```
import numpy as np
import pandas as pd
```

```
df=pd.read_csv('/content/telecom_customer_churn.csv')
```

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

	Customer ID	Gender	Age	Married	Number of Dependents	City	Zip Code	Latitude	Longitude
0	0002-ORFBO	Female	37	Yes	0	Frazier Park	93225	34.827662	-118.999073
1	0003-MKNFE	Male	46	No	0	Glendale	91206	34.162515	-118.203869
2	0004-TLHLJ	Male	50	No	0	Costa Mesa	92627	33.645672	-117.922613
3	0011-IGKFF	Male	78	Yes	0	Martinez	94553	38.014457	-122.115432
4	0013-EXCHZ	Female	75	Yes	0	Camarillo	93010	34.227846	-119.079903

```
df.columns
```

```
Index(['Customer ID', 'Gender', 'Age', 'Married', 'Number of Dependents',
       'City', 'Zip Code', 'Latitude', 'Longitude', 'Number of Referrals',
       'Tenure in Months', 'Offer', 'Phone Service',
       'Avg Monthly Long Distance Charges', 'Multiple Lines',
       'Internet Service', 'Internet Type', 'Avg Monthly GB Download',
       'Online Security', 'Online Backup', 'Device Protection Plan',
       'Premium Tech Support', 'Streaming TV', 'Streaming Movies',
       'Streaming Music', 'Unlimited Data', 'Contract', 'Paperless Billing',
       'Payment Method', 'Monthly Charge', 'Total Charges', 'Total Refunds',
       'Total Extra Data Charges', 'Total Long Distance Charges',
       'Total Revenue', 'Customer Status', 'Churn Category', 'Churn Reason'],
      dtype='object')
```

```
df1 = df.copy()
```

```
df1.head(7)
```

	Customer ID	Gender	Age	Married	Number of Dependents	City	Zip Code	Latitude	Longitude
0	0002-ORFBO	Female	37	Yes	0	Frazier Park	93225	34.827662	-118.999073
1	0003-MKNFE	Male	46	No	0	Glendale	91206	34.162515	-118.203869
2	0004-TLHLJ	Male	50	No	0	Costa Mesa	92627	33.645672	-117.922613
3	0011-IGKFF	Male	78	Yes	0	Martinez	94553	38.014457	-122.115432
4	0013-EXCHZ	Female	75	Yes	0	Camarillo	93010	34.227846	-119.079903
5	0013-MHZWF	Female	23	No	3	Midpines	95345	37.581496	-119.972762
6	0013-SMEOE	Female	67	Yes	0	Lompoc	93437	34.757477	-120.550507

```
df1.columns
```

```
Index(['Customer ID', 'Gender', 'Age', 'Married', 'Number of Dependents',
       'City', 'Zip Code', 'Latitude', 'Longitude', 'Number of Referrals',
       'Tenure in Months', 'Offer', 'Phone Service',
       'Avg Monthly Long Distance Charges', 'Multiple Lines',
       'Internet Service', 'Internet Type', 'Avg Monthly GB Download',
       'Online Security', 'Online Backup', 'Device Protection Plan',
```

```
       'Premium Tech Support', 'Streaming TV', 'Streaming Movies',
       'Streaming Music', 'Unlimited Data', 'Contract', 'Paperless Billing',
       'Payment Method', 'Monthly Charge', 'Total Charges', 'Total Refunds',
       'Total Extra Data Charges', 'Total Long Distance Charges',
       'Total Revenue', 'Customer Status', 'Churn Category', 'Churn Reason'],
      dtype='object')
```

```
df1.drop(['Customer ID','Total Refunds','Zip Code','Latitude', 'Longitude','Churn Category', 'Churn Reason'],axi
```

```
df1.shape
```

```
(7043, 31)
```

```
df1.dtypes
```

```
Gender                              object
Age                                  int64
Married                             object
Number of Dependents                 int64
City                                object
Number of Referrals                  int64
Tenure in Months                     int64
Offer                               object
Phone Service                       object
Avg Monthly Long Distance Charges  float64
Multiple Lines                      object
Internet Service                    object
Internet Type                       object
Avg Monthly GB Download            float64
Online Security                     object
Online Backup                       object
Device Protection Plan              object
Premium Tech Support                object
Streaming TV                        object
Streaming Movies                    object
Streaming Music                     object
Unlimited Data                      object
Contract                            object
Paperless Billing                   object
Payment Method                      object
Monthly Charge                     float64
Total Charges                      float64
Total Extra Data Charges             int64
Total Long Distance Charges        float64
Total Revenue                      float64
Customer Status                     object
dtype: object
```

```
features = df1.columns
for feature in features:
     print(f'{feature}--->{df[feature].nunique()}')
```

```
Gender--->2
Age--->62
Married--->2
Number of Dependents--->10
City--->1106
Number of Referrals--->12
Tenure in Months--->72
Offer--->6
Phone Service--->2
Avg Monthly Long Distance Charges--->3583
Multiple Lines--->2
Internet Service--->2
Internet Type--->3
Avg Monthly GB Download--->49
Online Security--->2
Online Backup--->2
Device Protection Plan--->2
Premium Tech Support--->2
Streaming TV--->2
Streaming Movies--->2
Streaming Music--->2
Unlimited Data--->2
Contract--->3
Paperless Billing--->2
Payment Method--->3
Monthly Charge--->1591
Total Charges--->6540
Total Extra Data Charges--->16
Total Long Distance Charges--->6068
Total Revenue--->6975
Customer Status--->3
```

```
df1.isnull().sum() / df1.shape[0]
```

```
Gender                                0.000000
Age                                   0.000000
Married                               0.000000
Number of Dependents                  0.000000
City                                  0.000000
Number of Referrals                   0.000000
Tenure in Months                      0.000000
Offer                                 0.000000
Phone Service                         0.000000
Avg Monthly Long Distance Charges     0.096834
Multiple Lines                        0.096834
Internet Service                      0.000000
Internet Type                         0.216669
Avg Monthly GB Download               0.216669
Online Security                       0.216669
Online Backup                         0.216669
Device Protection Plan                0.216669
Premium Tech Support                  0.216669
Streaming TV                          0.216669
Streaming Movies                      0.216669
Streaming Music                       0.216669
Unlimited Data                        0.216669
Contract                              0.000000
Paperless Billing                     0.000000
Payment Method                        0.000000
Monthly Charge                        0.000000
Total Charges                         0.000000
Total Extra Data Charges              0.000000
Total Long Distance Charges           0.000000
Total Revenue                         0.000000
Customer Status                       0.000000
dtype: float64
```

```
def clean_dataset(df):
    assert isinstance(df, pd.DataFrame)
    df.dropna(inplace=True)
    indices_to_keep = ~df.isin([np.nan, np.inf, -np.inf]).any(1)
    return df[indices_to_keep].astype(np.float64)
```

```
df1=df1.interpolate()
```

```
df1=df1.dropna()
df.head()
```

	Customer ID	Gender	Age	Married	Number of Dependents	City	Zip Code	Latitude	Longitude
0	0002-ORFBO	Female	37	Yes	0	Frazier Park	93225	34.827662	-118.999073
1	0003-MKNFE	Male	46	No	0	Glendale	91206	34.162515	-118.203869
2	0004-TLHLJ	Male	50	No	0	Costa Mesa	92627	33.645672	-117.922613
3	0011-IGKFF	Male	78	Yes	0	Martinez	94553	38.014457	-122.115432
4	0013-EXCHZ	Female	75	Yes	0	Camarillo	93010	34.227846	-119.079903

```
df['Unlimited Data']
```

```
0       Yes
1        No
2       Yes
3       Yes
4       Yes
       ...
7038    Yes
7039    Yes
7040    Yes
7041    Yes
7042    Yes
Name: Unlimited Data, Length: 7043, dtype: object
```

```
number_columns=['Age','Number of Dependents','Number of Referrals','Tenure in Months','Avg Monthly Long Distance
```

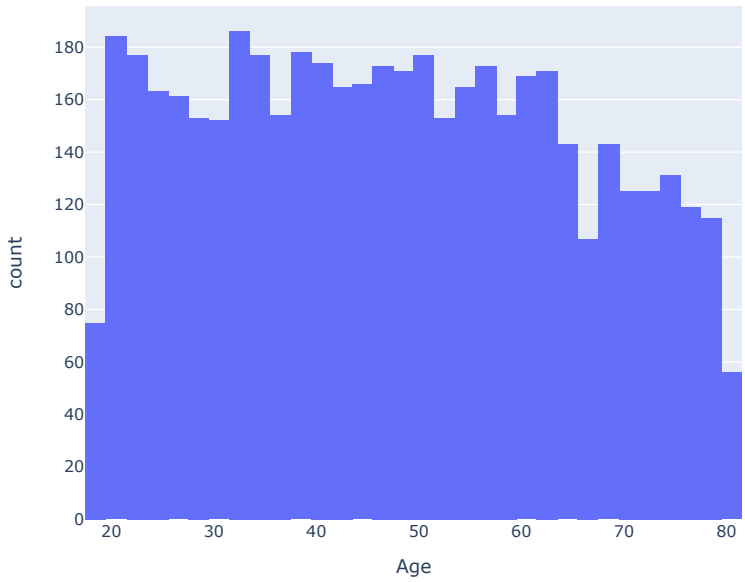
```
def unique_values_names(df):
    for column in df:
        if df[column].dtype=='object':
            print(f'{column}:{df[column].unique()}')
```

```
unique_values_names(df1)
```

```
Gender:['Female' 'Male']
Married:['Yes' 'No']
City:['Frazier Park' 'Glendale' 'Costa Mesa' ... 'Blairsden Graeagle'
 'Lost Hills' 'Windsor']
Offer:['None' 'Offer E' 'Offer D' 'Offer A' 'Offer B' 'Offer C']
Phone Service:['Yes']
Multiple Lines:['No' 'Yes']
Internet Service:['Yes']
Internet Type:['Cable' 'Fiber Optic' 'DSL']
Online Security:['No' 'Yes']
Online Backup:['Yes' 'No']
Device Protection Plan:['No' 'Yes']
Premium Tech Support:['Yes' 'No']
Streaming TV:['Yes' 'No']
Streaming Movies:['No' 'Yes']
Streaming Music:['No' 'Yes']
Unlimited Data:['Yes' 'No']
Contract:['One Year' 'Month-to-Month' 'Two Year']
Paperless Billing:['Yes' 'No']
Payment Method:['Credit Card' 'Bank Withdrawal' 'Mailed Check']
Customer Status:['Stayed' 'Churned' 'Joined']
```

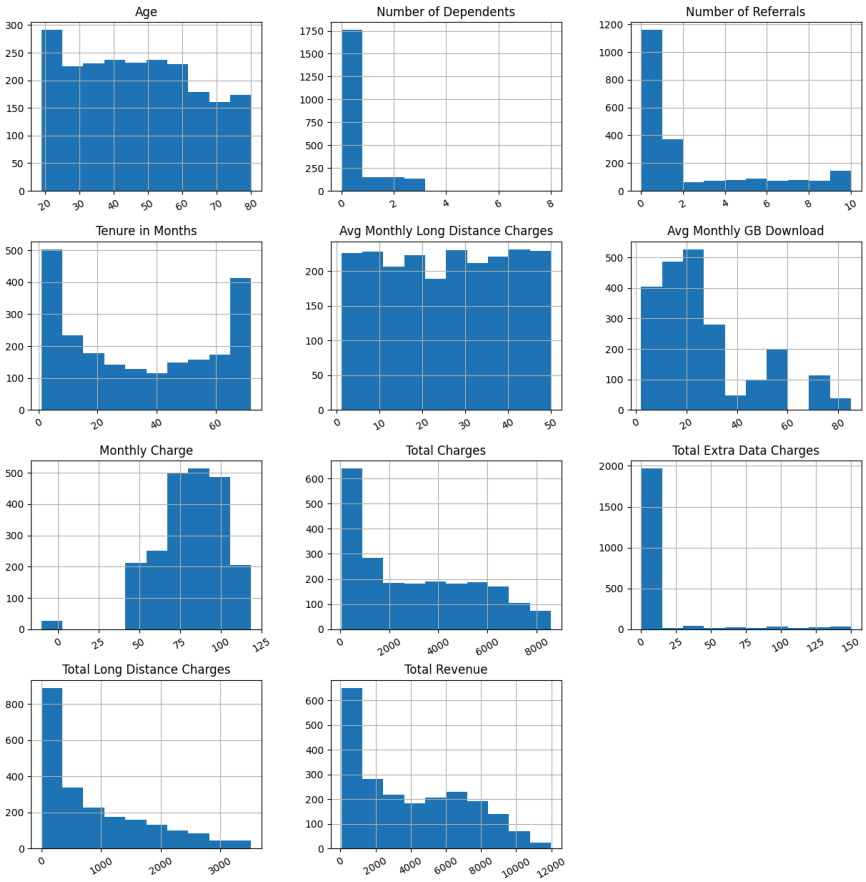
```
import plotly.express as px
```

```
fig = px.histogram(df1, x = 'Age')
fig.show()
```




```
df1.hist(figsize=(15,15), xrot=30)
```

```
array([[<Axes: title={'center': 'Age'}>,
        <Axes: title={'center': 'Number of Dependents'}>,
        <Axes: title={'center': 'Number of Referrals'}>],
       [<Axes: title={'center': 'Tenure in Months'}>,
        <Axes: title={'center': 'Avg Monthly Long Distance Charges'}>,
        <Axes: title={'center': 'Avg Monthly GB Download'}>],
       [<Axes: title={'center': 'Monthly Charge'}>,
        <Axes: title={'center': 'Total Charges'}>,
        <Axes: title={'center': 'Total Extra Data Charges'}>],
       [<Axes: title={'center': 'Total Long Distance Charges'}>,
        <Axes: title={'center': 'Total Revenue'}>, <Axes: >]],
      dtype=object)
```



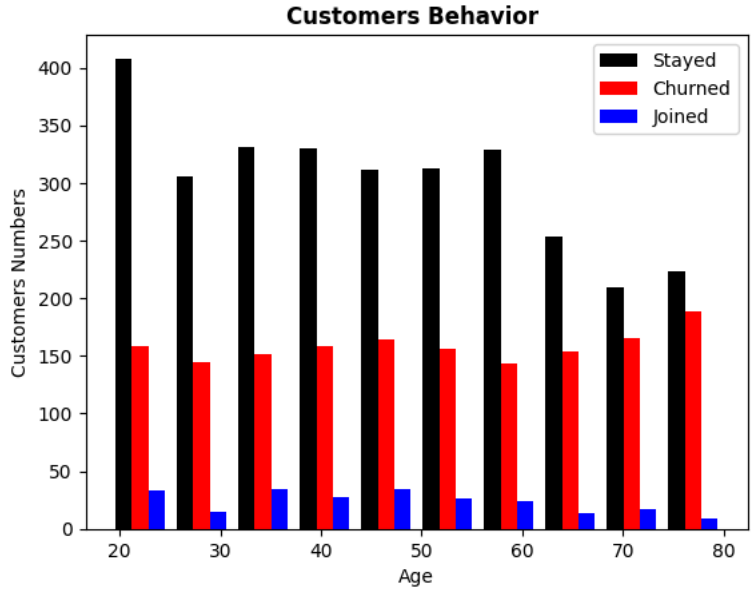

```
df1['Age']
```

```
0        37
1        46
```

```
2       50
3       78
4       75
        ..
7036    53
7038    20
7039    40
7040    22
7041    21
Name: Age, Length: 4835, dtype: int64
```

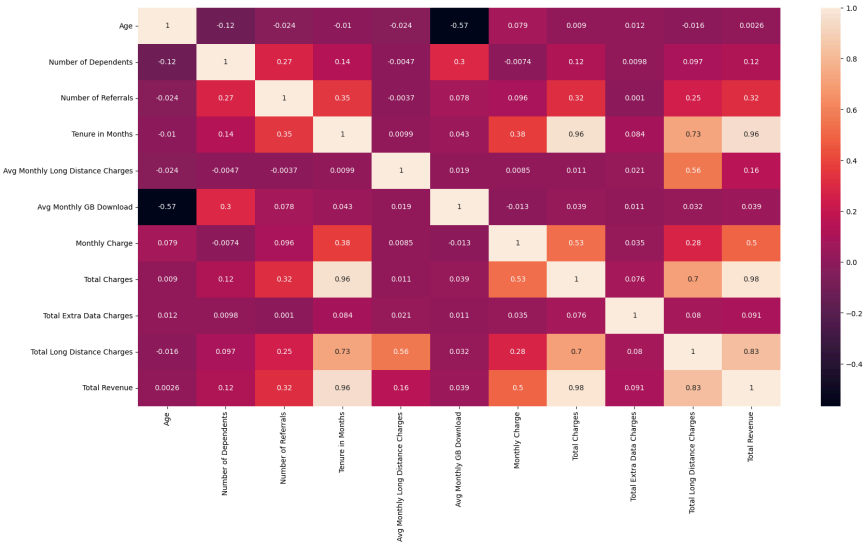
```
import matplotlib.pyplot as plt


Customer_Stayed=df1[df1['Customer Status']=='Stayed'].Age
Customer_Churned=df1[df1['Customer Status']=='Churned'].Age
Customer_Joined=df1[df1['Customer Status']=='Joined'].Age

plt.xlabel('Age')
plt.ylabel('Customers Numbers')
plt.hist([Customer_Stayed,Customer_Churned,Customer_Joined], color=['black','red','blue'],label=['Stayed','Churr

plt.title('Customers Behavior ',fontweight ="bold")
plt.legend()
```

```
<matplotlib.legend.Legend at 0x787821a791b0>
```

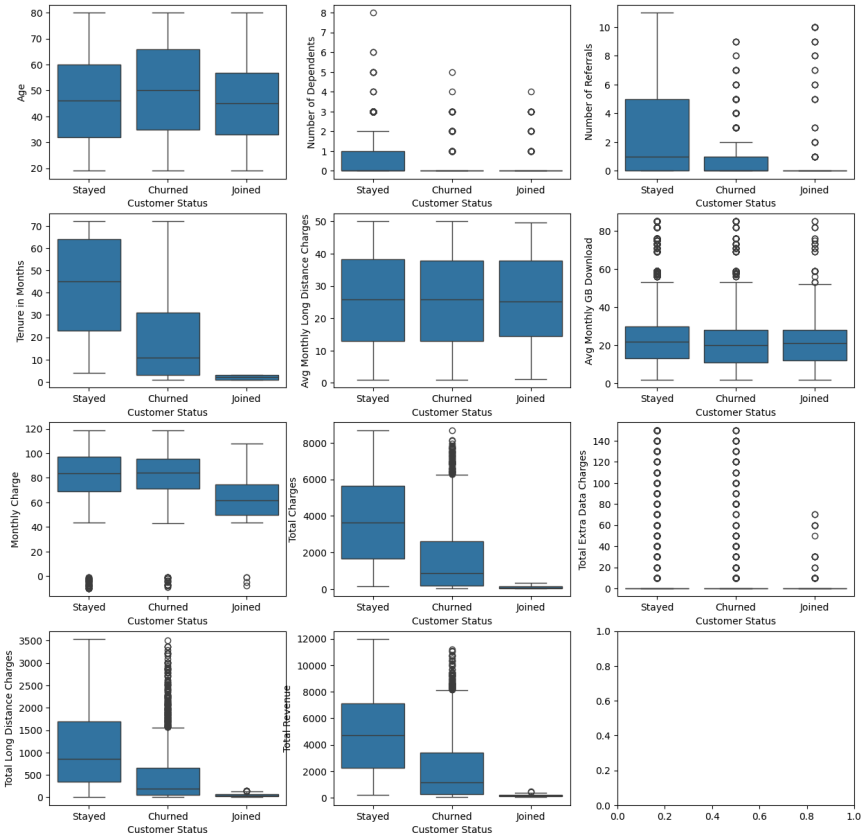



```
import seaborn as sns


data  = df1.corr()
plt.figure(figsize = (20,10))
sns.heatmap(data, annot = True)
```

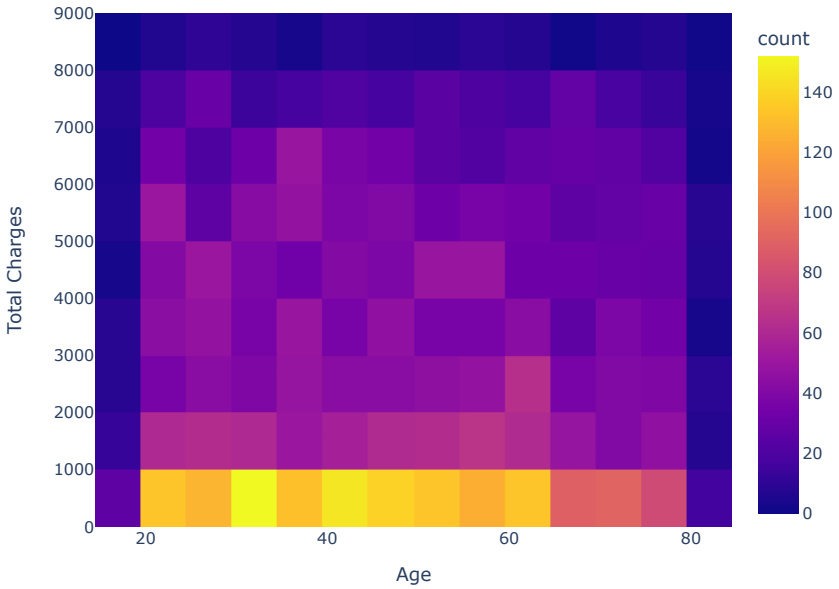
```
<ipython-input-27-026dd72ebe45>:1: FutureWarning:

The default value of numeric_only in DataFrame.corr is deprecated. In a future versio

<Axes: >
```




```
fig, ax = plt.subplots(4,3, figsize = (15,15))
for i, subplot in zip(number_columns, ax.flatten()):
    sns.boxplot(x = 'Customer Status', y = i , data = df1, ax = subplot)
```




```
fig = px.density_heatmap(df1, x='Age', y='Total Charges')
fig.show()
```

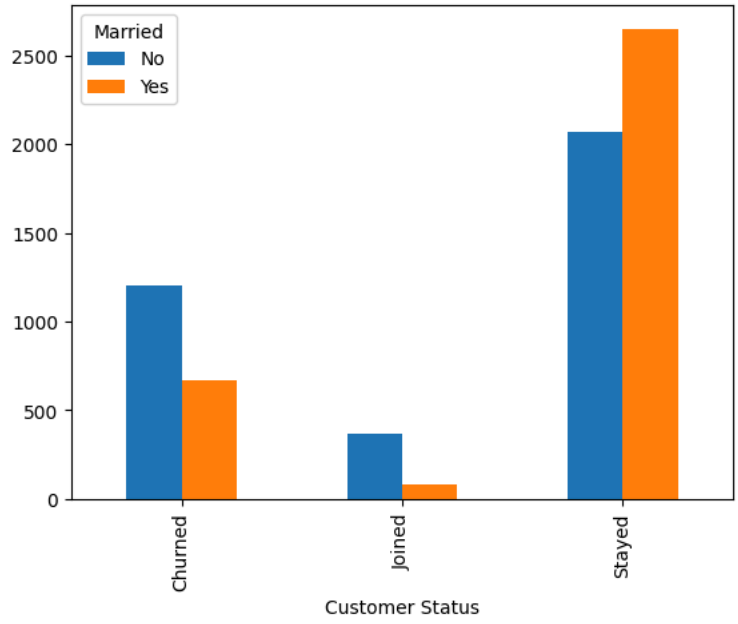



```
df1.columns
```

```
Index(['Gender', 'Age', 'Married', 'Number of Dependents', 'City',
       'Number of Referrals', 'Tenure in Months', 'Offer', 'Phone Service',
       'Avg Monthly Long Distance Charges', 'Multiple Lines',
       'Internet Service', 'Internet Type', 'Avg Monthly GB Download',
       'Online Security', 'Online Backup', 'Device Protection Plan',
       'Premium Tech Support', 'Streaming TV', 'Streaming Movies',
       'Streaming Music', 'Unlimited Data', 'Contract', 'Paperless Billing',
       'Payment Method', 'Monthly Charge', 'Total Charges',
       'Total Extra Data Charges', 'Total Long Distance Charges',
       'Total Revenue', 'Customer Status'],
      dtype='object')
```

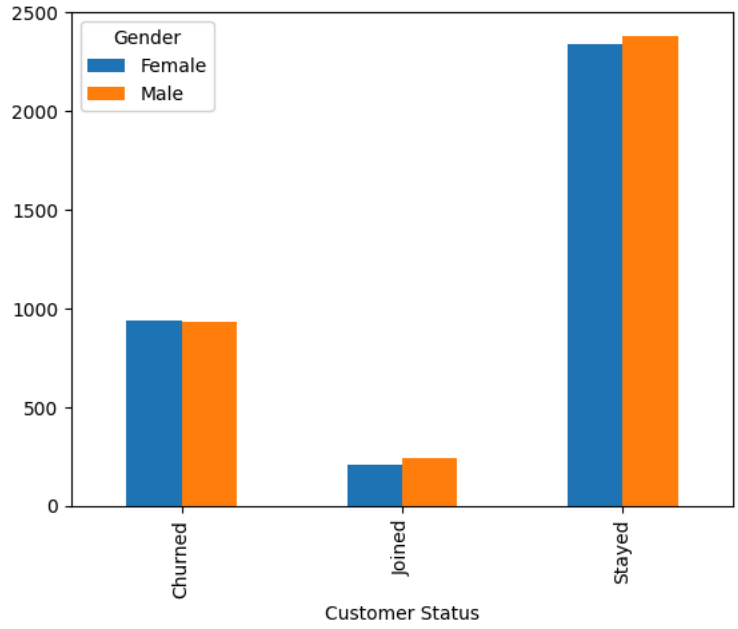
```
pd.crosstab(df['Customer Status'], df['Married']).plot(kind='bar')
```

```
<Axes: xlabel='Customer Status'>
```




```
pd.crosstab(df['Customer Status'], df['Gender']).plot(kind='bar')
```

```
<Axes: xlabel='Customer Status'>
```




```
df1['Payment Method'].unique()
```

```
array(['Credit Card', 'Bank Withdrawal', 'Mailed Check'], dtype=object)
```

```
Roles = {}
for j in df1['Payment Method'].unique():
    Roles[j] = df1[df1['Payment Method'] == j]
```

```
Roles.keys()
```

```
dict_keys(['Credit Card', 'Bank Withdrawal', 'Mailed Check'])
```

```
Roles['Credit Card']
```

	Gender	Age	Married	Number of Dependents	City	Number of Referrals	Tenure in Months	Offer	Phone Service	D
0	Female	37	Yes	0	Frazier Park	2	9	None	Yes	
1	Male	46	No	0	Glendale	0	9	None	Yes	
4	Female	75	Yes	0	Camarillo	3	3	None	Yes	
5	Female	23	No	3	Midpines	0	9	Offer E	Yes	
7	Male	52	Yes	0	Napa	8	63	Offer B	Yes	
...	...	...	...	...	...	...	...	...	...	
7035	Female	20	No	0	Los Angeles	0	7	Offer E	Yes	
7036	Female	53	No	0	Hume	0	1	Offer E	Yes	
7038	Female	20	No	0	La Mesa	0	13	Offer D	Yes	
7040	Male	22	No	0	Elk	0	2	Offer E	Yes	
7041	Male	21	Yes	0	Solana Beach	5	67	Offer A	Yes	

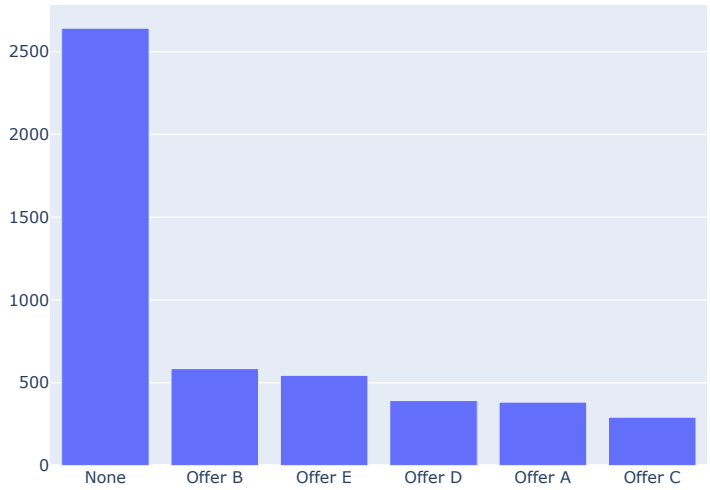
```
len(Roles)
```

```
3
```

```
off = df1['Offer'].value_counts()
off
```

```
None       2641
Offer B     585
Offer E     544
Offer D     392
Offer A     382
Offer C     291
Name: Offer, dtype: int64
```

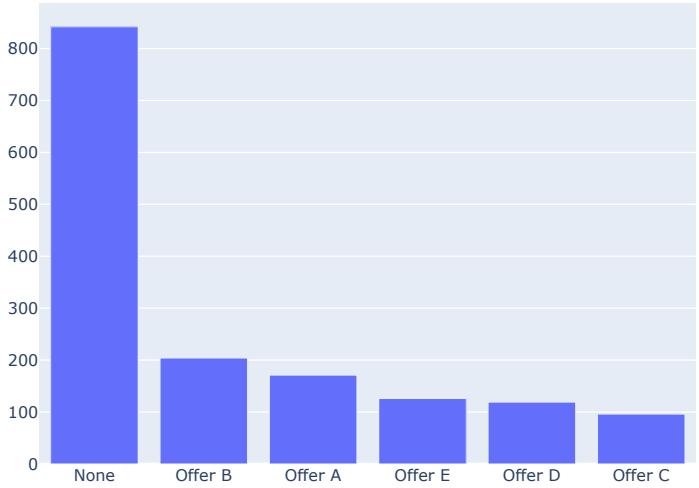
```
import plotly.graph_objects as go

fig = go.Figure([go.Bar(x=off.index, y=off.values)])
fig.show()
```




```
df1_off = Roles['Credit Card'].Offer.value_counts()
df1_off
```

```
None       842
Offer B    204
Offer A    171
Offer E    126
Offer D    119
Offer C     96
Name: Offer, dtype: int64
```

```
fig = go.Figure([go.Bar(x= df1_off.index, y=df1_off.values)])
fig.show()
```




```
df1 = df1.rename(columns = {'Customer Status':'Customer_Status'})
```

```
Roles1 = {}
for k in df1['Customer_Status'].unique():
    Roles1[k] = df1[df1['Customer_Status'] == k]
Roles1.keys()
```

```
dict_keys(['Stayed', 'Churned', 'Joined'])
```

```
df1_state = Roles1['Stayed'].Offer.value_counts()
df1_state
```

```
None       1601
Offer B     497
Offer A     348
Offer D     250
Offer C     204
Offer E     115
Name: Offer, dtype: int64
```

```
df1.replace({"Gender":{'Female':0,'Male':1}},inplace=True)
```

```
yes_and_no=[  'Paperless Billing', 'Unlimited Data',
       'Streaming Movies', 'Streaming Music',  'Streaming TV',
       'Premium Tech Support', 'Device Protection Plan', 'Online Backup', 'Online Security',
       'Multiple Lines',  'Married']
for i in yes_and_no:
    df1.replace({'No':0,'Yes':1},inplace=True)
```

```
df1.replace({"Phone Service":{'Yes':1}},inplace=True)
```

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
df1.Customer_Status = le.fit_transform(df1.Customer_Status)
```

```
df1 = pd.get_dummies(data=df1, columns=['Payment Method','Contract','Internet Type','Offer','City'])
```

```
cols_to_scale = ['Age','Number of Dependents','Number of Referrals','Tenure in Months','Avg Monthly Long Distanc
       'Total Extra Data Charges', 'Total Long Distance Charges','Total Revenue']

from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
df1[cols_to_scale] = scaler.fit_transform(df1[cols_to_scale])
```

```
X = df1.drop('Customer_Status',axis='columns')
y = df1['Customer_Status']
```

```
X.head(5)
```

	Gender	Age	Married	Number of Dependents	Number of Referrals	Tenure in Months	Phone Service	Avg Monthly Long Distance Charges	Mult: L:
0	0	0.295082	1	0.0	0.181818	0.112676	1	0.844835	
1	1	0.442623	0	0.0	0.000000	0.112676	1	0.197632	
2	1	0.508197	0	0.0	0.000000	0.042254	1	0.666394	
3	1	0.967213	1	0.0	0.090909	0.169014	1	0.547366	
4	0	0.918033	1	0.0	0.272727	0.028169	1	0.130053	

5 rows × 1129 columns

```
y.head(5)
```

```
0    2
1    2
2    0
3    0
4    0
Name: Customer_Status, dtype: int64
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y,test_size=0.2,random_state=5)
```

```
len(X_train)
```

```
3868
```

```
X_train[:10]
```

	Gender	Age	Married	Number of Dependents	Number of Referrals	Tenure in Months	Phone Service	Avg Monthly Long Distance Charges	M
1931	1	0.983607	1	0.000	0.363636	0.718310	1	0.574520	
1244	1	0.147541	1	0.000	0.090909	0.690141	1	0.676399	
3167	1	0.475410	1	0.250	0.090909	0.098592	1	0.117803	
5573	1	0.983607	1	0.000	0.727273	0.169014	1	0.962434	
2741	0	0.852459	0	0.000	0.000000	0.619718	1	0.238056	
1184	1	0.377049	1	0.375	0.727273	0.774648	1	0.813597	
4120	1	0.803279	1	0.000	0.363636	0.859155	1	0.076562	
373	1	0.114754	0	0.000	0.000000	0.802817	1	0.948550	
1499	1	0.606557	0	0.000	0.000000	0.084507	1	0.683544	
6702	0	0.327869	0	0.000	0.000000	0.887324	1	0.553695	

10 rows × 1129 columns

```
!pip install scikit-learn
```

```
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/dist-packages (1.2.2)
Requirement already satisfied: numpy>=1.17.3 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.23.5)
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.11.4)
Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.3.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (3.2.0)
```

```
model_params = {


    'random_forest': {
        'model': RandomForestClassifier(),
        'params' : {
            'n_estimators': [1,5,10]
        }
    },
    'logistic_regression' : {
        'model': LogisticRegression(solver='liblinear',multi_class='auto'),
        'params': {
            'C': [1,5,10]
        }
    },
    'naive_bayes_gaussian': {
        'model': GaussianNB(),
        'params': {}
    },

    'decision_tree': {
        'model': DecisionTreeClassifier(),
        'params': {
            'criterion': ['gini','entropy'],
        }
    },
       'XGB_Classifier':{
        'model':XGBClassifier(),
        'params':{
            'base_score':[0.5]

        }
    },
    'lightgbm_classifier':{
        'model':lgb.LGBMClassifier(),
        'params':{}
    },
}


from sklearn.model_selection import ShuffleSplit


from sklearn.model_selection import GridSearchCV
scores = []
cv = ShuffleSplit(n_splits=6, test_size=0.2, random_state=0)
for model_name, mp in model_params.items():
    clf =  GridSearchCV(mp['model'], mp['params'], cv=cv, return_train_score=False)
    clf.fit(X,y)
    scores.append({
        'model': model_name,
        'best_score': clf.best_score_,
        'best_params': clf.best_params_
    })

df = pd.DataFrame(scores,columns=['model','best_score','best_params'])
df
```

```
[LightGBM] [Info] Number of data points in the train set: 3868, number of used fea
[LightGBM] [Info] Start training from score -1.109791
[LightGBM] [Info] Start training from score -3.056486
[LightGBM] [Info] Start training from score -0.472696
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
[LightGBM] [Warning] Found whitespace in feature_names, replace with underlines
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of testing
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 1573
[LightGBM] [Info] Number of data points in the train set: 3868, number of used fea
[LightGBM] [Info] Start training from score -1.105097
[LightGBM] [Info] Start training from score -3.018746
[LightGBM] [Info] Start training from score -0.478103
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
[LightGBM] [Warning] Found whitespace in feature_names, replace with underlines
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of testing
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 1575
[LightGBM] [Info] Number of data points in the train set: 3868, number of used fea
[LightGBM] [Info] Start training from score -1.110576
[LightGBM] [Info] Start training from score -3.095707
[LightGBM] [Info] Start training from score -0.469383
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
[LightGBM] [Warning] Found whitespace in feature_names, replace with underlines
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of testing
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 1576
[LightGBM] [Info] Number of data points in the train set: 3868, number of used fea
[LightGBM] [Info] Start training from score -1.111361
[LightGBM] [Info] Start training from score -3.078709
[LightGBM] [Info] Start training from score -0.470210
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
[LightGBM] [Warning] Found whitespace in feature_names, replace with underlines
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of testing
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 1590
[LightGBM] [Info] Number of data points in the train set: 4835, number of used fea
[LightGBM] [Info] Start training from score -1.114666
[LightGBM] [Info] Start training from score -3.028315
[LightGBM] [Info] Start training from score -0.472281
```

	model	best_score	best_params
0	random_forest	0.784729	{'n_estimators': 10}
1	logistic_regression	0.786281	{'C': 1}
2	naive_bayes_gaussian	0.369355	{}
3	decision_tree	0.775595	{'criterion': 'gini'}
4	XGB_Classifier	0.822130	{'base_score': 0.5}
5	lightgbm_classifier	0.824371	{}

Random Forest Classifier

```
rf=RandomForestClassifier()
rf.fit(X_train, y_train)
```

```
RandomForestClassifier
RandomForestClassifier()
```

```
rf.score(X_test, y_test)
```

```
0.7911065149948294
```

```
y_predicted = rf.predict(X_test)
y_predicted[:5]
```

```
array([2, 2, 0, 2, 2])
```

```
y_test[:5]
```

```
3076    2
2931    2
3814    0
5052    2
2128    0
Name: Customer_Status, dtype: int64
```

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test, y_predicted)
```

```
0.7911065149948294
```

LogisticRegression

```
lr=LogisticRegression()
lr.fit(X_train, y_train)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: Conver

lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
```

```
LogisticRegression
LogisticRegression()
```

```
lr.score(X_test, y_test)
```

```
0.7786970010341262
```

```
y_predicted = lr.predict(X_test)
```

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test, y_predicted)
```

```
0.7786970010341262
```

GaussianNB

```
Gnb=GaussianNB()
Gnb.fit(X_train, y_train)
```

```
GaussianNB
GaussianNB()
```

```
Gnb.score(X_test, y_test)
```

```
0.34126163391933817
```

```
y_predicted = Gnb.predict(X_test)
```

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test, y_predicted)
```

```
0.34126163391933817
```

DecisionTreeClassifier

```
dt=DecisionTreeClassifier()
dt.fit(X_train, y_train)
```

```
DecisionTreeClassifier()
```

```
dt.score(X_test, y_test)
```

```
0.7549120992761117
```

```
y_predicted = dt.predict(X_test)
```

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test, y_predicted)
```

```
0.7549120992761117
```

XGBoost regressor

```
reg=XGBClassifier()
reg.fit(X_train, y_train)
```

```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, objective='multi:softprob', ...)
```

```
reg.score(X_test, y_test)
```

```
0.8138572905894519
```

```
y_predicted = reg.predict(X_test)
y_predicted[:5]
```

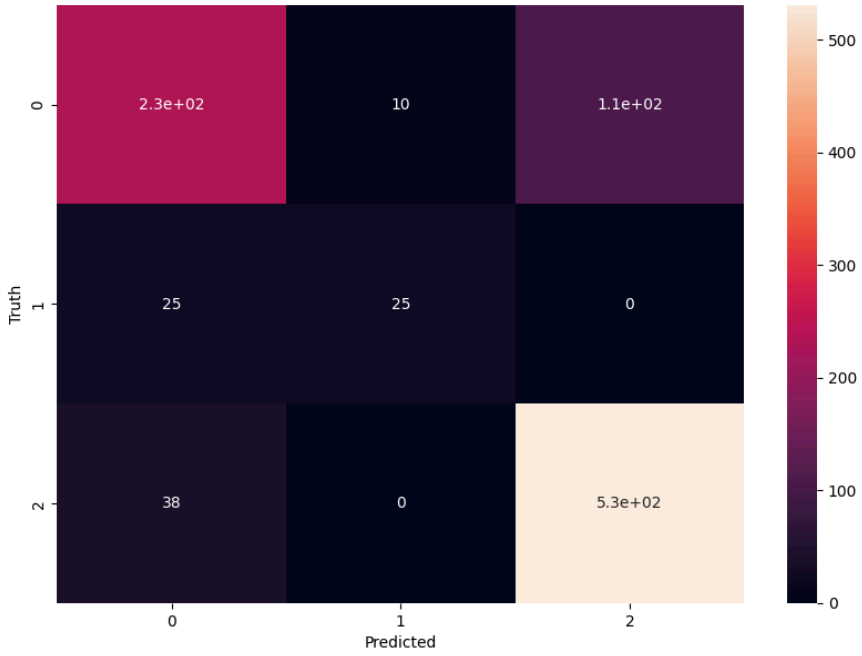
```
array([2, 2, 0, 2, 0])
```

```
y_test[:5]
```

```
3076    2
2931    2
3814    0
5052    2
2128    0
Name: Customer_Status, dtype: int64
```

```
import seaborn as sns
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_predicted)
plt.figure(figsize = (10,7))
sns.heatmap(cm, annot=True)
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(95.72222222222221, 0.5, 'Truth')
```




```
from sklearn.metrics import classification_report

print(classification_report(y_test, y_predicted))
```

```
              precision    recall  f1-score   support

           0       0.79      0.66      0.72       348
           1       0.71      0.50      0.59        50
           2       0.83      0.93      0.88       569

    accuracy                           0.81       967
   macro avg       0.78      0.70      0.73       967
weighted avg       0.81      0.81      0.81       967
```

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test, y_predicted)
```

```
0.8138572905894519
```

LightGBM Classifier

```
import lightgbm as lgb

lg=lgb.LGBMClassifier()
lg.fit(X_train, y_train)
```

```
[LightGBM] [Warning] Found whitespace in feature_names, replace with underlines
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of testing was
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 1576
[LightGBM] [Info] Number of data points in the train set: 3868, number of used featur
```

```
lg.score(X_test, y_test)
```

```
0.8169596690796277
```

```
y_predicted = lg.predict(X_test)
y_predicted[:5]
```

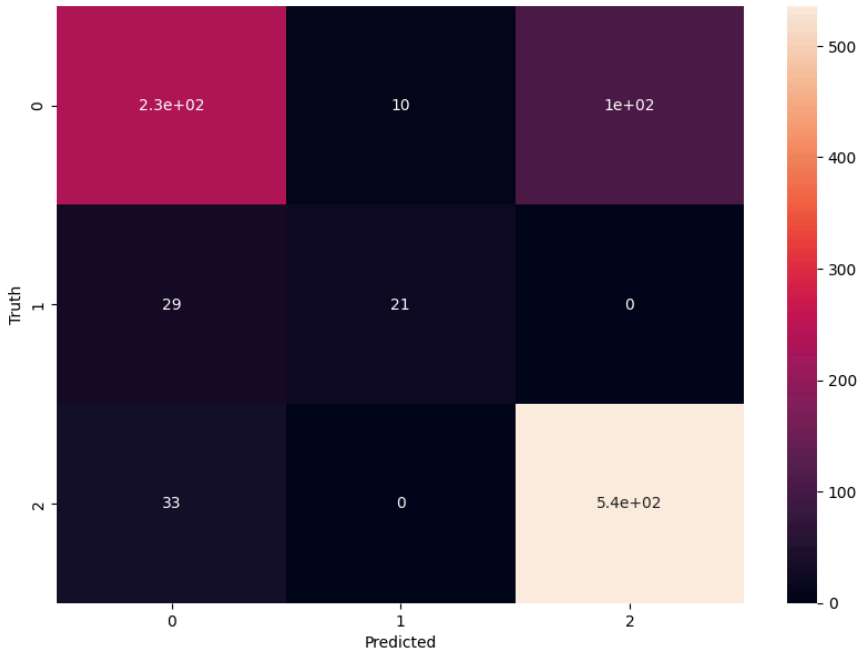
```
array([2, 2, 0, 2, 0])
```

```
y_test[:5]
```

```
3076    2
2931    2
3814    0
5052    2
2128    0
Name: Customer_Status, dtype: int64
```

```
import seaborn as sns
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_predicted)
plt.figure(figsize = (10,7))
sns.heatmap(cm, annot=True)
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(95.72222222222221, 0.5, 'Truth')
```




```
from sklearn.metrics import classification_report
```

```
print(classification_report(y_test, y_predicted))
```

```
              precision    recall  f1-score   support
```