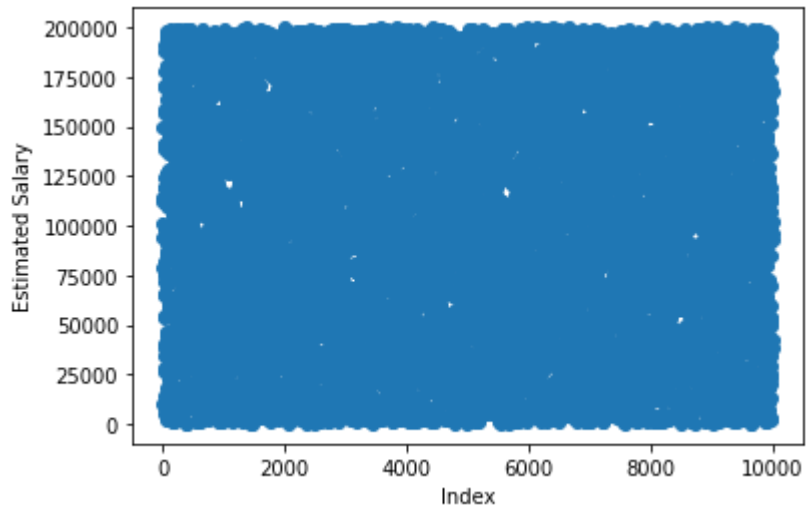
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
Value = pd.read_csv('/content/Churn_Modelling.csv') #loading the data set
Value.head(10)
```

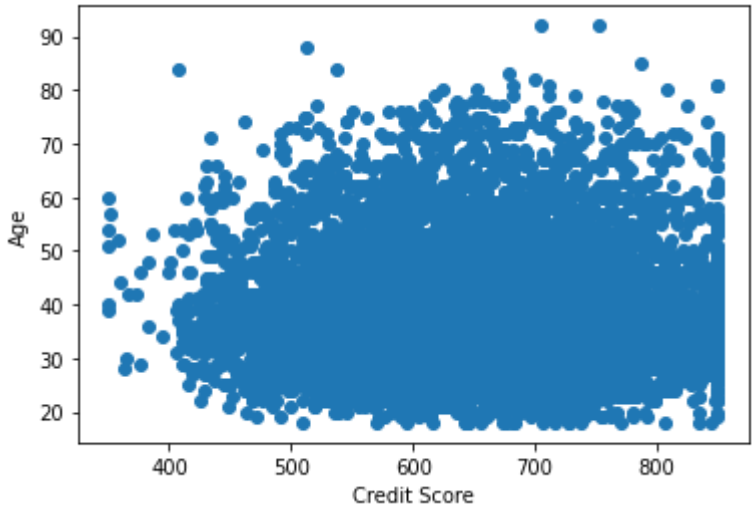
	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Ba
0	1	15634602	Hargrave	619	France	Female	42	2	
1	2	15647311	Hill	608	Spain	Female	41	1	838
2	3	15619304	Onio	502	France	Female	42	8	1596
3	4	15701354	Boni	699	France	Female	39	1	
4	5	15737888	Mitchell	850	Spain	Female	43	2	1255
5	6	15574012	Chu	645	Spain	Male	44	8	1137
6	7	15592531	Bartlett	822	France	Male	50	7	
7	8	15656148	Obinna	376	Germany	Female	29	4	1150
8	9	15792365	He	501	France	Male	44	4	1420
9	10	15592389	H?	684	France	Male	27	2	1346

```
plt.scatter(Value.index,Value['EstimatedSalary']) #univariate analysis
plt.xlabel('Index')
plt.ylabel('Estimated Salary')
plt.show()
```



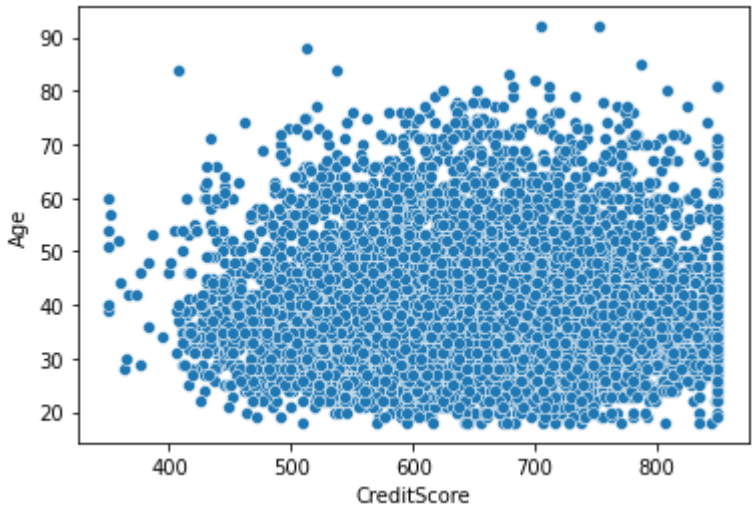
Data Visualization

```
plt.scatter(Value['CreditScore'],Value['Age']) #Bivariate analysis
plt.xlabel('Credit Score')
plt.ylabel('Age')
plt.show()
```

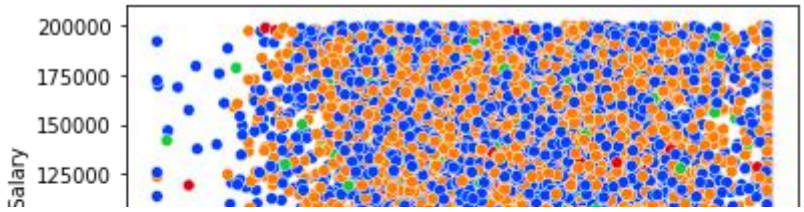



```
sns.scatterplot(x='CreditScore',y='Age',data=Value) #bivariant analysis
```

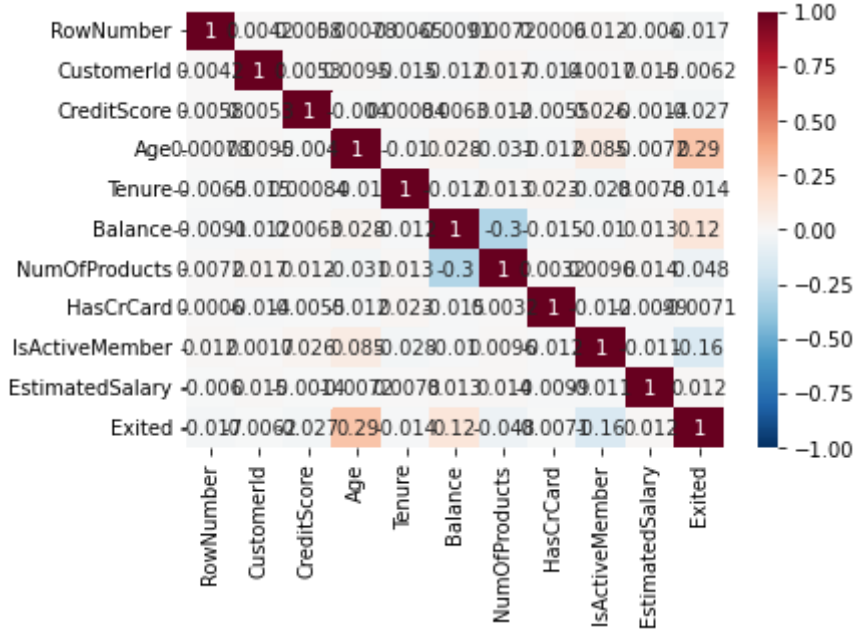
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f10a8222350>
```




```
sns.scatterplot(
    x='CreditScore',
    y='EstimatedSalary',
    data=Value,
    palette='bright',
    hue='NumOfProducts');  ##multivariant analysis
```




```
sns.heatmap(
    Value.corr(),
    cmap='RdBu_r',
    annot=True,
    vmin=-1, vmax=1); ##multivariant analysis
```




```
Value.describe(include='all')
```

