**1. One-way ANOVA (Single factor classification)**

**Definition:**

Tests whether there are significant differences between the means of **three or more groups** based on **one independent variable (factor)**.

**Example 1:**

**Problem:** if we want to test if three different fertilizers (A, B, C) have different effects on plant growth.

* **Independent variable (factor):** Fertilizer type (A, B, C)
* **Dependent variable:** Plant height

| **Fertilizer** | **Plant heights (cm)** |
| --- | --- |
| A | 20, 21, 19, 22 |
| B | 25, 27, 26, 28 |
| C | 15, 14, 16, 13 |

### ****Example 2. Effect of Teaching Method on Exam Scores****

| **Teaching Method** | **Student Scores** |
| --- | --- |
| Lecture | 75, 78, 72, 70, 77 |
| Group Discussion | 80, 85, 82, 84, 81 |
| Online Learning | 68, 70, 72, 65, 69 |

✅ **Factor:** Teaching Method (3 levels)  
✅ **Dependent Variable:** Student Scores

### ****Example 3. Effect of Different Diets on Weight Loss****

| **Diet Type** | **Weight Loss (kg)** |
| --- | --- |
| Keto | 4, 5, 6, 5, 4.5 |
| Vegan | 3, 2.5, 3.5, 3, 2.8 |
| Mediterranean | 2, 2.2, 2.5, 1.8, 2.0 |

✅ **Factor:** Diet Type (3 levels)  
✅ **Dependent Variable:** Weight Loss (kg)

### ****Key points across examples:****

✔ Only **one independent variable (classification factor)** in each example  
✔ **Three or more groups** compared  
✔ Dependent variable is **continuous (numerical)**

**2. Two-way ANOVA (Two factor classification)**

**Definition:**

Tests the effect of **two independent variables (factors)** on a dependent variable, including interaction effects.

**Example 1:**

**Problem:** You want to test if **fertilizer type (A, B)** and **watering frequency (daily, alternate days)** affect plant growth.

* **Independent variable 1:** Fertilizer type (A, B)
* **Independent variable 2:** Watering frequency (Daily, Alternate days)
* **Dependent variable:** Plant height

| **Fertilizer** | **Watering** | **Plant heights (cm)** |
| --- | --- | --- |
| A | Daily | 21, 22, 23 |
| A | Alt days | 18, 19, 17 |
| B | Daily | 25, 27, 26 |
| B | Alt days | 20, 22, 21 |

### ****Example 2. Effect of Teaching Method and Gender on Exam Scores****

| **Teaching Method** | **Gender** | **Exam Scores** |
| --- | --- | --- |
| Lecture | Male | 72, 75, 78 |
| Lecture | Female | 80, 82, 79 |
| Group Discussion | Male | 85, 88, 84 |
| Group Discussion | Female | 90, 92, 89 |

✅ **Factor 1:** Teaching Method (Lecture, Group Discussion)  
✅ **Factor 2:** Gender (Male, Female)  
✅ **Dependent Variable:** Exam Scores

### ****Example 3. Effect of Exercise Type and Time of Day on Calories Burned****

| **Exercise Type** | **Time of Day** | **Calories Burned** |
| --- | --- | --- |
| Running | Morning | 300, 320, 310 |
| Running | Evening | 280, 290, 275 |
| Cycling | Morning | 250, 260, 255 |
| Cycling | Evening | 240, 230, 235 |

✅ **Factor 1:** Exercise Type (Running, Cycling)  
✅ **Factor 2:** Time of Day (Morning, Evening)  
✅ **Dependent Variable:** Calories Burned

### ****Key points across examples:****

✔ Two **independent variables (classification factors)** in each example  
✔ Each combination of factors has **sample observations**  
✔ Dependent variable is **continuous (numerical)**