```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
df = pd.read_csv("Customer Churn.csv")
print(df)
df.head()
```

```
      customerID  gender  SeniorCitizen Partner Dependents  tenure  \
0     7590-VHVEG  Female              0     Yes         No       1   
1     5575-GNVDE    Male              0      No         No      34   
2     3668-QPYBK    Male              0      No         No       2   
3     7795-CFOCW    Male              0      No         No      45   
4     9237-HQITU  Female              0      No         No       2   
...          ...     ...           ...     ...        ...     ...   
7038  6840-RESVB    Male              0     Yes        Yes      24   
7039  2234-XADUH  Female              0     Yes        Yes      72   
7040  4801-JZAZL  Female              0     Yes        Yes      11   
7041  8361-LTMKD    Male              1     Yes         No       4   
7042  3186-AJIEK    Male              0      No         No      66   

     PhoneService     MultipleLines InternetService
OnlineSecurity  ...  \
0              No  No phone service             DSL
No  ...   
1             Yes                No             DSL
Yes  ...   
2             Yes                No             DSL
Yes  ...   
3              No  No phone service             DSL
Yes  ...   
4             Yes                No     Fiber optic
No  ...   
...           ...               ...             ...            ...  ..
.   
7038          Yes               Yes             DSL
Yes  ...   
7039          Yes               Yes     Fiber optic
No  ...   
7040           No  No phone service             DSL
Yes  ...   
7041          Yes               Yes     Fiber optic
No  ...   
7042          Yes                No     Fiber optic
Yes  ...   

     DeviceProtection TechSupport StreamingTV StreamingMovies
Contract  \
0                  No          No          No              No  Month-
to-month
```

```
1                 Yes          No          No              No
One year
2                  No          No          No              No  Month-
to-month
3                 Yes         Yes          No              No
One year
4                  No          No          No              No  Month-
to-month
...               ...         ...         ...             ...
...
7038              Yes         Yes         Yes             Yes
One year
7039              Yes          No         Yes             Yes
One year
7040               No          No          No              No  Month-
to-month
7041               No          No          No              No  Month-
to-month
7042              Yes         Yes         Yes             Yes
Two year

     PaperlessBilling              PaymentMethod MonthlyCharges
TotalCharges  \
0                 Yes           Electronic check          29.85
29.85
1                  No               Mailed check          56.95
1889.5
2                 Yes               Mailed check          53.85
108.15
3                  No  Bank transfer (automatic)          42.30
1840.75
4                 Yes           Electronic check          70.70
151.65
...               ...                        ...            ...
...
7038              Yes               Mailed check          84.80
1990.5
7039              Yes    Credit card (automatic)         103.20
7362.9
7040              Yes           Electronic check          29.60
346.45
7041              Yes               Mailed check          74.40
306.6
7042              Yes  Bank transfer (automatic)         105.65
6844.5

     Churn
0       No
1       No
```

```
2       Yes
3        No
4       Yes
...     ...
7038     No
7039     No
7040     No
7041    Yes
7042     No

[7043 rows x 21 columns]

   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
```

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

#replacing the blanks WITH 0 as tenure is 0 and total charges are recorded

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
```

```
Data columns (total 22 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 
 21  Total Charges     7043 non-null   object 
dtypes: float64(2), int64(2), object(18)
memory usage: 1.2+ MB
```

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

```
np.int64(0)
```

```
df.describe()
```

```
       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
```

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

```
np.int64(0)
```

```
def conv(value):  # Function definition
    if value == 1:  # Properly indented block
        return "yes"
    else:
        return "no"

# Apply the function to the 'SeniorCitizen' column
df["SeniorCitizen"] = df["SeniorCitizen"].apply(conv)
```

#converted the senior citizen (0 or 1) to (yes or no) for proper understanding

```
df.head(30)

    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
10  9763-GRSKD    Male            no     Yes        Yes      13
Yes
11  7469-LKBCI    Male            no      No         No      16
Yes
12  8091-TTVAX    Male            no     Yes         No      58
Yes
13  0280-XJGEX    Male            no      No         No      49
Yes
14  5129-JLPIS    Male            no      No         No      25
Yes
15  3655-SNQYZ  Female            no     Yes        Yes      69
Yes
16  8191-XWSZG  Female            no      No         No      52
Yes
17  9959-WOFKT    Male            no      No        Yes      71
Yes
```

```
18  4190-MFLUW  Female            no     Yes        Yes      10
Yes
19  4183-MYFRB  Female            no      No         No      21
Yes
20  8779-QRDMV    Male           yes      No         No       1
No
21  1680-VDCWW    Male            no     Yes         No      12
Yes
22  1066-JKSGK    Male            no      No         No       1
Yes
23  3638-WEABW  Female            no     Yes         No      58
Yes
24  6322-HRPFA    Male            no     Yes        Yes      49
Yes
25  6865-JZNKO  Female            no      No         No      30
Yes
26  6467-CHFZW    Male            no     Yes        Yes      47
Yes
27  8665-UTDHZ    Male            no     Yes        Yes       1
No
28  5248-YGIJN    Male            no     Yes         No      72
Yes
29  8773-HHUOZ  Female            no      No        Yes      17
Yes

       MultipleLines InternetService       OnlineSecurity  ...  \
0   No phone service             DSL                   No  ...
1                 No             DSL                  Yes  ...
2                 No             DSL                  Yes  ...
3   No phone service             DSL                  Yes  ...
4                 No     Fiber optic                   No  ...
5                Yes     Fiber optic                   No  ...
6                Yes     Fiber optic                   No  ...
7   No phone service             DSL                  Yes  ...
8                Yes     Fiber optic                   No  ...
9                 No             DSL                  Yes  ...
10                No             DSL                  Yes  ...
11                No              No  No internet service  ...
12               Yes     Fiber optic                   No  ...
13               Yes     Fiber optic                   No  ...
14                No     Fiber optic                  Yes  ...
15               Yes     Fiber optic                  Yes  ...
16                No              No  No internet service  ...
17               Yes     Fiber optic                  Yes  ...
18                No             DSL                   No  ...
19                No     Fiber optic                   No  ...
20  No phone service             DSL                   No  ...
21                No              No  No internet service  ...
22                No              No  No internet service  ...
```

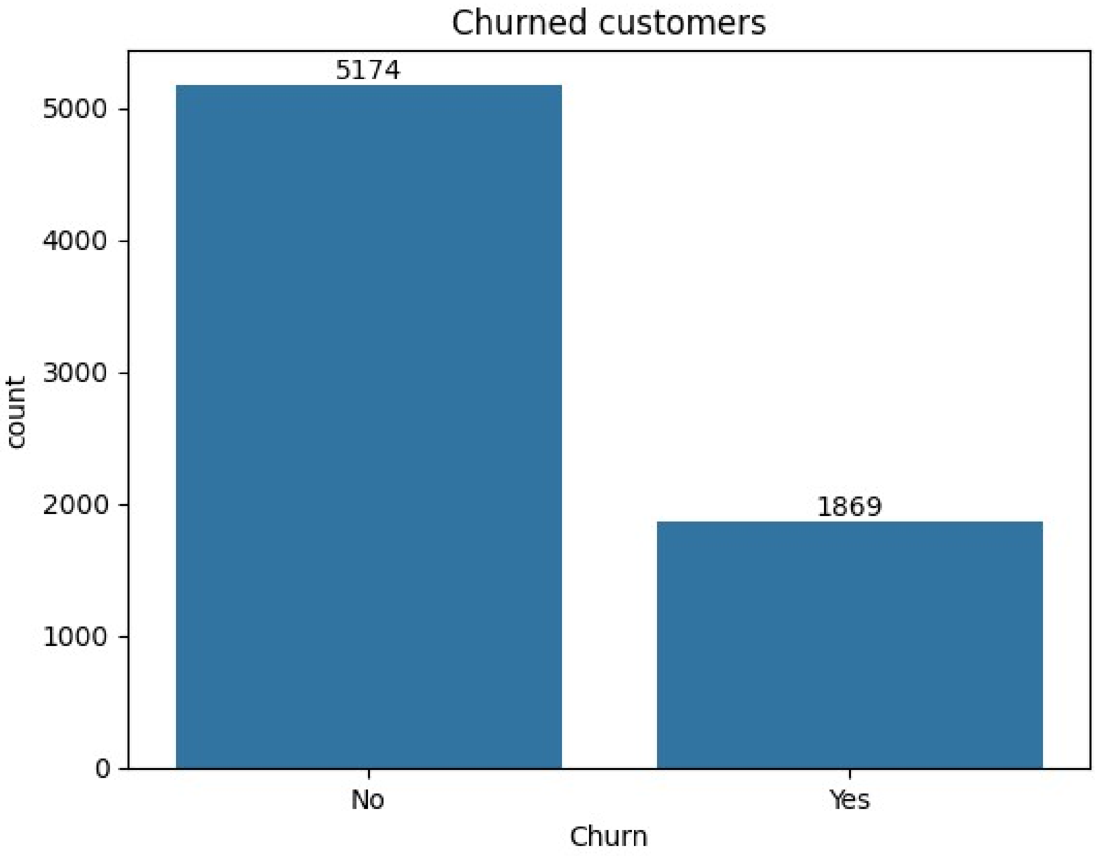
```
23               Yes             DSL                   No  ...
24                No             DSL                  Yes  ...
25                No             DSL                  Yes  ...
26               Yes     Fiber optic                   No  ...
27  No phone service             DSL                   No  ...
28               Yes             DSL                  Yes  ...
29                No             DSL                   No  ...

