In [1]:
```
#SOURABH SINGH THAKUR

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.ticker as mtick
import seaborn as sns
%matplotlib inline
```

In [ ]:
```
```

In [2]:
```
df = pd.read_csv('D://Customer_churn.csv')
```

Look at the top 5 records of data

In [3]:
```
df.head()
```

Out[3]:

	CustomerID	Count	Country	State	City	Zip Code	Lat Long	Latitude	Longitude	Gender	...	Streaming TV	Streaming Movies	Contract	Paperless Billing	Paym Meth
0	3668-QPYBK	1	United States	California	Los Angeles	90003	33.964131, -118.272783	33.964131	-118.272783	Male	...	No	No	Month-to-month	Yes	Mai che
1	9237-HQITU	1	United States	California	Los Angeles	90005	34.059281, -118.30742	34.059281	-118.307420	Female	...	No	No	Month-to-month	Yes	Electro che
2	9305-CDSKC	1	United States	California	Los Angeles	90006	34.048013, -118.293953	34.048013	-118.293953	Female	...	Yes	Yes	Month-to-month	Yes	Electro che
3	7892-POOKP	1	United States	California	Los Angeles	90010	34.062125, -118.315709	34.062125	-118.315709	Female	...	Yes	Yes	Month-to-month	Yes	Electro che
4	0280-XJGEX	1	United States	California	Los Angeles	90015	34.039224, -118.266293	34.039224	-118.266293	Male	...	Yes	Yes	Month-to-month	Yes	Ba trans (automa

5 rows × 31 columns

Check the various attributes of data like shape (rows and cols), Columns, datatypes

In [4]:
```
df.shape
```

Out[4]:
```
(7043, 31)
```

In [5]:
```
df.columns.values
```

Out[5]:
```
array(['CustomerID', 'Count', 'Country', 'State', 'City', 'Zip Code',
       'Lat Long', 'Latitude', 'Longitude', 'Gender', 'Senior Citizen',
       'Partner', 'Dependents', 'Tenure Months', 'Phone Service',
       'Multiple Lines', 'Internet Service', 'Online Security',
       'Online Backup', 'Device Protection', 'Tech Support',
       'Streaming TV', 'Streaming Movies', 'Contract',
       'Paperless Billing', 'Payment Method', 'Monthly Charges(Dollar)',
       'Total Charges(Dollar)', 'Churn Label', 'Churn Reason', 'Date '],
      dtype=object)
```

In [6]:
```
#Checking the data types of all the columns
df.dtypes
```

Out[6]:
```
CustomerID                 object
Count                       int64
Country                    object
State                      object
City                       object
Zip Code                    int64
Lat Long                   object
Latitude                  float64
Longitude                 float64
Gender                     object
Senior Citizen             object
Partner                    object
Dependents                 object
Tenure Months               int64
Phone Service              object
Multiple Lines             object
Internet Service           object
Online Security            object
Online Backup              object
Device Protection          object
Tech Support               object
Streaming TV               object
Streaming Movies           object
Contract                   object
Paperless Billing          object
Payment Method             object
Monthly Charges(Dollar)   float64
Total Charges(Dollar)      object
Churn Label                object
Churn Reason               object
Date                       object
dtype: object
```

```
#As we can see the total charges is object type we have to convert it to float type to get its statistical datas
```

In [7]:
```
#First we will replace the null values to 0 as without that is can not be changed to float type
df['Total Charges(Dollar)']=df['Total Charges(Dollar)'].replace(to_replace=' ',value=0)
```

In [8]:
```
df['Total Charges(Dollar)']=df['Total Charges(Dollar)'].astype(float)
```

```
Now checking the types
```

In [9]:
```
df.dtypes
```

Out[9]:
```
CustomerID                 object
Count                       int64
Country                    object
State                      object
City                       object
Zip Code                    int64
Lat Long                   object
Latitude                  float64
Longitude                 float64
Gender                     object
Senior Citizen             object
Partner                    object
Dependents                 object
Tenure Months               int64
Phone Service              object
Multiple Lines             object
Internet Service           object
Online Security            object
Online Backup              object
Device Protection          object
Tech Support               object
Streaming TV               object
Streaming Movies           object
Contract                   object
Paperless Billing          object
Payment Method             object
Monthly Charges(Dollar)   float64
Total Charges(Dollar)     float64
Churn Label                object
Churn Reason               object
Date                       object
dtype: object
```

In [ ]:
```
As we can see it has been changed to float type, now we can do further Exploratory data analysis for the data
```

In [10]:
```
#Check the descriptive statistics of numeric variables
df.describe()
```

Out[10]:

	Count	Zip Code	Latitude	Longitude	Tenure Months	Monthly Charges(Dollar)	Total Charges(Dollar)
count	7043.0	7043.000000	7043.000000	7043.000000	7043.000000	7.043000e+03	7.043000e+03
mean	1.0	93521.964646	36.282441	-119.798880	32.371149	2.839761e+06	2.841975e+06
std	0.0	1865.794555	2.455723	2.157889	24.559481	2.383149e+08	2.383148e+08
min	1.0	90001.000000	32.555828	-124.301372	0.000000	-2.000000e+04	-2.000000e+04
25%	1.0	92102.000000	34.030915	-121.815412	9.000000	3.550000e+01	3.985500e+02
50%	1.0	93552.000000	36.391777	-119.730885	29.000000	7.035000e+01	1.394550e+03
75%	1.0	95351.000000	38.224869	-118.043237	55.000000	8.985000e+01	3.790400e+03
max	1.0	96161.000000	41.962127	-114.192901	72.000000	2.000000e+10	2.000000e+10

```
There is some problem with dataset, for monthly charges and total charges as it cannot be this much big value, we have to find
and replace with suitable values.
```

In [11]:
```
#We have replaced the negative value -20000 with 0.
df['Monthly Charges(Dollar)']=df['Monthly Charges(Dollar)'].replace(to_replace=-20000,value=0)
```

In [12]:
```
df.describe()
```

Out[12]:

	Count	Zip Code	Latitude	Longitude	Tenure Months	Monthly Charges(Dollar)	Total Charges(Dollar)
count	7043.0	7043.000000	7043.000000	7043.000000	7043.000000	7.043000e+03	7.043000e+03
mean	1.0	93521.964646	36.282441	-119.798880	32.371149	2.839764e+06	2.841975e+06
std	0.0	1865.794555	2.455723	2.157889	24.559481	2.383149e+08	2.383148e+08
min	1.0	90001.000000	32.555828	-124.301372	0.000000	0.000000e+00	-2.000000e+04
25%	1.0	92102.000000	34.030915	-121.815412	9.000000	3.550000e+01	3.985500e+02
50%	1.0	93552.000000	36.391777	-119.730885	29.000000	7.035000e+01	1.394550e+03
75%	1.0	95351.000000	38.224869	-118.043237	55.000000	8.985000e+01	3.790400e+03
max	1.0	96161.000000	41.962127	-114.192901	72.000000	2.000000e+10	2.000000e+10

In [13]:
```
df.max()
```

```
C:\Users\112987\AppData\Local\Temp\ipykernel_19568\1151452817.py:1: FutureWarning: Dropping of nuisance columns in DataFrame re
ductions (with 'numeric_only=None') is deprecated; in a future version this will raise TypeError.  Select only valid columns be
fore calling the reduction.
  df.max()
```

Out[13]:
```
Count                                          1
Country                    United States of America
State                                  California
City                                        Zenia
Zip Code                                    96161
Lat Long                  41.962127, -122.527696
Latitude                                41.962127
Longitude                             -114.192901
Gender                                      Other
Senior Citizen                                Yes
Partner                                       Yes
Dependents                                    Yes
Tenure Months                                  72
Phone Service                                 Yes
Multiple Lines                                Yes
Internet Service                               No
Online Security                               Yes
Online Backup                                 Yes
Device Protection                             Yes
Tech Support                                  Yes
Streaming TV                                  Yes
Streaming Movies                              Yes
Contract                                 Two year
Paperless Billing                             Yes
Payment Method                        Mailed check
Monthly Charges(Dollar)              20000000000.0
Total Charges(Dollar)                20000000000.0
Churn Label                                   Yes
Date                                    31-Oct-22
dtype: object
```

As we can see Maximum value in monthly and total charges is 20000000000 which is an error so we will first replace it by 0

In [14]:
```
df['Monthly Charges(Dollar)']=df['Monthly Charges(Dollar)'].replace(to_replace=20000000000,value=0)
```

In [15]:
```
df.describe()
```

Out[15]:

	Count	Zip Code	Latitude	Longitude	Tenure Months	Monthly Charges(Dollar)	Total Charges(Dollar)
count	7043.0	7043.000000	7043.000000	7043.000000	7043.000000	7043.000000	7.043000e+03
mean	1.0	93521.964646	36.282441	-119.798880	32.371149	64.748495	2.841975e+06
std	0.0	1865.794555	2.455723	2.157889	24.559481	30.104693	2.383148e+08
min	1.0	90001.000000	32.555828	-124.301372	0.000000	0.000000	-2.000000e+04
25%	1.0	92102.000000	34.030915	-121.815412	9.000000	35.500000	3.985500e+02
50%	1.0	93552.000000	36.391777	-119.730885	29.000000	70.350000	1.394550e+03
75%	1.0	95351.000000	38.224869	-118.043237	55.000000	89.850000	3.790400e+03
max	1.0	96161.000000	41.962127	-114.192901	72.000000	118.750000	2.000000e+10

As we can see for Monthly Charges after replacing those 2 values mean is 64.74, so we can take mean in place of both the values to fill the zero values

In [16]:
```
df['Monthly Charges(Dollar)']=df['Monthly Charges(Dollar)'].replace(to_replace=0,value=64.74)
```

In [17]:
```
df.describe()
```

Out[17]:

	Count	Zip Code	Latitude	Longitude	Tenure Months	Monthly Charges(Dollar)	Total Charges(Dollar)
count	7043.0	7043.000000	7043.000000	7043.000000	7043.000000	7043.000000	7.043000e+03
mean	1.0	93521.964646	36.282441	-119.798880	32.371149	64.766879	2.841975e+06
std	0.0	1865.794555	2.455723	2.157889	24.559481	30.084906	2.383148e+08
min	1.0	90001.000000	32.555828	-124.301372	0.000000	18.250000	-2.000000e+04
25%	1.0	92102.000000	34.030915	-121.815412	9.000000	35.525000	3.985500e+02
50%	1.0	93552.000000	36.391777	-119.730885	29.000000	70.350000	1.394550e+03
75%	1.0	95351.000000	38.224869	-118.043237	55.000000	89.850000	3.790400e+03
max	1.0	96161.000000	41.962127	-114.192901	72.000000	118.750000	2.000000e+10

Same problem is in Total Charges also so we will follow the same steps as done for montlhy charges

In [18]:
```
df['Total Charges(Dollar)']=df['Total Charges(Dollar)'].replace(to_replace=-20000,value=0)
df['Total Charges(Dollar)']=df['Total Charges(Dollar)'].replace(to_replace=20000000000,value=0)
```

In [19]:
```
df.describe()
```

Out[19]:

	Count	Zip Code	Latitude	Longitude	Tenure Months	Monthly Charges(Dollar)	Total Charges(Dollar)
count	7043.0	7043.000000	7043.000000	7043.000000	7043.000000	7043.000000	7043.000000
mean	1.0	93521.964646	36.282441	-119.798880	32.371149	64.766879	2279.342709
std	0.0	1865.794555	2.455723	2.157889	24.559481	30.084906	2266.986989
min	1.0	90001.000000	32.555828	-124.301372	0.000000	18.250000	0.000000
25%	1.0	92102.000000	34.030915	-121.815412	9.000000	35.525000	397.775000
50%	1.0	93552.000000	36.391777	-119.730885	29.000000	70.350000	1393.600000
75%	1.0	95351.000000	38.224869	-118.043237	55.000000	89.850000	3786.600000
max	1.0	96161.000000	41.962127	-114.192901	72.000000	118.750000	8684.800000

As we can see mean is 2279.34 for Total Charges so we will replace the 0 values with the mean

In [20]:
```
df['Total Charges(Dollar)']=df['Total Charges(Dollar)'].replace(to_replace=0,value=2279.34)
```

In [21]:
```
df.describe()
```

Out[21]:

	Count	Zip Code	Latitude	Longitude	Tenure Months	Monthly Charges(Dollar)	Total Charges(Dollar)
count	7043.0	7043.000000	7043.000000	7043.000000	7043.000000	7043.000000	7043.000000
mean	1.0	93521.964646	36.282441	-119.798880	32.371149	64.766879	2283.549925
std	0.0	1865.794555	2.455723	2.157889	24.559481	30.084906	2264.866717
min	1.0	90001.000000	32.555828	-124.301372	0.000000	18.250000	18.800000
25%	1.0	92102.000000	34.030915	-121.815412	9.000000	35.525000	402.550000
50%	1.0	93552.000000	36.391777	-119.730885	29.000000	70.350000	1400.850000
75%	1.0	95351.000000	38.224869	-118.043237	55.000000	89.850000	3786.600000
max	1.0	96161.000000	41.962127	-114.192901	72.000000	118.750000	8684.800000

In [27]:
```
print(df['Gender'].unique())
```

```
['Male' 'Female' 'Other'
 'Fe maleeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee']
```

As we can see there is an unusual name in gender column so we can replace it by "Female"

In [28]:
```
der']=df['Gender'].replace(to_replace='Fe maleeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee',value='Female')
```

In [29]:
```
print(df['Gender'].unique())
```

```
['Male' 'Female' 'Other']
```

So the unusual name is replaced

In [30]:
```
print(df['State'].unique())
```

```
['California' 'Cali  fornia']
```

As 'California' and 'Cali fornia' is same se we can replace 'Cali fornia' with 'California'

In [31]:
```
df['State']=df['State'].replace(to_replace='Cali  fornia',value='California')
```

In [32]:
```
print(df['State'].unique())
```

```
['California']
```

So the unusual name is replaced

In [33]:
```
print(df['Country'].unique())
```

```
['United States' 'USA' 'United States of America' 'JAPAN TESTING']
```

As in data all citis are of USA, so United States, Unites States of America and JAPAN TESTING can be replaced by USA

In [34]:
```
df['Country']=df['Country'].replace(to_replace=['United States','United States of America','JAPAN TESTING'],value='USA')
```

In [35]:
```
print(df['Country'].unique())
```

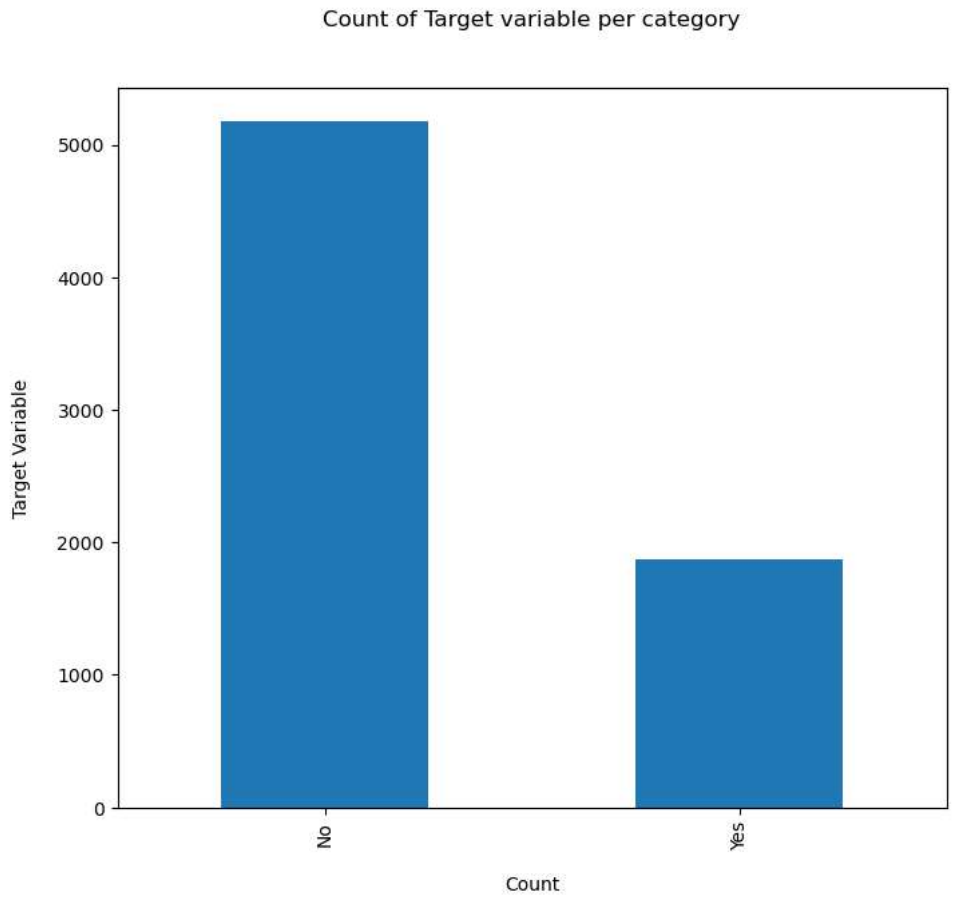
```
['USA']
```

All unwanted Country name replaced by a proper name 'USA' to mak it easy for Analysis

In [22]:
```
df['Churn Label'].value_counts()
```

Out[22]:
```
No     5174
Yes    1869
Name: Churn Label, dtype: int64
```

In [23]:
```
df['Churn Label'].value_counts().plot(kind='bar', figsize=(8, 7))
plt.xlabel("Count", labelpad=14)
plt.ylabel("Target Variable", labelpad=14)
plt.title("Count of Target variable per category", y=1.07);
```



In [24]:
```
print(df['Tenure Months'].max())
```

```
72
```

```
Divide customers into bins based on tenure e.g. for tenure < 12 months: assign a tenure group if 1-12, for tenure between 1 to
2 Yrs, tenure group of 13-24; so on...
```

In [25]:
```
# Group the tenure in bins of 12 months
labels = ["{0} - {1}".format(i, i + 11) for i in range(1, 72, 12)]

df['tenure_group'] = pd.cut(df['Tenure Months'], range(1, 80, 12), right=False, labels=labels)
```

In [26]:
```
df['tenure_group'].value_counts()
```

Out[26]:
```
1 - 12     2175
61 - 72    1407
13 - 24    1024
25 - 36     832
49 - 60     832
37 - 48     762
Name: tenure_group, dtype: int64
```

```
Remove columns not required for processing
```

 # drop columns CustomerID, Count, Country,State,Zip Code, Lat Long, Latitude, Longitude, Tenure Months, City

In [ ]:
```
'CustomerID', 'Count', 'Country','State','Zip Code', 'Lat Long', 'Latitude', 'Longitude', 'Tenure Months'], axis=1, inplace=True)
```

In [41]:
```
df.head()
```

Out[41]:

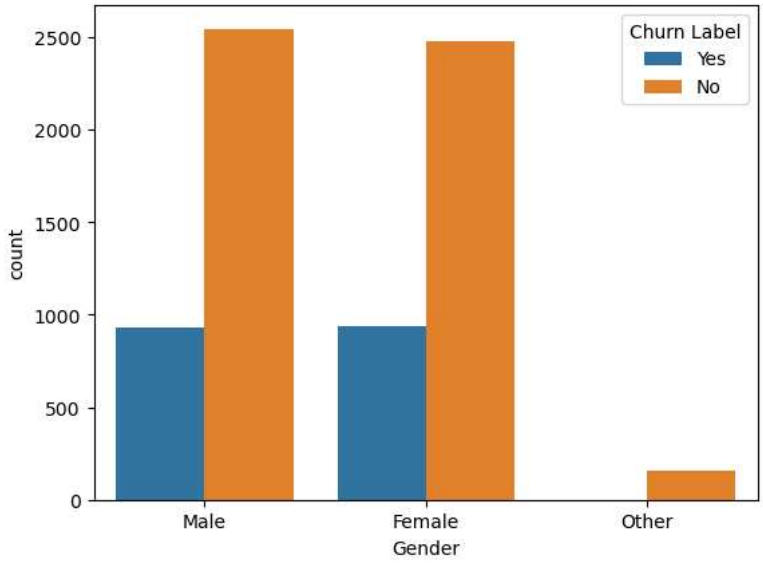
	City	Gender	Senior Citizen	Partner	Dependents	Phone Service	Multiple Lines	Internet Service	Online Security	Online Backup	...	Streaming Movies	Contract	Paperless Billing	Payment Method	Monthly Charges(Dollar)
0	Los Angeles	Male	No	No	No	Yes	No	DSL	Yes	Yes	...	No	Month-to-month	Yes	Mailed check	53.85
1	Los Angeles	Female	No	No	Yes	Yes	No	Fiber optic	No	No	...	No	Month-to-month	Yes	Electronic check	70.70
2	Los Angeles	Female	No	No	Yes	Yes	Yes	Fiber optic	No	No	...	Yes	Month-to-month	Yes	Electronic check	99.65
3	Los Angeles	Female	No	Yes	Yes	Yes	Yes	Fiber optic	No	No	...	Yes	Month-to-month	Yes	Electronic check	104.80
4	Los Angeles	Male	No	No	Yes	Yes	Yes	Fiber optic	No	Yes	...	Yes	Month-to-month	Yes	Bank transfer (automatic)	103.70

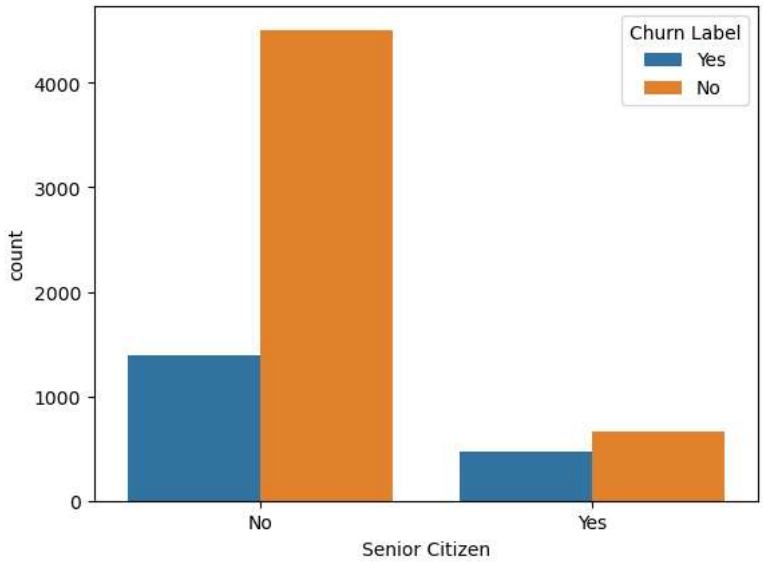
5 rows × 23 columns

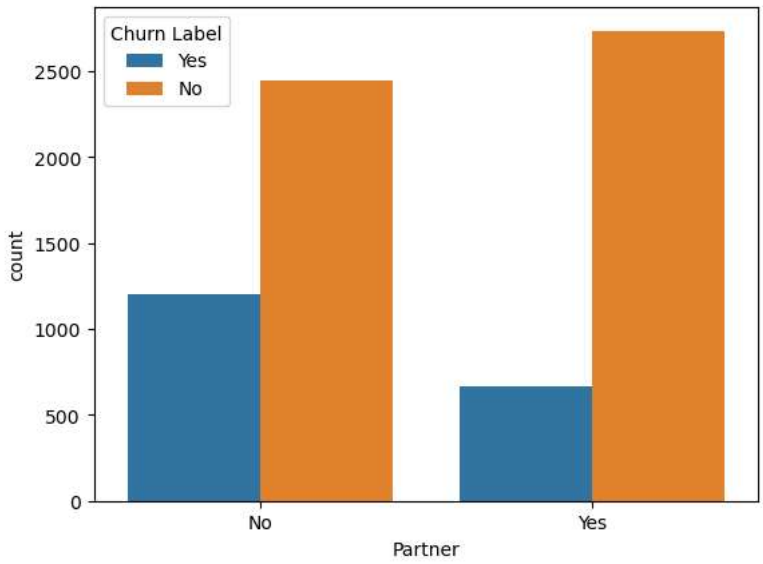
In [43]:
```
df.drop(columns= ['City', 'Churn Reason'], axis=1, inplace=True)
```

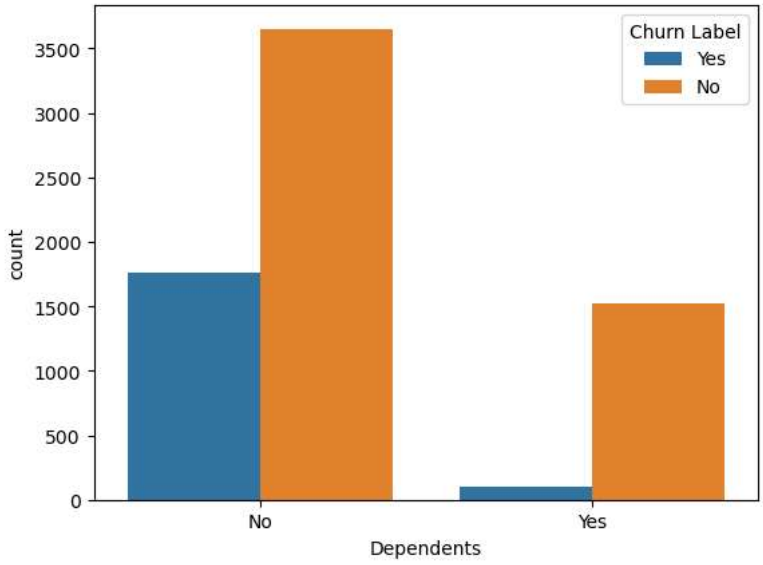
```
#Data Exploration
Univariate Analysis
```

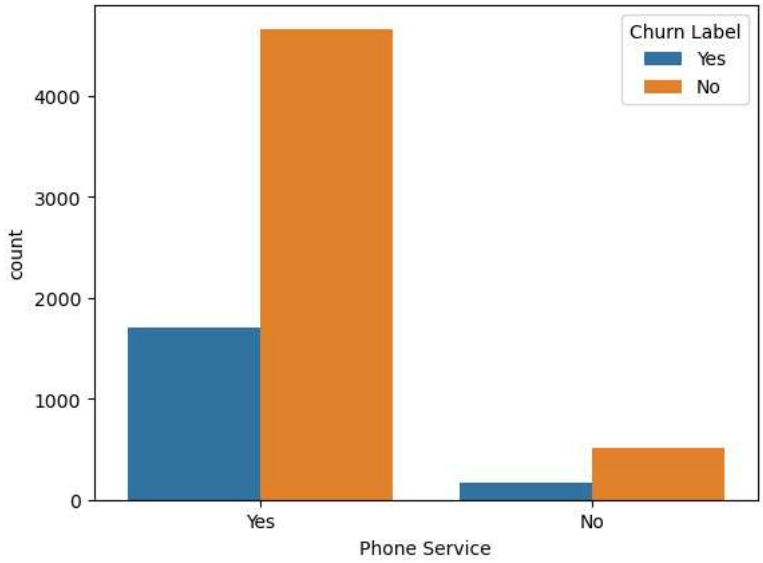
In [44]:
```
for i, predictor in enumerate(df.drop(columns=['Churn Label', 'Total Charges(Dollar)', 'Monthly Charges(Dollar)'])):
    plt.figure(i)
    sns.countplot(data=df, x=predictor, hue='Churn Label')
```

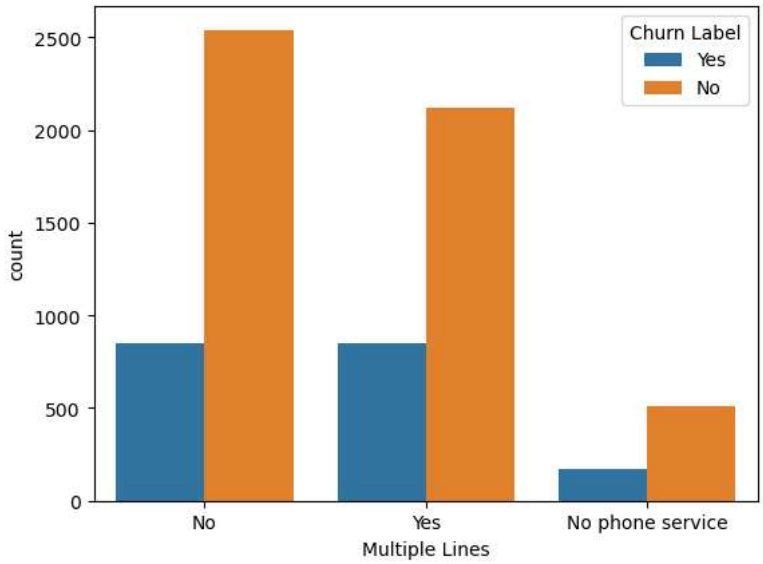


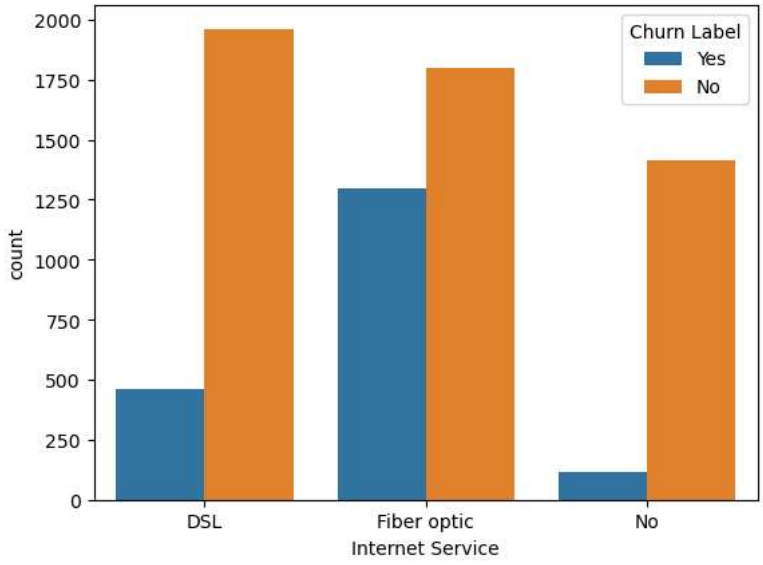


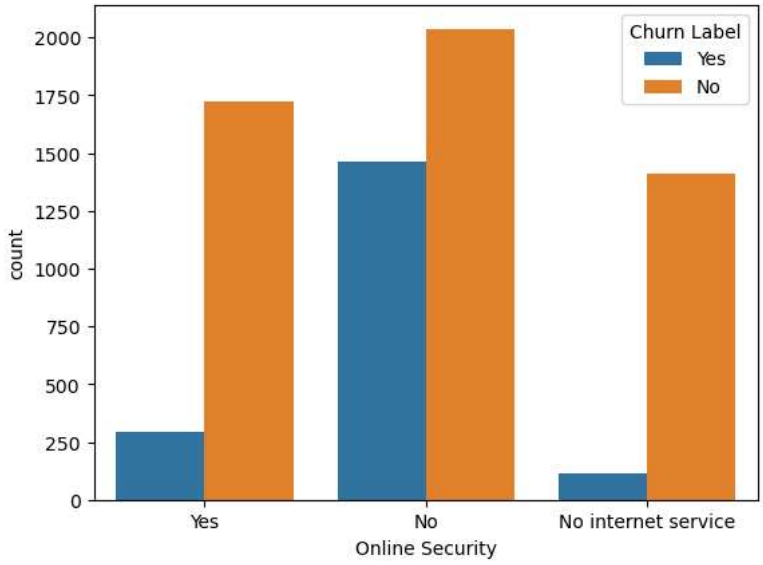


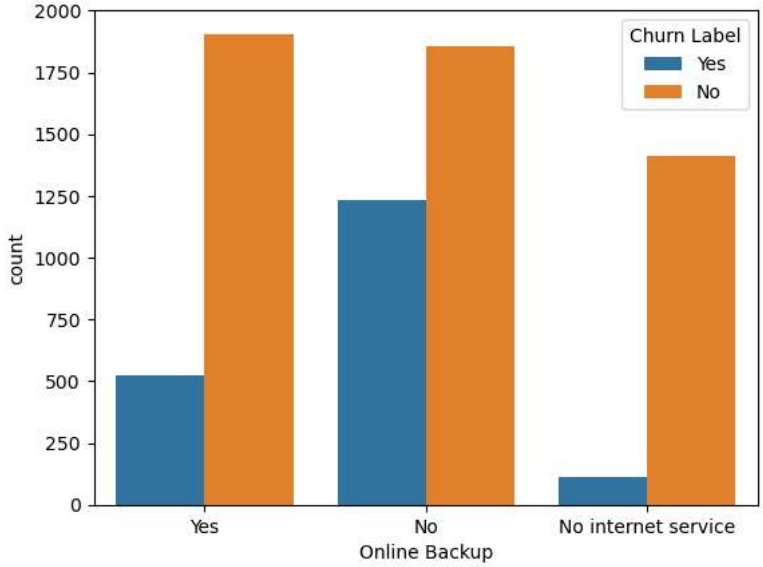

Churn Label
Yes
No
count
3500
3000
2500
2000
1500
1000
500
0
No
Yes
Dependents

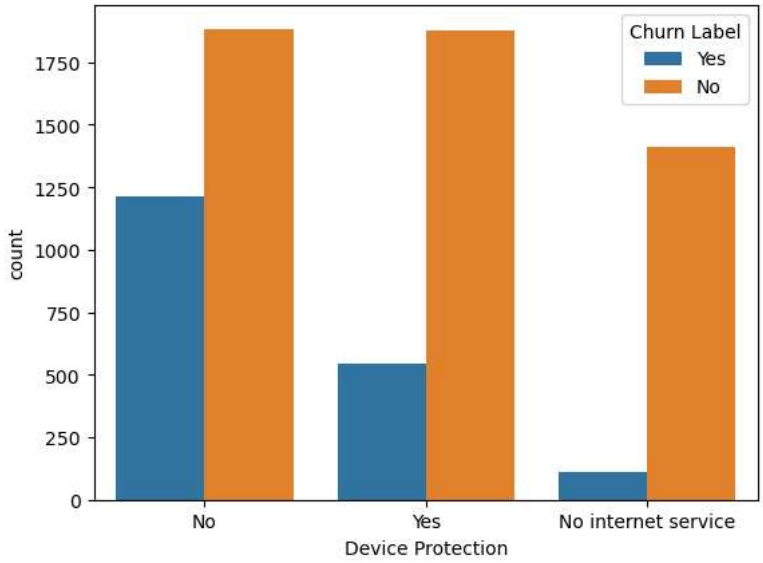

Churn Label
Yes
No
count
4000
3000
2000
1000
0
Yes
No
Phone Service

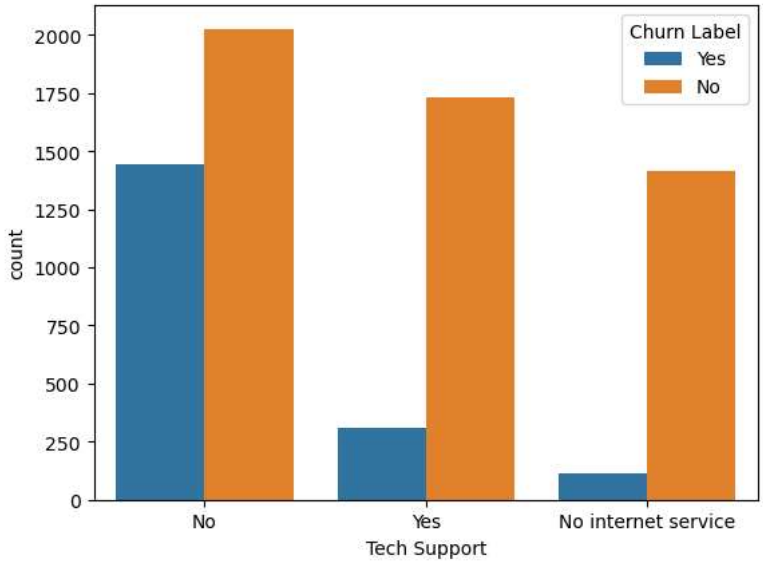

Churn Label
Yes
No
count
2500
2000
1500
1000
500
0
No
Yes
No phone service
Multiple Lines

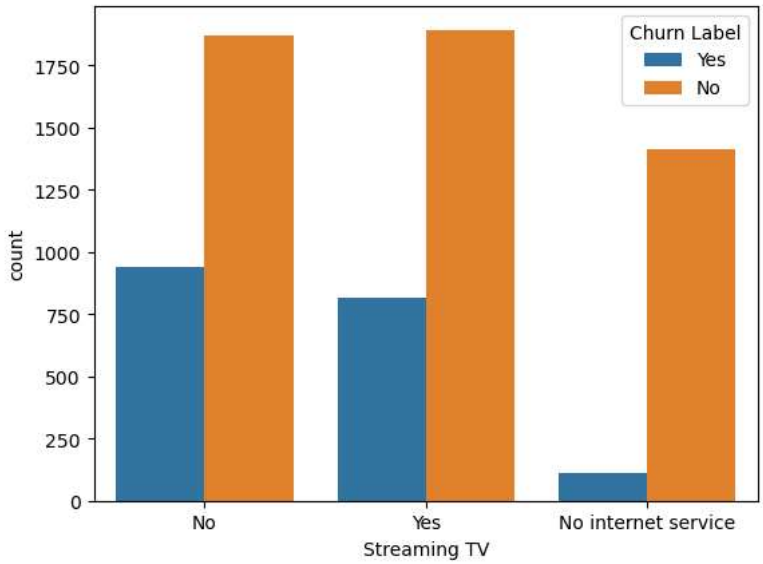

Churn Label
Yes
No
count
2000
1750
1500
1250
1000
750
500
250
0
DSL
Fiber optic
No
Internet Service

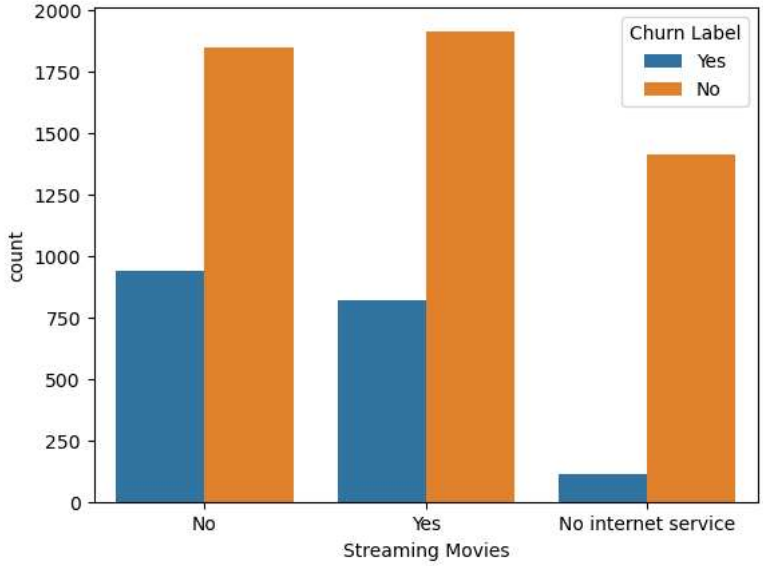

Churn Label
Yes
No
count
2000
1750
1500
1250
1000
750
500
250
0
Yes
No
No internet service
Online Security

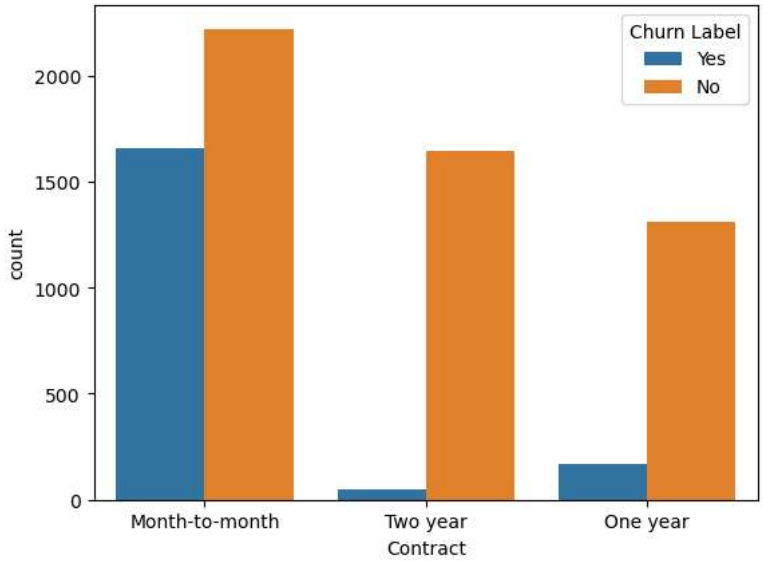

Churn Label
Yes
No
count
2000
1750
1500
1250
1000
750
500
250
0
Yes
No
No internet service
Online Backup

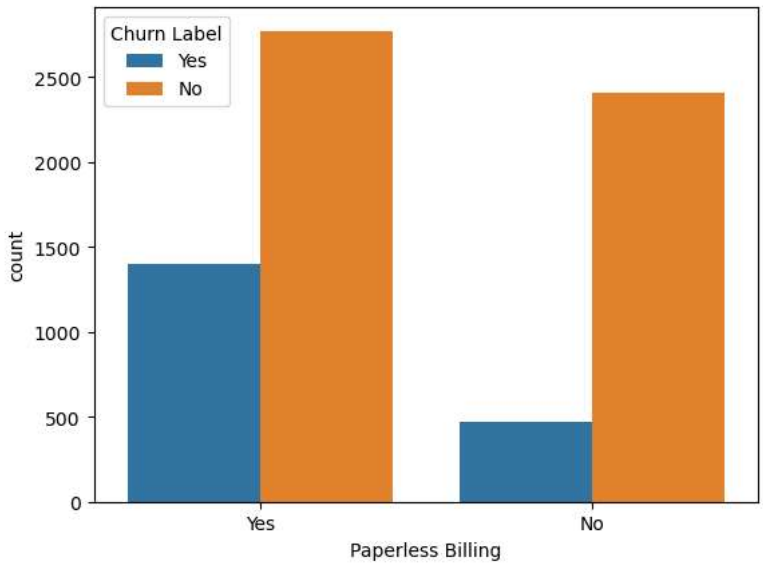

Churn Label
Yes
No
count
0
250
500
750
1000
1250
1500
1750
No
Yes
No internet service
Device Protection

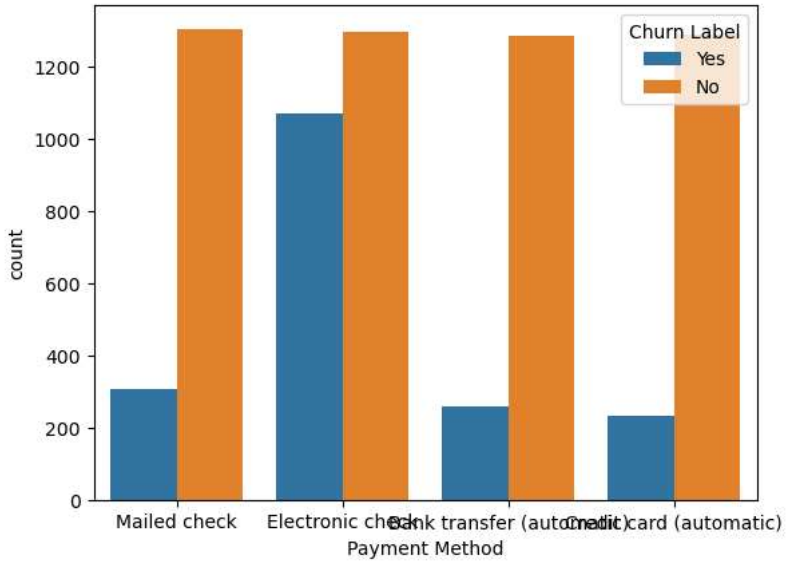

Churn Label
Yes
No
count
0
250
500
750
1000
1250
1500
1750
2000
No
Yes
No internet service
Tech Support

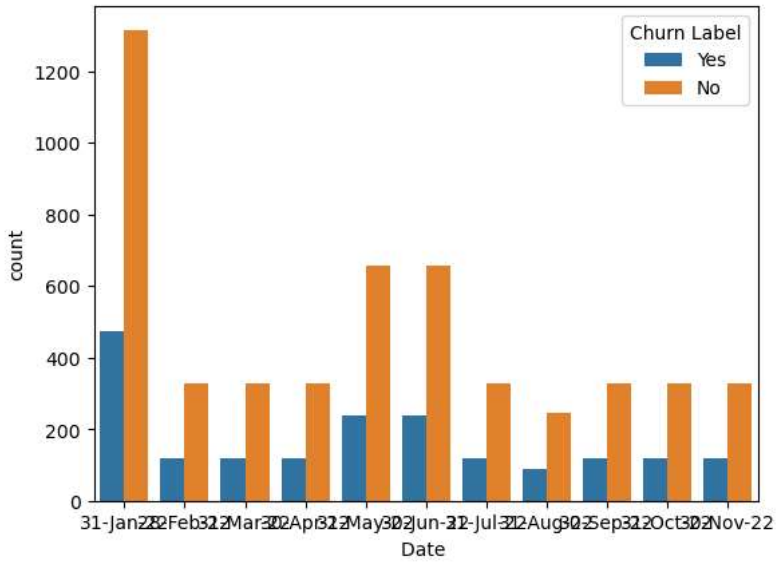

Churn Label
Yes
No
count
0
250
500
750
1000
1250
1500
1750
No
Yes
No internet service
Streaming TV

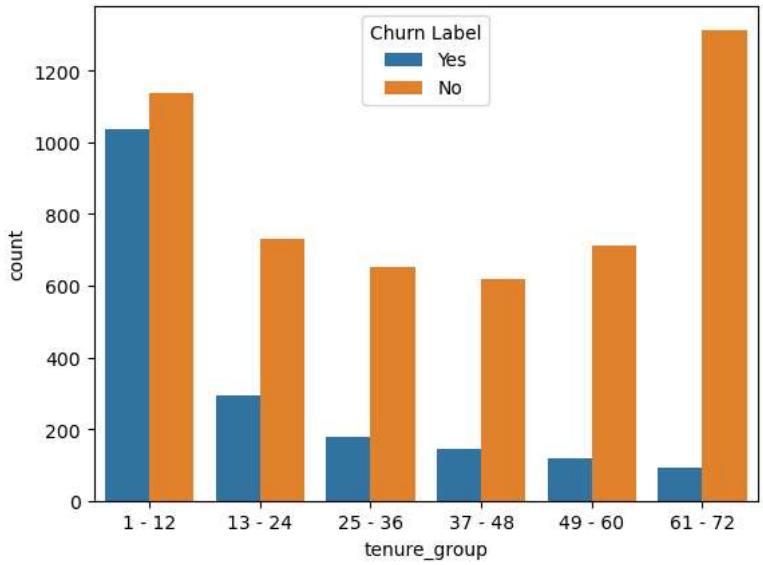

Churn Label
Yes
No
count
2000
1750
1500
1250
1000
750
500
250
0
No
Yes
No internet service
Streaming Movies


Churn Label
Yes
No
count
2000
1500
1000
500
0
Month-to-month
Two year
One year
Contract


Churn Label
Yes
No
count
2500
2000
1500
1000
500
0
Yes
No
Paperless Billing





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These are some chart which shows different relation for the persons who have churned and who have stayed
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