EXPERIMENT:13   Hypothetical using ANOVA-Test

Aim: To compare the growth rates of plants under three different fertilizer treatments

(Treatment A, B, and C) to determine if there is a significant difference in their mean growth.

Procedure:

1. Null Hypothesis (H_0): The mean growth rates of plants under all three fertilizer

treatments are equal.

2. Alternative Hypothesis (H_1): At least one pair of mean growth rates of plants under

different fertilizer treatments are not equal.

3. Samples:

o Measure the growth (in centimeters) of 25 plants under Treatment A.

o Measure the growth (in centimeters) of 25 plants under Treatment B.

o Measure the growth (in centimeters) of 25 plants under Treatment C.

4. ANOVA: Conduct a one-way ANOVA to compare the mean growth rates of plants

across the three fertilizer treatments.

5. Decision Rule: Use a significance level of $\alpha = 0.05$.

In [1]:

```python
import numpy as np
import scipy.stats as stats

np.random.seed(42)
n_plants = 25

growth_A = np.random.normal(loc=10, scale=2, size=n_plants)
growth_B = np.random.normal(loc=12, scale=3, size=n_plants)
growth_C = np.random.normal(loc=15, scale=2.5, size=n_plants)

all_data = np.concatenate([growth_A, growth_B, growth_C])
treatment_labels = ['A'] * n_plants + ['B'] * n_plants + ['C'] * n_plants

f_statistic, p_value = stats.f_oneway(growth_A, growth_B, growth_C)

print("Treatment A Mean Growth:", np.mean(growth_A))
print("Treatment B Mean Growth:", np.mean(growth_B))
print("Treatment C Mean Growth:", np.mean(growth_C))
print()
print(f"F-Statistic: {f_statistic:.4f}")
print(f"P-Value: {p_value:.4f}")

alpha = 0.05
```

```
if p_value < alpha:
    print("Reject the null hypothesis: There is a significant difference in
mean growth rates among the three treatments.")
else:
    print("Fail to reject the null hypothesis: There is no significant
difference in mean growth rates among the three treatments.")

if p_value < alpha:
    from statsmodels.stats.multicomp import pairwise_tukeyhsd
    tukey_results = pairwise_tukeyhsd(all_data, treatment_labels,
alpha=0.05)
    print("\nTukey's HSD Post-hoc Test:")
    print(tukey_results)
```

Treatment A Mean Growth: 9.672983882683818
Treatment B Mean Growth: 11.137680744437432
Treatment C Mean Growth: 15.265234904828972

F-Statistic: 36.1214
P-Value: 0.0000
Reject the null hypothesis: There is a significant difference in mean
growth rates among the three treatments.

```
Tukey's HSD Post-hoc Test:
Multiple Comparison of Means - Tukey HSD, FWER=0.05
==================================================
group1 group2 meandiff p-adj   lower  upper  reject
--------------------------------------------------
    A      B   1.4647 0.0877 -0.1683 3.0977  False
    A      C   5.5923    0.0  3.9593 7.2252   True
    B      C   4.1276    0.0  2.4946 5.7605   True
--------------------------------------------------
```

Result :

The mean growth of plants was highest in Treatment C, followed by B and A.

The ANOVA test gave a significant p-value (< 0.05), indicating differences among treatments.

Tukey's HSD test confirmed that each treatment group differed significantly in mean growth rate.