Using Random Forest to prepare a model on fraud data

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

from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report
from sklearn import preprocessing
from sklearn.metrics import accuracy_score,confusion_matrix
```

In [2]:
```
fraud_data=pd.read_csv('Fraud_check.csv')
fraud_data
```

Out[2]:

	Undergrad	Marital.Status	Taxable.Income	City.Population	Work.Experience	Urban
0	NO	Single	68833	50047	10	YES
1	YES	Divorced	33700	134075	18	YES
2	NO	Married	36925	160205	30	YES
3	YES	Single	50190	193264	15	YES
4	NO	Married	81002	27533	28	NO
...	...	...	...	...	...	...
595	YES	Divorced	76340	39492	7	YES
596	YES	Divorced	69967	55369	2	YES
597	NO	Divorced	47334	154058	0	YES
598	YES	Married	98592	180083	17	NO
599	NO	Divorced	96519	158137	16	NO

600 rows × 6 columns

In [3]:
```
fraud_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 6 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Undergrad        600 non-null    object
 1   Marital.Status   600 non-null    object
 2   Taxable.Income   600 non-null    int64 
 3   City.Population  600 non-null    int64 
 4   Work.Experience  600 non-null    int64 
 5   Urban            600 non-null    object
dtypes: int64(3), object(3)
memory usage: 28.2+ KB
```

In [4]:
```
fraud_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 6 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Undergrad        600 non-null    object
 1   Marital.Status   600 non-null    object
 2   Taxable.Income   600 non-null    int64 
 3   City.Population  600 non-null    int64 
 4   Work.Experience  600 non-null    int64 
 5   Urban            600 non-null    object
dtypes: int64(3), object(3)
memory usage: 28.2+ KB
```

