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BE -CSE 4YEAR  
SUBJECT:IBM

### #libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

### #load dataset

```
df = pd.read_csv(r"/content/Churn_Modelling.csv")
```

```
df.head(10)
```

	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
5	6	15574012	Chu	645	Spain	Male	44
6	7	15592531	Bartlett	822	France	Male	50
7	8	15656148	Obinna	376	Germany	Female	29
8	9	15792365	He	501	France	Male	44
9	10	15592389	H?	684	France	Male	27

	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	\
0	2	0.00	1	1	1	
1	1	83807.86	1	0	1	
2	8	159660.80	3	1	0	
3	1	0.00	2	0	0	
4	2	125510.82	1	1	1	
5	8	113755.78	2	1	0	
6	7	0.00	2	1	1	
7	4	115046.74	4	1	0	
8	4	142051.07	2	0	1	
9	2	134603.88	1	1	1	

	EstimatedSalary	Exited
0	101348.88	1
1	112542.58	0
2	113931.57	1

3	93826.63	0
4	79084.10	0
5	149756.71	1
6	10062.80	0
7	119346.88	1
8	74940.50	0
9	71725.73	0

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 10000 entries, 0 to 9999
```

```
Data columns (total 14 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	Geography	10000	non-null	object
5	Gender	10000	non-null	object
6	Age	10000	non-null	int64
7	Tenure	10000	non-null	int64
8	Balance	10000	non-null	float64
9	NumOfProducts	10000	non-null	int64
10	HasCrCard	10000	non-null	int64
11	IsActiveMember	10000	non-null	int64
12	EstimatedSalary	10000	non-null	float64
13	Exited	10000	non-null	int64

```
dtypes: float64(2), int64(9), object(3)
```

```
memory usage: 1.1+ MB
```

```
#Visualizations
```

```
#Univariate Analysis
```

```
import seaborn as sns
```

```
sns.kdeplot(df['CreditScore'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc4a0cd2790>
```



*#Bi - Variate Analysis*

```
plt.bar(df.CustomerId, df.CreditScore)
plt.title('CreditScore')
plt.xlabel('CustomerId')
plt.ylabel('CreditScore')
Text(0, 0.5, 'CreditScore')
```



```
sns.lmplot(x='Tenure', y='Balance', data=df ,hue='Exited',size=8)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/regression.py:581:  
UserWarning: The `size` parameter has been renamed to `height`; please  
update your code.  
warnings.warn(msg, UserWarning)
```

```
<seaborn.axisgrid.FacetGrid at 0x7fc4a149e2d0>
```



*#Multi - Variate Analysis*

```
ax =  
df[["CreditScore","Age","Tenure","Balance"]].plot(figsize=(80,40))  
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5));
```



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

```
RowNumber          0
CustomerId          0
Surname            0
CreditScore        0
Geography          0
Gender             0
Age               0
Tenure            0
Balance            0
NumOfProducts     0
HasCrCard          0
IsActiveMember     0
EstimatedSalary    0
Exited             0
dtype: int64
```

```
plt.figure(figsize=(15,13))
sns.heatmap(df.corr(),annot=True,cmap='BuPu')
plt.show()
```



```
df.drop(['RowNumber', 'CustomerId', 'Surname'], axis=1, inplace=True)
```

```
df.head()
```

	CreditScore	Geography	Gender	Age	Tenure	Balance
0	619	France	Female	42	2	0.00
1						
1	608	Spain	Female	41	1	83807.86
1						
2	502	France	Female	42	8	159660.80
3						
3	699	France	Female	39	1	0.00
2						
4	850	Spain	Female	43	2	125510.82
1						

  

	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	1	101348.88	1

1	0	1	112542.58	0
2	1	0	113931.57	1
3	0	0	93826.63	0
4	1	1	79084.10	0

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 11 columns):
#   Column                Non-Null Count  Dtype
---  -
0   CreditScore            10000 non-null  int64
1   Geography              10000 non-null  object
2   Gender                 10000 non-null  object
3   Age                   10000 non-null  int64
4   Tenure                10000 non-null  int64
5   Balance               10000 non-null  float64
6   NumOfProducts         10000 non-null  int64
7   HasCrCard             10000 non-null  int64
8   IsActiveMember        10000 non-null  int64
9   EstimatedSalary       10000 non-null  float64
10  Exited                 10000 non-null  int64
dtypes: float64(2), int64(7), object(2)
memory usage: 859.5+ KB
```

```
df["Geography"].unique()
```

```
array(['France', 'Spain', 'Germany'], dtype=object)
```

```
df["Gender"].unique()
```

```
array(['Female', 'Male'], dtype=object)
```

```
geo=pd.get_dummies(df["Geography"],drop_first=False)
```

```
geo.head()
```

	France	Germany	Spain
0	1	0	0
1	0	0	1
2	1	0	0
3	1	0	0
4	0	0	1

