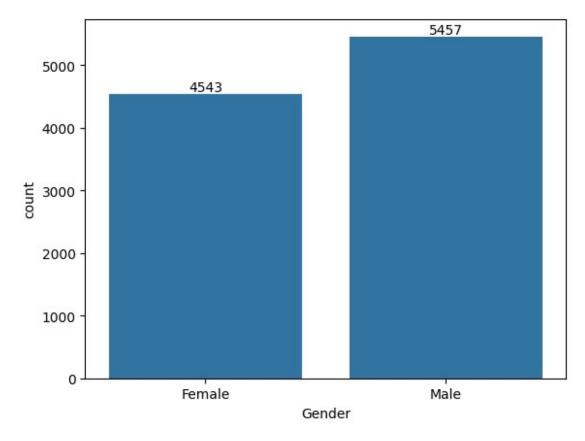
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
df = pd.read csv('Customer-Churn-Records.csv')
df.head()
   RowNumber CustomerId Surname CreditScore Geography Gender Age
/
0
                15634602 Hargrave
                                             619
                                                     France Female
                                                                      42
           2
                15647311
                               Hill
                                             608
                                                      Spain Female
                                                                      41
1
2
           3
                15619304
                               Onio
                                             502
                                                     France Female
                                                                      42
3
                15701354
                                             699
                                                     France Female
                                                                      39
                               Boni
                15737888
                          Mitchell
                                             850
                                                                      43
                                                      Spain Female
                      NumOfProducts
                                      HasCrCard
                                                 IsActiveMember \
   Tenure
             Balance
0
        2
                0.00
                                   1
                                              1
                                                               1
1
        1
            83807.86
                                   1
                                              0
                                                               1
                                              1
2
        8
                                   3
                                                               0
           159660.80
                                   2
3
        1
                0.00
                                              0
                                                               0
4
        2
                                   1
                                              1
                                                               1
           125510.82
   EstimatedSalary
                    Exited Complain Satisfaction Score Card Type \
0
         101348.88
                                                             DIAMOND
                          1
                                    1
                                                         2
         112542.58
                          0
                                    1
                                                         3
                                                             DIAMOND
1
2
         113931.57
                          1
                                    1
                                                         3
                                                             DIAMOND
3
                                    0
                                                         5
          93826.63
                          0
                                                                GOLD
                                                         5
4
          79084.10
                          0
                                                                GOLD
   Point Earned
0
            464
1
            456
2
            377
3
            350
4
            425
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 18 columns):
#
     Column
                         Non-Null Count
                                          Dtype
 0
     RowNumber
                          10000 non-null
                                          int64
```

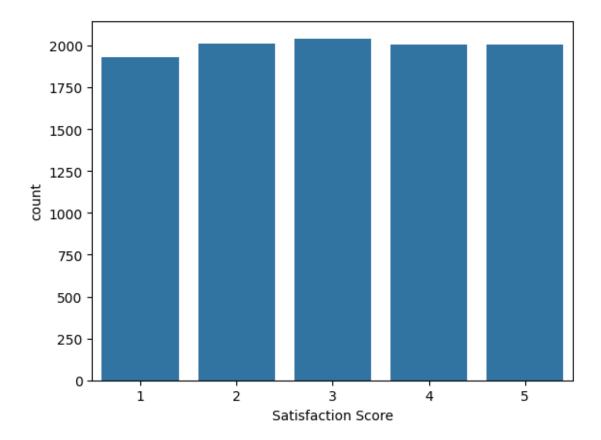
```
1
     CustomerId
                          10000 non-null
                                          int64
 2
     Surname
                          10000 non-null
                                          object
 3
     CreditScore
                          10000 non-null
                                          int64
 4
                          10000 non-null
                                          object
     Geography
 5
     Gender
                          10000 non-null
                                          object
 6
     Age
                          10000 non-null
                                          int64
 7
     Tenure
                          10000 non-null
                                          int64
 8
     Balance
                          10000 non-null
                                          float64
     NumOfProducts
 9
                          10000 non-null
                                          int64
 10
     HasCrCard
                          10000 non-null
                                          int64
 11
     IsActiveMember
                          10000 non-null
                                          int64
 12
    EstimatedSalary
                          10000 non-null
                                          float64
