In [1]:
```
import os
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.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.preprocessing import LabelEncoder
import joblib
```

In [2]:
```
from IPython.core.interactiveshell import InteractiveShell

InteractiveShell.ast_node_interactivity = "all"
```

In [3]:
```
os.getcwd()
os.chdir("C:/Users/surajit.bal_embibe/Desktop/Call_Centre_Customer_Churn_Alalysis")
os.getcwd()
```

Out[3]:
```
'C:\\Users\\surajit.bal_embibe\\Desktop\\Call_Centre_Customer_Churn_Alalysis'
```

Out[3]:
```
'C:\\Users\\surajit.bal_embibe\\Desktop\\Call_Centre_Customer_Churn_Alalysis'
```

In [4]:
```
data = pd.read_csv("Data/vw_ChurnData.csv")
data.head()
```

Out[4]:

	Customer_ID	Gender	Age	Married	State	Number_of_Referrals	Tenure_in_Montl
0	19877-DEL	Male	35	No	Delhi	7	
1	58353-MAH	Female	45	Yes	Maharashtra	14	
2	25063-WES	Male	51	No	West Bengal	4	
3	59787-KAR	Male	79	No	Karnataka	3	
4	28544-TAM	Female	80	No	Tamil Nadu	3	

5 rows × 32 columns

Data Processing

In [6]:
```
# Drop columns that wont be used for prediction
data.drop(["Customer_ID", "Churn_Category", "Churn_Reason"], axis = 1, inplace = Tr
```

In [7]:
```
# Handle missing values (you can choose other strategies based on your needs)
data.fillna("Unknown", inplace=True)
```

```
# List of columns to be label encoded
columns_to_encode = [
    'Gender', 'Married', 'State', 'Value_Deal', 'Phone_Service', 'Multiple_Lines',
     'Online_Security', 'Online_Backup', 'Device_Protection_Plan', 'Premium_Support
     'Streaming_Music', 'Unlimited_Data', 'Contract', 'Paperless_Billing', 'Payment
]


# Encode categorical variables except the target variables
label_encoders = {}
for i in columns_to_encode:
    label_encoders[i] = LabelEncoder()
    data[i] = label_encoders[i].fit_transform(data[i])

# Manually encode the target variable 'Customer_Status'
data['Customer_Status'] = data['Customer_Status'].map({'Stayed': 0, 'Churned': 1})

# Ensure all columns are numeric by converting any potential non-numeric columns
data = data.apply(pd.to_numeric, errors='coerce')

# Split data into features and target
x = data.drop('Customer_Status', axis = 1)
y = data['Customer_Status']


# Split data into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(x, y, train_size = 0.8, test_si
```

In [8]:

```
# Train Random Forest Model
# Initialize the Random Forest Classifier
rf_model = RandomForestClassifier(n_estimators= 100, random_state= 42)

# Train the model
rf_model.fit(x_train, y_train)
```

Out[8]:

```
▾ RandomForestClassifier
RandomForestClassifier(random_state=42)
```

In [9]:

```
# Evaluate Model
# Make Predictions
y_prediction = rf_model.predict(x_test)

# Evaluate the model
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_prediction))
print("\nClassification Report:")
print(classification_report(y_test, y_prediction))

# Feature Selection Feature Importance
importances = rf_model.feature_importances_
indices = np.argsort(importances)[::-1]
```

```
Confusion Matrix:
[[789  52]
 [135 226]]

Classification Report:
              precision    recall  f1-score   support

           0       0.85      0.94      0.89       841
           1       0.81      0.63      0.71       361

    accuracy                           0.84      1202
   macro avg       0.83      0.78      0.80      1202
weighted avg       0.84      0.84      0.84      1202
```

In [10]:
```
# Plot the feature importances
plt.figure(figsize = (15,6))
sns.barplot(x= importances[indices], y= x.columns[indices], color = 'green')
plt.title("Feature Importances")
plt.xlabel("Relative Importance")
plt.ylabel("Feature Names")
plt.show()
```

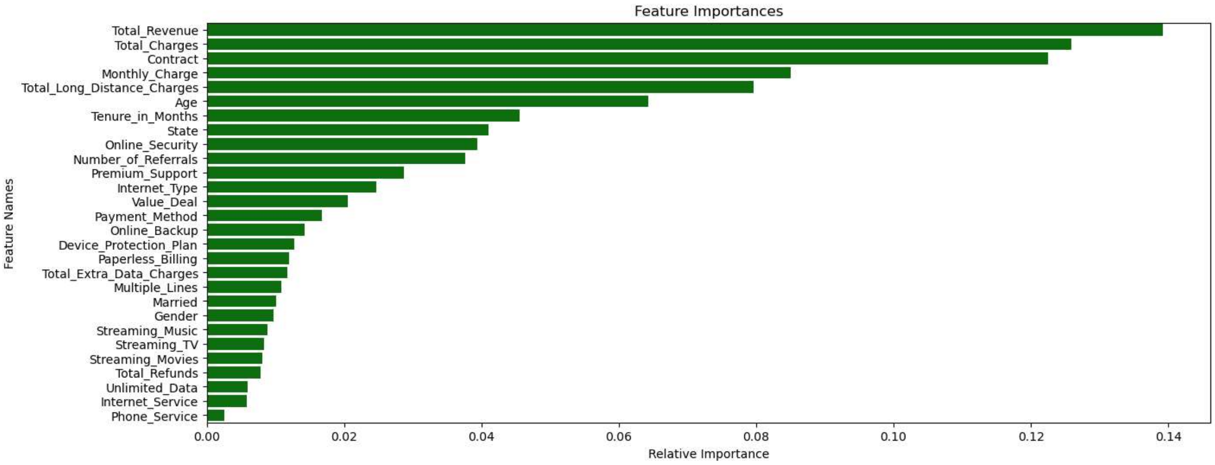
```
Out[10]: <Figure size 1500x600 with 0 Axes>

Out[10]: <Axes: ylabel='None'>

Out[10]: Text(0.5, 1.0, 'Feature Importances')

Out[10]: Text(0.5, 0, 'Relative Importance')

Out[10]: Text(0, 0.5, 'Feature Names')
```



Predict on New Data

In [12]:
```
new_data = pd.read_csv("Data/vw_JoinData.csv")
new_data.head()
```

Out[12]:

	Customer_ID	Gender	Age	Married	State	Number_of_Referrals	Tenure_in_Months
0	93520-GUJ	Female	67	No	Gujarat	13	19
1	57256-BIH	Female	18	No	Bihar	9	7
2	72357-MAD	Female	53	No	Madhya Pradesh	14	12
3	66612-KAR	Female	58	Yes	Karnataka	11	18
4	22119-WES	Male	31	Yes	West Bengal	5	5

5 rows × 32 columns

In [13]:

```
# Retain the original DataFrame to preserve unencoded columns
original_data = new_data.copy()

# Retain the Customer_ID column
customer_ids = new_data['Customer_ID']

# Drop columns that won't be used for prediction in the encoded DataFrame
new_data = new_data.drop(['Customer_ID', 'Customer_Status', 'Churn_Category', 'Chur

# Handle missing values by filling NaNs with a placeholder for categorical columns
new_data.fillna('Unknown', inplace=True)
```

In [14]:

```
# Assuming 'label_encoders' is the dictionary of saved LabelEncoders from the train
for column in new_data.select_dtypes(include=['object']).columns:
    if column in label_encoders:
        # Handle unseen labels (if any) by assigning them as 'Unknown'
        unseen_labels = set(new_data[column].unique()) - set(label_encoders[column]
        if unseen_labels:
            label_encoders[column].classes_ = np.append(label_encoders[column].clas

        # Transform the column using the existing LabelEncoder
        new_data[column] = new_data[column].apply(lambda x: 'Unknown' if x not in l
        new_data[column] = label_encoders[column].transform(new_data[column])
```

In [15]:

```
# Make predictions
new_predictions = rf_model.predict(new_data)

# Add predictions to the original DataFrame
original_data['Customer_Status_Predicted'] = new_predictions

# Filter the DataFrame to include only records predicted as "Churned" (assuming '1'
original_data = original_data[original_data['Customer_Status_Predicted'] == 1]
original_data.head()
```

Out[15]:

	Customer_ID	Gender	Age	Married	State	Number_of_Referrals	Tenure_in_Months
0	93520-GUJ	Female	67	No	Gujarat	13	19
1	57256-BIH	Female	18	No	Bihar	9	7
2	72357-MAD	Female	53	No	Madhya Pradesh	14	12
3	66612-KAR	Female	58	Yes	Karnataka	11	18
4	22119-WES	Male	31	Yes	West Bengal	5	5

5 rows × 33 columns

In [16]:

```
# Save the results
#original_data.to_csv("Data/Probable_Churn_prediction.csv", index = False)
```