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

import warnings
warnings.filterwarnings("ignore")
```

```
from google.colab import files
uploaded = files.upload()
```

Choose Files Churn_Modelling.csv

- **Churn_Modelling.csv**(text/csv) - 684858 bytes, last modified: 10/12/2022 - 100% done

```
Saving Churn_Modelling.csv to Churn_Modelling (1).csv
```

```
df=pd.read_csv("/content/Churn_Modelling.csv")
```

```
df.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
```

Univariateananlysis

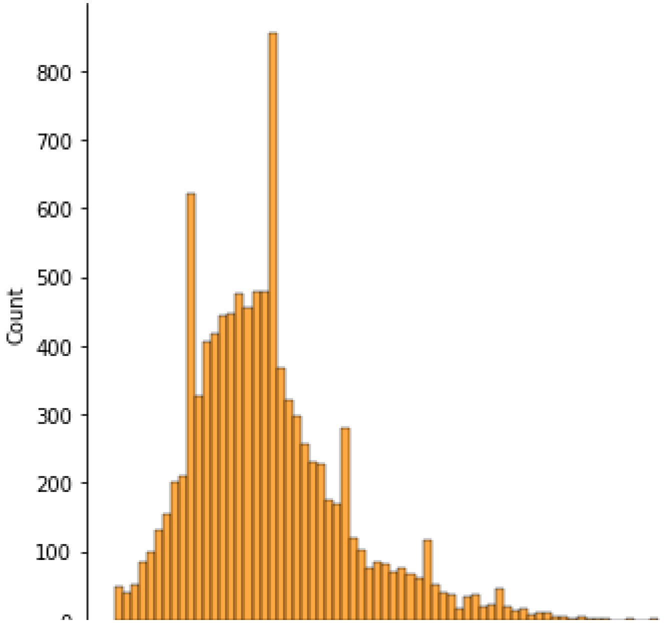
Histogram

```
df.describe()
```

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balanc
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.00000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.88928
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.40520
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.00000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.00000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.54000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.24000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.09000

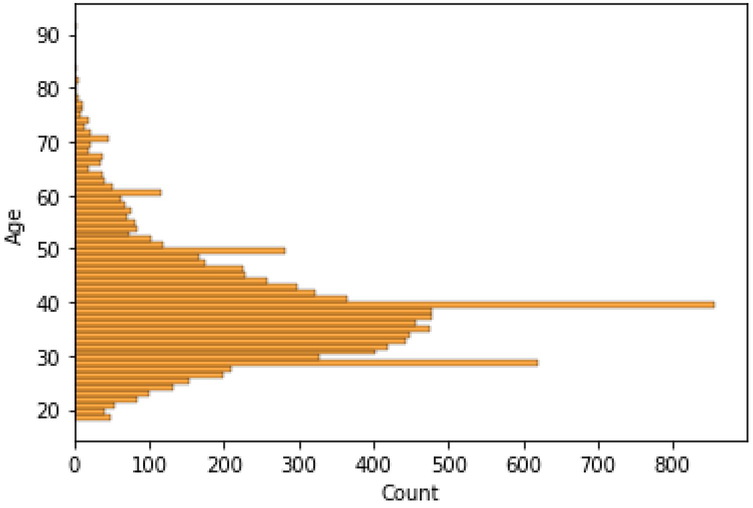
```
sns.displot(df["Age"], color='darkorange')
```

```
<seaborn.axisgrid.FacetGrid at 0x7f36bbc6aa50>
```



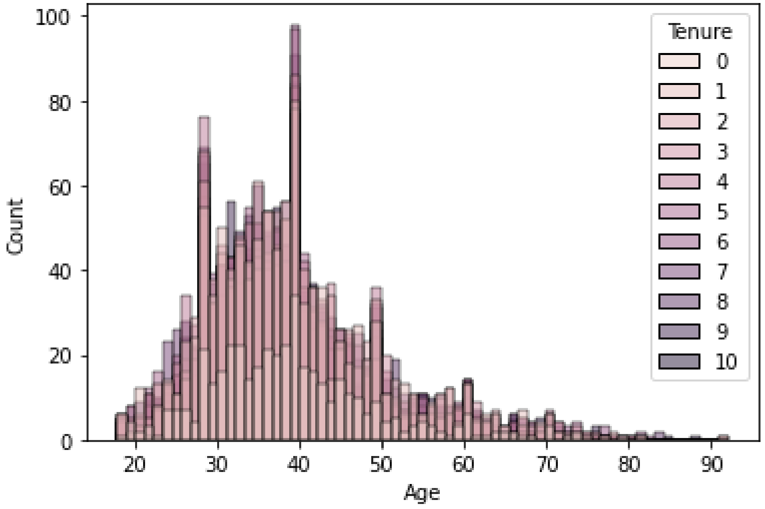
```
sns.histplot(y="Age",data=df,color='darkorange')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b89be150>
```



