Assignment -2

Python Programming

Assignment Date	01 October 2022
Student Name	UDAYA KRISHNAN M
Student Roll Number	212219060284
Maximum Marks	2 Marks

In [4]:
```
import pandas as pd
import numpy as np
import seaborn as sns
from matplotlib import pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

In [5]:
```
data=pd.read_csv("Churn_Modelling_ass2.csv")
```

In [6]:
```
data.head(10)
```

Out[6]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0
5	6	15574012	Chu	645	Spain	Male	44	8	113755.78	2	1	0	149756.71	1
6	7	15592531	Bartlett	822	France	Male	50	7	0.00	2	1	1	10062.80	0
7	8	15656148	Obinna	376	Germany	Female	29	4	115046.74	4	1	0	119346.88	1
8	9	15792365	He	501	France	Male	44	4	142051.07	2	0	1	74940.50	0
9	10	15592389	H?	684	France	Male	27	2	134603.88	1	1	1	71725.73	0

In [7]:
```
data.tail(10)
```

Out[7]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
9990	9991	15798964	Nkemakonam	714	Germany	Male	33	3	35016.60	1	1	0	53667.08	0
9991	9992	15769959	Ajuluchukwu	597	France	Female	53	4	88381.21	1	1	0	69384.71	1
9992	9993	15657105	Chukwualuka	726	Spain	Male	36	2	0.00	1	1	0	195192.40	0
9993	9994	15569266	Rahman	644	France	Male	28	7	155060.41	1	1	0	29179.52	0
9994	9995	15719294	Wood	800	France	Female	29	2	0.00	2	0	0	167773.55	0
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

In [8]:
```
#describe statistics
data.describe()
```

Out[8]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.00000	10000.000000	10000.000000	10000.000000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	1.530200	0.70550	0.515100	100090.239881	0.203700
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	0.581654	0.45584	0.499797	57510.492818	0.402769
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.00000	0.000000	11.580000	0.000000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.00000	0.000000	51002.110000	0.000000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000000	100193.915000	0.000000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.00000	1.000000	149388.247500	0.000000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.00000	1.000000	199992.480000	1.000000

In [9]:
```
data.kurt(axis=0,skipna=True)
```

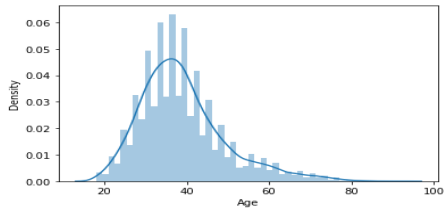
Out[9]:
```
RowNumber         -1.200000
CustomerId        -1.196113
CreditScore       -0.425726
Age                1.395347
Tenure            -1.165225
Balance           -1.489412
NumOfProducts      0.582981
HasCrCard         -1.186973
IsActiveMember    -1.996747
EstimatedSalary   -1.181518
Exited             0.165671
dtype: float64
```

In [10]:
```
data.kurt(axis=1,skipna=True)
```

Out[10]:
```
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
```

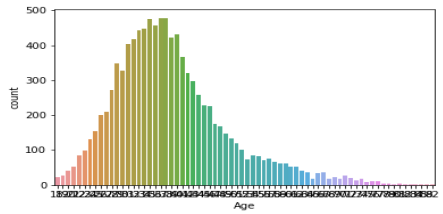
In [11]:
```
sns.distplot(data['Age'])
```

Out[11]:



In [12]:
```
sns.countplot(data["Age"])
```

Out[12]:



In [13]:
```
data.skew(axis=0,skipna=True)
```

Out[13]:
```
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
```

In [14]:
```
data.skew(axis=1,skipna=True)
```

Out[14]:
```
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
```

In [15]:
```
data.isnull().any()
```

Out[15]:
```
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
```

In [16]:
```
data.isnull().sum()
```

Out[16]:
```
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
```

In [17]:
```
data.duplicated()
```

Out[17]:
```
0       False
1       False
2       False
3       False
4       False
        ...
9995    False
9996    False
9997    False
9998    False
9999    False
Length: 10000, dtype: bool
```

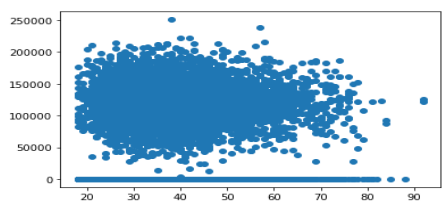
In [18]:
```
data.duplicated().sum()
```

Out[18]:
```
0
```

In [19]:
```
###VISUALISATION
```

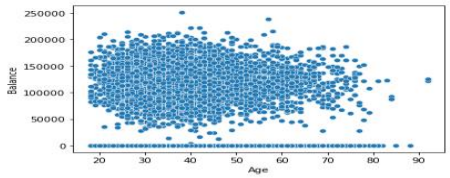
In [20]:
```
plt.scatter(data.Age,data.Balance)
```

Out[20]:



