

Expt No: 14

Date: 13-10-25

## Hypothetical using ANOVA Test

Objective: 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:  $\Rightarrow$  Measure the growth (in cm) of 25 plants under Treatment A  
 $\Rightarrow$  Measure the growth (in cm) of 25 plants under Treatment B  
 $\Rightarrow$  Measure the growth (in cm) of 25 plants under Treatment C
4. ANOVA: Conduct a one-way ANOVA to compare mean growth rates of plants across the three fertilizer treatments.
5. Decision Rule: Use a significance level of  $\alpha = 0.05$ .

Program:

```
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}")
```

### Output:

Treatment A Mean Growth : 9.67298

Treatment B Mean Growth : 11.13768

Treatment C Mean Growth : 15.2652

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.

$\alpha = 0.05$

if  $p\text{-value} < \alpha$ :

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.")

~~significant~~

if  $p\text{-value} < \alpha$ :

from statsmodels.stats.multicomp import pairwise\_tukeyhsd.

tukey\_results = pairwise\_tukeyhsd(all\_data, treatment\_labels,  $\alpha = 0.05$ )

print("\n Tukey's HSD Post-hoc Test:")

print(tukey\_results)

Result:

The calculated F-Statistic is 36.1214 with a p-value of 0.0000. Since the p-value  $< 0.05$  we reject the null hypothesis. Hence, there is a significant difference.