```
sns.histplot(x='Age',data=df,hue=df['Tenure'])
```

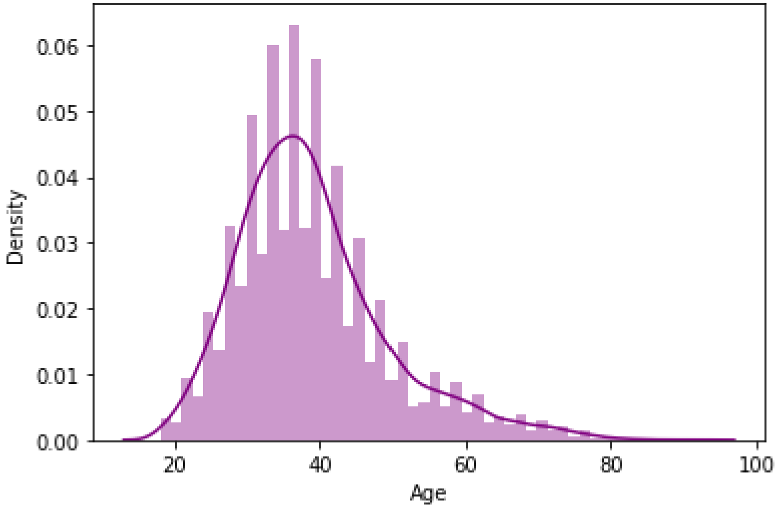
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b8485950>
```



Distplot

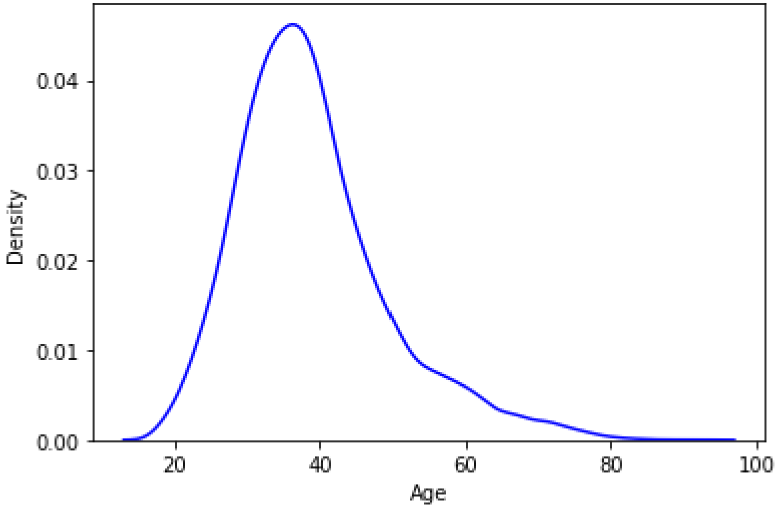
```
sns.distplot(df["Age"],color='purple')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b84ad910>
```



```
sns.distplot(df["Age"],hist=False,color='blue')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b8a9fe90>
```



Box plot

+ Code + Text

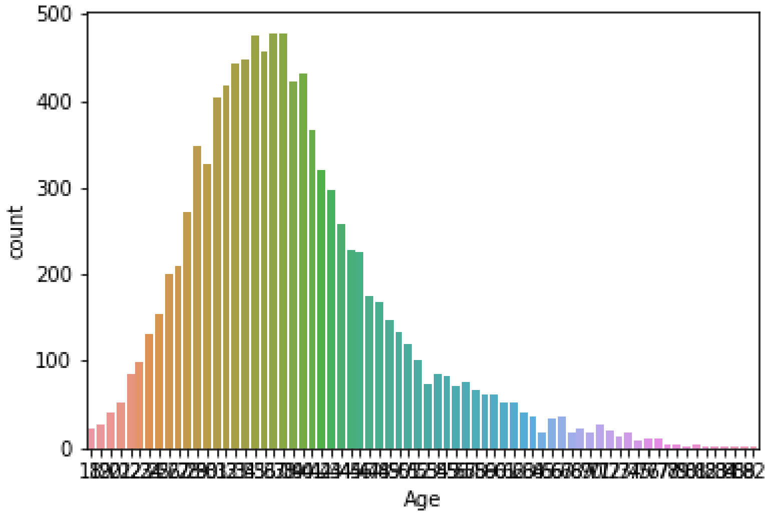
```
sns.boxplot(df["Age"],color='pink')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b7a51890>
```

Count plot

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

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b79139d0>
```

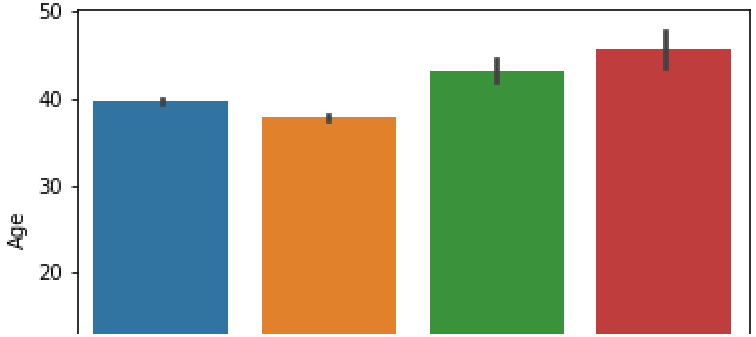


Bivariate analysis

Bar plot

```
sns.barplot(df["NumOfProducts"],df["Age"])
```

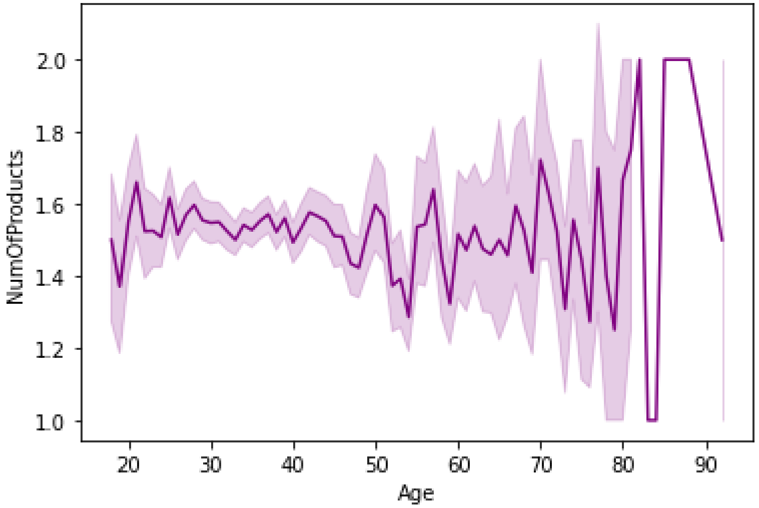
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b7711050>
```



Lineplot

```
sns.lineplot(df["Age"],df["NumOfProducts"], color='purple')
```

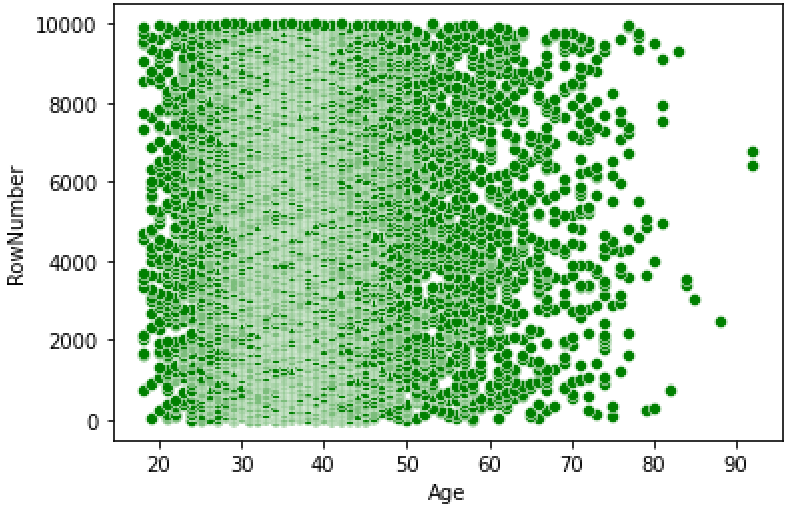
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b7689350>
```



Scatterplot

```
sns.scatterplot(x=df.Age,y=df.RowNumber,color='green')
```

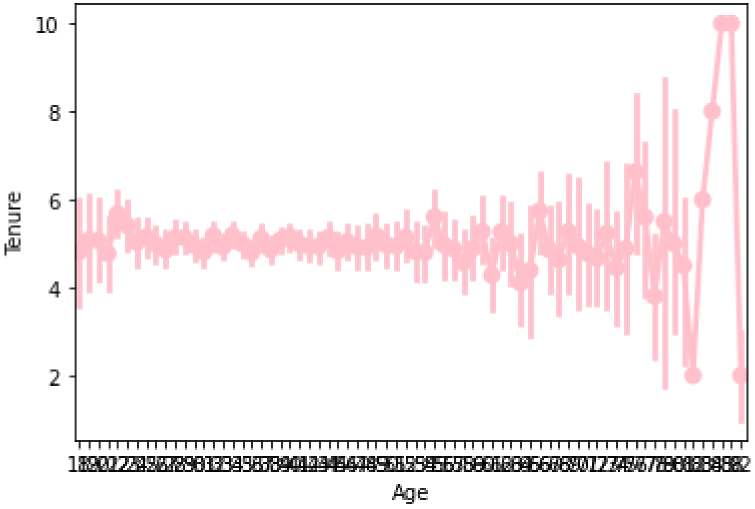
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b7aa9cd0>
```



Pointplot

```
sns.pointplot(x='Age',y='Tenure',data=df,color='pink')
```

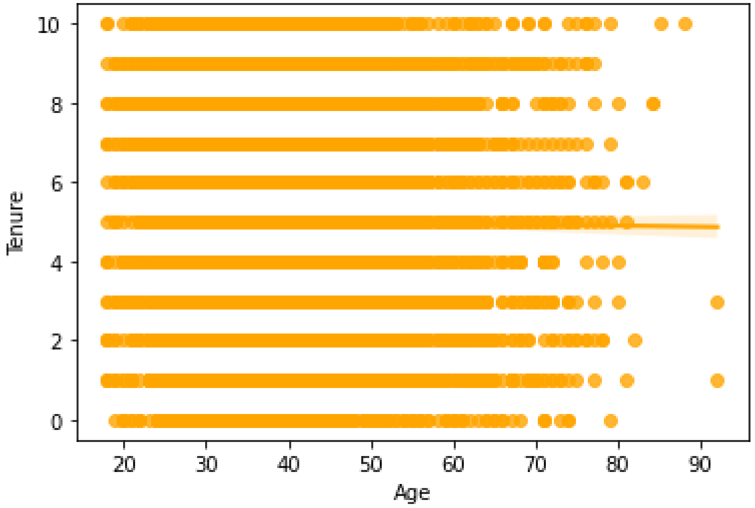
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b7bf8790>
```



Regplot

