```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

df = pd.read_csv("Customer Churn.csv")
df.head()
```

```
   customerID  gender  SeniorCitizen Partner Dependents  tenure
PhoneService  \
0  7590-VHVEG  Female              0     Yes         No       1
No
1  5575-GNVDE    Male              0      No         No      34
Yes
2  3668-QPYBK    Male              0      No         No       2
Yes
3  7795-CFOCW    Male              0      No         No      45
No
4  9237-HQITU  Female              0      No         No       2
Yes

      MultipleLines InternetService OnlineSecurity  ...
DeviceProtection  \
0  No phone service             DSL             No  ...
No
1                No             DSL            Yes  ...
Yes
2                No             DSL            Yes  ...
No
3  No phone service             DSL            Yes  ...
Yes
4                No     Fiber optic             No  ...
No

  TechSupport StreamingTV StreamingMovies        Contract
PaperlessBilling  \
0          No          No              No  Month-to-month
Yes
1          No          No              No        One year
No
2          No          No              No  Month-to-month
Yes
3         Yes          No              No        One year
No
4          No          No              No  Month-to-month
Yes

               PaymentMethod MonthlyCharges  TotalCharges Churn
0           Electronic check          29.85         29.85    No
1               Mailed check          56.95        1889.5    No
```

```
2                Mailed check          53.85        108.15   Yes
3  Bank transfer (automatic)          42.30       1840.75    No
4           Electronic check          70.70        151.65   Yes

[5 rows x 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
```

```
# replacing blanks with 0 as tenure is 0 and not total charges are recorded
# changing the datatype with float as totalcharges recorded are object

df["TotalCharges"] = df["TotalCharges"].replace(" ","0")
df["TotalCharges"]=df["TotalCharges"].astype("float")
```

```
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   float64
 20  Churn             7043 non-null   object
dtypes: float64(2), int64(2), object(17)
memory usage: 1.1+ MB
```

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

```
0
```

```
df.describe()
```

```
       SeniorCitizen       tenure  MonthlyCharges  TotalCharges
count    7043.000000  7043.000000     7043.000000   7043.000000
mean        0.162147    32.371149       64.761692   2279.734304
std         0.368612    24.559481       30.090047   2266.794470
min         0.000000     0.000000       18.250000      0.000000
25%         0.000000     9.000000       35.500000    398.550000
50%         0.000000    29.000000       70.350000   1394.550000
75%         0.000000    55.000000       89.850000   3786.600000
max         1.000000    72.000000      118.750000   8684.800000
```

```
df["customerID"].duplicated().sum()
```

```
0
```

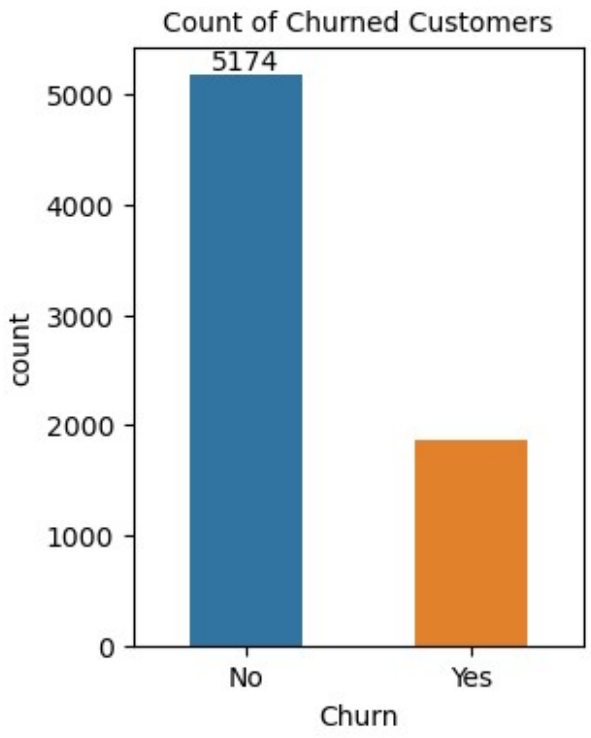
```
# converting 0 and 1 values of senior citizen to "yes" / "no" to make
it easier to understand.

def conv(value):
    if value == 1:
        return "yes"
    else:
```

```
        return "no"
df["SeniorCitizen"] = df["SeniorCitizen"].apply(conv)

df.head(10)
```

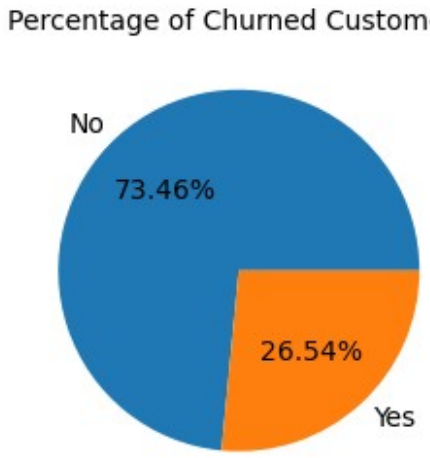
```
   customerID  gender SeniorCitizen Partner Dependents  tenure
PhoneService  \
0  7590-VHVEG  Female            no     Yes         No       1
No
1  5575-GNVDE    Male            no      No         No      34
Yes
2  3668-QPYBK    Male            no      No         No       2
Yes
3  7795-CFOCW    Male            no      No         No      45
No
4  9237-HQITU  Female            no      No         No       2
Yes
5  9305-CDSKC  Female            no      No         No       8
Yes
6  1452-KIOVK    Male            no      No        Yes      22
Yes
7  6713-OKOMC  Female            no      No         No      10
No
8  7892-POOKP  Female            no     Yes         No      28
Yes
9  6388-TABGU    Male            no      No        Yes      62
Yes

      MultipleLines InternetService OnlineSecurity  ...
DeviceProtection  \
0  No phone service             DSL             No  ...
No
1                No             DSL            Yes  ...
Yes
2                No             DSL            Yes  ...
No
3  No phone service             DSL            Yes  ...
Yes
4                No     Fiber optic             No  ...
No
5               Yes     Fiber optic             No  ...
Yes
6               Yes     Fiber optic             No  ...
No
7  No phone service             DSL            Yes  ...
No
8               Yes     Fiber optic             No  ...
Yes
9                No             DSL            Yes  ...
No
```

```
  TechSupport StreamingTV StreamingMovies        Contract
PaperlessBilling  \
0          No          No              No  Month-to-month
Yes
1          No          No              No        One year
No
2          No          No              No  Month-to-month
Yes
3         Yes          No              No        One year
No
4          No          No              No  Month-to-month
Yes
5          No         Yes             Yes  Month-to-month
Yes
6          No         Yes              No  Month-to-month
Yes
7          No          No              No  Month-to-month
No
8         Yes         Yes             Yes  Month-to-month
Yes
9          No          No              No        One year
No

               PaymentMethod MonthlyCharges  TotalCharges  Churn
0           Electronic check          29.85         29.85     No
1               Mailed check          56.95       1889.50     No
2               Mailed check          53.85        108.15    Yes
3  Bank transfer (automatic)          42.30       1840.75     No
4           Electronic check          70.70        151.65    Yes
5           Electronic check          99.65        820.50    Yes
6    Credit card (automatic)          89.10       1949.40     No
7               Mailed check          29.75        301.90     No
8           Electronic check         104.80       3046.05    Yes
9  Bank transfer (automatic)          56.15       3487.95     No

[10 rows x 21 columns]
```

```
plt.figure(figsize=(3,4))
ax = sns.countplot(x = "Churn",hue ="Churn",data = df,
width=0.5,palette = {"No": "#1f77b4", "Yes": "#ff7f0e"})
ax.bar_label(ax.containers[0])
plt.title("Count of Churned Customers",fontsize = 10)
plt.show()
```

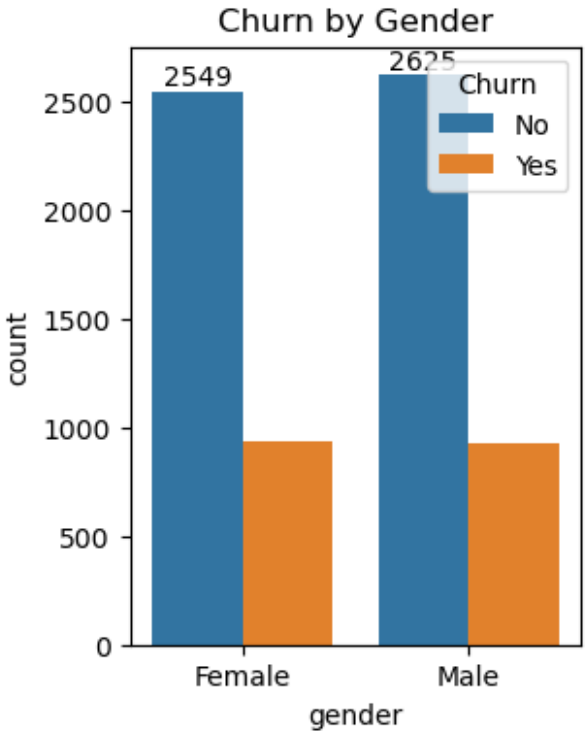



```
plt.figure(figsize = (3,4))
gb = df.groupby("Churn").agg({"Churn":"count"})
plt.pie(gb['Churn'],labels = gb.index,autopct = "%1.2f%%")
plt.title("Percentage of Churned Customers",fontsize = 10)
plt.show()
```

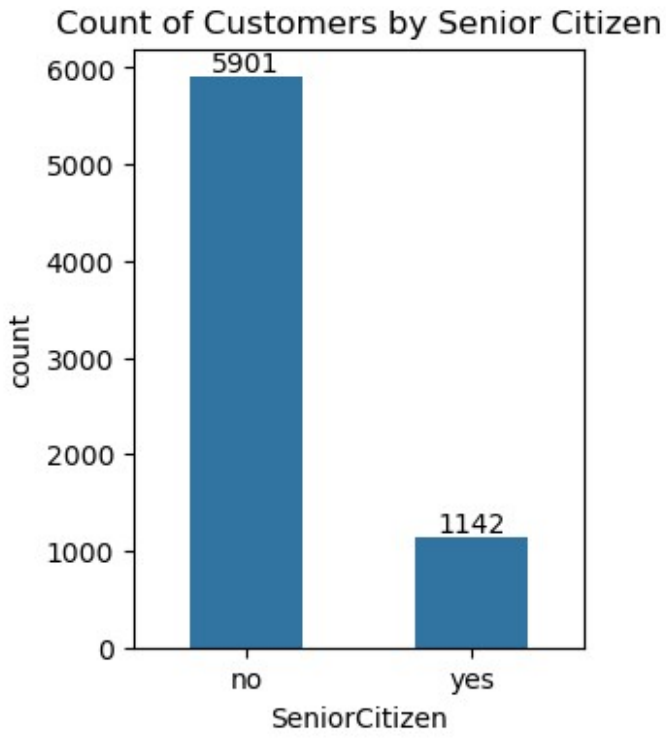



```
# from the given pie chart we can conclude that 26.54% of our
customers have churned out
# now let's explore the reason behind it
```

```
plt.figure(figsize=(3,4))
ax1 = sns.countplot(x = "gender",data = df,hue="Churn")
ax1.bar_label(ax1.containers[0])
plt.title("Churn by Gender")
plt.show()
```

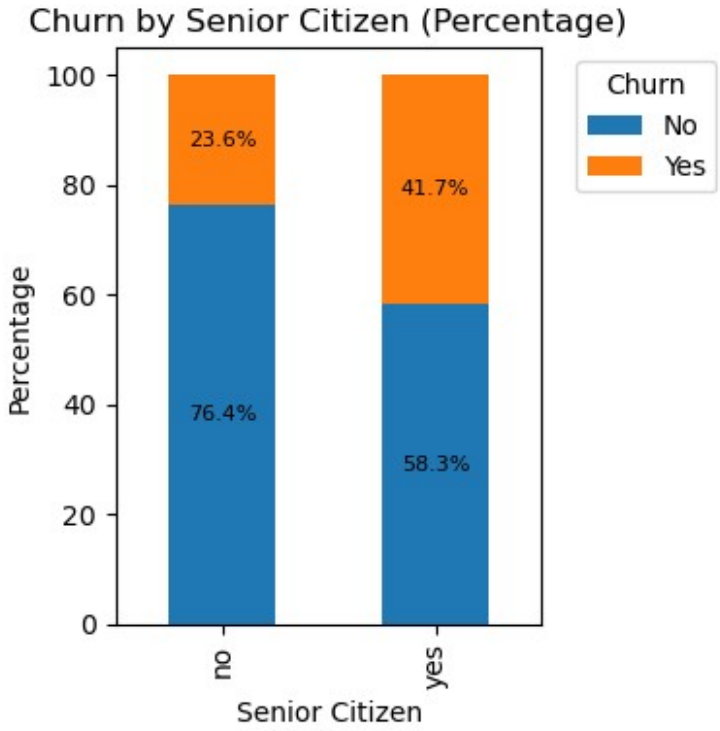



```
plt.figure(figsize=(3,4))
ax1 = sns.countplot(x = "SeniorCitizen",data = df,width = 0.5)
ax1.bar_label(ax1.containers[0])
plt.title("Count of Customers by Senior Citizen")
plt.show()
```

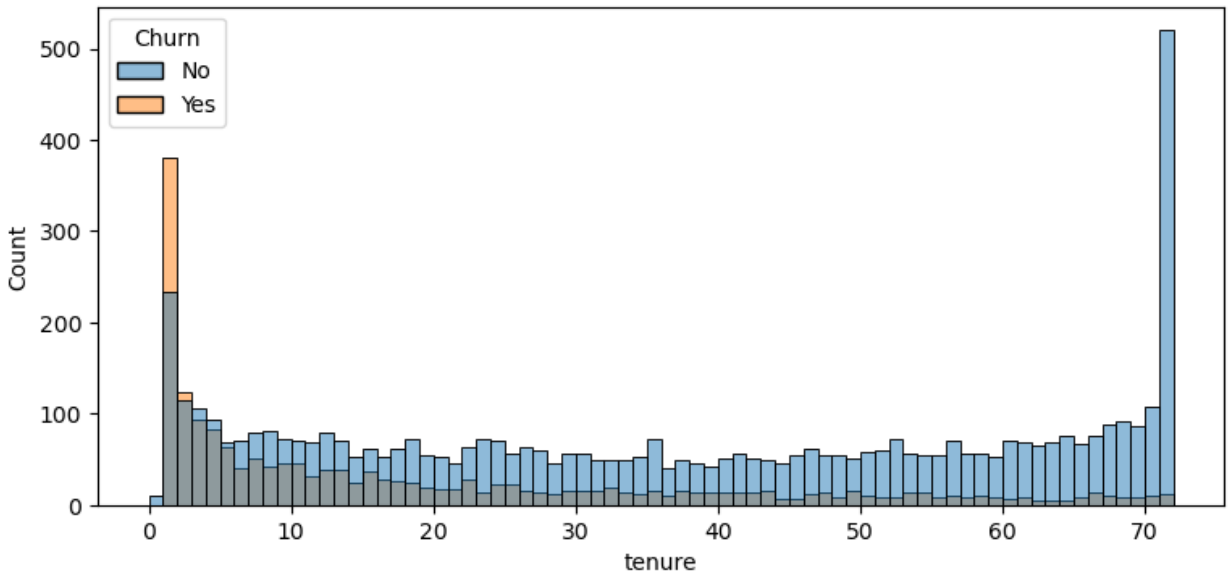



```
# Step 1: Group and calculate percentages
counts = df.groupby(['SeniorCitizen',
'Churn']).size().unstack(fill_value=0)
percentages = counts.div(counts.sum(axis=1), axis=0) * 100

# Step 2: Define custom colors for 'Churn' categories
palette = {"No": "#1f77b4", "Yes": "#ff7f0e"}
colors = [palette[churn_status] for churn_status in
percentages.columns]

# Step 3: Plot the stacked bar chart
ax = percentages.plot(kind='bar', stacked=True, color=colors,
figsize=(4, 4))

# Set labels and title
ax.set_ylabel('Percentage')
ax.set_xlabel('Senior Citizen')
ax.set_title('Churn by Senior Citizen (Percentage)')
ax.legend(title='Churn', bbox_to_anchor=(1.05, 1), loc='upper left')

# Add percentage labels to each segment
for container in ax.containers:
    labels = [f'{v.get_height():.1f}%' if v.get_height() > 0 else ''
for v in container]
    ax.bar_label(container, labels=labels, label_type='center',
fontsize=8)
```

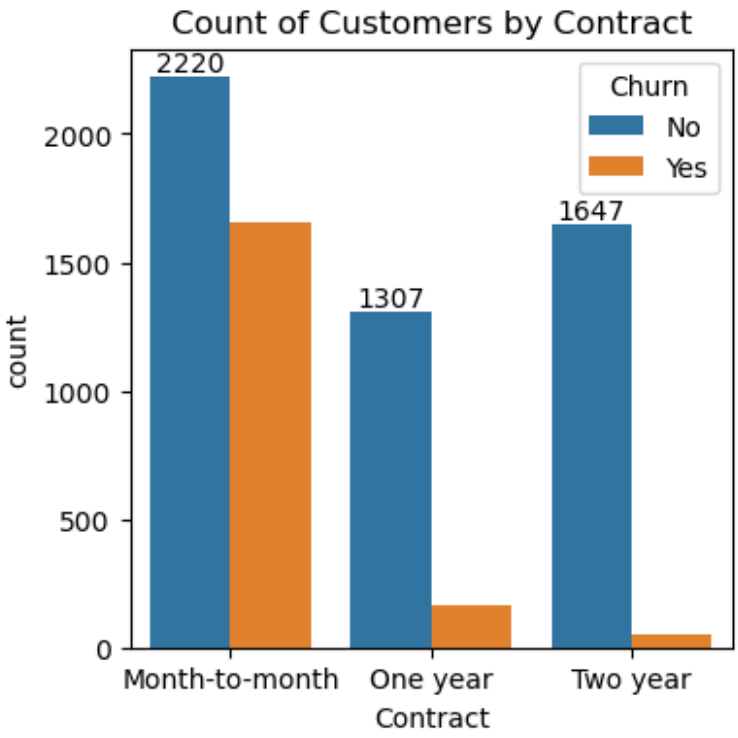
```
plt.tight_layout()
plt.show()
```




```
# Compartive a larger percentage of people in senior citizen category
have chunred out.

plt.figure(figsize = (9,4))
sns.histplot(x = "tenure",data = df,bins=72, hue = "Churn")
plt.show()
```




```
# people who have used our services for a long time have stayed and
people who have used our services
# 1 or 2 months have churned

plt.figure(figsize=(4,4))
ax = sns.countplot(x = "Contract",data = df,hue = "Churn")
ax.bar_label(ax.containers[0])
plt.title("Count of Customers by Contract")
plt.show()
```



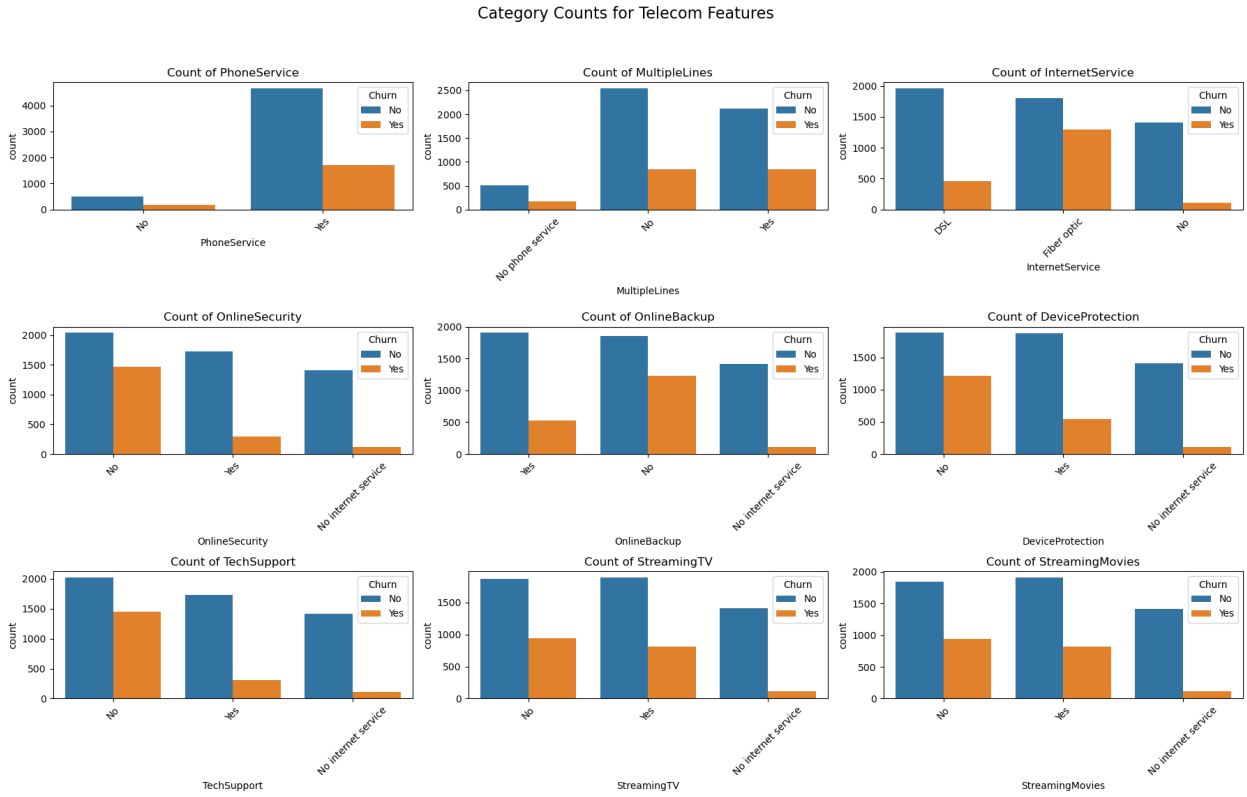

```
# people who have month to month contract are likely to churn then
from those who have 1 or 2
# year contract.
```

```
df.columns.values
```

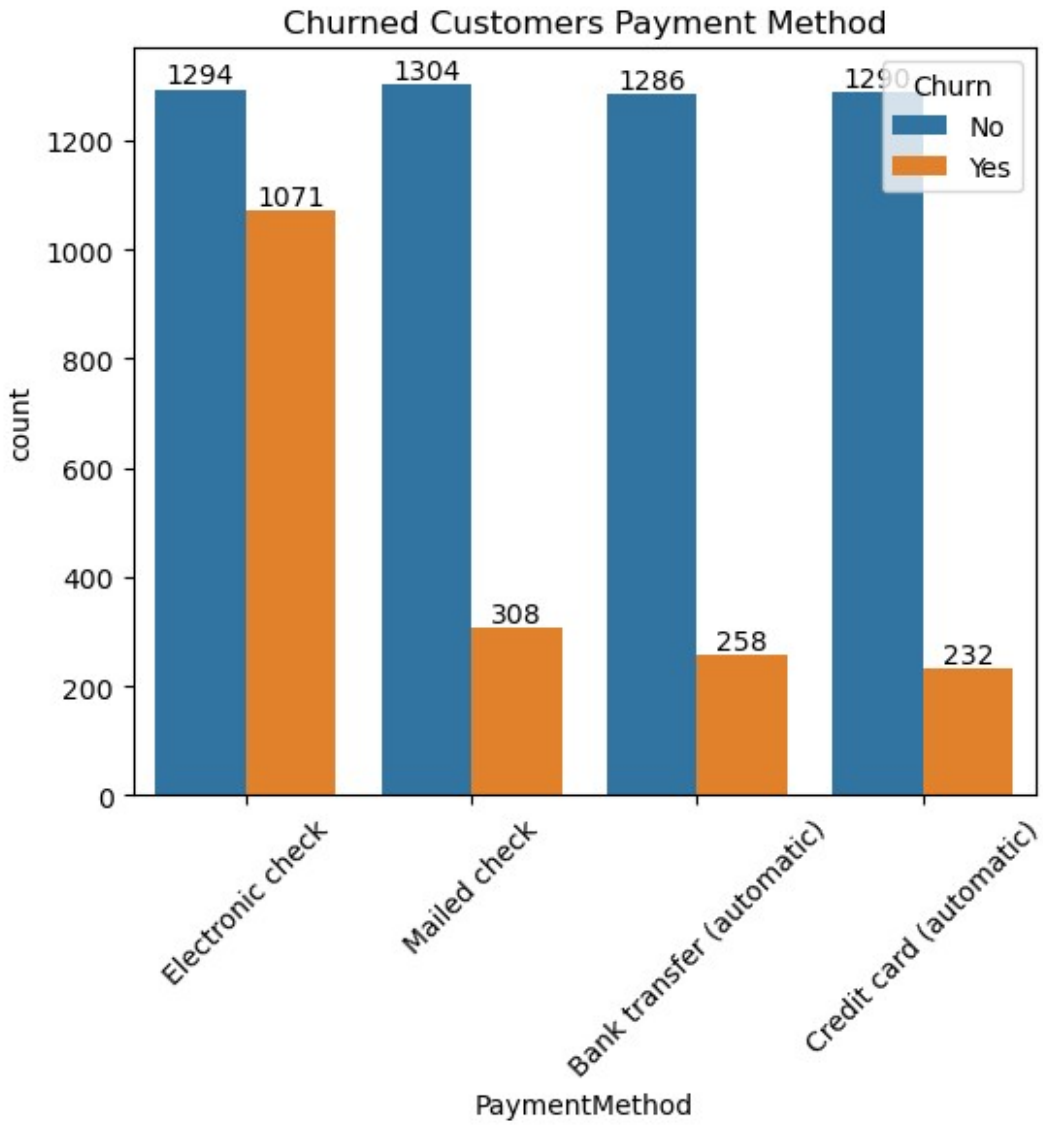
```
array(['customerID', 'gender', 'SeniorCitizen', 'Partner',
'Dependents',
       'tenure', 'PhoneService', 'MultipleLines', 'InternetService',
       'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
       'TechSupport', 'StreamingTV', 'StreamingMovies', 'Contract',
       'PaperlessBilling',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

```
# List of categorical columns
columns = ['PhoneService', 'MultipleLines', 'InternetService',
           'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
           'TechSupport', 'StreamingTV', 'StreamingMovies']

# Set up the plot grid (3 rows x 3 columns for 9 features)
fig, axes = plt.subplots(nrows=3, ncols=3, figsize=(18, 12))
fig.suptitle('Category Counts for Telecom Features', fontsize=16)

# Flatten axes to iterate easily
axes = axes.flatten()

# Loop through each column and create a countplot
```

```
for i, col in enumerate(columns):
    sns.countplot(data=df, x=col, ax=axes[i],hue = "Churn")
    axes[i].set_title(f'Count of {col}')
    axes[i].tick_params(axis='x', rotation=45)

# Adjust layout
plt.tight_layout(rect=[0, 0.03, 1, 0.95])
plt.show()
```




```
# the majority of customers who do not churn trend to have services like phoneservices, internetservices
# (particularly(DSL)) and online security enabled. online backup, techsupport, and streaming tv
# , churn rates are noticeably higher when these services are not used or are unavailable.

plt.figure(figsize =(6,5))
ax = sns.countplot(x = 'PaymentMethod',data = df, hue = "Churn")
ax.bar_label(ax.containers[0])
ax.bar_label(ax.containers[1])
plt.title("Churned Customers Payment Method")
plt.xticks(rotation = 45)
plt.show()
```




```
# customer is likely to churn when he is using electronic check  as a
payment method.
```