

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')
df
```

	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						
...
...						
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.

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passing other arguments without an explicit keyword will result in an
error or misinterpretation.

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	10000.000000	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	10000.000000	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
freq	32	5014	5457

HANDLE THE MISSING VALUES

```
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 only  
two possible variables: {df['Exited'].unique().tolist()}")
```

Our target variable is Exited. We can observe that it has only two possible 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,)
```