

CBCS SCHEME

USN 1CR24BAC45

MBABA314

Third Semester MBA Degree Examination, Dec.2025/Jan.2026

Data Visualization

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FOUR full questions from Q.No.1 to Q.No.7.

2. Question No. 8 is compulsory.

3. M : Marks, L: Bloom's level, C: Course outcomes.

			M	L	C
Q.1	a.	Define Visual Perception.	3	L1	CO1
	b.	What are the challenges faced in validating data visualisations?	7	L2	CO1
	c.	Explain Gestalt Principles.	10	L3	CO1
Q.2	a.	Define Visual mapping.	3	L1	CO1
	b.	Discuss validation approaches in visualization with examples.	7	L2	CO2
	c.	Explain task abstraction with examples.	10	L2	CO3
Q.3	a.	What are marks and channels in visualization?	3	L1	CO2
	b.	Discuss the role of data structures in visualization.	7	L2	CO2
	c.	Discuss visualization of multi-dimensional data with examples.	10	L3	CO3
Q.4	a.	What are text visualizations?	3	L1	CO2
	b.	Compare the visualization of clusters vs. groups. How does each help in interpreting complex data sets?	7	L3	CO3
	c.	Assess the role of software tools (Tableau, Power BI) in supporting strategic decision-making.	10	L2	CO4
Q.5	a.	Define volumetric data visualization and give one example of its application.	3	L1	CO3
	b.	Describe visualization of two-dimensional data with examples.	7	L3	CO2
	c.	Compare the visualization of process simulations vs. collaborative visualizations. How does each contribute to strategic insights?	10	L3	CO3
Q.6	a.	List any three uses of GIS systems in geographic information visualization.	3	L1	CO4

	b.	Explain how spatial axis orientation influences the interpretation of visualized data.	7	L2	CO3
	c.	Explain visualization techniques for text and text documents.	10	L3	CO3
Q.7	a.	Differentiate between color theory and color maps in visualization.	3	L2	CO2
	b.	How does collaborative visualizations contribute to strategic insights?	7	L2	CO3
	c.	Assess the role of color theory and map color channels in enhancing strategic communication through geographic visualizations.	10	L3	CO3
Q.8	Compulsory Question :				
	a.	A retail company faces information overload in its reporting system. Analyze how visualization can reduce cognitive burden using Gestalt principles.	10	L4	CO1
	b.	A policymaker wants to apply rules of thumb for arranging tables. Theoretically analyze categorical regions.	10	L4	CO2



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VTU Third Semester MBA Degree Examination (Dec 2025/Jan 2026) Data Visualization (MBABA314).

Question 1

a. Define Visual Perception.

Visual perception is the process by which the brain organizes and interprets sensory information from the eyes to understand the surrounding environment. In data visualization, it refers to how users "see" and decode graphical elements like shapes, colors, and spatial arrangements to derive meaning from data.

b. What are the challenges faced in validating data visualizations?

Validating a visualization is difficult because it involves both technical accuracy and human psychology.

- **Subjectivity:** Different users may interpret the same chart differently based on their prior knowledge.
- **Scalability:** A visualization that works for 10 data points may become unreadable (visual clutter) with 10,000.
- **Mismatched Abstraction:** The designer might create a "cool" chart that doesn't actually answer the user's specific business question.
- **Evaluation Metrics:** It is hard to quantify "insight." Measuring if a user "understood" something is more complex than measuring software speed.

c. Explain Gestalt Principles.

Gestalt principles describe how the human eye perceives visual elements as organized patterns rather than individual parts.

- **Proximity:** Elements close to each other are perceived as a group (e.g., dots in a scatter plot).
 - **Similarity:** Elements that look alike (same color or shape) are seen as related.
 - **Continuity:** The eye follows the smoothest path (e.g., trend lines in a line chart).
 - **Closure:** The brain fills in gaps to create whole shapes.
 - **Figure/Ground:** The ability to distinguish the main object (data) from the background.
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Question 2

a. Define Visual Mapping.

Visual mapping is the process of representing data attributes through visual marks (points, lines, areas) and channels (position, color, size). It is the core "translation" step where raw numbers become a visual form.

b. Discuss validation approaches in visualization with examples.

Validation ensures the visualization is both correct and effective.

- **Algorithm Validation:** Checking if the code correctly maps the data (e.g., ensuring a bar chart's height accurately reflects the value).
- **User Studies:** Observing real users to see if they can find the correct information.
- **Heuristic Evaluation:** Experts checking the design against established rules (like Tufte's principles).

c. Explain task abstraction with examples.

Task abstraction involves translating domain-specific goals into generic "why" and "how" questions.

- **Example:** A doctor wanting to "identify patient heart rate spikes" is abstracted to "Locate outliers in a time-series dataset." This allows designers to use standard visualization solutions for unique problems.
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Question 3

a. What are marks and channels in visualization?

- **Marks:** The basic geometric elements (Points, Lines, Areas).
- **Channels:** The visual properties that control the appearance of marks (Position, Color, Size, Shape, Tilt).

b. Discuss the role of data structures in visualization.

Data structures (Tables, Networks, Trees, Fields) dictate which visualization types are possible. For instance, a hierarchical data structure requires a Tree Map or Sunburst chart, whereas a relational table is best suited for Bar or Scatter plots. Efficient structures also ensure the visualization loads quickly.

c. Discuss visualization of multi-dimensional data with examples.

Multi-dimensional data involves many variables. Techniques include:

- **Parallel Coordinates:** Each dimension is a vertical axis; a data point is a line crossing them.
 - **Scatter Plot Matrices:** A grid of scatter plots showing every possible pair of variables.
 - **Heatmaps:** Using color intensity across a grid to show relationships between two categorical dimensions and one numerical value.
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Question 4

a. What are text visualizations?

Text visualizations represent non-numerical, unstructured data. Common examples include **Word Clouds**, where the size of a word represents its frequency, or **Sentiment Analysis charts** that visualize the emotional tone of a body of text.

b. Compare the visualization of clusters vs. groups. How does each help in interpreting complex data sets?

- **Clusters:** Discovered through data analysis (unsupervised learning). Visualizing clusters (e.g., via K-means on a scatter plot) helps identify hidden patterns and segments in the data.
- **Groups:** Pre-defined categories (e.g., "North Region" vs. "South Region"). Visualizing groups helps compare known entities against benchmarks.

c. Assess the role of software tools (Tableau, Power BI) in supporting strategic decision-making.

These tools allow non-technical executives to interact with data through "drill-down" capabilities.

- **Real-time Insights:** Strategic decisions are made on current, not old, data.
 - **Storytelling:** They allow users to create dashboards that narrate a "business story," making it easier to justify a strategic move to stakeholders.
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Question 5

a. Define volumetric data visualization and give one example.

Volumetric visualization involves representing 3D data where information is stored inside a volume, not just on the surface.

- **Example: MRI or CT scans** in healthcare, where doctors look "inside" the body to find tumors.

b. Describe visualization of two-dimensional data with examples.

2D visualization maps data onto an x and y plane.

- **Scatter Plot:** Shows the relationship between two continuous variables (e.g., Height vs. Weight).
- **Line Graph:** Shows a variable changing over time (e.g., Stock prices over a month).

c. Compare process simulations vs. collaborative visualizations.

- **Process Simulations:** Show how a system works over time (e.g., an assembly line). They help identify bottlenecks.
 - **Collaborative Visualizations:** Multiple users interact with the same data simultaneously. This contributes to strategic insights by combining the expertise of different departments (e.g., Sales and Finance) in one view.
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Question 6

a. List any three uses of GIS systems.

1. **Urban Planning:** Mapping infrastructure and zoning.
2. **Logistics:** Optimizing delivery routes based on geography.
3. **Environmental Monitoring:** Tracking deforestation or spread of wildfires.

b. Explain how spatial axis orientation influences interpretation.

The way axes are oriented can change the "story." For example, we naturally associate "Up" with "Good/Growth" and "Down" with "Bad/Decline." Inverting an axis can confuse the reader or, if used intentionally, highlight a specific trend like "depth" in oceanography.

c. Explain visualization techniques for text and text documents.

- **Tag Clouds:** Frequency analysis.
 - **Sentence Trees:** Visualizing word sequences and structure.
 - **Document Maps:** Grouping similar documents spatially based on theme or keywords.
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Question 7

a. Differentiate between color theory and color maps.

- **Color Theory:** The science/art of how colors mix and the psychological effects of color (e.g., Red = Danger).
- **Color Maps:** A specific mapping of data values to colors (e.g., a "Rainbow" map or a "Sequential" map from light blue to dark blue).

b. How does collaborative visualization contribute to strategic insights?

It breaks down "data silos." When different stakeholders look at the same visual, they can brainstorm in real-time, leading to a consensus on strategy that wouldn't happen if they were looking at separate static reports.

c. Assess the role of color theory and map color channels in geographic visualizations.

In maps, color is a "channel."

- **Choropleth Maps:** Use color saturation to show density (e.g., darker green = more forest).
 - **Strategic Communication:** Using the right colors prevents bias; for instance, using a diverging color map (Red to Blue) is better for showing "Profit vs. Loss" than a single-color gradient.
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Question 8 (Compulsory Case Study)

a. Information Overload in a Retail Company.

A retail company with too much data can use **Gestalt Principles** to simplify reporting:

- **Grouping (Proximity):** Place "Sales," "Revenue," and "Profit" charts together so the brain sees them as a single financial performance unit.
- **Similarity:** Use the same color for "Online Sales" across all different charts to reduce the effort needed to find that specific metric.
- **Enclosure:** Draw a box around "Urgent Alerts" (like low stock) to separate them from routine data, utilizing the **Figure/Ground** principle to make them stand out.

b. Rules of thumb for arranging tables and categorical regions.

For a policymaker, tables should follow these rules:

- **Alignment:** Numbers should be right-aligned to allow for easy comparison of magnitude.
- **Categorical Ordering:** Instead of alphabetical order, arrange regions by the metric of interest (e.g., highest poverty rate to lowest) to provide immediate insight.
- **Minimize Ink:** Remove heavy borders and gridlines (Tufte's Data-Ink ratio) so the categorical data stands out clearly.