

Assignment -2

Project Name	AI Based Discourse for Banking Industry
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IMPORT LIBRARIES

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

LOADING THE DATASET

```
df = pd.read_csv('Churn_Modelling.csv', encoding='latin-1')
```

```

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
...      ...      ...      ...      ...      ...      ...
...
9995      9996      15606229      Obijiaku      771      France      Male
39
9996      9997      15569892      Johnstone      516      France      Male
35
9997      9998      15584532      Liu      709      France      Female
36
9998      9999      15682355      Sabbatini      772      Germany      Male
42
9999      10000      15628319      Walker      792      France      Female
28
```

```

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
...      ...      ...      ...      ...      ...
9995      5      0.00      2      1      0
9996      10      57369.61      1      1      1
```

9997	7	0.00	1	0	1
9998	3	75075.31	2	1	0
9999	4	130142.79	1	1	0

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

[10000 rows x 14 columns]

VISUALIZATIONS

#visualization of categorical features

```
fig, ax = plt.subplots(3, 2, figsize = (15, 12))plt.title("Visualization")
sns.countplot('Geography', hue = 'Exited', data = df, ax = ax[0][0],palette='spring')
sns.countplot('Gender', hue = 'Exited', data = df, ax = ax[0][1],palette='spring')
sns.countplot('Tenure', hue = 'Exited', data = df, ax = ax[1][0],palette='spring')
sns.countplot('NumOfProducts', hue = 'Exited', data = df, ax = ax[1][1],palette='spring')
sns.countplot('HasCrCard', hue = 'Exited', data = df, ax = ax[2][0],palette='spring')
sns.countplot('IsActiveMember', hue = 'Exited', data = df, ax = ax[2][1],palette='spring')
```

```
ax[0][0].set_title('Count Plot of Geography',color='red',fontsize=15)ax[0][1].set_title('Count Plot of
Gender',color='red',fontsize=15) ax[1][0].set_title('Count Plot of Tenure',color='red',fontsize=15)
ax[1][1].set_title('Count Plot of NumOfProducts',color='red',fontsize=15)
ax[2][0].set_title('Count Plot of HasCrCard',color='red',fontsize=15)ax[2][1].set_title('Count Plot of
IsActiveMember',color='red',fontsize=15)
```

```
plt.tight_layout()plt.show()
```

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

FutureWarning

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

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FutureWarning



DESCRIPTIVE STATISTICS

df.dtypes

```

RowNumber          int64
CustomerId          int64
Surname            object
CreditScore         int64
Geography           object
Gender              object
Age                int64
Tenure              int64
Balance             float64
NumOfProducts       int64
HasCrCard           int64
IsActiveMember      int64
EstimatedSalary     float64
Exited              int64
dtype: object

```

```

df_num = df[['RowNumber','Tenure','CustomerId','CreditScore','Age','NumOfProducts',
             'HasCrCard','IsActiveMember','Exited']]

```

```
df_cat = df[['Surname','Geography','Gender']]df_num.head()
```

	RowNumber	Tenure	CustomerId	CreditScore	Age	NumOfProducts	HasCrCard \	
0	1	2	15634602			619	42	1
1								
1	2	1	15647311			608	41	1
0								
2	3	8	15619304			502	42	3
1								
3	4	1	15701354			699	39	2
0								
4	5	2	15737888			850	43	1
1								

	IsActiveMember	Exited
0	1	1
1	1	0
2	0	1
3	0	0
4	1	0

```
df_cat.head()
```

	Surname	Geography	Gender
0	Hargrave	France	Female
1	Hill	Spain	Female
2	Onio	France	Female
3	Boni	France	Female
4	Mitchell	Spain	Female

```
df_num.describe()
```

	RowNumber	Tenure	CustomerId	CreditScore
Age \				
count	10000.00000	10000.000000	1.000000e+04	10000.000000
mean	5000.50000	5.012800	1.569094e+07	650.528800
std	2886.89568	2.892174	7.193619e+04	96.653299
min	1.00000	0.000000	1.556570e+07	350.000000
25%	2500.75000	3.000000	1.562853e+07	584.000000
50%	5000.50000	5.000000	1.569074e+07	652.000000
75%	7500.25000	7.000000	1.575323e+07	718.000000
max	10000.00000	10.000000	1.581569e+07	850.000000

92.000000

	NumOfProducts	HasCrCard	IsActiveMember	Exited
count	10000.000000	10000.00000	10000.000000	10000.000000
mean	1.530200	0.70550	0.515100	0.203700
std	0.581654	0.45584	0.499797	0.402769
min	1.000000	0.00000	0.000000	0.000000
25%	1.000000	0.00000	0.000000	0.000000
50%	1.000000	1.00000	1.000000	0.000000
75%	2.000000	1.00000	1.000000	0.000000
max	4.000000	1.00000	1.000000	1.000000

```
df_cat.describe(exclude = ['int64','float64'])Surname Geography Gender
```

count	10000	10000	10000
unique	2932	3	2
top	Smith	France	Male
NaN	5457		

```
print("Column Missing values")print(".....")
df.isnull().sum()
```

Column	Missing values
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

```
print(f"Our target variable is Exited. We can observe that it has onlytwo possible variables:
{df['Exited'].unique().tolist()}")
```

Our target variable is Exited. We can observe that it has only twopossible variables: [1, 0]

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

```
new_names = {
    'CreditScore': 'credit_score', 'Geography':
    'country', 'Gender': 'gender',
    'Age': 'age',
    'Tenure': 'tenure', 'Balance':
    'balance',
    'NumOfProducts': 'number_products', 'HasCrCard':
    'owns_credit_card', 'IsActiveMember': 'is_active_member',
    'EstimatedSalary': 'estimated_salary', 'Exited': 'exited'
}
```

```
df.rename(columns=new_names, inplace=True)df.head()
```

	credit_score	country	gender	age	tenure	balance
0	619	France	Female	42	2	0.00
1	608	Spain	Female	41	1	83807.86
2	502	France	Female	42	8	159660.80
3	699	France	Female	39	1	0.00
4	850	Spain	Female	43	2	125510.82

	owns_credit_card	is_active_member	estimated_salary	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

REPLACE OUTLIERS

```
def detect_outlier(df):
    outlier = [] threshold =
    3 mean = np.mean(df)std =
    np.std(df) for i in df:
        z_score = (i - mean)/std
    if np.abs(z_score)>threshold:
        outlier.append(i)
    return outlier
CreditScore_list = df['CreditScore'].tolist()Balance_list =
df['Balance'].tolist()
```



```

EstimatedSalary_list = df_cat['EstimatedSalary'].tolist()
CreditScore_outlier = detect_outlier(CreditScore_list)
CreditScore_outlier
Output-[359, 350, 350, 358, 351, 350, 350, 350]
Balance_outlier = detect_outlier(Balance_list)
Balance_outlier
EstimatedSalary_outlier = detect_outlier(EstimatedSalary_list)
EstimatedSalary_outlier

```

```

print("Shape of Data before removing outliers: {}".format(df.shape))
Shape of Data before removing outliers: (10000, 11)

```

ENCODING

Encoding Categorical variables into numerical variables# One Hot Encoding

```

x = pd.get_dummies(x)
x.head()
x.shape

```

```

(10000, 13)

```

SPLIT THE DATA INTO DEPENDENT AND INDEPENDENT VARIABLES

splitting the dataset into x(independent variables) and y(dependent variables)

```

x = df.iloc[:,0:10]
y = df.iloc[:,10]

```

```

print(x.shape)
print(y.shape)

```

```

print(x.columns)
#print(y)

```

```

(10000, 10)
(10000,)

```

```

Index(['credit_score', 'country', 'gender', 'age', 'tenure', 'balance',
       'number_products', 'owns_credit_card', 'is_active_member', 'estimated_salary'],
      dtype='object')

```

SCALE THE INDEPENDENT VARIABLES

```

from sklearn.preprocessing import StandardScaler
sc = StandardScaler()

```

```
x_train = pd.DataFrame(x_train)
x_train.head()
```

	credit_score	country	gender	age	tenure		balance
number_products \							
2967		579	Germany	Female	39	5	117833.30
3							
700		750	France	Female	32	5	0.00
2							
3481		729	Spain	Female	34	9	53299.96
2							
1621		689	Spain	Male	38	5	75075.14
1							
800		605	France	Male	52	7	0.00
2							

	owns_credit_card	is_active_member	estimated_salary
2967	0	0	5831.00
700	1	0	95611.47
3481	1	1	42855.97
1621	1	1	8651.92
800	1	1	173952.50

SPLIT THE DATA INTO TRAINING AND TESTING

splitting the data into training and testing set

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size =0.25, random_state = 0)
```

```
print(x_train.shape)
print(y_train.shape)
print(x_test.shape)
print(y_test.shape)
```

```
(7500, 10)
(7500,)
(2500, 10)
(2500,)
```