# rd-fraud-detection-codsoft-task-3

October 30, 2023

**Credit Card Fraud Detection - Giriraju B**

Importing libraries

[150]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
```

[151]:
```
df=pd.read_csv('/content/creditcard.csv')
df.head()
```

[151]:

| | Time | V1 | V2 | V3 | V4 | V5 | V6 | V7 | \ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.0 | -1.359807 | -0.072781 | 2.536347 | 1.378155 | -0.338321 | 0.462388 | 0.239599 | |
| 1 | 0.0 | 1.191857 | 0.266151 | 0.166480 | 0.448154 | 0.060018 | -0.082361 | -0.078803 | |
| 2 | 1.0 | -1.358354 | -1.340163 | 1.773209 | 0.379780 | -0.503198 | 1.800499 | 0.791461 | |
| 3 | 1.0 | -0.966272 | -0.185226 | 1.792993 | -0.863291 | -0.010309 | 1.247203 | 0.237609 | |
| 4 | 2.0 | -1.158233 | 0.877737 | 1.548718 | 0.403034 | -0.407193 | 0.095921 | 0.592941 | |

| | V8 | V9 | … | V21 | V22 | V23 | V24 | V25 | \ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.098698 | 0.363787 | … | -0.018307 | 0.277838 | -0.110474 | 0.066928 | 0.128539 | |
| 1 | 0.085102 | -0.255425 | … | -0.225775 | -0.638672 | 0.101288 | -0.339846 | 0.167170 | |
| 2 | 0.247676 | -1.514654 | … | 0.247998 | 0.771679 | 0.909412 | -0.689281 | -0.327642 | |
| 3 | 0.377436 | -1.387024 | … | -0.108300 | 0.005274 | -0.190321 | -1.175575 | 0.647376 | |
| 4 | -0.270533 | 0.817739 | … | -0.009431 | 0.798278 | -0.137458 | 0.141267 | -0.206010 | |

| | V26 | V27 | V28 | Amount | Class |
|---|---|---|---|---|---|
| 0 | -0.189115 | 0.133558 | -0.021053 | 149.62 | 0 |
| 1 | 0.125895 | -0.008983 | 0.014724 | 2.69 | 0 |
| 2 | -0.139097 | -0.055353 | -0.059752 | 378.66 | 0 |
| 3 | -0.221929 | 0.062723 | 0.061458 | 123.50 | 0 |
| 4 | 0.502292 | 0.219422 | 0.215153 | 69.99 | 0 |

[5 rows x 31 columns]

[152]:
```
df.tail()
```

[152]:

```
            Time         V1         V2        V3        V4        V5  \
284802  172786.0 -11.881118  10.071785 -9.834783 -2.066656 -5.364473
284803  172787.0  -0.732789  -0.055080  2.035030 -0.738589  0.868229
284804  172788.0   1.919565  -0.301254 -3.249640 -0.557828  2.630515
284805  172788.0  -0.240440   0.530483  0.702510  0.689799 -0.377961
284806  172792.0  -0.533413  -0.189733  0.703337 -0.506271 -0.012546

               V6        V7        V8        V9  …       V21       V22  \
284802 -2.606837 -4.918215  7.305334  1.914428  …  0.213454  0.111864
284803  1.058415  0.024330  0.294869  0.584800  …  0.214205  0.924384
284804  3.031260 -0.296827  0.708417  0.432454  …  0.232045  0.578229
284805  0.623708 -0.686180  0.679145  0.392087  …  0.265245  0.800049
284806 -0.649617  1.577006 -0.414650  0.486180  …  0.261057  0.643078

              V23       V24       V25       V26       V27       V28  Amount  \
284802  1.014480 -0.509348  1.436807  0.250034  0.943651  0.823731    0.77
284803  0.012463 -1.016226 -0.606624 -0.395255  0.068472 -0.053527   24.79
284804 -0.037501  0.640134  0.265745 -0.087371  0.004455 -0.026561   67.88
284805 -0.163298  0.123205 -0.569159  0.546668  0.108821  0.104533   10.00
284806  0.376777  0.008797 -0.473649 -0.818267 -0.002415  0.013649  217.00

