Covariation exercise

Complete the following exercises on covariance structure using Numpy based tools

You will also want Matplotlib and Seaborn

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
# here is an import of the classic iris data se

#it load as a pd DataFrame,  we will extract th

iris = sns.load_dataset('iris')
iris.head()
```

Out[2]:

	sepal_length	sepal_width	petal_length	petal_width	s
0	5.1	3.5	1.4	0.2	
1	4.9	3.0	1.4	0.2	
2	4.7	3.2	1.3	0.2	
3	4.6	3.1	1.5	0.2	
4	5.0	3.6	1.4	0.2	

In [5]:

```
# iris 0-3 are the measurements,  species is i
# extract the predictors

iris_np=iris.iloc[:,0:4].to_numpy()

#check the shape of the resulting np matrix

iris_np.shape
```

Out[5]:

```
(150, 4)
```

Question 1

Find the variance matrix for iris_np, also find the correlation matrix

In [6]:

```
iris_np.var()
```

Out[6]:

```
3.896056416666667
```

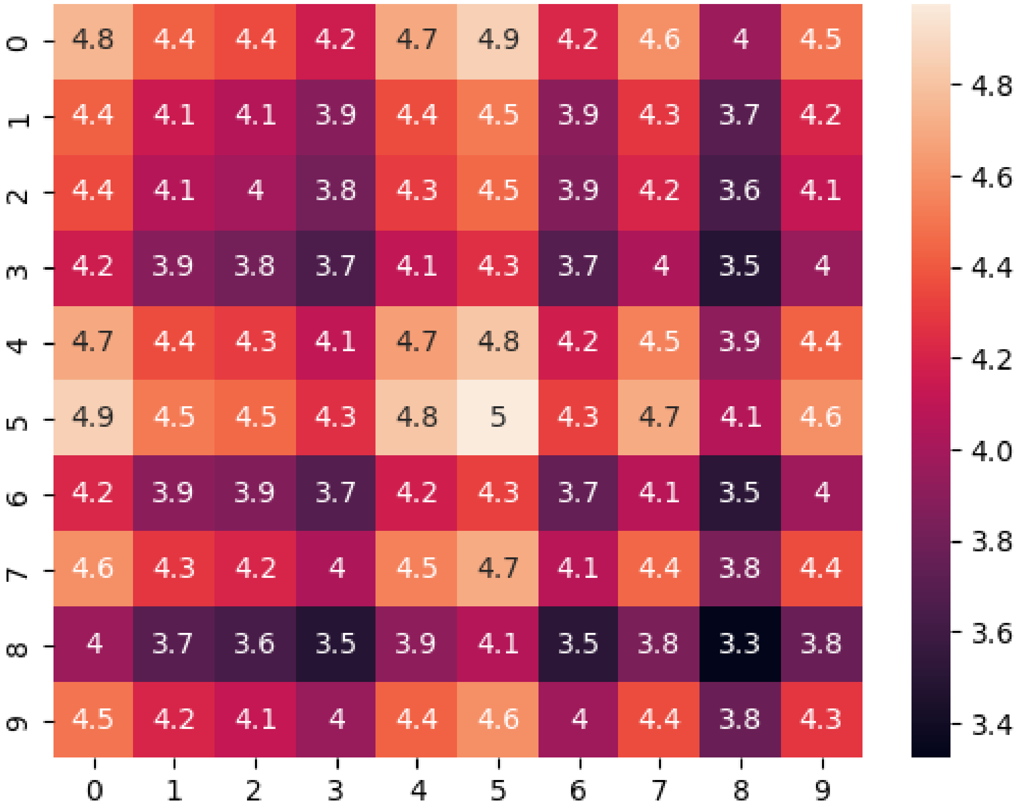
Question 2 produce heat maps of the iris_np variance and correlation matrices

In [20]:

```
reduced= iris_np[0:10,0:10]
```

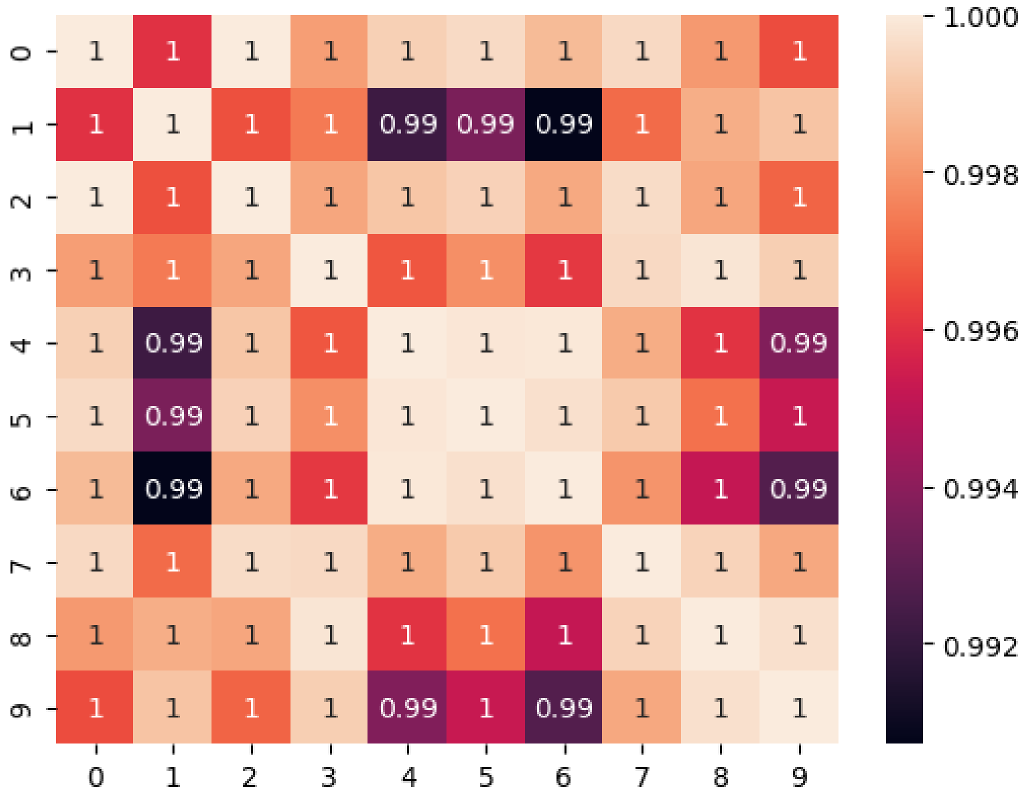
In [21]:
```
sns.heatmap(np.cov(reduced),annot=True)
```

Out[21]:
```
<Axes: >
```



In [22]:
```
sns.heatmap(np.corrcoef(reduced),annot=True)
```

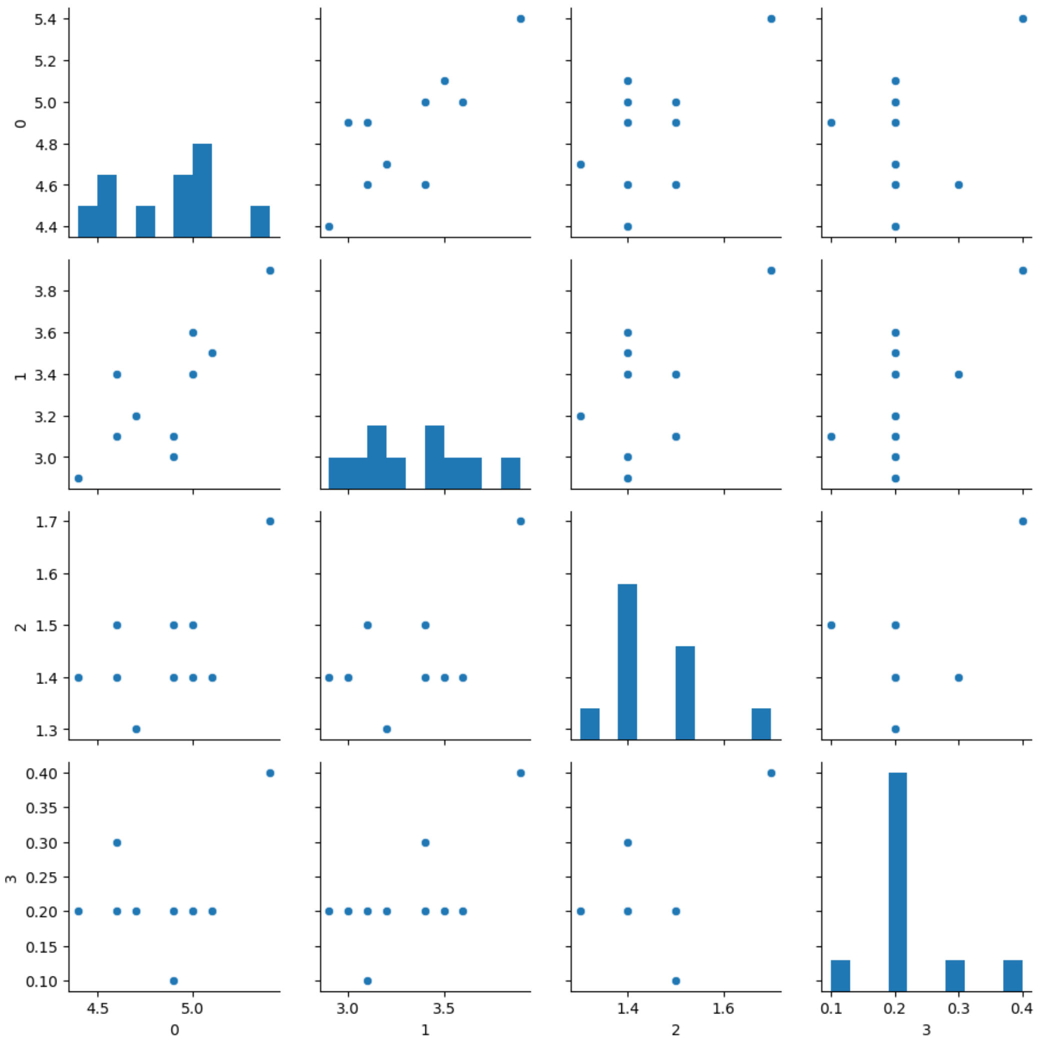
Out[22]:
```
<Axes: >
```



Question 3 show the "Scatter plot matrix" for the iris_np data using the sns pairgrid function, inserting histograms along the diagonals

In [24]:
```
g = sns.PairGrid(pd.DataFrame(reduced))