```
sns.regplot(df['Age'],df['Tenure'],color='orange')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36b5bb7790>
```

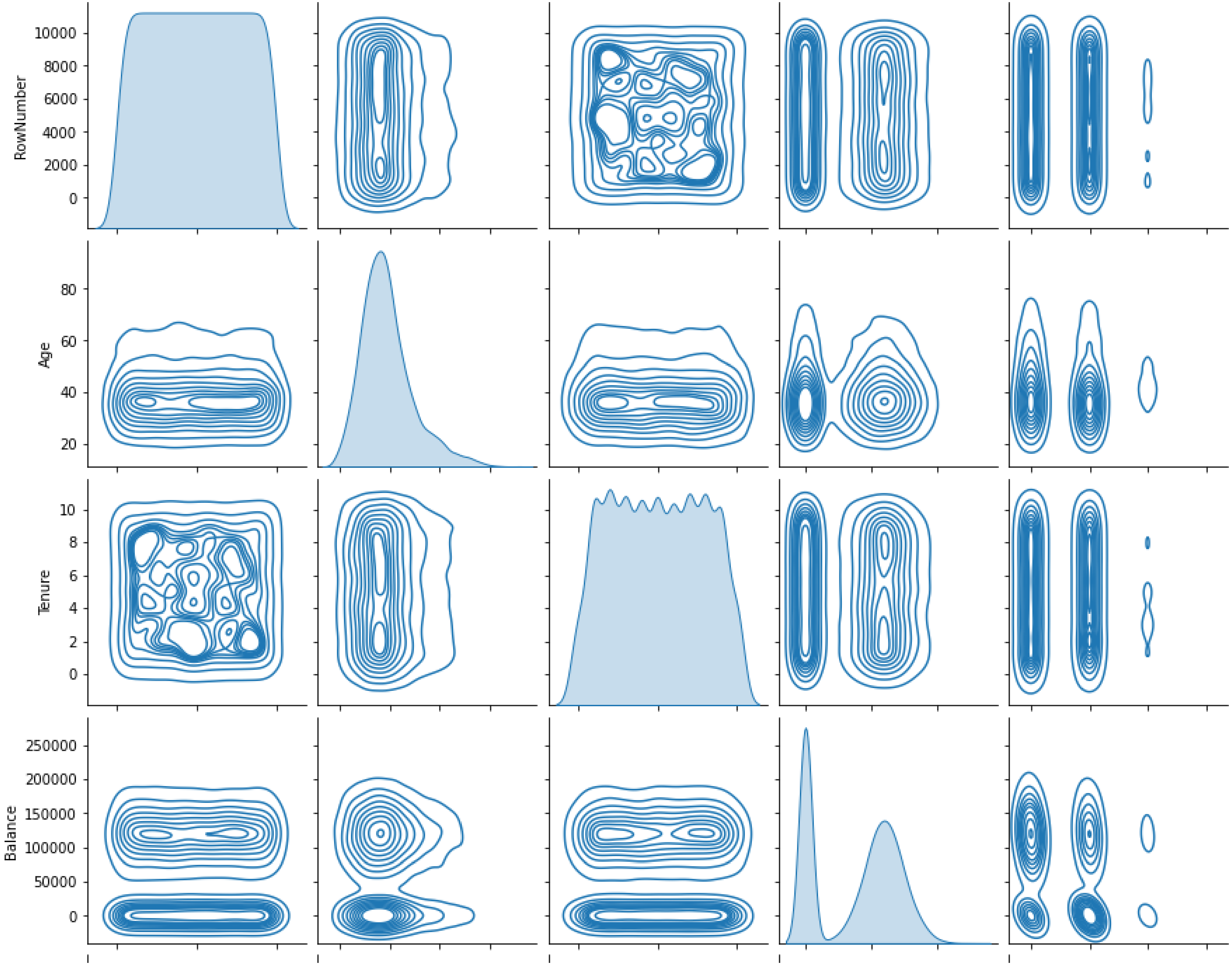


Multi-variate analysis

Pairplot

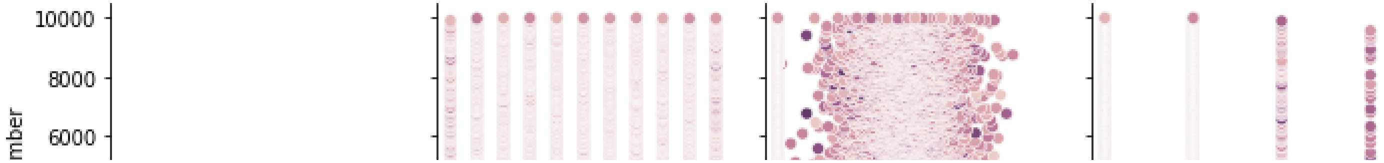
```
sns.pairplot(data=df[["RowNumber","Age","Tenure","Balance","NumOfProducts"]],kind="kde")
```

```
<seaborn.axisgrid.PairGrid at 0x7f36b5aebfd0>
```


RowNumber
10000
8000
6000
4000
2000
0
Age
80
60
40
20
Tenure
10
8
6
4
2
0
Balance
250000
200000
150000
100000
50000
0

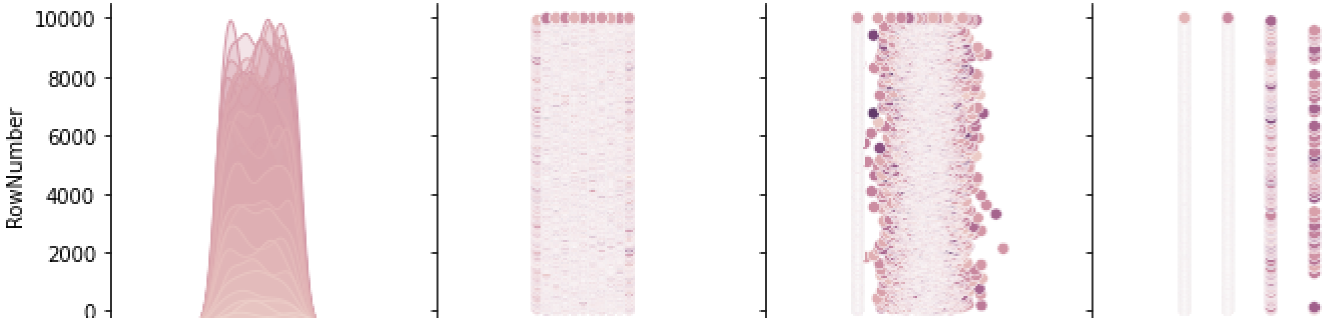
```
sns.pairplot(data=df[["RowNumber","Age","Tenure","Balance","NumOfProducts"]], hue="Age", diag_kind="hist")
```

```
<seaborn.axisgrid.PairGrid at 0x7f36b4c8de90>
```



```
sns.pairplot(data=df[["RowNumber","Age","Tenure","Balance","NumOfProducts"]], hue="Age")
```

```
<seaborn.axisgrid.PairGrid at 0x7f36b48bf190>
```



Descriptive statistics

```
df.describe()
```

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMem
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.00000	10000.000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	1.530200	0.70550	0.515
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	0.581654	0.45584	0.499
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.00000	0.000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.00000	0.000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.00000	1.000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.00000	1.000

Handling the missing values

```
data=pd.DataFrame({"a":[1,2,np.nan],"b":[1,np.nan,np.nan],"c":[1,2,4]})
data
```

	a	b	c
0	1.0	1.0	1
1	2.0	NaN	2
2	NaN	NaN	4

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

```
a     True
b     True
c    False
dtype: bool
```

```
data.isnull().sum()
```

```
a    1
b    2
c    0
dtype: int64
```

```
data.fillna(value = "S")
```

	a	b	c
0	1.0	1.0	1
1	2.0	S	2
2	S	S	4

```
data["a"].mean()
```

```
    1.5
```

```
data["a"].median()
```

```
    1.5
```

Finding and replacing outliers

```
outlierss=df.quantile(q=(0.25,0.75))
```

```
outlierss
```

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

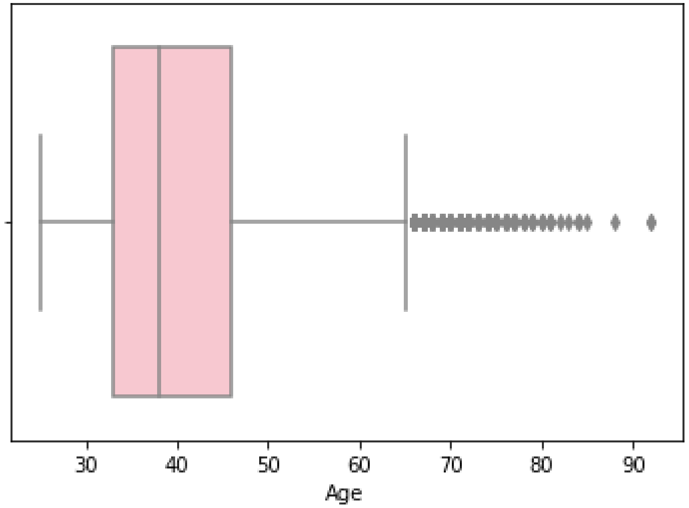
```
sns.boxplot(df["Age"],color='purple')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36ae44cc50>
```

```
df["Age"]=np.where(df["Age"]<25,50,df["Age"])
```

```
sns.boxplot(df["Age"],color='pink')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f36ae421e50>
```



Check for Categorical columns and perform encoding.

```
df.head(4)
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMe
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	

```
df["Gender"].replace({"Female":0,"Male":1},inplace = True)
df["Geography"].replace({"France":1,"Spain":2,"Germany":3},inplace = True)
df["Gender"].replace({"Female":0,"Male":1},inplace = True)
df["Geography"].replace({"France":1,"Spain":2,"Germany":3},inplace = True)
```

```
df.head(4)
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMe
0	1	15634602	Hargrave	619	1	0	42	2	0.00	1	1	
1	2	15647311	Hill	608	2	0	41	1	83807.86	1	0	
2	3	15619304	Onio	502	1	0	42	8	159660.80	3	1	
3	4	15701354	Boni	699	1	0	39	1	0.00	2	0	

Split the data into dependent and independent variables.

```
y = df["Surname"]
```

```
x=df.drop(columns=["Surname"],axis=1)
```

```
x.head()
```

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	Esti
1	2	15647311	608	2	0	41	1	83807.86	1	0	1	

Scale the independent variables

```
names=x.columns
names
```

```
Index(['RowNumber', 'CustomerId', 'CreditScore', 'Geography', 'Gender', 'Age',
       'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard', 'IsActiveMember',
       'EstimatedSalary', 'Exited'],
      dtype='object')
```

```
from sklearn.preprocessing import scale
```

```
X=scale(x)
```

```
X
```

```
array([[-1.73187761, -0.78321342, -0.32622142, ...,  0.97024255,
         0.02188649,  1.97716468],
       [-1.7315312 , -0.60653412, -0.44003595, ...,  0.97024255,
         0.21653375, -0.50577476],
       [-1.73118479, -0.99588476, -1.53679418, ..., -1.03067011,
         0.2406869 ,  1.97716468],
       ...,
       [ 1.73118479, -1.47928179,  0.60498839, ...,  0.97024255,
        -1.00864308,  1.97716468],
       [ 1.7315312 , -0.11935577,  1.25683526, ..., -1.03067011,
        -0.12523071,  1.97716468],
       [ 1.73187761, -0.87055909,  1.46377078, ..., -1.03067011,
        -1.07636976, -0.50577476]])
```

```
x = pd.DataFrame(X,columns = names )
x
```

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiv
0	-1.731878	-0.783213	-0.326221	-0.902587	-1.095988	0.179622	-1.041760	-1.225848	-0.911583	0.646092	0
1	-1.731531	-0.606534	-0.440036	0.301665	-1.095988	0.080092	-1.387538	0.117350	-0.911583	-1.547768	0
2	-1.731185	-0.995885	-1.536794	-0.902587	-1.095988	0.179622	1.032908	1.333053	2.527057	0.646092	-1
3	-1.730838	0.144767	0.501521	-0.902587	-1.095988	-0.118968	-1.387538	-1.225848	0.807737	-1.547768	-1
4	-1.730492	0.652659	2.063884	0.301665	-1.095988	0.279152	-1.041760	0.785728	-0.911583	0.646092	0
...	...	...	...	...	...	...	...	...	...	...	
9995	1.730492	-1.177652	1.246488	-0.902587	0.912419	-0.118968	-0.004426	-1.225848	0.807737	0.646092	-1
9996	1.730838	-1.682806	-1.391939	-0.902587	0.912419	-0.517088	1.724464	-0.306379	-0.911583	0.646092	0
9997	1.731185	-1.479282	0.604988	-0.902587	-1.095988	-0.417558	0.687130	-1.225848	-0.911583	-1.547768	0
9998	1.731531	-0.119356	1.256835	1.505917	0.912419	0.179622	-0.695982	-0.022608	0.807737	0.646092	-1
9999	1.731878	-0.870559	1.463771	-0.902587	-1.095988	-1.213798	-0.350204	0.859965	-0.911583	0.646092	-1

10000 rows × 13 columns

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)

x_train.head()
```

	RowNumber	CustomerId	CreditScore	Geography	Gender	Age	Tenure	B
7389	0.827747	-0.195066	0.170424	0.301665	-1.095988	-0.616618	-0.004426	-1.
9275	1.481077	0.810821	-2.312802	1.505917	0.912419	0.179622	-1.387538	-0.
2995	-0.694379	-1.507642	-1.195351	-0.902587	-1.095988	-1.114268	-1.041760	0.
5316	0.109639	1.243462	0.035916	0.301665	0.912419	-0.019438	-0.004426	0.
356	-1.608556	-1.100775	2.063884	0.301665	-1.095988	1.672571	1.032908	0.

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

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

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