```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import os
```

```
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
file= pd.ExcelFile('Bank_Personal_Loan_Modelling.xlsx')
```

```
description=pd.read_excel(file, 'Description')
df=pd.read_excel(file, 'Data')
```

```
description.head(10)
```

	Unnamed: 0	Unnamed: 1	Unnamed: 2
0	NaN	NaN	NaN
1	NaN	NaN	NaN
2	NaN	NaN	NaN
3	NaN	NaN	NaN
4	NaN	Data Description:	NaN
5	NaN	NaN	NaN
6	NaN	ID	Customer ID
7	NaN	Age	Customer's age in completed years
8	NaN	Experience	#years of professional experience
9	NaN	Income	Annual income of the customer ($000)

```
description.drop('Unnamed: 0',axis=1,inplace=True)
```

```
description.drop(axis=0,index=[0,1,2,3,4],inplace=True)
```

```
description.rename(columns={'Unnamed: 1':'Column Name','Unnamed: 2':'Column Description'}, inplace=True)
```

```
pd.set_option('display.max_colwidth', 0)
print(description)
```

```
           Column Name  \
5   NaN
6   ID
7   Age
8   Experience
9   Income
10  ZIPCode
11  Family
12  CCAvg
13  Education
14  Mortgage
15  Personal Loan
16  Securities Account
17  CD Account
18  Online
19  CreditCard

                                                          Column Description
5   NaN
6   Customer ID
7   Customer's age in completed years
8   #years of professional experience
9   Annual income of the customer ($000)
10  Home Address ZIP code.
11  Family size of the customer
12  Avg. spending on credit cards per month ($000)
13  Education Level. 1: Undergrad; 2: Graduate; 3: Advanced/Professional
14  Value of house mortgage if any. ($000)
15  Did this customer accept the personal loan offered in the last campaign?
16  Does the customer have a securities account with the bank?
17  Does the customer have a certificate of deposit (CD) account with the bank?
18  Does the customer use internet banking facilities?
19  Does the customer use a credit card issued by UniversalBank?
```

```
df.head()
```

	ID	Age	Experience	Income	ZIP Code	Family	CCAvg	Education	Mortgage	Personal Loan	Securities Account	CD Account	Online	CreditCard
0	1	25	1	49	91107	4	1.6	1	0	0	1	0	0	0
1	2	45	19	34	90089	3	1.5	1	0	0	1	0	0	0
2	3	39	15	11	94720	1	1.0	1	0	0	0	0	0	0
3	4	35	9	100	94112	1	2.7	2	0	0	0	0	0	0
4	5	35	8	45	91330	4	1.0	2	0	0	0	0	0	1

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 14 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   ID                  5000 non-null   int64  
 1   Age                 5000 non-null   int64  
 2   Experience          5000 non-null   int64  
 3   Income              5000 non-null   int64  
 4   ZIP Code            5000 non-null   int64  
 5   Family              5000 non-null   int64  
 6   CCAvg               5000 non-null   float64
 7   Education           5000 non-null   int64  
 8   Mortgage            5000 non-null   int64  
 9   Personal Loan       5000 non-null   int64  
 10  Securities Account  5000 non-null   int64  
 11  CD Account          5000 non-null   int64  
 12  Online              5000 non-null   int64  
 13  CreditCard          5000 non-null   int64  
dtypes: float64(1), int64(13)
memory usage: 547.0 KB
```

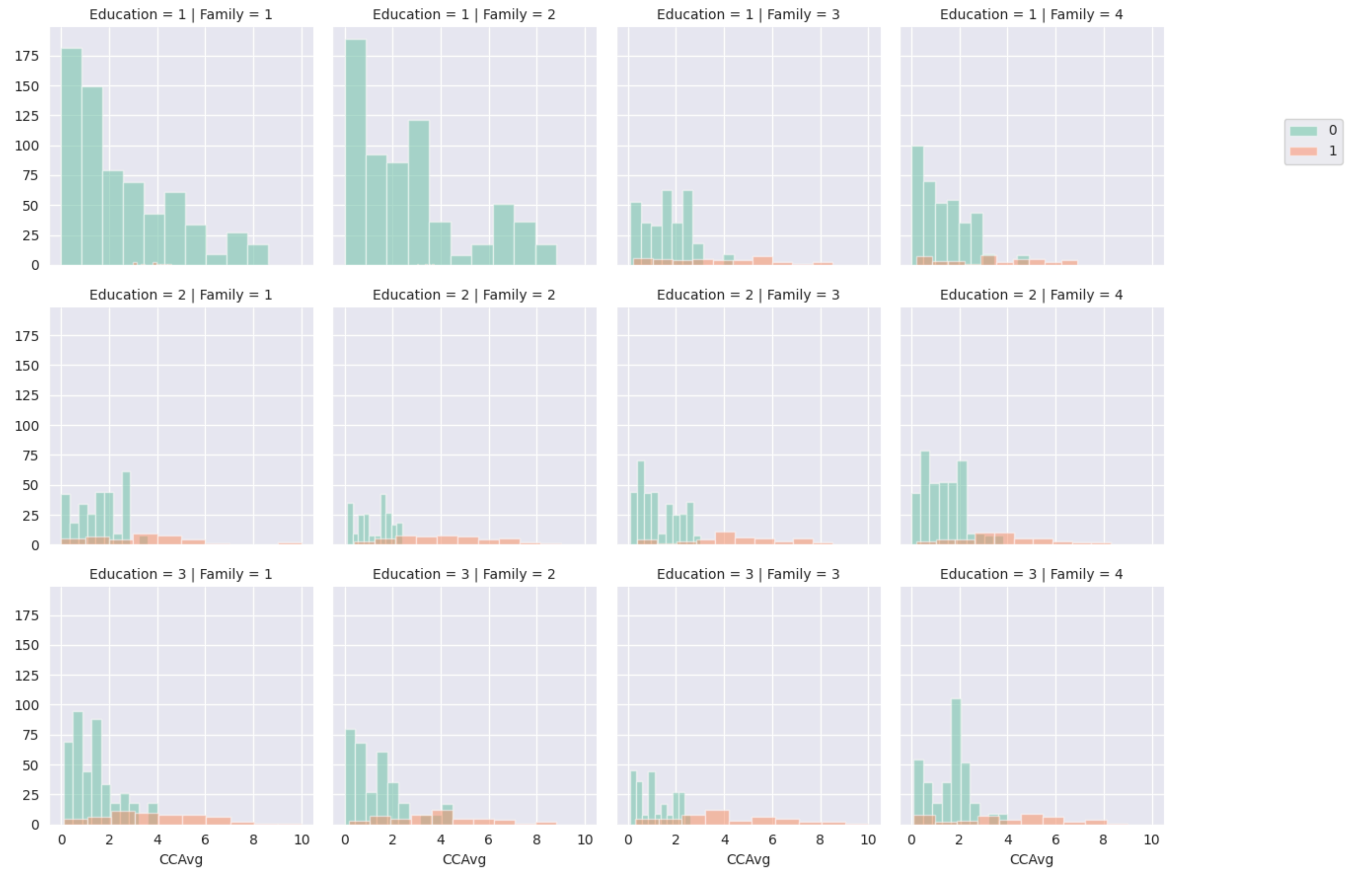
```
df.describe()
```

	ID	Age	Experience	Income	ZIP Code	Family	CCAvg	Education	Mortgage	Personal Loan
count	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000
mean	2500.500000	45.338400	20.104600	73.774200	93152.503000	2.396400	1.937913	1.881000	56.498800	0.096000
std	1443.520003	11.463166	11.467954	46.033729	2121.852197	1.147663	1.747666	0.839869	101.713802	0.294621
min	1.000000	23.000000	-3.000000	8.000000	9307.000000	1.000000	0.000000	1.000000	0.000000	0.000000
25%	1250.750000	35.000000	10.000000	39.000000	91911.000000	1.000000	0.700000	1.000000	0.000000	0.000000
50%	2500.500000	45.000000	20.000000	64.000000	93437.000000	2.000000	1.500000	2.000000	0.000000	0.000000
75%	3750.250000	55.000000	30.000000	98.000000	94608.000000	3.000000	2.500000	3.000000	101.000000	0.000000
max	5000.000000	67.000000	43.000000	224.000000	96651.000000	4.000000	10.000000	3.000000	635.000000	1.000000

```
df_loan_accept=df[df['Personal Loan']==1]
```

```
sns.set_style('darkgrid')
g=sns.FacetGrid(df,row='Education',col='Family',hue='Personal Loan',palette='Set2')
g=g.map(plt.hist, 'CCAvg', alpha=0.5)
plt.legend(bbox_to_anchor=(1.7,3))
```

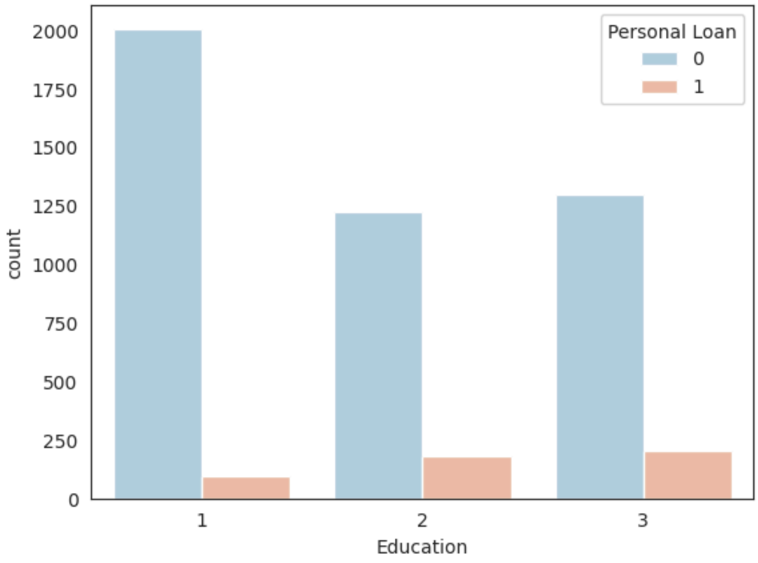
```
<matplotlib.legend.Legend at 0x7d5a6a695c90>
```



It can be inferred that usually Undergraduates with a small family donot tend apply for a loan.

```
sns.set_style('white')
sns.countplot(data=df,x='Education',hue='Personal Loan',palette='RdBu_r')
```

```
<Axes: xlabel='Education', ylabel='count'>
```

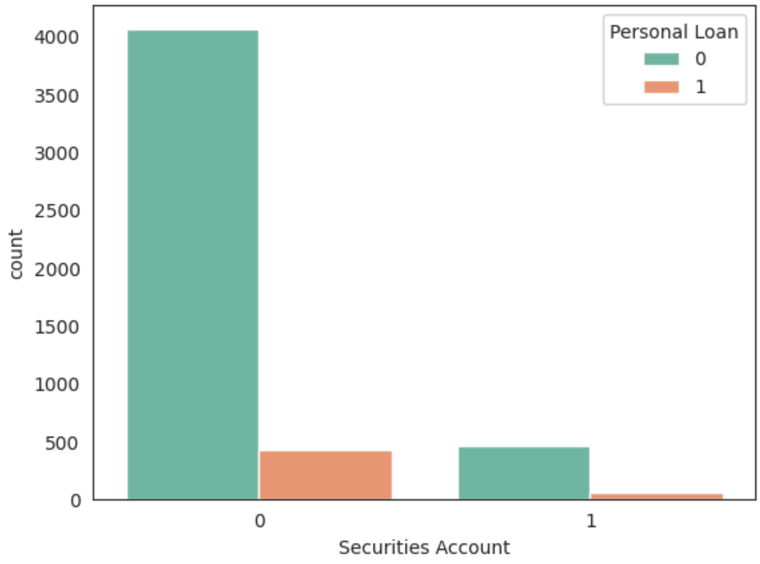


Most of the loan applicants are Professionals

The value of house mortagage for the non-applicants is much lower than that of applicants. This could be a possible reason for them not applying for a loan or not finding a policy based on there need.

```
sns.set_style('white')
sns.countplot(data=df,x='Securities Account',hue='Personal Loan',palette='Set2')
```

```
<Axes: xlabel='Securities Account', ylabel='count'>
```



It is clear that very few loan applicants have a securities account.

Using Decision Tree algorithm to predict the nature of loan acceptance

```
df.columns
```

```
Index(['ID', 'Age', 'Experience', 'Income', 'ZIP Code', 'Family', 'CCAvg',
       'Education', 'Mortgage', 'Personal Loan', 'Securities Account',
       'CD Account', 'Online', 'CreditCard'],
      dtype='object')
```

```
X=pd.DataFrame(columns=['Age','Experience','Income','Family','CCAvg','Education','Mortgage','Securities Account','CD Account','CreditCar
```

```
y=df['Personal Loan']
```

```
from sklearn.model_selection import train_test_split
```

```
X_train, X_test, y_train, y_test= train_test_split(X,y)
```

```
from sklearn.tree import DecisionTreeClassifier
```

```
dtree= DecisionTreeClassifier(max_leaf_nodes=3)
```

```
dtree.fit(X_train,y_train)
```

```
▾      DecisionTreeClassifier
DecisionTreeClassifier(max_leaf_nodes=3)
```

```
predictions= dtree.predict(X_test)
```

```
from sklearn.metrics import classification_report, confusion_matrix
```

```
print(classification_report(y_test,predictions))
```

```
              precision    recall  f1-score   support

           0       0.97      0.99      0.98      1119
           1       0.92      0.76      0.83       131

    accuracy                           0.97      1250
   macro avg       0.95      0.88      0.91      1250
weighted avg       0.97      0.97      0.97      1250
```

```
print(confusion_matrix(y_test,predictions))
```

```
[[1110    9]
 [  31  100]]
```

```
plt.figure(figsize=(9,7))
sns.distplot(y_test-predictions)
```

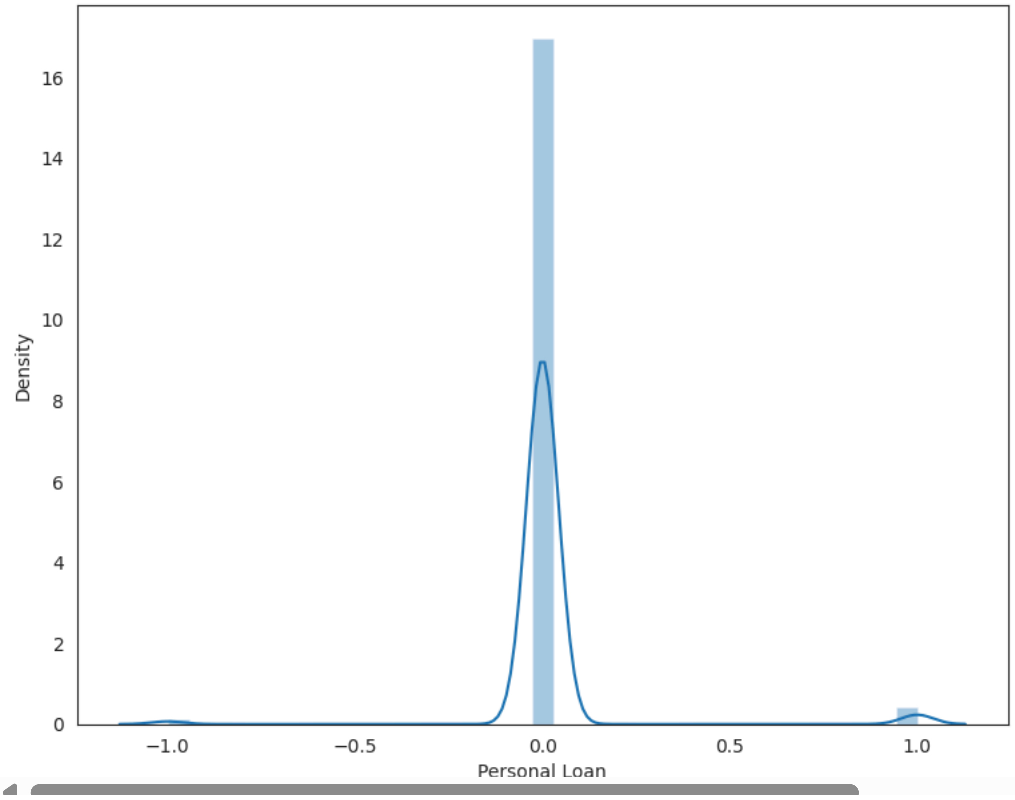
```
<ipython-input-31-629d0160bc60>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(y_test-predictions)
<Axes: xlabel='Personal Loan', ylabel='Density'>
```


Density
Personal Loan