MUST

Wisdom & Virtue

MIRPUR UNIVERSITY OF SCIENCE AND TECHNOLOGY (MUST)

Data Visualization

Lecture : Understanding Data Types
(Categorical, Numerical, Time-Series Data)

COURSE TEXTBOOKS

- **Data Visualization: A Practical Introduction** by Kieran Healy
- **Storytelling with Data** by Cole Nussbaumer Knaflic
- **The Visual Display of Quantitative Information** by Edward R. Tufte
- **Fundamentals of Data Visualization** by Claus O. Wilke

Lecture Contents

1. Introduction to Data
2. Types of Data

Data

Data is a collection of raw facts, figures, or symbols that represent information but have not yet been processed or organized to carry specific meaning. It can be quantitative (numerical) or qualitative (descriptive) and serves as the basic input for analysis, decision-making, and problem-solving.

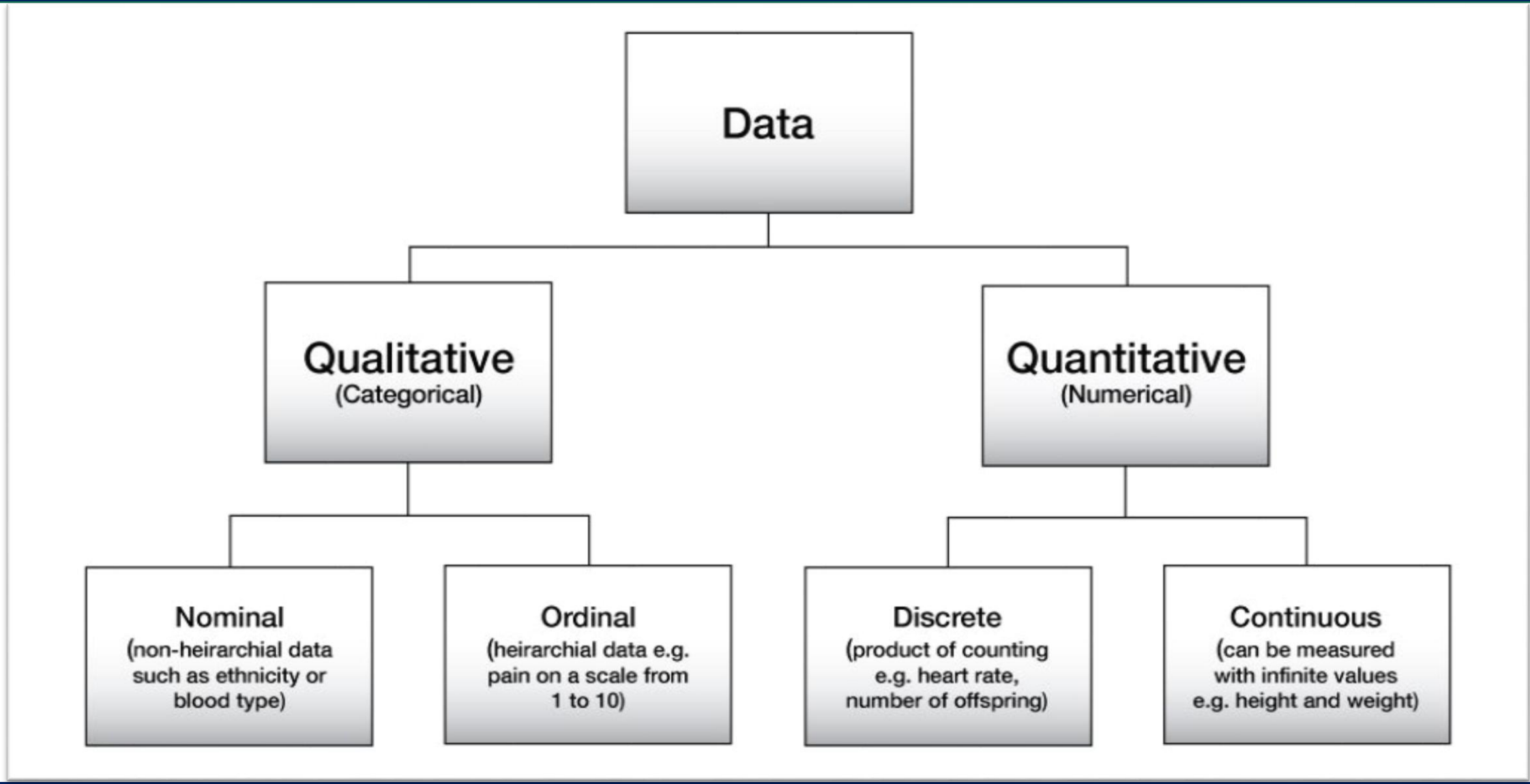
Examples:

- Temperatures recorded each day
  (e.g., 25°C, 30°C, 28°C)
- Sales numbers for a shop
  (e.g., 100 units sold, 200 units sold)
- The colors of cars in a parking lot
  (e.g., Red, Blue, White)

Types of Data

1. Qualitative (Categorical) Data
2. Quantitative (Numerical) Data
3. Time-Series Data

Data Types


Data
Qualitative
(Categorical)
Quantitative
(Numerical)
Nominal
(non-heirarchial data such as ethnicity or blood type)
Ordinal
(heirarchial data e.g. pain on a scale from 1 to 10)
Discrete
(product of counting e.g. heart rate, number of offspring)
Continuous
(can be measured with infinite values e.g. height and weight)

Qualitative Data

Qualitative data is non-numerical information that describes qualities, characteristics, or categories. It is usually expressed in words, labels, or descriptions rather than numbers.

Examples:

- Colors of flowers (red, yellow, pink)
- Customer feedback (happy, satisfied, disappointed)
- Nationalities (Pakistani, American, Chinese)
- Eye colors (brown, blue, green)

Quantitative Data

Quantitative data is numerical information that can be measured or counted. It deals with numbers, amounts, and quantities.

Examples:

- Age of people (20 years, 25 years)
- Height of students (150 cm, 160 cm)
- Number of books in a library (5,000 books)
- Marks obtained in a test (85 out of 100)

Qualitative vs Quantitative

Qualitative Data	Quantitative Data
•Deals with descriptions. •Data can be observed but not measured. •Colors, textures, smells, tastes, appearance, beauty, etc. •**Qualit**ative → **Quality**	Deals with numbers. • Data which can be measured. • Length, height, area, volume, weight, speed, time, temperature, humidity, sound levels, cost, members, ages, etc. • **Quantit**ative → **Quantity**

Qualitative vs Quantitative

Example

Oil Painting

Qualitative data:

- blue/green color, gold frame
- smells old and musty
- texture shows brush strokes of oil paint
- peaceful scene of the country
- masterful brush strokes

Example

Oil Painting

Quantitative data:

- picture is 10" by 14"
- with frame 14" by 18"
- weighs 8.5 pounds
- surface area of painting is 140 sq. in.
- cost $300

Qualitative Data

Nominal data:

Nominal data is used to label or name categories without any order or ranking. Categories are just different — no one is greater or smaller than the other.

Examples:

- Gender (male, female)
- Types of fruits (apple, banana, mango)

Qualitative Data

Ordinal data :

Ordinal data is used to label categories **with a meaningful order or ranking**, but the difference between ranks is not measured.

Examples:

- Education level (primary, secondary, university)
- Ranking in a race (1st, 2nd, 3rd)

Quantitative Data

Discrete data:

Discrete data is data that can only take certain specific values. It is countable and often involves whole numbers. You **can count** discrete data one by one.

Examples:

- Number of students in a class (20, 25)
- Number of cars in a parking lot (10, 15)
- Number of books on a shelf (50, 60)

Quantitative Data

Continuous data:

Continuous data is data that can take **any value** within a range. It is measurable and can include decimals and fractions.

Examples:

- Height of a person (e.g., 5.6 feet, 5.8 feet)
- Weight of an object (e.g., 65.5 kg, 70.2 kg)
- Temperature of a city (e.g., 23.4°C, 29.8°C)

Customer name	Item category	Size	Quantity	Cost
Sam	Shirt	S	2	50.21
Ram	Pant	M	1	23.5
Bob	Shirt	S	3	79.5
Anand		M	2	
Ravi	Pant	M	5	105.36
David	Shirt	L	2	71.49
Scott	Pant	M	1	42.86
Jess	Shirt	S	3	39.63
Matt	Pant	L	2	41.38
Brain	Pant	L	4	88.15

Nominal

Ordinal

Discrete

Continues

Time Series Data

- **Time series data** refers to data points that are collected or recorded at **regular intervals over time**. It typically shows trends, patterns, and behaviors over a period of time.
- Time series data helps in identifying trends, patterns, and forecasting future values.
- It's important to note that time is always the **independent variable** (on the x-axis), and the data values are the **dependent variable** (on the y-axis).

Time Series Data

Examples:
Stock prices are recorded at regular intervals, such as every minute, hour, day, or week.
1st Jan, 2023: $120
2nd Jan, 2023: $125
3rd Jan, 2023: $130
Sales data: Number of products sold each day. Example:
Monday: 150 units
Tuesday: 200 units
Website traffic: The number of visitors to a website each hour. Example:
9 AM: 500 visitors
10 AM: 600 visitors
11 AM: 550 visitors

THANKS