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```
# Import necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, r2_score,
accuracy_score, classification_report, confusion_matrix
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import RandomForestRegressor
from sklearn import ensemble

# Load the dataset
url = '/content/winequality-red.csv'
data = pd.read_csv(url)
```

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```
# Data Preprocessing
# Check for missing values
print(data.isnull().sum())
```

```
fixed acidity           0
volatile acidity        0
citric acid             0
residual sugar          0
chlorides               0
free sulfur dioxide     0
total sulfur dioxide    0
density                 0
pH                      0
sulphates               0
alcohol                 0
quality                 0
dtype: int64
```

```
# Data exploration and visualization
# Example: Histogram of wine quality
plt.figure(figsize=(8, 5))
sns.histplot(data['quality'], bins=6)
plt.xlabel('Wine Quality')
plt.ylabel('Frequency')
plt.title('Distribution of Wine Quality')
plt.show()
```

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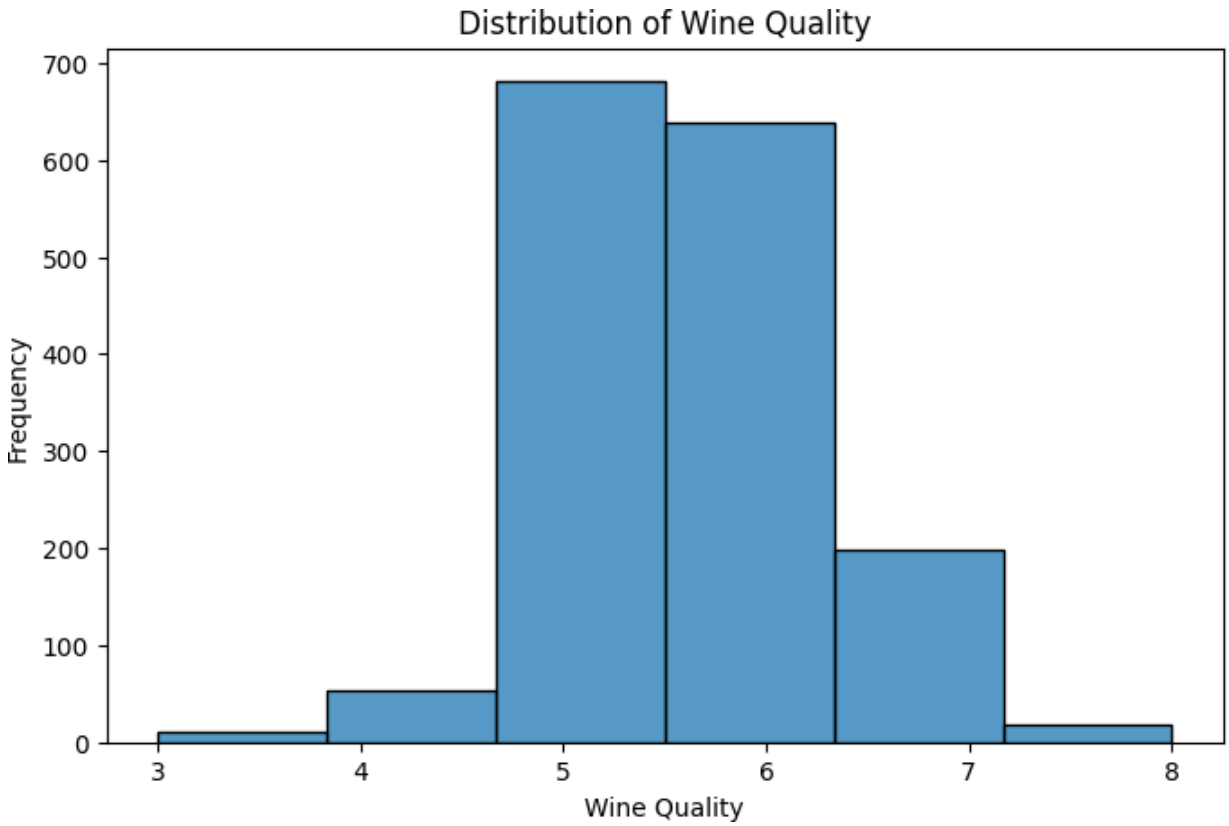


```
# Feature selection (if needed)
# Example: Selecting all features except 'quality' for regression
X = data.drop('quality', axis=1)
y = data['quality']

# Data splitting
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Data scaling (if needed)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Machine Learning Model Building
model = RandomForestRegressor(n_estimators=100, random_state=42)  #
Example: Random Forest Regressor
model.fit(X_train, y_train)

RandomForestRegressor(random_state=42)

# Model Evaluation (Regression)
y_pred = model.predict(X_test)
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)
```

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```
print(f'Mean Squared Error: {mse}')
print(f'R-squared: {r2}')
```

```
Mean Squared Error: 0.3006603124999999
R-squared: 0.5399271357910311
```

```
# Model Evaluation (Classification, if applicable)
# Example: Convert wine quality to classes (e.g., low, medium, high)
y_train_class = pd.cut(y_train, bins=[0, 4, 7, 10], labels=['low',
'medium', 'high'])
y_test_class = pd.cut(y_test, bins=[0, 4, 7, 10], labels=['low',
'medium', 'high'])

from sklearn.ensemble import RandomForestClassifier # Import the
RandomForestClassifier
from sklearn.metrics import accuracy_score, confusion_matrix,
classification_report

model_classification = RandomForestClassifier(n_estimators=100,
random_state=42)
model_classification.fit(X_train, y_train_class)
y_pred_class = model_classification.predict(X_test)

accuracy = accuracy_score(y_test_class, y_pred_class)
conf_matrix = confusion_matrix(y_test_class, y_pred_class)
class_report = classification_report(y_test_class, y_pred_class,
target_names=['low', 'medium', 'high'])

print(f'Accuracy:  {accuracy}')
print('Confusion Matrix:\n', conf_matrix)
print('Classification Report:\n', class_report)
```

```
Accuracy: 0.95
Confusion Matrix:
 [[  0   0   5]
 [  0   1  10]
 [  0   1 303]]
Classification Report:
               precision    recall  f1-score   support

          low       0.00      0.00      0.00         5
       medium       0.50      0.09      0.15        11
         high       0.95      1.00      0.97       304

     accuracy                           0.95       320
    macro avg       0.48      0.36      0.38       320
weighted avg       0.92      0.95      0.93       320
```

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```
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/
_classification.py:1344: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
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`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
# Cross-validation (optional)
cv_scores = cross_val_score(model, X, y, cv=5)
print(f'Cross-validation scores: {cv_scores}')
```

```
Cross-validation scores: [0.25905968 0.340902   0.36511431 0.315745
0.26449954]
```

```
# Test with random observation
# Example: Create a new observation and predict its quality
new_observation = np.array([7.0, 0.2, 0.28, 1.8, 0.045, 40, 170, 0.99,
3.0, 0.47, 9.2])
new_observation = scaler.transform(new_observation.reshape(1, -1))
predicted_quality = model.predict(new_observation)
print(f'Predicted Wine Quality: {predicted_quality[0]}')
```

```
Predicted Wine Quality: 4.97
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439:
UserWarning: X does not have valid feature names, but StandardScaler
was fitted with feature names
  warnings.warn(
```