In [5]:
```
fraud_data.duplicated().sum()
```

Out[5]:
```
0
```

In [6]:
```
fraud_data.describe(include='all')
```

Out[6]:

	Undergrad	Marital.Status	Taxable.Income	City.Population	Work.Experience	Urban
count	600	600	600.000000	600.000000	600.000000	600
unique	2	3	NaN	NaN	NaN	2
top	YES	Single	NaN	NaN	NaN	YES
freq	312	217	NaN	NaN	NaN	302
mean	NaN	NaN	55208.375000	108747.368333	15.558333	NaN
std	NaN	NaN	26204.827597	49850.075134	8.842147	NaN
min	NaN	NaN	10003.000000	25779.000000	0.000000	NaN
25%	NaN	NaN	32871.500000	66966.750000	8.000000	NaN
50%	NaN	NaN	55074.500000	106493.500000	15.000000	NaN
75%	NaN	NaN	78611.750000	150114.250000	24.000000	NaN
max	NaN	NaN	99619.000000	199778.000000	30.000000	NaN

In [7]:
```
corr=fraud_data.corr()
corr
```

Out[7]:

	Taxable.Income	City.Population	Work.Experience
Taxable.Income	1.000000	-0.064387	-0.001818
City.Population	-0.064387	1.000000	0.013135
Work.Experience	-0.001818	0.013135	1.000000

In [8]:
```
sns.heatmap(corr,annot=True)
plt.show()
```

In [9]:
```
fraud_data
```

Out[9]:

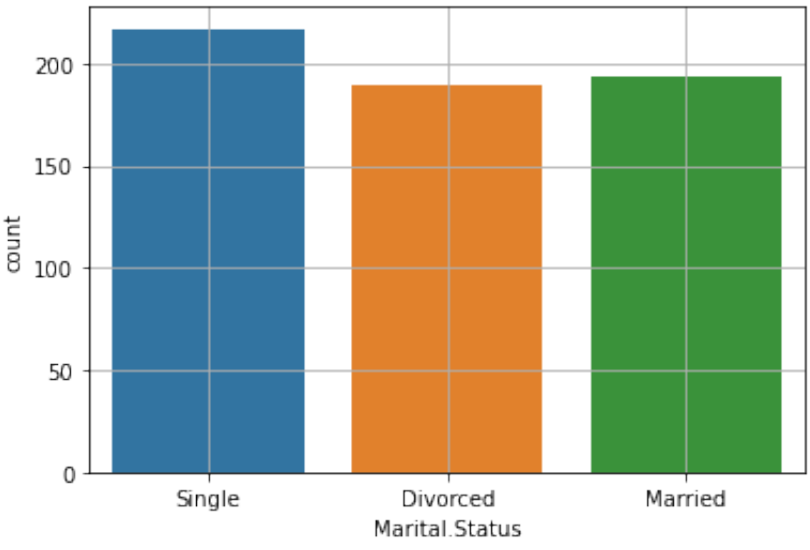
	Undergrad	Marital.Status	Taxable.Income	City.Population	Work.Experience	Urban
0	NO	Single	68833	50047	10	YES
1	YES	Divorced	33700	134075	18	YES
2	NO	Married	36925	160205	30	YES
3	YES	Single	50190	193264	15	YES
4	NO	Married	81002	27533	28	NO
...	...	...	...	...	...	...
595	YES	Divorced	76340	39492	7	YES
596	YES	Divorced	69967	55369	2	YES
597	NO	Divorced	47334	154058	0	YES
598	YES	Married	98592	180083	17	NO
599	NO	Divorced	96519	158137	16	NO

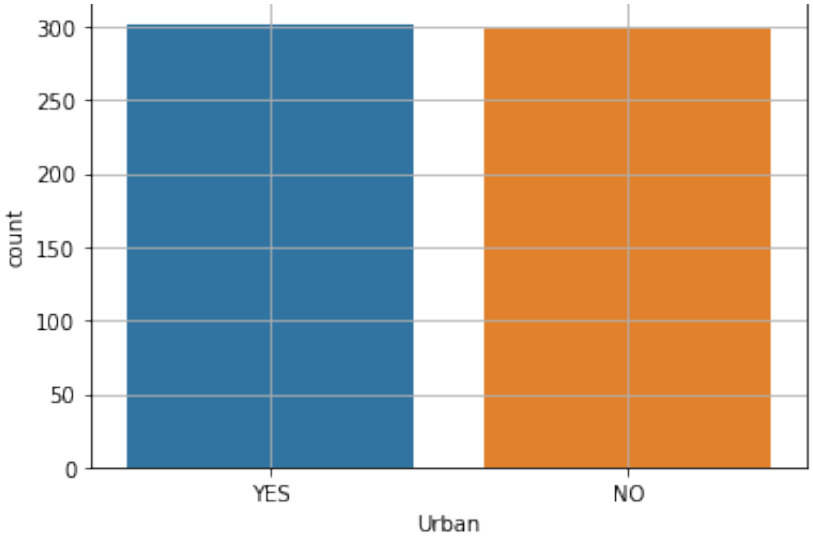
600 rows × 6 columns

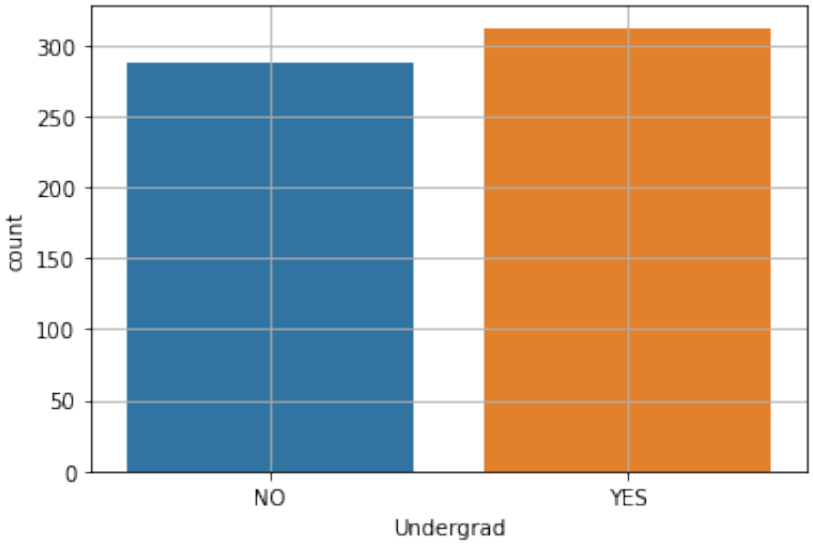
In [10]:
```
sns.countplot(x='Marital.Status',data=fraud_data)
plt.grid(True)
plt.show()

