Import standard libraries

```
# Import standard 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, OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
from sklearn.impute import SimpleImputer
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, roc_auc_score, confusion_matrix, ConfusionMatrixDisplay

from xgboost import XGBClassifier
import shap

import nltk
from nltk.corpus import stopwords
from sklearn.feature_extraction.text import TfidfVectorizer
from wordcloud import WordCloud

nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
True
```

import dataset

```
df = pd.read_csv("mtn_customer_churn.csv")
```

```
df.head(5)
```

| | Customer ID | Full Name | Date of Purchase | Age | State | MTN Device | Gender | Satisfaction Rate | Customer Review | Customer Tenure in months | Subscription Plan | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | CUST0001 | Ngozi Berry | Jan-25 | 27 | Kwara | 4G Router | Male | 2 | Fair | 2 | 165GB Monthly Plan | 3 |
| 1 | CUST0002 | Zainab Baker | Mar-25 | 16 | Abuja (FCT) | Mobile SIM Card | Female | 2 | Fair | 22 | 12.5GB Monthly Plan | |
| 2 | CUST0003 | Saidu Evans | Mar-25 | 21 | Sokoto | 5G Broadband Router | Male | 1 | Poor | 60 | 150GB FUP Monthly Unlimited | 2 |
| 3 | CUST0003 | Saidu Evans | Mar-25 | 21 | Sokoto | Mobile SIM Card | Male | 1 | Poor | 60 | 1GB+1.5mins Daily Plan | |
| 4 | CUST0003 | Saidu Evans | Mar-25 | 21 | Sokoto | Broadband MiFi | Male | 1 | Poor | 60 | 30GB Monthly Broadband Plan | |

Next steps: Generate code with df   View recommended plots   New interactive sheet

checking for duplicates

```
# Count number of unique customers vs total records
unique_customers = df['Customer ID'].nunique()
total_records = len(df)
```

```
print(f"Total Records: {total_records}")
print(f"Unique Customers: {unique_customers}")
```

```
Total Records: 974
Unique Customers: 496
```

## clean and aggregate data

```
# Convert Date of Purchase to datetime
df['Date of Purchase'] = pd.to_datetime(df['Date of Purchase'], format='%b-%y')

# Create a feature for Recency
latest_date = df['Date of Purchase'].max()
df['Recency'] = (latest_date - df['Date of Purchase']).dt.days

# Define aggregation rules
agg_dict = {
    'Age': 'mean',
    'Satisfaction Rate': 'mean',
    'Customer Tenure in months': 'max',
    'Total Revenue': 'sum',
    'Data Usage': 'sum',
    'Number of Times Purchased': 'sum',
    'Recency': 'min',
    'MTN Device': lambda x: ', '.join(x.unique()),
    'Gender': 'first',
    'State': 'first',
    'Customer Churn Status': 'first',
    'Reasons for Churn': 'first'
}

# Group by Customer ID
df_agg = df.groupby('Customer ID').agg(agg_dict).reset_index()
```

## Feature Engineering

```
# Number of devices used per customer
df_agg['Number of Devices'] = df_agg['MTN Device'].apply(lambda x: len(str(x).split(',')))

# Average monthly revenue
df_agg['Avg Monthly Revenue'] = df_agg['Total Revenue'] / df_agg['Customer Tenure in months']

# Fill missing values
df_agg.fillna({
    'Avg Monthly Revenue': 0,
    'Satisfaction Rate': 3  # Neutral
}, inplace=True)
```

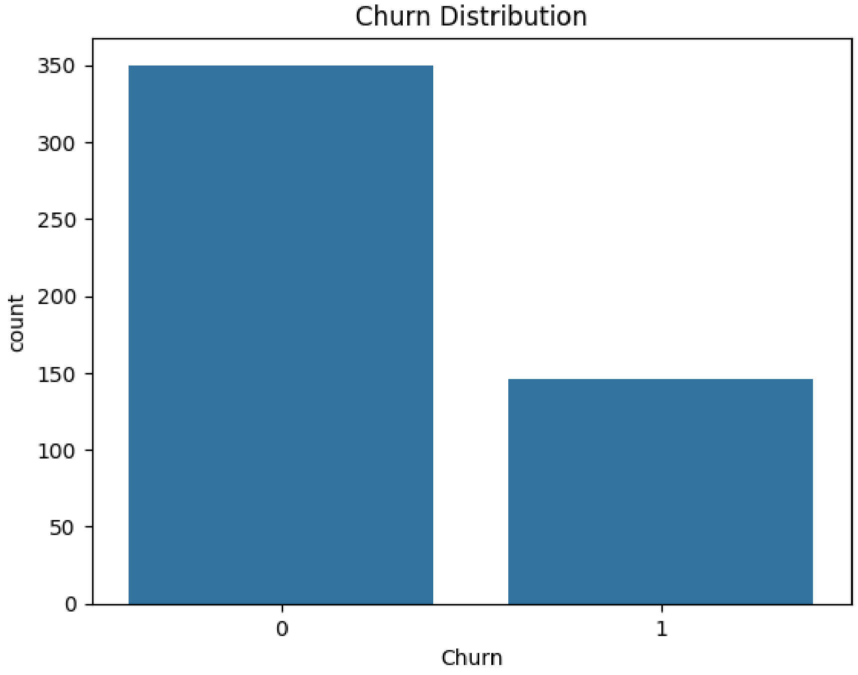
## Encode Target Variable

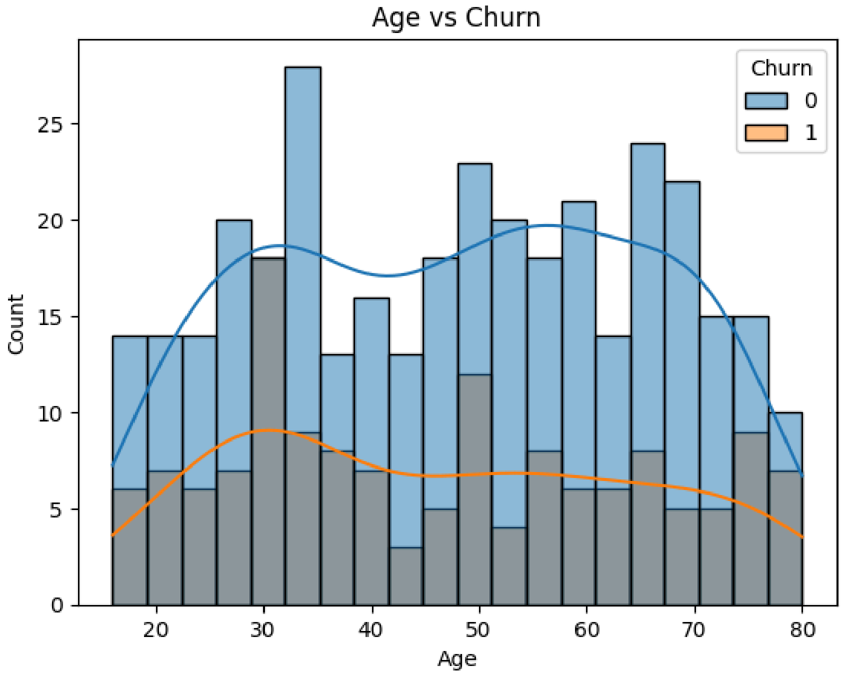
```
df_agg['Churn'] = df_agg['Customer Churn Status'].map({'Yes': 1, 'No': 0})
```

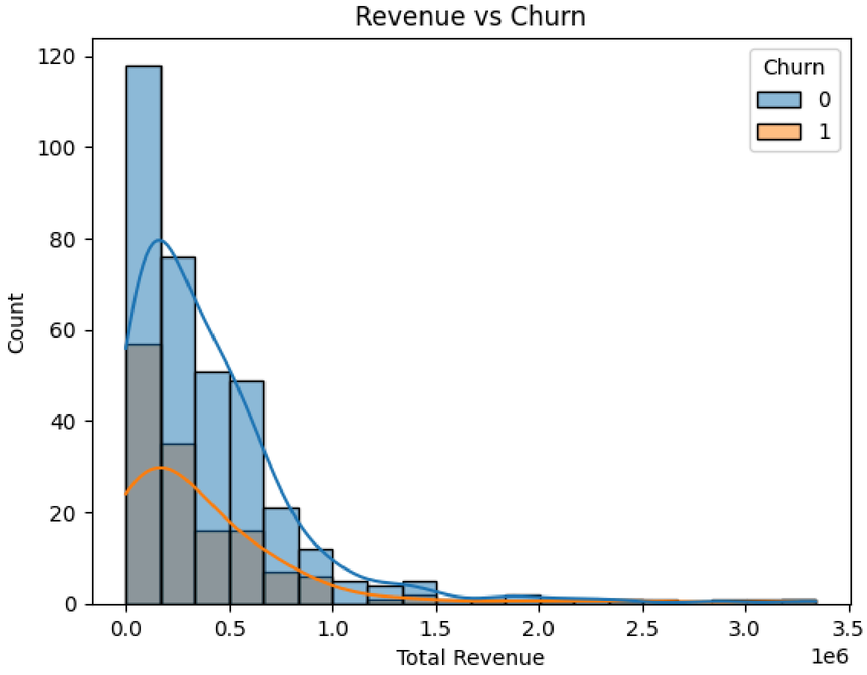
## Exploratory Data Analysis (EDA)

```
# Distribution of Churn
sns.countplot(data=df_agg, x='Churn')
plt.title('Churn Distribution')
plt.show()

# Age vs Churn
sns.histplot(data=df_agg, x='Age', hue='Churn', bins=20, kde=True)
plt.title('Age vs Churn')
plt.show()

# Revenue vs Churn
sns.histplot(data=df_agg, x='Total Revenue', hue='Churn', bins=20, kde=True)
```

```
plt.title('Revenue vs Churn')
plt.show()
```


Churn Distribution
count
350
300
250
200
150
100
50
0
0
1
Churn


Age vs Churn
Churn
0
1
Count
25
20
15
10
5
0
20
30
40
50
60
70
80
Age


Revenue vs Churn
Churn
0
1
Count
120
100
80
60
40
20
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1e6
Total Revenue

## Prepare Features for Modeling

```
# Select features and target
X = df_agg.drop(columns=['Churn', 'Customer ID', 'Customer Churn Status', 'MTN Device', 'Reasons for Churn'])
y = df_agg['Churn']

# Identify categorical and numerical columns
categorical_cols = ['Gender', 'State']
numerical_cols = [col for col in X.columns if col not in categorical_cols]

# Preprocessor pipeline
preprocessor = ColumnTransformer([
    ('num', StandardScaler(), numerical_cols),
    ('cat', OneHotEncoder(handle_unknown='ignore'), categorical_cols)
])

X_preprocessed = preprocessor.fit_transform(X)
```

## Train/Test Split

```
X_train, X_test, y_train, y_test = train_test_split(X_preprocessed, y, test_size=0.2, stratify=y, random_state=42
```

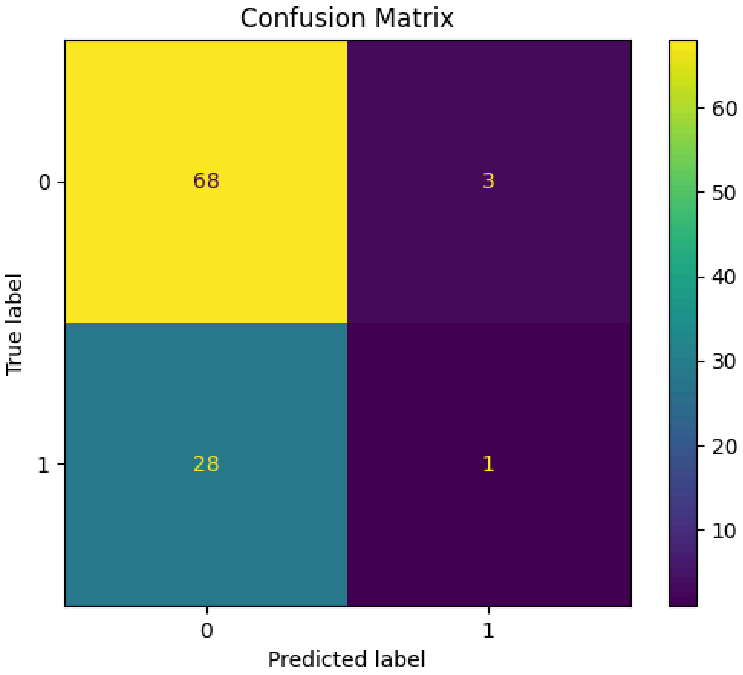
## Train Model (Random Forest)

```
model = RandomForestClassifier(class_weight='balanced', random_state=42)
model.fit(X_train, y_train)

# Predictions
y_pred = model.predict(X_test)
y_proba = model.predict_proba(X_test)[:, 1]
```

## Evaluate Model

```
# Classification report
print(classification_report(y_test, y_pred))

# ROC AUC Score
print("ROC AUC Score:", roc_auc_score(y_test, y_proba))

# Confusion Matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm)
disp.plot()
plt.title('Confusion Matrix')
plt.show()
```

```
              precision    recall  f1-score   support

           0       0.71      0.96      0.81        71
           1       0.25      0.03      0.06        29

    accuracy                           0.69       100
   macro avg       0.48      0.50      0.44       100
weighted avg       0.58      0.69      0.60       100

ROC AUC Score: 0.4193783389995144
```

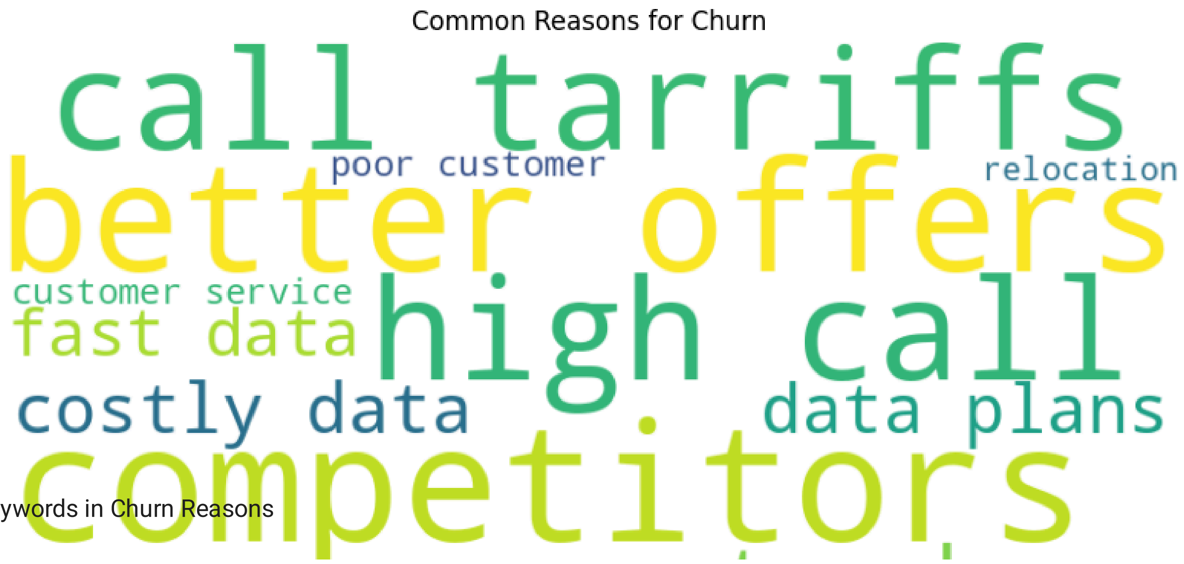


Clean and Analyze Text

```
# Extract 'Reasons for Churn' data
reasons_df = df_agg[['Customer ID', 'Reasons for Churn']].copy()
reasons_df = reasons_df[reasons_df['Reasons for Churn'].notna()]

# Clean text
def clean_text(text):
    if pd.isna(text):
        return ''
    text = text.lower().strip()
    text = ''.join([c for c in text if c.isalnum() or c in [' ', '-']])
    return text

reasons_df['Cleaned Reason'] = reasons_df['Reasons for Churn'].apply(clean_text)
```

Word Cloud of Churn Reasons

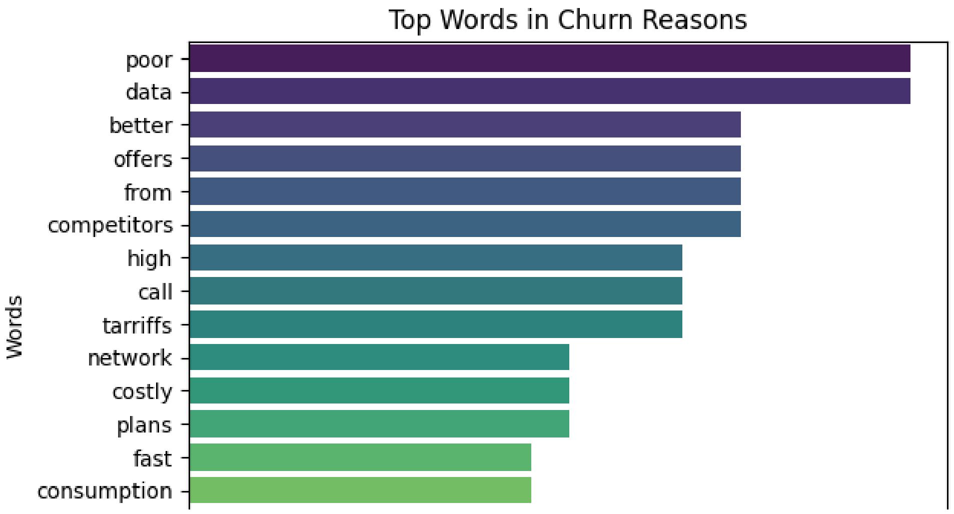
```
# Generate word cloud
text = ' '.join(reasons_df['Cleaned Reason'])
wordcloud = WordCloud(width=800, height=400, background_color='white').generate(text)

plt.figure(figsize=(10, 6))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.title('Common Reasons for Churn')
plt.show()
```



## Top Keywords in Churn Reasons

```
from collections import Counter
import re

# Extract words
words = re.findall(r'\w+', text)
common_words = Counter(words).most_common(20)

# Display top words
common_words_df = pd.DataFrame(common_words, columns=['Word', 'Count'])
sns.barplot(data=common_words_df, x='Count', y='Word', palette='viridis')
plt.title('Top Words in Churn Reasons')
plt.xlabel('Frequency')
plt.ylabel('Words')
plt.show()
```

```
<ipython-input-18-2127629990>:10: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variab

  sns.barplot(data=common_words_df, x='Count', y='Word', palette='viridis')
```


Top Words in Churn Reasons
Words
poor
data
better
offers
from
competitors
high
call
tarriffs
network
costly
plans
fast
consumption