In [16]:
```
# import required libraries
import pandas as pd
import numpy as np
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt
```

In [17]:
```
# load the dataset
url = 'https://archive.ics.uci.edu/ml/machine-learning-databases/wine/wine.dat
names = ['class', 'alcohol', 'malic_acid', 'ash', 'alcalinity_of_ash',
         'magnesium', 'total_phenols', 'flavanoids', 'nonflavanoid_phenols',
         'proanthocyanins', 'color_intensity', 'hue', 'od280/od315_of_diluted_
dataset = pd.read_csv(url, names=names)
```

In [25]:
```
dataset
```

Out[25]:

	class	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nc
0	1	14.23	1.71	2.43	15.6	127	2.80	3.06	
1	1	13.20	1.78	2.14	11.2	100	2.65	2.76	
2	1	13.16	2.36	2.67	18.6	101	2.80	3.24	
3	1	14.37	1.95	2.50	16.8	113	3.85	3.49	
4	1	13.24	2.59	2.87	21.0	118	2.80	2.69	
...	...	...	...	...	...	...	...	...	
173	3	13.71	5.65	2.45	20.5	95	1.68	0.61	
174	3	13.40	3.91	2.48	23.0	102	1.80	0.75	
175	3	13.27	4.28	2.26	20.0	120	1.59	0.69	
176	3	13.17	2.59	2.37	20.0	120	1.65	0.68	
177	3	14.13	4.10	2.74	24.5	96	2.05	0.76	

178 rows × 14 columns

In [26]:
```
eigenvalues = pca.explained_variance_
print("Eigenvalues of the retained principal components:\n", eigenvalues)
```

```
Eigenvalues of the retained principal components:
 [4.73243698 2.51108093 1.45424187 0.92416587 0.85804868 0.64528221
 0.55414147 0.35046627]
```

In [27]:
```
sum(eigenvalues)
```

Out[27]:
```
12.029864272097052
```

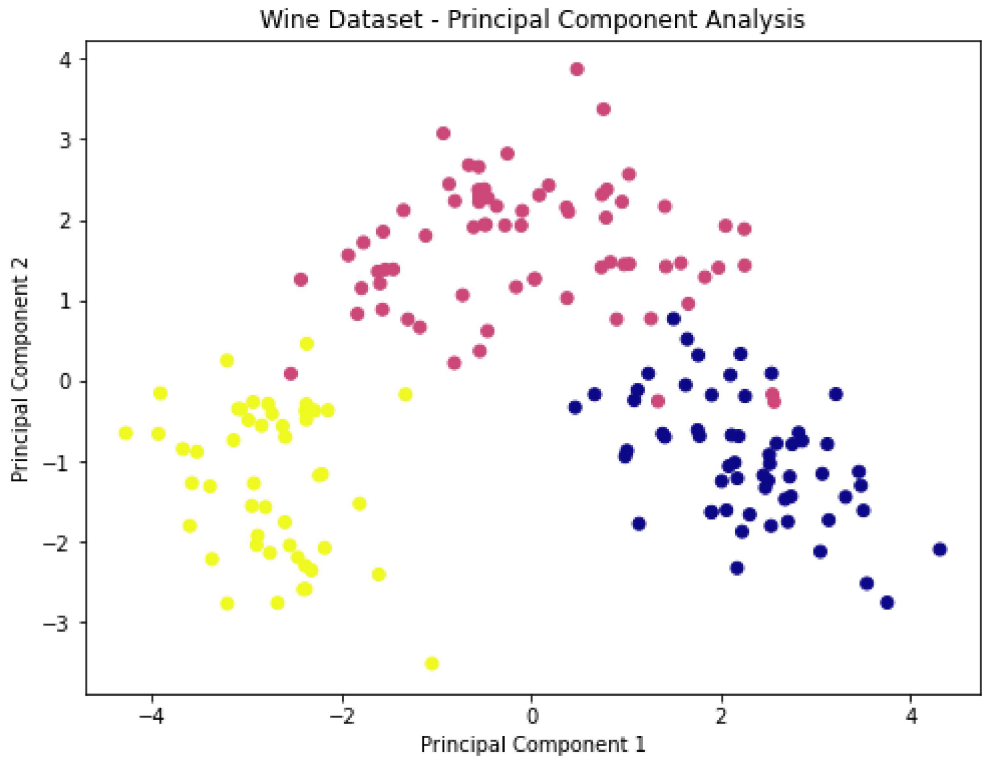
In [28]:
```
(eigenvalues[0]+eigenvalues[1]+eigenvalues[2]+eigenvalues[3]+eigenvalues[4])/s
```

Out[28]:
```
0.8711631387849638
```

In [29]:
```
# apply PCA
pca = PCA(n_components=4)
principalComponents = pca.fit_transform(x)
principalDf = pd.DataFrame(data = principalComponents, columns = ['PC1', 'PC2'

# combine the transformed data with class labels
finalDf = pd.concat([principalDf, dataset[['class']]], axis=1)

# print the transformed dataset
print("Transformed dataset with 4 principal components:\n", finalDf.head())
```

```
Transformed dataset with 4 principal components:
         PC1       PC2       PC3       PC4  class
0  3.316751 -1.443463 -0.165739 -0.215631      1
1  2.209465  0.333393 -2.026457 -0.291358      1
2  2.516740 -1.031151  0.982819  0.724902      1
3  3.757066 -2.756372 -0.176192  0.567983      1
4  1.008908 -0.869831  2.026688 -0.409766      1
```

In [30]:
```

# plot the principal components
plt.figure(figsize=(8,6))
plt.scatter(principalDf['PC1'], principalDf['PC2'], c=dataset['class'], cmap='
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.title('Wine Dataset - Principal Component Analysis')
plt.show()
```



In [ ]: