In [73]:
```
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.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, classification_report, confusion
import plotly.express as px
```

In [74]:
```
df = pd.read_csv("apple_quality.csv")
#Display first 5 Header details
df.head()
```

Out[74]:

	A_id	Size	Weight	Sweetness	Crunchiness	Juiciness	Ripeness	Acidity	Q
0	0.0	-3.970049	-2.512336	5.346330	-1.012009	1.844900	0.329840	-0.491590483	
1	1.0	-1.195217	-2.839257	3.664059	1.588232	0.853286	0.867530	-0.722809367	
2	2.0	-0.292024	-1.351282	-1.738429	-0.342616	2.838636	-0.038033	2.621636473	
3	3.0	-0.657196	-2.271627	1.324874	-0.097875	3.637970	-3.413761	0.790723217	
4	4.0	1.364217	-1.296612	-0.384658	-0.553006	3.030874	-1.303849	0.501984036	

In [6]:
```
#checking null values
df.isna().sum()
```

Out[6]:
```
A_id           1
Size           1
Weight         1
Sweetness      1
Crunchiness    1
Juiciness      1
Ripeness       1
Acidity        0
Quality        1
dtype: int64
```

In [7]:
```
df[df['A_id'].isna()==True]
```

Out[7]:

	A_id	Size	Weight	Sweetness	Crunchiness	Juiciness	Ripeness	
4000	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Created_by_Nidula_El

In [8]:
```
#dropping one null values from dataset
df = df.dropna()
```

In [9]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4000 entries, 0 to 3999
Data columns (total 9 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   A_id         4000 non-null   float64
 1   Size         4000 non-null   float64
 2   Weight       4000 non-null   float64
 3   Sweetness    4000 non-null   float64
 4   Crunchiness  4000 non-null   float64
 5   Juiciness    4000 non-null   float64
 6   Ripeness     4000 non-null   float64
 7   Acidity      4000 non-null   object 
 8   Quality      4000 non-null   object 
dtypes: float64(7), object(2)
memory usage: 312.5+ KB
```

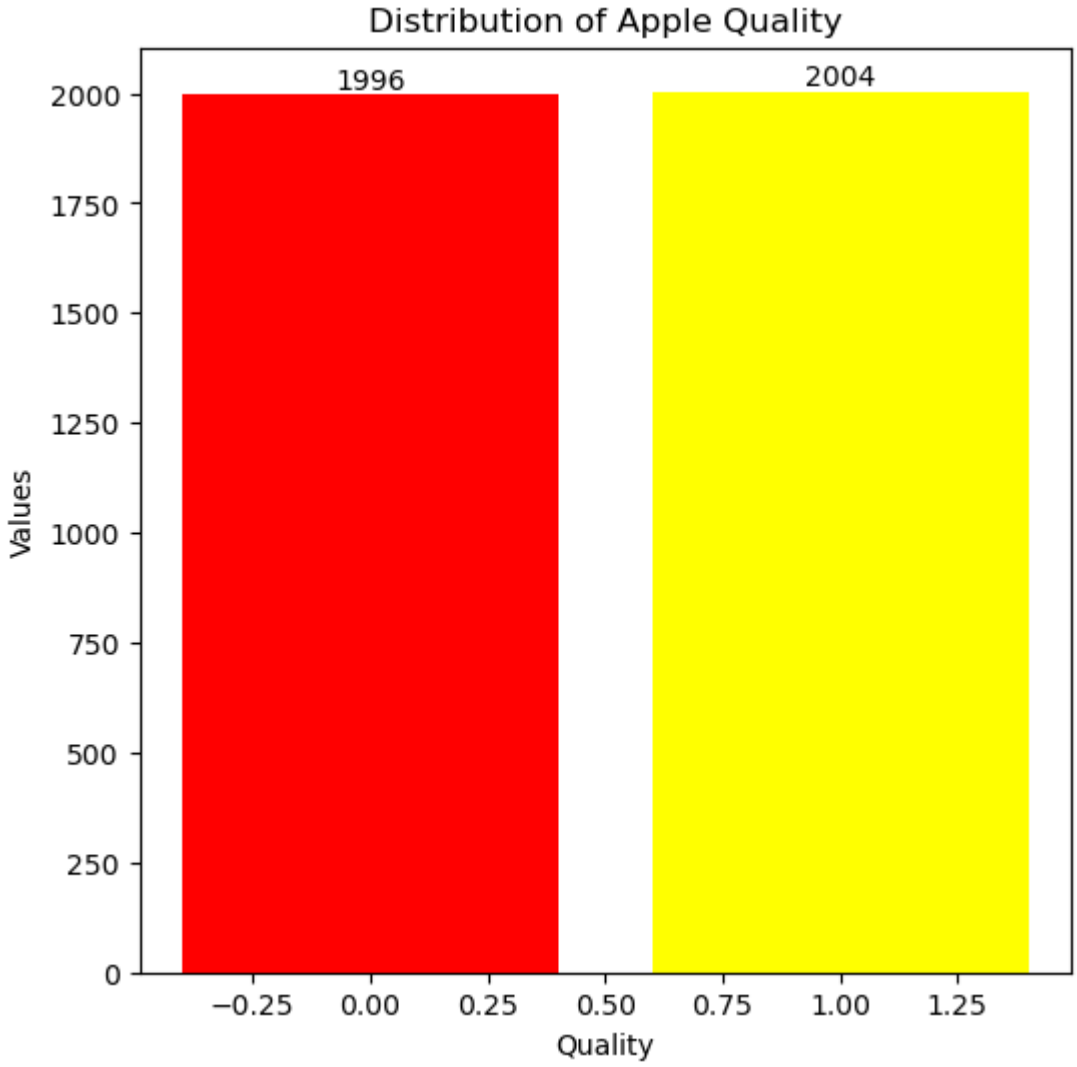
In [11]:
```
#changing the data type for Acidity
df['Acidity']=df['Acidity'].astype(float)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4000 entries, 0 to 3999
Data columns (total 9 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   A_id         4000 non-null   float64
 1   Size         4000 non-null   float64
 2   Weight       4000 non-null   float64
 3   Sweetness    4000 non-null   float64
 4   Crunchiness  4000 non-null   float64
 5   Juiciness    4000 non-null   float64
 6   Ripeness     4000 non-null   float64
 7   Acidity      4000 non-null   float64
 8   Quality      4000 non-null   object 
dtypes: float64(8), object(1)
memory usage: 312.5+ KB
```

In [14]:
```
df['Quality'].value_counts()
```

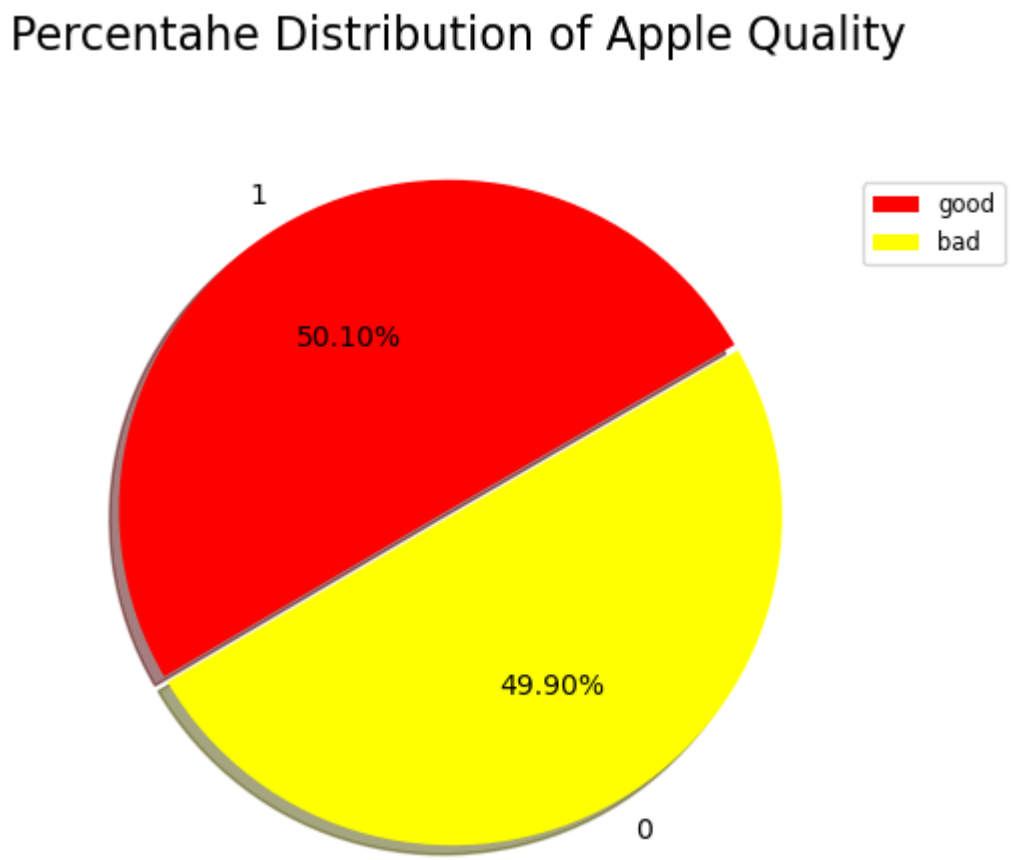
Out[14]:
```
good    2004
bad     1996
Name: Quality, dtype: int64
```

In [28]:
```
#Checking Distribuition of the apple quality

colors = ['yellow', 'red']
quality_counts = df['Quality'].value_counts()
plt.figure(figsize=(6,6))
bars = plt.bar(quality_counts.index, quality_counts.values, color=['yellow',
plt.xlabel('Quality')
plt.ylabel('Values')
plt.title('Distribution of Apple Quality')

# Add data values on top of the bars
for bar in bars:
    yval = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, yval + 0.05, yval, ha='center'


plt.show()
```



In [30]:
```
plt.pie(x=df["Quality"].value_counts(), labels=df["Quality"].value_counts().
        explode=[0.01, 0.01], startangle=30, autopct='%0.2f%%', colors=["Red
plt.legend(labels=["good", "bad"], loc=(1,0.8), fontsize="small")
plt.suptitle("Percentahe Distribution of Apple Quality", fontsize=16)
plt.tight_layout()
print(df.Quality.value_counts())
plt.show()
```

```
1    2004
0    1996
Name: Quality, dtype: int64
```



In [20]:
```
df['Quality'] = df['Quality'].replace({'bad':0,'good':1})
df.Quality
```

Out[20]:
```
0       1
1       1
2       0
3       1
4       1
       ..
3995    0
3996    1
3997    0
3998    1
3999    1
Name: Quality, Length: 4000, dtype: int64
```

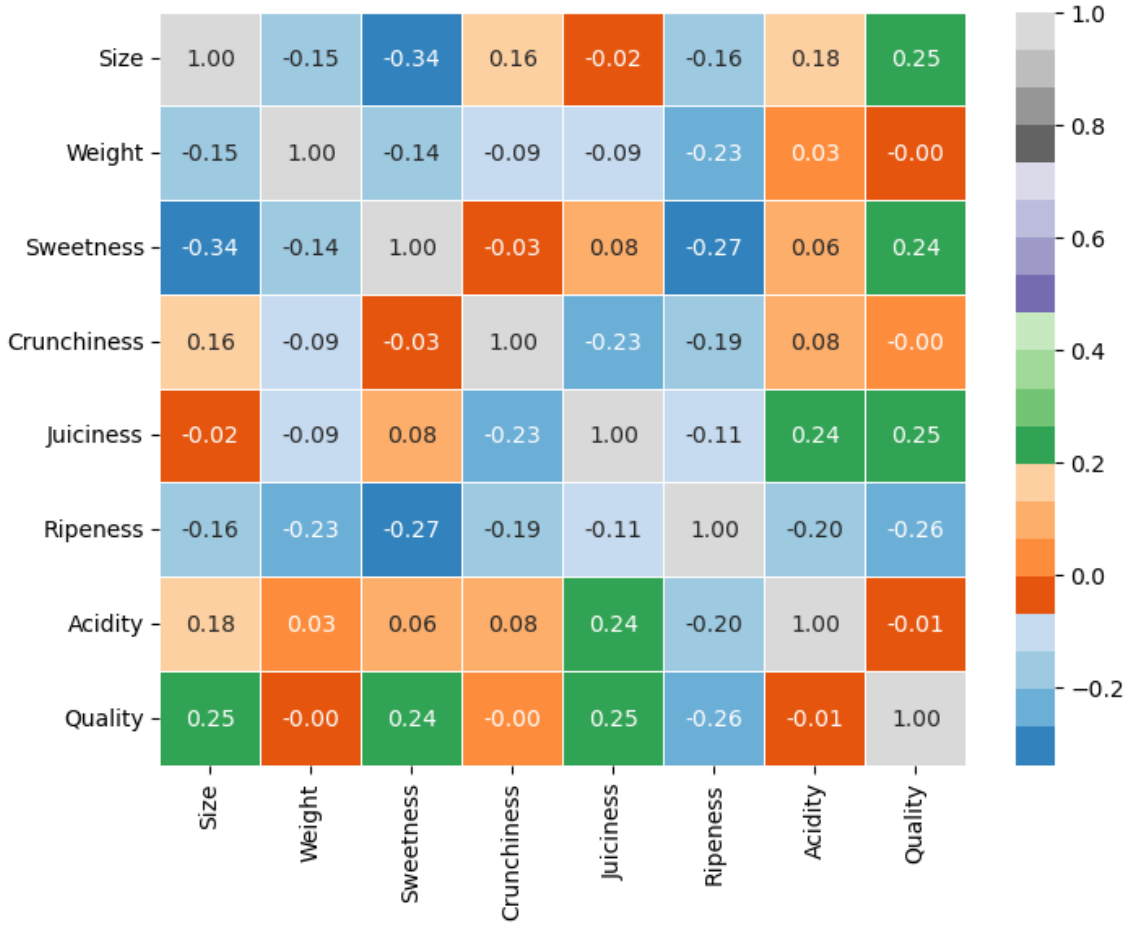
In [50]:
```
df.head()
```

Out[50]:

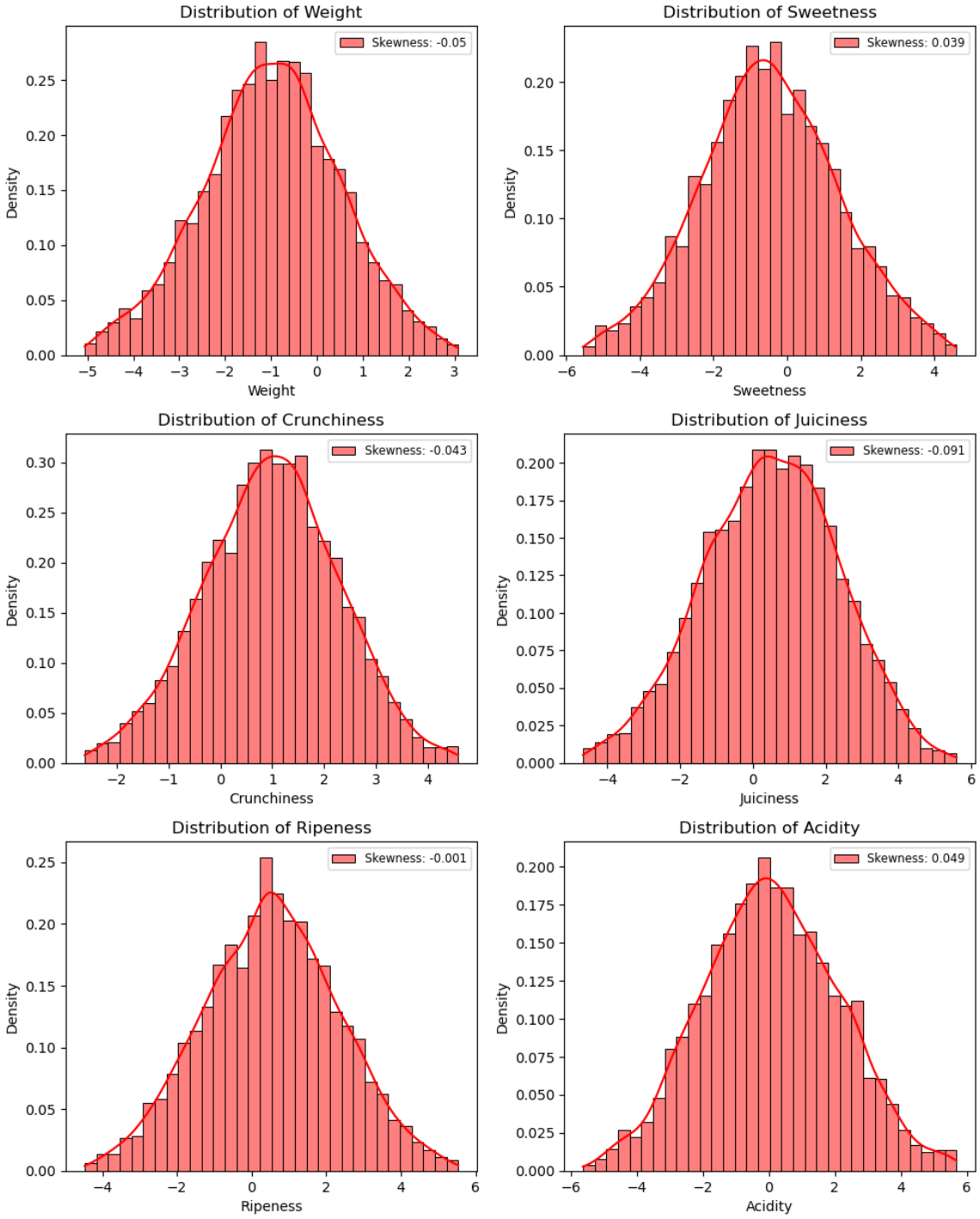
	Size	Weight	Sweetness	Crunchiness	Juiciness	Ripeness	Acidity	Quality
1	-1.195217	-2.839257	3.664059	1.588232	0.853286	0.867530	-0.722809	1
2	-0.292024	-1.351282	-1.738429	-0.342616	2.838636	-0.038033	2.621636	0
3	-0.657196	-2.271627	1.324874	-0.097875	3.637970	-3.413761	0.790723	1
4	1.364217	-1.296612	-0.384658	-0.553006	3.030874	-1.303849	0.501984	1
5	-3.425400	-1.409082	-1.913511	-0.555775	-3.853071	1.914616	-2.981523	0

In [21]:
```
# drropping irrelevant feature
df.drop('A_id',axis=1,inplace=True)
```

In [67]:
```
#checking for correlation between variables

plt.figure(figsize=(8,6))
sns.heatmap(df.corr(), annot=True, fmt='.2f', linewidths=0.4, cmap="tab20c")
plt.show()
```



In [48]:
```
col_pal = sns.color_palette()
plt.figure(figsize=(10, 16))
for i, col in enumerate(num_cols):
    plt.subplot(4, 2, i+1)
    sns.histplot(df[col], kde=True, color='red', label=f"Skewness: {df[col].
    plt.legend(fontsize="small")
    plt.title(f"Distribution of {col}")
plt.tight_layout()
plt.show()
```



In [49]:
```
# removing outliers
num_cols = df.select_dtypes(include=["float", "int"]).columns[1:-1]
def clean_outliers(data, column):
    Q1 = data[column].quantile(0.25)
    Q3 = data[column].quantile(0.75)
    IQR = Q3 - Q1
    lower_limit = Q1 - (IQR * 1.5)
    upper_limit = Q3 + (IQR * 1.5)
    data = data[~((data[column] > upper_limit) | (data[column] < lower_limit
    return data

for i in num_cols:
    df = clean_outliers(df, i)

df.shape
```

Out[49]: (3781, 8)

In [52]:
```
# Split the dataset into features (X) and target variable (y)
X = df.drop('Quality', axis=1)
y = df['Quality']

# Standardize the features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0

# Train a logistic regression model
model = LogisticRegression()
model.fit(X_train, y_train)

# Predict on the testing set
y_pred = model.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 0.750330250990753
```

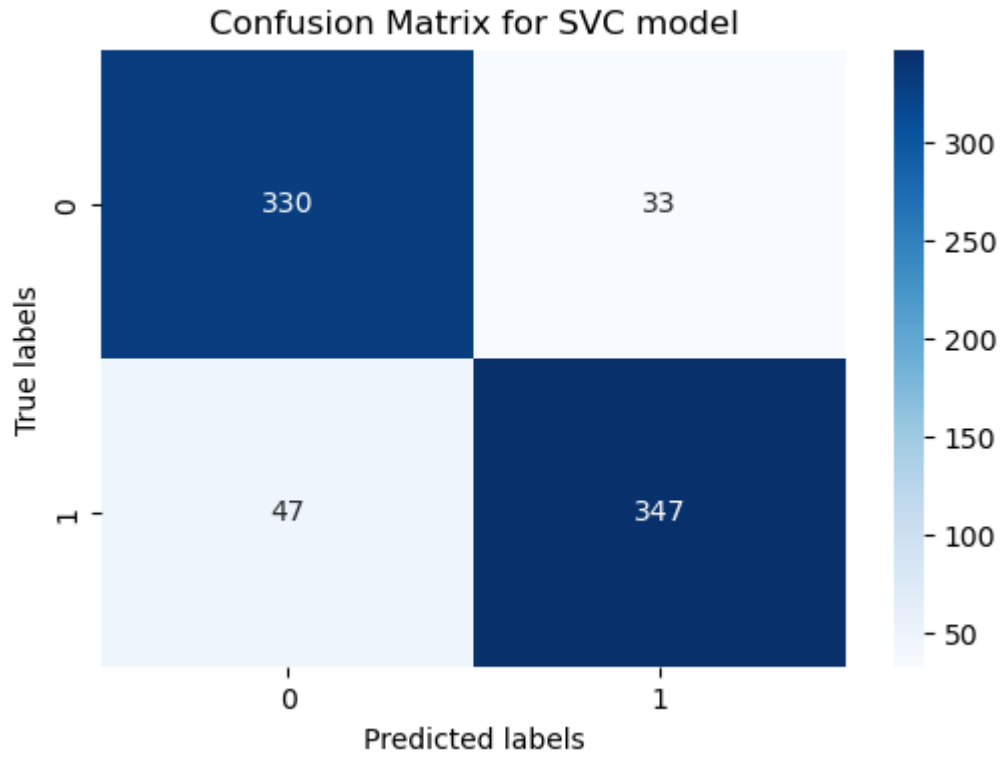
In [53]:
```
# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)

# Generate classification report
print("\nClassification Report:")
print(classification_report(y_test, y_pred))

# Generate confusion matrix
print("\nConfusion Matrix:")
print(confusion_matrix(y_test, y_pred))
```

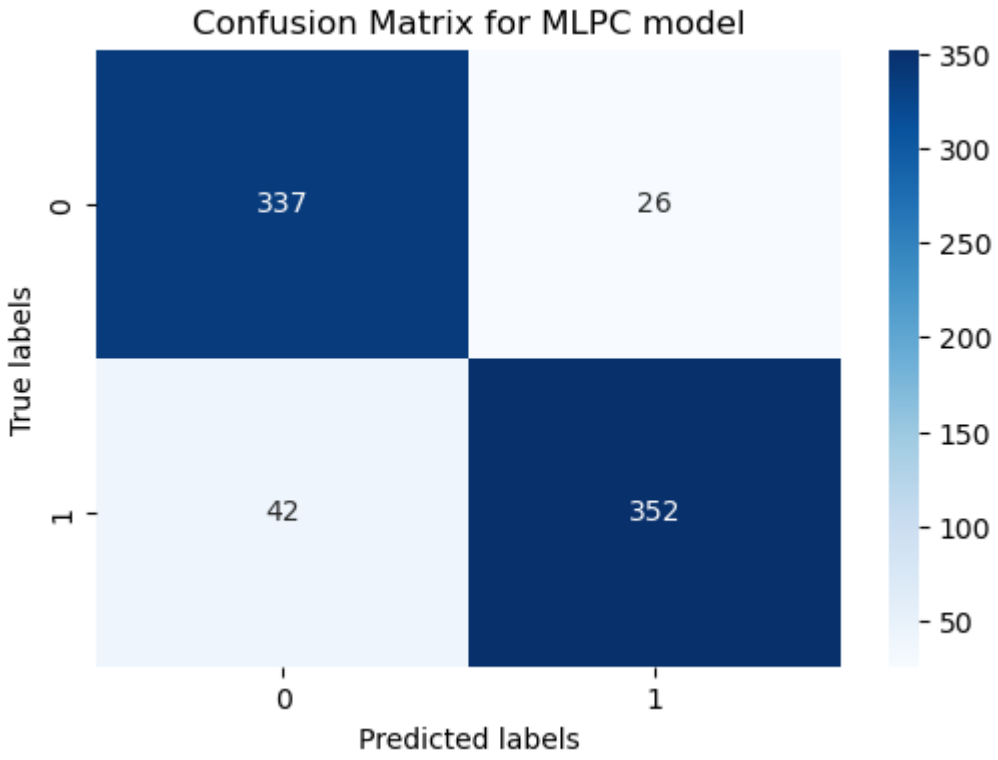
```
Accuracy: 0.750330250990753

Classification Report:
              precision    recall  f1-score   support

           0       0.73      0.76      0.74       363
           1       0.77      0.74      0.76       394

    accuracy                           0.75       757
   macro avg       0.75      0.75      0.75       757
weighted avg       0.75      0.75      0.75       757


Confusion Matrix:
[[276  87]
 [102 292]]
```

In [54]:
```
# train with Support Vector Classifier (SVC) and Multi-Layer Perceptron Clas
from sklearn.svm import SVC
from sklearn.neural_network import MLPClassifier

# Train SVC model
svc_model = SVC()
svc_model.fit(X_train, y_train)

# Predict using SVC model
svc_y_pred = svc_model.predict(X_test)

# Evaluate SVC model
svc_accuracy = accuracy_score(y_test, svc_y_pred)
print("SVC Accuracy:", svc_accuracy)

# Train MLPC model
mlpc_model = MLPClassifier(random_state=42)
mlpc_model.fit(X_train, y_train)

# Predict using MLPC model
mlpc_y_pred = mlpc_model.predict(X_test)

# Evaluate MLPC model
mlpc_accuracy = accuracy_score(y_test, mlpc_y_pred)
print("MLPC Accuracy:", mlpc_accuracy)
```

```
SVC Accuracy: 0.8943196829590488
MLPC Accuracy: 0.9101717305151915

C:\Users\User\anaconda3\lib\site-packages\sklearn\neural_network\_multilay
er_perceptron.py:686: ConvergenceWarning:

Stochastic Optimizer: Maximum iterations (200) reached and the optimizatio
n hasn't converged yet.
```

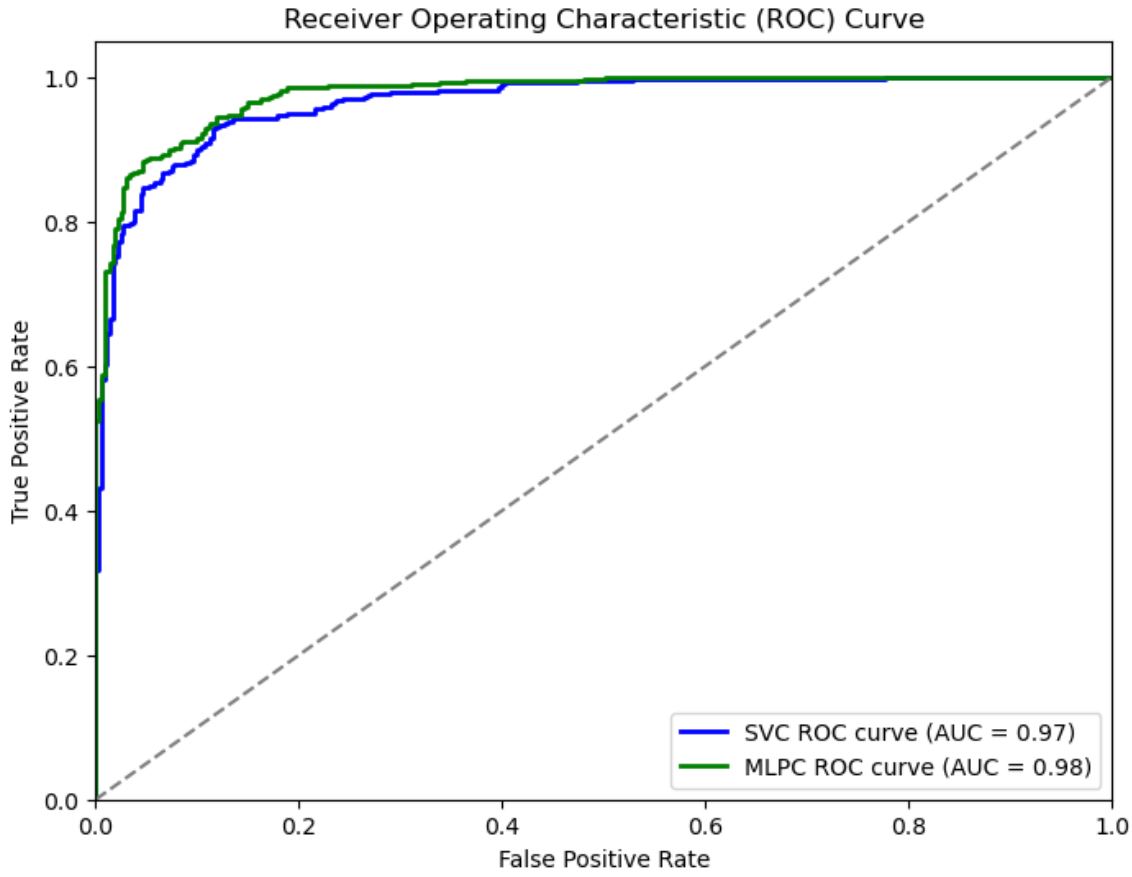
In [64]:
```
# Define function to plot confusion matrix
def plot_confusion_matrix(conf_matrix, title):
    plt.figure(figsize=(6, 4))
    sns.heatmap(conf_matrix, annot=True, cmap='Blues', fmt='g')
    plt.xlabel('Predicted labels')
    plt.ylabel('True labels')
    plt.title(title)

# Plot confusion matrix for SVC model
plot_confusion_matrix(svc_conf_matrix, 'Confusion Matrix for SVC model')

# Plot confusion matrix for MLPC model
plot_confusion_matrix(mlpc_conf_matrix, 'Confusion Matrix for MLPC model')

plt.show()
```





In [65]:
```
from sklearn.metrics import roc_curve, roc_auc_score
import matplotlib.pyplot as plt

# Compute ROC curve and ROC area for SVC model
svc_scores = svc_model.decision_function(X_test)
svc_fpr, svc_tpr, _ = roc_curve(y_test, svc_scores)
svc_auc = roc_auc_score(y_test, svc_scores)

# Compute ROC curve and ROC area for MLPC model
mlpc_scores = mlpc_model.predict_proba(X_test)[:, 1]
mlpc_fpr, mlpc_tpr, _ = roc_curve(y_test, mlpc_scores)
mlpc_auc = roc_auc_score(y_test, mlpc_scores)
```

In [66]:
```
# Plot ROC curve
plt.figure(figsize=(8, 6))
plt.plot(svc_fpr, svc_tpr, color='blue', lw=2, label=f'SVC ROC curve (AUC =
plt.plot(mlpc_fpr, mlpc_tpr, color='green', lw=2, label=f'MLPC ROC curve (AU
plt.plot([0, 1], [0, 1], color='gray', linestyle='--')
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic (ROC) Curve')
plt.legend(loc='lower right')
plt.show()
```



In [ ]: