Importing Libraries

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

Loading Dataset

```
df=pd.read_csv(r'C:\Users\LENOVO\Downloads\Churn_Modelling.csv')
```

```
df.shape
```

```
(10000, 14)
```

df.head()

	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

df.tail()

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0

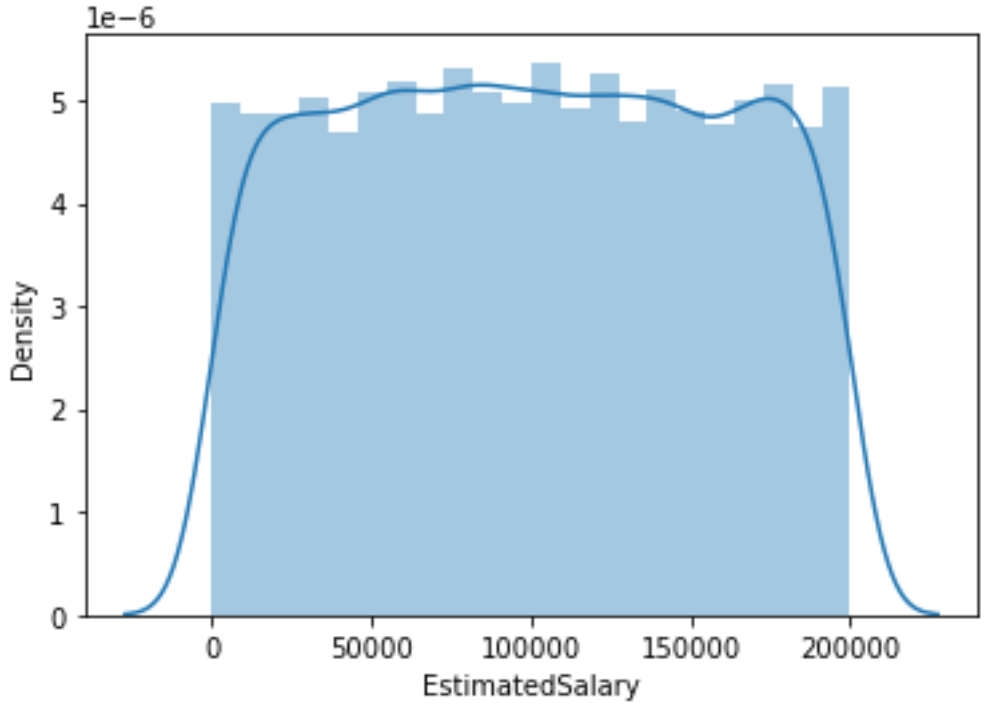
	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	9999	15682355	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

Visualizations

1. Univariate

```
sns.distplot(df['EstimatedSalary'],hist=True)
```

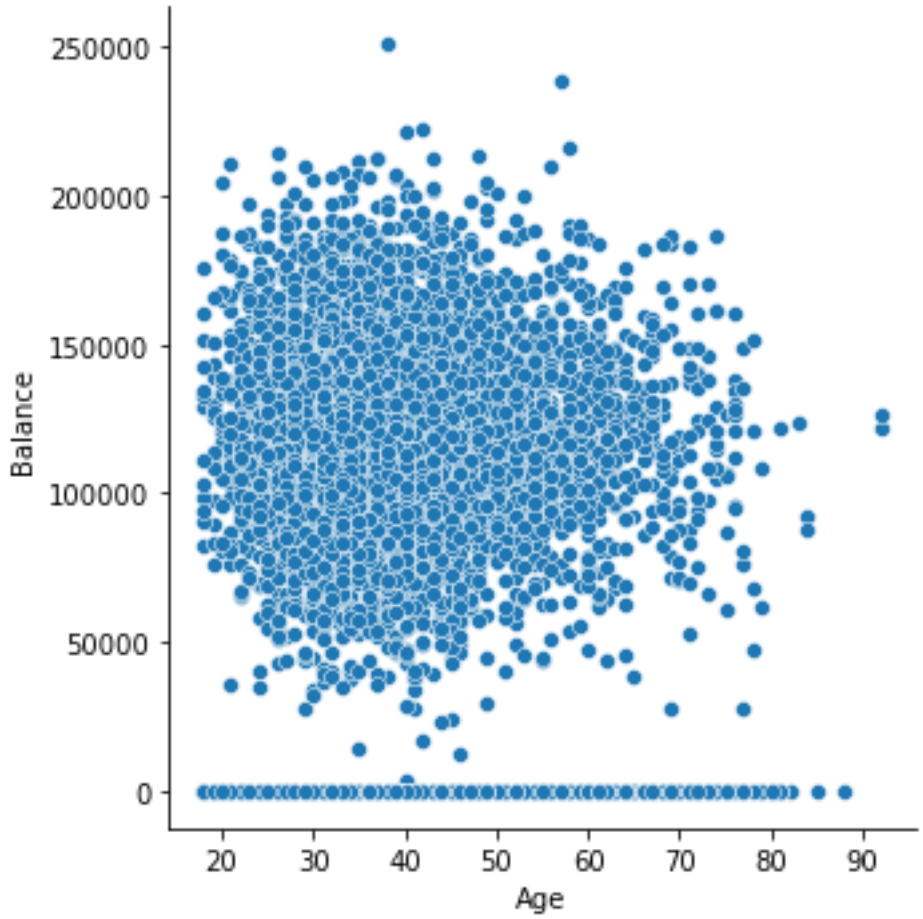
```
C:\Users\LENOVO\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
<AxesSubplot:xlabel='EstimatedSalary', ylabel='Density'>
```



2. Bivariate

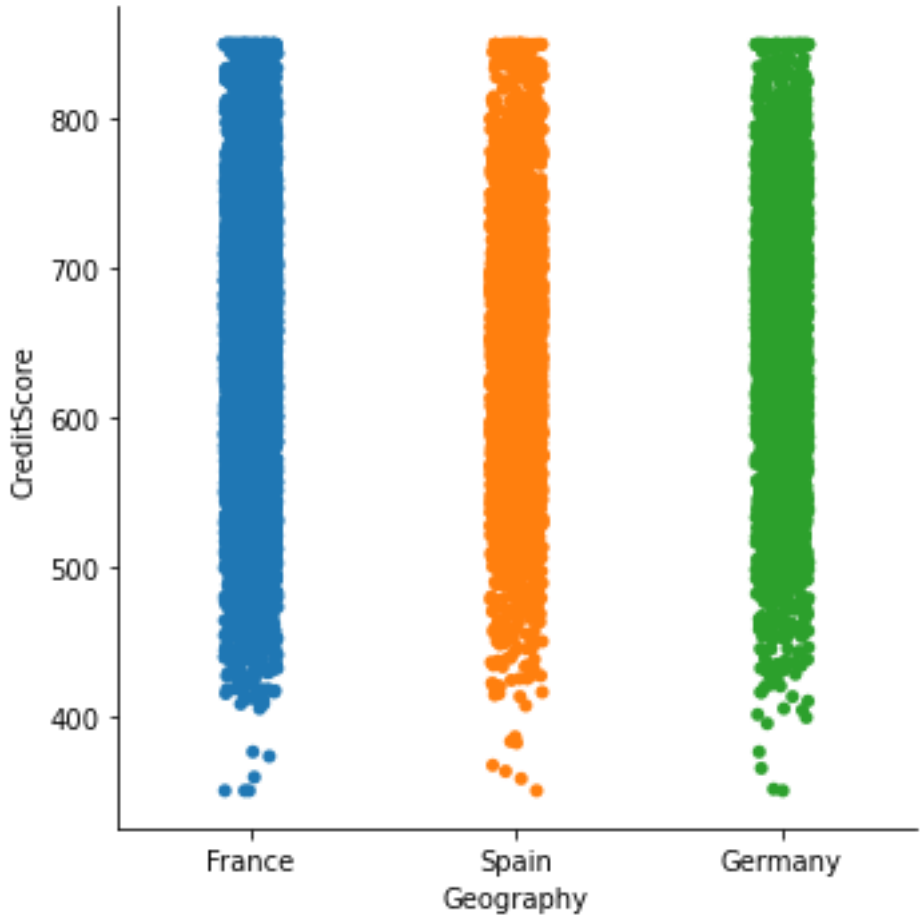
sns.relplot(x='Age',y='Balance',data=df)

<seaborn.axisgrid.FacetGrid at 0x1fd190d2070>




```
sns.catplot(x='Geography',y='CreditScore',data=df)
# for categorical data
```

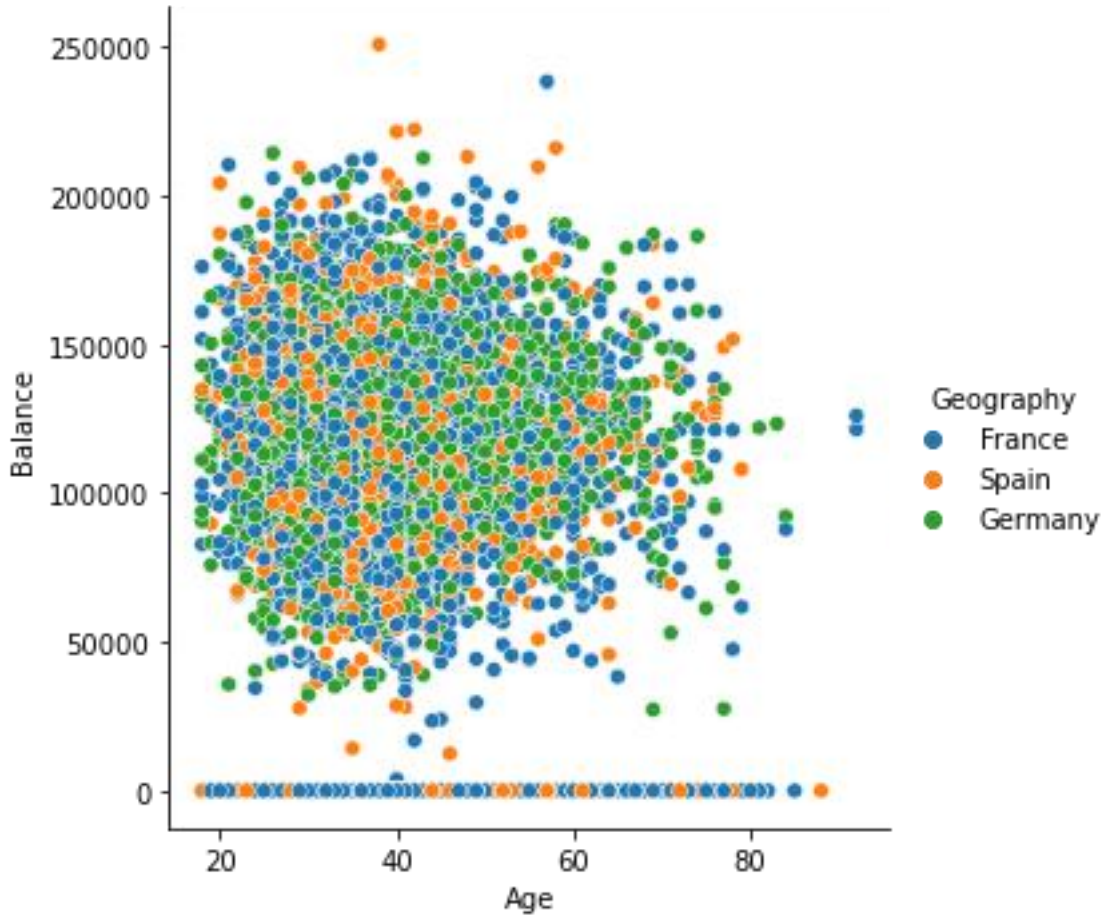
```
<seaborn.axisgrid.FacetGrid at 0x1fd194e8d90>
```



3. Multivariate

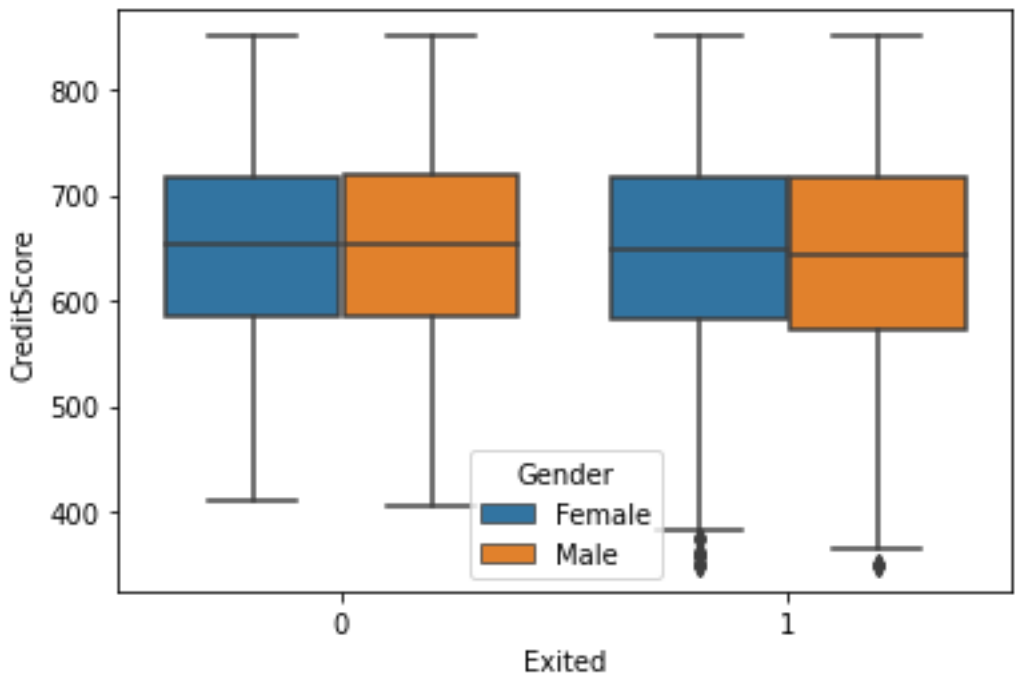
sns.relplot(x='Age',y='Balance',hue='Geography',data=df)

<seaborn.axisgrid.FacetGrid at 0x1fd1956e580>




```
sns.boxplot(x='Exited',y='CreditScore',hue='Gender',data=df)
# for categorical data
```

<AxesSubplot:xlabel='Exited', ylabel='CreditScore'>



Descriptive Statistics

df.describe()

	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

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
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

Handling the missing(null) values

df.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

df.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

 # Since no null values are found no need to handle

Split the data into dependent and independent variables

```
x=df.iloc[:,3:13].values
print(x.shape)
y=df.iloc[:,13:14].values
print(y.shape)
```

```
(10000, 10)
(10000, 1)
```

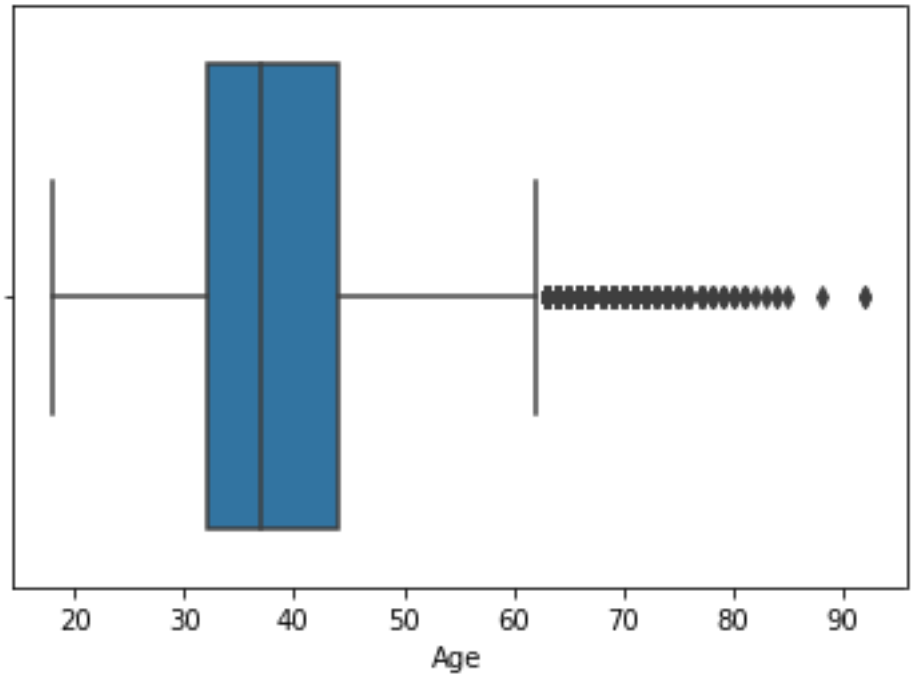
Finding and Replacing Outliers

```
df.skew()
```

```
C:\Users\LENOVO\AppData\Local\Temp\ipykernel_3336\1665899112.py:1: FutureWarning: Dropping of nuisance columns in DataFrame reductions (with 'numeric_only=None') is deprecated; in a future version this will raise TypeError.  Select only valid columns before calling the reduction.
  df.skew()
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
```

```
sns.boxplot(df["Age"])
```

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




```
q1 = df["Age"].describe()["25%"]
q3 = df["Age"].describe()["75%"]
iqr = q3-q1
l_b = q1 -(1.5*iqr)
u_b = q3 + (1.5*iqr)
df[df["Age"]<l_b]
```

	Row Number	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited

```
df[df["Age"]>u_b]
```

	Row Number	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
58	59	15623944	T'ien	511	Spain	Female	66	4	0.00	1	1	0	1643.11	1
85	86	15805254	Nduka	652	Spain	Female	75	10	0.00	2	1	1	114675.75	0
104	105	15804919	Dunbabin	670	Spain	Female	65	1	0.00	1	1	1	177655.68	1

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
158	159	15589975	Maclean	646	France	Female	73	6	97259.25	1	0	1	104719.66	0
181	182	15789669	Hsia	510	France	Male	65	2	0.00	2	1	1	48071.61	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9753	9754	15705174	Chiedozie	656	Germany	Male	68	7	153545.11	1	1	1	186574.68	0
9765	9766	15777067	Thomas	445	France	Male	64	2	136770.67	1	0	1	43678.06	0
9832	9833	15814690	Chukwujekwu	595	Germany	Female	64	2	105736.32	1	1	1	89935.73	1
9894	9895	15704795	Vagin	521	France	Female	77	6	0.00	2	1	1	49054.10	0
9936	9937	15653037	Parks	609	France	Male	77	1	0.00	1	0	1	18708.76	0

359 rows × 14 columns

#Replace the outlier

outlier_list = list(df[df["Age"] > u_b]["Age"])

outlier_list

[66,
75,
65,
73,
65,
72,
67,

67,
79,
80,
68,
75,
66,
66,
70,
63,
72,
64,
64,
70,
67,
82,
63,
69,
65,
69,
64,
65,
74,
67,
66,
67,
63,
70,
71,
72,
67,
74,
76,
66,
63,
66,
68,
67,
63,
71,
66,
69,
73,
65,
66,
64,
69,
64,
77,
74,
65,
70,
67,
69,
67,
74,
69,
74,

74,
64,
63,
63,
70,
74,
65,
72,
77,
66,
65,
74,
88,
63,
71,
63,
64,
67,
70,
68,
72,
71,
66,
75,
67,
73,
69,
76,
63,
85,
67,
74,
76,
66,
69,
66,
72,
63,
71,
63,
74,
67,
72,
72,
66,
84,
71,
66,
63,
74,
69,
84,
67,
64,
68,
66,
77,

70,
67,
79,
67,
76,
73,
66,
67,
64,
73,
76,
72,
64,
71,
63,
70,
65,
66,
65,
80,
66,
63,
63,
63,
63,
66,
74,
69,
63,
64,
76,
75,
68,
69,
77,
64,
66,
74,
71,
67,
68,
64,
68,
70,
64,
75,
66,
64,
78,
65,
74,
64,
64,
71,
77,
79,
70,

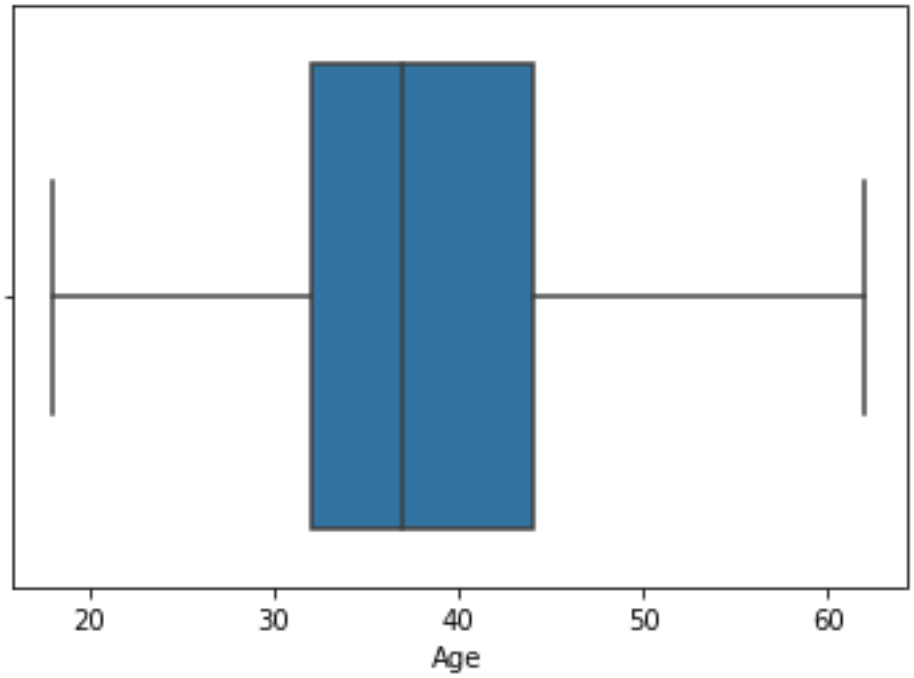
81,
64,
68,
68,
63,
79,
66,
64,
70,
69,
71,
72,
66,
68,
63,
71,
72,
72,
64,
78,
75,
65,
65,
67,
63,
68,
71,
73,
64,
66,
71,
69,
71,
66,
76,
69,
73,
64,
64,
75,
73,
71,
72,
63,
67,
68,
73,
67,
64,
63,
92,
65,
75,
67,
71,
64,
66,

64,
66,
67,
77,
92,
67,
63,
66,
66,
68,
65,
72,
71,
76,
63,
67,
67,
66,
67,
63,
65,
70,
72,
77,
74,
72,
73,
77,
67,
71,
64,
72,
81,
76,
69,
68,
74,
64,
64,
71,
68,
63,
67,
63,
64,
76,
63,
63,
68,
67,
72,
70,
81,
67,
73,
66,
68,

71,
66,
63,
75,
69,
64,
69,
70,
71,
71,
66,
70,
63,
64,
65,
63,
67,
71,
67,
65,
66,
63,
73,
66,
64,
72,
71,
69,
67,
64,
81,
73,
63,
67,
74,
83,
69,
71,
78,
63,
70,
69,
72,
70,
63,
74,
80,
69,
72,
67,
76,
71,
67,
71,
78,
63,
63,

```
 68,
 64,
 70,
 78,
 69,
 68,
 64,
 64,
 77,
 77]
outlier_dict = {}.fromkeys(outlier_list,u_b)
outlier_dict
{66: 62.0,
 75: 62.0,
 65: 62.0,
 73: 62.0,
 72: 62.0,
 67: 62.0,
 79: 62.0,
 80: 62.0,
 68: 62.0,
 70: 62.0,
 63: 62.0,
 64: 62.0,
 82: 62.0,
 69: 62.0,
 74: 62.0,
 71: 62.0,
 76: 62.0,
 77: 62.0,
 88: 62.0,
 85: 62.0,
 84: 62.0,
 78: 62.0,
 81: 62.0,
 92: 62.0,
 83: 62.0}
df["Age"] = df["Age"].replace(outlier_dict)
sns.boxplot(df["Age"])


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



df[df["Age"]>u_b]

Row Number	Customer Id	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited

Check for Categorical columns and perform encoding.

```
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct=ColumnTransformer([('oh',OneHotEncoder(),[1,2])],remainder='passthrough')
x=ct.fit_transform(x)
print(x.shape)
```

(10000, 13)

```
# saving the data
import joblib
joblib.dump(ct,"churnct.pkl")
```

['churnct.pkl']

Split the data into training and testing

```
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,random_state=0)
print(x_train.shape)
print(x_test.shape)
```

(8000, 13)

(2000, 13)

Scale the independent variables

```
from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
x_train=sc.fit_transform(x_train)
x_test=sc.transform(x_test)
```

```
joblib.dump(sc,"churnsc.pkl")
```

```
['churnsc.pkl']
```