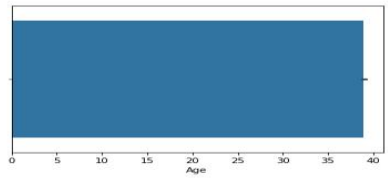
In [21]:
```
sns.scatterplot(data.Age,data.Balance)
```

Out[21]:



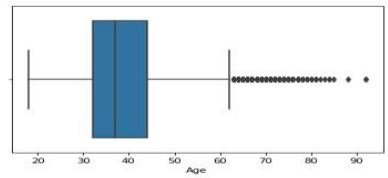
In [22]:
```
sns.barplot(data['Age'])
```

Out[22]:



In [23]:
```
sns.boxplot(data['Age'])
```

Out[23]:



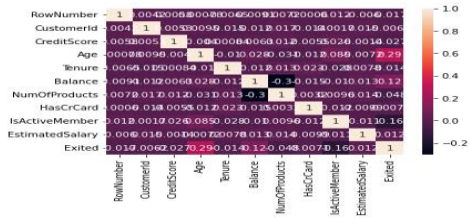
In [24]:
```
data.corr()
```

Out[24]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
RowNumber	1.000000	0.004202	0.005840	0.000783	-0.006495	-0.009067	0.007246	0.000599	0.012044	-0.005988	-0.016571
CustomerId	0.004202	1.000000	0.005308	0.009497	-0.014883	-0.012419	0.016972	-0.014025	0.001665	0.015271	-0.006248
CreditScore	0.005840	0.005308	1.000000	-0.003965	0.000842	0.006268	0.012238	-0.005458	0.025651	-0.001384	-0.027094
Age	0.000783	0.009497	-0.003965	1.000000	-0.009997	0.028308	-0.030680	-0.011721	0.085472	-0.007201	0.285323
Tenure	-0.006495	-0.014883	0.000842	-0.009997	1.000000	-0.012254	0.013444	0.022583	-0.028362	0.007784	-0.014001
Balance	-0.009067	-0.012419	0.006268	0.028308	-0.012254	1.000000	-0.304180	-0.014858	-0.010084	0.012797	0.118533
NumOfProducts	0.007246	0.016972	0.012238	-0.030680	0.013444	-0.304180	1.000000	0.003183	0.009612	0.014204	-0.047820
HasCrCard	0.000599	-0.014025	-0.005458	-0.011721	0.022583	-0.014858	0.003183	1.000000	-0.011866	-0.009933	-0.007138
IsActiveMember	0.012044	0.001665	0.025651	0.085472	-0.028362	-0.010084	0.009612	-0.011866	1.000000	-0.011421	-0.156128
EstimatedSalary	-0.005988	0.015271	-0.001384	-0.007201	0.007784	0.012797	0.014204	-0.009933	-0.011421	1.000000	0.012097
Exited	-0.016571	-0.006248	-0.027094	0.285323	-0.014001	0.118533	-0.047820	-0.007138	-0.156128	0.012097	1.000000

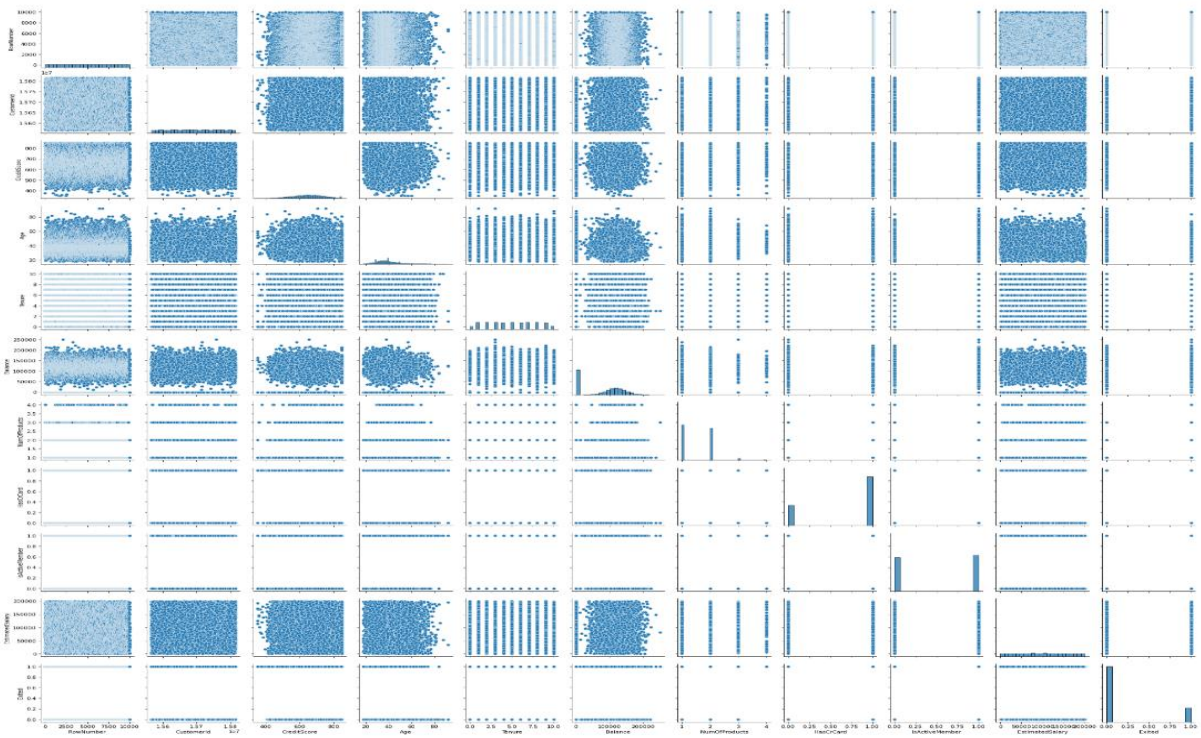
In [25]:
```
sns.heatmap(data.corr(),annot=True)
```

Out[25]:



In [36]:
```
sns.pairplot(data)
```

Out[36]:



In [39]:
```
from scipy.stats import spearmanr
```

In [40]:

```
corr=spearmanr(data)
corr
```

Out[40]:

```
SpearmanrResult(correlation=array([[ 1.00000000e+00,  4.18684789e-03,  1.82537815e-03,
         5.13017187e-03, -1.01176571e-02,  1.81963613e-02,
         4.76064421e-04, -6.93433206e-03, -9.01325568e-03,
         8.30510741e-03,  5.98746525e-04,  1.20443901e-02,
        -6.00682958e-03, -1.65713715e-02],
       [ 4.18684789e-03,  1.00000000e+00,  5.31564210e-03,
         5.96746465e-03,  6.03529435e-03, -2.62440728e-03,
         8.77466555e-03, -1.50720283e-02, -1.39321914e-02,
         1.92970188e-02, -1.40233299e-02,  1.68193033e-03,
         1.52457829e-02, -6.26374782e-03],
       [ 1.82537815e-03,  5.31564210e-03,  1.00000000e+00,
         6.68503170e-03, -2.26792517e-02, -2.14337922e-03,
         1.37678535e-03, -1.70916721e-02, -8.00358124e-04,
        -1.72831393e-02, -8.93818901e-03,  1.37684719e-03,
         1.17949476e-02, -1.09832944e-02],
       [ 5.13017187e-03,  5.96746465e-03,  6.68503170e-03,
         1.00000000e+00,  6.10527978e-03, -3.01144279e-03,
        -7.97404431e-03,  1.13317419e-03,  5.68657057e-03,
         1.25677271e-02, -3.80181966e-03,  2.42623407e-02,
         1.23652438e-03, -2.32893966e-02],
       [-1.01176571e-02,  6.03529435e-03, -2.26792517e-02,
         6.10527978e-03,  1.00000000e+00,  2.05197803e-03,
         3.53513965e-02,  3.76366156e-03,  9.94871724e-02,
         7.69108918e-04, -7.22407343e-03,  4.44007080e-03,
        -1.94818567e-04,  5.30920641e-02],
       [ 1.81963613e-02, -2.62440728e-03, -2.14337922e-03,
        -3.01144279e-03,  2.05197803e-03,  1.00000000e+00,
        -2.97848194e-02,  1.50959348e-02,  1.35043861e-02,
        -1.28505367e-02,  5.76612437e-03,  2.25443247e-02,
        -8.26853704e-03, -1.06512488e-01],
       [ 4.76064421e-04,  8.77466555e-03,  1.37678535e-03,
        -7.97404431e-03,  3.53513965e-02, -2.97848194e-02,
         1.00000000e+00, -1.04049493e-02,  3.33043436e-02,
        -5.85664619e-02, -1.52782371e-02,  3.98391734e-02,
        -2.43149876e-03,  3.23967912e-01],
       [-6.93433206e-03, -1.50720283e-02, -1.70916721e-02,
         1.13317419e-03,  3.76366156e-03,  1.50959348e-02,
        -1.04049493e-02,  1.00000000e+00, -9.51289512e-03,
         1.29080538e-02,  2.23540939e-02, -2.86732861e-02,
         7.77808376e-03, -1.39780555e-02],
       [-9.01325568e-03, -1.39321914e-02, -8.00358124e-04,
         5.68657057e-03,  9.94871724e-02,  1.35043861e-02,
         3.33043436e-02, -9.51289512e-03,  1.00000000e+00,
        -3.16626558e-01, -9.83460270e-03, -1.14965258e-02,
         1.17780035e-02,  1.11110193e-01],
       [ 8.30510741e-03,  1.92970188e-02, -1.72831393e-02,
         1.25677271e-02,  7.69108918e-04, -1.28505367e-02,
        -5.85664619e-02,  1.29080538e-02, -3.16626558e-01,
         1.00000000e+00,  3.85886031e-03,  1.62917706e-02,
         1.25698129e-02, -1.25282063e-01],
       [ 5.98746525e-04, -1.40233299e-02, -8.93818901e-03,
        -3.80181966e-03, -7.22407343e-03,  5.76612437e-03,
        -1.52782371e-02,  2.23540939e-02, -9.83460270e-03,
         3.85886031e-03,  1.00000000e+00, -1.18656369e-02,
        -1.00409074e-02, -7.13776560e-03],
       [ 1.20443901e-02,  1.68193033e-03,  1.37684719e-03,
         2.42623407e-02,  4.44007080e-03,  2.25443247e-02,
         3.98391734e-02, -2.86732861e-02, -1.14965258e-02,
         1.62917706e-02, -1.18656369e-02,  1.00000000e+00,
        -1.14690521e-02, -1.56128278e-01],
       [-6.00682958e-03,  1.52457829e-02,  1.17949476e-02,
         1.23652438e-03, -1.94818567e-04, -8.26853704e-03,
        -2.43149876e-03,  7.77808376e-03,  1.17780035e-02,
         1.25698129e-02, -1.00409074e-02, -1.14690521e-02,
         1.00000000e+00,  1.20805366e-02],
       [-1.65713715e-02, -6.26374782e-03, -1.09832944e-02,
        -2.32893966e-02,  5.30920641e-02, -1.06512488e-01,
         3.23967912e-01, -1.39780555e-02,  1.11110193e-01,
        -1.25282063e-01, -7.13776560e-03, -1.56128278e-01,
         1.20805366e-02,  1.00000000e+00]]), pvalue=array([[0.00000000e+000, 6.75483429e-001, 8.55178468e-001,
        6.07981798e-001, 3.11698199e-001, 6.88261457e-002,
        9.62034639e-001, 4.88086885e-001, 3.67465405e-001,
        4.06300660e-001, 9.52261425e-001, 2.28461236e-001,
        5.48097586e-001, 9.75106276e-002],
       [6.75483429e-001, 0.00000000e+000, 5.95071292e-001,
        5.50722932e-001, 5.46203060e-001, 7.93006618e-001,
        3.80283664e-001, 1.31785022e-001, 1.63585747e-001,
        5.36514208e-002, 1.60847582e-001, 8.66447868e-001,
        1.27389774e-001, 5.31116466e-001],
       [8.55178468e-001, 5.95071292e-001, 0.00000000e+000,
        5.03861020e-001, 2.33332702e-002, 8.30304249e-001,
        8.90508036e-001, 8.74364323e-002, 9.36216720e-001,
        8.39475437e-002, 3.71469037e-001, 8.90503148e-001,
        2.38243578e-001, 2.72106138e-001],
       [6.07981798e-001, 5.50722932e-001, 5.03861020e-001,
        0.00000000e+000, 5.41558890e-001, 7.63332662e-001,
        4.25266703e-001, 9.09790109e-001, 5.69634028e-001,
        2.08874884e-001, 7.03844602e-001, 1.52541637e-002,
        9.01602674e-001, 1.98609526e-002],
       [3.11698199e-001, 5.46203060e-001, 2.33332702e-002,
        5.41558890e-001, 0.00000000e+000, 8.37437458e-001,
        4.06537979e-004, 7.06678685e-001, 2.01668047e-023,
        9.38702072e-001, 4.70093788e-001, 6.57076013e-001,
        9.84458653e-001, 1.08256524e-007],
       [6.88261457e-002, 7.93006618e-001, 8.30304249e-001,
        7.63332662e-001, 8.37437458e-001, 0.00000000e+000,
        2.89407525e-003, 1.31173411e-001, 1.76909716e-001,
        1.98811127e-001, 5.64246762e-001, 2.41686809e-002,
        4.08370570e-001, 1.25850456e-026],
       [9.62034639e-001, 3.80283664e-001, 8.90508036e-001,
        4.25266703e-001, 4.06537979e-004, 2.89407525e-003,
        0.00000000e+000, 2.98157345e-001, 8.65526378e-004,
        4.60240532e-009, 1.26581605e-001, 6.74797620e-005,
        8.07912562e-001, 4.60367975e-243],
       [4.88086885e-001, 1.31785022e-001, 8.74364323e-002,
        9.09790109e-001, 7.06678685e-001, 1.31173411e-001,
        2.98157345e-001, 0.00000000e+000, 3.41506861e-001,
        1.96808492e-001, 2.53904935e-002, 4.13650739e-003,
        4.36732384e-001, 1.62203448e-001],
       [3.67465405e-001, 1.63585747e-001, 9.36216720e-001,
        5.69634028e-001, 2.01668047e-023, 1.76909716e-001,
        8.65526378e-004, 3.41506861e-001, 0.00000000e+000,
        1.12319427e-231, 3.25429744e-001, 2.50330560e-001,
        2.38918636e-001, 7.64706959e-029],
       [4.06300660e-001, 5.36514208e-002, 8.39475437e-002,
        2.08874884e-001, 9.38702072e-001, 1.98811127e-001,
        4.60240532e-009, 1.96808492e-001, 1.12319427e-231,
        0.00000000e+000, 6.99615740e-001, 1.03295766e-001,
        2.08799333e-001, 2.85374243e-036],
       [9.52261425e-001, 1.60847582e-001, 3.71469037e-001,
        7.03844602e-001, 4.70093788e-001, 5.64246762e-001,
        1.26581605e-001, 2.53904935e-002, 3.25429744e-001,
        6.99615740e-001, 0.00000000e+000, 2.35441825e-001,
        3.15383179e-001, 4.75414918e-001],
       [2.28461236e-001, 8.66447868e-001, 8.90503148e-001,
        1.52541637e-002, 6.57076013e-001, 2.41686809e-002,
        6.74797620e-005, 4.13650739e-003, 2.50330560e-001,
        1.03295766e-001, 2.35441825e-001, 0.00000000e+000,
        2.51464473e-001, 1.34826852e-055],
       [5.48097586e-001, 1.27389774e-001, 2.38243578e-001,
        9.01602674e-001, 9.84458653e-001, 4.08370570e-001,
        8.07912562e-001, 4.36732384e-001, 2.38918636e-001,
        2.08799333e-001, 3.15383179e-001, 2.51464473e-001,
        0.00000000e+000, 2.27067756e-001],
       [9.75106276e-002, 5.31116466e-001, 2.72106138e-001,
        1.98609526e-002, 1.08256524e-007, 1.25850456e-026,
        4.60367975e-243, 1.62203448e-001, 7.64706959e-029,
        2.85374243e-036, 4.75414918e-001, 1.34826852e-055,
        2.27067756e-001, 0.00000000e+000]]))
```

In [41]:

```
import statsmodels.api as sm
```

In [42]:
```
x=data[["EstimatedSalary"]]
y=data["CreditScore"]
```

In [43]:
```
model=sm.OLS(y,x)
result=model.fit()
result.summary()
```

Out[43]: 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:	Sat, 24 Sep 2022	**Prob (F-statistic):**	0.00
Time:	15:56:14	**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

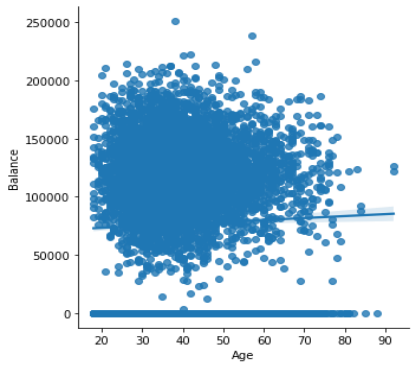
Notes:
[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [44]:
```
from sklearn.preprocessing import scale
x=scale(x)
x
```

Out[44]:
```
array([[ 0.02188649],
       [ 0.21653375],
       [ 0.2406869 ],
       ...,
       [-1.00864308],
       [-0.12523071],
       [-1.07636976]])
```

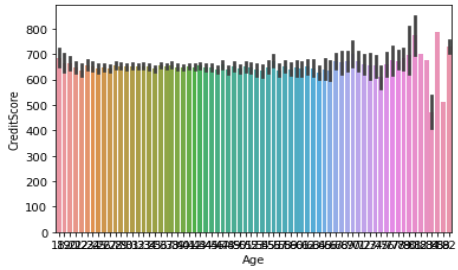
In [45]:
```
sns.lmplot(x='Age',y='Balance',data=data)
```

Out[45]:



In [46]:
```
sns.barplot(x="Age",y="CreditScore",data=data)
```

Out[46]:



In [32]:
```
###outier detection
```

In [47]:
```
qnt = data.quantile(q=[0.75,0.25])
qnt
```

Out[47]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0.75	7500.25	15753233.75	718.0	44.0	7.0	127644.24	2.0	1.0	1.0	149388.2475	0.0
0.25	2500.75	15628528.25	584.0	32.0	3.0	0.00	1.0	0.0	0.0	51002.1100	0.0

In [48]:
```
iqr=qnt.loc[0.75]-qnt.loc[0.25]
iqr
```

Out[48]:
```
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
```

In [51]:
```
upper= qnt.loc[0.75]+1.5*iqr
upper
```

Out[51]:
```
RowNumber          1.499950e+04
CustomerId         1.594029e+07
CreditScore        9.190000e+02
Age                6.200000e+01
Tenure             1.300000e+01
Balance            3.191106e+05
NumOfProducts      3.500000e+00
HasCrCard          2.500000e+00
IsActiveMember     2.500000e+00
EstimatedSalary    2.969675e+05
Exited             0.000000e+00
dtype: float64
```

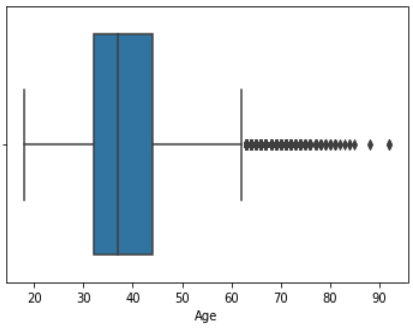
In [52]:
```
lower= qnt.loc[0.25]-1.5*iqr
lower
```

Out[52]:
```
RowNumber         -4.998500e+03
CustomerId         1.544147e+07
CreditScore        3.830000e+02
Age                1.400000e+01
Tenure            -3.000000e+00
Balance           -1.914664e+05
NumOfProducts     -5.000000e-01
HasCrCard         -1.500000e+00
IsActiveMember    -1.500000e+00
EstimatedSalary   -9.657710e+04
Exited             0.000000e+00
dtype: float64
```

In [36]:
```
###rplacing outlier
```

In [37]:
```
sns.boxplot(data["Age"])
```

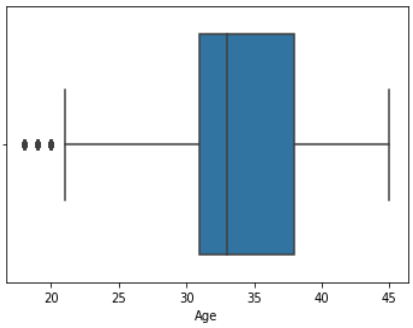
Out[37]:



In [53]:
```
data["Age"]= np.where(data["Age"]>45,31,data["Age"])
```

In [54]:
```
sns.boxplot(data["Age"])
```

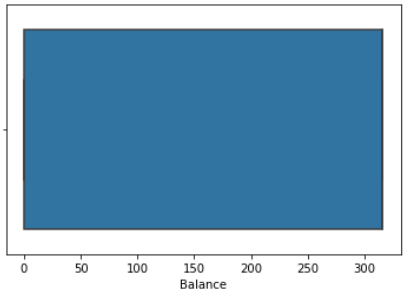
Out[54]:



In [55]:
```
data["Balance"]= np.where(data["Balance"]>618,316,data["Balance"])
```

In [56]:
```
sns.boxplot(data["Balance"])
```

Out[56]:



In [57]:
```
data.head()
```

Out[57]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	Female	42	2	0.0	1	1	1	101348.88	1
1	2	15647311	Hill	608	Spain	Female	41	1	316.0	1	0	1	112542.58	0
2	3	15619304	Onio	502	France	Female	42	8	316.0	3	1	0	113931.57	1
3	4	15701354	Boni	699	France	Female	39	1	0.0	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	Female	43	2	316.0	1	1	1	79084.10	0

In [58]:
```
data["Gender"].replace({"Female":0, "Male":1},inplace = True)
```

In [59]:
```
data.head(10)
```

Out[59]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	0	42	2	0.0	1	1	1	101348.88	1
1	2	15647311	Hill	608	Spain	0	41	1	316.0	1	0	1	112542.58	0
2	3	15619304	Onio	502	France	0	42	8	316.0	3	1	0	113931.57	1
3	4	15701354	Boni	699	France	0	39	1	0.0	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	0	43	2	316.0	1	1	1	79084.10	0
5	6	15574012	Chu	645	Spain	1	44	8	316.0	2	1	0	149756.71	1
6	7	15592531	Bartlett	822	France	1	31	7	0.0	2	1	1	10062.80	0
7	8	15656148	Obinna	376	Germany	0	29	4	316.0	4	1	0	119346.88	1
8	9	15792365	He	501	France	1	44	4	316.0	2	0	1	74940.50	0
9	10	15592389	H?	684	France	1	27	2	316.0	1	1	1	71725.73	0

In [60]:
```
data["HasCrCard"].replace({1:"yes",0:"no"},inplace = True)
```

In [61]:
```
data.head(10)
```

Out[61]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	0	42	2	0.0	1	yes	1	101348.88	1
1	2	15647311	Hill	608	Spain	0	41	1	316.0	1	no	1	112542.58	0
2	3	15619304	Onio	502	France	0	42	8	316.0	3	yes	0	113931.57	1
3	4	15701354	Boni	699	France	0	39	1	0.0	2	no	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	0	43	2	316.0	1	yes	1	79084.10	0
5	6	15574012	Chu	645	Spain	1	44	8	316.0	2	yes	0	149756.71	1
6	7	15592531	Bartlett	822	France	1	31	7	0.0	2	yes	1	10062.80	0
7	8	15656148	Obinna	376	Germany	0	29	4	316.0	4	yes	0	119346.88	1
8	9	15792365	He	501	France	1	44	4	316.0	2	no	1	74940.50	0
9	10	15592389	H?	684	France	1	27	2	316.0	1	yes	1	71725.73	0

In [62]:
```
#Label encoding
```

In [74]:
```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
```

In [75]:
```
data["Age"]=le.fit_transform(data["Age"])
```

In [76]:
```
data.Age.unique()
```

Out[76]:
```
array([24, 23, 21, 25, 26, 13, 11,  9,  6, 16,  7, 17, 27, 14, 20, 18, 15,
       22, 19,  1,  8,  3,  4, 12, 10,  2,  5,  0], dtype=int64)
```

In [77]:
```
x=data.iloc[:,0:13].values
x
```

Out[77]:
```
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)
```

In [78]:
```
y=data.iloc[:,13:14].values
y
```

Out[78]:
```
array([[1],
       [0],
       [1],
       ...,
       [1],
       [1],
       [0]], dtype=int64)
```

In [79]:
```
data.head()
```

Out[79]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	0	24	2	0.0	1	yes	1	101348.88	1
1	2	15647311	Hill	608	Spain	0	23	1	316.0	1	no	1	112542.58	0
2	3	15619304	Onio	502	France	0	24	8	316.0	3	yes	0	113931.57	1
3	4	15701354	Boni	699	France	0	21	1	0.0	2	no	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	0	25	2	316.0	1	yes	1	79084.10	0

In [80]:
```
from sklearn.preprocessing import  OneHotEncoder
```

In [81]:
```
ohe= OneHotEncoder()
```

In [82]:
```
z=ohe.fit_transform(x[:,0:14]).toarray()
z
```

Out[82]:
```
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.]])
```

In [83]:
```
###split the data into training and testing
```

In [84]:
```
from sklearn.model_selection import train_test_split
```

In [85]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)
```

In [86]:
```
x_train.shape,x_test.shape,y_train.shape,y_test.shape
```

Out[86]:
```
((8000, 13), (2000, 13), (8000, 1), (2000, 1))
```

In [87]:
```
x_train
```

Out[87]:
```
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)
```

In [88]:
```
x_test
```

Out[88]:
```
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)
```

In [89]:
```
y_train
```

Out[89]:
```
array([[0],
       [0],
       [0],
       ...,
       [0],
       [0],
       [1]], dtype=int64)
```

In [90]:
```
y_test
```

Out[90]:
```
array([[0],
       [1],
       [0],
       ...,
       [0],
       [0],
       [0]], dtype=int64)
```

In [91]:
```
from sklearn.preprocessing import scale
```

In [92]:
```
x=data["CreditScore"]
S=scale(x)
S
```

Out[92]:
```
array([-0.32622142, -0.44003595, -1.53679418, ...,  0.60498839,
        1.25683526,  1.46377078])
```

In [93]:
```
###INDEPENDENT VARIABLE
```

In [94]:
```
y=data["Age"]
y
```

Out[94]:
```
0       24
1       23
2       24
3       21
4       25
        ..
9995    21
9996    17
9997    18
9998    24
9999    10
Name: Age, Length: 10000, dtype: int64
```

In [ ]:
```

```

In [95]:
```
x=data.drop(data["Age"],axis=0)
x
```

Out[95]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
28	29	15728693	McWilliams	574	Germany	0	25	3	316.0	1	yes	1	100187.43	0
29	30	15656300	Lucciano	411	France	1	11	0	316.0	2	yes	1	53483.21	0
30	31	15589475	Azikiwe	591	Spain	0	21	3	0.0	3	yes	0	140469.38	1
31	32	15706552	Odinakachukwu	533	France	1	18	7	316.0	1	no	1	156731.91	0
32	33	15750181	Sanderson	553	Germany	1	23	9	316.0	2	no	0	81898.81	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	1	21	5	0.0	2	yes	0	96270.64	0
9996	9997	15569892	Johnstone	516	France	1	17	10	316.0	1	yes	1	101699.77	0
9997	9998	15584532	Liu	709	France	0	18	7	0.0	1	no	1	42085.58	1
9998	9999	15682355	Sabbatini	772	Germany	1	24	3	316.0	2	yes	0	92888.52	1
9999	10000	15628319	Walker	792	France	0	10	4	316.0	1	yes	0	38190.78	0

9972 rows × 14 columns

In [96]:
```
###spiliting dependent variable
```

In [97]:
```
y=data.iloc[:,-1].values
y
```

Out[97]:
```
array([1, 0, 1, ..., 1, 1, 0], dtype=int64)
```

In [98]:
```
data=pd.DataFrame({"Age":[1,2,np.nan],"CreditScore":[1,np.nan,np.nan],"Balance":[1,2,3]})
data
```

Out[98]:

	Age	CreditScore	Balance
0	1.0	1.0	1
1	2.0	NaN	2
2	NaN	NaN	3

In [99]:
```
data.isnull().any()
```

Out[99]:
```
Age             True
CreditScore     True
Balance        False
dtype: bool
```

In [100…
```
data.isnull().sum()
```

Out[100…
```
Age            1
CreditScore    2
Balance        0
dtype: int64
```

In [101…
```
data.dropna()
```

Out[101…

	Age	CreditScore	Balance
0	1.0	1.0	1

In [102…
```
data.dropna(axis=1)
```

Out[102…

	Balance
0	1
1	2
2	3

In [103…
```
data["Age"].mean()
```

Out[103…
```
1.5
```

In [ ]: