**📊 1. Univariate Analysis**

**✅ Definition:**

Analysis of **a single variable**.

**✅ Purpose:**

To understand the **distribution**, **central tendency**, and **spread** of one variable.

**✅ Common Tools:**

* **Mean, Median, Mode**
* **Standard Deviation**
* **Histogram**
* **Box Plot**
* **Bar Chart** (for categorical data)

**✅ Example:**

* Analyze **marks of students** in one subject.

| **Marks** |
| --- |
| 45 |
| 56 |
| 67 |

You only study how marks are spread — no comparison with other variables.

**📈 2. Bivariate Analysis**

**✅ Definition:**

Analysis of **two variables** to find relationships between them.

**✅ Purpose:**

To check **correlation**, **association**, or **influence**.

**✅ Common Tools:**

* **Scatter Plot**
* **Correlation Coefficient**
* **Cross Tabulation (for categorical data)**
* **Line Plot** (for time or trends)

**✅ Example:**

* Study relation between **study hours** and **exam marks**.

| **Hours** | **Marks** |
| --- | --- |
| 1 | 35 |
| 2 | 50 |
| 3 | 70 |

Used to find if **more hours** leads to **higher marks** (positive correlation).

**🔀 3. Multivariate Analysis**

**✅ Definition:**

Analysis of **three or more variables** at the same time.

**✅ Purpose:**

To understand **complex relationships**, **influences**, or **interactions** among variables.

**✅ Common Tools:**

* **Multiple Regression**
* **Multivariate ANOVA**
* **Principal Component Analysis (PCA)**
* **Bubble Chart**
* **3D Plot**

**✅ Example:**

* Predict **marks** based on:
  + Study hours
  + Sleep time
  + Attendance

| **Hours** | **Sleep** | **Attendance** | **Marks** |
| --- | --- | --- | --- |
| 2 | 6 | 90% | 50 |
| 3 | 7 | 95% | 70 |

Multivariate analysis can help build a **prediction model** using all factors.

**✅ Summary Table**

| **Feature** | **Univariate** | **Bivariate** | **Multivariate** |
| --- | --- | --- | --- |
| Variables Analyzed | 1 | 2 | 3 or more |
| Goal | Describe | Find relationship | Understand interaction |
| Graphs Used | Histogram, Boxplot | Scatter, Line Chart | Bubble Plot, 3D Plot |
| Techniques | Descriptive stats | Correlation, T-tests | Regression, PCA, ANOVA |