```
gen=pd.get_dummies(df["Gender"],drop_first=False)
```

```
df=pd.concat([df, geo,gen], axis=1)
```

```
df
```

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	\
--	-------------	-----------	--------	-----	--------	---------	---------------	---



0	619	France	Female	42	2	0.00
1						
1	608	Spain	Female	41	1	83807.86
1						
2	502	France	Female	42	8	159660.80
3						
3	699	France	Female	39	1	0.00
2						
4	850	Spain	Female	43	2	125510.82
1						
...	...	...	...	...	...	...
...						
9995	771	France	Male	39	5	0.00
2						
9996	516	France	Male	35	10	57369.61
1						
9997	709	France	Female	36	7	0.00
1						
9998	772	Germany	Male	42	3	75075.31
2						
9999	792	France	Female	28	4	130142.79
1						

	HasCrCard	IsActiveMember	EstimatedSalary	Exited	France
Germany \					
0	1	1	101348.88	1	1
0					
1	0	1	112542.58	0	0
0					
2	1	0	113931.57	1	1
0					
3	0	0	93826.63	0	1
0					
4	1	1	79084.10	0	0
0					
...	...	...	...	...	...
...					
9995	1	0	96270.64	0	1
0					
9996	1	1	101699.77	0	1
0					
9997	0	1	42085.58	1	1
0					
9998	1	0	92888.52	1	0
1					
9999	1	0	38190.78	0	1
0					

	Spain	Female	Male
0	0	1	0

```

1      1      1      0
2      0      1      0
3      0      1      0
4      1      1      0
...
9995   ...   ...   ...
9995      0      0      1
9996      0      0      1
9997      0      1      0
9998      0      0      1
9999      0      1      0

```

[10000 rows x 16 columns]

```
df.drop(["Geography","Gender"], axis=1, inplace=True)
```

```
df.head()
```

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	\
0	619	42	2	0.00	1	1	
1	608	41	1	83807.86	1	0	
2	502	42	8	159660.80	3	1	
3	699	39	1	0.00	2	0	
4	850	43	2	125510.82	1	1	

	IsActiveMember	EstimatedSalary	Exited	France	Germany	Spain	\
Female							
0	1	101348.88	1	1	0	0	
1							
1	1	112542.58	0	0	0	1	
1							
2	0	113931.57	1	1	0	0	
1							
3	0	93826.63	0	1	0	0	
1							
4	1	79084.10	0	0	0	1	
1							

	Male
0	0
1	0
2	0
3	0
4	0

```
x=df.drop('Exited',axis=1)
```

x

	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	\
0	619	42	2	0.00	1	1	
1	608	41	1	83807.86	1	0	

2	502	42	8	159660.80	3	1
3	699	39	1	0.00	2	0
4	850	43	2	125510.82	1	1
...	...	...	...	...	...	...
9995	771	39	5	0.00	2	1
9996	516	35	10	57369.61	1	1
9997	709	36	7	0.00	1	0
9998	772	42	3	75075.31	2	1
9999	792	28	4	130142.79	1	1

	IsActiveMember	EstimatedSalary	France	Germany	Spain	Female
Male						
0	1	101348.88	1	0	0	1
0						
1	1	112542.58	0	0	1	1
0						
2	0	113931.57	1	0	0	1
0						
3	0	93826.63	1	0	0	1
0						
4	1	79084.10	0	0	1	1
0						
...	...	...	...	...	...	...
...						
9995	0	96270.64	1	0	0	0
1						
9996	1	101699.77	1	0	0	0
1						
9997	1	42085.58	1	0	0	1
0						
9998	0	92888.52	0	1	0	0
1						
9999	0	38190.78	1	0	0	1
0						

[10000 rows x 13 columns]

y=df['Exited']

y

0	1
1	0
2	1
3	0
4	0
...	...
9995	0
9996	0
9997	1
9998	1

```

9999      0
Name: Exited, Length: 10000, dtype: int64

df.shape
(10000, 14)

x.shape
(10000, 13)

y.shape
(10000,)

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=0)

x_train.shape
(8000, 13)

x_test.shape
(2000, 13)

y_test.shape
(2000,)

from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
x_train = sc.fit_transform(x_train)
x_train
array([[ 0.16958176, -0.46460796,  0.00666099, ...,  1.74309049,
         1.09168714, -1.09168714],
       [-2.30455945,  0.30102557, -1.37744033, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-1.19119591, -0.94312892, -1.031415   , ..., -0.57369368,
         1.09168714, -1.09168714],
       ...,
       [ 0.9015152 , -0.36890377,  0.00666099, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-0.62420521, -0.08179119,  1.39076231, ...,  1.74309049,
         1.09168714, -1.09168714],
       [-0.28401079,  0.87525072, -1.37744033, ..., -0.57369368,
         1.09168714, -1.09168714]])

x_test = sc.transform(x_test)

```

x\_test

```
array([[ -0.55204276, -0.36890377,  1.04473698, ..., -0.57369368,
        1.09168714, -1.09168714],
       [-1.31490297,  0.10961719, -1.031415   , ..., -0.57369368,
        1.09168714, -1.09168714],
       [ 0.57162971,  0.30102557,  1.04473698, ...,  1.74309049,
        1.09168714, -1.09168714],
       ...,
       [-0.74791227, -0.27319958, -1.37744033, ...,  1.74309049,
        -0.91601335,  0.91601335],
       [-0.00566991, -0.46460796, -0.33936434, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-0.79945688, -0.84742473,  1.04473698, ..., -0.57369368,
        -0.91601335,  0.91601335]])
```