g = g.map_diag(plt.hist)
#g.map_diag(sns.histplot)
g.map_offdiag(sns.scatterplot)
```

Out[24]:
```
<seaborn.axisgrid.PairGrid at 0x2024e22da90>
```



Question 4 Run the eigen analysis

How many distinct variables appear to be present

In [32]:
```
w,v=np.linalg.eigh(np.corrcoef(iris_np))
print(len(np.unique(w)), "distinct variables ap
```

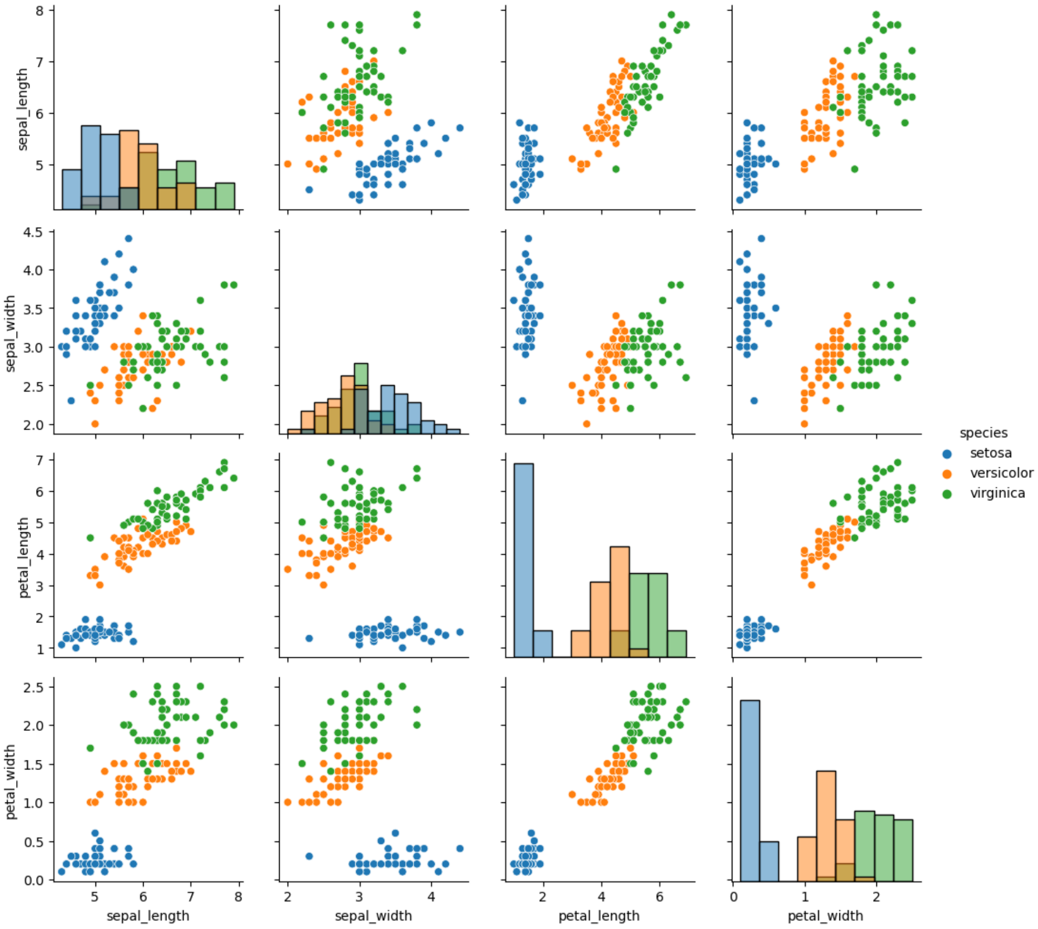
```
150 distinct variables appear to be present
```

In [33]:
```
# this code,  using the pandas data frame adds

# explain what this tells you about the potent

g = sns.PairGrid(iris, hue="species")
g.map_diag(sns.histplot)
g.map_offdiag(sns.scatterplot)
g.add_legend()
```

Out[33]:
```
<seaborn.axisgrid.PairGrid at 0x2024f097190>
```



Answer:

- Difference petal length and width and sepal width Setosa and compared to versicolor and virginica

Question 4- Explain what the color code pairgrid above tells you about how likely it is you could create a classifier based on these measurements

Answer:

- the color code pairgrid compares the species based on a possible relationship between changes observed in two different sets of variables

Question 5 - carry out a standard scaling of the data in the 0 column in iris_np

Verify that mean and variance have the expected values

In [39]:

```
print(iris_np.mean(), iris_np.var())

#standard scaling
xc = iris_np-iris_np.mean()
xs=xc/np.var(xc)**0.5
print(xs.mean(), xs.var())
```

```
3.4644999999999997 3.896056416666667
9.473903143468003e-17 1.0
```

Answer:

- we can see that the variance is equal to 1, and the mean is close to 0

Question 6- carry out a normalization of the 1 position column in iris-np

find the range of the normalized data, it's mean and variance

```
In [43]: xn=iris_np/(iris_np.max()-iris_np.min())
         xn.min(), xn.max(), xn.max()-xn.min()
         # Notice that the min and the max are close to
```

```
Out[43]: (0.01282051282051282, 1.0128205128205128, 1.
         0)
```