Customer Retention Prediction

[1]:
```
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, LabelEncoder
from sklearn.ensemble import RandomForestClassifier
from xgboost import XGBClassifier
from sklearn.metrics import accuracy_score, classification_report, roc_auc_score
```

Uploading the dataset

[2]:
```
df = pd.read_excel(r"/content/drive/MyDrive/Telco_customer_churn (1).xlsx")
```

[3]:
```
# Display First Few Rows
print(df.head())
```

```
   CustomerID  Count        Country       State         City  Zip Code  \
0  3668-QPYBK      1  United States  California  Los Angeles     90003
1  9237-HQITU      1  United States  California  Los Angeles     90005
2  9305-CDSKC      1  United States  California  Los Angeles     90006
3  7892-POOKP      1  United States  California  Los Angeles     90010
4  0280-XJGEX      1  United States  California  Los Angeles     90015

                Lat Long     Latitude    Longitude  Gender  ...  \
0  33.964131, -118.272783  33.964131 -118.272783    Male  ...
1   34.059281, -118.30742  34.059281 -118.307420  Female  ...
2  34.048013, -118.293953  34.048013 -118.293953  Female  ...
3  34.062125, -118.315709  34.062125 -118.315709  Female  ...
4  34.039224, -118.266293  34.039224 -118.266293    Male  ...

        Contract  \
0  Month-to-month
1  Month-to-month
2  Month-to-month
3  Month-to-month
4  Month-to-month

  Paperless Billing              Payment Method  Monthly Charges  Total Charges  \
0               Yes                Mailed check            53.85         108.15
1               Yes            Electronic check            70.70         151.65
2               Yes            Electronic check            99.65          820.5
3               Yes            Electronic check           104.80        3046.05
4               Yes  Bank transfer (automatic)           103.70         5036.3
```

	Churn Label	Churn Value	Churn Score	CLTV	Churn Reason
0	Yes	1	86	3239	Competitor made better offer
1	Yes	1	67	2701	Moved
2	Yes	1	86	5372	Moved
3	Yes	1	84	5003	Moved
4	Yes	1	89	5340	Competitor had better devices

[5 rows x 33 columns]

[4]:
Data Preprocessing and Handling Missing Values

[5]:
```
numeric_df = df.select_dtypes(include=np.number)
df[numeric_df.columns] = df[numeric_df.columns].fillna(numeric_df.median())
```

[6]:
```
# Encoding Categorical Variables
label_enc = LabelEncoder()
categorical_cols = df.select_dtypes(include=['object']).columns
for col in categorical_cols:
    if df[col].apply(type).nunique() > 1:
        df[col] = df[col].astype(str)
    df[col] = label_enc.fit_transform(df[col])
```

[7]:
```
# Feature Selection
features = [ 'Monthly Charges','Total Charges','CLTV','Churn Score','Payment Method','Contract']
target = 'Churn Value'
```

[8]:
```
X = df[features]
y = df[target]
```

[9]:
```
y = label_enc.fit_transform(y)
```

[10]:
```
# Train-Test Split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

[11]:
```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
!pip install --upgrade scikit-learn xgboost
```

Requirement already satisfied: scikit-learn in /usr/local/lib/python3.11/dist-packages (1.1.3)
Collecting scikit-learn
  Downloading scikit_learn-1.6.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (18 kB)
Requirement already satisfied: xgboost in /usr/local/lib/python3.11/dist-

```
packages (2.1.4)
Requirement already satisfied: numpy>=1.19.5 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.26.4)
Requirement already satisfied: scipy>=1.6.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.13.1)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.4.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (3.5.0)
Requirement already satisfied: nvidia-nccl-cu12 in /usr/local/lib/python3.11/dist-packages (from xgboost) (2.21.5)
Downloading scikit_learn-1.6.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (13.5 MB)
                                        13.5/13.5 MB 51.4 MB/s eta 0:00:00
Installing collected packages: scikit-learn
  Attempting uninstall: scikit-learn
    Found existing installation: scikit-learn 1.1.3
    Uninstalling scikit-learn-1.1.3:
      Successfully uninstalled scikit-learn-1.1.3
Successfully installed scikit-learn-1.6.1
```

[12]:
```
import sklearn
import xgboost

print("Scikit-learn version:", sklearn.__version__)
print("XGBoost version:", xgboost.__version__)
```

