01. Impot libraries

```
In [63]:import pandas as pd
         import numpy as np
         import matplotlib.pyplot as plt
         import seaborn as sns
```

02. Upload database

```
In [2]:from google.colab import drive
        drive.mount('/content/drive')

       Mounted at /content/drive
```

Read the Dataset

```
In [3]:mydata = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/Churn_Modelling.csv'
```

```
In [8]:mydata.shape
```

```
Out[8]:   14)
(10000,
```

```
In [6]:mydata.head()
```

Out[6]:
RowNumber CustomerId Surname CreditScore

Geography Gender Age Tenure Balanc 0 1 15634602

Hargrave 619 France Female 42 2 0.0 **1** 2 15647311 Hill 608

Spain Female 41 1 83807.8 **2** 3 15619304 Onio 502 France

Female 42 8 159660.8 **3** 4 15701354 Boni 699 France

Female 39 1 0.0 **4** 5 15737888 Mitchell 850 Spain Female

43 2 125510.8

```
In [11]:mydata.columns
```

```
Out[11]:
Index(['RowNumber', 'CustomerId',
'Surname', 'CreditScore', 'Geography',
'Gender', 'Age', 'Tenure', 'Balance',
'NumOfProducts', 'HasCrCard',
'IsActiveMember', 'EstimatedSalary',
'Exited'],
 dtype='object')
```

```
In [12]:mydata.tail()
```

Out[12]:
RowNumber CustomerId Surname CreditScore

Geography Gender Age Tenure Ba 9995 9996 15606229

Obijiaku 771 France Male 39 5 **9996** 9997 15569892

Johnstone 516 France Male 35 10 573 **9997** 9998 15584532

Liu 709 France Female 36 7

RowNumber CustomerId Surname CreditScore Geography Gender Age Tenure Ba 9998 9999

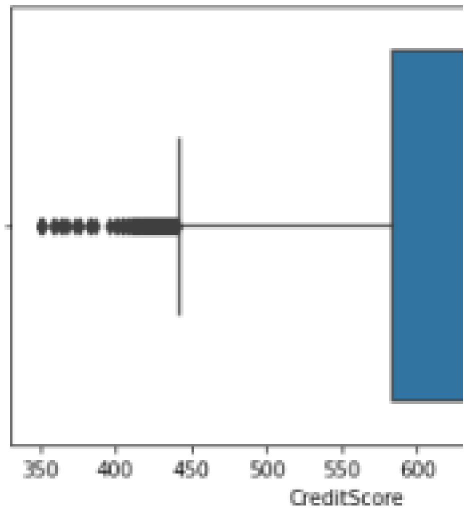
15682355 Sabbatini 772 Germany Male 42 3 750 **9999** 10000 15628319 Walker 792 France Female 28 4 130

03. Perform Visualizations

```
In [99]: sns.boxplot(mydata['CreditScore'])
```

```
/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 vali
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

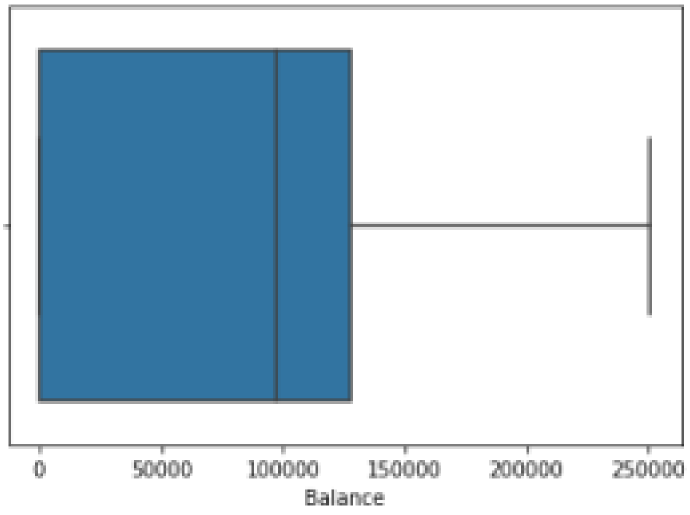
```
Out[99]:
<matplotlib.axes._subplots.AxesSu

bplot at 0x7f6c25826090>
```



```
In [102…sns.boxplot(mydata['Balance'])
```

```
/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 vali
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

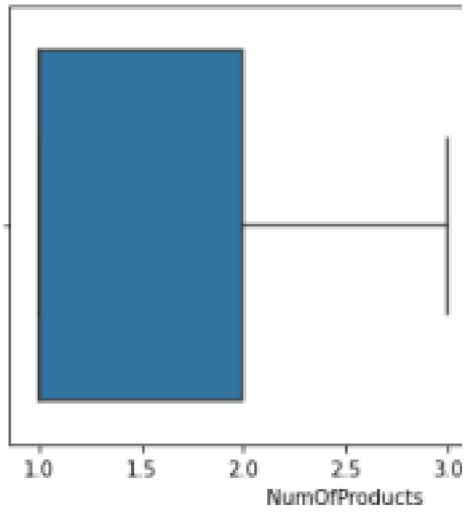
```
Out[102…
<matplotlib.axes._subplots.AxesSu

bplot at 0x7f6c25724310>
```



```
In [103…sns.boxplot(mydata['NumOfProducts'])
```

```
/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 vali
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

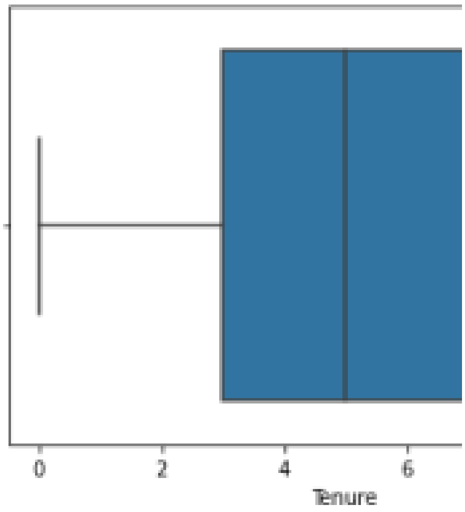
```
Out[103…
<matplotlib.axes._subplots.AxesSu

bplot at 0x7f6c2570ed10>
```



```
In [104…sns.boxplot(mydata['Tenure'])
```

```
/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 vali
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

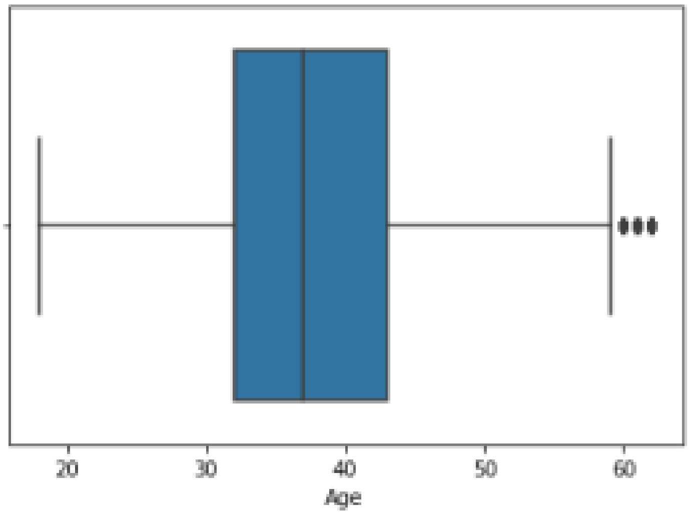
```
Out[104…
<matplotlib.axes._subplots.AxesSu

bplot at 0x7f6c25687550>
```



```
In [105…sns.boxplot(mydata['Age'])
```

```
/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 vali
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

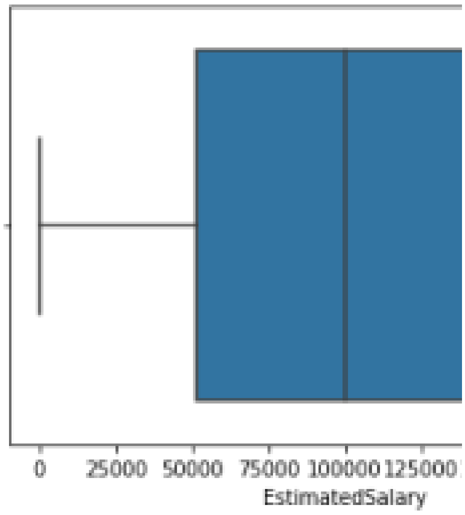
```
                                bplot at 0x7f6c255fb190>
Out[105...
<matplotlib.axes._subplots.AxesSu
```



```
In [106...sns.boxplot(mydata['EstimatedSalary'])
```

```
/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 vali
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

```
Out[106...
<matplotlib.axes._subplots.AxesSu

bplot at 0x7f6c255e2450>
```

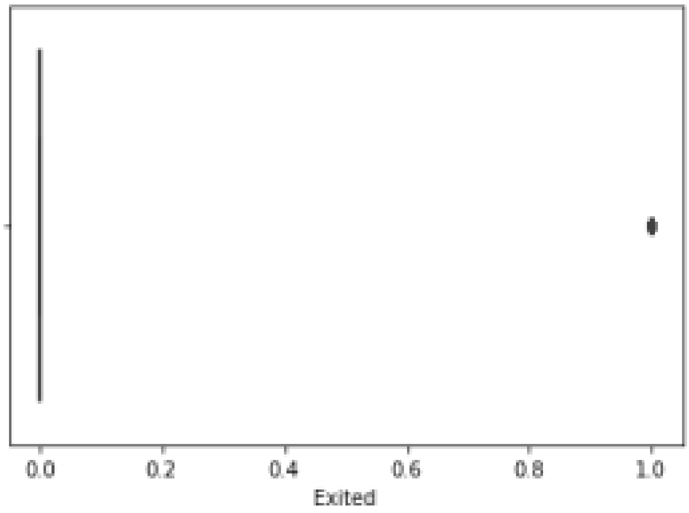


```
In [107...sns.boxplot(mydata['Exited'])
```

```
/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 vali
```

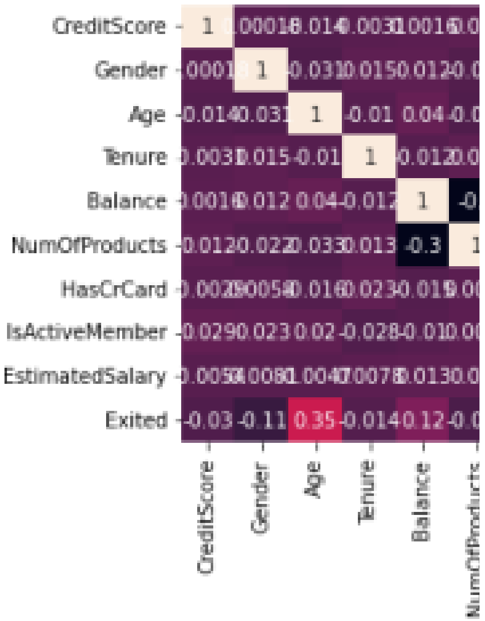
```
d positional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
 FutureWarning
```

```
Out[107…
<matplotlib.axes._subplots.AxesSu                              bplot at 0x7f6c25543890>
```



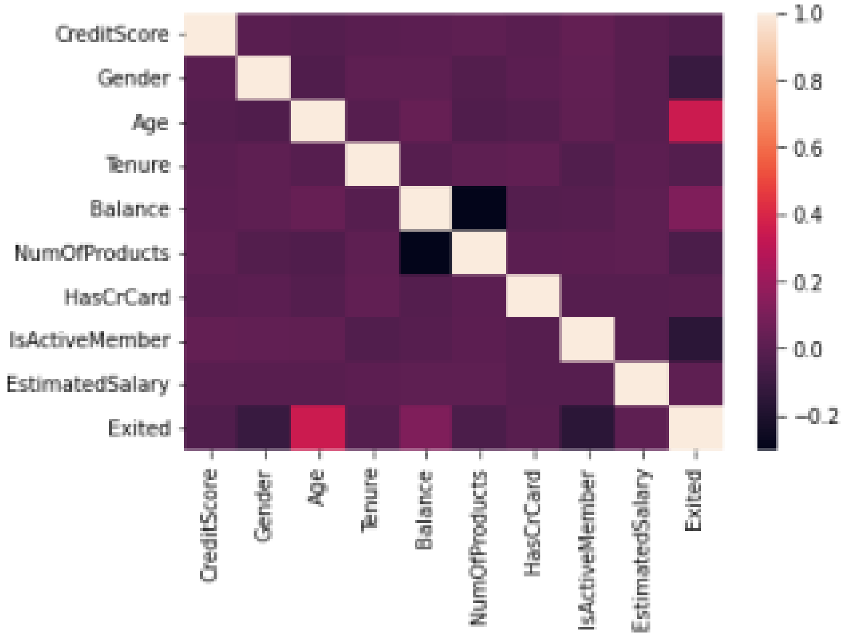
```
In [108…sns.heatmap(mydata.corr(),annot=True)
```

```
Out[108…
<matplotlib.axes._subplots.AxesSub

plot at 0x7f6c25443f10>
```



```
In [109…sns.heatmap(mydata.corr(),annot=False)
```

```
Out[109…
<matplotlib.axes._subplots.AxesSu
bplot at 0x7f6c25443750>
```



05. Handling the Missing Values

```
In [16]: mydata.duplicated().sum()
```

```
Out[16]: 0
```

```
In [17]: mydata.isna().sum()
```

```
Out[17]:
RowNumber 0
CustomerId 0
Surname 0
CreditScore 0
Geography 0
Gender 0 Age 0
Tenure 0
Balance 0
NumOfProducts
0 HasCrCard 0
IsActiveMember
0
EstimatedSalar
```

```
y 0 Exited 0   dtype: int64
```

In [18]:
```
mydata.nunique()
```

Out[18]:
```
RowNumber 10000
CustomerId 10000
Surname 2932
CreditScore 460
Geography 3
Gender 2 Age 70
Tenure 11
Balance 6382
NumOfProducts 4
HasCrCard 2
IsActiveMember 2
EstimatedSalary
9999
```

```
Exited 2
dtype: int64
```

In [19]:
```
mydata.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
```

In [25]:
```
mydata.drop(columns=['Gender','HasCrCard','IsActiveMember','Exited']).describe()
```

Out[25]:

RowNumber CustomerId CreditScore Age Tenure

Balance Nu count 10000.00000 1.000000e+04

10000.000000 10000.000000 10000.000000 10000.000000

mean 5000.50000 1.569094e+07 650.528800 38.921800

5.012800 76485.889288

std 2886.89568 7.193619e+04 96.653299 10.487806

2.892174 62397.405202 **min** 1.00000 1.556570e+07

350.000000 18.000000 0.000000 0.000000 **25%** 2500.75000

1.562853e+07 584.000000 32.000000 3.000000 0.000000

50% 5000.50000 1.569074e+07 652.000000 37.000000

5.000000 97198.540000 **75%** 7500.25000 1.575323e+07

718.000000 44.000000 7.000000 127644.240000 **max**

10000.00000 1.581569e+07 850.000000 92.000000

10.000000 250898.090000

In [26]:
```
qnt=mydata.drop(columns=['Gender','Tenure','HasCrCard','IsActiveMember'])
```

06. Find Outliers

```
In [110⋯qnt=mydata.drop(columns=['Gender','Tenure','HasCrCard','IsActiveMember','NumOfPro
         qnt
```

0.0000 51002.1100 **0.85** 705.0 47.0

Out[110…

140895.0965 170322.3935

CreditScore Age Balance

EstimatedSalary 0.25 584.0 32.0

```
In [111⋯Q1=qnt.iloc[0]
         Q4=qnt.iloc[1]
```

```
In [112⋯iqr=Q4-Q1
        iqr
```

```
                         140895.0965
                         EstimatedSalary
Out[112…                 119320.2835 dtype:
CreditScore 121.0000     float64
Age 15.0000 Balance
```

```
In [113⋯upper=qnt.iloc[1]+2.5*iqr
             upper
```

```
                          493132.83775
                          EstimatedSalary
Out[113…                  468623.10225 dtype:
CreditScore               float64
1007.50000 Age
84.50000 Balance
```

```
In [114⋯lower=qnt.iloc[0]-2.5*iqr
             lower
```

```
                          EstimatedSalary
                          -247298.59875 dtype:
Out[114…                  float64
CreditScore
281.50000 Age
-5.50000 Balance
-352237.74125
```

Replace Outliers

```
In [115⋯mydata['CreditScore']= np.where(mydata['CreditScore']>756,650.5288,mydata['Credit
             mydata['Age']= np.where(mydata['Age']>62, 38.9218,mydata['Age'])
```

07. Categorical Columns and Performing Encoding

```
In [132⋯mydata['Gender'].replace({'Male': 1, 'Female':0}, inplace=True)
         mydata.head(8)
```

Out[132…

CreditScore Gender Age Tenure Balance

NumOfProducts HasCrCard IsActiveMember 0 619.0000

0 42.0 2 0.00 1 1 1 **1** 608.0000 0 41.0 1 83807.86 1 0 1 **2**

502.0000 0 42.0 8 159660.80 3 1 0 **3** 699.0000 0 39.0 1

0.00 2 0 0 **4** 650.5288 0 43.0 2 125510.82 1 1 1 **5** 645.0000

1 44.0 8 113755.78 2 1 0 **6** 650.5288 1 50.0 7 0.00 2 1 1 **7**

376.0000 0 29.0 4 115046.74 4 1 0

Dropping Unwanted Columns

```
In [144…mydata =mydata.drop(columns=['Age'])
              mydata.head()
```

Out[144…

Gender Tenure Balance NumOfProducts HasCrCard

IsActiveMember EstimatedSalary Ex 0 0 2 0.00 1 1 1

101348.88 **1** 0 1 83807.86 1 0 1 112542.58 **2** 0 8 159660.80

3 1 0 113931.57 **3** 0 1 0.00 2 0 0 93826.63 **4** 0 2 125510.82 1

1 1 79084.10

08. Split Data Into Dependent and Independent Variables

```
In [78]: a=mydata.iloc[:,:-2]
           a.head()
```

Out[78]:

CreditScore Gender Age Tenure Balance

NumOfProducts HasCrCard IsActiveMember 0 619.0000

0 42.0 2 0.00 1 1 1 **1** 608.0000 0 41.0 1 83807.86 1 0 1 **2**

502.0000 0 42.0 8 159660.80 3 1 0 **3** 699.0000 0 39.0 1

0.00 2 0 0 **4** 650.5288 0 43.0 2 125510.82 1 1 1

```
In [83]: b=mydata.iloc[:,-2]
```

```
In [84]: b.head()
```

```
Out[84]:
0 101348.88
1 112542.58
2 113931.57
3 93826.63
4 79084.10
Name: EstimatedSalary, dtype: float64
```

09. Scale The Independent Variables

```
In [85]: from sklearn.preprocessing import StandardScaler
```

```
In [86]: cls=StandardScaler()
           a=cls.fit_transform(a)
```

```
In [130…a
```

```
Out[130…
array([[-0.13284832, -1.09598752,
0.48205148, ..., -0.91158349,
0.64609167, 0.97024255],
 [-0.28182929, -1.09598752,
0.36638802, ..., -0.91158349,
-1.54776799, 0.97024255],
 [-1.71746409, -1.09598752,
0.48205148, ..., 2.52705662,
0.64609167, -1.03067011],
 ...,
 [ 1.08608688, -1.09598752,
-0.21192932, ..., -0.91158349,
-1.54776799, 0.97024255],
 [ 0.29416906, 0.91241915,
0.48205148, ..., 0.80773656,
0.64609167, -1.03067011],
 [ 0.29416906, -1.09598752,
-1.13723705, ..., -0.91158349,
0.64609167, -1.03067011]])
```

10.Split Data Into Training and Testing

```
In [88]: from sklearn.model_selection import train_test_split
```

```
In [92]: a_train,a_test,b_train,b_test= train_test_split(a,b,test_size=0.4,random_state=0)
```

```
In [93]: a_train.shape
```

```
Out[93]:  (6000, 8)
```

```
In [94]: a_test.shape
          (4000, 8)

Out[94]:
```

```
In [95]: a_train
```

```
Out[95]:
array([[-0.67459731, 0.91241915,
0.59771495, ..., -0.91158349,
0.64609167, 0.97024255],
 [ 0.31409458, -1.09598752,
0.25072455, ..., -0.91158349,
0.64609167, 0.97024255],
 [ 0.31409458, 0.91241915,
-0.09626585, ..., 0.80773656,
0.64609167, -1.03067011],
 ...,
 [ 1.47885489, 0.91241915,
-0.32759278, ..., 0.80773656,
0.64609167, -1.03067011],
 [-0.52561634, -1.09598752,
0.01939762, ..., 0.80773656,
0.64609167, 0.97024255],
 [-0.07867343, -1.09598752,
1.17603229, ..., -0.91158349,
0.64609167, -1.03067011]])
```

```
In [96]: a_test
```

```
Out[96]:
array([[-0.43081026, -1.09598752,
-0.32759278, ..., -0.91158349,
0.64609167, 0.97024255],
 [-1.43304588, -1.09598752,
0.25072455, ..., -0.91158349,
0.64609167, -1.03067011],
 [ 1.04545571, -1.09598752,
0.48205148, ..., -0.91158349,
0.64609167, 0.97024255],
 ...,
 [ 1.58720469, -1.09598752,
-1.59989092, ..., -0.91158349,
-1.54776799, 0.97024255],
 [ 0.84229984, 0.91241915,
0.01939762, ..., 0.80773656,
-1.54776799, -1.03067011],
```

```
 [-1.39241471, 0.91241915, -0.90591012, ..., 0.80773656,
-1.54776799, -1.03067011]])
```

```
In [131]:b_train
```

```
Out[131…
7809 198402.37
5279 124550.88
3279 68789.93
8984 42669.37
8466 83343.73
 ...
9225 162961.79
4859 107753.07
3264 181429.87
```

```
9845 148750.16
2732 118855.26
Name: EstimatedSalary, Length: 6000, dtype: float64
```

```
In [98]: b_test
```

```
Out[98]:
9394 192852.67
898 128702.10
2398 75732.25
5906 89368.59
2343 135662.17
 ...
4758 48545.10
9914 180844.81
7067 94105.00
4578 44653.50
4202 100995.68
Name: EstimatedSalary, Length:
4000, dtype: float64
```

```
In [ ]:
```