Loading Data

In [1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns

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

In [2]:
```python
df = pd.read_csv("C:/Users/User/Desktop/application_record.csv")
df.head()
```

Out[2]:

	ID	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NAME_EDUCATIC
0	5008804	M	Y	Y	0	427500.0	Working	Higher e
1	5008805	M	Y	Y	0	427500.0	Working	Higher e
2	5008806	M	Y	Y	0	112500.0	Working	Secondary / s
3	5008808	F	N	Y	0	270000.0	Commercial associate	Secondary / s
4	5008809	F	N	Y	0	270000.0	Commercial associate	Secondary / s

In [3]:
```python
df.shape
```

Out[3]:
```
(438557, 18)
```

In [4]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 438557 entries, 0 to 438556
Data columns (total 18 columns):
 #   Column               Non-Null Count   Dtype
---  ------               --------------   -----
 0   ID                   438557 non-null  int64
 1   CODE_GENDER          438557 non-null  object
 2   FLAG_OWN_CAR         438557 non-null  object
 3   FLAG_OWN_REALTY      438557 non-null  object
 4   CNT_CHILDREN         438557 non-null  int64
 5   AMT_INCOME_TOTAL     438557 non-null  float64
 6   NAME_INCOME_TYPE     438557 non-null  object
 7   NAME_EDUCATION_TYPE  438557 non-null  object
 8   NAME_FAMILY_STATUS   438557 non-null  object
 9   NAME_HOUSING_TYPE    438557 non-null  object
 10  DAYS_BIRTH           438557 non-null  int64
 11  DAYS_EMPLOYED        438557 non-null  int64
 12  FLAG_MOBIL           438557 non-null  int64
 13  FLAG_WORK_PHONE      438557 non-null  int64
 14  FLAG_PHONE           438557 non-null  int64
 15  FLAG_EMAIL           438557 non-null  int64
 16  OCCUPATION_TYPE      304354 non-null  object
 17  CNT_FAM_MEMBERS      438557 non-null  float64
dtypes: float64(2), int64(8), object(8)
memory usage: 60.2+ MB
```

In [5]:
```python
credit_df = pd.read_csv("C:/Users/User/Desktop/credit_record.csv")
credit_df.head()
```

Out[5]:

	ID	MONTHS_BALANCE	STATUS
0	5001711	0	X
1	5001711	-1	0
2	5001711	-2	0
3	5001711	-3	0
4	5001712	0	C

In [6]:
```python
credit_df.shape
```

Out[6]:
```
(1048575, 3)
```

In [7]:
```python
credit_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1048575 entries, 0 to 1048574
Data columns (total 3 columns):
 #   Column          Non-Null Count    Dtype
---  ------          --------------    -----
 0   ID              1048575 non-null  int64
 1   MONTHS_BALANCE  1048575 non-null  int64
 2   STATUS          1048575 non-null  object
dtypes: int64(2), object(1)
memory usage: 24.0+ MB
```

In [8]:
```python
# dropping occupation type which has many null values
df.drop('OCCUPATION_TYPE', axis=1, inplace=True)
```

In [9]:
```python
# Checking duplicates in 'ID' column
len(df['ID']) - len(df['ID'].unique())
```

Out[9]:
```
47
```

In [10]:
```python
# Dropping duplicate entries from ID column
df = df.drop_duplicates('ID', keep='last')
```

In [11]:
```python
# Checking Non-Numerical Columns
cat_columns = df.columns[(df.dtypes =='object').values].tolist()
cat_columns
```

Out[11]:
```
['CODE_GENDER',
 'FLAG_OWN_CAR',
 'FLAG_OWN_REALTY',
 'NAME_INCOME_TYPE',
 'NAME_EDUCATION_TYPE',
 'NAME_FAMILY_STATUS',
 'NAME_HOUSING_TYPE']
```

In [12]:
```python
# Checking Numerical Columns
df.columns[(df.dtypes !='object').values].tolist()
```

Out[12]:
```
['ID',
 'CNT_CHILDREN',
 'AMT_INCOME_TOTAL',
 'DAYS_BIRTH',
 'DAYS_EMPLOYED',
 'FLAG_MOBIL',
 'FLAG_WORK_PHONE',
 'FLAG_PHONE',
 'FLAG_EMAIL',
 'CNT_FAM_MEMBERS']
```

In [13]:
```python
# Checking unique values from Categorical Columns

for i in df.columns[(df.dtypes =='object').values].tolist():
    print(i,'\n')
    print(df[i].value_counts())
    print('-----------------------------------------------')
```

```
CODE_GENDER

F    294412
M    144098
Name: CODE_GENDER, dtype: int64
-----------------------------------------------
FLAG_OWN_CAR

N    275428
Y    163082
Name: FLAG_OWN_CAR, dtype: int64
-----------------------------------------------
FLAG_OWN_REALTY

Y    304043
N    134467
Name: FLAG_OWN_REALTY, dtype: int64
-----------------------------------------------
NAME_INCOME_TYPE

Working                 226087
Commercial associate    100739
Pensioner                75483
State servant            36184
Student                     17
Name: NAME_INCOME_TYPE, dtype: int64
-----------------------------------------------
NAME_EDUCATION_TYPE

Secondary / secondary special    301789
Higher education                 117509
Incomplete higher                 14849
Lower secondary                    4051
Academic degree                     312
Name: NAME_EDUCATION_TYPE, dtype: int64
-----------------------------------------------
NAME_FAMILY_STATUS

Married                 299798
Single / not married     55268
Civil marriage           36524
Separated                27249
Widow                    19671
Name: NAME_FAMILY_STATUS, dtype: int64
-----------------------------------------------
NAME_HOUSING_TYPE

House / apartment      393788
With parents            19074
Municipal apartment     14213
Rented apartment         5974
Office apartment         3922
Co-op apartment          1539
Name: NAME_HOUSING_TYPE, dtype: int64
-----------------------------------------------
```

In [14]:
```python
# Checking unique values from Numerical Columns
df['CNT_CHILDREN'].value_counts()
```

Out[14]:
```
0     304038
1      88518
2      39879
3       5430
4        486
5        133
7          9
9          5
12         4
6          4
14         3
19         1
Name: CNT_CHILDREN, dtype: int64
```

In [15]:
```python
# Checking Min , Max values from 'DAYS_BIRTH' column
print('Min DAYS_BIRTH :', df['DAYS_BIRTH'].min(),'\nMax DAYS_BIRTH :', df['DAYS_BIRTH'].max())
```

```
Min DAYS_BIRTH : -25201
Max DAYS_BIRTH : -7489
```

In [16]:
```python
# Converting 'DAYS_BIRTH' values from Day to Years
df['DAYS_BIRTH'] = round(df['DAYS_BIRTH']/-365,0)
df.rename(columns={'DAYS_BIRTH':'AGE_YEARS'}, inplace=True)
# Checking unique values greater than 0
df[df['DAYS_EMPLOYED']>0]['DAYS_EMPLOYED'].unique()
```

Out[16]:
```
array([365243], dtype=int64)
```

In [17]:
```python
# As mentioned in document, if 'DAYS_EMPLOYED' is positive no, it means person currently unemployed, hence repl
df['DAYS_EMPLOYED'].replace(365243, 0, inplace=True)
```

In [18]:
```python
# Converting 'DAYS_EMPLOYED' values from Day to Years
df['DAYS_EMPLOYED'] = abs(round(df['DAYS_EMPLOYED']/-365,0))
df.rename(columns={'DAYS_EMPLOYED':'YEARS_EMPLOYED'}, inplace=True)
```

In [19]:
```python
df['FLAG_MOBIL'].value_counts()
```

Out[19]:
```
1    438510
Name: FLAG_MOBIL, dtype: int64
```

In [20]:
```python
# As all the values in column are 1, hence dropping column
df.drop('FLAG_MOBIL', axis=1, inplace=True)
```

In [21]:
```python
df['FLAG_WORK_PHONE'].value_counts()
```

Out[21]:
```
0    348118
1     90392
Name: FLAG_WORK_PHONE, dtype: int64
```

In [22]:
```python
# This column only contains 0 & 1 values for Mobile no submitted, hence dropping column
df.drop('FLAG_WORK_PHONE', axis=1, inplace=True)
```

In [23]:
```python
df['FLAG_PHONE'].value_counts()
```

Out[23]:
```
0    312323
1    126187
Name: FLAG_PHONE, dtype: int64
```

In [24]:
```python
# This column only contains 0 & 1 values for Phone no submitted, hence dropping column
df.drop('FLAG_PHONE', axis=1, inplace=True)
```

In [25]:
```python
df['FLAG_EMAIL'].value_counts()
```

Out[25]:
```
0    391062
1     47448
Name: FLAG_EMAIL, dtype: int64
```

In [26]:
```python
# This column only contains 0 & 1 values for Email submitted, hence dropping column
df.drop('FLAG_EMAIL', axis=1, inplace=True)
```

In [27]:
```python
df['CNT_FAM_MEMBERS'].value_counts()
```

Out[27]:
```
2.0     233867
1.0      84483
3.0      77119
4.0      37351
5.0       5081
6.0        459
7.0        124
9.0          9
11.0         5
14.0         4
8.0          4
15.0         3
20.0         1
Name: CNT_FAM_MEMBERS, dtype: int64
```

In [28]:
```python
df.head()
```

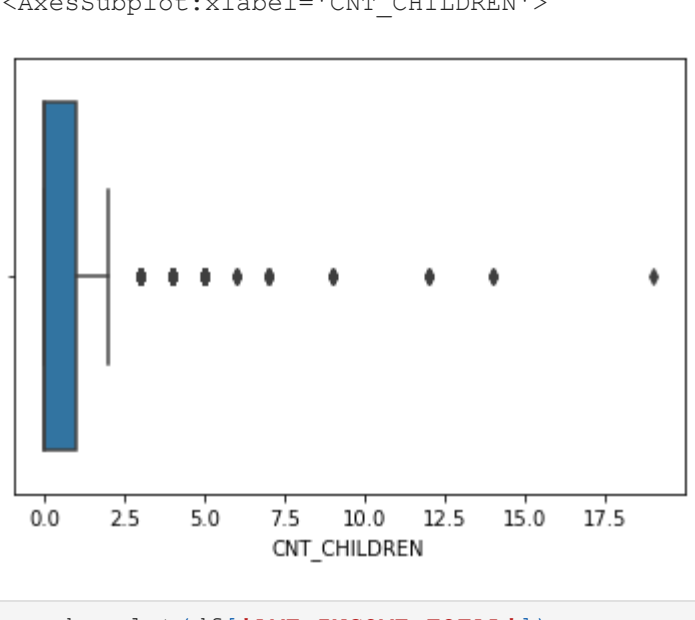
Out[28]:

	ID	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NAME_EDUCATIC
0	5008804	M	Y	Y	0	427500.0	Working	Higher e
1	5008805	M	Y	Y	0	427500.0	Working	Higher e
2	5008806	M	Y	Y	0	112500.0	Working	Secondary / s
3	5008808	F	N	Y	0	270000.0	Commercial associate	Secondary / s
4	5008809	F	N	Y	0	270000.0	Commercial associate	Secondary / s

Visualization

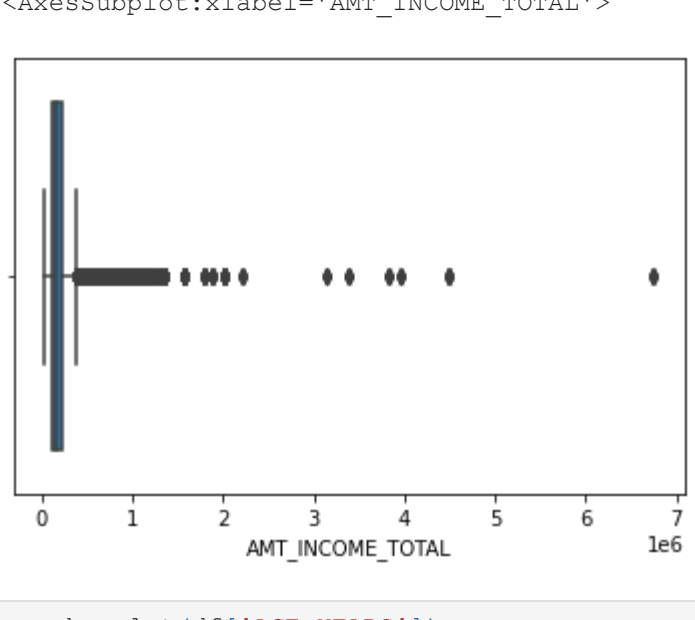
In [29]:
```python
#create plot to detect outliers
sns.boxplot(df['CNT_CHILDREN'])
```

Out[29]:
```
<AxesSubplot:xlabel='CNT_CHILDREN'>
```



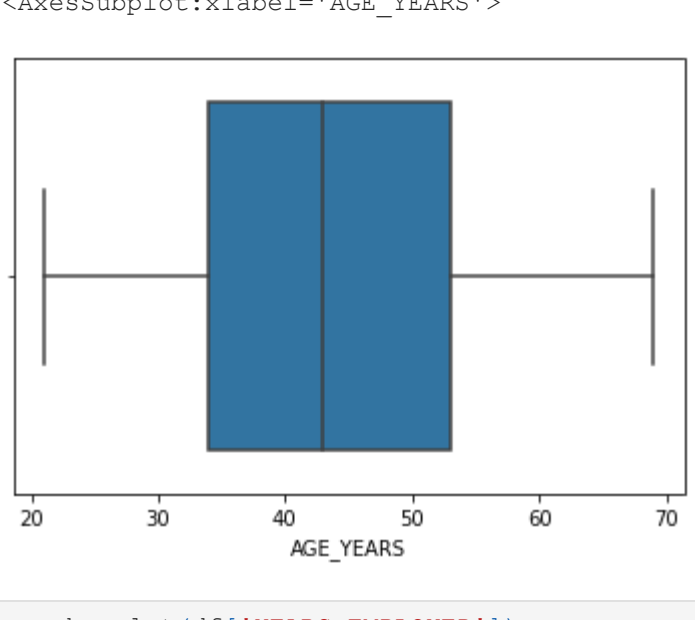
In [30]:
```python
sns.boxplot(df['AMT_INCOME_TOTAL'])
```

Out[30]:
```
<AxesSubplot:xlabel='AMT_INCOME_TOTAL'>
```



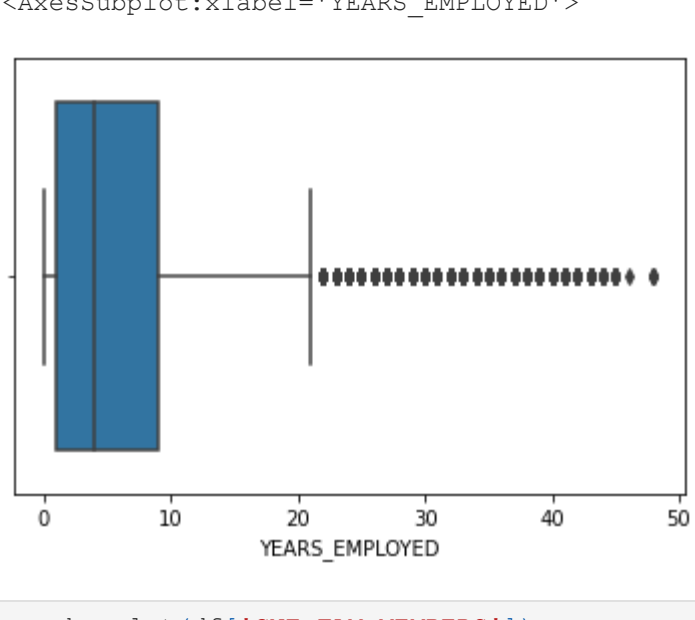
In [31]:
```python
sns.boxplot(df['AGE_YEARS'])
```

Out[31]:
```
<AxesSubplot:xlabel='AGE_YEARS'>
```



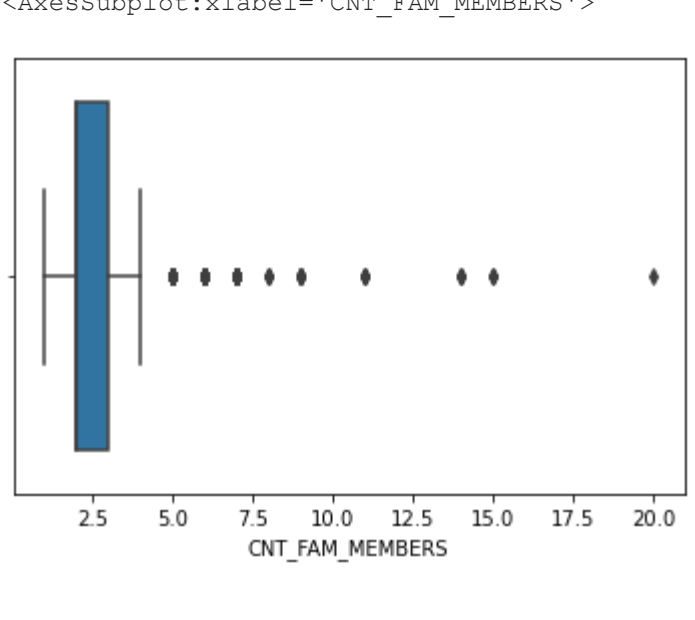
In [32]:
```python
sns.boxplot(df['YEARS_EMPLOYED'])
```

Out[32]:
```
<AxesSubplot:xlabel='YEARS_EMPLOYED'>
```



In [33]:
```python
sns.boxplot(df['CNT_FAM_MEMBERS'])
```

Out[33]:
```
<AxesSubplot:xlabel='CNT_FAM_MEMBERS'>
```



Data cleansing (Removing Outliers)

In [34]:
```python
high_bound = df['CNT_CHILDREN'].quantile(0.999)
print('high_bound :', high_bound)
low_bound = df['CNT_CHILDREN'].quantile(0.001)
print('low_bound :', low_bound)
```

```
high_bound : 4.0
low_bound : 0.0
```

In [35]:
```python
df = df[(df['CNT_CHILDREN']>=low_bound) & (df['CNT_CHILDREN']<=high_bound)]
```

In [36]:
```python
high_bound = df['AMT_INCOME_TOTAL'].quantile(0.999)
print('high_bound :', high_bound)
low_bound = df['AMT_INCOME_TOTAL'].quantile(0.001)
print('low_bound :', low_bound)
```

```
high_bound : 990000.0
low_bound : 36000.0
```

In [37]:
```python
df = df[(df['AMT_INCOME_TOTAL']>=low_bound) & (df['AMT_INCOME_TOTAL']<=high_bound)]
```

In [38]:
```python
high_bound = df['YEARS_EMPLOYED'].quantile(0.999)
print('high_bound :', high_bound)
low_bound = df['YEARS_EMPLOYED'].quantile(0.001)
print('low_bound :', low_bound)
```

```
high_bound : 40.0
low_bound : 0.0
```

In [39]:
```python
df = df[(df['YEARS_EMPLOYED']>=low_bound) & (df['YEARS_EMPLOYED']<=high_bound)]
```

In [40]:
```python
high_bound = df['CNT_FAM_MEMBERS'].quantile(0.999)
print('high_bound :', high_bound)
low_bound = df['CNT_FAM_MEMBERS'].quantile(0.001)
print('low_bound :', low_bound)
```

```
high_bound : 6.0
low_bound : 1.0
```

In [41]:
```python
df = df[(df['CNT_FAM_MEMBERS']>=low_bound) & (df['CNT_FAM_MEMBERS']<=high_bound)]
```

In [42]:
```python
df.head()
```

Out[42]:

	ID	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NAME_EDUCATIC
0	5008804	M	Y	Y	0	427500.0	Working	Higher e
1	5008805	M	Y	Y	0	427500.0	Working	Higher e
2	5008806	M	Y	Y	0	112500.0	Working	Secondary / s
3	5008808	F	N	Y	0	270000.0	Commercial associate	Secondary / s
4	5008809	F	N	Y	0	270000.0	Commercial associate	Secondary / s

On File - Credit Record.csv

In [43]:
```python
credit_df.head()
```

Out[43]:

	ID	MONTHS_BALANCE	STATUS
0	5001711	0	X
1	5001711	-1	0
2	5001711	-2	0
3	5001711	-3	0
4	5001712	0	C

In [44]:
```python
df.isnull().sum()
```

Out[44]:
```
ID                     0
CODE_GENDER            0
FLAG_OWN_CAR           0
FLAG_OWN_REALTY        0
CNT_CHILDREN           0
AMT_INCOME_TOTAL       0
NAME_INCOME_TYPE       0
NAME_EDUCATION_TYPE    0
NAME_FAMILY_STATUS     0
NAME_HOUSING_TYPE      0
AGE_YEARS              0
YEARS_EMPLOYED         0
CNT_FAM_MEMBERS        0
dtype: int64
```

In [45]:
```python
credit_df['STATUS'].value_counts()
```

Out[45]:
```
C    442031
0    383120
X    209230
1     11090
5      1693
2       868
3       320
4       223
Name: STATUS, dtype: int64
```

In [46]:
```python
# categorizing 'STATUS' column to binary classification   0 : Good Client and 1 : bad client
credit_df['STATUS'].replace(['C', 'X'],0, inplace=True)
```

In [47]:
```python
credit_df['STATUS'].replace(['2','3','4','5'],1, inplace=True)
```

In [48]:
```python
credit_df['STATUS'] = credit_df['STATUS'].astype('int')
```

In [49]:
```python
credit_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1048575 entries, 0 to 1048574
Data columns (total 3 columns):
 #   Column          Non-Null Count    Dtype
---  ------          --------------    -----
 0   ID              1048575 non-null  int64
 1   MONTHS_BALANCE  1048575 non-null  int64
 2   STATUS          1048575 non-null  int32
dtypes: int32(1), int64(2)
memory usage: 20.0 MB
```

In [50]:
```python
credit_df['STATUS'].value_counts(normalize=True)*100
```

Out[50]:
```
0    98.646353
1     1.353647
Name: STATUS, dtype: float64
```

In [51]:
```python
credit_df_trans = credit_df.groupby('ID').agg(max).reset_index()
```

In [52]:
```python
credit_df_trans.drop('MONTHS_BALANCE', axis=1, inplace=True)
credit_df_trans.head()
```

Out[52]:

	ID	STATUS
0	5001711	0
1	5001712	0
2	5001713	0
3	5001714	0
4	5001715	0

In [53]:
```python
credit_df_trans['STATUS'].value_counts(normalize=True)*100
```

Out[53]:
```
0    88.365771
1    11.634229
Name: STATUS, dtype: float64
```

Merging Dataframes

In [92]:
```python
# merging the two datasets based on 'ID'
data = pd.merge(df, credit_df_trans, on='ID', how='inner')
data.shape
```

Out[92]:
```
(36326, 14)
```

In [55]:
```python
data.shape
```

Out[55]:
```
(36326, 14)
```

In [56]:
```python
data.drop('ID', axis=1, inplace=True)
```

In [57]:
```python
# checking if there are still duplicate rows in Final Dataframe
len(data) - len(data.drop_duplicates())
```

Out[57]:
```
25268
```

In [58]:
```python
# Dropping duplicate records
data = data.drop_duplicates()
data.reset_index(drop=True ,inplace=True)
```

In [59]:
```python
data.shape
```

Out[59]:
```
(11058, 13)
```

In [60]:
```python
data.isnull().sum()
```

Out[60]:
```
CODE_GENDER            0
FLAG_OWN_CAR           0
FLAG_OWN_REALTY        0
CNT_CHILDREN           0
AMT_INCOME_TOTAL       0
NAME_INCOME_TYPE       0
NAME_EDUCATION_TYPE    0
NAME_FAMILY_STATUS     0
NAME_HOUSING_TYPE      0
AGE_YEARS              0
YEARS_EMPLOYED         0
CNT_FAM_MEMBERS        0
STATUS                 0
dtype: int64
```

In [61]:
```python
data['STATUS'].value_counts(normalize=True)*100
```

Out[61]:
```
0    78.513294
1    21.486706
Name: STATUS, dtype: float64
```

Feature Engineering

In [62]:
```python
data.head()
```

Out[62]:

	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NAME_EDUCATION_TYPE
0	M	Y	Y	0	427500.0	Working	Higher education
1	M	Y	Y	0	112500.0	Working	Secondary / secondary special
2	F	N	Y	0	270000.0	Commercial associate	Secondary / secondary special
3	F	N	Y	0	283500.0	Pensioner	Higher education
4	M	Y	Y	0	270000.0	Working	Higher education

In [63]:
```python
cat_columns = data.columns[(data.dtypes =='object').values].tolist()
cat_columns
```

Out[63]:
```
['CODE_GENDER',
 'FLAG_OWN_CAR',
 'FLAG_OWN_REALTY',
 'NAME_INCOME_TYPE',
 'NAME_EDUCATION_TYPE',
 'NAME_FAMILY_STATUS',
 'NAME_HOUSING_TYPE']
```

In [64]:
```python
#Converting all Non-Numerical Columns to Numerical
from sklearn.preprocessing import LabelEncoder

for col in cat_columns:
        globals()['LE_{}'.format(col)] = LabelEncoder()
        data[col] = globals()['LE_{}'.format(col)].fit_transform(data[col])
data.head()
```

Out[64]:

	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NAME_EDUCATION_TYPE
0	1	1	1	0	427500.0	4	1
1	1	1	1	0	112500.0	4	4
2	0	0	1	0	270000.0	0	4
3	0	0	1	0	283500.0	1	1
4	1	1	1	0	270000.0	4	1

In [65]:
```python
for col in cat_columns:
    print(col , "  : ", globals()['LE_{}'.format(col)].classes_)
```

```
CODE_GENDER   :  ['F' 'M']
FLAG_OWN_CAR   :  ['N' 'Y']
FLAG_OWN_REALTY   :  ['N' 'Y']
NAME_INCOME_TYPE   :  ['Commercial associate' 'Pensioner' 'State servant' 'Student' 'Working']
NAME_EDUCATION_TYPE   :  ['Academic degree' 'Higher education' 'Incomplete higher'
 'Lower secondary' 'Secondary / secondary special']
NAME_FAMILY_STATUS   :  ['Civil marriage' 'Married' 'Separated' 'Single / not married' 'Widow']
NAME_HOUSING_TYPE   :  ['Co-op apartment' 'House / apartment' 'Municipal apartment'
 'Office apartment' 'Rented apartment' 'With parents']
```

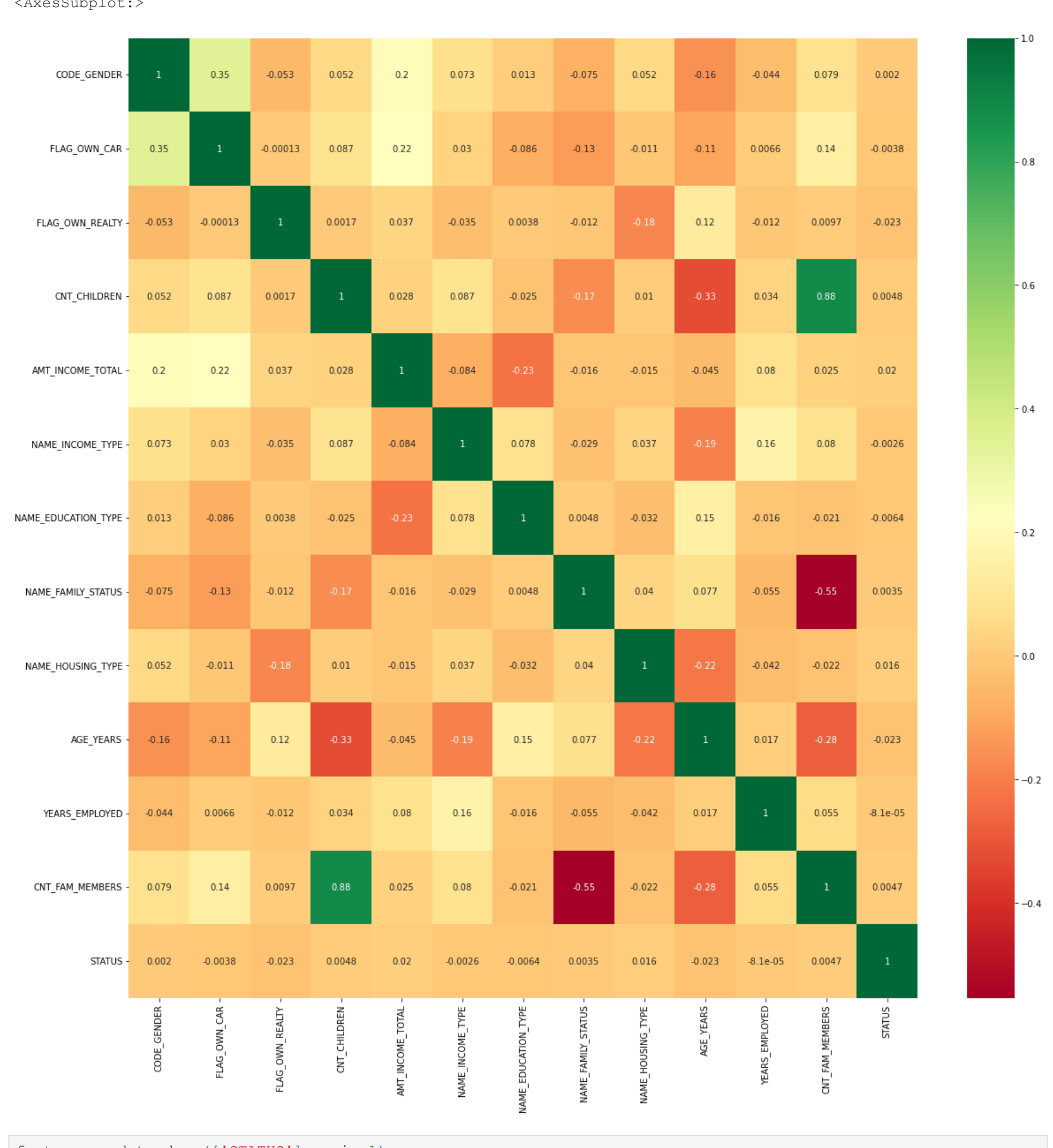
In [66]:
```python
data.corr()
```

Out[66]:

	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NA
CODE_GENDER	1.000000	0.348307	-0.052647	0.052351	0.199358	0.072725	
FLAG_OWN_CAR	0.348307	1.000000	-0.000126	0.087407	0.218026	0.030008	
FLAG_OWN_REALTY	-0.052647	-0.000126	1.000000	0.001740	0.036549	-0.034673	
CNT_CHILDREN	0.052351	0.087407	0.001740	1.000000	0.027806	0.086772	
AMT_INCOME_TOTAL	0.199358	0.218026	0.036549	0.027806	1.000000	-0.083800	
NAME_INCOME_TYPE	0.072725	0.030008	-0.034673	0.086772	-0.083800	1.000000	
NAME_EDUCATION_TYPE	0.013080	-0.085706	0.003771	-0.025059	-0.231827	0.077636	
NAME_FAMILY_STATUS	-0.075315	-0.125707	-0.011871	-0.166742	-0.015623	-0.029347	
NAME_HOUSING_TYPE	0.052185	-0.011203	-0.178070	0.010091	-0.014723	0.036582	
AGE_YEARS	-0.157507	-0.106634	0.121351	-0.326642	-0.044799	-0.191870	
YEARS_EMPLOYED	-0.043657	0.006570	-0.011665	0.033979	0.079548	0.163301	
CNT_FAM_MEMBERS	0.078853	0.138978	0.009698	0.884676	0.025272	0.080072	
STATUS	0.002039	-0.003826	-0.022887	0.004820	0.020289	-0.002579	

In [67]:
```python
top_corr_features = data.corr().index
plt.figure(figsize=(20, 20))
sns.heatmap(data[top_corr_features].corr(),annot=True,cmap="RdYlGn")
```

Out[67]:
```
<AxesSubplot:>
```



In [68]:
```python
features = data.drop(['STATUS'], axis=1)
label = data['STATUS']
```

In [69]:
```python
features.head()
```

Out[69]:

	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT_CHILDREN	AMT_INCOME_TOTAL	NAME_INCOME_TYPE	NAME_EDUCATION_TYPE
0	1	1	1	0	427500.0	4	1
1	1	1	1	0	112500.0	4	4
2	0	0	1	0	270000.0	0	4
3	0	0	1	0	283500.0	1	1
4	1	1	1	0	270000.0	4	1

In [70]:
```python
label.head()
```

Out[70]:
```
0    1
1    0
2    0
3    0
4    0
Name: STATUS, dtype: int32
```

Machine Learning Model

Random Forest before Balancing

In [71]:
```python
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(features,
                                                    label,
                                                    test_size=0.2,
                                                    random_state = 15)
```

In [82]:
```python
# Using RandomForest Classifier to build the forecasting model
from sklearn.ensemble import RandomForestClassifier
rf=RandomForestClassifier(random_state=20, n_estimators=100, criterion='entropy')
rf.fit(x_train, y_train)
```

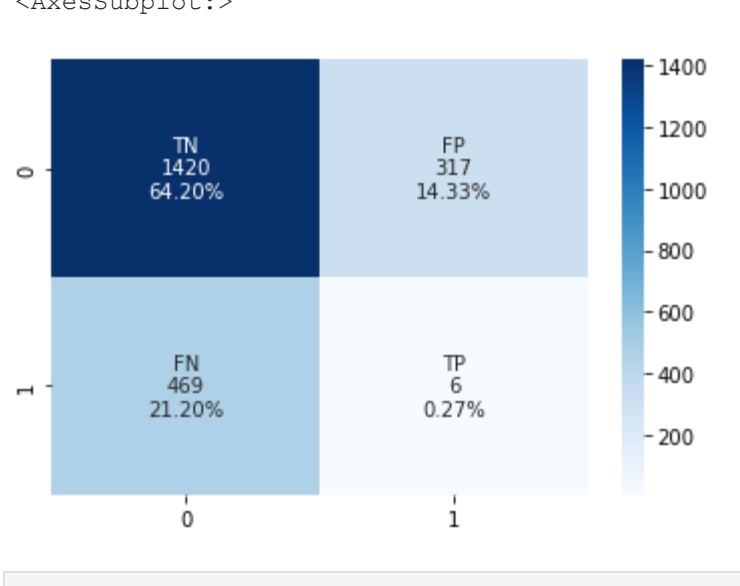
Out[82]:
```
RandomForestClassifier(criterion='entropy', random_state=20)
```

In [83]:
```python
print('Random Forest Accuracy : ', rf.score(x_test, y_test)*100, '%')

from sklearn.metrics import confusion_matrix
prediction = rf.predict(x_test)
cf_matrix=confusion_matrix(y_test, prediction)
print('\nConfusion matrix :')
print(confusion_matrix(y_test, prediction))

from sklearn.metrics import classification_report
print('\nClassification report:')
print(classification_report(y_test, prediction))
```

```
Random Forest Accuracy :  64.46654611211574 %

Confusion matrix :
[[1420  317]
 [ 469    6]]

Classification report:
              precision    recall  f1-score   support

           0       0.75      0.82      0.78      1737
           1       0.02      0.01      0.02       475

    accuracy                           0.64      2212
   macro avg       0.39      0.42      0.40      2212
weighted avg       0.59      0.64      0.62      2212
```

In [128...
```python
condition = ["TN","FP","FN","TP"]
counts = ['{0:0.0f}'.format(value) for value in cf_matrix.flatten()]
percent = ['{0:.2%}'.format(value) for value in cf_matrix.flatten()/np.sum(cf_matrix)]
labels = [f'{v1}\n{v2}\n{v3}' for v1, v2, v3 in zip(condition,counts,percent)]
labels = np.asarray(labels).reshape(2,2)
sns.heatmap(cf_matrix, annot=labels, fmt='', cmap='Blues')
```

Out[128]:
```
<AxesSubplot:>
```



In [133...
```python
# Getting the auc score
from sklearn.metrics import roc_auc_score
prob_rf=rf.predict_proba(x_test)
roc_auc_score_rf=roc_auc_score(y_test,prob_rf[:,1])
print('The AUC score is: '+ str(roc_auc_score_rf))
```

```
The AUC score is: 0.24015028936763327
```

Decision Tree before Balancing

In [116...
```python
from sklearn import tree
dt =tree.DecisionTreeClassifier(criterion='entropy')
dt.fit(x_train, y_train)
```

Out[116]:

```
DecisionTreeClassifier(criterion='entropy')
```

In [117…

```
text_representation = tree.export_text(dt)
print(text_representation)
```

```
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_10 >  1.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 2.00
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  2.00
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |--- feature_4 >  249750.00
|   |   |   |   |   |   |   |   |--- feature_10 <= 15.50
|   |   |   |   |   |   |   |   |   |--- feature_10 <= 12.50
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 40.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  40.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |--- feature_10 >  12.50
|   |   |   |   |   |   |   |   |   |   |--- feature_6 <= 1.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_6 >  1.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |--- feature_10 >  15.50
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_9 >  43.50
|   |   |   |   |   |   |--- feature_10 <= 1.50
|   |   |   |   |   |   |   |--- feature_9 <= 58.50
|   |   |   |   |   |   |   |   |--- feature_9 <= 50.50
|   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_7 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |--- feature_9 >  50.50
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 297000.00
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 53.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  53.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |--- feature_4 >  297000.00
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_9 >  58.50
|   |   |   |   |   |   |   |   |--- feature_7 <= 2.50
|   |   |   |   |   |   |   |   |   |--- feature_7 <= 1.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 3.00
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 11
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  3.00
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_7 >  1.50
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_7 >  2.50
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 66.00
|   |   |   |   |   |   |   |   |   |   |--- feature_6 <= 2.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_6 >  2.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 10
|   |   |   |   |   |   |   |   |   |--- feature_9 >  66.00
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_10 >  1.50
|   |   |   |   |   |   |   |--- feature_4 <= 384750.00
|   |   |   |   |   |   |   |   |--- feature_3 <= 1.50
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 44.50
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 1.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  1.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 12
|   |   |   |   |   |   |   |   |   |--- feature_9 >  44.50
|   |   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |   |   |--- feature_7 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 21
|   |   |   |   |   |   |   |   |--- feature_3 >  1.50
|   |   |   |   |   |   |   |   |   |--- feature_5 <= 3.00
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_5 >  3.00
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 337500.00
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  337500.00
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_4 >  384750.00
|   |   |   |   |   |   |   |   |--- feature_6 <= 2.50
|   |   |   |   |   |   |   |   |   |--- feature_10 <= 10.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 1.00
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  1.00
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_10 >  10.50
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 46.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  46.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |--- feature_6 >  2.50
|   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 3.00
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 8
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  3.00
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |--- feature_3 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_7 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
```

In [107…

```
tree.plot_tree(dt)
```

Out[107]:

```
[Text(0.2877560177364865, 0.9545454545454546, 'X[9] <= 35.5\nentropy = 0.751\nsamples = 8846\nvalue = [6945, 1901]'),
 Text(0.07564400337837837, 0.8636363636363636, 'X[4] <= 65250.0\nentropy = 0.79\nsamples = 2689\nvalue = [2052, 637]'),
 Text(0.021959459459459946, 0.7727272727272727, 'X[10] <= 13.0\nentropy = 0.414\nsamples = 24\nvalue = [22, 2]'),
 Text(0.018581081081081082, 0.6818181818181818, 'X[11] <= 2.5\nentropy = 0.258\nsamples = 23\nvalue = [22, 1]'),
 Text(0.015202702702702704, 0.5909090909090909, 'X[11] <= 1.5\nentropy = 0.544\nsamples = 8\nvalue = [7, 1]'),
 Text(0.011824324324324325, 0.5, 'entropy = 0.0\nsamples = 4\nvalue = [4, 0]'),
 Text(0.018581081081081082, 0.5, 'X[4] <= 51750.0\nentropy = 0.811\nsamples = 4\nvalue = [3, 1]'),
 Text(0.015202702702702704, 0.4090909090909091, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.021959459459459946, 0.4090909090909091, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.021959459459459946, 0.5909090909090909, 'entropy = 0.0\nsamples = 15\nvalue = [15, 0]'),
 Text(0.025337837837837784, 0.6818181818181818, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.12932854729729729, 0.7727272727272727, 'X[4] <= 562500.0\nentropy = 0.792\nsamples = 2665\nvalue = [2030, 635]'),
 Text(0.09987331081081081, 0.6818181818181818, 'X[11] <= 5.5\nentropy = 0.79\nsamples = 2653\nvalue = [2024, 629]'),
 Text(0.09649493243243243, 0.5909090909090909, 'X[3] <= 2.5\nentropy = 0.791\nsamples = 2647\nvalue = [2018, 629]'),
 Text(0.05532094594594594, 0.5, 'X[8] <= 1.5\nentropy = 0.787\nsamples = 2596\nvalue = [1986, 610]'),
 Text(0.028716216216216218, 0.4090909090909091, 'X[10] <= 15.5\nentropy = 0.775\nsamples = 2123\nvalue = [1638, 485]'),
 Text(0.025337837837837784, 0.3181818181818182, 'X[9] <= 27.5\nentropy = 0.776\nsamples = 2118\nvalue = [1633, 485]'),
 Text(0.013513513513513514, 0.22727272727272727, 'X[11] <= 3.5\nentropy = 0.724\nsamples = 467\nvalue = [373, 94]'),
 Text(0.006756756756756757, 0.13636363636363635, 'X[10] <= 6.5\nentropy = 0.741\nsamples = 439\nvalue = [347, 92]'),
 Text(0.0033783783783783786, 0.045454545454545456, 'entropy = 0.753\nsamples = 412\nvalue = [323, 89]'),
 Text(0.010135135135135136, 0.045454545454545456, 'entropy = 0.503\nsamples = 27\nvalue = [24, 3]'),
 Text(0.02027027027027027, 0.13636363636363635, 'X[4] <= 159750.0\nentropy = 0.371\nsamples = 28\nvalue = [26, 2]'),
 Text(0.016891891891891893, 0.045454545454545456, 'entropy = 0.0\nsamples = 17\nvalue = [17, 0]'),
 Text(0.02364864864864865, 0.045454545454545456, 'entropy = 0.684\nsamples = 11\nvalue = [9, 2]'),
 Text(0.037162162162162164, 0.22727272727272727, 'X[4] <= 472500.0\nentropy = 0.79\nsamples = 1651\nvalue = [1260, 391]'),
 Text(0.033783783783783786, 0.13636363636363635, 'X[7] <= 0.5\nentropy = 0.791\nsamples = 1647\nvalue = [1256, 391]'),
 Text(0.030405405405405407, 0.045454545454545456, 'entropy = 0.855\nsamples = 175\nvalue = [126, 49]'),
 Text(0.037162162162162164, 0.045454545454545456, 'entropy = 0.782\nsamples = 1472\nvalue = [1130, 342]'),
 Text(0.04054054054054054, 0.13636363636363635, 'entropy = 0.0\nsamples = 4\nvalue = [4, 0]'),
 Text(0.032094594594594594, 0.3181818181818182, 'entropy = 0.0\nsamples = 5\nvalue = [5, 0]'),
 Text(0.08192567567567567, 0.4090909090909091, 'X[4] <= 209250.0\nentropy = 0.833\nsamples = 473\nvalue = [348, 125]'),
 Text(0.06587837837837837, 0.3181818181818182, 'X[9] <= 33.5\nentropy = 0.796\nsamples = 349\nvalue = [265, 84]'),
 Text(0.05405405405405406, 0.22727272727272727, 'X[4] <= 175837.5\nentropy = 0.823\nsamples = 307\nvalue = [228, 79]'),
 Text(0.0472972972972973, 0.13636363636363635, 'X[4] <= 145125.0\nentropy = 0.864\nsamples = 234\nvalue = [167, 67]'),
 Text(0.04391891891891892, 0.045454545454545456, 'entropy = 0.811\nsamples = 172\nvalue = [129, 43]'),
 Text(0.05067567567567568, 0.045454545454545456, 'entropy = 0.963\nsamples = 62\nvalue = [38, 24]'),
 Text(0.060810810810810814, 0.13636363636363635, 'X[10] <= 3.5\nentropy = 0.645\nsamples = 73\nvalue = [61, 12]'),
 Text(0.057432432432432436, 0.045454545454545456, 'entropy = 0.378\nsamples = 41\nvalue = [38, 3]'),
 Text(0.06418918918918919, 0.045454545454545456, 'entropy = 0.857\nsamples = 32\nvalue = [23, 9]'),
 Text(0.0777027027027027, 0.22727272727272727, 'X[0] <= 0.5\nentropy = 0.527\nsamples = 42\nvalue = [37, 5]'),
 Text(0.07432432432432433, 0.13636363636363635, 'X[5] <= 1.0\nentropy = 0.65\nsamples = 30\nvalue = [25, 5]'),
 Text(0.07094594594594594, 0.045454545454545456, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.0777027027027027, 0.045454545454545456, 'entropy = 0.738\nsamples = 24\nvalue = [19, 5]'),
 Text(0.08108108108108109, 0.13636363636363635, 'entropy = 0.0\nsamples = 12\nvalue = [12, 0]'),
 Text(0.09797297297297297, 0.3181818181818182, 'X[10] <= 9.5\nentropy = 0.916\nsamples = 124\nvalue = [83, 41]'),
 Text(0.09121621621621621, 0.22727272727272727, 'X[10] <= 8.5\nentropy = 0.897\nsamples = 118\nvalue = [81, 37]'),
 Text(0.08783783783783784, 0.13636363636363635, 'X[9] <= 27.5\nentropy = 0.912\nsamples = 113\nvalue = [76, 37]'),
 Text(0.08445945945945946, 0.045454545454545456, 'entropy = 0.764\nsamples = 36\nvalue = [28, 8]'),
 Text(0.09121621621621621, 0.045454545454545456, 'entropy = 0.956\nsamples = 77\nvalue = [48, 29]'),
 Text(0.0945945945945946, 0.13636363636363635, 'entropy = 0.0\nsamples = 5\nvalue = [5, 0]'),
 Text(0.10472972972972973, 0.22727272727272727, 'X[5] <= 3.0\nentropy = 0.918\nsamples = 6\nvalue = [2, 4]'),
 Text(0.10135135135135136, 0.13636363636363635, 'X[10] <= 10.5\nentropy = 1.0\nsamples = 4\nvalue = [2, 2]'),
 Text(0.09797297297297297, 0.045454545454545456, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.10472972972972973, 0.045454545454545456, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.10810810810810811, 0.13636363636363635, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.13766891891891891, 0.5, 'X[4] <= 258750.0\nentropy = 0.953\nsamples = 51\nvalue = [32, 19]'),
 Text(0.12668918918918918, 0.4090909090909091, 'X[10] <= 4.5\nentropy = 0.884\nsamples = 43\nvalue = [30, 13]'),
 Text(0.11486486486486487, 0.3181818181818182, 'X[11] <= 4.5\nentropy = 0.544\nsamples = 16\nvalue = [14, 2]'),
 Text(0.11148648648648649, 0.22727272727272727, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.11824324324324324, 0.22727272727272727, 'X[4] <= 96750.0\nentropy = 0.371\nsamples = 14\nvalue = [13, 1]'),
 Text(0.11486486486486487, 0.13636363636363635, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.12162162162162163, 0.13636363636363635, 'entropy = 0.0\nsamples = 12\nvalue = [12, 0]'),
 Text(0.13851351351351351, 0.3181818181818182, 'X[2] <= 0.5\nentropy = 0.975\nsamples = 27\nvalue = [16, 11]'),
 Text(0.13175675675675674, 0.22727272727272727, 'X[4] <= 123750.0\nentropy = 0.722\nsamples = 10\nvalue = [8, 2]'),
 Text(0.12837837837837837, 0.13636363636363635, 'entropy = 0.0\nsamples = 4\nvalue = [4, 0]'),
 Text(0.13513513513513514, 0.13636363636363635, 'X[10] <= 9.5\nentropy = 0.918\nsamples = 6\nvalue = [4, 2]'),
 Text(0.13175675675675674, 0.045454545454545456, 'entropy = 1.0\nsamples = 4\nvalue = [2, 2]'),
 Text(0.13851351351351351, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.14527027027027026, 0.22727272727272727, 'X[9] <= 28.5\nentropy = 0.998\nsamples = 17\nvalue = [8, 9]'),
 Text(0.14189189189189189, 0.13636363636363635, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.14864864864864866, 0.13636363636363635, 'X[6] <= 1.5\nentropy = 0.989\nsamples = 16\nvalue = [7, 9]'),
 Text(0.14527027027027026, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.15202702702702703, 0.045454545454545456, 'entropy = 0.997\nsamples = 15\nvalue = [7, 8]'),
 Text(0.14864864864864866, 0.4090909090909091, 'X[4] <= 315000.0\nentropy = 0.811\nsamples = 8\nvalue = [2, 6]'),
 Text(0.14527027027027026, 0.3181818181818182, 'entropy = 0.0\nsamples = 6\nvalue = [0, 6]'),
 Text(0.15202702702702703, 0.3181818181818182, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.10325168918918919, 0.5909090909090909, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.15878378378378377, 0.6818181818181818, 'X[9] <= 27.5\nentropy = 1.0\nsamples = 12\nvalue = [6, 6]'),
 Text(0.15540540540540540, 0.5909090909090909, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.16216216216216217, 0.5909090909090909, 'X[4] <= 787500.0\nentropy = 0.994\nsamples = 11\nvalue = [5, 6]'),
 Text(0.15878378378378377, 0.5, 'X[10] <= 2.5\nentropy = 1.0\nsamples = 10\nvalue = [5, 5]'),
 Text(0.1554054054054054, 0.4090909090909091, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.16216216216216217, 0.4090909090909091, 'X[2] <= 0.5\nentropy = 1.0\nsamples = 8\nvalue = [4, 4]'),
 Text(0.15878378378378377, 0.3181818181818182, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.16554054054054054, 0.3181818181818182, 'X[4] <= 643500.0\nentropy = 1.0\nsamples = 6\nvalue = [3, 3]'),
 Text(0.16216216216216217, 0.22727272727272727, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.16891891891891891, 0.22727272727272727, 'X[4] <= 720000.0\nentropy = 1.0\nsamples = 4\nvalue = [2, 2]'),
 Text(0.16554054054054054, 0.13636363636363635, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.17229729729729729, 0.13636363636363635, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.16554054054054054, 0.5, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.49986803209459457, 0.8636363636363636, 'X[2] <= 0.5\nentropy = 0.732\nsamples = 6157\nvalue = [4893, 1264]'),
 Text(0.31524493243243246, 0.7727272727272727, 'X[6] <= 3.5\nentropy = 0.771\nsamples = 1909\nvalue = [1477, 432]'),
 Text(0.24577702702702703, 0.6818181818181818, 'X[10] <= 4.5\nentropy = 0.715\nsamples = 514\nvalue = [413, 101]'),
 Text(0.22297297297297297, 0.5909090909090909, 'X[5] <= 3.0\nentropy = 0.632\nsamples = 220\nvalue = [185, 35]'),
 Text(0.20608108108108109, 0.5, 'X[11] <= 3.5\nentropy = 0.742\nsamples = 152\nvalue = [120, 32]'),
 Text(0.20270270270270271, 0.4090909090909091, 'X[8] <= 1.5\nentropy = 0.732\nsamples = 151\nvalue = [120, 31]'),
 Text(0.1891891891891892, 0.3181818181818182, 'X[4] <= 393750.0\nentropy = 0.678\nsamples = 123\nvalue = [101, 22]'),
 Text(0.18243243243243243, 0.22727272727272727, 'X[4] <= 326250.0\nentropy = 0.647\nsamples = 115\nvalue = [96, 19]'),
 Text(0.17905405405405406, 0.13636363636363635, 'X[4] <= 50625.0\nentropy = 0.667\nsamples = 109\nvalue = [90, 19]'),
 Text(0.17567567567567569, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.18243243243243243, 0.045454545454545456, 'entropy = 0.678\nsamples = 106\nvalue = [87, 19]'),
 Text(0.1858108108108108, 0.13636363636363635, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.19594594594594594, 0.22727272727272727, 'X[10] <= 2.5\nentropy = 0.954\nsamples = 8\nvalue = [5, 3]'),
 Text(0.19256756756756757, 0.13636363636363635, 'X[5] <= 0.5\nentropy = 0.971\nsamples = 5\nvalue = [2, 3]'),
 Text(0.1891891891891892, 0.045454545454545456, 'entropy = 0.811\nsamples = 4\nvalue = [1, 3]'),
 Text(0.19594594594594594, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.19932432432432431, 0.13636363636363635, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.21621621621621623, 0.3181818181818182, 'X[6] <= 1.5\nentropy = 0.906\nsamples = 28\nvalue = [19, 9]'),
 Text(0.21283783783783783, 0.22727272727272727, 'X[0] <= 0.5\nentropy = 0.931\nsamples = 26\nvalue = [17, 9]'),
 Text(0.20608108108108109, 0.13636363636363635, 'X[1] <= 0.5\nentropy = 0.977\nsamples = 17\nvalue = [10, 7]'),
 Text(0.20270270270270271, 0.045454545454545456, 'entropy = 0.954\nsamples = 16\nvalue = [10, 6]'),
 Text(0.20945945945945946, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.21959459459459946, 0.13636363636363635, 'X[4] <= 191250.0\nentropy = 0.764\nsamples = 9\nvalue = [7, 2]'),
 Text(0.21621621621621623, 0.045454545454545456, 'entropy = 0.918\nsamples = 6\nvalue = [4, 2]'),
 Text(0.22297297297297297, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.21959459459459946, 0.22727272727272727, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.20945945945945946, 0.4090909090909091, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.23986486486486486, 0.5, 'X[9] <= 42.5\nentropy = 0.261\nsamples = 68\nvalue = [65, 3]'),
 Text(0.23648648648648649, 0.4090909090909091, 'entropy = 0.0\nsamples = 36\nvalue = [36, 0]'),
 Text(0.24324324324324326, 0.4090909090909091, 'X[9] <= 46.5\nentropy = 0.449\nsamples = 32\nvalue = [29, 3]'),
 Text(0.23986486486486486, 0.3181818181818182, 'X[10] <= 3.5\nentropy = 0.722\nsamples = 15\nvalue = [12, 3]'),
 Text(0.23648648648648649, 0.22727272727272727, 'X[1] <= 0.5\nentropy = 0.592\nsamples = 14\nvalue = [12, 2]'),
 Text(0.23310810810810811, 0.13636363636363635, 'X[3] <= 0.5\nentropy = 0.764\nsamples = 9\nvalue = [7, 2]'),
 Text(0.22972972972972974, 0.045454545454545456, 'entropy = 0.918\nsamples = 6\nvalue = [4, 2]'),
 Text(0.23648648648648649, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.23986486486486486, 0.13636363636363635, 'entropy = 0.0\nsamples = 5\nvalue = [5, 0]'),
 Text(0.24324324324324326, 0.22727272727272727, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.24662162162162163, 0.3181818181818182, 'entropy = 0.0\nsamples = 17\nvalue = [17, 0]'),
 Text(0.2685810810810811, 0.5909090909090909, 'X[4] <= 83250.0\nentropy = 0.768\nsamples = 294\nvalue = [228, 66]'),
 Text(0.2652027027027027, 0.5, 'entropy = 0.0\nsamples = 9\nvalue = [9, 0]'),
 Text(0.2719594594594595, 0.5, 'X[9] <= 61.0\nentropy = 0.781\nsamples = 285\nvalue = [219, 66]'),
 Text(0.2685810810810811, 0.4090909090909091, 'X[9] <= 50.5\nentropy = 0.789\nsamples = 279\nvalue = [213, 66]'),
 Text(0.25675675675675674, 0.3181818181818182, 'X[9] <= 49.5\nentropy = 0.745\nsamples = 217\nvalue = [171, 46]'),
 Text(0.25337837837837837, 0.22727272727272727, 'X[11] <= 1.5\nentropy = 0.76\nsamples = 209\nvalue = [163, 46]'),
 Text(0.24662162162162163, 0.13636363636363635, 'X[9] <= 38.5\nentropy = 0.439\nsamples = 22\nvalue = [20, 2]'),
 Text(0.24324324324324326, 0.045454545454545456, 'entropy = 0.863\nsamples = 7\nvalue = [5, 2]'),
 Text(0.25, 0.045454545454545456, 'entropy = 0.0\nsamples = 15\nvalue = [15, 0]'),
 Text(0.26013513513513514, 0.13636363636363635, 'X[10] <= 14.5\nentropy = 0.787\nsamples = 187\nvalue = [143, 44]'),
 Text(0.25675675675675674, 0.045454545454545456, 'entropy = 0.83\nsamples = 141\nvalue = [104, 37]'),
 Text(0.2635135135135135, 0.045454545454545456, 'entropy = 0.615\nsamples = 46\nvalue = [39, 7]'),
 Text(0.26013513513513514, 0.22727272727272727, 'entropy = 0.0\nsamples = 8\nvalue = [8, 0]'),
 Text(0.28040540540540543, 0.3181818181818182, 'X[4] <= 787500.0\nentropy = 0.907\nsamples = 62\nvalue = [42, 20]'),
 Text(0.27702702702702703, 0.22727272727272727, 'X[7] <= 3.5\nentropy = 0.895\nsamples = 61\nvalue = [42, 19]'),
 Text(0.27364864864864863, 0.13636363636363635, 'X[8] <= 4.0\nentropy = 0.907\nsamples = 59\nvalue = [40, 19]'),
 Text(0.27027027027027027, 0.045454545454545456, 'entropy = 0.918\nsamples = 57\nvalue = [38, 19]'),
 Text(0.27702702702702703, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.28040540540540543, 0.13636363636363635, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.28378378378378377, 0.22727272727272727, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.2753378378378378, 0.4090909090909091, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.38471283783783783, 0.6818181818181818, 'X[0] <= 0.5\nentropy = 0.79\nsamples = 1395\nvalue = [1064, 331]'),
 Text(0.3154560810810811, 0.5909090909090909, 'X[9] <= 36.5\nentropy = 0.809\nsamples = 921\nvalue = [692, 229]'),
 Text(0.2939189189189189, 0.5, 'X[5] <= 2.0\nentropy = 0.503\nsamples = 18\nvalue = [16, 2]'),
 Text(0.2905405405405405, 0.4090909090909091, 'X[4] <= 94500.0\nentropy = 0.764\nsamples = 9\nvalue = [7, 2]'),
 Text(0.28716216216216217, 0.3181818181818182, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.2939189189189189, 0.3181818181818182, 'X[1] <= 0.5\nentropy = 0.863\nsamples = 7\nvalue = [5, 2]'),
 Text(0.2905405405405405, 0.22727272727272727, 'X[10] <= 3.5\nentropy = 0.918\nsamples = 6\nvalue = [4, 2]'),
 Text(0.28716216216216217, 0.13636363636363635, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.2939189189189189, 0.13636363636363635, 'X[11] <= 4.0\nentropy = 0.971\nsamples = 5\nvalue = [3, 2]'),
 Text(0.2905405405405405, 0.045454545454545456, 'entropy = 0.918\nsamples = 3\nvalue = [2, 1]'),
 Text(0.2972972972972973, 0.045454545454545456, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.2972972972972973, 0.22727272727272727, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.2972972972972973, 0.4090909090909091, 'entropy = 0.0\nsamples = 9\nvalue = [9, 0]'),
 Text(0.33699324324324326, 0.5, 'X[3] <= 2.5\nentropy = 0.813\nsamples = 903\nvalue = [676, 227]'),
 Text(0.33361486486486486, 0.4090909090909091, 'X[11] <= 1.5\nentropy = 0.816\nsamples = 897\nvalue = [670, 227]'),
 Text(0.31756756756756754, 0.3181818181818182, 'X[9] <= 38.5\nentropy = 0.771\nsamples = 230\nvalue = [178, 52]'),
 Text(0.3108108108108108, 0.22727272727272727, 'X[9] <= 37.5\nentropy = 1.0\nsamples = 10\nvalue = [5, 5]'),
 Text(0.30743243243243246, 0.13636363636363635, 'X[7] <= 2.5\nentropy = 0.954\nsamples = 8\nvalue = [5, 3]'),
 Text(0.30405405405405406, 0.045454545454545456, 'entropy = 1.0\nsamples = 4\nvalue = [2, 2]'),
 Text(0.3108108108108108, 0.045454545454545456, 'entropy = 0.811\nsamples = 4\nvalue = [3, 1]'),
 Text(0.3141891891891892, 0.13636363636363635, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.32432432432432434, 0.22727272727272727, 'X[8] <= 0.5\nentropy = 0.748\nsamples = 220\nvalue = [173, 47]'),
 Text(0.32094594594594594, 0.13636363636363635, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.3277027027027027, 0.13636363636363635, 'X[9] <= 46.5\nentropy = 0.742\nsamples = 219\nvalue = [173, 46]'),
 Text(0.32432432432432434, 0.045454545454545456, 'entropy = 0.57\nsamples = 52\nvalue = [45, 7]'),
 Text(0.3310810810810811, 0.045454545454545456, 'entropy = 0.784\nsamples = 167\nvalue = [128, 39]'),
 Text(0.34966216216216217, 0.3181818181818182, 'X[9] <= 62.5\nentropy = 0.83\nsamples = 667\nvalue = [492, 175]'),
 Text(0.33783783783783783, 0.22727272727272727, 'X[4] <= 37012.5\nentropy = 0.82\nsamples = 634\nvalue = [472, 162]'),
 Text(0.33445945945945946, 0.13636363636363635, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.34121621621621623, 0.13636363636363635, 'X[7] <= 2.5\nentropy = 0.818\nsamples = 633\nvalue = [472, 161]'),
 Text(0.33783783783783783, 0.045454545454545456, 'entropy = 0.809\nsamples = 607\nvalue = [456, 151]'),
 Text(0.34459459459459457, 0.045454545454545456, 'entropy = 0.961\nsamples = 26\nvalue = [16, 10]'),
 Text(0.36148648648648651, 0.22727272727272727, 'X[1] <= 0.5\nentropy = 0.967\nsamples = 33\nvalue = [20, 13]'),
 Text(0.3547297297297297, 0.13636363636363635, 'X[4] <= 78750.0\nentropy = 0.918\nsamples = 27\nvalue = [18, 9]'),
 Text(0.35135135135135137, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.3581081081081081, 0.045454545454545456, 'entropy = 0.954\nsamples = 24\nvalue = [15, 9]'),
 Text(0.36824324324324326, 0.13636363636363635, 'X[9] <= 63.5\nentropy = 0.918\nsamples = 6\nvalue = [2, 4]'),
 Text(0.36486486486486486, 0.045454545454545456, 'entropy = 0.918\nsamples = 3\nvalue = [2, 1]'),
 Text(0.3716216216216216, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [0, 3]'),
 Text(0.3403716216216216, 0.4090909090909091, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.45396959459459457, 0.5909090909090909, 'X[3] <= 0.5\nentropy = 0.751\nsamples = 474\nvalue = [372, 102]'),
 Text(0.43496621621621623, 0.5, 'X[7] <= 3.5\nentropy = 0.69\nsamples = 320\nvalue = [261, 59]'),
 Text(0.4206081081081081, 0.4090909090909091, 'X[8] <= 3.5\nentropy = 0.674\nsamples = 316\nvalue = [260, 56]'),
 Text(0.40202702702702703, 0.3181818181818182, 'X[5] <= 0.5\nentropy = 0.654\nsamples = 303\nvalue = [252, 51]'),
 Text(0.38851351351351351, 0.22727272727272727, 'X[7] <= 1.5\nentropy = 0.509\nsamples = 62\nvalue = [55, 7]'),
 Text(0.38175675675675674, 0.13636363636363635, 'X[7] <= 0.5\nentropy = 0.332\nsamples = 49\nvalue = [46, 3]'),
 Text(0.3783783783783784, 0.045454545454545456, 'entropy = 0.863\nsamples = 7\nvalue = [5, 2]'),
 Text(0.38513513513513514, 0.045454545454545456, 'entropy = 0.162\nsamples = 42\nvalue = [41, 1]'),
 Text(0.39527027027027023, 0.13636363636363635, 'X[10] <= 15.5\nentropy = 0.89\nsamples = 13\nvalue = [9, 4]'),
 Text(0.3918918918918919, 0.045454545454545456, 'entropy = 0.811\nsamples = 12\nvalue = [9, 3]'),
 Text(0.39864864864864863, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.4155405405405405, 0.22727272727272727, 'X[9] <= 38.5\nentropy = 0.686\nsamples = 241\nvalue = [197, 44]'),
 Text(0.40878378378378377, 0.13636363636363635, 'X[4] <= 159750.0\nentropy = 0.286\nsamples = 20\nvalue = [19, 1]'),
 Text(0.40540540540540543, 0.045454545454545456, 'entropy = 0.503\nsamples = 9\nvalue = [8, 1]'),
 Text(0.41216216216216217, 0.045454545454545456, 'entropy = 0.0\nsamples = 11\nvalue = [11, 0]'),
 Text(0.4222972972972973, 0.13636363636363635, 'X[4] <= 326250.0\nentropy = 0.711\nsamples = 221\nvalue = [178, 43]'),
 Text(0.4189189189189189, 0.045454545454545456, 'entropy = 0.726\nsamples = 213\nvalue = [170, 43]'),
 Text(0.42567567567567566, 0.045454545454545456, 'entropy = 0.0\nsamples = 8\nvalue = [8, 0]'),
 Text(0.4391891891891892, 0.3181818181818182, 'X[4] <= 123750.0\nentropy = 0.961\nsamples = 13\nvalue = [8, 5]'),
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 Text(0.44256756756756754, 0.22727272727272727, 'X[7] <= 1.5\nentropy = 1.0\nsamples = 10\nvalue = [5, 5]'),
 Text(0.4358108108108108, 0.13636363636363635, 'X[9] <= 40.5\nentropy = 0.918\nsamples = 6\nvalue = [2, 4]'),
 Text(0.43243243243243246, 0.045454545454545456, 'entropy = 0.918\nsamples = 3\nvalue = [2, 1]'),
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 Text(0.44932432432432434, 0.13636363636363635, 'X[5] <= 1.0\nentropy = 0.811\nsamples = 4\nvalue = [3, 1]'),
 Text(0.44594594594594594, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.4527027027027027, 0.045454545454545456, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.44932432432432434, 0.4090909090909091, 'X[9] <= 54.0\nentropy = 0.811\nsamples = 4\nvalue = [1, 3]'),
 Text(0.44594594594594594, 0.3181818181818182, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.4527027027027027, 0.3181818181818182, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.47297297297297297, 0.5, 'X[8] <= 2.5\nentropy = 0.854\nsamples = 154\nvalue = [111, 43]'),
 Text(0.46283783783783783, 0.4090909090909091, 'X[11] <= 1.5\nentropy = 0.894\nsamples = 135\nvalue = [93, 42]'),
 Text(0.4594594594594595, 0.3181818181818182, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.46621621621621623, 0.3181818181818182, 'X[7] <= 0.5\nentropy = 0.882\nsamples = 133\nvalue = [93, 40]'),
 Text(0.46283783783783783, 0.22727272727272727, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.46959459459459457, 0.22727272727272727, 'X[1] <= 0.5\nentropy = 0.899\nsamples = 127\nvalue = [87, 40]'),
 Text(0.46283783783783783, 0.13636363636363635, 'X[5] <= 3.0\nentropy = 0.753\nsamples = 37\nvalue = [29, 8]'),
 Text(0.4594594594594595, 0.045454545454545456, 'entropy = 0.0\nsamples = 8\nvalue = [8, 0]'),
 Text(0.46621621621621623, 0.045454545454545456, 'entropy = 0.85\nsamples = 29\nvalue = [21, 8]'),
 Text(0.47635135135135137, 0.13636363636363635, 'X[9] <= 46.5\nentropy = 0.939\nsamples = 90\nvalue = [58, 32]'),
 Text(0.47297297297297297, 0.045454545454545456, 'entropy = 0.964\nsamples = 72\nvalue = [44, 28]'),
 Text(0.4797297297297297, 0.045454545454545456, 'entropy = 0.764\nsamples = 18\nvalue = [14, 4]'),
 Text(0.4831081081081081, 0.4090909090909091, 'X[4] <= 123750.0\nentropy = 0.297\nsamples = 19\nvalue = [18, 1]'),
 Text(0.4797297297297297, 0.3181818181818182, 'X[3] <= 1.5\nentropy = 0.918\nsamples = 3\nvalue = [2, 1]'),
 Text(0.47635135135135137, 0.22727272727272727, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.4831081081081081, 0.22727272727272727, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.4864864864864865, 0.3181818181818182, 'entropy = 0.0\nsamples = 16\nvalue = [16, 0]'),
 Text(0.6844911317567568, 0.7727272727272727, 'X[4] <= 191250.0\nentropy = 0.714\nsamples = 4248\nvalue = [3416, 832]'),
 Text(0.5770692567567568, 0.6818181818181818, 'X[10] <= 4.5\nentropy = 0.688\nsamples = 2643\nvalue = [2158, 485]'),
 Text(0.5198479729729729, 0.5909090909090909, 'X[4] <= 42750.0\nentropy = 0.726\nsamples = 1480\nvalue = [1181, 299]'),
 Text(0.5, 0.5, 'X[9] <= 59.5\nentropy = 0.985\nsamples = 7\nvalue = [3, 4]'),
 Text(0.4966216216216216, 0.4090909090909091, 'X[9] <= 54.0\nentropy = 0.971\nsamples = 5\nvalue = [3, 2]'),
 Text(0.49324324324324326, 0.3181818181818182, 'X[4] <= 39150.0\nentropy = 1.0\nsamples = 4\nvalue = [2, 2]'),
 Text(0.48986486486486486, 0.22727272727272727, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.4966216216216216, 0.22727272727272727, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.5, 0.3181818181818182, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.5033783783783784, 0.4090909090909091, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.5396959459459459, 0.5, 'X[9] <= 68.5\nentropy = 0.722\nsamples = 1473\nvalue = [1178, 295]'),
 Text(0.5363175675675675, 0.4090909090909091, 'X[5] <= 3.0\nentropy = 0.721\nsamples = 1472\nvalue = [1178, 294]'),
 Text(0.5118243243243243, 0.3181818181818182, 'X[1] <= 0.5\nentropy = 0.694\nsamples = 960\nvalue = [781, 179]'),
 Text(0.5033783783783784, 0.22727272727272727, 'X[4] <= 182250.0\nentropy = 0.719\nsamples = 751\nvalue = [602, 149]'),
 Text(0.5, 0.13636363636363635, 'X[4] <= 55125.0\nentropy = 0.722\nsamples = 744\nvalue = [595, 149]'),
 Text(0.4966216216216216, 0.045454545454545456, 'entropy = 0.449\nsamples = 32\nvalue = [29, 3]'),
 Text(0.5033783783783784, 0.045454545454545456, 'entropy = 0.732\nsamples = 712\nvalue = [566, 146]'),
 Text(0.5067567567567568, 0.13636363636363635, 'entropy = 0.0\nsamples = 7\nvalue = [7, 0]'),
 Text(0.5202702702702703, 0.22727272727272727, 'X[4] <= 141750.0\nentropy = 0.593\nsamples = 209\nvalue = [179, 30]'),
 Text(0.5135135135135135, 0.13636363636363635, 'X[4] <= 83250.0\nentropy = 0.471\nsamples = 129\nvalue = [116, 13]'),
 Text(0.5101351351351351, 0.045454545454545456, 'entropy = 0.852\nsamples = 18\nvalue = [13, 5]'),
 Text(0.5168918918918919, 0.045454545454545456, 'entropy = 0.374\nsamples = 111\nvalue = [103, 8]'),
 Text(0.527027027027027, 0.13636363636363635, 'X[9] <= 61.5\nentropy = 0.746\nsamples = 80\nvalue = [63, 17]'),
 Text(0.5236486486486487, 0.045454545454545456, 'entropy = 0.668\nsamples = 63\nvalue = [52, 11]'),
 Text(0.5304054054054054, 0.045454545454545456, 'entropy = 0.937\nsamples = 17\nvalue = [11, 6]'),
 Text(0.5608108108108109, 0.3181818181818182, 'X[7] <= 2.5\nentropy = 0.768\nsamples = 512\nvalue = [397, 115]'),
 Text(0.5472972972972973, 0.22727272727272727, 'X[6] <= 1.5\nentropy = 0.735\nsamples = 436\nvalue = [346, 90]'),
 Text(0.5405405405405406, 0.13636363636363635, 'X[1] <= 0.5\nentropy = 0.457\nsamples = 52\nvalue = [47, 5]'),
 Text(0.5371621621621622, 0.045454545454545456, 'entropy = 0.663\nsamples = 29\nvalue = [24, 5]'),
 Text(0.543918918918919, 0.045454545454545456, 'entropy = 0.0\nsamples = 23\nvalue = [23, 0]'),
 Text(0.5540540540540541, 0.13636363636363635, 'X[9] <= 49.5\nentropy = 0.763\nsamples = 384\nvalue = [299, 85]'),
 Text(0.5506756756756757, 0.045454545454545456, 'entropy = 0.808\nsamples = 278\nvalue = [209, 69]'),
 Text(0.5574324324324325, 0.045454545454545456, 'entropy = 0.612\nsamples = 106\nvalue = [90, 16]'),
 Text(0.5743243243243243, 0.22727272727272727, 'X[10] <= 0.5\nentropy = 0.914\nsamples = 76\nvalue = [51, 25]'),
 Text(0.5675675675675675, 0.13636363636363635, 'X[9] <= 43.5\nentropy = 0.811\nsamples = 4\nvalue = [1, 3]'),
 Text(0.5641891891891891, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.5709459459459459, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [0, 3]'),
 Text(0.5810810810810811, 0.13636363636363635, 'X[9] <= 59.0\nentropy = 0.888\nsamples = 72\nvalue = [50, 22]'),
 Text(0.5777027027027027, 0.045454545454545456, 'entropy = 0.913\nsamples = 67\nvalue = [45, 22]'),
 Text(0.5844594594594594, 0.045454545454545456, 'entropy = 0.0\nsamples = 5\nvalue = [5, 0]'),
 Text(0.5430743243243243, 0.4090909090909091, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.6342905405405406, 0.5909090909090909, 'X[4] <= 182250.0\nentropy = 0.634\nsamples = 1163\nvalue = [977, 186]'),
 Text(0.6309121621621622, 0.5, 'X[4] <= 119475.0\nentropy = 0.638\nsamples = 1150\nvalue = [964, 186]'),
 Text(0.6013513513513513, 0.4090909090909091, 'X[8] <= 1.5\nentropy = 0.571\nsamples = 415\nvalue = [359, 56]'),
 Text(0.597972972972973, 0.3181818181818182, 'X[10] <= 14.5\nentropy = 0.586\nsamples = 398\nvalue = [342, 56]'),
 Text(0.5912162162162162, 0.22727272727272727, 'X[8] <= 0.5\nentropy = 0.521\nsamples = 273\nvalue = [241, 32]'),
 Text(0.5878378378378378, 0.13636363636363635, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.5945945945945946, 0.13636363636363635, 'X[9] <= 50.5\nentropy = 0.512\nsamples = 272\nvalue = [241, 31]'),
 Text(0.5912162162162162, 0.045454545454545456, 'entropy = 0.429\nsamples = 182\nvalue = [166, 16]'),
 Text(0.597972972972973, 0.045454545454545456, 'entropy = 0.65\nsamples = 90\nvalue = [75, 15]'),
 Text(0.6047297297297297, 0.22727272727272727, 'X[9] <= 39.5\nentropy = 0.706\nsamples = 125\nvalue = [101, 24]'),
 Text(0.6013513513513513, 0.13636363636363635, 'entropy = 0.0\nsamples = 12\nvalue = [12, 0]'),
 Text(0.6081081081081081, 0.13636363636363635, 'X[7] <= 0.5\nentropy = 0.746\nsamples = 113\nvalue = [89, 24]'),
 Text(0.6047297297297297, 0.045454545454545456, 'entropy = 1.0\nsamples = 8\nvalue = [4, 4]'),
 Text(0.6114864864864865, 0.045454545454545456, 'entropy = 0.702\nsamples = 105\nvalue = [85, 20]'),
 Text(0.6047297297297297, 0.3181818181818182, 'entropy = 0.0\nsamples = 17\nvalue = [17, 0]'),
 Text(0.6604729729729730, 0.4090909090909091, 'X[0] <= 0.5\nentropy = 0.673\nsamples = 735\nvalue = [605, 130]'),
 Text(0.6402027027027027, 0.3181818181818182, 'X[10] <= 26.5\nentropy = 0.714\nsamples = 536\nvalue = [431, 105]'),
 Text(0.6283783783783784, 0.22727272727272727, 'X[11] <= 3.5\nentropy = 0.726\nsamples = 515\nvalue = [411, 104]'),
 Text(0.6216216216216216, 0.13636363636363635, 'X[7] <= 3.5\nentropy = 0.743\nsamples = 479\nvalue = [378, 101]'),
 Text(0.6182432432432432, 0.045454545454545456, 'entropy = 0.754\nsamples = 452\nvalue = [354, 98]'),
 Text(0.625, 0.045454545454545456, 'entropy = 0.503\nsamples = 27\nvalue = [24, 3]'),
 Text(0.6351351351351351, 0.13636363636363635, 'X[7] <= 2.5\nentropy = 0.414\nsamples = 36\nvalue = [33, 3]'),
 Text(0.6317567567567568, 0.045454545454545456, 'entropy = 0.316\nsamples = 35\nvalue = [33, 2]'),
 Text(0.6385135135135135, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.6520270270270270, 0.22727272727272727, 'X[4] <= 148500.0\nentropy = 0.276\nsamples = 21\nvalue = [20, 1]'),
 Text(0.6486486486486487, 0.13636363636363635, 'X[4] <= 139500.0\nentropy = 0.503\nsamples = 9\nvalue = [8, 1]'),
 Text(0.6452702702702703, 0.045454545454545456, 'entropy = 0.0\nsamples = 7\nvalue = [7, 0]'),
 Text(0.6520270270270270, 0.045454545454545456, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.6554054054054054, 0.13636363636363635, 'entropy = 0.0\nsamples = 12\nvalue = [12, 0]'),
 Text(0.6807432432432432, 0.3181818181818182, 'X[10] <= 10.5\nentropy = 0.545\nsamples = 199\nvalue = [174, 25]'),
 Text(0.6689189189189189, 0.22727272727272727, 'X[4] <= 123750.0\nentropy = 0.671\nsamples = 125\nvalue = [103, 22]'),
 Text(0.6621621621621622, 0.13636363636363635, 'X[10] <= 7.5\nentropy = 0.918\nsamples = 3\nvalue = [1, 2]'),
 Text(0.6587837837837838, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [1, 0]'),
 Text(0.6655405405405406, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.6756756756756757, 0.13636363636363635, 'X[7] <= 3.5\nentropy = 0.644\nsamples = 122\nvalue = [102, 20]'),
 Text(0.6722972972972973, 0.045454545454545456, 'entropy = 0.627\nsamples = 121\nvalue = [102, 19]'),
 Text(0.6790540540540541, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.6925675675675675, 0.22727272727272727, 'X[8] <= 3.5\nentropy = 0.245\nsamples = 74\nvalue = [71, 3]'),
 Text(0.6891891891891891, 0.13636363636363635, 'X[1] <= 0.5\nentropy = 0.181\nsamples = 73\nvalue = [71, 2]'),
 Text(0.6858108108108109, 0.045454545454545456, 'entropy = 0.353\nsamples = 30\nvalue = [28, 2]'),
 Text(0.6925675675675675, 0.045454545454545456, 'entropy = 0.0\nsamples = 43\nvalue = [43, 0]'),
 Text(0.6959459459459459, 0.13636363636363635, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.6376689189189189, 0.5, 'entropy = 0.0\nsamples = 13\nvalue = [13, 0]'),
 Text(0.7919130067567568, 0.6818181818181818, 'X[9] <= 37.5\nentropy = 0.753\nsamples = 1605\nvalue = [1258, 347]'),
 Text(0.7331081081081081, 0.5909090909090909, 'X[7] <= 1.5\nentropy = 0.552\nsamples = 125\nvalue = [109, 16]'),
 Text(0.7297297297297297, 0.5, 'X[10] <= 5.5\nentropy = 0.642\nsamples = 98\nvalue = [82, 16]'),
 Text(0.7162162162162162, 0.4090909090909091, 'X[10] <= 3.5\nentropy = 0.529\nsamples = 50\nvalue = [44, 6]'),
 Text(0.7128378378378378, 0.3181818181818182, 'X[10] <= 1.5\nentropy = 0.661\nsamples = 35\nvalue = [29, 6]'),
 Text(0.7060810810810811, 0.22727272727272727, 'X[1] <= 0.5\nentropy = 0.371\nsamples = 14\nvalue = [13, 1]'),
 Text(0.7027027027027027, 0.13636363636363635, 'X[4] <= 236250.0\nentropy = 0.811\nsamples = 4\nvalue = [3, 1]'),
 Text(0.6993243243243243, 0.045454545454545456, 'entropy = 1.0\nsamples = 2\nvalue = [1, 1]'),
 Text(0.7060810810810811, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.7094594594594594, 0.13636363636363635, 'entropy = 0.0\nsamples = 10\nvalue = [10, 0]'),
 Text(0.7195945945945946, 0.22727272727272727, 'X[4] <= 213750.0\nentropy = 0.792\nsamples = 21\nvalue = [16, 5]'),
 Text(0.7162162162162162, 0.13636363636363635, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.722972972972973, 0.13636363636363635, 'X[3] <= 1.5\nentropy = 0.852\nsamples = 18\nvalue = [13, 5]'),
 Text(0.7195945945945946, 0.045454545454545456, 'entropy = 0.722\nsamples = 10\nvalue = [8, 2]'),
 Text(0.7263513513513513, 0.045454545454545456, 'entropy = 0.954\nsamples = 8\nvalue = [5, 3]'),
 Text(0.7195945945945946, 0.3181818181818182, 'entropy = 0.0\nsamples = 15\nvalue = [15, 0]'),
 Text(0.7432432432432432, 0.4090909090909091, 'X[8] <= 4.5\nentropy = 0.738\nsamples = 48\nvalue = [38, 10]'),
 Text(0.7398648648648649, 0.3181818181818182, 'X[7] <= 0.5\nentropy = 0.705\nsamples = 47\nvalue = [38, 9]'),
 Text(0.7364864864864865, 0.22727272727272727, 'entropy = 0.0\nsamples = 5\nvalue = [5, 0]'),
 Text(0.7432432432432432, 0.22727272727272727, 'X[5] <= 1.0\nentropy = 0.75\nsamples = 42\nvalue = [33, 9]'),
 Text(0.7364864864864865, 0.13636363636363635, 'X[11] <= 3.5\nentropy = 0.414\nsamples = 12\nvalue = [11, 1]'),
 Text(0.7331081081081081, 0.045454545454545456, 'entropy = 0.0\nsamples = 8\nvalue = [8, 0]'),
 Text(0.7398648648648649, 0.045454545454545456, 'entropy = 0.811\nsamples = 4\nvalue = [3, 1]'),
 Text(0.75, 0.13636363636363635, 'X[10] <= 15.5\nentropy = 0.837\nsamples = 30\nvalue = [22, 8]'),
 Text(0.7466216216216216, 0.045454545454545456, 'entropy = 0.877\nsamples = 27\nvalue = [19, 8]'),
 Text(0.7533783783783784, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.7466216216216216, 0.3181818181818182, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.7364864864864865, 0.5, 'entropy = 0.0\nsamples = 27\nvalue = [27, 0]'),
 Text(0.8507179054054054, 0.5909090909090909, 'X[4] <= 218250.0\nentropy = 0.767\nsamples = 1480\nvalue = [1149, 331]'),
 Text(0.7998310810810811, 0.5, 'X[0] <= 0.5\nentropy = 0.842\nsamples = 337\nvalue = [246, 91]'),
 Text(0.7820945945945946, 0.4090909090909091, 'X[3] <= 0.5\nentropy = 0.758\nsamples = 224\nvalue = [175, 49]'),
 Text(0.7668918918918919, 0.3181818181818182, 'X[7] <= 0.5\nentropy = 0.792\nsamples = 193\nvalue = [147, 46]'),
 Text(0.7635135135135135, 0.22727272727272727, 'entropy = 0.0\nsamples = 11\nvalue = [11, 0]'),
 Text(0.7702702702702703, 0.22727272727272727, 'X[9] <= 45.5\nentropy = 0.816\nsamples = 182\nvalue = [136, 46]'),
 Text(0.7635135135135135, 0.13636363636363635, 'X[10] <= 14.5\nentropy = 0.954\nsamples = 40\nvalue = [25, 15]'),
 Text(0.7601351351351351, 0.045454545454545456, 'entropy = 0.98\nsamples = 36\nvalue = [21, 15]'),
 Text(0.7668918918918919, 0.045454545454545456, 'entropy = 0.0\nsamples = 4\nvalue = [4, 0]'),
 Text(0.777027027027027, 0.13636363636363635, 'X[9] <= 66.0\nentropy = 0.757\nsamples = 142\nvalue = [111, 31]'),
 Text(0.7736486486486487, 0.045454545454545456, 'entropy = 0.747\nsamples = 141\nvalue = [111, 30]'),
 Text(0.7804054054054054, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.7972972972972973, 0.3181818181818182, 'X[9] <= 39.5\nentropy = 0.459\nsamples = 31\nvalue = [28, 3]'),
 Text(0.793918918918919, 0.22727272727272727, 'X[10] <= 10.0\nentropy = 0.779\nsamples = 13\nvalue = [10, 3]'),
 Text(0.7905405405405406, 0.13636363636363635, 'X[10] <= 1.5\nentropy = 0.918\nsamples = 9\nvalue = [6, 3]'),
 Text(0.7871621621621622, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [2, 0]'),
 Text(0.793918918918919, 0.045454545454545456, 'entropy = 0.985\nsamples = 7\nvalue = [4, 3]'),
 Text(0.7972972972972973, 0.13636363636363635, 'entropy = 0.0\nsamples = 4\nvalue = [4, 0]'),
 Text(0.8006756756756757, 0.22727272727272727, 'entropy = 0.0\nsamples = 18\nvalue = [18, 0]'),
 Text(0.8175675675675675, 0.4090909090909091, 'X[11] <= 4.5\nentropy = 0.952\nsamples = 113\nvalue = [71, 42]'),
 Text(0.8141891891891891, 0.3181818181818182, 'X[8] <= 3.0\nentropy = 0.943\nsamples = 111\nvalue = [71, 40]'),
 Text(0.8108108108108109, 0.22727272727272727, 'X[10] <= 10.5\nentropy = 0.951\nsamples = 108\nvalue = [68, 40]'),
 Text(0.8040540540540541, 0.13636363636363635, 'X[7] <= 0.5\nentropy = 0.922\nsamples = 89\nvalue = [59, 30]'),
 Text(0.8006756756756757, 0.045454545454545456, 'entropy = 0.0\nsamples = 4\nvalue = [4, 0]'),
 Text(0.8074324324324325, 0.045454545454545456, 'entropy = 0.937\nsamples = 85\nvalue = [55, 30]'),
 Text(0.8175675675675675, 0.13636363636363635, 'X[9] <= 41.5\nentropy = 0.998\nsamples = 19\nvalue = [9, 10]'),
 Text(0.8141891891891891, 0.045454545454545456, 'entropy = 0.0\nsamples = 4\nvalue = [0, 4]'),
 Text(0.8209459459459459, 0.045454545454545456, 'entropy = 0.971\nsamples = 15\nvalue = [9, 6]'),
 Text(0.8175675675675675, 0.22727272727272727, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.8209459459459459, 0.3181818181818182, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.9016047297297297, 0.5, 'X[9] <= 43.5\nentropy = 0.741\nsamples = 1143\nvalue = [903, 240]'),
 Text(0.8572635135135135, 0.4090909090909091, 'X[0] <= 0.5\nentropy = 0.656\nsamples = 301\nvalue = [250, 51]'),
 Text(0.8378378378378378, 0.3181818181818182, 'X[1] <= 0.5\nentropy = 0.73\nsamples = 157\nvalue = [125, 32]'),
 Text(0.8277027027027027, 0.22727272727272727, 'X[4] <= 229500.0\nentropy = 0.587\nsamples = 78\nvalue = [67, 11]'),
 Text(0.8243243243243243, 0.13636363636363635, 'entropy = 0.0\nsamples = 21\nvalue = [21, 0]'),
 Text(0.831081081081081, 0.13636363636363635, 'X[11] <= 2.5\nentropy = 0.708\nsamples = 57\nvalue = [46, 11]'),
 Text(0.8277027027027027, 0.045454545454545456, 'entropy = 0.842\nsamples = 37\nvalue = [27, 10]'),
 Text(0.8344594594594594, 0.045454545454545456, 'entropy = 0.286\nsamples = 20\nvalue = [19, 1]'),
 Text(0.847972972972973, 0.22727272727272727, 'X[8] <= 1.5\nentropy = 0.835\nsamples = 79\nvalue = [58, 21]'),
 Text(0.8445945945945946, 0.13636363636363635, 'X[4] <= 607500.0\nentropy = 0.85\nsamples = 76\nvalue = [55, 21]'),
 Text(0.8412162162162162, 0.045454545454545456, 'entropy = 0.866\nsamples = 73\nvalue = [52, 21]'),
 Text(0.847972972972973, 0.045454545454545456, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.8513513513513513, 0.13636363636363635, 'entropy = 0.0\nsamples = 3\nvalue = [3, 0]'),
 Text(0.8766891891891891, 0.3181818181818182, 'X[4] <= 249750.0\nentropy = 0.563\nsamples = 144\nvalue = [125, 19]'),
 Text(0.8648648648648649, 0.22727272727272727, 'X[4] <= 240750.0\nentropy = 0.715\nsamples = 56\nvalue = [45, 11]'),
 Text(0.8581081081081081, 0.13636363636363635, 'X[6] <= 1.5\nentropy = 0.559\nsamples = 46\nvalue = [40, 6]'),
 Text(0.8547297297297297, 0.045454545454545456, 'entropy = 0.918\nsamples = 12\nvalue = [8, 4]'),
 Text(0.8614864864864865, 0.045454545454545456, 'entropy = 0.323\nsamples = 34\nvalue = [32, 2]'),
 Text(0.8716216216216216, 0.13636363636363635, 'X[5] <= 2.0\nentropy = 1.0\nsamples = 10\nvalue = [5, 5]'),
 Text(0.8682432432432432, 0.045454545454545456, 'entropy = 0.0\nsamples = 2\nvalue = [0, 2]'),
 Text(0.875, 0.045454545454545456, 'entropy = 0.954\nsamples = 8\nvalue = [5, 3]'),
 Text(0.8885135135135135, 0.22727272727272727, 'X[10] <= 15.5\nentropy = 0.439\nsamples = 88\nvalue = [80, 8]'),
 Text(0.8851351351351351, 0.13636363636363635, 'X[10] <= 12.5\nentropy = 0.473\nsamples = 79\nvalue = [71, 8]'),
 Text(0.8817567567567568, 0.045454545454545456, 'entropy = 0.391\nsamples = 65\nvalue = [60, 5]'),
 Text(0.8885135135135135, 0.045454545454545456, 'entropy = 0.75\nsamples = 14\nvalue = [11, 3]'),
 Text(0.8918918918918919, 0.13636363636363635, 'entropy = 0.0\nsamples = 9\nvalue = [9, 0]'),
 Text(0.9459459459459459, 0.4090909090909091, 'X[10] <= 1.5\nentropy = 0.768\nsamples = 842\nvalue = [653, 189]'),
 Text(0.9189189189189189, 0.3181818181818182, 'X[9] <= 58.5\nentropy = 0.693\nsamples = 253\nvalue = [206, 47]'),
 Text(0.9054054054054054, 0.22727272727272727, 'X[9] <= 50.5\nentropy = 0.526\nsamples = 143\nvalue = [126, 17]'),
 Text(0.8986486486486487, 0.13636363636363635, 'X[7] <= 0.5\nentropy = 0.667\nsamples = 69\nvalue = [57, 12]'),
 Text(0.8952702702702703, 0.045454545454545456, 'entropy = 0.971\nsamples = 10\nvalue = [6, 4]'),
 Text(0.9020270270270270, 0.045454545454545456, 'entropy = 0.573\nsamples = 59\nvalue = [51, 8]'),
 Text(0.9121621621621622, 0.13636363636363635, 'X[4] <= 297000.0\nentropy = 0.357\nsamples = 74\nvalue = [69, 5]'),
 Text(0.9087837837837838, 0.045454545454545456, 'entropy = 0.496\nsamples = 46\nvalue = [41, 5]'),
 Text(0.9155405405405406, 0.045454545454545456, 'entropy = 0.0\nsamples = 28\nvalue = [28, 0]'),
 Text(0.9324324324324325, 0.22727272727272727, 'X[7] <= 2.5\nentropy = 0.845\nsamples = 110\nvalue = [80, 30]'),
 Text(0.9256756756756757, 0.13636363636363635, 'X[7] <= 1.5\nentropy = 0.79\nsamples = 76\nvalue = [58, 18]'),
 Text(0.9222972972972973, 0.045454545454545456, 'entropy = 0.822\nsamples = 70\nvalue = [52, 18]'),
 Text(0.9290540540540541, 0.045454545454545456, 'entropy = 0.0\nsamples = 6\nvalue = [6, 0]'),
 Text(0.9391891891891891, 0.13636363636363635, 'X[9] <= 66.0\nentropy = 0.937\nsamples = 34\nvalue = [22, 12]'),
 Text(0.9358108108108109, 0.045454545454545456, 'entropy = 0.918\nsamples = 33\nvalue = [22, 11]'),
 Text(0.9425675675675675, 0.045454545454545456, 'entropy = 0.0\nsamples = 1\nvalue = [0, 1]'),
 Text(0.972972972972973, 0.3181818181818182, 'X[4] <= 384750.0\nentropy = 0.797\nsamples = 589\nvalue = [447, 142]'),
 Text(0.9594594594594594, 0.22727272727272727, 'X[3] <= 1.5\nentropy = 0.764\nsamples = 486\nvalue = [378, 108]'),
 Text(0.9527027027027027, 0.13636363636363635, 'X[9] <= 44.5\nentropy = 0.774\nsamples = 466\nvalue = [360, 106]'),
 Text(0.9493243243243243, 0.045454545454545456, 'entropy = 0.918\nsamples = 33\nvalue = [22, 11]'),
 Text(0.956081081081081, 0.045454545454545456, 'entropy = 0.759\nsamples = 433\nvalue = [338, 95]'),
 Text(0.9662162162162162, 0.13636363636363635, 'X[5] <= 3.0\nentropy = 0.469\nsamples = 20\nvalue = [18, 2]'),
 Text(0.9628378378378378, 0.045454545454545456, 'entropy = 0.0\nsamples = 12\nvalue = [12, 0]'),
 Text(0.9695945945945946, 0.045454545454545456, 'entropy = 0.811\nsamples = 8\nvalue = [6, 2]'),
 Text(0.9864864864864865, 0.22727272727272727, 'X[6] <= 2.5\nentropy = 0.915\nsamples = 103\nvalue = [69, 34]'),
 Text(0.9797297297297297, 0.13636363636363635, 'X[10] <= 10.5\nentropy = 0.755\nsamples = 46\nvalue = [36, 10]'),
 Text(0.9763513513513513, 0.045454545454545456, 'entropy = 0.48\nsamples = 29\nvalue = [26, 3]'),
 Text(0.9831081081081081, 0.045454545454545456, 'entropy = 0.977\nsamples = 17\nvalue = [10, 7]'),
 Text(0.9932432432432432, 0.13636363636363635, 'X[3] <= 0.5\nentropy = 0.982\nsamples = 57\nvalue = [33, 24]'),
 Text(0.9898648648648649, 0.045454545454545456, 'entropy = 0.939\nsamples = 45\nvalue = [29, 16]'),
 Text(0.9966216216216216, 0.045454545454545456, 'entropy = 0.918\nsamples = 12\nvalue = [4, 8]')]
```
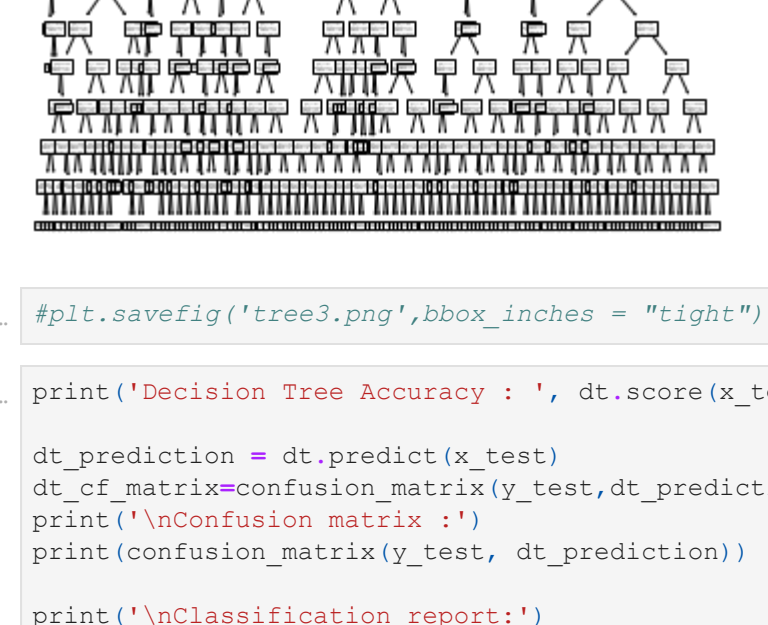



In [108…

```
#plt.savefig('tree3.png',bbox_inches = "tight")
```

In [118…

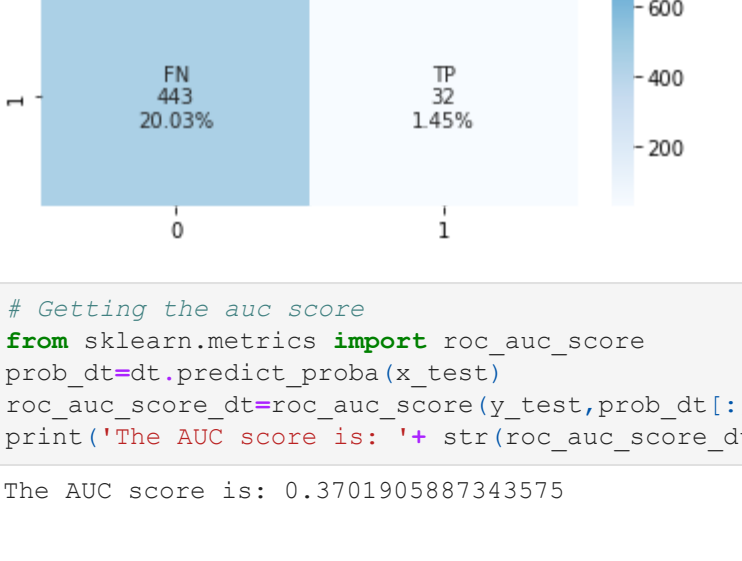
```
print('Decision Tree Accuracy : ', dt.score(x_test, y_test)*100, '%')

dt_prediction = dt.predict(x_test)
dt_cf_matrix=confusion_matrix(y_test,dt_prediction)
print('\nConfusion matrix :')
print(confusion_matrix(y_test, dt_prediction))

print('\nClassification report:')
print(classification_report(y_test, dt_prediction))
```

```
Decision Tree Accuracy :  58.67992766726944 %

Confusion matrix :
[[1266  471]
 [ 443   32]]

Classification report:
              precision    recall  f1-score   support

           0       0.74      0.73      0.73      1737
           1       0.06      0.07      0.07       475

    accuracy                           0.59      2212
   macro avg       0.40      0.40      0.40      2212
weighted avg       0.60      0.59      0.59      2212
```

In [129…

```
condition_dt = ["TN","FP","FN","TP"]
counts_dt = ['{0:0.0f}'.format(value) for value in dt_cf_matrix.flatten()]
percent_dt = ['{0:.2%}'.format(value) for value in dt_cf_matrix.flatten()/np.sum(dt_cf_matrix)]
labels_dt = [f'{v1}\n{v2}\n{v3}' for v1, v2, v3 in zip(condition_dt,counts_dt,percent_dt)]
labels_dt = np.asarray(labels_dt).reshape(2,2)
sns.heatmap(dt_cf_matrix, annot=labels_dt, fmt='', cmap='Blues')
```

Out[129]: <AxesSubplot:>



In [132…

```
# Getting the auc score
from sklearn.metrics import roc_auc_score
prob_dt=dt.predict_proba(x_test)
roc_auc_score_dt=roc_auc_score(y_test,prob_dt[:,1])
print('The AUC score is: '+ str(roc_auc_score_dt))
```

```
The AUC score is: 0.3701905887343575
```

Balancing dataset

In [110…

```
# scaling all features
from sklearn.preprocessing import MinMaxScaler
MMS = MinMaxScaler()
x_train_scaled = pd.DataFrame(MMS.fit_transform(x_train), columns=x_train.columns)
x_test_scaled = pd.DataFrame(MMS.transform(x_test), columns=x_test.columns)
```

In [111…

```
# adding samples to minority class using SMOTE
from imblearn.over_sampling import SMOTE
oversample = SMOTE()

x_train_oversam, y_train_oversam = oversample.fit_resample(x_train_scaled, y_train)
x_test_oversam, y_test_oversam = oversample.fit_resample(x_test_scaled, y_test)
```

In [112…

```
# Original majority and minority class
y_train.value_counts(normalize=True)*100
```

Out[112]:

```
0    78.510061
1    21.489939
Name: STATUS, dtype: float64
```

In [113…

```
# after using SMOTE
y_train_oversam.value_counts(normalize=True)*100
```

Out[113]:

```
0    50.0
1    50.0
Name: STATUS, dtype: float64
```

Machine Learning Model after Balancing

Random Forest after balancing

In [114…

```
# Using RandomForest Classifier to build the forecasting model
from sklearn.ensemble import RandomForestClassifier
rf_oversam=RandomForestClassifier(random_state=20, n_estimators=100, criterion='entropy')
rf_oversam.fit(x_train_oversam, y_train_oversam)
```

Out[114]: RandomForestClassifier(criterion='entropy', random_state=20)

In [115…

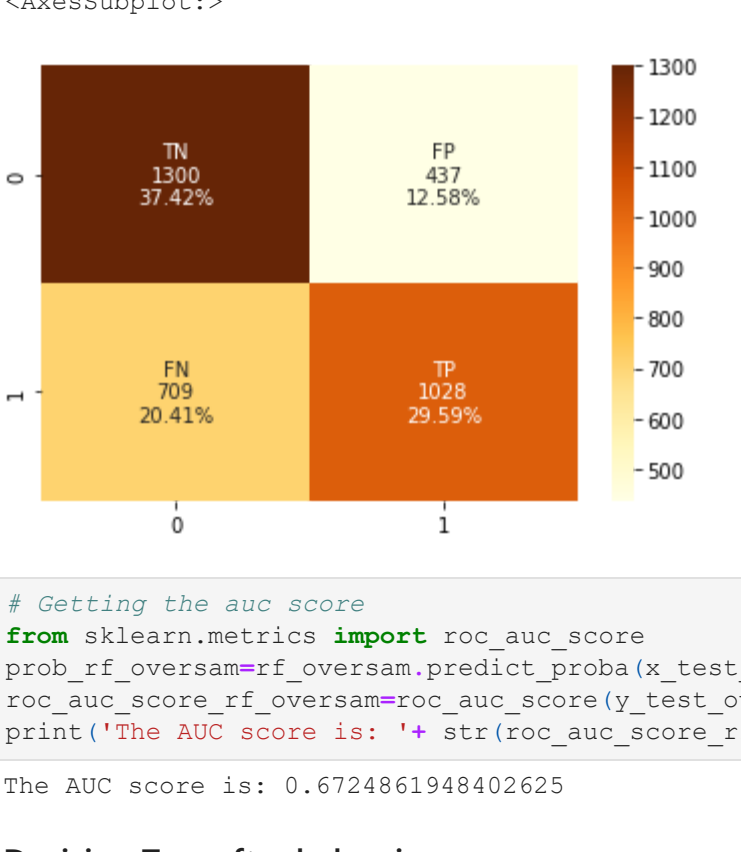
```
print('Random Forest (Balancing) Accuracy : ', rf_oversam.score(x_test_oversam, y_test_oversam)*100, '%')

from sklearn.metrics import confusion_matrix
prediction_oversam = rf_oversam.predict(x_test_oversam)
cf_matrix_oversam=confusion_matrix(y_test_oversam, prediction_oversam)
print('\nConfusion matrix :')
print(confusion_matrix(y_test_oversam, prediction_oversam))

from sklearn.metrics import classification_report
print('\nClassification report:')
print(classification_report(y_test_oversam, prediction_oversam))
```

```
Random Forest (Balancing) Accuracy :  67.01208981001727 %

Confusion matrix :
[[1300  437]
 [ 709 1028]]

Classification report:
              precision    recall  f1-score   support

           0       0.65      0.75      0.69      1737
           1       0.70      0.59      0.64      1737

    accuracy                           0.67      3474
   macro avg       0.67      0.67      0.67      3474
weighted avg       0.67      0.67      0.67      3474
```

In [119…

```
condition_oversam = ["TN","FP","FN","TP"]
counts_oversam = ['{0:0.0f}'.format(value) for value in cf_matrix_oversam.flatten()]
percent_oversam = ['{0:.2%}'.format(value) for value in cf_matrix_oversam.flatten()/np.sum(cf_matrix_oversam)]
labels_oversam = [f'{v1}\n{v2}\n{v3}' for v1, v2, v3 in zip(condition_oversam,counts_oversam,percent_oversam)]
labels_oversam = np.asarray(labels_oversam).reshape(2,2)
sns.heatmap(cf_matrix_oversam, annot=labels_oversam, fmt='', cmap='YlOrBr')
```

Out[119]: <AxesSubplot:>



In [134…

```
# Getting the auc score
from sklearn.metrics import roc_auc_score
prob_rf_oversam=rf_oversam.predict_proba(x_test_oversam)
roc_auc_score_rf_oversam=roc_auc_score(y_test_oversam,prob_rf_oversam[:,1])
print('The AUC score is: '+ str(roc_auc_score_rf_oversam))
```

```
The AUC score is: 0.6724861948402625
```

Decision Tree after balancing

In [121…

```
from sklearn import tree
dt_oversam =tree.DecisionTreeClassifier(criterion='entropy')
dt_oversam.fit(x_train_oversam, y_train_oversam)
```

Out[121]: DecisionTreeClassifier(criterion='entropy')

In [122…

```
text_representation_oversam = tree.export_text(dt_oversam)
print(text_representation_oversam)
```

```
|--- feature_10 <= 0.03
|   |--- feature_10 <= 0.02
|   |   |--- feature_10 <= 0.00
|   |   |   |--- feature_9 <= 0.73
|   |   |   |   |--- feature_9 <= 0.73
|   |   |   |   |   |--- feature_9 <= 0.71
|   |   |   |   |   |   |--- feature_4 <= 0.20
|   |   |   |   |   |   |   |--- feature_5 <= 0.02
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.45
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.22
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.10
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  0.10
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.22
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.30
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.30
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |--- feature_9 >  0.45
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_5 >  0.02
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.59
|   |   |   |   |   |   |   |   |   |--- feature_6 <= 0.38
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_6 >  0.38
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.20
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.20
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 21
|   |   |   |   |   |   |   |   |--- feature_9 >  0.59
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.71
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.69
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 13
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.69
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.71
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.17
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 10
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.17
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |--- feature_4 >  0.20
|   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.58
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.14
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.58
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.70
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.70
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.38
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.30
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 8
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.30
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_5 >  0.38
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |--- feature_7 <= 0.38
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_7 >  0.38
|   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.12
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_3 >  0.12
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_9 >  0.71
|   |   |   |   |   |   |--- class: 1
|   |   |   |   |--- feature_9 >  0.73
|   |   |   |   |   |--- feature_4 <= 0.21
|   |   |   |   |   |   |--- feature_4 <= 0.17
|   |   |   |   |   |   |   |--- feature_11 <= 0.30
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.11
|   |   |   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.62
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.62
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_4 >  0.11
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_11 >  0.30
|   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_4 >  0.17
|   |   |   |   |   |   |   |--- feature_7 <= 0.12
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_7 >  0.12
|   |   |   |   |   |   |   |   |--- feature_11 <= 0.10
|   |   |   |   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.19
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.19
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_11 >  0.10
|   |   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_4 >  0.21
|   |   |   |   |   |   |--- class: 0
|   |   |   |--- feature_9 >  0.73
|   |   |   |   |--- feature_9 <= 0.75
|   |   |   |   |   |--- class: 1
|   |   |   |   |--- feature_9 >  0.75
|   |   |   |   |   |--- feature_9 <= 0.92
|   |   |   |   |   |   |--- feature_9 <= 0.90
|   |   |   |   |   |   |   |--- feature_9 <= 0.90
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.88
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.87
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.85
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 25
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.85
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.87
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.04
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.04
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 19
|   |   |   |   |   |   |   |   |--- feature_9 >  0.88
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_9 >  0.90
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.03
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_4 >  0.03
|   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.81
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.07
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.07
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 11
|   |   |   |   |   |   |   |   |   |--- feature_7 >  0.81
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.17
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.17
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_9 >  0.90
|   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |--- feature_9 >  0.92
|   |   |   |   |   |   |--- feature_4 <= 0.06
|   |   |   |   |   |   |   |--- feature_9 <= 0.98
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.96
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.94
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.93
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 10
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.93
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.94
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_9 >  0.96
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.02
|   |   |   |   |   |   |   |   |   |   |--- feature_6 <= 0.62
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_6 >  0.62
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.02
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.97
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.97
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |--- feature_9 >  0.98
|   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_4 >  0.06
|   |   |   |   |   |   |   |--- feature_9 <= 0.92
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.23
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.18
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.10
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  0.10
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.18
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.19
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.19
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |--- feature_4 >  0.23
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_9 >  0.92
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.94
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_9 >  0.94
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.94
|   |   |   |   |   |   |   |   |   |   |--- feature_6 <= 0.88
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_6 >  0.88
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.94
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.96
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.96
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 10
|   |   |--- feature_10 >  0.00
|   |   |   |--- class: 1
|   |--- feature_10 >  0.02
|   |   |--- feature_4 <= 0.15
|   |   |   |--- feature_7 <= 0.00
|   |   |   |   |--- feature_4 <= 0.05
|   |   |   |   |   |--- class: 0
|   |   |   |   |--- feature_4 >  0.05
|   |   |   |   |   |--- feature_6 <= 0.88
|   |   |   |   |   |   |--- feature_9 <= 0.07
|   |   |   |   |   |   |   |--- feature_9 <= 0.05
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_9 >  0.05
|   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_9 >  0.07
|   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_6 >  0.88
|   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |--- feature_9 <= 0.45
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.15
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_9 >  0.15
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.22
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.22
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.34
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.34
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |--- feature_9 >  0.45
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |--- feature_9 <= 0.39
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_9 >  0.39
|   |   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.60
|   |   |   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.60
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |--- feature_7 >  0.00
|   |   |   |   |--- feature_7 <= 0.24
|   |   |   |   |   |--- class: 1
|   |   |   |   |--- feature_7 >  0.24
|   |   |   |   |   |--- feature_4 <= 0.15
|   |   |   |   |   |   |--- feature_4 <= 0.06
|   |   |   |   |   |   |   |--- feature_4 <= 0.05
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.24
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.04
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.04
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.04
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.04
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_9 >  0.24
|   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.48
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.48
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |--- feature_4 >  0.05
|   |   |   |   |   |   |   |   |--- feature_3 <= 0.38
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_3 >  0.38
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_4 >  0.06
|   |   |   |   |   |   |   |--- feature_4 <= 0.10
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.09
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.09
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.08
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 16
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.08
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.09
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.12
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.12
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_4 >  0.09
|   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.25
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.09
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.09
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_5 >  0.25
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_4 >  0.10
|   |   |   |   |   |   |   |   |--- feature_6 <= 0.88
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.49
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.22
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  0.22
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 10
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.49
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_6 >  0.88
|   |   |   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.06
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  0.06
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.32
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |   |   |--- feature_3 >  0.32
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |--- feature_4 >  0.15
|   |   |   |   |   |   |--- class: 1
|   |   |--- feature_4 >  0.15
|   |   |   |--- feature_7 <= 0.79
|   |   |   |   |--- feature_9 <= 0.01
|   |   |   |   |   |--- class: 1
|   |   |   |   |--- feature_9 >  0.01
|   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |--- feature_8 <= 0.90
|   |   |   |   |   |   |   |--- feature_11 <= 0.10
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.16
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.09
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.09
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_9 >  0.16
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_11 >  0.10
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.32
|   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.24
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.62
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.62
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |--- feature_7 >  0.24
|   |   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.32
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 12
|   |   |   |   |   |   |   |   |   |   |--- feature_7 >  0.32
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |--- feature_4 >  0.32
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.26
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.26
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.48
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.48
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |--- feature_8 >  0.90
|   |   |   |   |   |   |   |--- feature_9 <= 0.11
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_9 >  0.11
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.16
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_4 >  0.16
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.19
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.19
|   |   |   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |--- feature_9 <= 0.88
|   |   |   |   |   |   |   |--- feature_3 <= 0.25
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.72
|   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.62
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.18
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 12
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.18
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |--- feature_7 >  0.62
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.07
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.07
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 14
|   |   |   |   |   |   |   |   |--- feature_9 >  0.72
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_3 >  0.25
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.51
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.19
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.15
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.15
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.19
|   |   |   |   |   |   |   |   |   |   |--- feature_6 <= 0.38
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_6 >  0.38
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |--- feature_9 >  0.51
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_9 >  0.88
|   |   |   |   |   |   |   |--- feature_4 <= 0.21
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_4 >  0.21
|   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |--- feature_7 >  0.79
|   |   |   |   |--- feature_5 <= 0.25
|   |   |   |   |   |--- class: 0
|   |   |   |   |--- feature_5 >  0.25
|   |   |   |   |   |--- feature_9 <= 0.80
|   |   |   |   |   |   |--- feature_9 <= 0.42
|   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_9 >  0.42
|   |   |   |   |   |   |   |--- feature_9 <= 0.60
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.27
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_4 >  0.27
|   |   |   |   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_9 >  0.60
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.19
|   |   |   |   |   |   |   |   |   |--- feature_8 <= 0.30
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_8 >  0.30
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_4 >  0.19
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.23
|   |   |   |   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.23
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_9 >  0.80
|   |   |   |   |   |   |--- class: 0
|--- feature_10 >  0.03
|   |--- feature_10 <= 0.05
|   |   |--- class: 1
|   |--- feature_10 >  0.05
|   |   |--- feature_10 <= 0.05
|   |   |   |--- feature_3 <= 0.47
|   |   |   |   |--- feature_6 <= 0.52
|   |   |   |   |   |--- feature_4 <= 0.08
|   |   |   |   |   |   |--- feature_9 <= 0.27
|   |   |   |   |   |   |   |--- feature_9 <= 0.24
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.07
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_4 >  0.07
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.11
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.11
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.16
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.16
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_9 >  0.24
|   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_9 >  0.27
|   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_4 >  0.08
|   |   |   |   |   |   |--- feature_4 <= 0.10
|   |   |   |   |   |   |   |--- feature_9 <= 0.52
|   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_9 >  0.52
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_4 >  0.10
|   |   |   |   |   |   |   |--- feature_3 <= 0.24
|   |   |   |   |   |   |   |   |--- feature_3 <= 0.06
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.13
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.62
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.62
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 8
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.13
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.14
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 14
|   |   |   |   |   |   |   |   |--- feature_3 >  0.06
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_3 >  0.24
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.51
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.24
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.28
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.28
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.24
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_9 >  0.51
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.56
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.25
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.25
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.56
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |--- feature_6 >  0.52
|   |   |   |   |   |--- feature_4 <= 0.39
|   |   |   |   |   |   |--- feature_6 <= 0.74
|   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_6 >  0.74
|   |   |   |   |   |   |   |--- feature_11 <= 0.25
|   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.60
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.38
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 13
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.38
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.60
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 8
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.72
|   |   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.12
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_7 >  0.12
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 17
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.72
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.74
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.74
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |--- feature_11 >  0.25
|   |   |   |   |   |   |   |   |--- feature_8 <= 0.23
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.42
|   |   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.22
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_3 >  0.22
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 11
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.42
|   |   |   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |--- feature_8 >  0.23
|   |   |   |   |   |   |   |   |   |--- feature_8 <= 0.75
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_8 >  0.75
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.25
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.25
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |--- feature_4 >  0.39
|   |   |   |   |   |   |--- class: 1
|   |   |   |--- feature_3 >  0.47
|   |   |   |   |--- feature_4 <= 0.26
|   |   |   |   |   |--- feature_9 <= 0.41
|   |   |   |   |   |   |--- feature_7 <= 0.38
|   |   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.25
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.09
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.09
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.19
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.19
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_9 >  0.25
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.27
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_9 >  0.27
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.36
|   |   |   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.36
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.07
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.07
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |--- feature_7 >  0.38
|   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |--- feature_9 >  0.41
|   |   |   |   |   |   |--- class: 0
|   |   |   |   |--- feature_4 >  0.26
|   |   |   |   |   |--- feature_3 <= 0.62
|   |   |   |   |   |   |--- feature_4 <= 0.36
|   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_4 >  0.36
|   |   |   |   |   |   |   |--- feature_6 <= 0.62
|   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_6 >  0.62
|   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |--- feature_3 >  0.62
|   |   |   |   |   |   |--- class: 1
|   |   |--- feature_10 >  0.05
|   |   |   |--- feature_10 <= 0.07
|   |   |   |   |--- class: 1
|   |   |   |--- feature_10 >  0.07
|   |   |   |   |--- feature_10 <= 0.08
|   |   |   |   |   |--- feature_9 <= 0.29
|   |   |   |   |   |   |--- feature_9 <= 0.15
|   |   |   |   |   |   |   |--- feature_4 <= 0.15
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.13
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.07
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.12
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.12
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.07
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.04
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.04
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |--- feature_4 >  0.13
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_4 >  0.15
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.38
|   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.16
|   |   |   |   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |--- feature_11 >  0.16
|   |   |   |   |   |   |   |   |   |   |--- feature_6 <= 0.38
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |   |--- feature_6 >  0.38
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_4 >  0.38
|   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.29
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_11 >  0.29
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.11
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.11
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |--- feature_9 >  0.15
|   |   |   |   |   |   |   |--- feature_11 <= 0.20
|   |   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |   |--- feature_8 <= 0.30
|   |   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.12
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_3 >  0.12
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |--- feature_8 >  0.30
|   |   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.12
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_7 >  0.12
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.27
|   |   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.75
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 14
|   |   |   |   |   |   |   |   |   |   |--- feature_7 >  0.75
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.27
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_11 >  0.20
|   |   |   |   |   |   |   |   |--- feature_11 <= 0.40
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_11 >  0.40
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.17
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.17
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.28
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.28
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |--- feature_9 >  0.29
|   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |--- feature_6 <= 0.88
|   |   |   |   |   |   |   |   |--- feature_8 <= 0.70
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_8 >  0.70
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.51
|   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.51
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_6 >  0.88
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.41
|   |   |   |   |   |   |   |   |   |--- feature_8 <= 0.28
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |--- feature_8 >  0.28
|   |   |   |   |   |   |   |   |   |   |--- feature_8 <= 0.38
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_8 >  0.38
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |--- feature_9 >  0.41
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.08
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.75
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.75
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 5
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.08
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.64
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.64
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 3
|   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |--- feature_0 <= 0.50
|   |   |   |   |   |   |   |   |--- feature_7 <= 0.88
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.57
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.15
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 14
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.15
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 10
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.57
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.14
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 6
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.14
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |--- feature_7 >  0.88
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.14
|   |   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |   |--- feature_5 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.14
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.20
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.20
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |--- feature_0 >  0.50
|   |   |   |   |   |   |   |   |--- feature_9 <= 0.74
|   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.53
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 14
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |--- feature_9 >  0.53
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.68
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.68
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 8
|   |   |   |   |   |   |   |   |--- feature_9 >  0.74
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |--- feature_10 >  0.08
|   |   |   |   |   |--- feature_10 <= 0.10
|   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |--- feature_10 >  0.10
|   |   |   |   |   |   |--- feature_4 <= 0.08
|   |   |   |   |   |   |   |--- feature_4 <= 0.08
|   |   |   |   |   |   |   |   |--- feature_4 <= 0.06
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.06
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.05
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 22
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.05
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.06
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.53
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.53
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |--- feature_4 >  0.06
|   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.08
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.06
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 2
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.06
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 18
|   |   |   |   |   |   |   |   |   |--- feature_4 >  0.08
|   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |--- feature_4 >  0.08
|   |   |   |   |   |   |   |   |--- feature_7 <= 0.88
|   |   |   |   |   |   |   |   |   |--- feature_7 <= 0.51
|   |   |   |   |   |   |   |   |   |   |--- feature_8 <= 0.90
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 19
|   |   |   |   |   |   |   |   |   |   |--- feature_8 >  0.90
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |--- feature_7 >  0.51
|   |   |   |   |   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 7
|   |   |   |   |   |   |   |   |--- feature_7 >  0.88
|   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |--- feature_4 >  0.08
|   |   |   |   |   |   |   |--- feature_10 <= 0.10
|   |   |   |   |   |   |   |   |--- feature_1 <= 0.50
|   |   |   |   |   |   |   |   |   |--- feature_2 <= 0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.02
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 13
|   |   |   |   |   |   |   |   |   |   |--- feature_3 >  0.02
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 12
|   |   |   |   |   |   |   |   |   |--- feature_2 >  0.50
|   |   |   |   |   |   |   |   |   |   |--- feature_4 <= 0.10
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 8
|   |   |   |   |   |   |   |   |   |   |--- feature_4 >  0.10
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 17
|   |   |   |   |   |   |   |   |--- feature_1 >  0.50
|   |   |   |   |   |   |   |   |   |--- feature_5 <= 0.92
|   |   |   |   |   |   |   |   |   |   |--- feature_9 <= 0.43
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 11
|   |   |   |   |   |   |   |   |   |   |--- feature_9 >  0.43
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 4
|   |   |   |   |   |   |   |   |   |--- feature_5 >  0.92
|   |   |   |   |   |   |   |   |   |   |--- feature_11 <= 0.30
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 15
|   |   |   |   |   |   |   |   |   |   |--- feature_11 >  0.30
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 9
|   |   |   |   |   |   |   |--- feature_10 >  0.10
|   |   |   |   |   |   |   |   |--- feature_10 <= 0.12
|   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |--- feature_10 >  0.12
|   |   |   |   |   |   |   |   |   |--- feature_10 <= 0.13
|   |   |   |   |   |   |   |   |   |   |--- feature_3 <= 0.62
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 19
|   |   |   |   |   |   |   |   |   |   |--- feature_3 >  0.62
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0
|   |   |   |   |   |   |   |   |   |--- feature_10 >  0.13
|   |   |   |   |   |   |   |   |   |   |--- feature_10 <= 0.15
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1
|   |   |   |   |   |   |   |   |   |   |--- feature_10 >  0.15
|   |   |   |   |   |   |   |   |   |   |   |--- truncated branch of depth 49
```

In [123…

```python
print('Decision Tree (Balancing) Accuracy : ', dt_oversam.score(x_test_oversam, y_test_oversam)*100, '%')

dt_prediction_oversam = dt_oversam.predict(x_test_oversam)
dt_cf_matrix_oversam=confusion_matrix(y_test_oversam,dt_prediction_oversam)
print('\nConfusion matrix :')
print(confusion_matrix(y_test_oversam, dt_prediction_oversam))

print('\nClassification report:')
print(classification_report(y_test_oversam, dt_prediction_oversam))
```

```
Decision Tree (Balancing) Accuracy :  69.63154864709269 %

Confusion matrix :
[[1236  501]
 [ 554 1183]]

Classification report:
              precision    recall  f1-score   support

           0       0.69      0.71      0.70      1737
           1       0.70      0.68      0.69      1737

    accuracy                           0.70      3474
   macro avg       0.70      0.70      0.70      3474
weighted avg       0.70      0.70      0.70      3474
```

In [136…

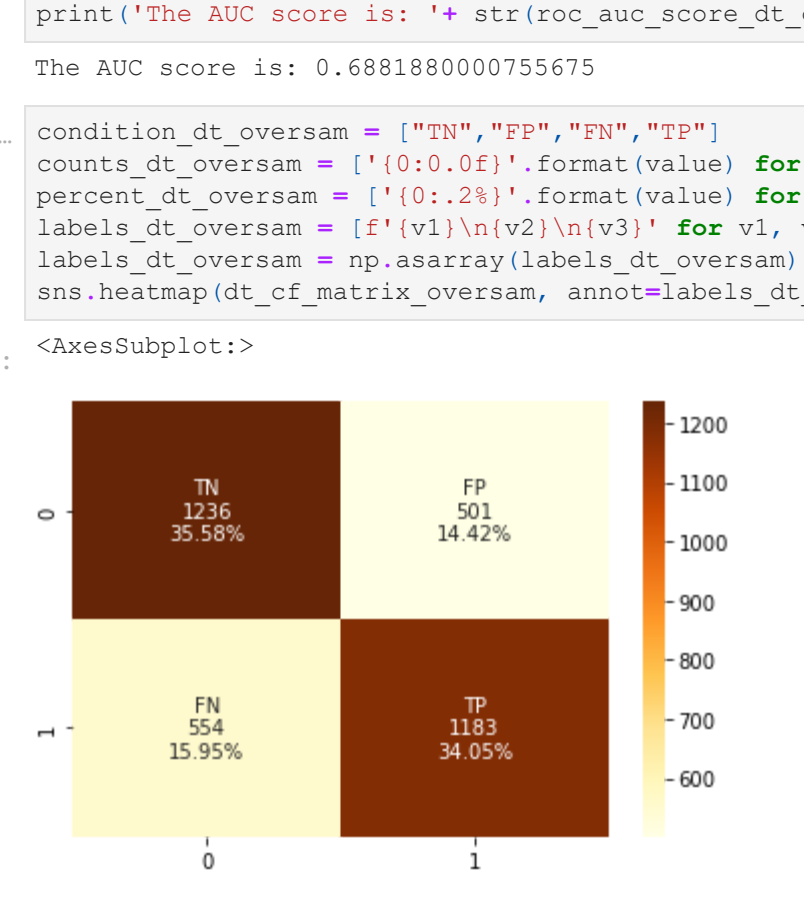
```python
# Getting the auc score
from sklearn.metrics import roc_auc_score
prob_dt_oversam=dt_oversam.predict_proba(x_test_oversam)
roc_auc_score_dt_oversam=roc_auc_score(y_test_oversam,prob_dt_oversam[:,1])
print('The AUC score is: '+ str(roc_auc_score_dt_oversam))
```

```
The AUC score is: 0.6881880000755675
```

In [138…

```python
condition_dt_oversam = ["TN","FP","FN","TP"]
counts_dt_oversam = ['{0:0.0f}'.format(value) for value in dt_cf_matrix_oversam.flatten()]
percent_dt_oversam = ['{0:.2%}'.format(value) for value in dt_cf_matrix_oversam.flatten()/np.sum(dt_cf_matrix_o
labels_dt_oversam = [f'{v1}\n{v2}\n{v3}' for v1, v2, v3 in zip(condition_dt_oversam,counts_dt_oversam,percent_d
labels_dt_oversam = np.asarray(labels_dt_oversam).reshape(2,2)
sns.heatmap(dt_cf_matrix_oversam, annot=labels_dt_oversam, fmt='', cmap='YlOrBr')
```

Out[138]: <AxesSubplot:>



In [ ]: