Data Visualization Assignment - 1

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Human Perceptual Processing, Gestalt principles, and data Visualization

1. Human Perceptual Processing models:-

* Human's perceive patterns and relationships faster than raw numbers.
* Visualization leverages pre-attentive attributes (Color, size, shape, orientation) that the human brain detects quickly without conscious effort

Example:-

A red dot among blue dots immediately stands out and Quickly anomaly detection in charts.

2. Gestalt principles in Visualization:-

Gestalt Psychology explains how humans group visual Elements

* proximity:-
  Items close together are seen as a group
  Ex:- clustered bar charts.
* Similarity:-
  Similar colors / shapes imply relation
  Ex:- Same color for one category across charts).
* Continuity:-
  lines are perceived as continous trends:-
  Ex:- line charts for time series.

* Closure:-

Viewers "fill in gaps"

Ex:- Incomplete pie slices still from a circle.

3. Reducing information overload:-

* Gibson's Affordance Theory:-

Visual design should suggest its use

Ex:- A slider in a dashboard "affords" interaction → users know they can filter data.

* Data Abstraction:-

Summarize and filter unnecessary details.

Example:-

Summarize and filter unnecessary details.

Instead of raw IM sales records, show aggregated monthly sales trend.

* Appropriate Representation:- Match chart type with data

Categorical → bar chart / pie chart

Continous data trend → line chart

High dimensional → heat map / slip (A plots).

Example:- In a financial dashboard too many raw stock prices = overload. Instead.

* line chart for trends (Clarity)
* Heat map for correlations
* drop down for filtering stocks (affordances).

Visualization for univariate, Bivariate and Multivariate Analysis:-

1. univariate Analysis (one Variable):-

* Focus: Distribution, frequency, summary of one Variable

Common techniques:

- Bar chart → for Categorical data (eg: gender counts)
- Histogram → for Continous data (eg. Exam score distribution).
- Violin / box plot → for spread & outliers.

Example:-

Dataset student Exam scores

- Histogram → shows Most students scored between 60-80.

2. Bi-Variate Analysis (Two Variables):-

- focus: Relationship between two Variables
- Techniques:
  - Scatterplot → two continous Variables
  - Bar chart → categorical Vs Continous
  - Line chart with fit line → trend / relationship

Example:-

Dataset: Hours studied Vs Exam score

- Scatterplot with regression line → shows positive Correlation

3. Multivate Analysis (More than two Variable):-

focus: Interaction among 3 + Variables.

Techniques:-

- Heat Map → Correlation Matrix of Multiple Continous Varia Variable.

Bubble Chart → x, y, and bubble size : 3rd variable.

- Pair plot → Multiple Scatterplot for combinations.
- Parallel coordinates → high dimensional Continous data.

Example :-

- Dataset : Car features (price, Mileage, Horsepower, Engine size)
- Heat Map :- Shows Mileage negativity Correlated with horse power)
- Bubble Chart :- x = Engine size, y = price, Bubble size = Mileage

Comparision Table :-

Analysis Type	Variables	Categorical Data	Continous data	Example Visualization
Univariate	1	Barchart	Histogram Box plot	Student Score distribution
Bivariate	2	Grouped Bar Chart	Scatterplot, line Chart	Hours Studied vs Score
Multivariate	3+	Mosaic plot	HeatMap Bubble Chart, Parallel Coords	Car features, Comparision

Choice of Visualization depends on:

* Data type (categorical → bar, continous → histogram / line)
* number of Variables (uni → boplots, bi → Scatter / line, multi → heat maps, bubble, parallel Words.