

Exercise-14

November 2, 2025

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[1]: import numpy as np
import scipy.stats as stats
```

```
[2]: 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)
```

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

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[4]: f_statistic, p_value = stats.f_oneway(growth_A, growth_B, growth_C)
```

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[5]: 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}")
```

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

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[8]: 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)
```

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
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```

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[ ]:
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