                          10000 non-null
                                          int64
 13
    Exited
 14
    Complain
                          10000 non-null
                                          int64
 15
     Satisfaction Score
                          10000 non-null
                                          int64
     Card Type
                          10000 non-null
 16
                                          object
     Point Earned
17
                          10000 non-null
                                          int64
dtypes: float64(2), int64(12), object(4)
memory usage: 1.4+ MB
# To check the null values in the data
df.isnull().sum()
RowNumber
                       0
                       0
CustomerId
                       0
Surname
                       0
CreditScore
Geography
                       0
                       0
Gender
Age
                       0
Tenure
                       0
Balance
                       0
NumOfProducts
                       0
HasCrCard
                       0
                       0
IsActiveMember
EstimatedSalary
                       0
                       0
Exited
Complain
                       0
Satisfaction Score
                       0
                       0
Card Type
Point Earned
                       0
dtype: int64
df.describe()
         RowNumber
                       CustomerId
                                    CreditScore
                                                           Age
Tenure \
count 10000.00000 1.000000e+04 10000.000000
                                                  10000.000000
10000.000000
        5000.50000 1.569094e+07
mean
                                     650.528800
                                                     38.921800
```

5.0128	30					
std	2886.89568	7.19361	9e+04	96.653299	10.487806	
2.8921 min	1.00000	1.55657	0e+07	350.000000	18.000000	
0.0000 25%	90 2500.75000	1.56285	3e+07	584.000000	32.000000	
3.0000 50%		1.56907		652.000000	37.000000	
5.0000	90					
75% 7.0000	7500.25000 90	1.57532	3e+07	718.000000	44.000000	
max 10.000	10000.00000	1.58156	9e+07	850.000000	92.000000	
10.000						
count mean std	Balance 10000.00000 76485.88928 62397.40520	0 1000 8	Products 0.000000 1.530200 0.581654	HasCrCard 10000.00000 0.70550 0.45584	IsActiveMember 10000.000000 0.515100 0.499797	\
min	0.00000	0	1.000000	0.00000	0.00000	
25% 50%	0.00000 97198.54000	-	1.000000	$0.00000 \\ 1.00000$	0.000000 1.000000	
75% max	127644.24000 250898.09000		2.000000 4.000000	1.00000 1.00000	1.000000 1.000000	
IIIax						_
\	EstimatedSal	ary	Exited	Complain	Satisfaction	Score
count	10000.000	000 100	00.000000	10000.000000	10000.	000000
mean	100090.239	881	0.203800	0.204400	3.	013800
std	57510.492	818	0.402842	0.403283	1.	405919
min	11.580	000	0.000000	0.000000	1.	000000
25%	51002.110	000	0.000000	0.00000	2.	000000
50%	100193.915	000	0.000000	0.000000	3.	000000
75%	149388.247	500	0.000000	0.00000	4.	000000
max	199992.480	000	1.000000	1.000000	5.	000000
count mean std min 25%	Point Earned 10000.000000 606.515100 225.924839 119.000000 410.000000 605.000000					
30 0	000100000					

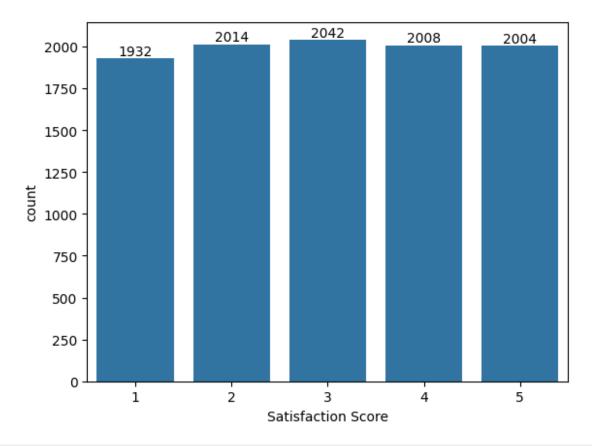
```
75%
         801.000000
        1000.000000
max
df.duplicated().sum()
np.int64(0)
df["CustomerId"].duplicated().sum()
np.int64(0)
df.head()
   RowNumber CustomerId Surname CreditScore Geography Gender Age
/
0
                                                                      42
                15634602 Hargrave
                                             619
                                                     France Female
1
           2
                15647311
                               Hill
                                             608
                                                      Spain Female
                                                                      41
2
           3
                15619304
                               Onio
                                             502
                                                     France Female
                                                                      42
                                             699
3
                15701354
                               Boni
                                                     France Female
                                                                      39
                15737888 Mitchell
                                             850
                                                      Spain Female
                                                                      43
             Balance
                      NumOfProducts
                                      HasCrCard
                                                  IsActiveMember
   Tenure
0
        2
                0.00
                                               1
                                                               1
            83807.86
                                              0
                                                               1
1
        1
                                   1
                                               1
2
        8
           159660.80
                                   3
                                                               0
3
                                   2
        1
                0.00
                                               0
                                                               0
           125510.82
                                   1
                                               1
                                                               1
   EstimatedSalary Exited Complain Satisfaction Score Card Type \
0
         101348.88
                          1
                                                         2
                                                             DIAMOND
1
         112542.58
                          0
                                    1
                                                         3
                                                             DIAMOND
2
                                    1
                                                         3
         113931.57
                          1
                                                             DIAMOND
                                                         5
3
          93826.63
                          0
                                    0
                                                                GOLD
4
          79084.10
                                                         5
                                                                GOLD
                          0
   Point Earned
0
            464
            456
1
2
            377
3
            350
            425
4
# count of customers by Gender
ax = sns.countplot(x = 'Gender', data = df)
ax.bar label(ax.containers[0])
plt.show()
```



```
# rating for satisfaction score
sns.countplot(x = 'Satisfaction Score', data = df)
plt.show()
```



count of customers rated for every satisfaction score
ax = sns.countplot(x = 'Satisfaction Score', data = df)
ax.bar_label(ax.containers[0])
plt.show()



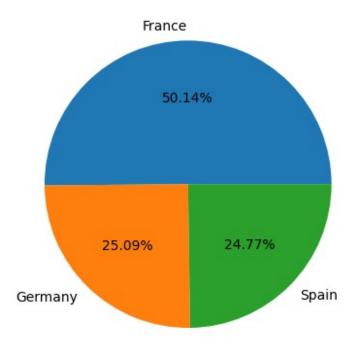
df	.head()								
	RowNumb	er	Custom	erId	Surname	CreditScore	Geography	Gender	Age
0		1	1563	4602	Hargrave	619	France	e Female	42
1		2	1564	7311	Hill	608	Spair	n Female	41
2		3	1561	9304	Onio	502	France	e Female	42
3		4	1570	1354	Boni	699	France	e Female	39
4		5	1573	7888	Mitchell	850	Spair	n Female	43
	_								
0	Tenure 2		Balance 0.00	Num(OfProducts 1	HasCrCard 1	IsActiveM	lember ∖ 1	
1	1	8	3807.86		1	0		1	
2	8	15	9660.80		3	1		0	
3	1		0.00		2	0		0	
4	2	12	5510.82		1	1		1	
0 1		013	alary 48.88 42.58	Exited : (L :	n Satisfact: 1 1	ion Score 2 3	Card Type DIAMOND DIAMOND	

```
2
         113931.57
                          1
                                     1
                                                          3
                                                               DIAMOND
                                                          5
3
          93826.63
                                     0
                                                                  GOLD
                          0
                                                          5
4
          79084.10
                          0
                                     0
                                                                  GOLD
   Point Earned
0
            464
1
            456
2
            377
3
             350
4
            425
# Conversion of O and 1 values to Yes and No
def conv(value):
    if value == 1:
        return "yes"
    else:
        return "no"
df['IsActiveMember'] = df['IsActiveMember'].apply(conv)
df.head()
   RowNumber CustomerId Surname CreditScore Geography Gender Age
0
                 15634602 Hargrave
                                              619
                                                      France Female
                                                                        42
           1
                                                       Spain Female
1
                 15647311
                                Hill
                                              608
                                                                        41
2
           3
                 15619304
                                Onio
                                              502
                                                                        42
                                                      France Female
3
           4
                 15701354
                                Boni
                                              699
                                                      France Female
                                                                        39
           5
                 15737888 Mitchell
                                              850
                                                       Spain Female
                                                                        43
   Tenure
             Balance
                       NumOfProducts HasCrCard IsActiveMember \
0
        2
                 0.00
                                    1
                                                1
                                                             yes
        1
            83807.86
                                    1
                                                0
1
                                                             yes
2
        8
           159660.80
                                    3
                                                1
                                                               no
3
        1
                 0.00
                                    2
                                                0
                                                               no
4
           125510.82
                                    1
                                                1
                                                             yes
   EstimatedSalary
                     Exited Complain Satisfaction Score Card Type \
0
         101348.88
                          1
                                     1
                                                          2
                                                               DIAMOND
                                     1
1
         112542.58
                          0
                                                          3
                                                               DIAMOND
                                                          3
2
         113931.57
                          1
                                     1
                                                               DIAMOND
                                                          5
3
          93826.63
                          0
                                     0
                                                                  GOLD
                                                          5
4
          79084.10
                                     0
                          0
                                                                  GOLD
   Point Earned
```

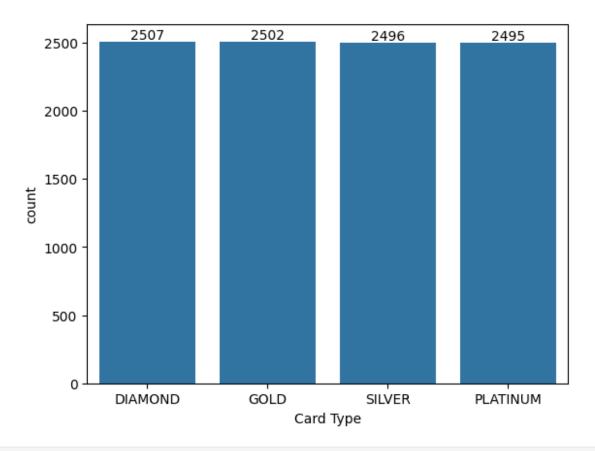
```
0
            464
            456
1
2
            377
3
            350
4
            425
# Conversion of O and 1 values to Yes and No
def conv(value):
    if value == 1:
        return "yes"
    else:
        return "no"
df['HasCrCard'] = df['HasCrCard'].apply(conv)
df.head()
   RowNumber CustomerId Surname CreditScore Geography Gender Age
0
                15634602 Hargrave
                                              619
                                                     France Female
                                                                       42
                15647311
                               Hill
                                              608
                                                                       41
1
                                                      Spain Female
                15619304
2
                                              502
                                                     France Female
           3
                               Onio
                                                                       42
3
           4
                15701354
                               Boni
                                              699
                                                     France Female
                                                                       39
           5
                15737888 Mitchell
                                              850
                                                      Spain Female
                                                                       43
             Balance NumOfProducts HasCrCard IsActiveMember
   Tenure
EstimatedSalary
        2
                0.00
                                            yes
                                                           yes
101348.88
            83807.86
                                             no
                                                           yes
112542.58
           159660.80
        8
                                            yes
                                                            no
113931.57
                0.00
                                             no
                                                            no
93826.63
           125510.82
                                            yes
                                                           yes
79084.10
           Complain Satisfaction Score Card Type
                                                     Point Earned
   Exited
0
                                            DIAMOND
                                                               464
        1
                                        2
                   1
                                        3
                                                               456
1
        0
                   1
                                            DIAMOND
2
                                        3
        1
                   1
                                            DIAMOND
                                                               377
3
        0
                   0
                                        5
                                               GOLD
                                                               350
                                        5
4
                                               GOLD
                                                               425
```

```
# Conversion of O and 1 values to Yes and No
def conv(value):
    if value == 1:
        return "ves"
    else:
        return "no"
df['Exited'] = df['Exited'].apply(conv)
df.head()
   RowNumber CustomerId Surname CreditScore Geography Gender Age
0
                15634602 Hargrave
                                             619
                                                    France Female
                                                                      42
1
           2
                15647311
                              Hill
                                             608
                                                     Spain Female
                                                                      41
2
           3
                15619304
                              Onio
                                             502
                                                    France Female
                                                                      42
3
                15701354
                              Boni
                                             699
                                                    France Female
                                                                      39
                15737888 Mitchell
                                             850
                                                     Spain Female
                                                                      43
             Balance NumOfProducts HasCrCard IsActiveMember
   Tenure
EstimatedSalary \
        2
                0.00
                                           yes
                                                          yes
101348.88
            83807.86
                                            no
        1
                                                          yes
112542.58
          159660.80
        8
                                           yes
                                                           no
113931.57
        1
                0.00
                                            no
                                                           no
93826.63
        2
          125510.82
                                           yes
                                                          yes
79084.10
          Complain Satisfaction Score Card Type Point Earned
  Exited
0
                                          DIAMOND
                                                            464
                 1
                                      2
     yes
1
                 1
                                      3
                                          DIAMOND
                                                            456
      no
2
     yes
                 1
                                      3
                                          DIAMOND
                                                            377
3
                                      5
                 0
                                             GOLD
                                                            350
      no
                                      5
4
      no
                                             GOLD
                                                            425
# Conversion of O and 1 values to Yes and No
def conv(value):
    if value == 1:
        return "yes"
    else:
```

```
return "no"
df['Complain'] = df['Complain'].apply(conv)
df.head()
   RowNumber CustomerId Surname CreditScore Geography Gender Age
/
0
                15634602 Hargrave
                                              619
                                                     France Female
                                                                       42
           1
           2
                15647311
                               Hill
                                              608
                                                      Spain Female
                                                                       41
1
                15619304
                               Onio
                                              502
                                                     France Female
2
           3
                                                                       42
3
           4
                15701354
                               Boni
                                              699
                                                     France Female
                                                                       39
           5
                                              850
                15737888
                           Mitchell
                                                      Spain Female
                                                                       43
   Tenure
             Balance NumOfProducts HasCrCard IsActiveMember
EstimatedSalary \
                0.00
        2
                                   1
                                            yes
                                                           yes
101348.88
            83807.86
        1
                                             no
                                                           yes
112542.58
           159660.80
                                            yes
                                                            no
113931.57
                0.00
                                   2
        1
                                             no
                                                            no
93826.63
           125510.82
        2
                                            yes
                                                           yes
79084.10
                   Satisfaction Score Card Type
  Exited Complain
                                                   Point Earned
0
     yes
                                     2
                                          DIAMOND
                                                             464
              yes
                                     3
                                                             456
1
                                          DIAMOND
      no
              yes
2
                                     3
                                          DIAMOND
                                                             377
     yes
              yes
3
                                     5
                                             GOLD
                                                             350
      no
               no
                                     5
                                             GOLD
4
                                                            425
      no
               no
# region wise percentage of customers
gb = df.groupby("Geography").agg({'Geography':'count'})
plt.pie(gb["Geography"], labels = gb.index, autopct = "%1.2f%%")
plt.show()
```



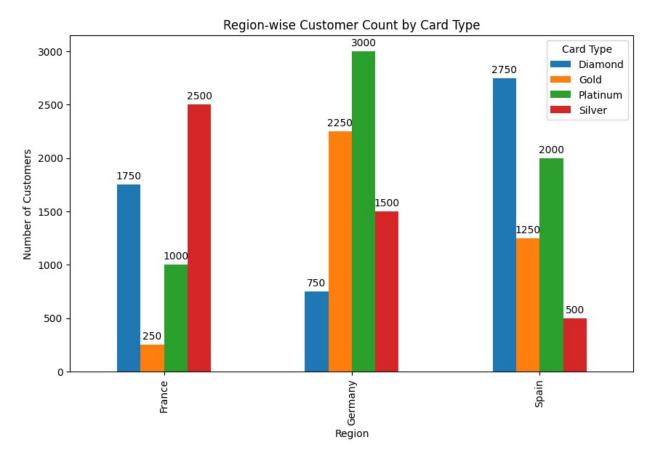
```
# count of customers rated for every satisfaction score
ax = sns.countplot(x = 'Card Type', data = df)
ax.bar_label(ax.containers[0])
plt.show()
```



df.head()							
	er	CustomerId	Surname	CreditScore	Geography	Gender	Age
0	1	15634602	Hargrave	619	France	Female	42
1	2	15647311	Hill	608	Spain	Female	41
2	3	15619304	Onio	502	France	Female	42
3	4	15701354	Boni	699	France	Female	39
4	5	15737888	Mitchell	850	Spain	Female	43
Tenure EstimatedS			OfProducts	HasCrCard I	sActiveMemb	er	
0 2	a ca i	0.00	1	yes	у	es	
101348.88 1 1 112542.58	83	3807.86	1	no	у	es	
2 8	159	9660.80	3	yes		no	
113931.57 3 1 93826.63		0.00	2	no		no	

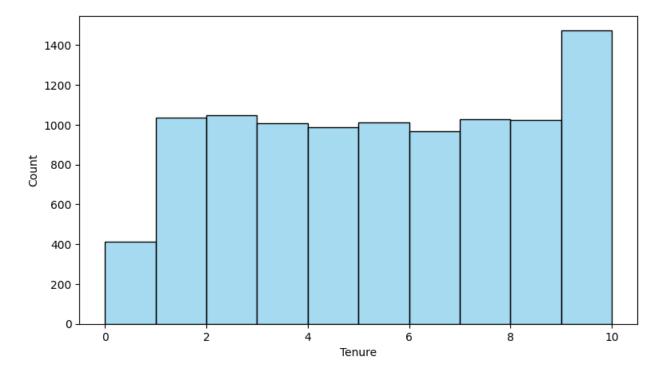
```
2 125510.82
                                           ves
                                                          ves
79084.10
                   Satisfaction Score Card Type
                                                  Point Earned
  Exited Complain
0
                                     2
                                         DIAMOND
                                                           464
     ves
              ves
1
                                     3
                                         DIAMOND
                                                           456
      no
              yes
2
                                     3
                                         DIAMOND
                                                           377
     yes
              yes
3
                                     5
      no
               no
                                            GOLD
                                                           350
                                     5
4
                                            GOLD
                                                           425
      no
               no
data = {
    'Region':
['France','Spain','Germany','France','Spain','Germany','France','Spain
','Germany','France','Spain','Germany'],
    'Card_Type': ['Gold', 'Silver', 'Diamond', 'Platinum', 'Gold',
'Silver', 'Diamond', 'Platinum', 'Gold', 'Silver', 'Diamond',
'Platinum'],
    'Customer Count':
[250,500,750,1000,1250,1500,1750,2000,2250,2500,2750,3000]
df = pd.DataFrame(data)
# Pivot the data for better visualization
pivot df = df.pivot table(index='Region', columns='Card Type',
values='Customer Count', aggfunc='sum')
# print("Region-wise Customer Count by Card Type:")
# print(pivot df)
# Plot a bar chart
ax = pivot df.plot(kind='bar', figsize=(10, 6))
plt.title('Region-wise Customer Count by Card Type')
plt.xlabel('Region')
plt.ylabel('Number of Customers')
plt.legend(title='Card Type')
# Add value labels on bars
for container in ax.containers:
    ax.bar label(container, fmt='%d', label type='edge', fontsize=10,
padding=3)
# # Plot a bar chart
# pivot df.plot(kind='bar', figsize=(10, 6))
# plt.title('Region-wise Customer Count by Card Type')
# plt.xlabel('Region')
# plt.vlabel('Number of Customers')
# plt.legend(title='Card Type')
```

plt.xticks(rotation=45) # plt.show()



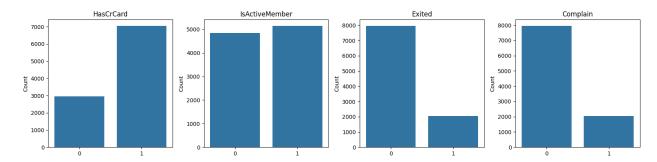
df	= pd.re	ead _.	_csv('Cus	tom	er-Churn-Re	ecords.csv')			
df	.head()								
	RowNumb	er	Customer	Id	Surname	CreditScore	Geography	Gender	Age
0		1	156346	02	Hargrave	619	France	Female	42
1		2	156473	11	Hill	608	Spain	Female	41
2		3	156193	04	Onio	502	France	Female	42
3		4	157013	54	Boni	699	France	Female	39
4		5	157378	88	Mitchell	850	Spain	Female	43
	_		D 1		0.50		T A 1 ' M		
0	Tenure 2		0.00	Num	1	1	IsActiveMe	mber \	
1 2	1 8		3807.86 9660.80		1 3	0 1		1 0	

```
2
3
        1
                 0.00
                                                0
                                                                 0
4
        2
          125510.82
                                                1
                                                                 1
   EstimatedSalary
                     Exited Complain Satisfaction Score Card Type \
0
         101348.88
                                                               DIAMOND
                          1
1
         112542.58
