```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import (
classification_report, confusion_matrix, accuracy_score, roc_curve, auc)
from sklearn.linear_model import LogisticRegression
from imblearn.over_sampling import SMOTE
```

```
# Load the dataset
df = pd.read_csv('Customer Churn Data.csv')
```

```
# Show first five rows
df.head()
```

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...
0	7590-VHVEG	Female	0	Yes	No	1	No	No phone service	DSL	No	...
1	5575-GNVDE	Male	0	No	No	34	Yes	No	DSL	Yes	...
2	3668-QPYBK	Male	0	No	No	2	Yes	No	DSL	Yes	...
3	7795-CFOCW	Male	0	No	No	45	No	No phone service	DSL	Yes	...
4	9237-HQITU	Female	0	No	No	2	Yes	No	Fiber optic	No	...

5 rows × 21 columns

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   customerID        7043 non-null   object
 1   gender            7043 non-null   object
 2   SeniorCitizen     7043 non-null   int64
 3   Partner           7043 non-null   object
 4   Dependents        7043 non-null   object
 5   tenure            7043 non-null   int64
 6   PhoneService      7043 non-null   object
 7   MultipleLines     7043 non-null   object
 8   InternetService   7043 non-null   object
 9   OnlineSecurity    7043 non-null   object
 10  OnlineBackup      7043 non-null   object
 11  DeviceProtection  7043 non-null   object
 12  TechSupport       7043 non-null   object
 13  StreamingTV       7043 non-null   object
 14  StreamingMovies   7043 non-null   object
 15  Contract          7043 non-null   object
 16  PaperlessBilling  7043 non-null   object
 17  PaymentMethod     7043 non-null   object
 18  MonthlyCharges    7043 non-null   float64
 19  TotalCharges      7043 non-null   object
 20  Churn             7043 non-null   object
dtypes: float64(1), int64(2), object(18)
memory usage: 1.1+ MB
```

```
#Breif Description of Data
df.describe()
```

	SeniorCitizen	tenure	MonthlyCharges
count	7043.000000	7043.000000	7043.000000
mean	0.162147	32.371149	64.761692
std	0.368612	24.559481	30.090047
min	0.000000	0.000000	18.250000
25%	0.000000	9.000000	35.500000
50%	0.000000	29.000000	70.350000
75%	0.000000	55.000000	89.850000
max	1.000000	72.000000	118.750000

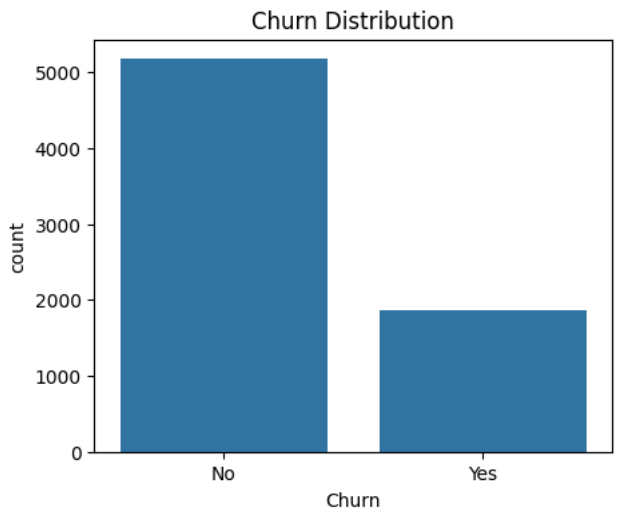
```
#all coulmns names
df.columns
```

```
Index(['customerID', 'gender', 'SeniorCitizen', 'Partner', 'Dependents',
       'tenure', 'PhoneService', 'MultipleLines', 'InternetService',
       'OnlineSecurity', 'OnlineBackup', 'DeviceProtection', 'TechSupport',
       'StreamingTV', 'StreamingMovies', 'Contract', 'PaperlessBilling',
       'PaymentMethod', 'MonthlyCharges', 'TotalCharges', 'Churn'],
      dtype='object')
```

```
print(df.isnull().sum())
```

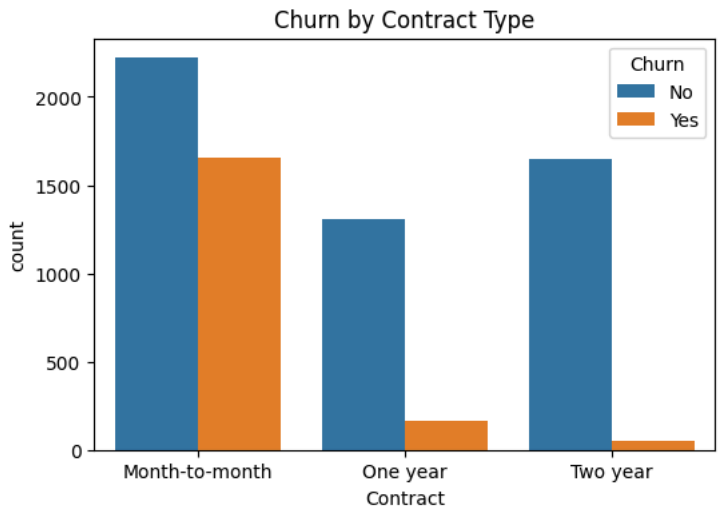
```
customerID          0
gender              0
SeniorCitizen       0
Partner             0
Dependents          0
tenure              0
PhoneService        0
MultipleLines       0
InternetService     0
OnlineSecurity      0
OnlineBackup        0
DeviceProtection    0
TechSupport         0
StreamingTV         0
StreamingMovies     0
Contract            0
PaperlessBilling    0
PaymentMethod       0
MonthlyCharges      0
TotalCharges        0
Churn               0
dtype: int64
```

```
#first we see the distribution of churn
plt.figure(figsize=(5,4))
sns.countplot(x='Churn', data=df)
plt.title('Churn Distribution')
plt.show()
```




```
#here we can see the Churn By Contract Type
plt.figure(figsize=(6,4))
sns.countplot(x='Contract', hue='Churn', data=df)
```

```
plt.title('Churn by Contract Type')
plt.show()
```




```
#handling the missing values
df['TotalCharges'] = pd.to_numeric(df['TotalCharges'], errors='coerce')
df['TotalCharges'] = df['TotalCharges'].fillna(df['TotalCharges'].median())
```

```
#droping Unnecessary coulmn
df.drop('customerID', axis=1, inplace=True)
```

```
#Converts all string,object columns into numbers.
from sklearn.preprocessing import LabelEncoder

df['Churn'] = df['Churn'].map({'Yes': 1, 'No': 0})

le = LabelEncoder()
for col in df.select_dtypes(include=['object']).columns:
    df[col] = le.fit_transform(df[col])
```

```
#spliting the data
X = df.drop('Churn', axis=1)
y = df['Churn']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=60, stratify=y)
```

```
#handling imbalanced data with SMOTE
print("Before SMOTE:", y_train.value_counts())
smote = SMOTE(random_state=42)
X_train, y_train = smote.fit_resample(X_train, y_train)
print("After SMOTE:", pd.Series(y_train).value_counts())
```

```
Before SMOTE: Churn
0    3622
1    1308
Name: count, dtype: int64
After SMOTE: Churn
0    3622
1    3622
Name: count, dtype: int64
```

```
#traning the model
model = LogisticRegression(max_iter=1000, random_state=50)
model.fit(X_train, y_train)
```

```
/usr/local/lib/python3.11/dist-packages/sklearn/linear_model/_logistic.py:465: ConvergenceWarning: lbfgs failed to converge (status=
STOP: TOTAL NO. OF ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

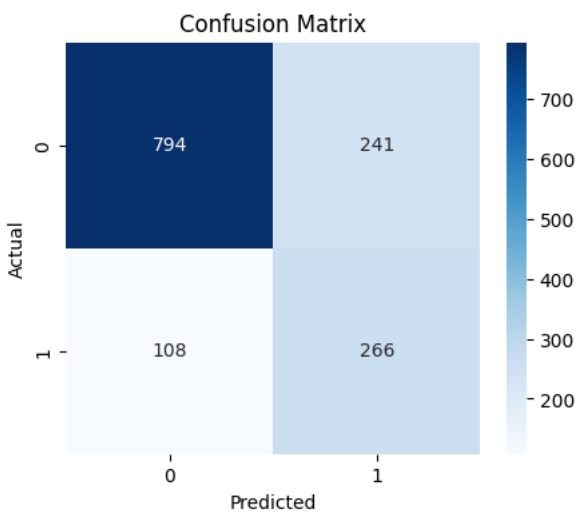
```
LogisticRegression
LogisticRegression(max_iter=1000, random_state=50)
```

```
y_pred = model.predict(X_test)
print("Accuracy:", accuracy_score(y_test, y_pred))
```