sns.countplot(x='Urban',data=fraud_data)
plt.grid(True)
plt.show()

sns.countplot(x='Undergrad',data=fraud_data)
plt.grid(True)
plt.show()
```







In [11]:
```
nt('minimum_value : ' , fraud_data['Taxable.Income'].min() ,'\n maxi
```

```
minimum_value :  10003
 maximun_value : 99619
```

In [12]:
```
#Converting Target variable 'Sales' into categories Low, Medium and
fraud_data['Taxable.Income'] = pd.cut(x=fraud_data['Taxable.Income'
fraud_data['Taxable.Income']
```

Out[12]:
```
0      Good
1      Good
2      Good
3      Good
4      Good
       ...
595    Good
596    Good
597    Good
598    Good
599    Good
Name: Taxable.Income, Length: 600, dtype: category
Categories (2, object): ['Risky' < 'Good']
```

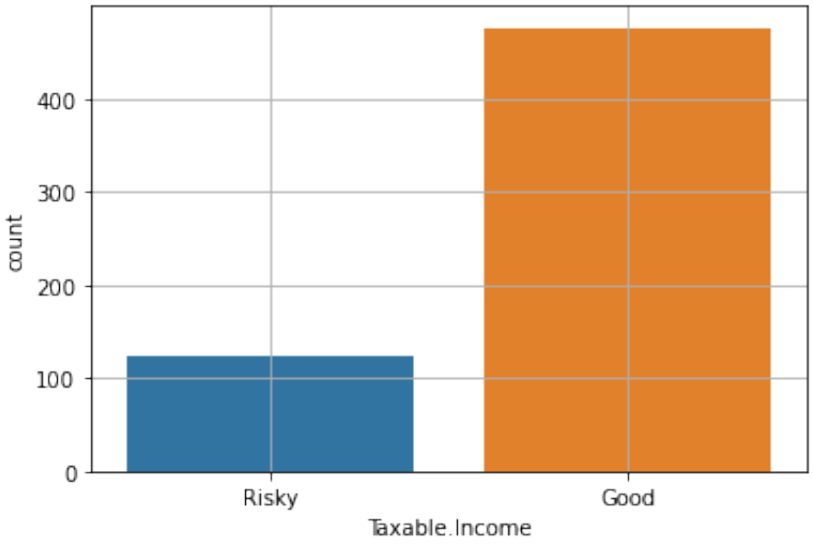
In [13]:
```
fraud_data.head()
```

Out[13]:

	Undergrad	Marital.Status	Taxable.Income	City.Population	Work.Experience	Urban
0	NO	Single	Good	50047	10	YES
1	YES	Divorced	Good	134075	18	YES
2	NO	Married	Good	160205	30	YES
3	YES	Single	Good	193264	15	YES
4	NO	Married	Good	27533	28	NO

In [14]:
```
sns.countplot(fraud_data['Taxable.Income'])
plt.grid(True)
plt.show()
```

```
/opt/anaconda3/lib/python3.9/site-packages/seaborn/_decorators.py:
36: FutureWarning: Pass the following variable as a keyword arg: x
. From version 0.12, the only valid positional argument will be `d
ata`, and passing other arguments without an explicit keyword will
result in an error or misinterpretation.
  warnings.warn(
```



In [15]:
```
fraud_data['Taxable.Income'].value_counts()
```

Out[15]:
```
Good     476
Risky    124
Name: Taxable.Income, dtype: int64
```

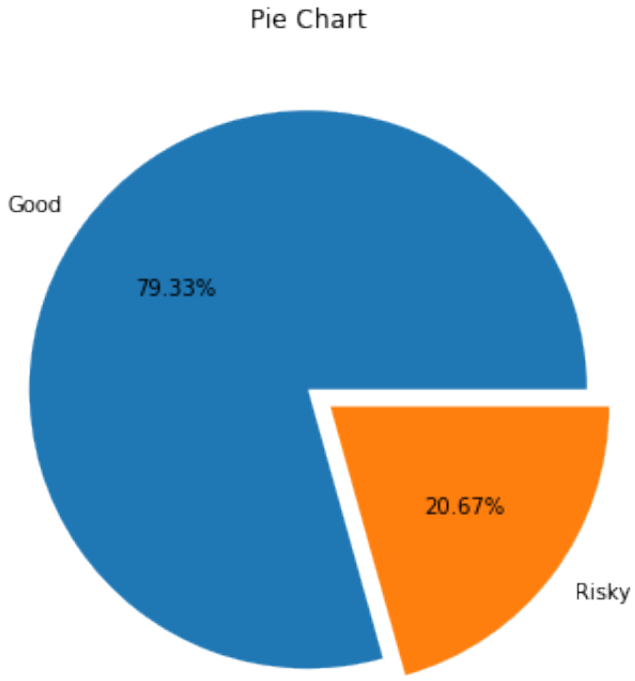
In [16]:
```
fraud_data = pd.get_dummies(fraud_data,columns = ["Taxable.Income"]
```

In [17]:
```
fraud_data.head()
```

Out[17]:

	Undergrad	Marital.Status	City.Population	Work.Experience	Urban	Taxable.Income_Good
0	NO	Single	50047	10	YES	
1	YES	Divorced	134075	18	YES	
2	NO	Married	160205	30	YES	
3	YES	Single	193264	15	YES	
4	NO	Married	27533	28	NO	

In [18]:
```
#subscription to the term deposit
plt.figure(figsize=(10,6))
plt.pie(fraud_data['Taxable.Income_Good'].value_counts(),labels=['G
plt.title('Pie Chart')
plt.show()
```



In [21]:
```
#encoding categorical fraud_data
label_encoder = preprocessing.LabelEncoder()

fraud_data['Undergrad'] = label_encoder.fit_transform(fraud_data['U
fraud_data['Taxable.Income_Good'] = label_encoder.fit_transform(fra
fraud_data['Marital.Status'] = label_encoder.fit_transform(fraud_da
fraud_data['Urban'] = label_encoder.fit_transform(fraud_data['Urban

fraud_data
```

Out[21]:

	Undergrad	Marital.Status	City.Population	Work.Experience	Urban	Taxable.Income_Gc
0	0	2	50047	10	1	
1	1	0	134075	18	1	
2	0	1	160205	30	1	
3	1	2	193264	15	1	
4	0	1	27533	28	0	
...	...	...	...	...	...	
595	1	0	39492	7	1	
596	1	0	55369	2	1	
597	0	0	154058	0	1	
598	1	1	180083	17	0	
599	0	0	158137	16	0	

600 rows × 6 columns

Data Preparation

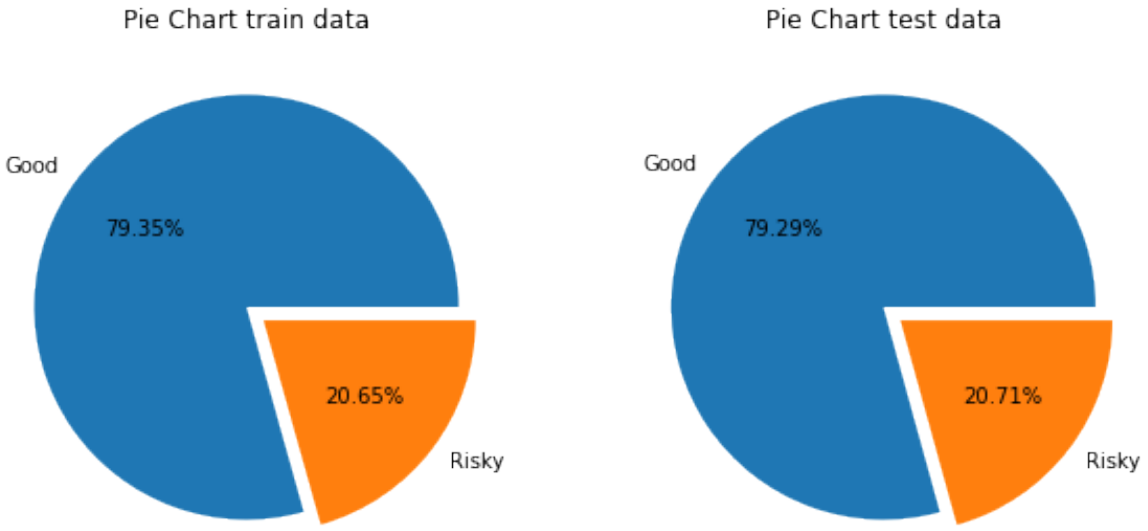
In [22]:
```
X=fraud_data.drop('Taxable.Income_Good',axis=1)
y=fraud_data[['Taxable.Income_Good']]
```

Spliting and Handling imbalanced data

In [23]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size = 0.
```