```
Scikit-learn version: 1.1.3
XGBoost version: 2.1.4
```

[13]:
```
!pip install scikit-learn==1.1.3
```

```
Collecting scikit-learn==1.1.3
  Using cached scikit_learn-1.1.3-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (10 kB)
Requirement already satisfied: numpy>=1.17.3 in /usr/local/lib/python3.11/dist-packages (from scikit-learn==1.1.3) (1.26.4)
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.11/dist-packages (from scikit-learn==1.1.3) (1.13.1)
Requirement already satisfied: joblib>=1.0.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn==1.1.3) (1.4.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn==1.1.3) (3.5.0)
Using cached scikit_learn-1.1.3-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (32.0 MB)
```

```
Installing collected packages: scikit-learn
  Attempting uninstall: scikit-learn
    Found existing installation: scikit-learn 1.6.1
    Uninstalling scikit-learn-1.6.1:
      Successfully uninstalled scikit-learn-1.6.1
ERROR: pip's dependency resolver does not currently take into account all
the packages that are installed. This behaviour is the source of the following
dependency conflicts.
mlxtend 0.23.4 requires scikit-learn>=1.3.1, but you have scikit-learn 1.1.3
which is incompatible.
sklearn-compat 0.1.3 requires scikit-learn<1.7,>=1.2, but you have scikit-learn
1.1.3 which is incompatible.
imbalanced-learn 0.13.0 requires scikit-learn<2,>=1.3.2, but you have scikit-
learn 1.1.3 which is incompatible.
bigframes 1.34.0 requires scikit-learn>=1.2.2, but you have scikit-learn 1.1.3
which is incompatible.
Successfully installed scikit-learn-1.1.3
```

Model Training

[27]:
```
model = XGBClassifier()
model.fit(X_train, y_train)
```

[27]:
```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, random_state=None, ...)
```

[15]:
```
# Predictions
y_pred = model.predict(X_test)
```

Model Evaluation

[16]:
```
accuracy = accuracy_score(y_test, y_pred)
roc_score = roc_auc_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
print("ROC-AUC Score:", roc_score)
print(classification_report(y_test, y_pred))
```

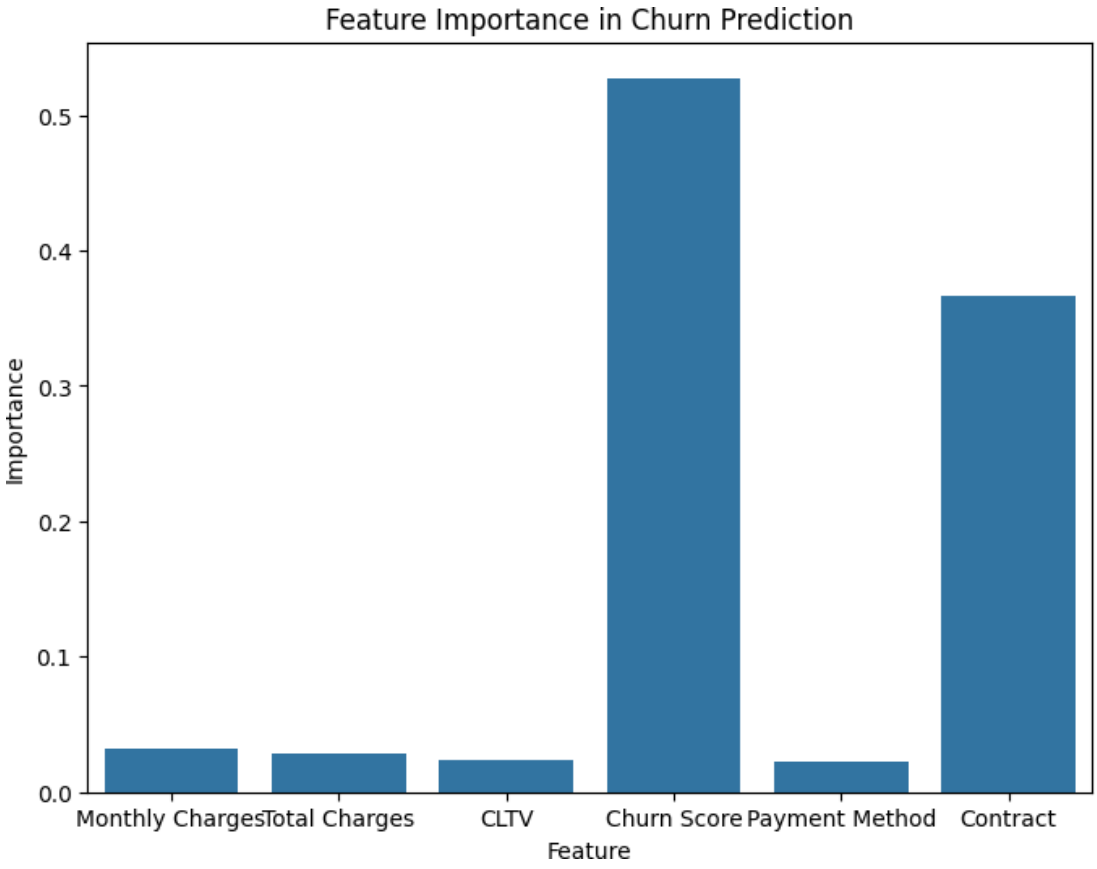
```
Accuracy: 0.9112845990063875
ROC-AUC Score: 0.8852452923686819
              precision    recall  f1-score   support

           0       0.93      0.95      0.94      1009
           1       0.86      0.82      0.84       400

    accuracy                           0.91      1409
   macro avg       0.89      0.89      0.89      1409
weighted avg       0.91      0.91      0.91      1409
```

Feature Importance

[17]:
```
# Feature Importance
feature_importance = model.feature_importances_
plt.figure(figsize=(8,6))
sns.barplot(x=features, y=feature_importance)
plt.xlabel("Feature")
plt.ylabel("Importance")
plt.title("Feature Importance in Churn Prediction")
plt.show()
```


Feature Importance in Churn Prediction
Importance
0.0
0.1
0.2
0.3
0.4
0.5
Monthly Charges
Total Charges
CLTV
Churn Score
Payment Method
Contract
Feature

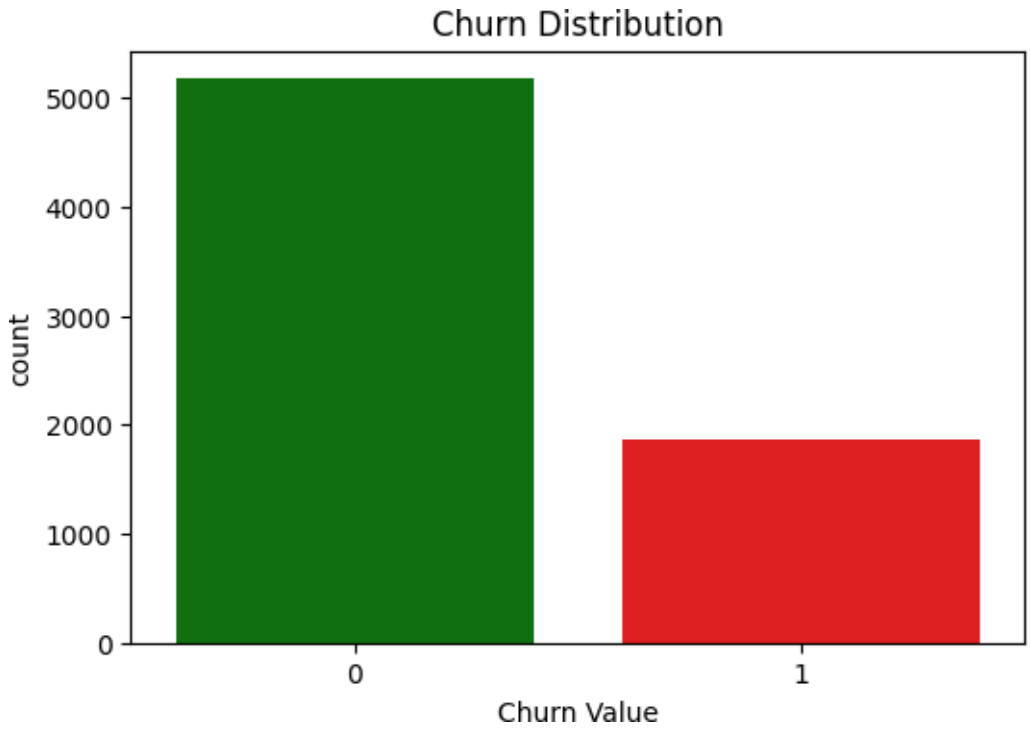
Customer Retention & Churn Overview

[19]:
```
plt.figure(figsize=(6,4))
sns.countplot(x='Churn Value', data=df, palette=['green', 'red'])
plt.title('Churn Distribution')
plt.show()
```

<ipython-input-19-559b51ffd2cb>:6: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

sns.countplot(x='Churn Value', data=df, palette=['green', 'red']



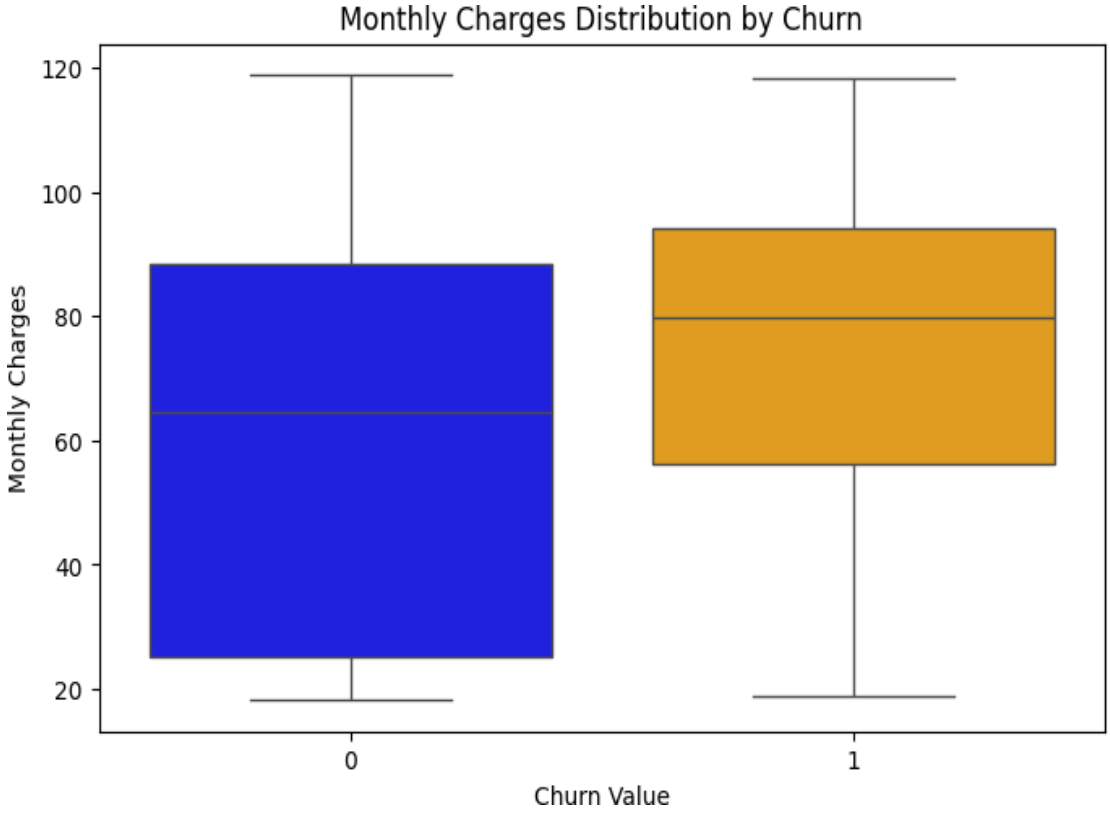
Monthly Charges vs. Churn

[24]:
```
plt.figure(figsize=(8,5))
sns.boxplot(x='Churn Value', y='Monthly Charges', data=df, palette=['blue',
 'orange'])
plt.title('Monthly Charges Distribution by Churn')
plt.show()
```

```
<ipython-input-24-b61ab3eafaf2>:2:      FutureWarning:
```

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

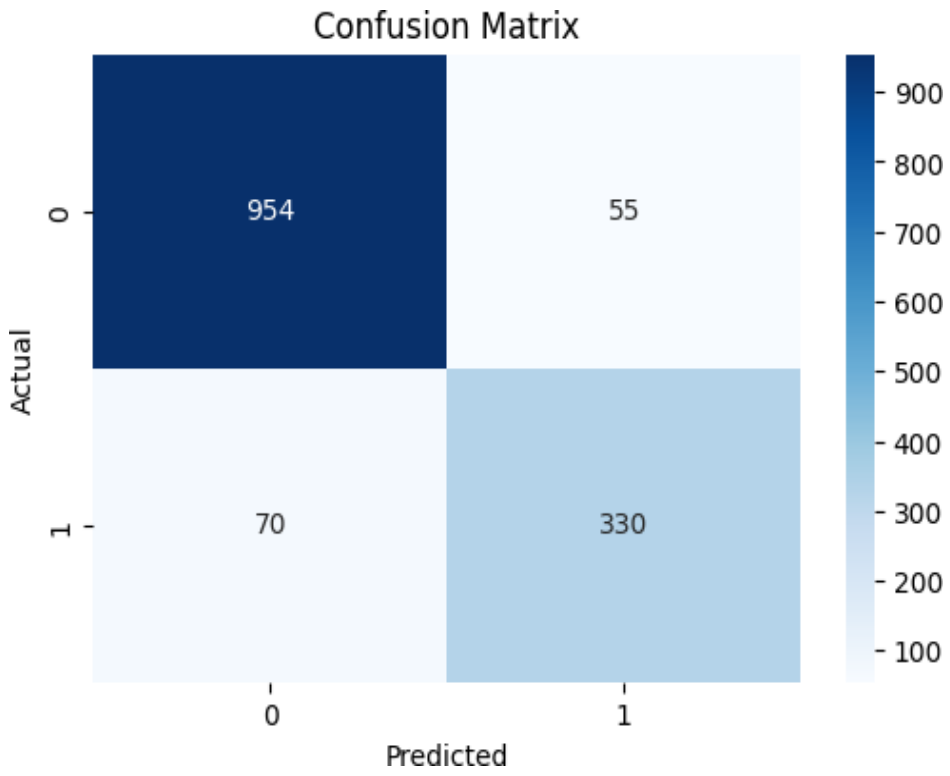
```
  sns.boxplot(x='Churn Value', y='Monthly Charges', data=df, palette=['blue',
'orange'])
```



Model Performance Evaluation

[26]:
```
y_pred = model.predict(X_test)
cm = confusion_matrix(y_test, y_pred)

plt.figure(figsize=(6,4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.title('Confusion Matrix')
plt.show()
```


Confusion Matrix
954
55
70
330
Actual
0
1
Predicted
0
1
900
800
700
600
500
400
300
200
100