	RowNumber	CustomerId	Surname	CreditScore	Geograph
count	10000.00000	1.000000e+04	10000	10000.000000	1000
unique	NaN	NaN	2932	NaN	
top	NaN	NaN	Smith	NaN	Franc
freq	NaN	NaN	32	NaN	501
mean	5000.50000	1.569094e+07	NaN	650.528800	Na
std	2886.89568	7.193619e+04	NaN	96.653299	Na
min	1.00000	1.556570e+07	NaN	350.000000	Na
25%	2500.75000	1.562853e+07	NaN	584.000000	Na

Handling Missing values and outliers

```
Value.isnull().sum() # finding missing value and found no missing value present in this da
```

```
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
```

```
qnt = Value.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

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

```
Upper_exterm= qnt.loc[0.75]+1.5*IQR
lower_exterm= qnt.loc[0.25]-1.5*IQR
```

```
Upper_exterm
```

```
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
```

lower_exterm

```
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
```

```
print(Value[Value['Balance']>319110.6],
Value[Value['Balance']<-191466.4])  ##no outlier in Balance
```

```
Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: [] Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: []
```

```
print(Value[Value['Age']>62])  ##outlier in Age
```

```
      RowNumber  CustomerId      Surname  CreditScore Geography  Gender  Age  \
58           59    15623944        T'ien          511     Spain  Female   66
85           86    15805254      Ndukaku          652     Spain  Female   75
104         105    15804919     Dunbabin          670     Spain  Female   65
158         159    15589975      Maclean          646    France  Female   73
181         182    15789669         Hsia          510    France    Male   65
...         ...         ...          ...          ...       ...     ...  ...
9753       9754    15705174    Chiedozie          656   Germany    Male   68
9765       9766    15777067       Thomas          445    France    Male   64
9832       9833    15814690  Chukwujekwu          595   Germany  Female   64
9894       9895    15704795        Vagin          521    France  Female   77
9936       9937    15653037        Parks          609    France    Male   77

      Tenure    Balance  NumOfProducts  HasCrCard  IsActiveMember  \
58         4       0.00              1          1               0
85        10       0.00              2          1               1
104        1       0.00              1          1               1
158        6   97259.25              1          0               1
181        2       0.00              2          1               1
```

```
...      ...        ...             ...        ...             ...
9753       7  153545.11             1          1               1
9765       2  136770.67             1          0               1
9832       2  105736.32             1          1               1
9894       6       0.00             2          1               1
9936       1       0.00             1          0               1

      EstimatedSalary  Exited
58            1643.11       1
85          114675.75       0
104         177655.68       1
158         104719.66       0
181          48071.61       0
...               ...     ...
9753        186574.68       0
9765         43678.06       0
9832         89935.73       1
9894         49054.10       0
9936         18708.76       0

[359 rows x 14 columns]
```

```
#replaced with mean value
Value['Age']= np.where(Value['Age']>62,Value['Age'].mean(),Value['Age'])
```

```
Value[Value['Age']<14] #no outlier lower exterm here
```

```
print(Value[Value['Tenure']>13],
 Value[Value['Tenure']<-3])  ##no outlier Tenure
```

```
Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: [] Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: []
```

```
print(Value[Value['CreditScore']>919])  ##no outlier in Upper exterm of Credit SCore
```

```
Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: []
```

```
Value[Value['CreditScore']<383] #outliers
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	G
7	8	15656148	Obinna	376	Germany	F
942	943	15804586	Lin	376	France	F
1193	1194	15779947	Thomas	363	Spain	F
1405	1406	15612494	Panicucci	359	France	F
1631	1632	15685372	Azubuike	350	Spain	
1838	1839	15758813	Campbell	350	Germany	
1962	1963	15692416	Aikenhead	358	Spain	F
2473	2474	15679249	Chou	351	Germany	F
2579	2580	15597896	Ozoemena	365	Germany	
8154	8155	15791533	Ch'ien	367	Spain	
8723	8724	15803202	Onyekachi	350	France	
8762	8763	15765173	Lin	350	France	F

```
 #replaced with mean value
Value['CreditScore']= np.where(Value['CreditScore']<383,Value['CreditScore'].mean(),Value[
```

```
print(Value[Value['EstimatedSalary']>296967.5],
 Value[Value['EstimatedSalary']<-965771])  ##no outlier
```

```
Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: [] Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography, Gender, Age, Tenur
Index: []
```

```
pd.get_dummies(Value,columns=['Gender','Geography']) ## one hot encoding but it is not rec
```

	RowNumber	CustomerId	Surname	CreditScore	Age	Tenure
0	1	15634602	Hargrave	619.0	42.0	2
1	2	15647311	Hill	608.0	41.0	1
2	3	15619304	Onio	502.0	42.0	8
3	4	15701354	Boni	699.0	39.0	1
4	5	15737888	Mitchell	850.0	43.0	2
...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771.0	39.0	5
9996	9997	15569892	Johnstone	516.0	35.0	10

```
pd.get_dummies(Value,columns=['Surname'])
```

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age
0	1	15634602	619.0	France	Female	42.0
1	2	15647311	608.0	Spain	Female	41.0
2	3	15619304	502.0	France	Female	42.0
3	4	15701354	699.0	France	Female	39.0
4	5	15737888	850.0	Spain	Female	43.0
...	...	...	...	...	...	...
9995	9996	15606229	771.0	France	Male	39.0
9996	9997	15569892	516.0	France	Male	35.0
9997	9998	15584532	709.0	France	Female	36.0
9998	9999	15682355	772.0	Germany	Male	42.0

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

```
## Label encoding is perfect for data preprocessing
Value['Surname']=var.fit_transform(Value['Surname'])  ## not much considered for data pred
Value['Gender']=var.fit_transform(Value['Gender'])
Value['Geography']=var.fit_transform(Value['Geography'])
```

```
Value
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gen
0	1	15634602	1115	619.0	0	
1	2	15647311	1177	608.0	2	
2	3	15619304	2040	502.0	0	
3	4	15701354	289	699.0	0	
4	5	15737888	1822	850.0	2	
...	...	...	...	...	...	
9995	9996	15606229	1999	771.0	0	
9996	9997	15569892	1336	516.0	0	
9997	9998	15584532	1570	709.0	0	

Separating dependent and Independent Variables

```
y = Value['EstimatedSalary']
x = Value.drop(columns=['EstimatedSalary','RowNumber'],axis=1)
x
```

	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	N
0	15634602	1115	619.0	0	0	42.0	2	0.00	
1	15647311	1177	608.0	2	0	41.0	1	83807.86	

```
Names = x.columns
## scaling the independent variable
from sklearn.preprocessing import scale
x=scale(x)
x=pd.DataFrame(x,columns=Names)
```

	...	...	...	...	...	...	...	...	...

```
x.head()
```

	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Bala
0	-0.783213	-0.464183	-0.332960	-0.901886	-1.095988	0.482051	-1.041760	-1.225
1	-0.606534	-0.390911	-0.447549	1.515067	-1.095988	0.366388	-1.387538	0.117
2	-0.995885	0.628988	-1.551769	-0.901886	-1.095988	0.482051	1.032908	1.333
3	0.144767	-1.440356	0.500414	-0.901886	-1.095988	0.135061	-1.387538	-1.225
4	0.652659	0.371354	2.073407	1.515067	-1.095988	0.597715	-1.041760	0.785

```
# Splitting data inti training and test SET
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)


len(x_train) ## 80% of total data
```

```
8000
```

Colab paid products - Cancel contracts here