```
import pandas as pd
import numpy as np
```

```
data= pd.read_csv("https://archive.ics.uci.edu/ml/machine-learning-databases/wine-quality/winequality-red.csv", delimiter=";")
data.head()
```

| | fixed acidity | volatile acidity | citric acid | residual sugar | chlorides | free sulfur dioxide | total sulfur dioxide | density | pH | sulph |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 7.4 | 0.70 | 0.00 | 1.9 | 0.076 | 11.0 | 34.0 | 0.9978 | 3.51 | |
| **1** | 7.8 | 0.88 | 0.00 | 2.6 | 0.098 | 25.0 | 67.0 | 0.9968 | 3.20 | |
| **2** | 7.8 | 0.76 | 0.04 | 2.3 | 0.092 | 15.0 | 54.0 | 0.9970 | 3.26 | |
| **3** | 11.2 | 0.28 | 0.56 | 1.9 | 0.075 | 17.0 | 60.0 | 0.9980 | 3.16 | |

```
print(data['quality'].unique())
```

```
[5 6 7 4 8 3]
```

```
X = data.drop('quality', axis=1)
y = data['quality']
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y,test_size=0.2,random_state=42)
```

```
from sklearn.neural_network import MLPClassifier
mlp = MLPClassifier(max_iter=500, activation='relu')
mlp.fit(X_train,y_train)
pred = mlp.predict(X_test)
```

```
from sklearn.metrics import classification_report
print(classification_report(y_test,pred))
```

```
              precision    recall  f1-score   support

           3       0.00      0.00      0.00         1
           4       0.00      0.00      0.00        10
           5       0.57      0.75      0.65       130
           6       0.52      0.51      0.51       132
           7       0.40      0.19      0.26        42
           8       0.00      0.00      0.00         5

    accuracy                           0.54       320
   macro avg       0.25      0.24      0.24       320
weighted avg       0.50      0.54      0.51       320

/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c
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/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c
  _warn_prf(average, modifier, msg_start, len(result))
```
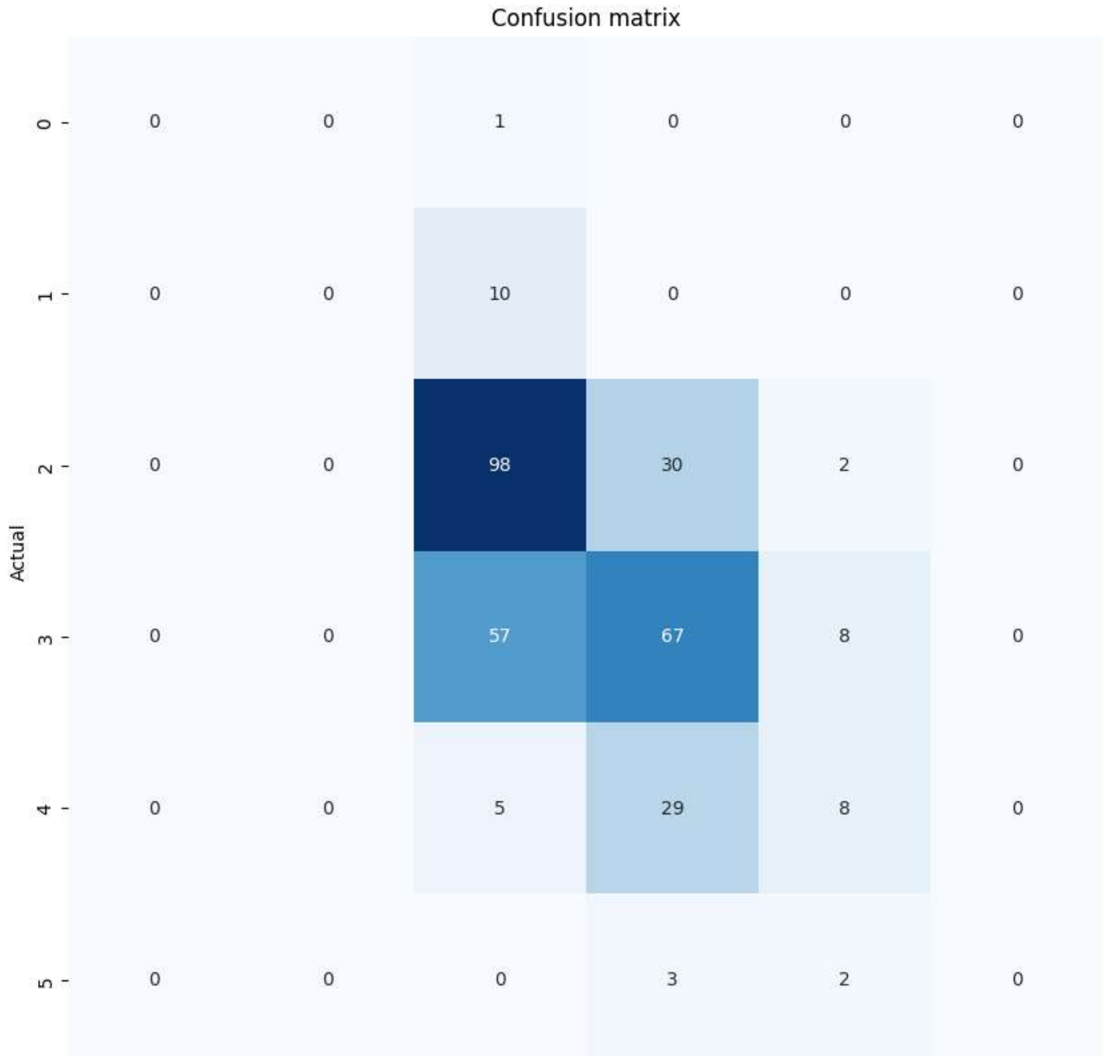
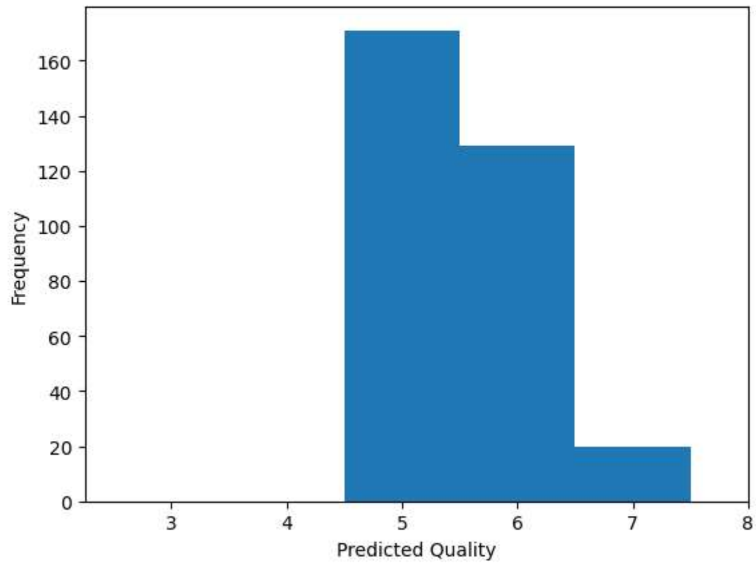

```
import matplotlib.pyplot as plt
from sklearn.metrics import confusion_matrix
import seaborn as sns
# Plot confusion matrix
cm = confusion_matrix(y_test, pred)
fig, ax = plt.subplots(figsize=(10,10))
sns.heatmap(cm, annot=True, fmt='d', cmap=plt.cm.Blues, cbar=False)
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.title('Confusion matrix')
plt.show()
```



```
# Plot histogram of predicted quality values for MLP classifier
pred = mlp.predict(X_test)
plt.hist(pred, bins=range(3, 9), align='left')
plt.xticks(range(3, 9))
plt.xlabel("Predicted Quality")
plt.ylabel("Frequency")
plt.show()
```


Frequency
Predicted Quality