        Class
284802      0
284803      0
284804      0
284805      0
284806      0

[5 rows x 31 columns]
```

[153]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 284807 entries, 0 to 284806
Data columns (total 31 columns):
 #   Column  Non-Null Count   Dtype
---  ------  --------------   -----
 0   Time    284807 non-null  float64
 1   V1      284807 non-null  float64
 2   V2      284807 non-null  float64
 3   V3      284807 non-null  float64
 4   V4      284807 non-null  float64
 5   V5      284807 non-null  float64
 6   V6      284807 non-null  float64
 7   V7      284807 non-null  float64
```

```
 8   V8      284807 non-null  float64
 9   V9      284807 non-null  float64
 10  V10     284807 non-null  float64
 11  V11     284807 non-null  float64
 12  V12     284807 non-null  float64
 13  V13     284807 non-null  float64
 14  V14     284807 non-null  float64
 15  V15     284807 non-null  float64
 16  V16     284807 non-null  float64
 17  V17     284807 non-null  float64
 18  V18     284807 non-null  float64
 19  V19     284807 non-null  float64
 20  V20     284807 non-null  float64
 21  V21     284807 non-null  float64
 22  V22     284807 non-null  float64
 23  V23     284807 non-null  float64
 24  V24     284807 non-null  float64
 25  V25     284807 non-null  float64
 26  V26     284807 non-null  float64
 27  V27     284807 non-null  float64
 28  V28     284807 non-null  float64
 29  Amount  284807 non-null  float64
 30  Class   284807 non-null  int64
dtypes: float64(30), int64(1)
memory usage: 67.4 MB
```

[154]:
```
df.isnull().sum()
```

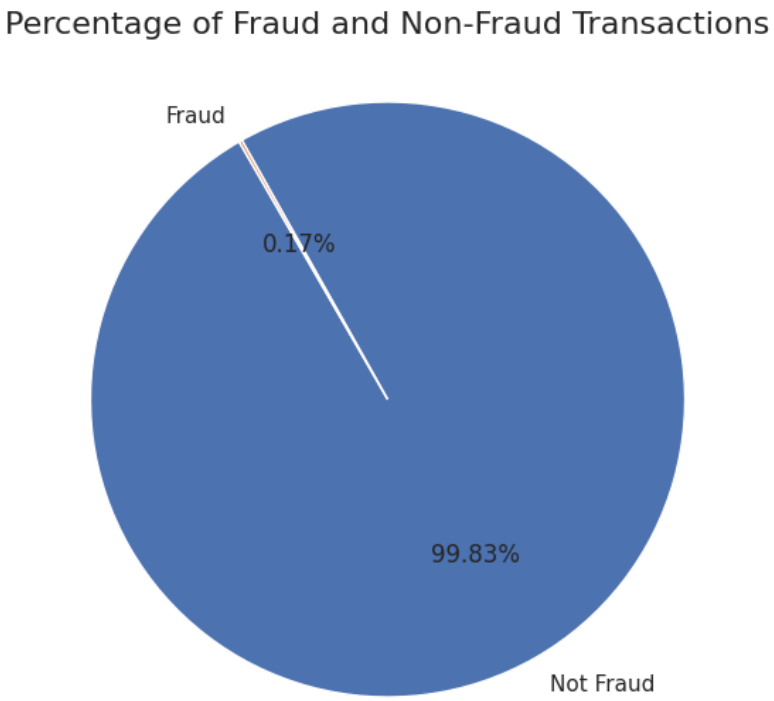
[154]:
```
Time      0
V1        0
V2        0
V3        0
V4        0
V5        0
V6        0
V7        0
V8        0
V9        0
V10       0
V11       0
V12       0
V13       0
V14       0
V15       0
V16       0
V17       0
V18       0
```

```
V19       0
V20       0
V21       0
V22       0
V23       0
V24       0
V25       0
V26       0
V27       0
V28       0
Amount    0
Class     0
dtype: int64
```

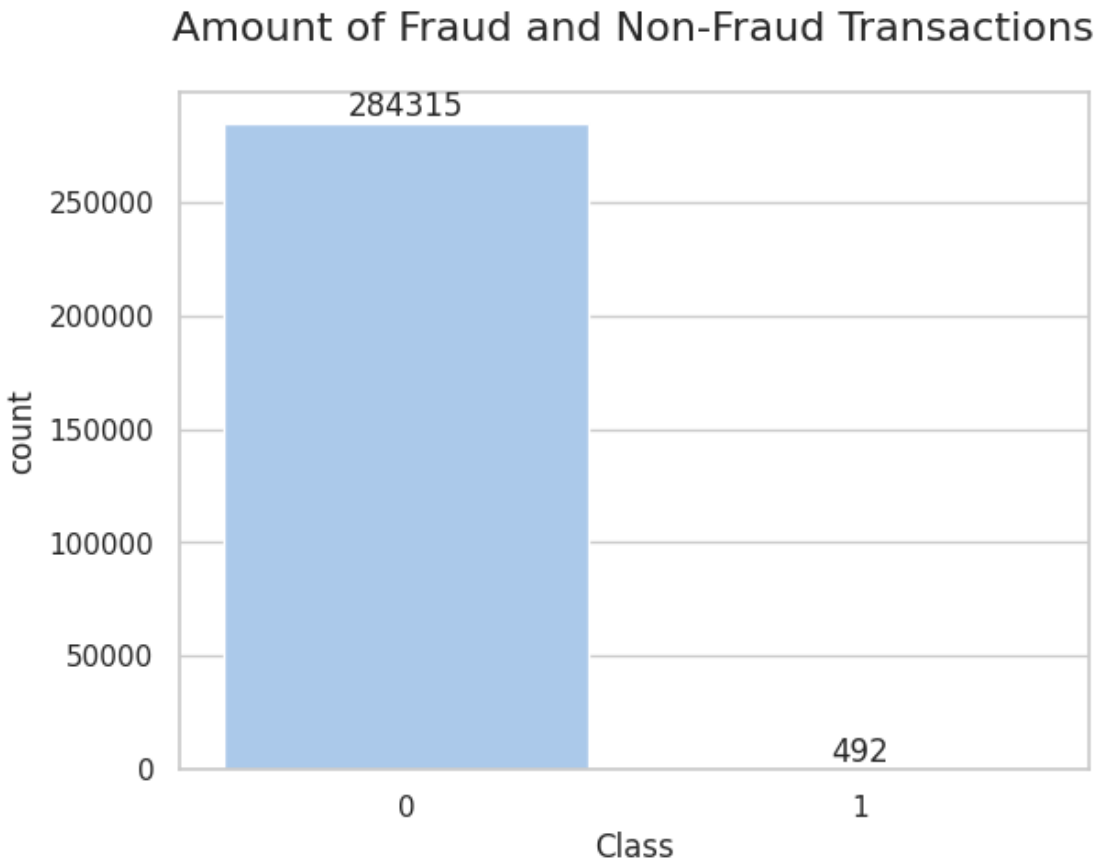
[155]:
```
df['Class'].value_counts()
```

[155]:
```
0    284315
1       492
Name: Class, dtype: int64
```

[156]:
```
labels = 'Not Fraud', 'Fraud'
sizes = [df.Class[df['Class'] == 0].count(), df.Class[df['Class'] == 1].count()]
fig1, ax1 = plt.subplots(figsize=(10, 6))
ax1.pie(sizes, labels=labels, autopct='%1.2f%%', shadow=False, startangle=120)
ax1.axis('equal')
title = "Percentage of Fraud and Non-Fraud Transactions"
plt.title(title, size=16, pad=20)
plt.show()
```




[157]:
```
sns.set(style="whitegrid")
ax = sns.countplot(x='Class', data=df, order=[0, 1], label='Count',␣
 ↪palette='pastel')
counts = df['Class'].value_counts()
for i, count in enumerate(counts):
    ax.text(i, count, str(count), ha='center', va='bottom', fontsize=12)
title = "Amount of Fraud and Non-Fraud Transactions"
ax.set_title(title, size=16)
plt.title(title, size=16, pad=20)
plt.show()
```




This is highly unbalanced. 0 is Normal transaction and 1 is Fraudlent Transaction

[158]:
```
Legit=df[df.Class==0]
Fraud=df[df.Class==1]
```

[159]:
```
print(Legit.shape)
print(Fraud.shape)
```

```
(284315, 31)
(492, 31)
```

[184]:
```
sns.distplot(df['Time'])
plt.show()
```

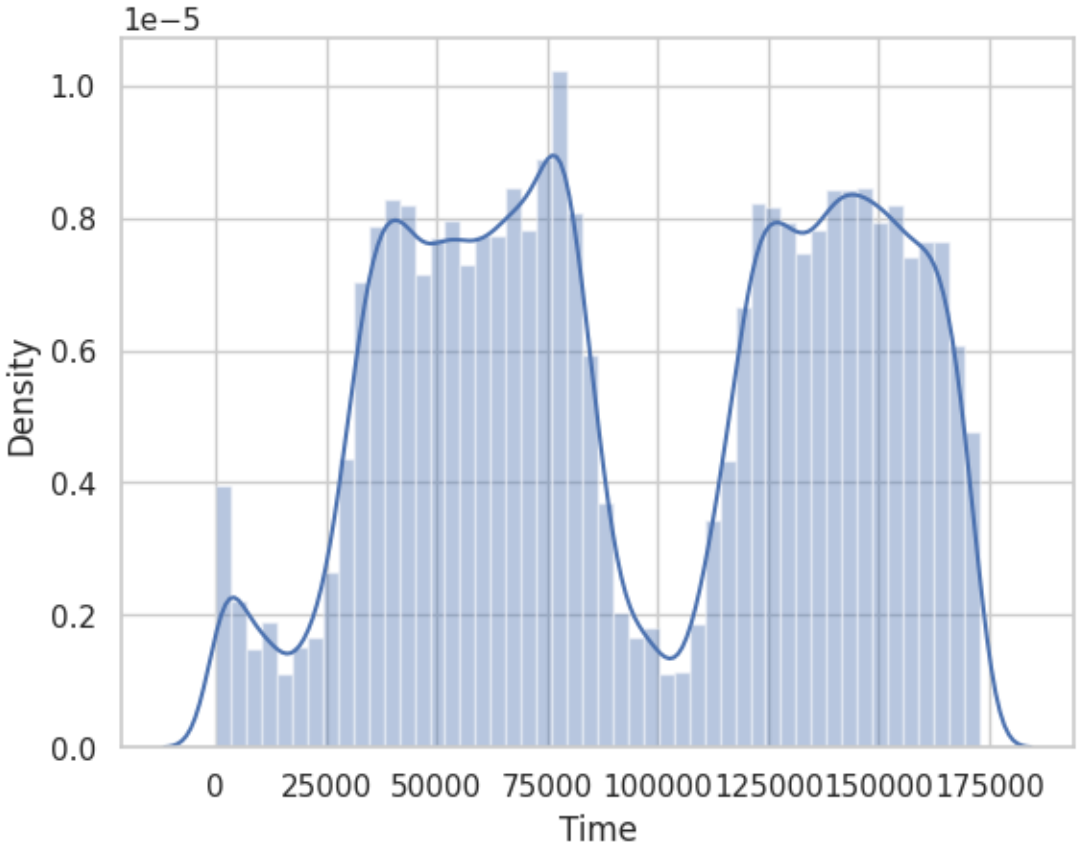
```
<ipython-input-184-8730e128497f>:1: UserWarning:

`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(df['Time'])
```




[160]:
```
Legit.Amount.describe()
```

[160]:
```
count    284315.000000
mean         88.291022
std         250.105092
min           0.000000
25%           5.650000
50%          22.000000
75%          77.050000
max       25691.160000
Name: Amount, dtype: float64
```

[161]:
```
Fraud.Amount.describe()
```

[161]:
```
count     492.000000
mean      122.211321
std       256.683288
min         0.000000
25%         1.000000
50%         9.250000
75%       105.890000
max      2125.870000
Name: Amount, dtype: float64
```

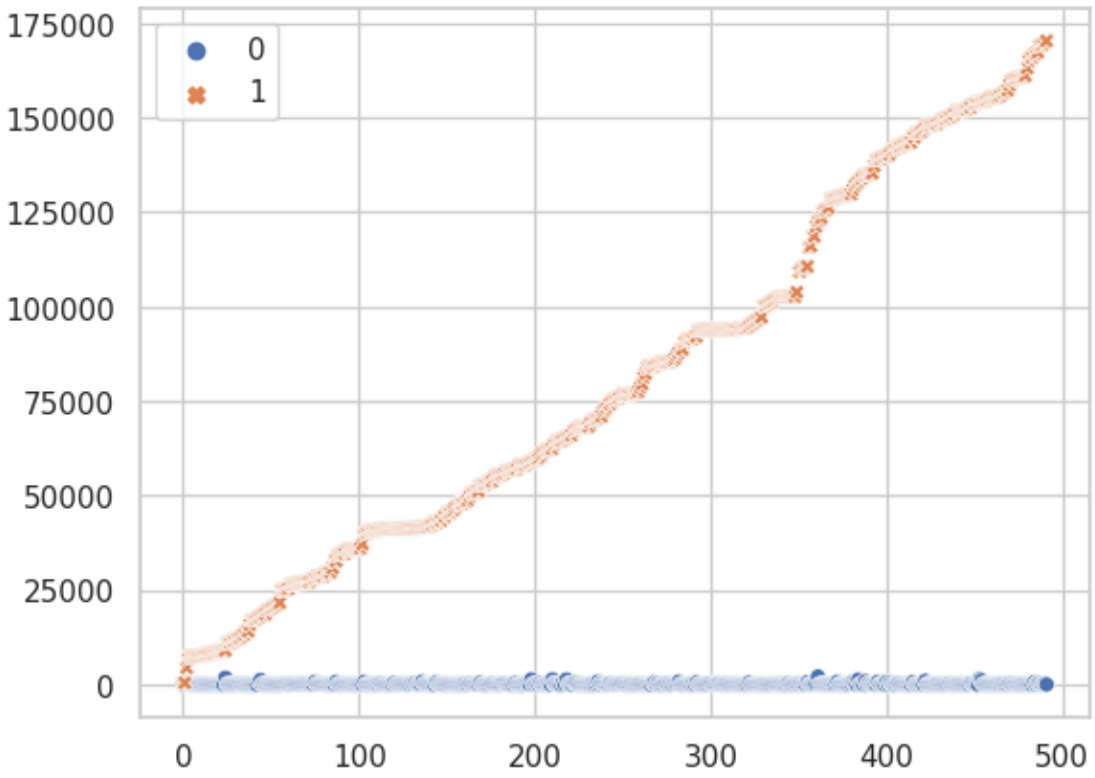
[162]:
```
df.groupby('Class').mean()
```

[162]:

| Class | Time | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 | V9 | … | V20 | V21 | V22 | V23 | V24 | V25 | V26 | V27 | V28 | Amount |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 94838.202258 | 0.008258 | -0.006271 | 0.012171 | -0.007860 | 0.005453 | 0.002419 | 0.009637 | -0.000987 | 0.004467 | … | -0.000644 | -0.001235 | -0.000024 | 0.000070 | 0.000182 | -0.000072 | -0.000089 | -0.000295 | -0.000131 | 88.291022 |
| 1 | 80746.806911 | -4.771948 | 3.623778 | -7.033281 | 4.542029 | -3.151225 | -1.397737 | -5.568731 | 0.570636 | -2.581123 | … | 0.372319 | 0.713588 | 0.014049 | -0.040308 | -0.105130 | 0.041449 | 0.051648 | 0.170575 | 0.075667 | 122.211321 |

[2 rows x 30 columns]

[183]:
```
sns.scatterplot(df[df['Class']==1][['Amount','Time']].values)
plt.show()
```




### Equaling the Fraud & Legit numbers

[163]:
```
Legit_sample=Legit.sample(n=492)
```

### Contatenating Two Dataframes

[164]:
```
df.new=pd.concat([Legit_sample,Fraud],axis=0)
```

```
<ipython-input-164-31066150e47b>:1: UserWarning: Pandas doesn't allow columns to
be created via a new attribute name - see https://pandas.pydata.org/pandas-
docs/stable/indexing.html#attribute-access
  df.new=pd.concat([Legit_sample,Fraud],axis=0)
```

### Normal Transaction

[165]:
```
df.new.head()
```

[165]:

| | Time | V1 | V2 | V3 | V4 | V5 | V6 | \ |
|---|---|---|---|---|---|---|---|---|
| 25542 | 33659.0 | 0.768339 | -1.528915 | 0.671929 | -0.784746 | -1.751015 | -0.488586 | |
| 158281 | 111113.0 | 2.105250 | 0.185232 | -1.394275 | 0.307472 | 0.541140 | -0.681034 | |
| 162569 | 115219.0 | 2.110837 | -1.115878 | 0.380569 | -0.775945 | -1.647459 | -0.257212 | |
| 252408 | 155793.0 | 2.067731 | 0.177746 | -1.684627 | 0.423875 | 0.430133 | -0.890014 | |
| 278725 | 168388.0 | 1.991229 | -0.032907 | -2.047936 | 0.153355 | 0.634608 | -0.323808 | |

```
              V7        V8        V9  …       V21       V22       V23  \
25542  -0.500464  0.014844  2.531866  …  0.133782  0.291348 -0.359974
158281  0.166989 -0.441286  1.831992  …  0.112498  0.793382 -0.027106
162569 -1.577400  0.026295  0.441391  …  0.442233  1.457486  0.177474
252408  0.215259 -0.260619  0.434835  … -0.356530 -0.909479  0.336941
278725  0.058439 -0.083924  0.762592  … -0.243854 -0.494031  0.023766

              V24       V25       V26       V27       V28  Amount  Class
25542   0.489697  0.526475  0.147203  0.007573  0.059866  249.00      0
158281  0.476600  0.416848 -0.480340 -0.013822 -0.052981    1.00      0
162569 -0.011693 -0.380001 -0.088345  0.068258 -0.029552    9.99      0
252408  0.578458 -0.250807  0.168091 -0.060726 -0.028844    4.49      0
278725 -1.211285  0.033012 -0.043332 -0.008892 -0.033804   35.38      0

[5 rows x 31 columns]
```

**Fraudlent Transaction**

[166]:
```
df.new.tail()
```

[166]:
```
             Time        V1        V2        V3        V4        V5        V6  \
279863  169142.0 -1.927883  1.125653 -4.518331  1.749293 -1.566487 -2.010494
280143  169347.0  1.378559  1.289381 -5.004247  1.411850  0.442581 -1.326536
280149  169351.0 -0.676143  1.126366 -2.213700  0.468308 -1.120541 -0.003346
281144  169966.0 -3.113832  0.585864 -5.399730  1.817092 -0.840618 -2.943548
281674  170348.0  1.991976  0.158476 -2.583441  0.408670  1.151147 -0.096695

              V7        V8        V9  …       V21       V22       V23  \
279863 -0.882850  0.697211 -2.064945  …  0.778584 -0.319189  0.639419
280143 -1.413170  0.248525 -1.127396  …  0.370612  0.028234 -0.145640
280149 -2.234739  1.210158 -0.652250  …  0.751826  0.834108  0.190944
281144 -2.208002  1.058733 -1.632333  …  0.583276 -0.269209 -0.456108
281674  0.223050 -0.068384  0.577829  … -0.164350 -0.295135 -0.072173

              V24       V25       V26       V27       V28  Amount  Class
279863 -0.294885  0.537503  0.788395  0.292680  0.147968  390.00      1
280143 -0.081049  0.521875  0.739467  0.389152  0.186637    0.76      1
280149  0.032070 -0.739695  0.471111  0.385107  0.194361   77.89      1
281144 -0.183659 -0.328168  0.606116  0.884876 -0.253700  245.00      1
281674 -0.450261  0.313267 -0.289617  0.002988 -0.015309   42.53      1

[5 rows x 31 columns]
```

[167]:
```
df.new["Class"].value_counts()
```

[167]:
```
0    492
1    492
Name: Class, dtype: int64
```

[168]:
```
df.new.groupby('Class').mean()
```

[168]:
```
                Time        V1        V2        V3        V4        V5  \
Class
0      92404.668699 -0.097676 -0.017284 -0.021619  0.003334 -0.023866
1      80746.806911 -4.771948  3.623778 -7.033281  4.542029 -3.151225

             V6        V7        V8        V9  …       V20       V21  \
Class                                          …
0     -0.085432  0.005330 -0.064021 -0.011526  … -0.021644 -0.079637
1     -1.397737 -5.568731  0.570636 -2.581123  …  0.372319  0.713588

            V22       V23       V24       V25       V26       V27       V28  \
Class
0      0.045524 -0.053218  0.029643  0.000817  0.003066  0.023885  0.017528
1      0.014049 -0.040308 -0.105130  0.041449  0.051648  0.170575  0.075667

           Amount
Class
0       95.477276
1      122.211321

[2 rows x 30 columns]
```

