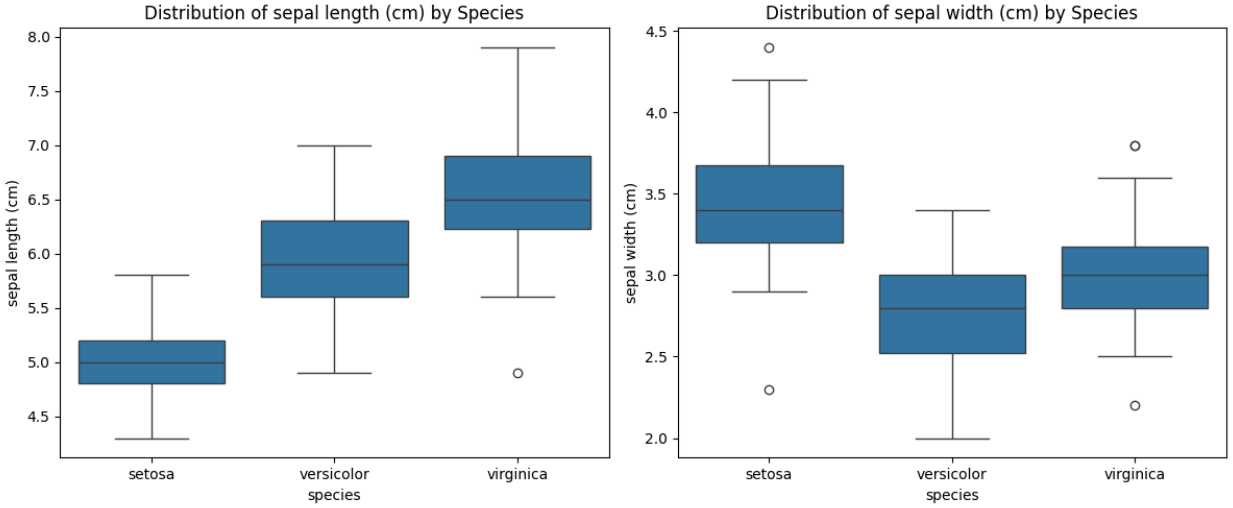
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats
from sklearn.datasets import load_iris

iris = load_iris()
df = pd.DataFrame(data=iris.data, columns=iris.feature_names)
df['species'] = pd.Categorical.from_codes(iris.target,
iris.target_names)

print("CORRELATION MATRIX ANALYSIS")
print("--------------------------")

correlation_matrix = df.iloc[:, 0:4].corr()
print("Correlation Matrix:")
print(correlation_matrix)
print("\n")

print("COVARIANCE ANALYSIS")
print("------------------")

covariance_matrix = df.iloc[:, 0:4].cov()
print("Covariance Matrix:")
print(covariance_matrix)
print("\n")

print("ANOVA ANALYSIS")
print("-------------")
features = iris.feature_names
print("One-way ANOVA results for each feature across different
species:")
for feature in features:
groups = [df[df['species'] == species][feature] for species in
iris.target_names]
f_val, p_val = stats.f_oneway(*groups)

print(f"\nFeature: {feature}")
print(f"F-value: {f_val:.4f}")
print(f"p-value: {p_val:.8f}")

if p_val < 0.05:
print("Result: There are significant differences between species for
this feature")
else:
print("Result: No significant differences between species for this
feature")
```

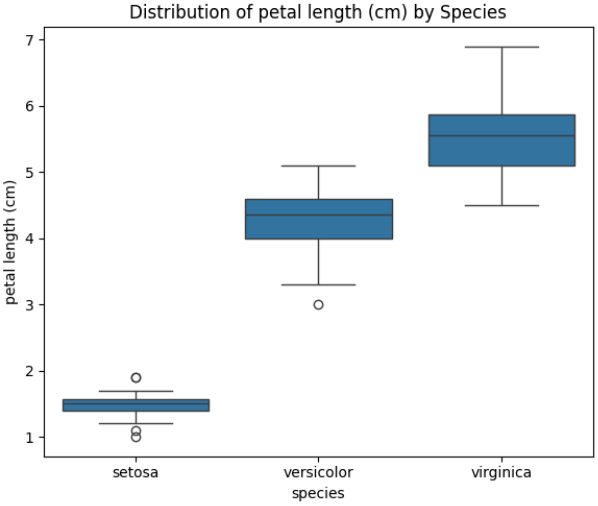
```
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', vmin=-1,
vmax=1)
plt.title('Correlation Matrix Heatmap of Iris Features')
plt.tight_layout()
plt.savefig('correlation_heatmap.png')

plt.figure(figsize=(10, 8))
sns.heatmap(covariance_matrix, annot=True, cmap='viridis')
plt.title('Covariance Matrix Heatmap of Iris Features')
plt.tight_layout()
plt.savefig('covariance_heatmap.png')

plt.figure(figsize=(12, 10))
for i, feature in enumerate(features):
plt.subplot(2, 2, i+1)
sns.boxplot(x='species', y=feature, data=df)
plt.title(f'Distribution of {feature} by Species')
plt.tight_layout()
plt.savefig('anova_boxplots.png')

plt.figure(figsize=(12, 10))
sns.pairplot(df, hue='species')
plt.tight_layout()
plt.savefig('feature_relationships.png')

print("\nAnalysis complete. All visualizations have been saved.")
```

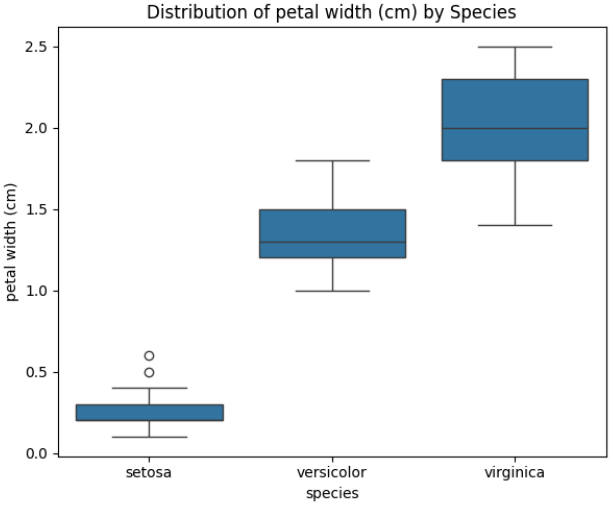
```
ishadpande@Argos:~/Documents/dev/practicals/PS$ /usr/bin/python /home/ishadpande/Documents/dev/practicals/PS/4.py
CORRELATION MATRIX ANALYSIS
-------------------------
Correlation Matrix:
                   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)
sepal length (cm)           1.000000         -0.117570           0.871754          0.817941
sepal width (cm)           -0.117570          1.000000          -0.428440         -0.366126
petal length (cm)           0.871754         -0.428440           1.000000          0.962865
petal width (cm)            0.817941         -0.366126           0.962865          1.000000


COVARIANCE ANALYSIS
-----------------
Covariance Matrix:
                   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)
sepal length (cm)           0.685694         -0.042434           1.274315          0.516271
sepal width (cm)           -0.042434          0.189979          -0.329656         -0.121639
petal length (cm)           1.274315         -0.329656           3.116278          1.295609
petal width (cm)            0.516271         -0.121639           1.295609          0.581006
```

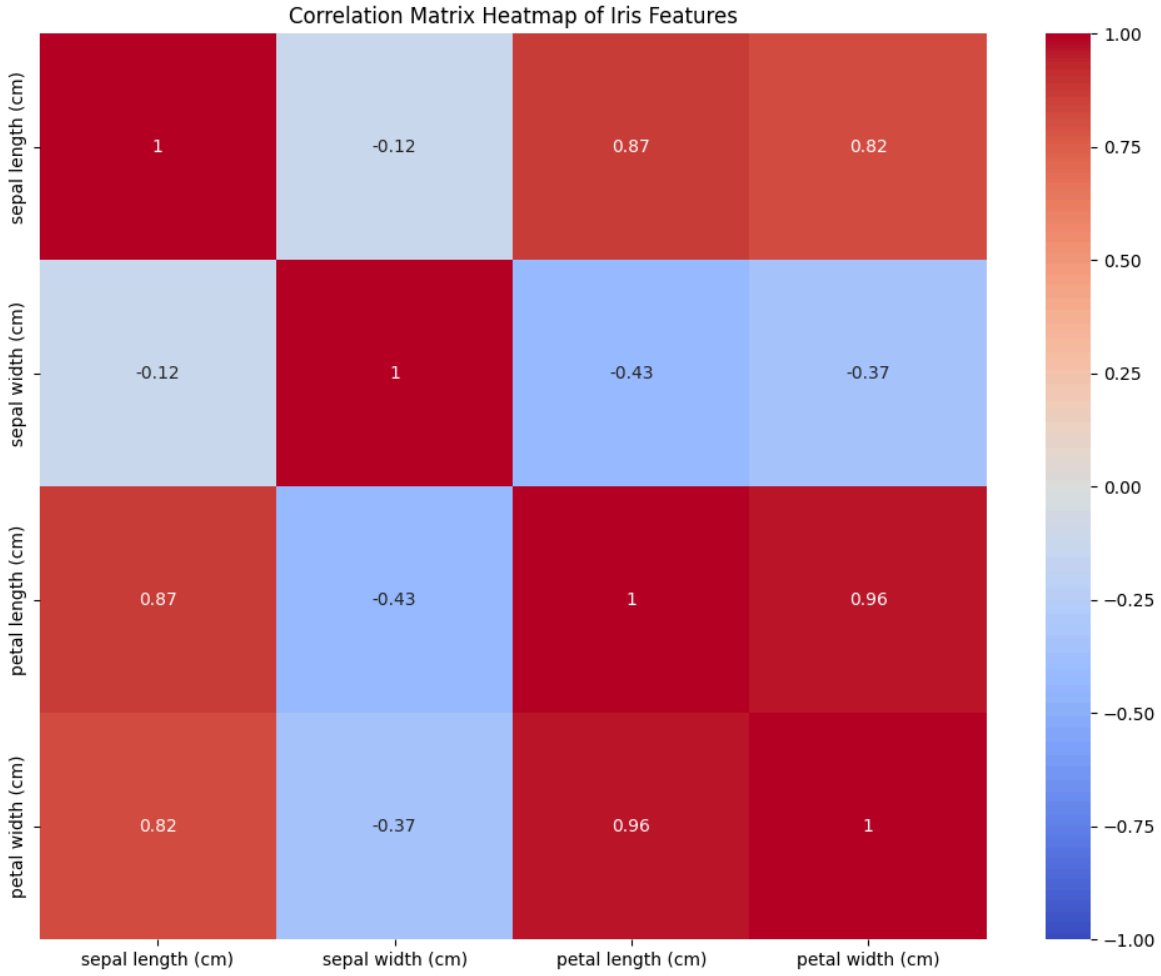
```
ANOVA ANALYSIS
-------------
One-way ANOVA results for each feature across different species:

Feature: sepal length (cm)
F-value: 119.2645
p-value: 0.00000000
Result: There are significant differences between species for this feature

Feature: sepal width (cm)
F-value: 49.1600
p-value: 0.00000000
Result: There are significant differences between species for this feature

Feature: petal length (cm)
F-value: 1180.1612
p-value: 0.00000000
Result: There are significant differences between species for this feature

Feature: petal width (cm)
F-value: 960.0071
p-value: 0.00000000
Result: There are significant differences between species for this feature

Analysis complete. All visualizations have been saved.
```

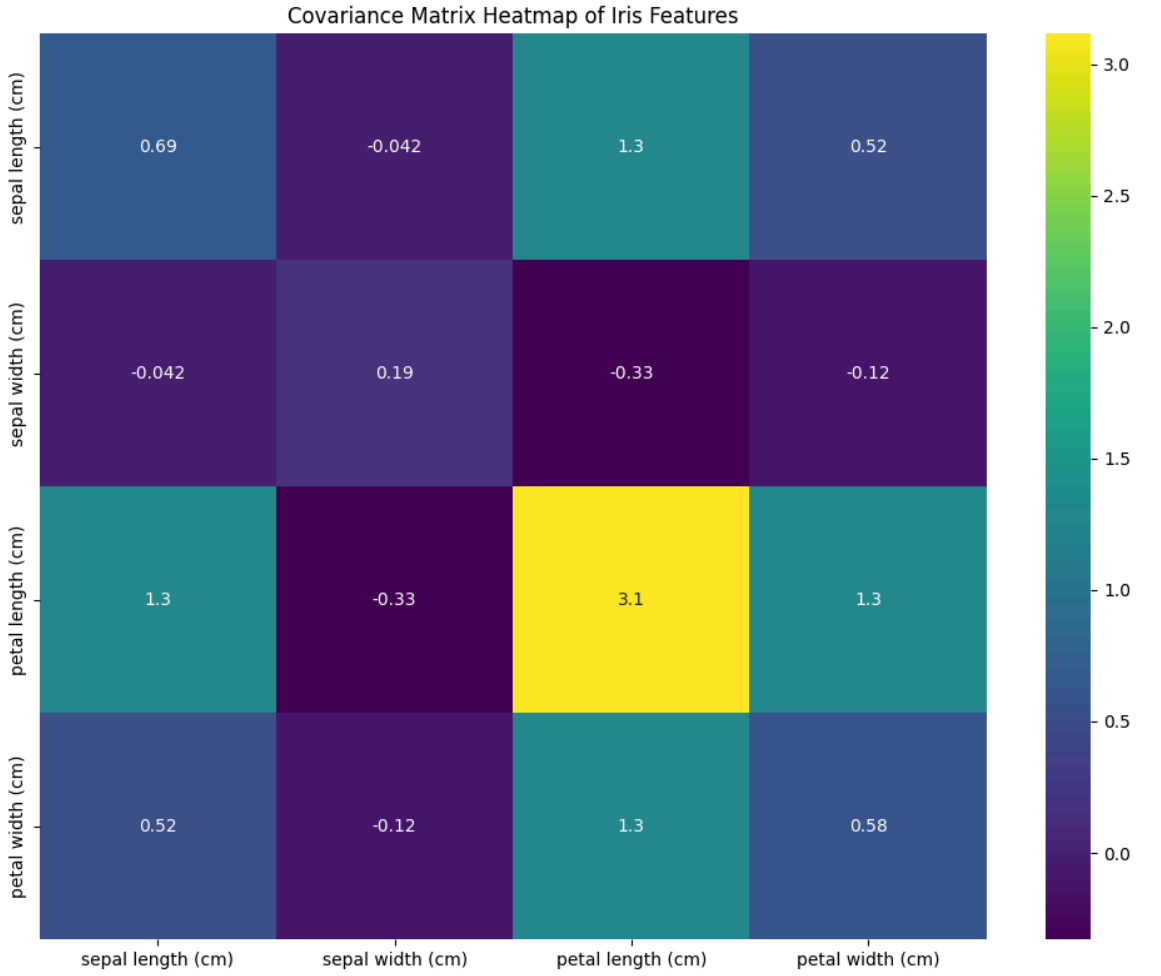

Distribution of sepal length (cm) by Species
sepal length (cm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
setosa
versicolor
virginica
species

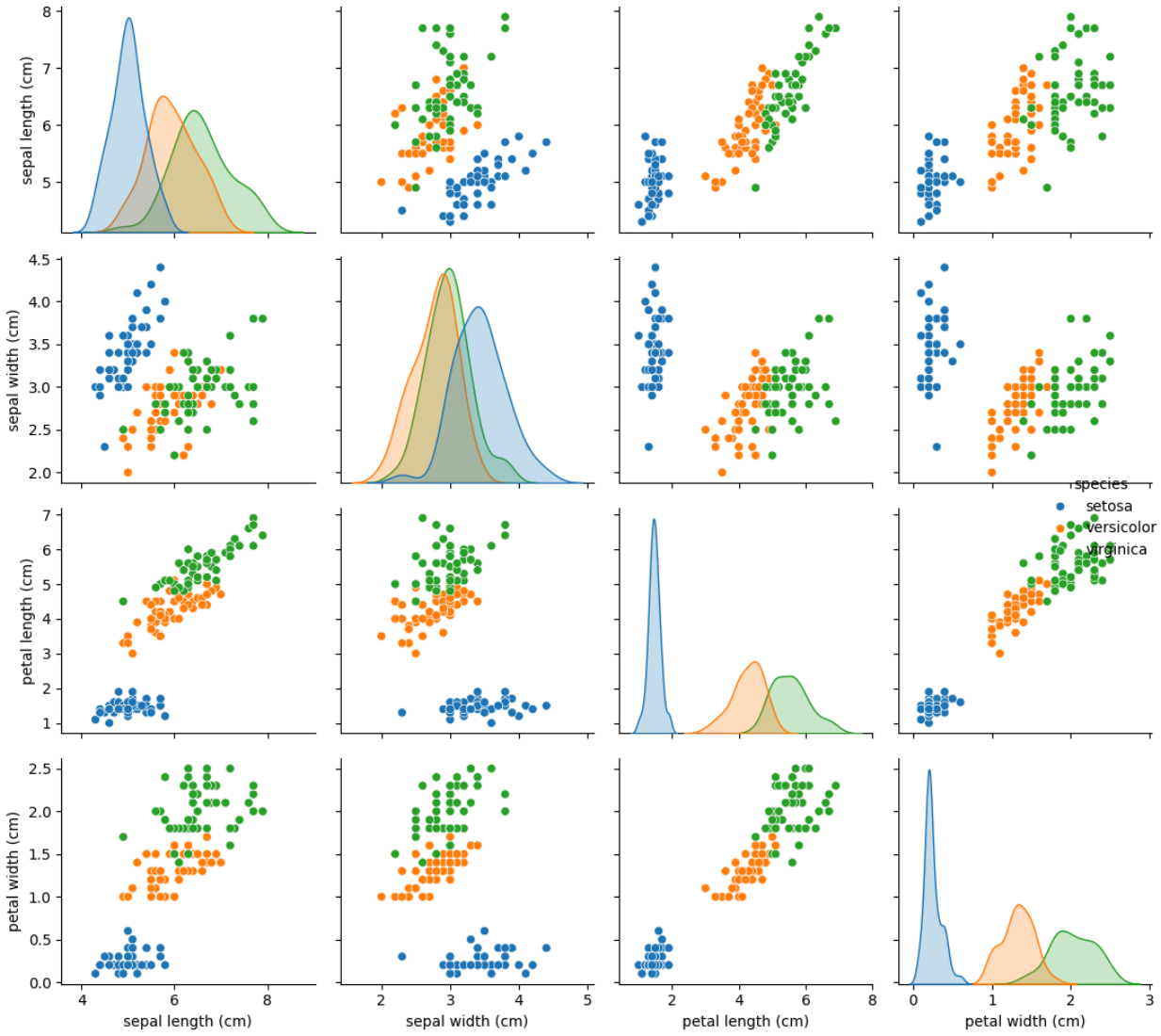
Distribution of sepal width (cm) by Species
sepal width (cm)
4.5
4.0
3.5
3.0
2.5
2.0
setosa
versicolor
virginica
species


Distribution of petal length (cm) by Species
petal length (cm)
7
6
5
4
3
2
1
setosa
versicolor
virginica
species


Distribution of petal width (cm) by Species
petal width (cm)
2.5
2.0
1.5
1.0
0.5
0.0
setosa
versicolor
virginica
species


Correlation Matrix Heatmap of Iris Features
sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)
1
-0.12
0.87
0.82
-0.12
1
-0.43
-0.37
0.87
-0.43
1
0.96
0.82
-0.37
0.96
1
sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00


Covariance Matrix Heatmap of Iris Features
sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)
0.69
-0.042
1.3
0.52
-0.042
0.19
-0.33
-0.12
1.3
-0.33
3.1
1.3
0.52
-0.12
1.3
0.58
sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0


sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)
species
setosa
versicolor
virginica