[1]:
```
import pandas as pd
import numpy as np
```

[2]:
```
df = pd.read_csv('WA_Fn-UseC_-Telco-Customer-Churn.csv')
```

[3]:
```
print(df.info())
print(df.describe())
print(df.isnull().sum())
```

```
<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
None
```

```
       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
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
```

[4]:
```
df['TotalCharges'] = df['TotalCharges'].replace(' ', np.nan).astype(float)
df['TotalCharges'] = df['TotalCharges'].fillna(df['MonthlyCharges'])
```

[5]:
```
df['Churn'] = df['Churn'].apply(lambda x: 1 if x == 'Yes' else 0)
```

[6]:
```
import sqlite3
```

[7]:
```
conn = sqlite3.connect('telecom_churn.db')
df.to_sql('customers', conn, if_exists='replace', index=False)
```

[7]:
```
7043
```

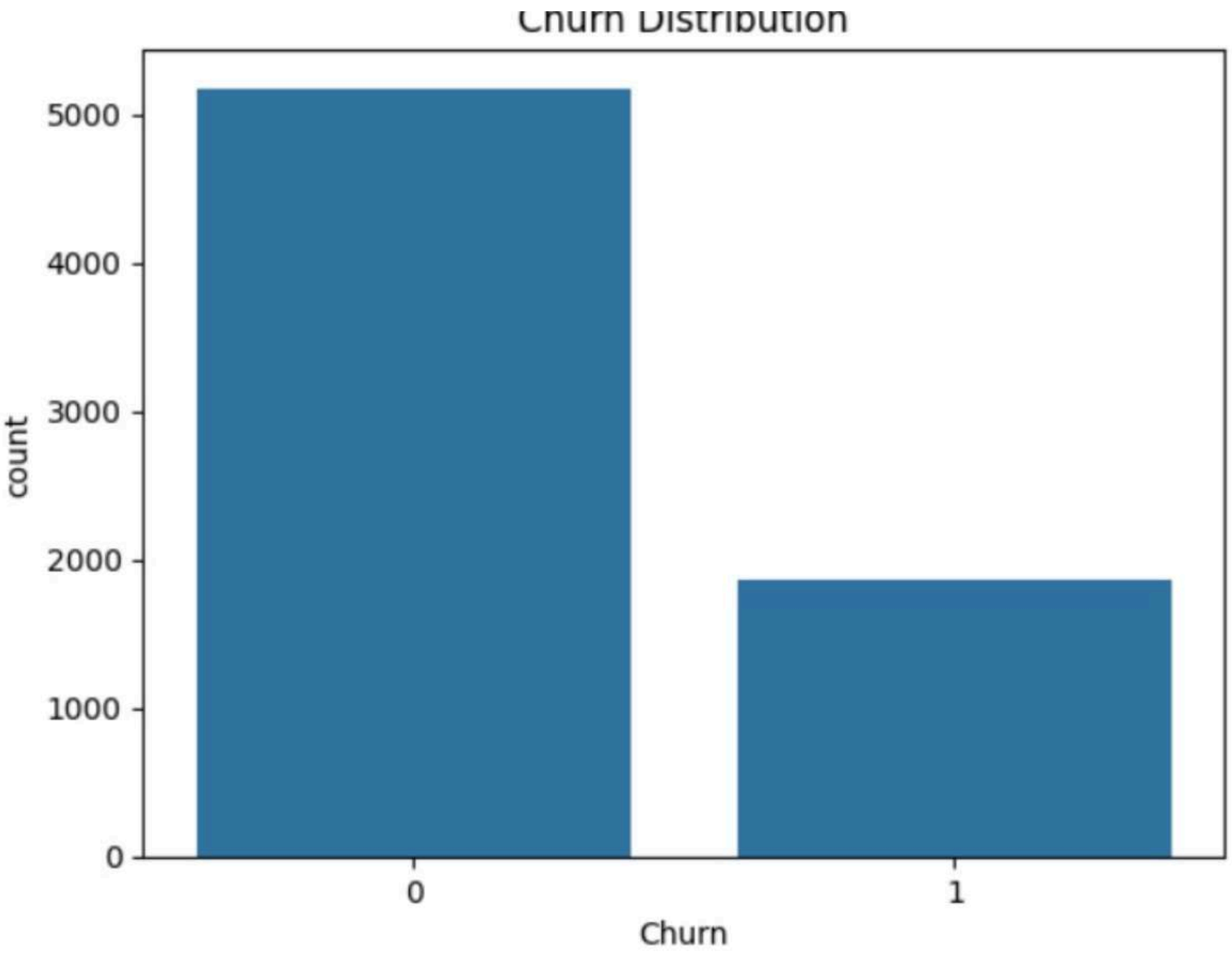
[8]:
```
# Example SQL query
query = """
SELECT
    InternetService,
    AVG(MonthlyCharges) as avg_monthly_charge,
    SUM(Churn) as churn_count,
    COUNT(*) as total_customers,
    SUM(Churn)*100.0/COUNT(*) as churn_rate
FROM customers
GROUP BY InternetService
"""

pd.read_sql(query, conn)
```

[8]:

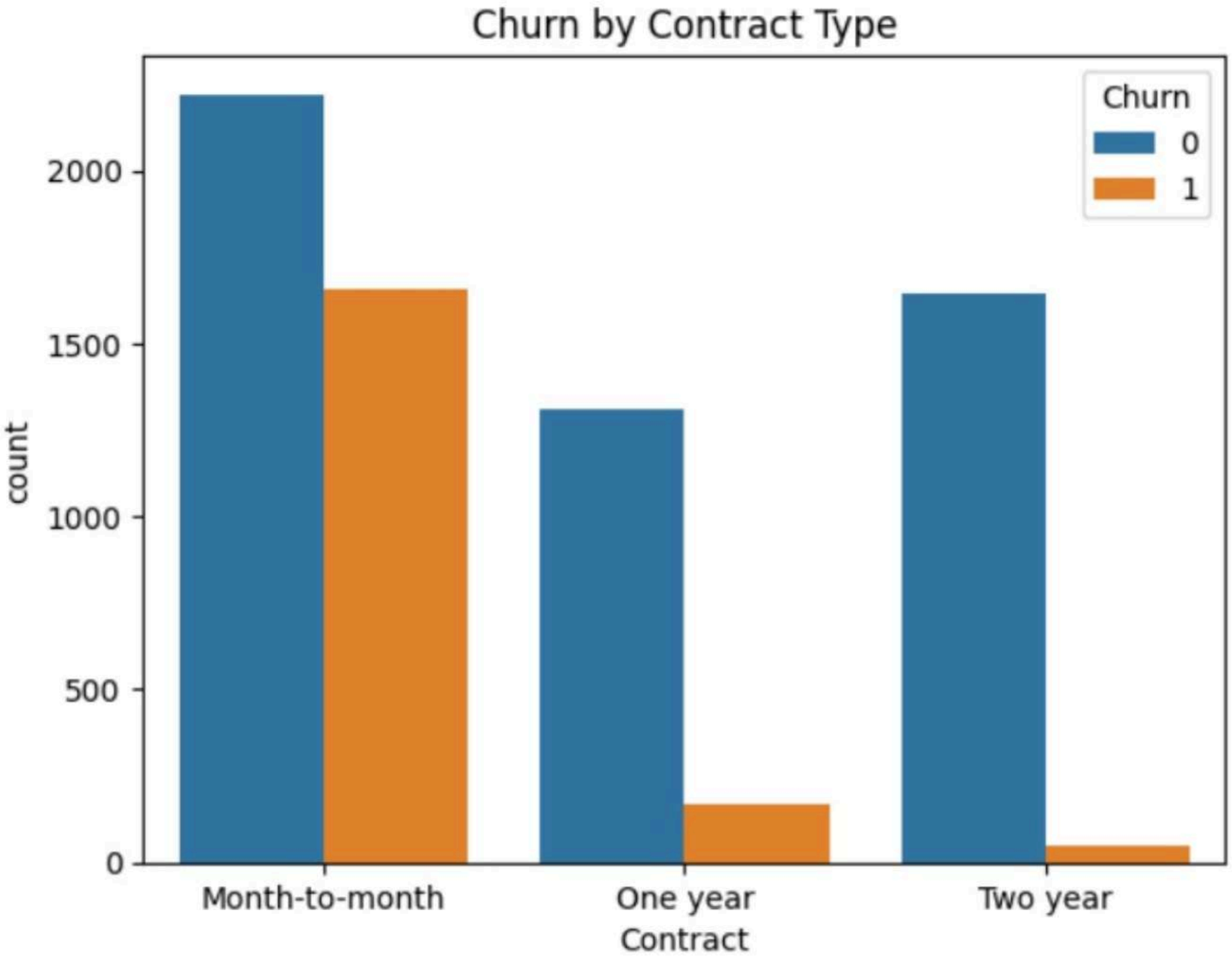
	InternetService	avg_monthly_charge	churn_count	total_customers	churn_rate
0	DSL	58.102169	459	2421	18.959108
1	Fiber optic	91.500129	1297	3096	41.892765
2	No	21.079194	113	1526	7.404980

[9]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

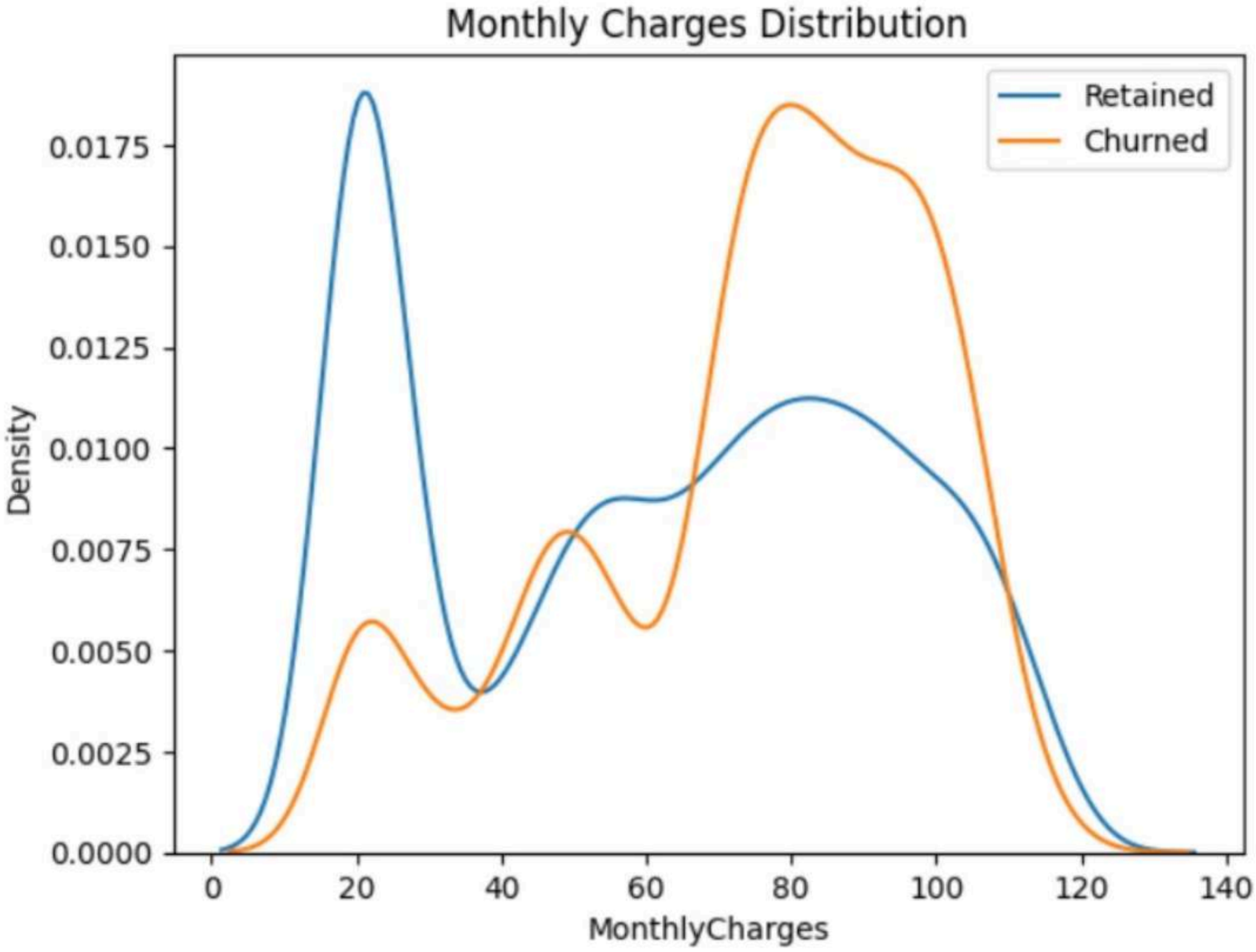
[10]:
```
sns.countplot(x='Churn', data=df)
plt.title('Churn Distribution')
plt.show()
```


Churn Distribution
5000
4000
3000
2000
1000
0
count
0
1
Churn

11]:
```
sns.countplot(x='Contract', hue='Churn', data=df)
plt.title('Churn by Contract Type')
plt.show()
```



[12]:
```
# Monthly charges distribution for churned vs retained
sns.kdeplot(df[df['Churn']==0]['MonthlyCharges'], label='Retained')
sns.kdeplot(df[df['Churn']==1]['MonthlyCharges'], label='Churned')
plt.title('Monthly Charges Distribution')
plt.legend()
plt.show()
```



[13]:
```
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.model_selection import train_test_split
```

[14]:
```
# Encode categorical variables
cat_cols = ['gender', 'Partner', 'Dependents', 'PhoneService', 'MultipleLines',
            'InternetService', 'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
            'TechSupport', 'StreamingTV', 'StreamingMovies', 'Contract',
            'PaperlessBilling', 'PaymentMethod']

le = LabelEncoder()
for col in cat_cols:
    df[col] = le.fit_transform(df[col])
```

[15]:
```
# Select features and target
X = df.drop(['customerID', 'Churn'], axis=1)
y = df['Churn']
```

[16]:
```
# Scale numerical features
scaler = StandardScaler()
num_cols = ['tenure', 'MonthlyCharges', 'TotalCharges']
X[num_cols] = scaler.fit_transform(X[num_cols])
```

[17]:
```
# Split data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

[19]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, roc_auc_score
```

[20]:
```python
# Random Forest
rf = RandomForestClassifier()
rf.fit(X_train, y_train)
y_pred = rf.predict(X_test)
print("\nRandom Forest:")
print(classification_report(y_test, y_pred))
print("ROC-AUC:", roc_auc_score(y_test, rf.predict_proba(X_test)[:, 1]))
```

```
Random Forest:
              precision    recall  f1-score   support

           0       0.83      0.91      0.87      1036
           1       0.66      0.48      0.55       373

    accuracy                           0.80      1409
   macro avg       0.74      0.69      0.71      1409
weighted avg       0.78      0.80      0.78      1409

ROC-AUC: 0.8326091794590453
```

[23]:
```python
# Add predicted probabilities to dataframe
df['Churn_Probability'] = rf.predict_proba(X)[:, 1]
```

[24]:
```python
# Create segments
def create_segments(row):
    if row['Churn_Probability'] > 0.7:
        return 'High Risk'
    elif row['Churn_Probability'] > 0.4:
        return 'Medium Risk'
    elif row['tenure'] > 24:
        return 'Loyal'
    else:
        return 'Low Risk'

df['Segment'] = df.apply(create_segments, axis=1)
```

[25]:
```python
# Analyze segments
segment_analysis = df.groupby('Segment').agg({
    'Churn': 'mean',
    'MonthlyCharges': 'mean',
    'tenure': 'mean',
    'customerID': 'count'
}).rename(columns={'customerID': 'Count'})
```