

In [3]:

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import numpy as np
import scipy.stats as stats
from statsmodels.stats.multicomp import pairwise_tukeyhsd

# Set a random seed for reproducibility
np.random.seed(42)

# Generate hypothetical growth data for three treatments (A, B, C)
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)

# Perform one-way ANOVA
f_statistic, p_value = stats.f_oneway(growth_A, growth_B, growth_C)

# Print results
print(f"Treatment A Mean Growth: {np.mean(growth_A):.2f}")
print(f"Treatment B Mean Growth: {np.mean(growth_B):.2f}")
print(f"Treatment C Mean Growth: {np.mean(growth_C):.2f}\n")

print(f"F-Statistic: {f_statistic:.4f}")
print(f"P-Value: {p_value:.4f}")

# Decision rule
alpha = 0.05
if p_value < alpha:
    print("Reject H0: Significant difference among treatments.")

# Post-hoc test (Tukey's HSD)
all_data = np.concatenate([growth_A, growth_B, growth_C])
labels = ['A'] * n_plants + ['B'] * n_plants + ['C'] * n_plants
tukey_results = pairwise_tukeyhsd(all_data, labels, alpha=0.05)
print("\nTukey's HSD Results:")
print(tukey_results)
else:
    print("Fail to reject H0: No significant difference among treatments.")
```

Treatment A Mean Growth: 9.67
Treatment B Mean Growth: 11.14
Treatment C Mean Growth: 15.27

F-Statistic: 36.1214
P-Value: 0.0000
Reject H₀: Significant difference among treatments.

Tukey's HSD Results:
Multiple Comparison of Means - Tukey HSD, FWER=0.05
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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

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