       DeviceProtection          TechSupport          StreamingTV  \
0                    No                   No                   No   
1                   Yes                   No                   No   
2                    No                   No                   No   
3                   Yes                  Yes                   No   
4                    No                   No                   No   
5                   Yes                   No                  Yes   
6                    No                   No                  Yes   
7                    No                   No                   No   
8                   Yes                  Yes                  Yes   
9                    No                   No                   No   
10                   No                   No                   No   
11  No internet service  No internet service  No internet service   
12                  Yes                   No                  Yes   
13                  Yes                   No                  Yes   
14                  Yes                  Yes                  Yes   
15                  Yes                  Yes                  Yes   
16  No internet service  No internet service  No internet service   
17                  Yes                   No                  Yes   
18                  Yes                  Yes                   No   
19                  Yes                   No                   No   
20                  Yes                   No                   No   
21  No internet service  No internet service  No internet service   
22  No internet service  No internet service  No internet service   
23                   No                  Yes                   No   
24                   No                  Yes                   No   
25                   No                   No                   No   
26                   No                   No                  Yes   
27                   No                   No                   No   
28                  Yes                  Yes                  Yes   
29                   No                   No                  Yes   

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

```
8                   Yes  Month-to-month              Yes
9                    No        One year               No
10                   No  Month-to-month              Yes
11  No internet service        Two year               No
12                  Yes        One year               No
13                  Yes  Month-to-month              Yes
14                  Yes  Month-to-month              Yes
15                  Yes        Two year               No
16  No internet service        One year               No
17                  Yes        Two year               No
18                   No  Month-to-month               No
19                  Yes  Month-to-month              Yes
20                  Yes  Month-to-month              Yes
21  No internet service        One year               No
22  No internet service  Month-to-month               No
23                   No        Two year              Yes
24                   No  Month-to-month               No
25                   No  Month-to-month              Yes
26                  Yes  Month-to-month              Yes
27                   No  Month-to-month               No
28                  Yes        Two year              Yes
29                  Yes  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            Electronic check          99.65         820.5   Yes
6     Credit card (automatic)          89.10        1949.4    No
7                Mailed check          29.75         301.9    No
8            Electronic check         104.80       3046.05   Yes
9   Bank transfer (automatic)          56.15       3487.95    No
10               Mailed check          49.95        587.45    No
11    Credit card (automatic)          18.95         326.8    No
12    Credit card (automatic)         100.35        5681.1    No
13  Bank transfer (automatic)         103.70        5036.3   Yes
14           Electronic check         105.50       2686.05    No
15    Credit card (automatic)         113.25       7895.15    No
16               Mailed check          20.65       1022.95    No
17  Bank transfer (automatic)         106.70       7382.25    No
18    Credit card (automatic)          55.20        528.35   Yes
19           Electronic check          90.05        1862.9    No
20           Electronic check          39.65         39.65   Yes
21  Bank transfer (automatic)          19.80        202.25    No
22               Mailed check          20.15         20.15   Yes
23    Credit card (automatic)          59.90        3505.1    No
24    Credit card (automatic)          59.60        2970.3    No
```

```
25  Bank transfer (automatic)           55.30        1530.6    No
26             Electronic check         99.35       4749.15   Yes
27             Electronic check         30.20          30.2   Yes
28    Credit card (automatic)           90.25       6369.45    No
29                 Mailed check         64.70        1093.1   Yes

[30 rows x 21 columns]
```

#Churned figures in the bar plot representation

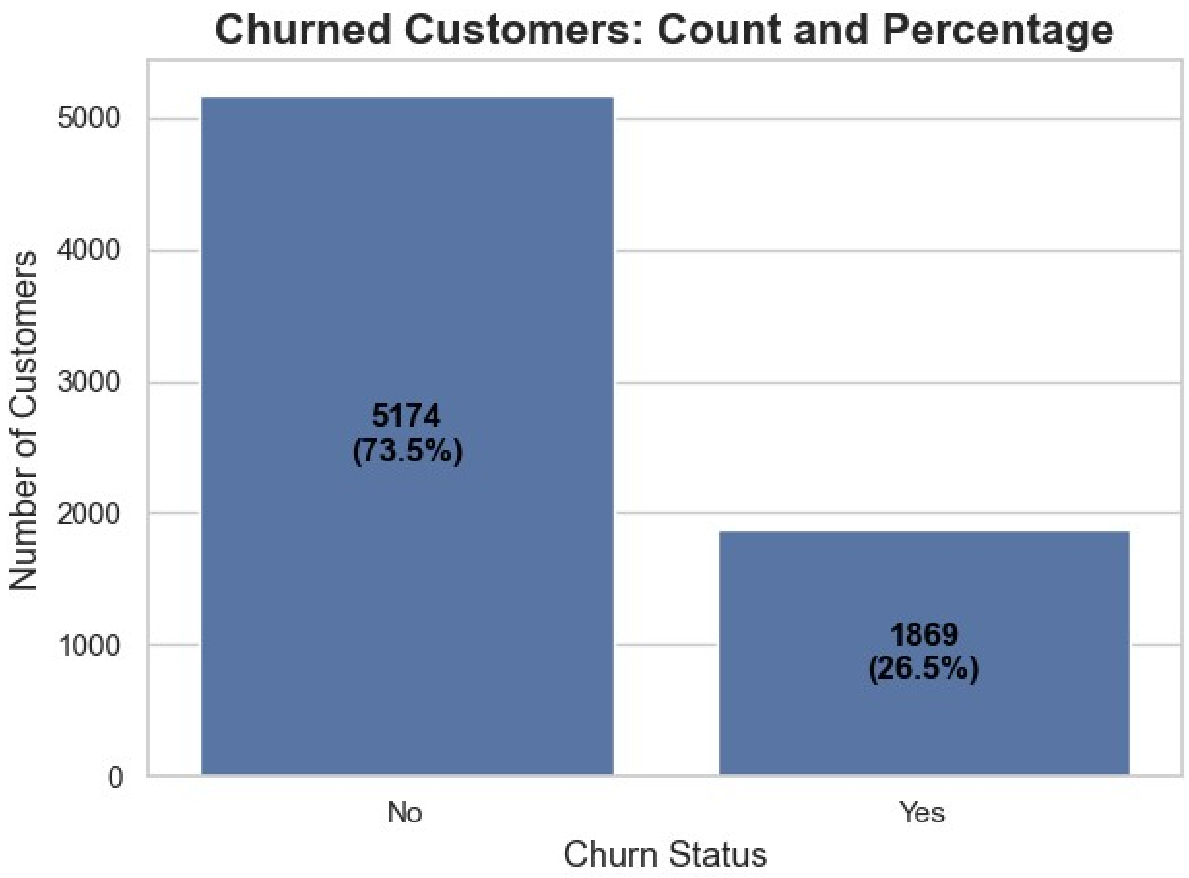
```
ax = sns.countplot(x = 'Churn' , data = df)
ax.bar_label(ax.containers[0])
plt.title("Churned customers")
plt.show()
print(df['Churn'].value_counts())
```



```
Churn
No     5174
Yes    1869
Name: count, dtype: int64
```

#percentage analysis Churned customers

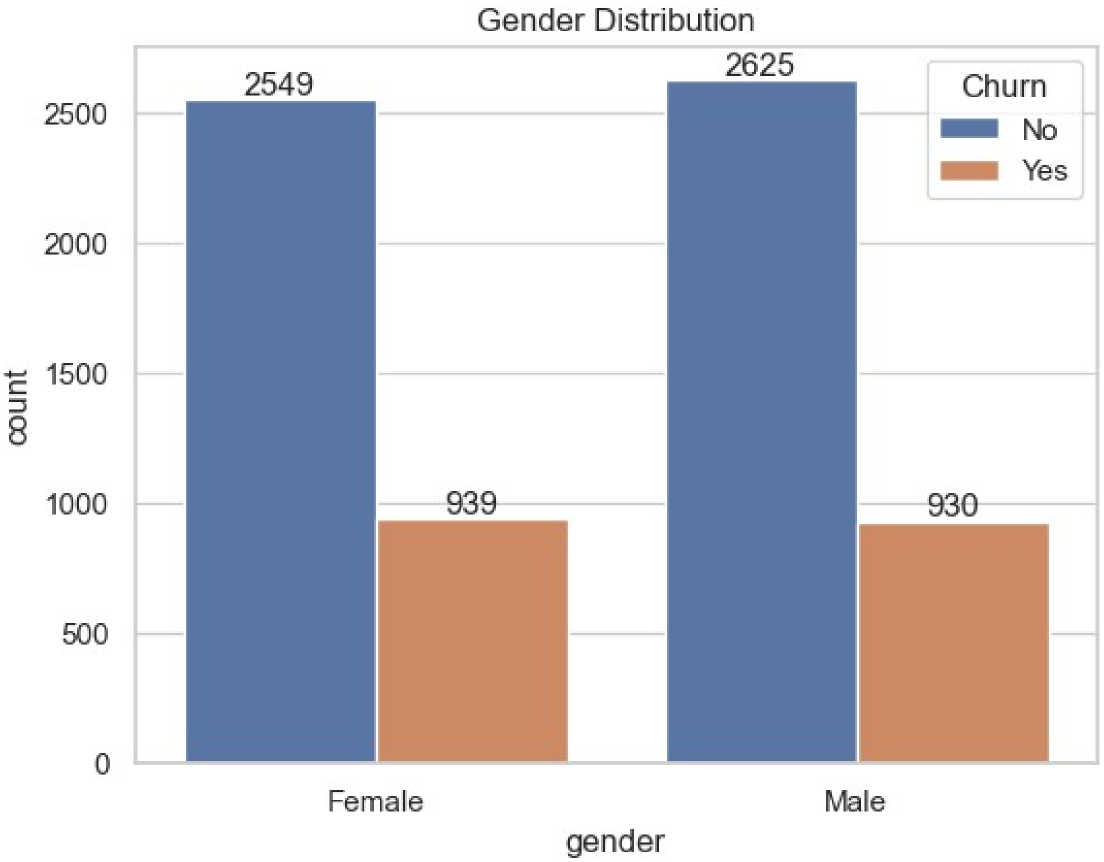
```
# Set style and font
sns.set(style='whitegrid')
plt.rcParams.update({'font.size': 12})  # Default font size

# Create the countplot
ax = sns.countplot(x='Churn', data=df)

# Calculate counts and total
counts = df['Churn'].value_counts()
total = len(df)

# Add count and percentage labels INSIDE the bars
for container in ax.containers:
    labels = [f'{int(value)}\n({value/total:.1%})' for value in
container.datavalues]
    ax.bar_label(container, labels=labels, label_type='center',
fontsize=12, color='black',fontweight= 'bold')

# Set title and axis labels
plt.title("Churned Customers: Count and Percentage", fontsize=16,
fontweight='bold')
plt.xlabel("Churn Status", fontsize=13)
plt.ylabel("Number of Customers", fontsize=13)

plt.tight_layout()
plt.show()

# Print value counts and percentages
print("Value Counts:")
print(counts)

print("\nPercentages:")
print(df['Churn'].value_counts(normalize=True).map("{:.2%}".format))
```



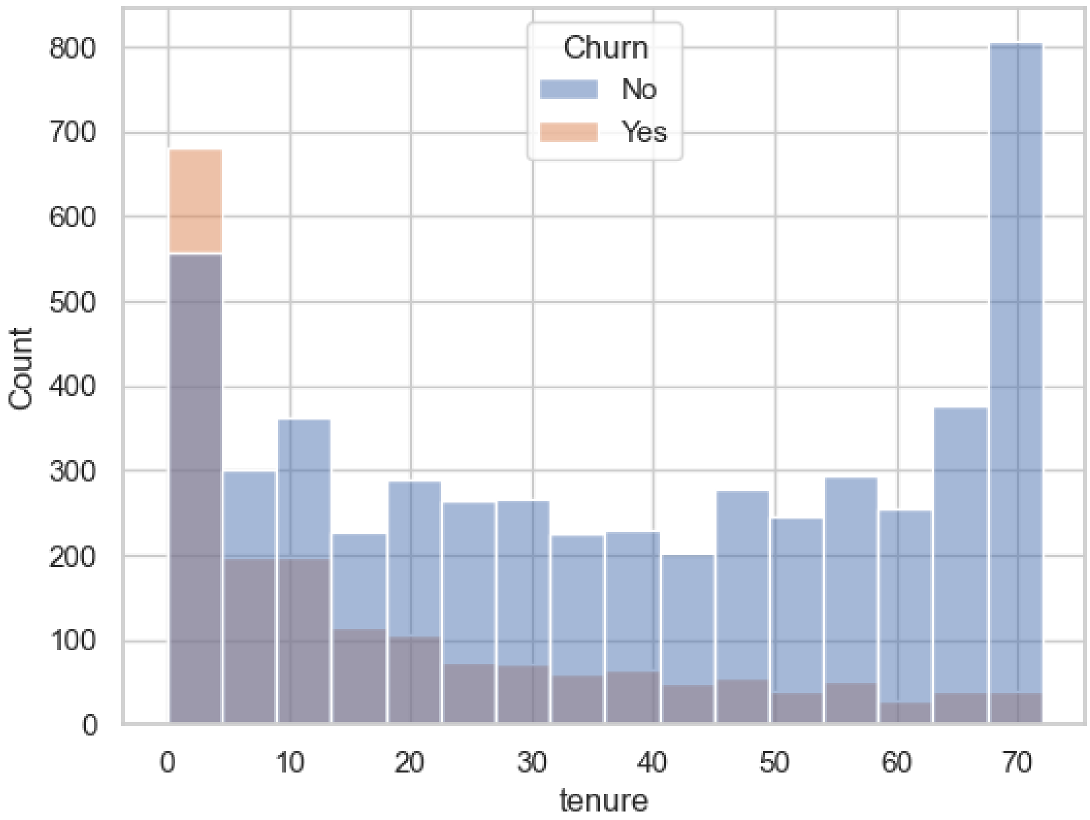
```
Value Counts:
Churn
No     5174
Yes    1869
Name: count, dtype: int64

Percentages:
Churn
No     73.46%
Yes    26.54%
Name: proportion, dtype: object
```

#Gender distribution of the Churned customers

```
ax = sns.countplot(x = "gender" , data = df, hue = "Churn")
ax.bar_label(ax.containers[0])
ax.bar_label(ax.containers[1])
plt.title("Gender Distribution")
plt.show()
print(df['gender'].value_counts())
```

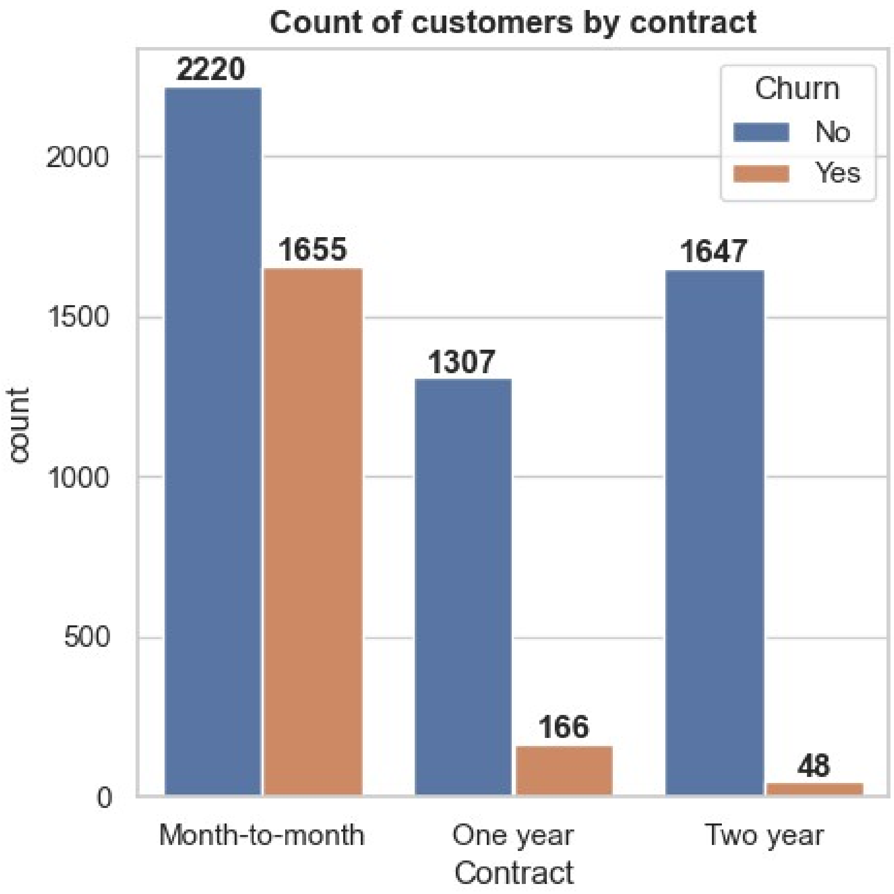


```
gender
Male      3555
Female    3488
Name: count, dtype: int64

sns.histplot(x = "tenure", data = df,hue = 'Churn')
plt.show()
```



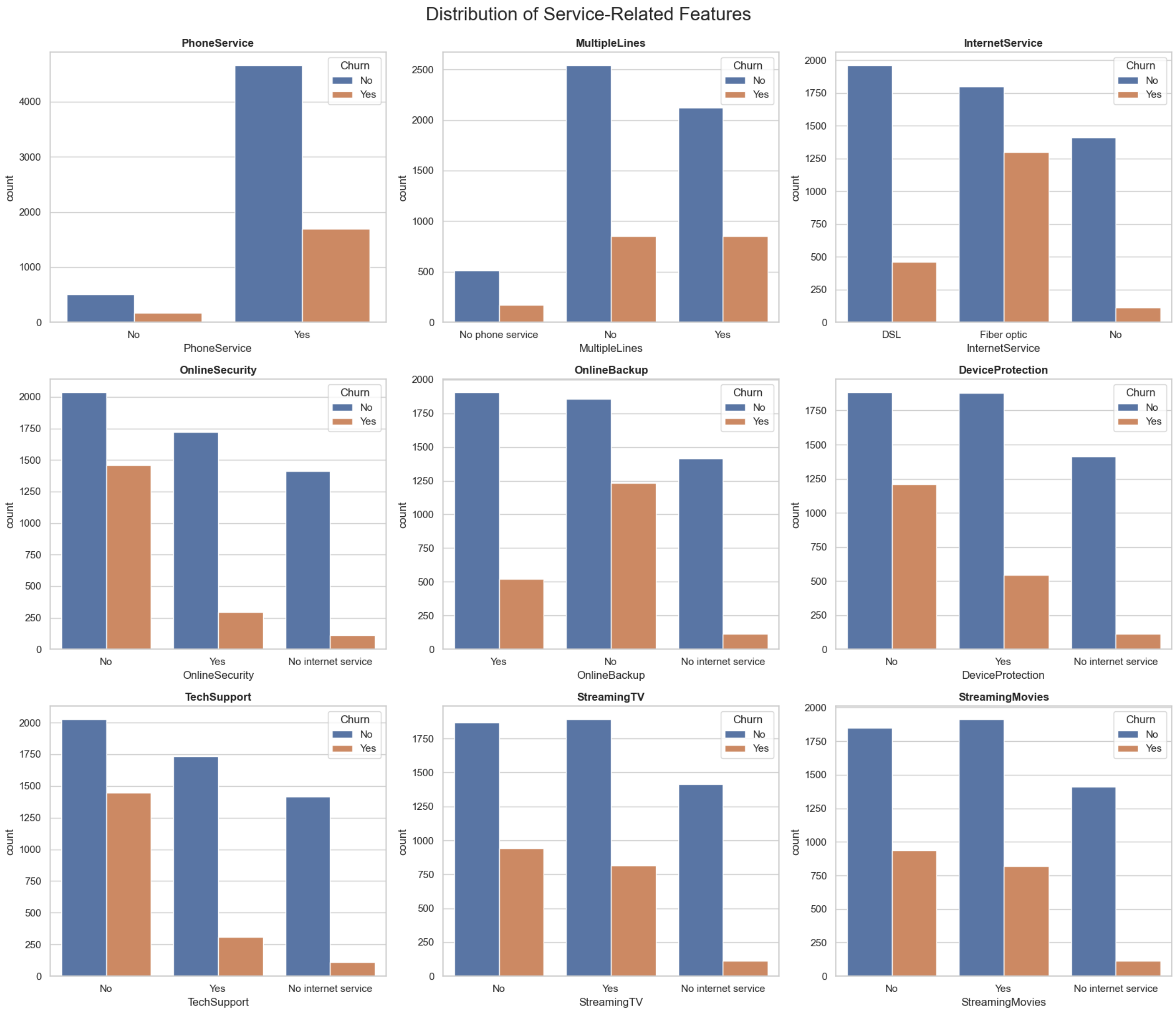
#people churned eventually after short duration of time but who stayed for a longer tenure haven't churned

```
plt.figure(figsize = (5,5))
ax = sns.countplot(x = "Contract" , data = df,hue = "Churn")
ax.bar_label(ax.containers[0],fontweight='bold')
ax.bar_label(ax.containers[1],fontweight='bold')
plt.title("Count of customers by contract",fontweight='bold')
plt.show()
```



#count of customers by 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)

columns = ['PhoneService', 'MultipleLines', 'InternetService',
           'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
           'TechSupport', 'StreamingTV', 'StreamingMovies']

plt.figure(figsize=(18, 15))
for i, col in enumerate(columns, 1):
    plt.subplot(3, 3, i)
    sns.countplot(data=df, x=col,hue ="Churn")
    plt.title(col,fontweight='bold')
    plt.xticks(rotation=0)
    plt.tight_layout()
plt.suptitle('Distribution of Service-Related Features', fontsize=20,
y=1.02)
plt.show()
```

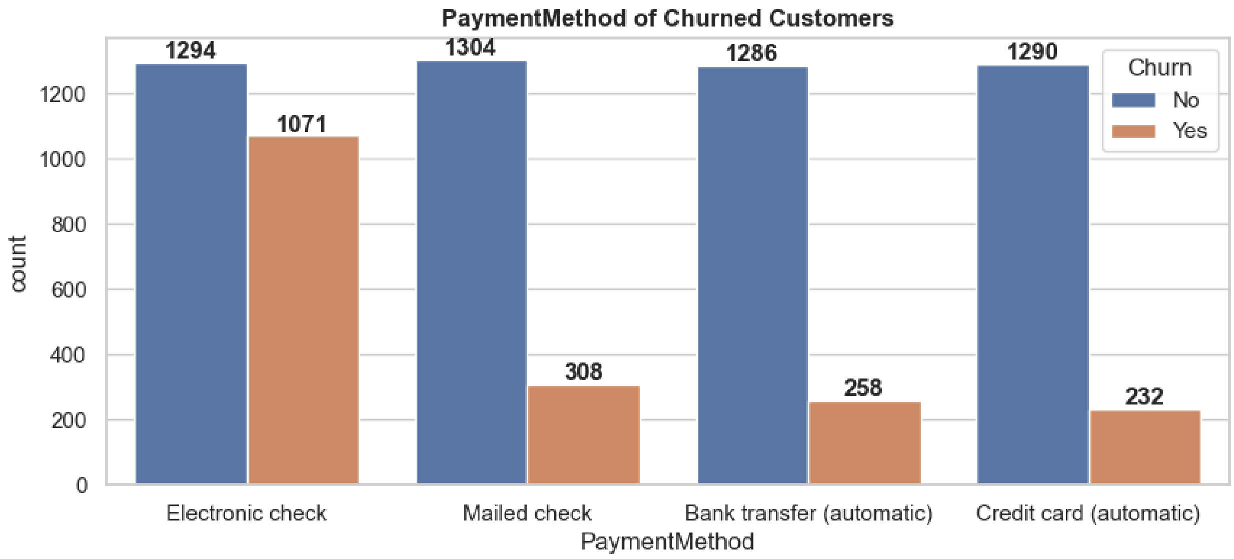


#This set of countplots visualizes the distribution of key service-related features (like InternetService, OnlineSecurity, TechSupport, etc.) with respect to customer churn. Each plot shows how many customers have or lack a particular service, and whether they have churned or not.

From the plots, we observe that customers who do not have services like OnlineSecurity, TechSupport, DeviceProtection show a higher churn rate. Similarly, users with Fiber optic internet also seem to churn more frequently compared to DSL users.

These trends can help telecom companies focus on improving service offerings , bundling features to reduce churn.

```
plt.figure(figsize = (10,4))
ax = sns.countplot(x = "PaymentMethod" , data = df,hue = "Churn")
ax.bar_label(ax.containers[0],fontweight='bold')
ax.bar_label(ax.containers[1],fontweight='bold')
plt.title("PaymentMethod of Churned Customers",fontweight='bold')
plt.show()
```



#Electronic check has the highest churned customer figures