Splitting the datas into Features and Targets

[169]:
```
X= df.new.drop(columns='Class',axis=1)
Y= df.new['Class']
```

[170]:
```
print(X)
```

```
            Time        V1        V2        V3        V4        V5        V6  \
25542    33659.0  0.768339 -1.528915  0.671929 -0.784746 -1.751015 -0.488586
158281  111113.0  2.105250  0.185232 -1.394275  0.307472  0.541140 -0.681034
162569  115219.0  2.110837 -1.115878  0.380569 -0.775945 -1.647459 -0.257212
252408  155793.0  2.067731  0.177746 -1.684627  0.423875  0.430133 -0.890014
278725  168388.0  1.991229 -0.032907 -2.047936  0.153355  0.634608 -0.323808
…            …         …         …         …         …         …         …
279863  169142.0 -1.927883  1.125653 -4.518331  1.749293 -1.566487 -2.010494
280143  169347.0  1.378559  1.289381 -5.004247  1.411850  0.442581 -1.326536
280149  169351.0 -0.676143  1.126366 -2.213700  0.468308 -1.120541 -0.003346
281144  169966.0 -3.113832  0.585864 -5.399730  1.817092 -0.840618 -2.943548
281674  170348.0  1.991976  0.158476 -2.583441  0.408670  1.151147 -0.096695
```

```
              V7        V8        V9  …       V20       V21       V22  \
25542  -0.500464  0.014844  2.531866  …  0.334264  0.133782  0.291348
158281  0.166989 -0.441286  1.831992  … -0.166055  0.112498  0.793382
162569 -1.577400  0.026295  0.441391  …  0.066605  0.442233  1.457486
252408  0.215259 -0.260619  0.434835  … -0.127504 -0.356530 -0.909479
278725  0.058439 -0.083924  0.762592  … -0.064723 -0.243854 -0.494031
…            …         …       …  …         …         …         …
279863 -0.882850  0.697211 -2.064945  …  1.252967  0.778584 -0.319189
280143 -1.413170  0.248525 -1.127396  …  0.226138  0.370612  0.028234
280149 -2.234739  1.210158 -0.652250  …  0.247968  0.751826  0.834108
281144 -2.208002  1.058733 -1.632333  …  0.306271  0.583276 -0.269209
281674  0.223050 -0.068384  0.577829  … -0.017652 -0.164350 -0.295135

              V23       V24       V25       V26       V27       V28  Amount
25542  -0.359974  0.489697  0.526475  0.147203  0.007573  0.059866  249.00
158281 -0.027106  0.476600  0.416848 -0.480340 -0.013822 -0.052981    1.00
162569  0.177474 -0.011693 -0.380001 -0.088345  0.068258 -0.029552    9.99
252408  0.336941  0.578458 -0.250807  0.168091 -0.060726 -0.028844    4.49
278725  0.023766 -1.211285  0.033012 -0.043332 -0.008892 -0.033804   35.38
…            …         …         …         …         …         …       …
279863  0.639419 -0.294885  0.537503  0.788395  0.292680  0.147968  390.00
280143 -0.145640 -0.081049  0.521875  0.739467  0.389152  0.186637    0.76
280149  0.190944  0.032070 -0.739695  0.471111  0.385107  0.194361   77.89
281144 -0.456108 -0.183659 -0.328168  0.606116  0.884876 -0.253700  245.00
281674 -0.072173 -0.450261  0.313267 -0.289617  0.002988 -0.015309   42.53

[984 rows x 30 columns]
```

[171]:
```
print(Y)
```

```
25542     0
158281    0
162569    0
252408    0
278725    0
         ..
279863    1
280143    1
280149    1
281144    1
281674    1
Name: Class, Length: 984, dtype: int64
```

### Training & Testing Data

[172]:
```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.
↪2,stratify=Y,random_state=2)
```

[173]:
```
print(X.shape,X_train.shape, X_test.shape)
```

```
(984, 30) (787, 30) (197, 30)
```

**Model Training**

Logistic Regression

[174]:
```
model=LogisticRegression()
```

[175]:
```
model.fit(X_train,Y_train)
```

[175]:
```
LogisticRegression()
```

Model Evaluation

Accuracy Score

[176]:
```
X_train_prediction=model.predict(X_train)
training_data_accuracy=accuracy_score(X_train_prediction, Y_train)
```

[177]:
```
print("Accuracy Score is : ",training_data_accuracy)
```

```
Accuracy Score is :  0.9212198221092758
```

[178]:
```
X_test_prediction = model.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)
```

[179]:
```
print("Accuracy Score is : ",test_data_accuracy)
```

```
Accuracy Score is :  0.8883248730964467
```

**Thank You !!**