

## Assignment -2

### Python Programming

Assignment Date	01 October 2022
Student Name	Steve John D
Student Roll Number	212219060259
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	Obijaku	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	10000.000000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000
mean	5000.500000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	1.530200	0.705500	0.515100	100090.239881	0.203700
std	2886.895688	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	0.581654	0.455840	0.499797	57510.492818	0.402769
min	1.000000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.000000	0.000000	11.580000	0.000000
25%	2500.750000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.000000	0.000000	51002.110000	0.000000
50%	5000.500000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.000000	1.000000	100193.915000	0.000000
75%	7500.250000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.000000	1.000000	149388.247500	0.000000
max	10000.000000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.000000	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)
```

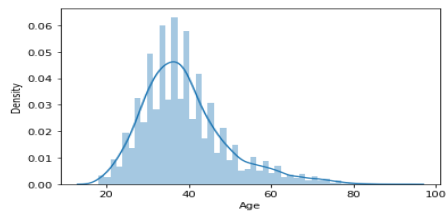
```
Out[10]:
```

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

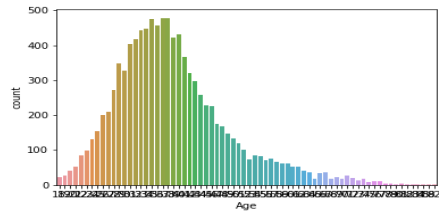
```
In [11]: sns.distplot(data['Age'])
```

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
```

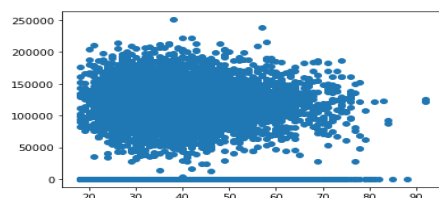
```
In [18]: data.duplicated().sum()
```

Out[18]: 0

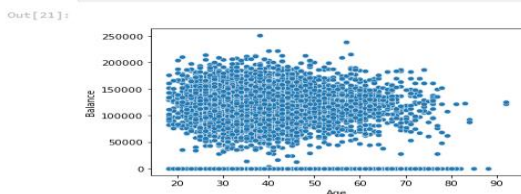
```
In [19]: ###VISUALISATION
```

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

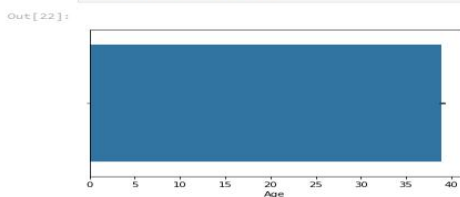
Out[20]:



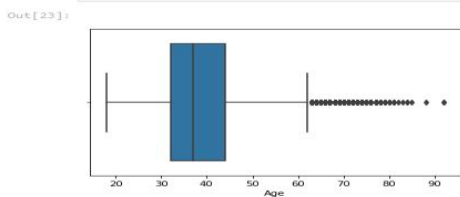
```
In [21]: sns.scatterplot(data.Age,data.Balance)
```



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



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

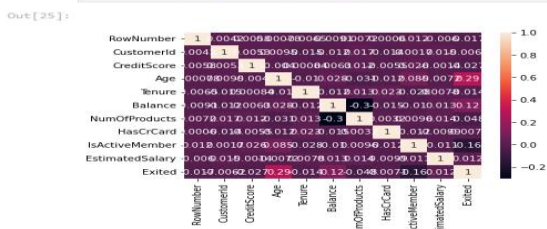


```
In [24]: data.corr()
```

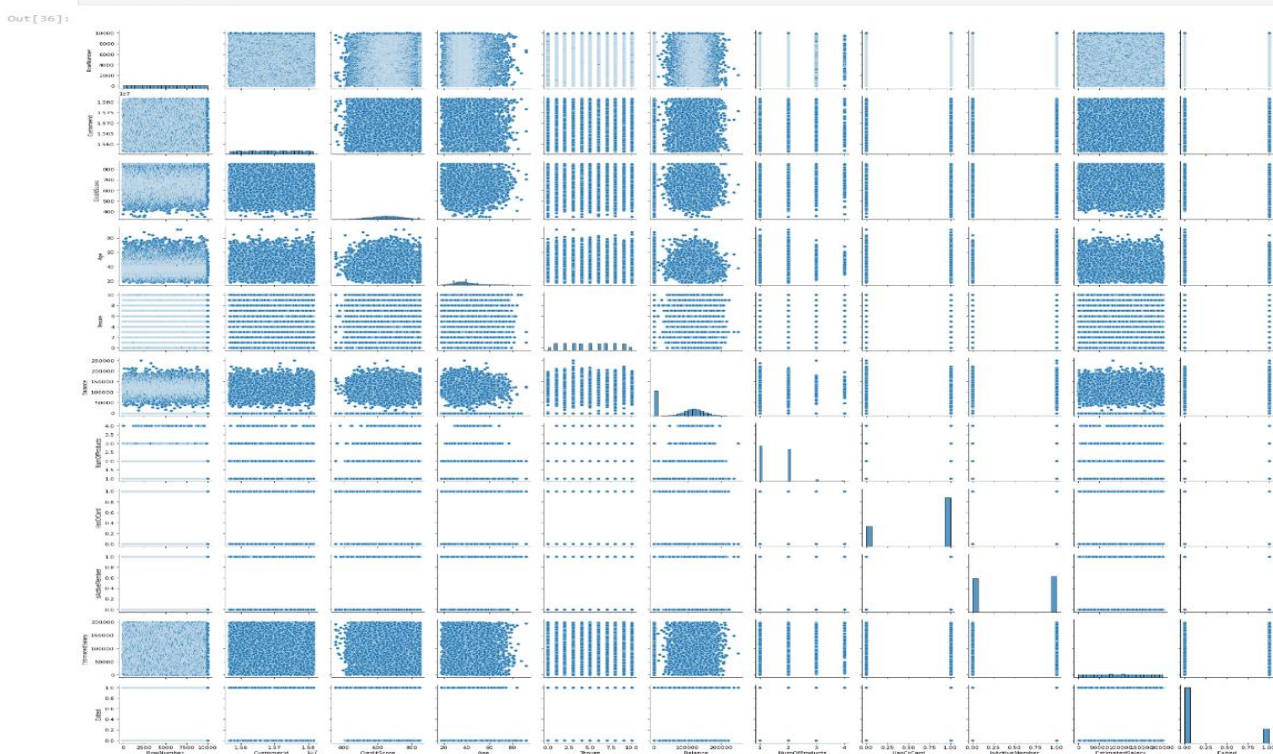
Out[24]:

	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)
```



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



```
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-03, -1.40233299e-02,  1.68193033e-03,
 1.52457829e-02, -6.26374782e-03],
 [ 5.31564210e-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],
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 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,
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 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,
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-5.85664619e-02, -1.52782371e-02,  3.98391734e-02,
-2.43149876e-03,  3.23967912e-01],
 [-6.93433206e-03, -1.50720283e-02, -1.70916721e-02,
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-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,
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 1.17780035e-02,  1.11110193e-01],
 [ 8.30510741e-03,  1.92970188e-02, -1.72831393e-02,
 1.25677271e-02,  7.69108918e-04, -1.28505367e-02,
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 1.00000000e+00,  3.85886031e-03,  1.62917706e-02,
 1.25698129e-02, -1.25282063e-01],
 [ 5.98746525e-04, -1.40233299e-02, -8.93818901e-03,
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-1.52782371e-02,  2.23540939e-02, -9.83460270e-03,
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-1.00409074e-02, -7.13776560e-03],
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 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,
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 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],
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 3.65142088e-002,  1.60847582e-001,  8.66447868e-001,
 1.27389774e-001,  5.31116466e-001],
 [8.55178468e-001,  5.95071292e-001,  0.00000000e+000,
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 8.90508036e-001,  8.74364323e-002,  9.36216720e-001,
 8.39475437e-002,  3.71469037e-001,  8.90503148e-001,
 2.38243578e-001,  7.22106138e-001],
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 9.01602674e-001,  1.98609526e-002],
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 4.60240532e-009,  1.26581605e-001,  6.74797620e-005,
 8.07912562e-001,  4.60367975e-243],
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 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,
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 2.38918636e-001,  7.64706959e-029],
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 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:

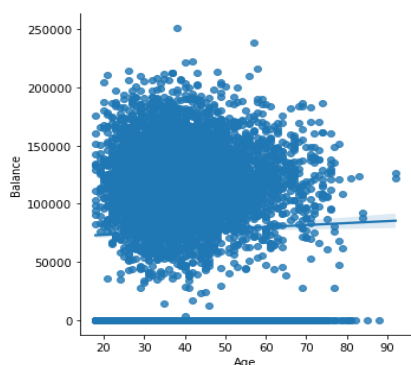
- [1]  $R^2$  is computed without centering (uncentered) since the model does not contain a constant.
- [2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

```
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]])
```

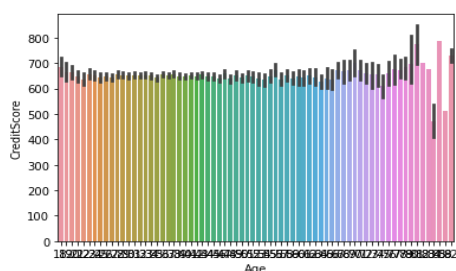
```
In [45]: sns.lmplot(x='Age',y='Balance',data=data)
```

Out[45]:



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

Out[46]:



```
In [32]: ###outlier 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
```

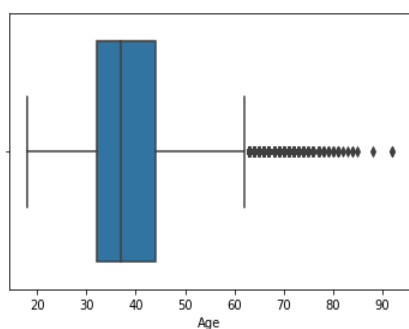
```
In [52]: lower= qnt.loc[0.25]-1.5*iqr
lower
```

```
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]: ###replacing outlier
```

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

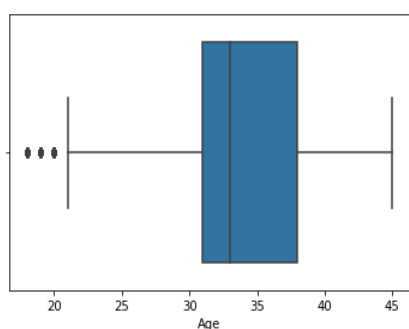
```
Out[37]:
```



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

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

```
Out[54]:
```

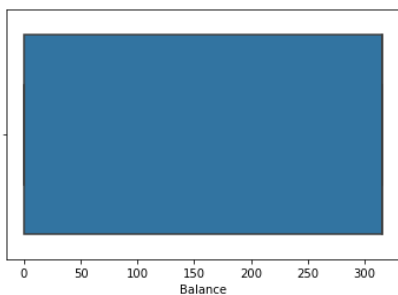




```
In [55]: data["Balance"] = np.where(data["Balance"]>618,316,data["Balance"])
```

```
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({"yes":1,"no":0},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, 15633677, '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 x 14 columns

In [96]: ###spilting 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         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 [ ]:
```