```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
import seaborn as sns
import statistics
import warnings
warnings.filterwarnings('ignore')
from scipy import stats
import statsmodels.api as sm



data=pd.read_csv('churn_modelling.csv')

data.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
```

```
data.mode()
```

```
      RowNumber  CustomerId Surname  CreditScore Geography Gender
Age  \
0             1    15565701   Smith        850.0    France   Male
37.0
1             2    15565706     NaN          NaN       NaN    NaN
NaN
2             3    15565714     NaN          NaN       NaN    NaN
NaN
3             4    15565779     NaN          NaN       NaN    NaN
NaN
4             5    15565796     NaN          NaN       NaN    NaN
NaN
...         ...         ...     ...          ...       ...    ...   ..
.
9995       9996    15815628     NaN          NaN       NaN    NaN
NaN
9996       9997    15815645     NaN          NaN       NaN    NaN
NaN
9997       9998    15815656     NaN          NaN       NaN    NaN
NaN
9998       9999    15815660     NaN          NaN       NaN    NaN
NaN
9999      10000    15815690     NaN          NaN       NaN    NaN
NaN

      Tenure  Balance  NumOfProducts  HasCrCard  IsActiveMember  \
0        2.0      0.0            1.0        1.0             1.0
1        NaN      NaN            NaN        NaN             NaN
2        NaN      NaN            NaN        NaN             NaN
3        NaN      NaN            NaN        NaN             NaN
4        NaN      NaN            NaN        NaN             NaN
...      ...      ...            ...        ...             ...
9995     NaN      NaN            NaN        NaN             NaN
9996     NaN      NaN            NaN        NaN             NaN
9997     NaN      NaN            NaN        NaN             NaN
```

```
9998     NaN      NaN            NaN        NaN             NaN
9999     NaN      NaN            NaN        NaN             NaN

      EstimatedSalary  Exited
0            24924.92     0.0
1                 NaN     NaN
2                 NaN     NaN
3                 NaN     NaN
4                 NaN     NaN
...               ...     ...
9995              NaN     NaN
9996              NaN     NaN
9997              NaN     NaN
9998              NaN     NaN
9999              NaN     NaN

[10000 rows x 14 columns]
```

```
data.mean()
```

```
RowNumber          5.000500e+03
CustomerId         1.569094e+07
CreditScore        6.505288e+02
Age                3.892180e+01
Tenure             5.012800e+00
Balance            7.648589e+04
NumOfProducts      1.530200e+00
HasCrCard          7.055000e-01
IsActiveMember     5.151000e-01
EstimatedSalary    1.000902e+05
Exited             2.037000e-01
dtype: float64
```

```
data.median()
```

```
RowNumber          5.000500e+03
CustomerId         1.569074e+07
CreditScore        6.520000e+02
Age                3.700000e+01
Tenure             5.000000e+00
Balance            9.719854e+04
NumOfProducts      1.000000e+00
HasCrCard          1.000000e+00
IsActiveMember     1.000000e+00
EstimatedSalary    1.001939e+05
Exited             0.000000e+00
dtype: float64
```

```
data.describe()
```

```
         RowNumber    CustomerId   CreditScore           Age
Tenure  \
count  10000.00000  1.000000e+04  10000.000000  10000.000000
10000.000000
mean    5000.50000  1.569094e+07    650.528800     38.921800
5.012800
std     2886.89568  7.193619e+04     96.653299     10.487806
2.892174
min        1.00000  1.556570e+07    350.000000     18.000000
0.000000
25%     2500.75000  1.562853e+07    584.000000     32.000000
3.000000
50%     5000.50000  1.569074e+07    652.000000     37.000000
5.000000
75%     7500.25000  1.575323e+07    718.000000     44.000000
7.000000
max    10000.00000  1.581569e+07    850.000000     92.000000
10.000000

             Balance  NumOfProducts    HasCrCard  IsActiveMember  \
count   10000.000000   10000.000000  10000.00000    10000.000000
mean    76485.889288       1.530200      0.70550        0.515100
std     62397.405202       0.581654      0.45584        0.499797
min         0.000000       1.000000      0.00000        0.000000
25%         0.000000       1.000000      0.00000        0.000000
50%     97198.540000       1.000000      1.00000        1.000000
75%    127644.240000       2.000000      1.00000        1.000000
max    250898.090000       4.000000      1.00000        1.000000

       EstimatedSalary        Exited
count     10000.000000  10000.000000
mean     100090.239881      0.203700
std       57510.492818      0.402769
min          11.580000      0.000000
25%       51002.110000      0.000000
50%      100193.915000      0.000000
75%      149388.247500      0.000000
max      199992.480000      1.000000

data.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
```

```
data.kurt(axis=1,skipna=True)
```

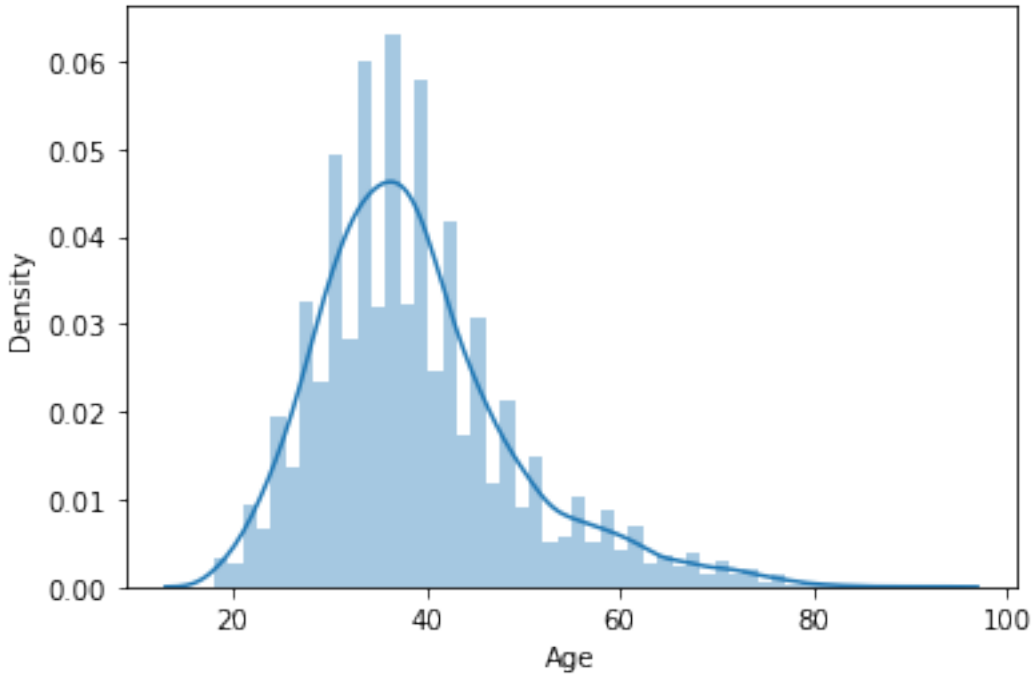
```
0       10.998778
1       10.997909
2       10.995886
3       10.998962
4       10.997675
          ...
9995    10.998908
9996    10.998551
9997    10.999788
9998    10.998530
9999    10.997973
Length: 10000, dtype: float64
```

```
data.kurt(axis=0,skipna=True)
```

```
RowNumber         -1.200000
CustomerId        -1.196113
CreditScore       -0.425726
Age                1.395347
Tenure            -1.165225
Balance           -1.489412
NumOfProducts      0.582981
HasCrCard         -1.186973
IsActiveMember    -1.996747
EstimatedSalary   -1.181518
Exited             0.165671
dtype: float64
```

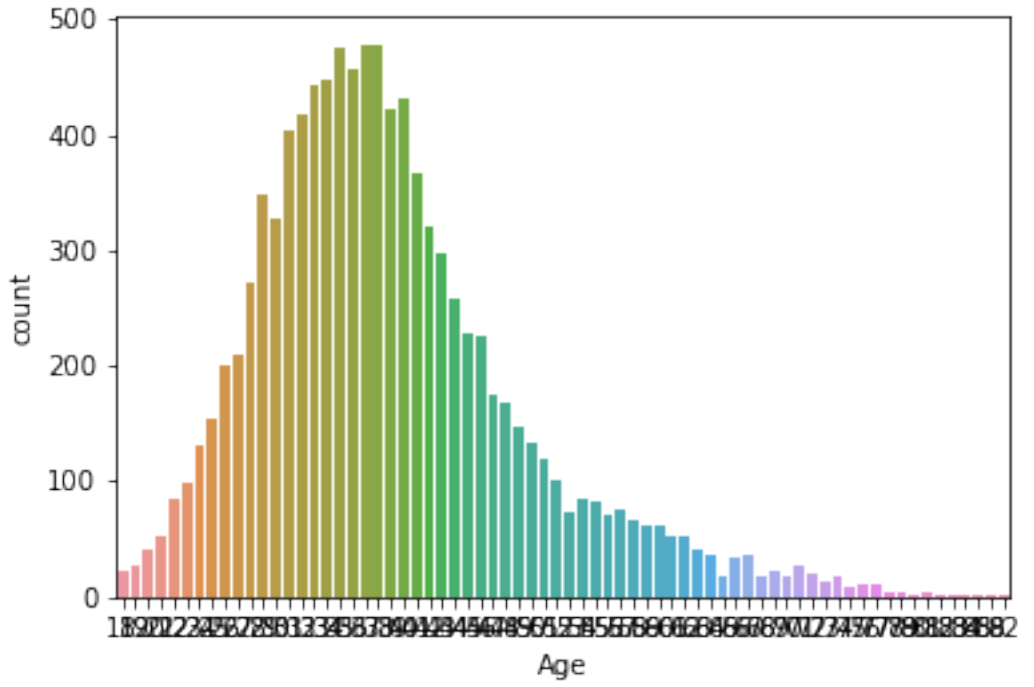
```
sns.distplot(data['Age'])
```

```
<AxesSubplot:xlabel='Age', ylabel='Density'>
```




```
sns.countplot(data['Age'])
```

```
<AxesSubplot:xlabel='Age', ylabel='count'>
```




```
data.skew(axis=0,skipna=True)
```

```
RowNumber           0.000000
CustomerId          0.001149
```

```
CreditScore       -0.071607
Age                1.011320
Tenure             0.010991
Balance           -0.141109
NumOfProducts      0.745568
HasCrCard         -0.901812
IsActiveMember    -0.060437
EstimatedSalary    0.002085
Exited             1.471611
dtype: float64
```

```
data.skew(axis=1,skipna=True)
```

```
0       3.316373
1       3.316193
2       3.315777
3       3.316411
4       3.316145
          ...
9995    3.316399
9996    3.316325
9997    3.316581
9998    3.316321
9999    3.316207
Length: 10000, dtype: float64
```

```
data.isnull().any()
```

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

```
data.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
```

```
data.duplicated()
```

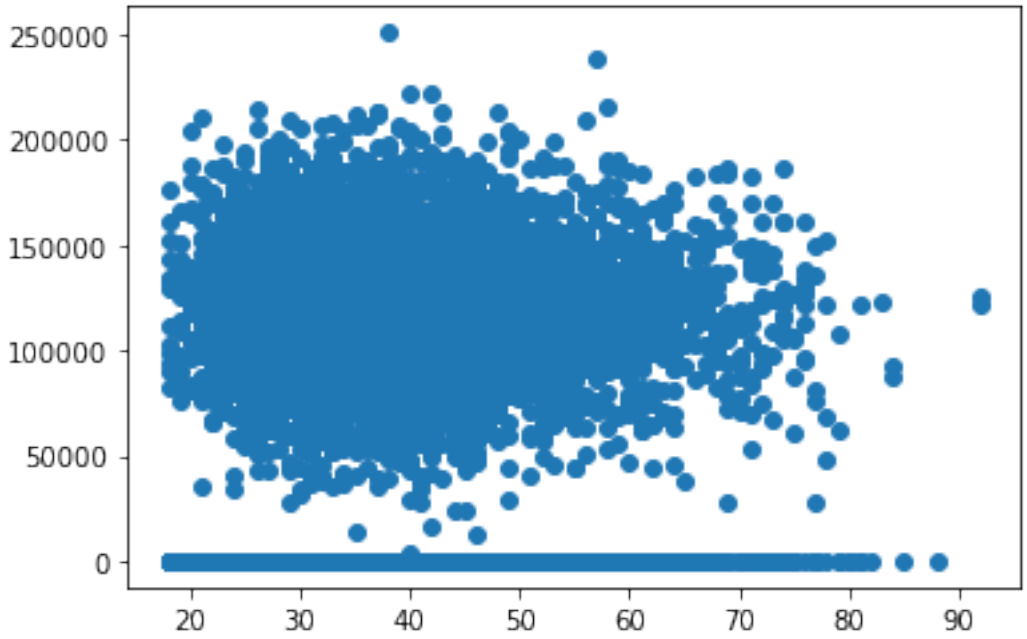
```
0       False
1       False
2       False
3       False
4       False
        ...
9995    False
9996    False
9997    False
9998    False
9999    False
Length: 10000, dtype: bool
```

```
data.duplicated().sum()
```

```
0
```

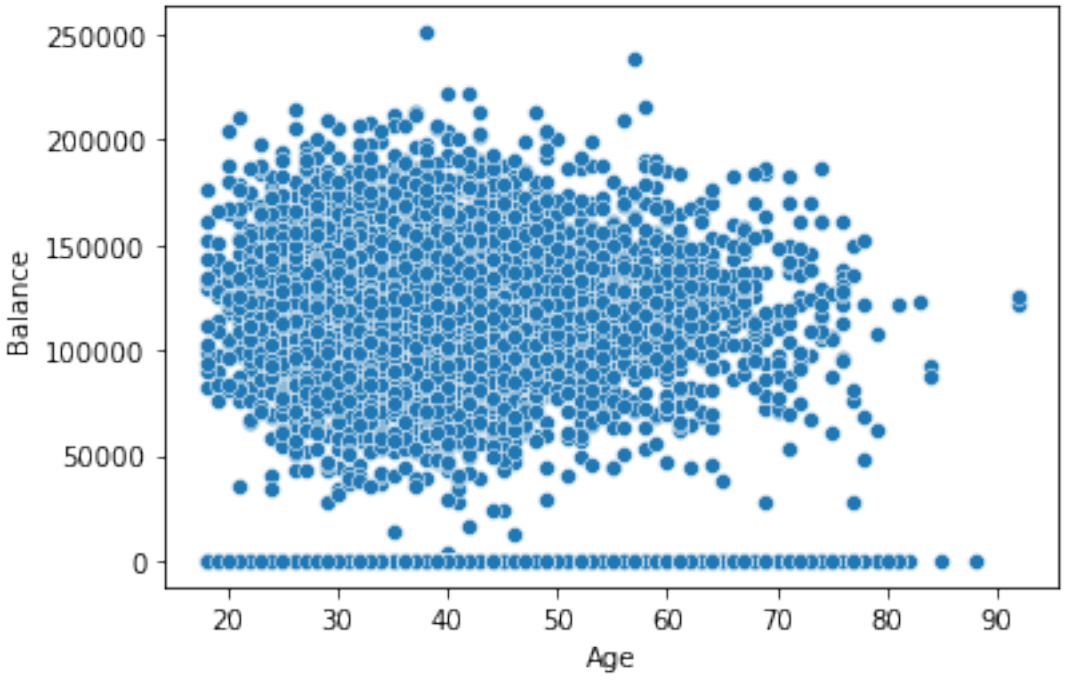
```
plt.scatter(data.Age,data.Balance)
```

```
<matplotlib.collections.PathCollection at 0x207f186af10>
```



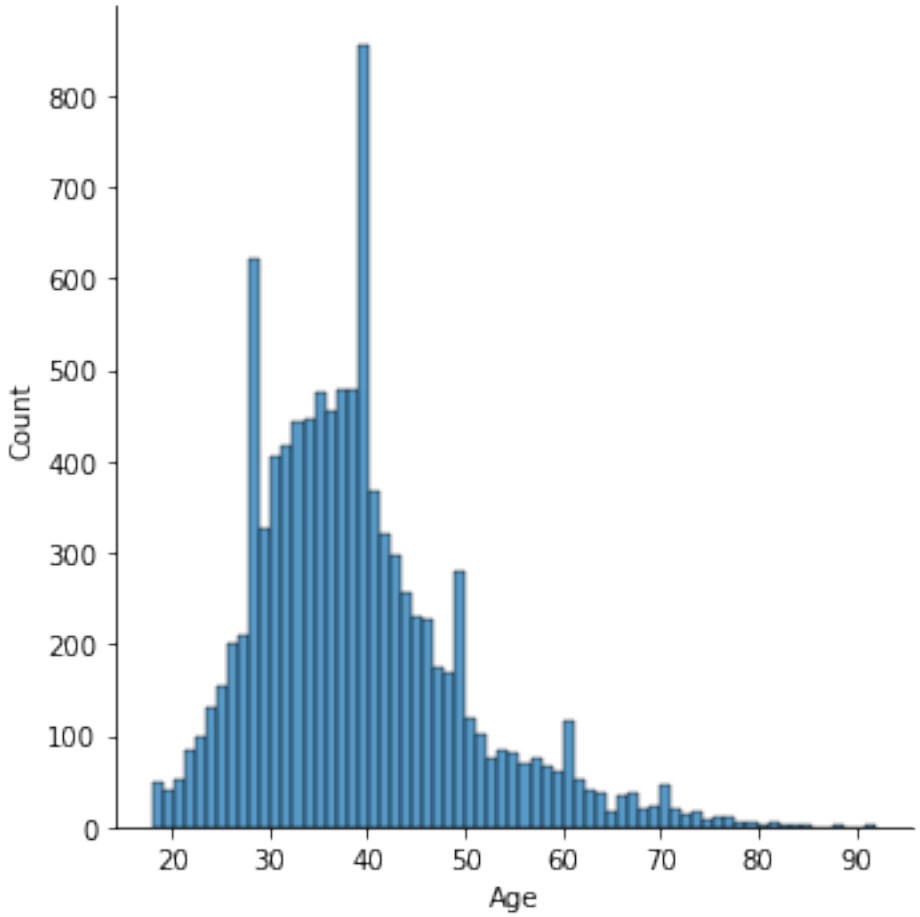

```
sns.scatterplot(x=data.Age,y=data.Balance)
```

```
<AxesSubplot:xlabel='Age', ylabel='Balance'>
```



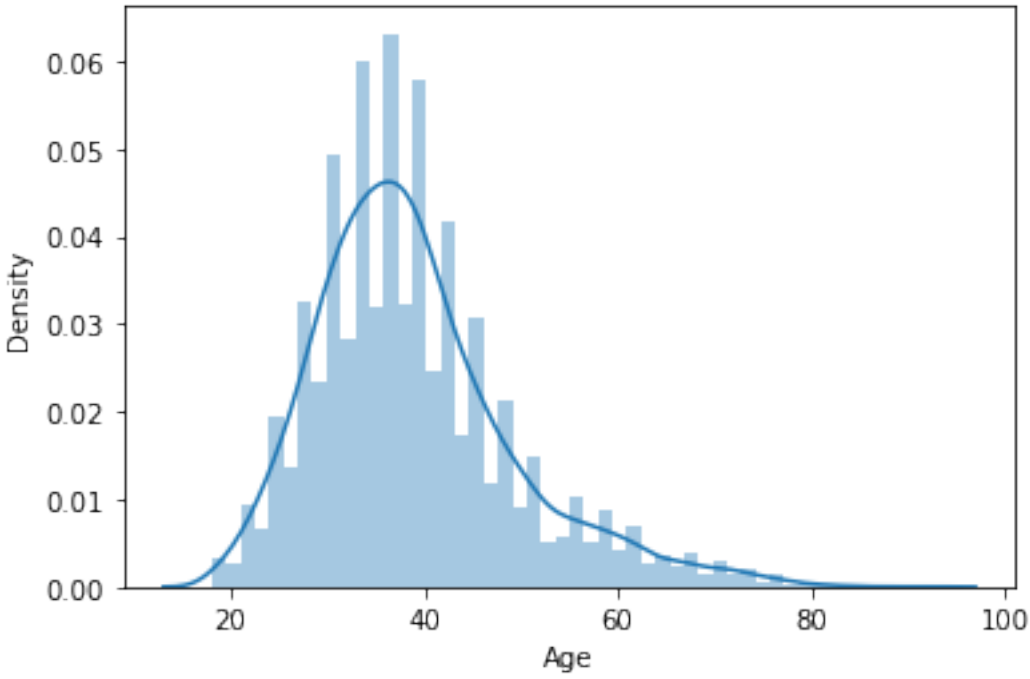

```
sns.displot(data['Age'])
```

```
<seaborn.axisgrid.FacetGrid at 0x207f1775e20>
```



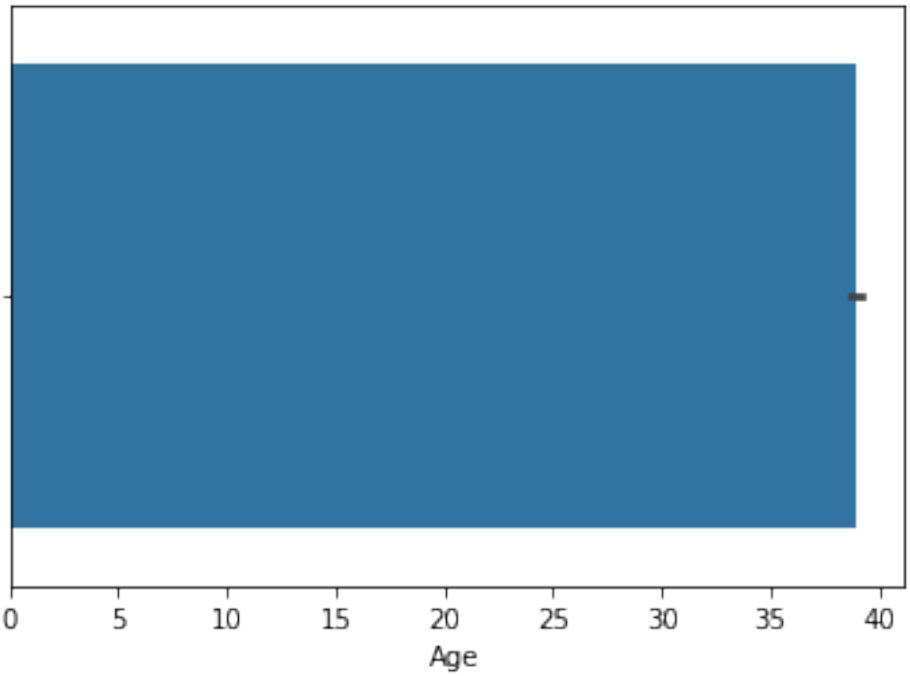

```
sns.distplot(data['Age'])
```

```
<AxesSubplot:xlabel='Age', ylabel='Density'>
```



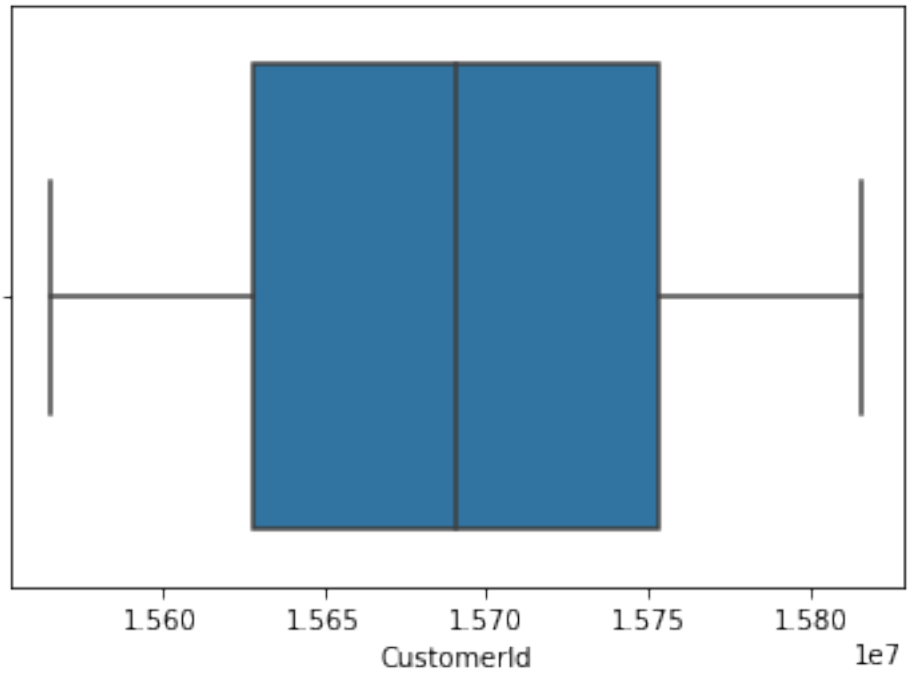

```
sns.barplot(data['Age'])
```

```
<AxesSubplot:xlabel='Age'>
```




```
sns.boxplot(data['CustomerId'])
```

```
<AxesSubplot:xlabel='CustomerId'>
```



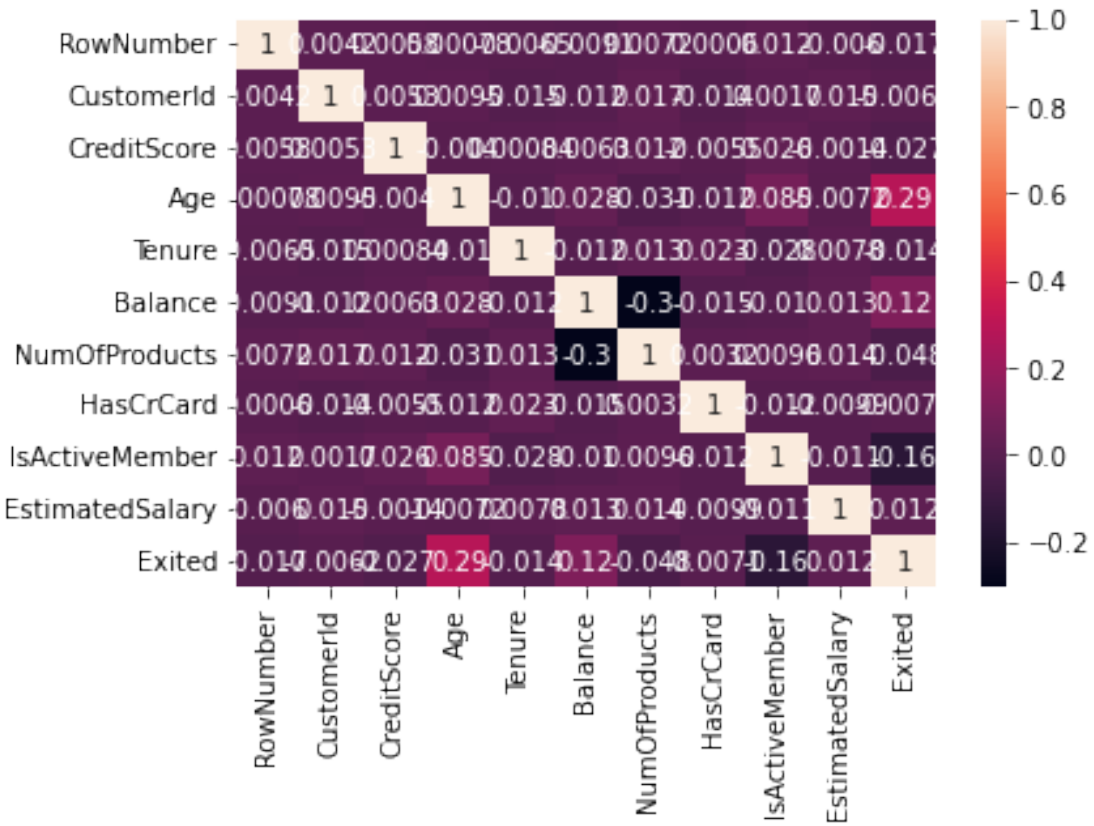

```
data.corr()
```

```
                 RowNumber  CustomerId  CreditScore       Age
Tenure  \
RowNumber         1.000000    0.004202     0.005840  0.000783 -
0.006495
CustomerId        0.004202    1.000000     0.005308  0.009497 -
0.014883
CreditScore       0.005840    0.005308     1.000000 -0.003965
0.000842
Age               0.000783    0.009497    -0.003965  1.000000 -
0.009997
Tenure           -0.006495   -0.014883     0.000842 -0.009997
1.000000
Balance          -0.009067   -0.012419     0.006268  0.028308 -
0.012254
NumOfProducts     0.007246    0.016972     0.012238 -0.030680
0.013444
HasCrCard         0.000599   -0.014025    -0.005458 -0.011721
0.022583
IsActiveMember    0.012044    0.001665     0.025651  0.085472 -
0.028362
EstimatedSalary  -0.005988    0.015271    -0.001384 -0.007201
0.007784
Exited           -0.016571   -0.006248    -0.027094  0.285323 -
0.014001

                  Balance  NumOfProducts  HasCrCard  IsActiveMember  \
RowNumber       -0.009067       0.007246   0.000599        0.012044
```

```
CustomerId      -0.012419       0.016972  -0.014025        0.001665
CreditScore      0.006268       0.012238  -0.005458        0.025651
Age              0.028308      -0.030680  -0.011721        0.085472
Tenure          -0.012254       0.013444   0.022583       -0.028362
Balance          1.000000      -0.304180  -0.014858       -0.010084
NumOfProducts   -0.304180       1.000000   0.003183        0.009612
HasCrCard       -0.014858       0.003183   1.000000       -0.011866
IsActiveMember  -0.010084       0.009612  -0.011866        1.000000
EstimatedSalary  0.012797       0.014204  -0.009933       -0.011421
Exited           0.118533      -0.047820  -0.007138       -0.156128

                 EstimatedSalary    Exited
RowNumber              -0.005988 -0.016571
CustomerId              0.015271 -0.006248
CreditScore            -0.001384 -0.027094
Age                    -0.007201  0.285323
Tenure                  0.007784 -0.014001
Balance                 0.012797  0.118533
NumOfProducts           0.014204 -0.047820
HasCrCard              -0.009933 -0.007138
IsActiveMember         -0.011421 -0.156128
EstimatedSalary         1.000000  0.012097
Exited                  0.012097  1.000000
```

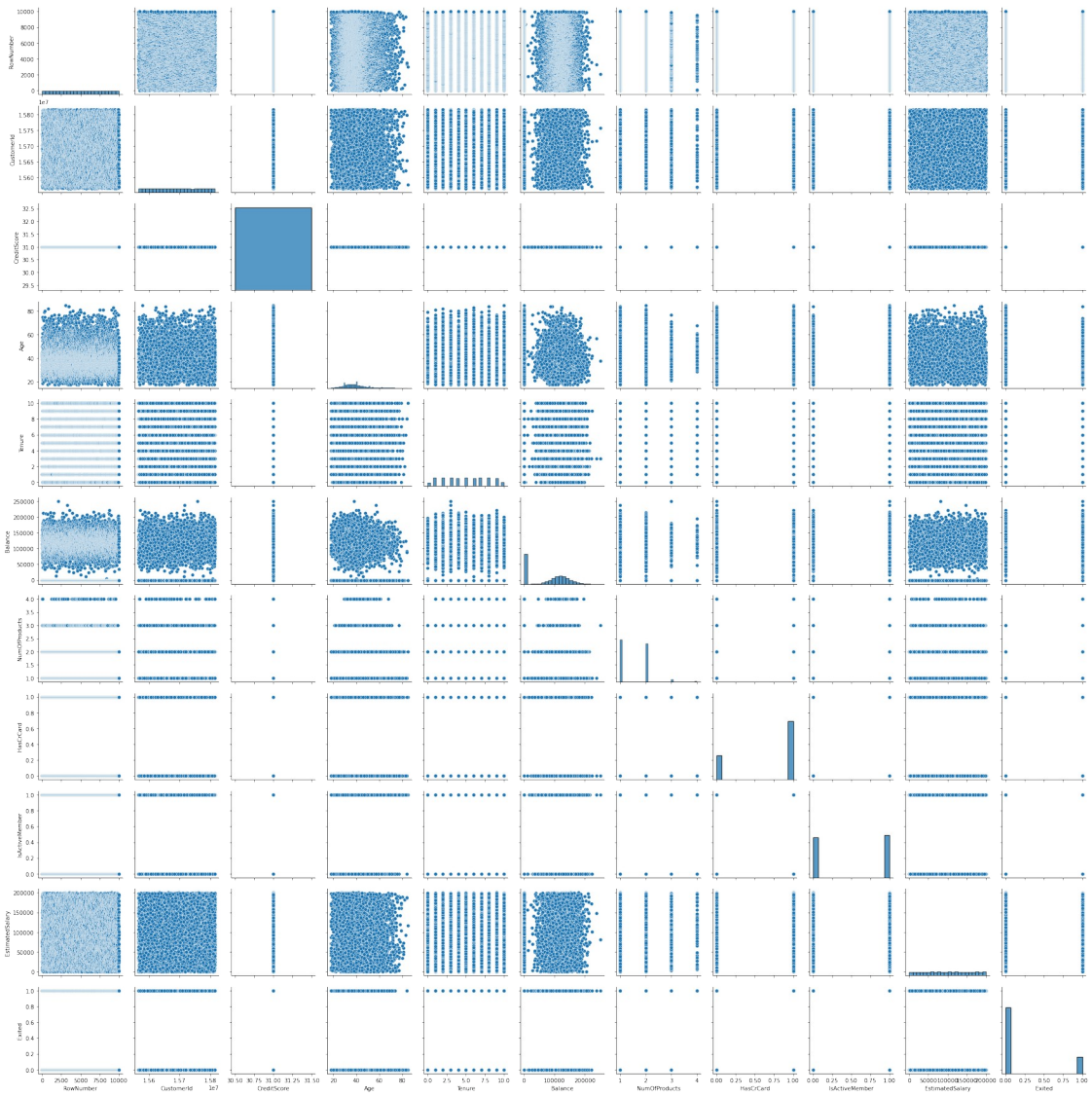
```
sns.heatmap(data.corr(),annot=True)
```

```
<AxesSubplot:>
```




```
sns.pairplot(data)
```

```
<seaborn.axisgrid.PairGrid at 0x20797105700>
```




```
x=data.iloc[:,:-1].values
```

```
x
```

```
array([[1, 15634602, 'Hargrave', ..., 1, 1, 101348.88],
       [2, 15647311, 'Hill', ..., 0, 1, 112542.58],
       [3, 15619304, 'Onio', ..., 1, 0, 113931.57],
       ...,
       [9998, 15584532, 'Liu', ..., 0, 1, 42085.58],
       [9999, 15682355, 'Sabbatini', ..., 1, 0, 92888.52],
       [10000, 15628319, 'Walker', ..., 1, 0, 38190.78]],
dtype=object)
```

```
y=data.iloc[:,4].values
```

```
y
```

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

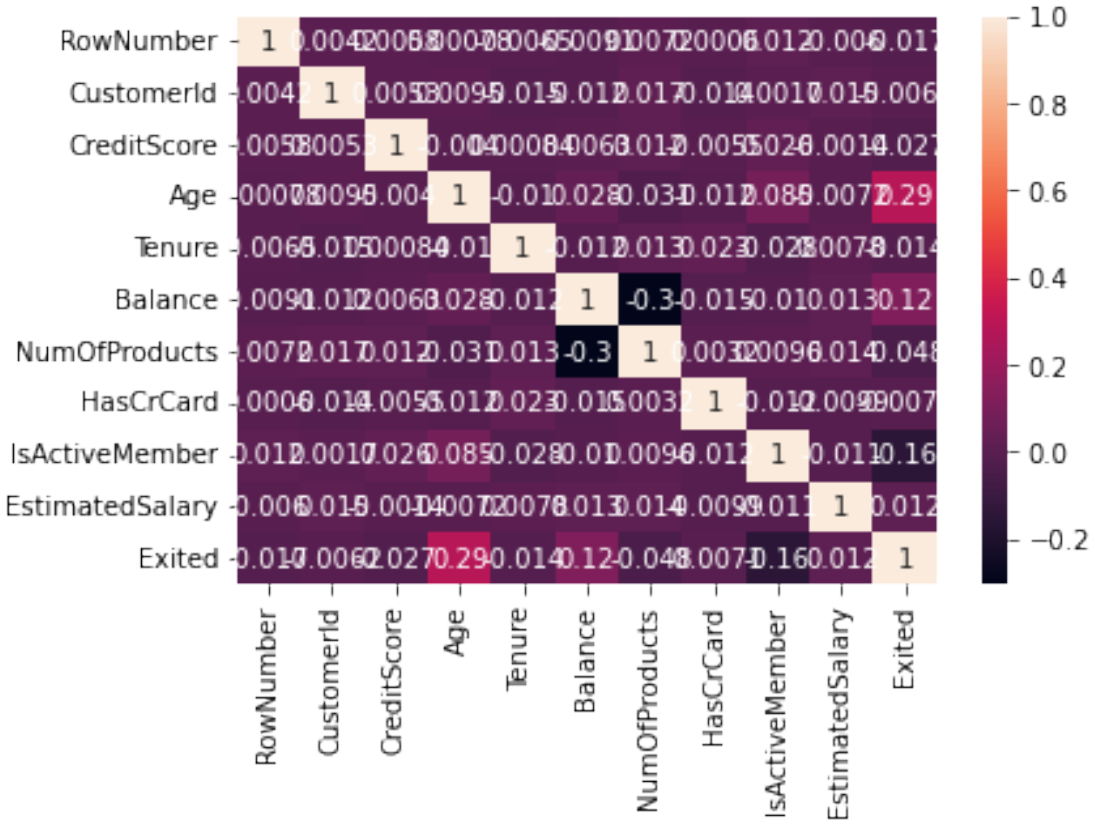
```
data.head(10)
```

```
   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
```

```
sns.heatmap(data.corr(),annot=True)
```

```
<AxesSubplot:>
```




```
x=data[["EstimatedSalary"]]
y=data['CreditScore']
```

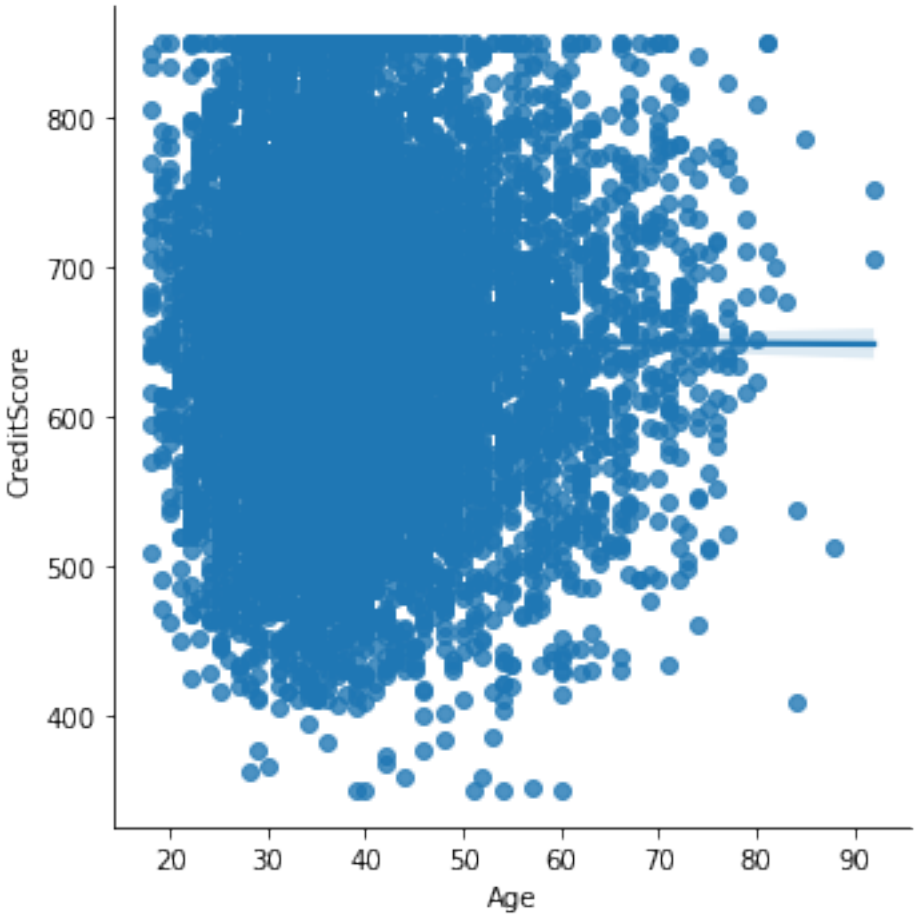
```
model=sm.OLS(y,x)
result=model.fit()
result.summary()
```

```
<class 'statsmodels.iolib.summary.Summary'>
"""
                                 OLS Regression Results

=============================================================================
=================
Dep. Variable:            CreditScore   R-squared (uncentered):
0.735
Model:                            OLS   Adj. R-squared (uncentered):
0.735
Method:                 Least Squares   F-statistic:
```

```
2.779e+04
Date:                Mon, 19 Sep 2022   Prob (F-statistic):
0.00
Time:                        09:21:32   Log-Likelihood:
-72429.
No. Observations:               10000   AIC:
1.449e+05
Df Residuals:                    9999   BIC:
1.449e+05
Df Model:                           1

Covariance Type:            nonrobust

==============================================================================
=============
                     coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
-------------
EstimatedSalary     0.0049   2.93e-05    166.705      0.000
0.005       0.005
==============================================================================
========
Omnibus:                     1758.359   Durbin-Watson:
1.554
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
376.161
Skew:                           0.004   Prob(JB):
2.08e-82
Kurtosis:                       2.050   Cond. No.
1.00
==============================================================================
========

Notes:
[1] R² is computed without centering (uncentered) since the model does
not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
"""
```

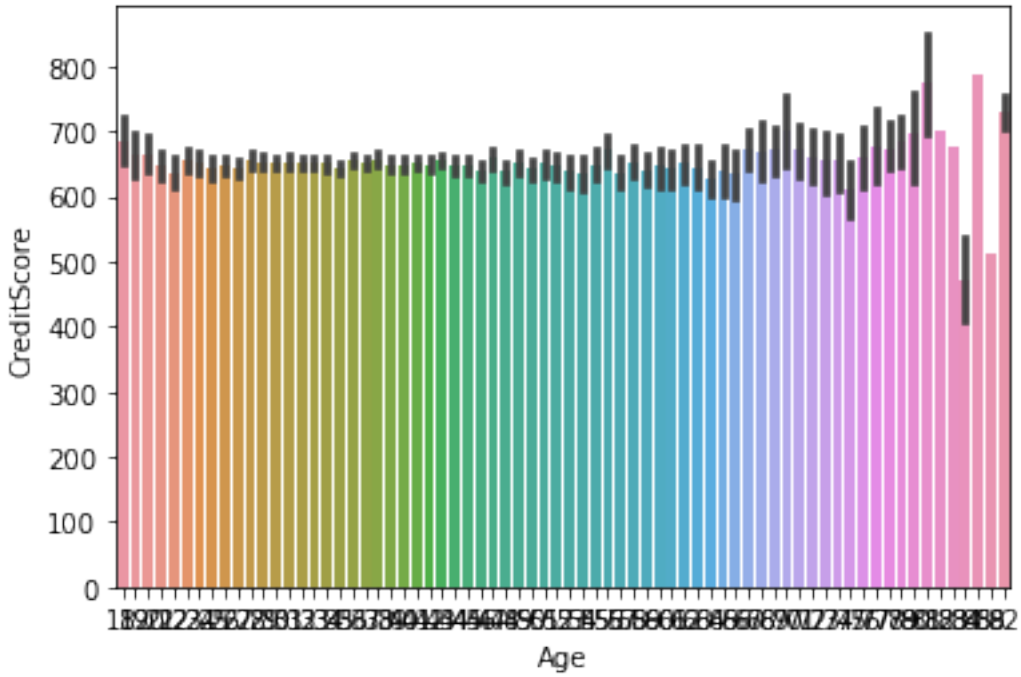
```
sns.lmplot(data=data,x="Age",y="CreditScore")
```

```
<seaborn.axisgrid.FacetGrid at 0x20790cd1730>
```




```
sns.barplot(x='Age',y='CreditScore',data=data)
```

```
<AxesSubplot:xlabel='Age', ylabel='CreditScore'>
```




```
qnt=data.quantile(q=(0.25,0.75))
```

```
qnt
```

```
      RowNumber   CustomerId  CreditScore   Age  Tenure    Balance  \
0.25    2500.75  15628528.25        584.0  32.0     3.0       0.00
0.75    7500.25  15753233.75        718.0  44.0     7.0  127644.24

      NumOfProducts  HasCrCard  IsActiveMember  EstimatedSalary
Exited
0.25            1.0        0.0             0.0       51002.1100
0.0
0.75            2.0        1.0             1.0      149388.2475
0.0
```

```
iqr=qnt.loc[0.25]-qnt.loc[0.75]
```

```
iqr
```

```
RowNumber           -4999.5000
CustomerId        -124705.5000
CreditScore          -134.0000
Age                   -12.0000
Tenure                 -4.0000
Balance          -127644.2400
NumOfProducts         -1.0000
HasCrCard             -1.0000
IsActiveMember        -1.0000
EstimatedSalary    -98386.1375
```

```
Exited                  0.0000
dtype: float64
```

```
lower=qnt.loc[0.25]-1.5*iqr
```

```
lower
```

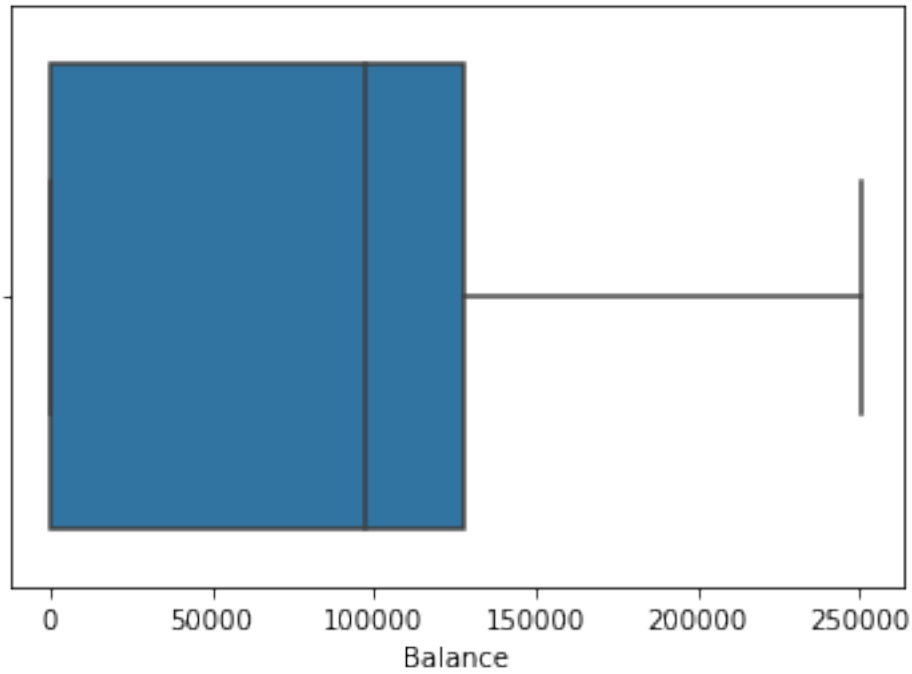
```
RowNumber          1.000000e+04
CustomerId         1.581559e+07
CreditScore        7.850000e+02
Age                5.000000e+01
Tenure             9.000000e+00
Balance            1.914664e+05
NumOfProducts      2.500000e+00
HasCrCard          1.500000e+00
IsActiveMember     1.500000e+00
EstimatedSalary    1.985813e+05
Exited             0.000000e+00
dtype: float64
```

```
data['Age']=np.where(data['Age']>87,40,data['Age'])
```

```
data['Balance']=np.where(data['Balance']>618,316,data['Balance'])
```

```
sns.boxplot(data['Balance'])
```

```
<AxesSubplot:xlabel='Balance'>
```




```
data.head(2)
```

```
   RowNumber  CustomerId   Surname  CreditScore Geography  Gender  Age
\
0          1    15634602  Hargrave           31    France  Female   42

1          2    15647311      Hill           31     Spain  Female   41


   Tenure   Balance  NumOfProducts  HasCrCard  IsActiveMember  \
0       2      0.00              1          1               1
1       1  83807.86              1          0               1

   EstimatedSalary  Exited
0        101348.88       1
1        112542.58       0
```

```
data['Gender'].replace({'Female':0,'Male':1},inplace=True)
```

```
data.head(10)
```

```
   RowNumber  CustomerId   Surname  CreditScore Geography  Gender  Age
\
0          1    15634602  Hargrave           31    France       0   42

1          2    15647311      Hill           31     Spain       0   41

2          3    15619304      Onio           31    France       0   42

3          4    15701354      Boni           31    France       0   39

4          5    15737888  Mitchell           31     Spain       0   43

5          6    15574012       Chu           31     Spain       1   44

6          7    15592531  Bartlett           31    France       1   50

7          8    15656148    Obinna           31   Germany       0   29

8          9    15792365        He           31    France       1   44

9         10    15592389        H?           31    France       1   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
```

```
data['HasCrCard'].replace({1:'YES',0:'NO'},inplace=True)
```

```
data.head(10)
```

```
   RowNumber  CustomerId   Surname  CreditScore Geography  Gender  Age
\
0          1    15634602  Hargrave           31    France       0   42

1          2    15647311      Hill           31     Spain       0   41

2          3    15619304      Onio           31    France       0   42

3          4    15701354      Boni           31    France       0   39

4          5    15737888  Mitchell           31     Spain       0   43

5          6    15574012       Chu           31     Spain       1   44

6          7    15592531  Bartlett           31    France       1   50

7          8    15656148    Obinna           31   Germany       0   29

8          9    15792365        He           31    France       1   44

9         10    15592389        H?           31    France       1   27


   Tenure    Balance  NumOfProducts HasCrCard  IsActiveMember  \
0       2       0.00              1       YES               1
1       1   83807.86              1        NO               1
2       8  159660.80              3       YES               0
3       1       0.00              2        NO               0
4       2  125510.82              1       YES               1
```

```
5       8  113755.78             2       YES              0
6       7       0.00             2       YES              1
7       4  115046.74             4       YES              0
8       4  142051.07             2        NO              1
9       2  134603.88             1       YES              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
```

```
from sklearn.preprocessing import OneHotEncoder


oe_style = OneHotEncoder()
oe_results = oe_style.fit_transform(data[['Age']])

pd.DataFrame(oe_results.toarray(),
columns=oe_style.categories_).head()
```

```
    18   19   20   21   22   23   24   25   26   27  ...   76   77
78   79  \
0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  ...  0.0  0.0
0.0  0.0
1  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  ...  0.0  0.0
0.0  0.0
2  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  ...  0.0  0.0
0.0  0.0
3  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  ...  0.0  0.0
0.0  0.0
4  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  ...  0.0  0.0
0.0  0.0

    80   81   82   83   84   85
0  0.0  0.0  0.0  0.0  0.0  0.0
1  0.0  0.0  0.0  0.0  0.0  0.0
2  0.0  0.0  0.0  0.0  0.0  0.0
3  0.0  0.0  0.0  0.0  0.0  0.0
4  0.0  0.0  0.0  0.0  0.0  0.0

[5 rows x 68 columns]
```

```
y=data['Age']
```

```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()

data['Age']=le.fit_transform(data['Age'])

data.head(10)
```

```
   RowNumber  CustomerId   Surname  CreditScore Geography  Gender  Age
\
0          1    15634602  Hargrave           31    France       0   24

1          2    15647311      Hill           31     Spain       0   23

2          3    15619304      Onio           31    France       0   24

3          4    15701354      Boni           31    France       0   21

4          5    15737888  Mitchell           31     Spain       0   25

5          6    15574012       Chu           31     Spain       1   26

6          7    15592531  Bartlett           31    France       1   32

7          8    15656148    Obinna           31   Germany       0   11

8          9    15792365        He           31    France       1   26

9         10    15592389        H?           31    France       1    9


   Tenure    Balance  NumOfProducts HasCrCard  IsActiveMember  \
0       2       0.00              1       YES               1
1       1   83807.86              1        NO               1
2       8  159660.80              3       YES               0
3       1       0.00              2        NO               0
4       2  125510.82              1       YES               1
5       8  113755.78              2       YES               0
6       7       0.00              2       YES               1
7       4  115046.74              4       YES               0
8       4  142051.07              2        NO               1
9       2  134603.88              1       YES               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
```

```
data.Age.unique()
```

```
array([24, 23, 21, 25, 26, 32, 11,  9, 13,  6, 16,  7, 17, 27, 40, 14,
20,
       28, 18, 15, 22, 33, 43, 31, 19,  1, 48, 38,  8,  3, 37, 57,  4,
12,
       10, 47, 30, 34, 39, 55, 29, 36, 54,  2, 49, 61, 44, 35, 62, 41,
50,
        5, 42, 52, 45, 46,  0, 64, 51, 56, 53, 58, 59, 67, 66, 60, 63,
65],
      dtype=int64)
```

```
x=data.iloc[:,0:13].values
```

```
x
```

```
array([[1, 15634602, 'Hargrave', ..., 'YES', 1, 101348.88],
       [2, 15647311, 'Hill', ..., 'NO', 1, 112542.58],
       [3, 15619304, 'Onio', ..., 'YES', 0, 113931.57],
       ...,
       [9998, 15584532, 'Liu', ..., 'NO', 1, 42085.58],
       [9999, 15682355, 'Sabbatini', ..., 'YES', 0, 92888.52],
       [10000, 15628319, 'Walker', ..., 'YES', 0, 38190.78]],
dtype=object)
```

```
y=data.iloc[:,13:14].values
```

```
y
```

```
array([[1],
       [0],
       [1],
       ...,
       [1],
       [1],
       [0]], dtype=int64)
```

```
from sklearn. preprocessing import OneHotEncoder
```

```
ohe=OneHotEncoder()
```

```
z=ohe.fit_transform(x[:,0:14]).toarray()
```

```
z
```

```
array([[1., 0., 0., ..., 0., 0., 0.],
       [0., 1., 0., ..., 0., 0., 0.],
       [0., 0., 1., ..., 0., 0., 0.],
       ...,
```

```
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.]])
```

```
##split
```

```
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,rando
m_state=0)

x_train.shape,x_test.shape,y_train.shape,y_test.shape
```

```
((8000, 13), (2000, 13), (8000, 1), (2000, 1))
```

```
x_train
```

```
array([[7390, 15676909, 'Mishin', ..., 'YES', 0, 163830.64],
       [9276, 15749265, 'Carslaw', ..., 'YES', 1, 57098.0],
       [2996, 15582492, 'Moore', ..., 'YES', 0, 185630.76],
       ...,
       [3265, 15574372, 'Hoolan', ..., 'YES', 0, 181429.87],
       [9846, 15664035, 'Parsons', ..., 'YES', 1, 148750.16],
       [2733, 15592816, 'Udokamma', ..., 'YES', 0, 118855.26]],
      dtype=object)
```

```
x_test
```

```
array([[9395, 15615753, 'Upchurch', ..., 'YES', 1, 192852.67],
       [899, 15654700, 'Fallaci', ..., 'YES', 0, 128702.1],
       [2399, 15633877, 'Morrison', ..., 'YES', 1, 75732.25],
       ...,
       [9550, 15772604, 'Chiemezie', ..., 'YES', 0, 141533.19],
       [2741, 15787699, 'Burke', ..., 'YES', 1, 11276.48],
       [6691, 15579223, 'Niu', ..., 'YES', 0, 192950.6]],
dtype=object)
```

```
y_train
```

```
array([[0],
       [0],
       [0],
       ...,
       [0],
       [0],
       [1]], dtype=int64)
```

```
y_test
```

```
array([[0],
       [1],
       [0],
       ...,
```

```
       [0],
       [0],
       [0]], dtype=int64)
```

```
from sklearn.preprocessing import scale

x=data['Balance']

S=scale(x)

S
```

```
array([-1.22584767,  0.11735002,  1.33305335, ..., -1.22584767,
       -0.02260751,  0.85996499])
```

```
###independent variables

w=data.drop(data['Age'],axis=0)

w
```

```
      RowNumber  CustomerId     Surname  CreditScore Geography  Gender
Age  \
68           69    15638424     Glauert           31   Germany       0
17
69           70    15755648      Pisano           31    France       0
3
70           71    15703793  Konovalova           31   Germany       1
40
71           72    15620344       McKee           31    France       1
11
72           73    15812518     Palermo           31     Spain       0
19
...         ...         ...         ...          ...       ...     ...
...
9995       9996    15606229    Obijiaku           31    France       1
21
9996       9997    15569892   Johnstone           31    France       1
17
9997       9998    15584532         Liu           31    France       0
18
9998       9999    15682355   Sabbatini           31   Germany       1
24
9999      10000    15628319      Walker           31    France       0
10

      Tenure    Balance  NumOfProducts HasCrCard  IsActiveMember  \
68         5  150725.53              2        NO               1
69         8   98373.26              1       YES               0
70         2  133745.44              4       YES               0
71         6       0.00              1       YES               0
72         0  163607.18              1        NO               1
```

```
...      ...        ...             ...       ...              ...
9995       5       0.00             2       YES                0
9996      10   57369.61             1       YES                1
9997       7       0.00             1        NO                1
9998       3   75075.31             2       YES                0
9999       4  130142.79             1       YES                0

      EstimatedSalary  Exited
68          113656.85       0
69           18203.00       0
70           28373.86       1
71           33953.87       0
72           44203.55       0
...               ...     ...
9995         96270.64       0
9996        101699.77       0
9997         42085.58       1
9998         92888.52       1
9999         38190.78       0

[9932 rows x 14 columns]
```

```
y=data.iloc[:,-1].values
```

```
y
```

```
array([1, 0, 1, ..., 1, 1, 0], dtype=int64)
```