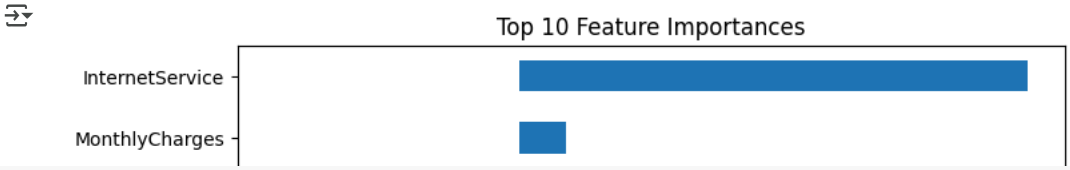
```
print("\nConfusion Matrix:\n", confusion_matrix(y_test, y_pred))
print("\nClassification Report:\n", classification_report(y_test, y_pred))
```

```
Accuracy: 0.7647893989588264

Confusion Matrix:
 [[1197  355]
 [ 142  419]]

Classification Report:
              precision    recall  f1-score   support

           0       0.89      0.77      0.83      1552
           1       0.54      0.75      0.63       561

    accuracy                           0.76      2113
   macro avg       0.72      0.76      0.73      2113
weighted avg       0.80      0.76      0.77      2113
```

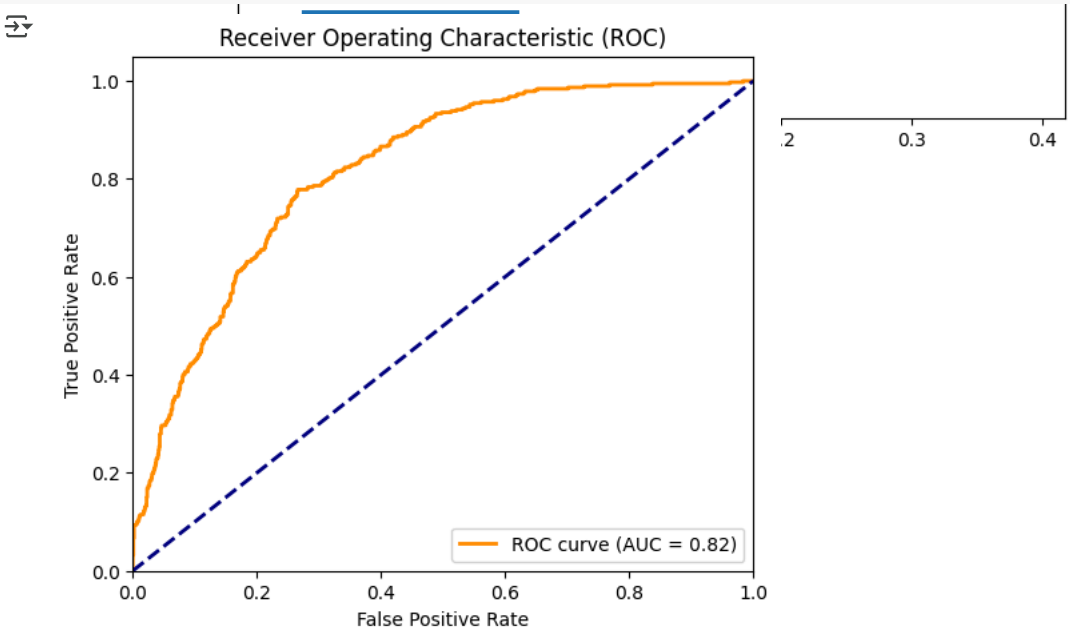
```
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.title('Confusion Matrix')
plt.show()
```




```
# Get feature importance from logistic regression coefficients
feature_importance = pd.Series(model.coef_[0], index=X.columns).sort_values(ascending=False)

plt.figure(figsize=(8,6))
feature_importance.head(10).plot(kind='barh')
plt.title('Top 10 Feature Importances')
plt.xlabel('Coefficient Value')
plt.gca().invert_yaxis()
plt.show()
```




```
y_pred_proba = model.predict_proba(X_test)[:,1]
fpr, tpr, thresholds = roc_curve(y_test, y_pred_proba)
roc_auc = auc(fpr, tpr)

plt.figure(figsize=(6,5))
plt.plot(fpr, tpr, color='darkorange', lw=2, label='ROC curve (AUC = %0.2f)' % roc_auc)
plt.plot([0, 1], [0, 1], color='navy', lw=2, 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)')
plt.legend(loc="lower right")
plt.show()
```




```
# Print final accuracy and AUC
print(f"Final Accuracy: {accuracy_score(y_test, y_pred):.4f}")
print(f"Final ROC AUC: {roc_auc:.4f}")
```

```
Final Accuracy: 0.7523
Final ROC AUC: 0.8180
```

```
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression

# Scale the data
scaler = StandardScaler()
X_train_sm_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Fit the model
model = LogisticRegression(max_iter=2000, random_state=80)
model.fit(X_train_sm_scaled, y_train)

# Predict
y_pred = model.predict(X_test_scaled)
```

```
Start coding or generate with AI.
```