                          0
                                     1
                                                          3
                                                               DIAMOND
2
                                                          3
                                     1
         113931.57
                          1
                                                               DIAMOND
3
                                                          5
          93826.63
                          0
                                     0
                                                                  GOLD
4
          79084.10
                                     0
                                                          5
                                                                  GOLD
   Point Earned
0
            464
            456
1
2
            377
3
            350
4
            425
df_copy = df.copy()
plt.figure(figsize = (9,5))
sns.histplot(x = 'Tenure', data=df, bins=10, color= 'skyblue')
plt.show()
```



```
df.columns.values
array(['RowNumber', 'CustomerId', 'Surname', 'CreditScore',
    'Geography',
        'Gender', 'Age', 'Tenure', 'Balance', 'NumOfProducts',
```

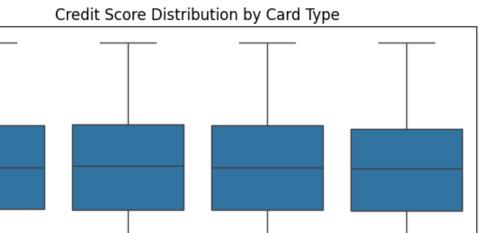
```
'HasCrCard',
       'IsActiveMember', 'EstimatedSalary', 'Exited', 'Complain',
       'Satisfaction Score', 'Card Type', 'Point Earned'],
dtype=object)
columns = ['HasCrCard', 'IsActiveMember', 'Exited', 'Complain']
# Create subplots
fig, axes = plt.subplots(1, 4, figsize=(16, 4)) # 1 row, 4 columns
# Generate countplots for each column
for i, col in enumerate(columns):
    sns.countplot(x=df[col], ax=axes[i])
    axes[i].set title(col) # Set title
    axes[i].set_xlabel('') # Remove x-label text
    axes[i].set_ylabel('Count')
# Adjust layout for better spacing
plt.tight layout()
plt.show()
```



Here 1 represents "YES" and 0 represents "NO".

df	.head()						
	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age
0	1	15634602	Hargrave	619	France	Female	42
1	2	15647311	Hill	608	Spain	Female	41
2	3	15619304	Onio	502	France	Female	42
3	4	15701354	Boni	699	France	Female	39
4	5	15737888	Mitchell	850	Spain	Female	43

```
Tenure
             Balance NumOfProducts HasCrCard
                                                 IsActiveMember \
0
                0.00
        2
                                   1
                                              1
                                                               1
1
        1
            83807.86
                                   1
                                              0
                                                               1
2
                                   3
                                              1
                                                               0
        8
           159660.80
3
        1
                0.00
                                   2
                                              0
                                                               0
4
                                   1
        2
           125510.82
                                              1
                                                               1
   EstimatedSalary Exited Complain Satisfaction Score Card Type \
0
         101348.88
                         1
                                                         2
                                                             DIAMOND
                                    1
1
                                                         3
         112542.58
                         0
                                    1
                                                             DIAMOND
2
                                                         3
         113931.57
                          1
                                    1
                                                             DIAMOND
                                                         5
3
                                    0
          93826.63
                          0
                                                                GOLD
4
          79084.10
                         0
                                    0
                                                         5
                                                                GOLD
   Point Earned
0
            464
1
            456
2
            377
3
            350
4
            425
plt.figure(figsize=(8, 5))
sns.boxplot(x=df['Card Type'], y=df['CreditScore'])
plt.title('Credit Score Distribution by Card Type')
plt.xlabel('Card Type')
plt.ylabel('Credit Score')
plt.xticks(rotation=45)
plt.show()
```



Credit Score

df	.head()								
\	RowNumb	er	Custome	rId	Surname	CreditScore	Geography	Gender	Age
0		1	15634	602	Hargrave	619	France	Female	42
1		2	15647	311	Hill	608	Spain	Female	41
2		3	15619	304	Onio	502	France	Female	42
3		4	15701	354	Boni	699	France	Female	39
4		5	15737	888	Mitchell	850	Spain	Female	43
	_		_						
0	Tenure 2		Balance 0.00	Num	OfProducts 1	HasCrCard 1	IsActiveMe	ember \ 1	
1	1		3807.86		1	0		1	
2	8 1	159	9660.80		3 2	1 0		0 0	
4	2	12	5510.82		1	1		1	

Card Type

0 1 2 3 4	EstimatedSalary 101348.88 112542.58 113931.57 93826.63 79084.10	Exited 1 0 1 0 0	Complain 1 1 1 0 0	Satisfaction	Score 2 3 3 5 5	DIAMOND DIAMOND	\
0 1 2 3 4	Point Earned 464 456 377 350 425						