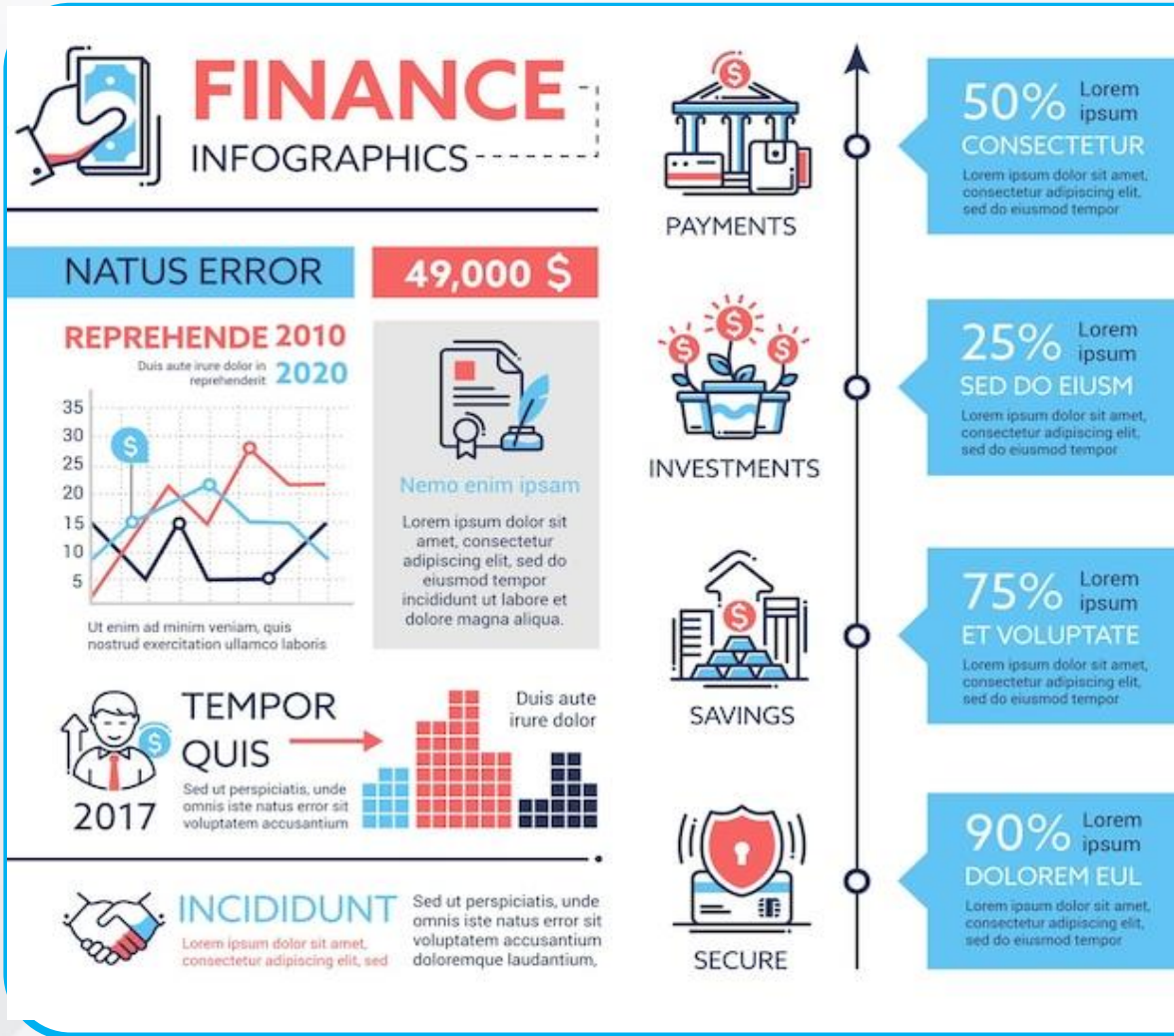
Types of Data Visualizations:



- Mind maps are useful tools in data visualization and analysis for idea organization, brainstorming, hierarchical representation, and enhanced memory and learning.
- They simplify complex data sets, aid in project planning, and aid in strategic planning.
- For example, in the financial sector, they aid in investment portfolio management, financial strategy planning, and risk management frameworks.

Types of Data Visualizations:

C. Infographics and Dashboards:



Infographics: Combine text, icons, and visual elements to convey information in a concise and engaging manner.

Types of Data Visualizations:

Dashboard:



Dashboards: Provide an overview of key metrics and trends through interactive visualizations and widgets.

Principles of Effective Data Visualization:

1. Simplicity and Clarity:

- Emphasize the importance of keeping visualizations simple and easy to understand.
- Avoid unnecessary clutter, excessive detail, or distracting elements.
- Use clear labels, titles, and annotations to guide the audience's interpretation of the data.

2. Accuracy and Precision:

Stress the need for accurate representation of data without distorting or misleading information.

- Ensure that visualizations accurately reflect the underlying data values and relationships.
- Use appropriate scales, axes, and data formats to maintain precision in the visualization.

Principles of Effective Data Visualization:

3. Relevance and Context:

- Highlight the importance of relevance by focusing on the most pertinent information for the audience.
- Provide context to help viewers interpret the data correctly, including background information, comparisons, and explanations.
- Tailor visualizations to the specific needs and interests of the audience to ensure relevance.

4. Engagement and Impact:

- Encourage the use of engaging visual elements, such as color, size, and interactivity, to capture the audience's attention.
- Aim to create visualizations that resonate emotionally and intellectually with viewers.
- Design visualizations with the goal of leaving a lasting impact on the audience, whether through highlighting key insights, telling a compelling story, or inspiring action.

Data Visualization Tools and Software :

Tableau

User-Friendly Interface: Easy to learn and use without extensive programming knowledge.

Data Integration: Connects to various data sources like databases, Excel, cloud data.

Real-Time Data Updates: Automatically updates data from multiple sources.

Advanced Analytics: Supports predictive analytics, statistical analysis, and forecasting.

Interactive Dashboards: Create and share interactive visualizations easily.

Security: Offers advanced security features to protect sensitive data.

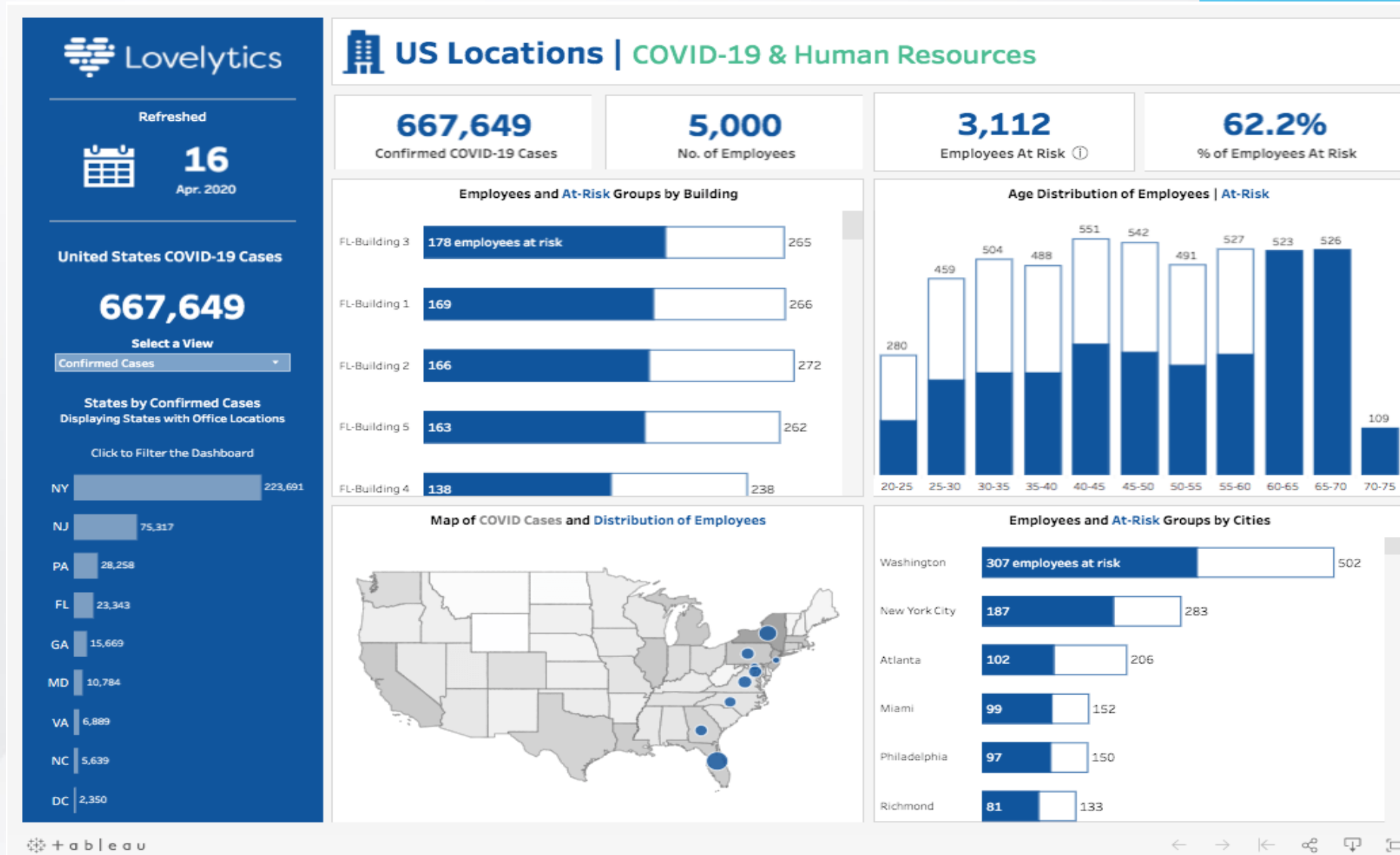
Collaboration: Enables team collaboration through shared dashboards and reports.

Mobile Support: Access and interact with dashboards on mobile devices.

Customization: Highly customizable visualizations to fit specific needs.

Scalability: Handles large datasets efficiently.

Tableau Dashboard :



Data Visualization Tools and Software:

2- Microsoft Power BI: Key Features and Capabilities

1. Integration with Microsoft Ecosystem

- **Seamless Integration:** Integrates smoothly with other Microsoft products like Excel, Azure, and SharePoint.
- **Office 365 Integration:** Easily embeds within Office 365 applications for enhanced productivity.

2. Ease of Use

- **User-Friendly Interface:** Intuitive and easy-to-navigate interface.
- **Drag-and-Drop Functionality:** Simplifies the creation of dashboards and reports.

3. Real-Time Data Access

- **Real-Time Dashboards:** Access real-time data from multiple sources.
- **Automatic Refresh:** Scheduled data refreshes to keep dashboards current.

Data Visualization Tools and Software:

4. Advanced Data Modeling

- **DAX Language:** Powerful Data Analysis Expressions (DAX) language for complex calculations.
- **Data Transformation:** Built-in Power Query for data cleaning and transformation.

5. Extensive Data Connectivity

- **Wide Range of Connectors:** Connects to a vast array of data sources including databases, cloud services, and web APIs.
- **Data Blending:** Combines data from various sources for comprehensive analysis.

6. Interactive Visualizations

- **Dynamic Visuals:** Creates interactive and dynamic visualizations.
- **Drill-Through Capabilities:** Drill through data to uncover deeper insights.

7. Collaboration and Sharing

- **Power BI Service:** Cloud-based service for sharing and collaboration.
- **Publish to Web:** Ability to publish reports to the web or share via URL.

Data Visualization Tools and Software:

8. Mobile Accessibility

- **Mobile Apps:** Dedicated mobile apps for iOS and Android.
- **Responsive Dashboards:** Dashboards adjust automatically to fit different screen sizes.

9. Security and Compliance

- **Row-Level Security:** Define security roles to control data access at a granular level.
- **Compliance:** Meets various industry standards and compliance requirements.

10. AI and Machine Learning Integration

- **AI Insights:** Built-in AI capabilities for automated insights.
- **Integration with Azure ML:** Leverages Azure Machine Learning for advanced analytics.

Data Visualization Tools and Software:

Power BI: Key Features and Capabilities

11. Cost-Effective

- **Affordable Pricing:** Competitive pricing model suitable for organizations of all sizes.
- **Free Version:** Offers a free version with essential features for individual users.

12. Custom Visualizations

- **Custom Visuals:** Access to a wide range of custom visuals from the Power BI marketplace.
- **Developer Tools:** Create and share custom visuals using Power BI Developer Tools.

13. Data Governance

- **Data Lineage:** Track data lineage to understand data sources and transformations.
- **Data Catalog:** Integrated data catalog for easier data discovery and management.

Data Visualization Tools and Software:

3. Google Data Studio:

- a) **Free to Use:** Completely free with Google account.
- b) **Google Ecosystem Integration:** Seamless integration with Google Analytics, Google Ads, BigQuery, and more.
- c) **Customizable Reports:** Highly customizable and visually appealing reports and dashboards.
- d) **Data Connectivity:** Connects to multiple data sources including Google Sheets, SQL databases, and more.

Data Visualization Tools and Software:

3. Google Data Studio:

- e) **Real-Time Data:** Real-time data updates and live data connections.
- f) **Collaboration:** Easy sharing and collaboration features.
- g) **Interactive Visualizations:** Interactive charts, graphs, and tables.
- h) **Templates:** Pre-built templates for quick report creation.
- i) **User-Friendly Interface:** Intuitive drag-and-drop interface.
- j) **Embedding Options:** Embed reports in websites and share via links.

Data Visualization Tools and Software:

Feature/Program	Tableau	Power BI	Google Data Studio
Integration	Extensive data source integration	Strong Microsoft ecosystem integration	Excellent Google ecosystem integration
Ease of Use	User-friendly, intuitive interface	Easy to use with drag-and-drop functionality	Very user-friendly and simple to use
Cost	Higher cost, premium features	Cost-effective, competitive pricing	Free with a Google account
Real-Time Data	Live data connections and automatic updates	Real-time dashboards and automatic refresh	Real-time data updates
Advanced Analytics	Strong analytical and statistical capabilities	Advanced analytics with DAX and Azure ML	Basic analytical capabilities

Data Visualization Tools and Software:

Feature/Program	Tableau	Power BI	Google Data Studio
Customization	Highly customizable visualizations	Wide range of custom visuals	Customizable but less advanced
Collaboration	Easy sharing, strong collaboration features	Excellent sharing and collaboration	Simple sharing and collaboration
Security	Advanced security features	Row-level security and compliance features	Basic security, relies on Google account
Mobile Support	Dedicated mobile apps, responsive design	Mobile apps for iOS and Android	Responsive design, no dedicated app
Scalability	Handles large datasets efficiently	Efficient with large datasets	Suitable for smaller datasets
AI and ML Integration	Limited AI features	Strong AI and ML integration with Azure	Limited AI features
Learning Curve	Slightly steeper learning curve	Moderate learning curve	Very low learning curve

Comparing data visualization tools:

Considerations for Selection:

- **Business Needs:** Consider the specific requirements and objectives of your organization, such as data complexity, collaboration needs, and budget constraints.
- **Data Requirements:** Evaluate the types and sources of data you need to analyze and visualize, as well as the scalability required to handle large datasets.
- **User Preferences:** Take into account the preferences and skill levels of your users, including their familiarity with specific tools and ecosystems..

Data Visualization Process:

1.Steps in the Data Visualization Process:

- **Data Collection:** Gather relevant data from various sources, including databases, spreadsheets, APIs, and external sources.
- **Data Preparation:** Clean and preprocess the data to ensure accuracy and consistency, including handling missing values, removing duplicates, and formatting data for analysis.
- **Data Analysis:** Explore the dataset to identify patterns, trends, and relationships using statistical methods and visualization techniques.

Data Visualization Process:

- ✓ - **Visualization Design:** Select appropriate visualization types based on the data characteristics and analysis goals, such as bar charts, line graphs, scatter plots, or maps.
- ✓ - **Visualization Creation:** Create visualizations using data visualization tools or programming languages like Python or R, ensuring clarity, accuracy, and effectiveness in conveying insights.
- ✓ - **Interpretation:** Interpret the visualizations to extract meaningful insights and actionable recommendations, considering the context of the data and the objectives of the analysis.
- ✓ - **Communication:** Present the visualizations and findings to stakeholders through reports, dashboards, presentations, or interactive tools, ensuring clear and effective communication of insights.

Data Visualization Process:

2. Key Considerations in the Data Visualization Process:

- **Data Quality:** Ensure the quality and integrity of the data to produce accurate and reliable visualizations.
- **Audience:** Consider the audience's background, knowledge, and information needs when designing and presenting visualizations.
- **Visualization Principles:** Adhere to principles of effective visualization design, such as simplicity, clarity, consistency, and relevance.
 - Iterative

Data Visualization Process:

- Iterative Process:** View data visualization as an iterative process, refining and improving visualizations based on feedback and further analysis.
- Ethical Considerations:** Consider ethical implications, such as privacy, bias, and transparency, when collecting, analyzing, and visualizing data.

Data Visualization Process:

1. Importance of Data Storytelling:

- **Engagement:** Data storytelling adds a human element to data analysis, engaging stakeholders and making complex information more relatable and understandable.
- **Contextualization:** By contextualizing data within a narrative framework, stakeholders can better grasp the significance of the insights, leading to more informed decision-making.

Data Visualization Process:

- Retention:** Stories are more memorable than raw data, increasing the likelihood that stakeholders will retain and act upon the insights communicated through data visualization.
- Persuasion:** Effective storytelling can persuade stakeholders to take action based on the insights derived from the data, leading to positive outcomes for the organization.

Data Visualization Process:

2. Techniques for Crafting Compelling Data Narratives:

- **Identify the Audience:** Tailor the narrative to the audience's interests, knowledge level, and information needs to ensure relevance and engagement.
- **Define the Message:** Clearly define the main message or takeaway you want to convey with the data, focusing on a central theme or hypothesis.

Data Visualization Process:

- **Structure the Story:** Develop a structured narrative arc that includes elements such as introduction, conflict or challenge, resolution, and conclusion, guiding stakeholders through the data journey.
- **Use Visuals Strategically:** Integrate visualizations strategically within the narrative to reinforce key points, illustrate trends, and support the storytelling process.

Data Visualization Process:

-Incorporate Emotion: Appeal to stakeholders' emotions by weaving personal anecdotes, case studies, or real-life examples into the narrative, making the data more compelling and relatable.

-Iterate and Refine: Continuously iterate and refine the data narrative based on feedback, testing different storytelling techniques to optimize engagement and impact.

Conclusion..:

1. Grasping Data Visualization Basics:

1. Understand the core concepts, significance, various forms, and optimal practices of data visualization.

2. Techniques for Effective Visualization:

1. Delve into methods for selecting appropriate charts, preparing data efficiently, and enhancing visual presentation to convey insights clearly.

3. Practical Examples and Applications:

1. Learn from real-world case studies across different sectors, illustrating how data visualization supports decision-making and enhances business performance.

4. Current Trends and Future Prospects:

1. Explore the newest developments in data visualization, including technological advancements, ethical issues, and future AI and machine learning integrations.



Chapter 02

Summary of chapter

Revision Questions

- 1. Question:** Describe the key differences between quantitative and qualitative data.
- 2. Question:** What are the four main strategies of data analysis and briefly explain each?
- 3. Question:** Outline the steps involved in the data visualization process.



Chapter
02

Revision questions



Thank You