In [24]:
```
plt.figure(figsize=(10,6))
#train data
ax1 = plt.subplot(121)
line1=plt.pie(y_train.value_counts(),labels=['Good','Risky'],explod
plt.title('Pie Chart train data')

#test data
ax2 = plt.subplot(122)
line2=plt.pie(y_test.value_counts(),labels=['Good','Risky'],explode
plt.title('Pie Chart test data')
plt.show()
```



In [25]:
```
print('X_train_shape :',X_train.shape,'\ny_train_shape',y_train.sha
```

```
X_train_shape : (402, 5)
y_train_shape (402, 1)
```

In [26]:
```
print('X_test_shape :',X_test.shape,'\ny_test_shape',y_test.shape)
```

```
X_test_shape : (198, 5)
y_test_shape (198, 1)
```

Model Building

In [27]:
```
rf_classifier = RandomForestClassifier(random_state=38)
rf_classifier.fit(X_train,y_train)
```

```
/var/folders/9_/ckpgdd3s4qzg3w1zytsfvsmh0000gn/T/ipykernel_14422/5
93298316.py:2: DataConversionWarning: A column-vector y was passed
when a 1d array was expected. Please change the shape of y to (n_s
amples,), for example using ravel().
  rf_classifier.fit(X_train,y_train)
```

Out[27]:

```
▾ RandomForestClassifier

RandomForestClassifier(random_state=38)
```

Grid SearchCv

In [28]:
```
from sklearn.model_selection import GridSearchCV

grid_search = GridSearchCV(estimator = rf_classifier,
                           param_grid = {'criterion':['entropy','gi
                                         'max_depth':[2,3,4,5,6,7,8
                           cv=5)
grid_search.fit(X,y)
print(grid_search.best_params_)
print(grid_search.best_score_)
```

In [29]:
```
#new Model
rf_classifier_1 = RandomForestClassifier(criterion = 'entropy',rand
rf_classifier_1.fit(X_train, y_train)
```

```
/var/folders/9_/ckpgdd3s4qzg3w1zytsfvsmh0000gn/T/ipykernel_14422/9
95457025.py:3: DataConversionWarning: A column-vector y was passed
when a 1d array was expected. Please change the shape of y to (n_s
amples,), for example using ravel().
  rf_classifier_1.fit(X_train, y_train)
```

Out[29]:
```
▾ RandomForestClassifier
RandomForestClassifier(criterion='entropy', max_depth=2, random_s
tate=38)
```

In [30]:
```
y_pred_train = rf_classifier_1.predict(X_train)
```

In [31]:
```
y_pred_test = rf_classifier_1.predict(X_test)
y_pred_test
```

Out[31]:
```
array([1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1])
```

In [32]:
```
accuracy_score(y_train,y_pred_train)
```

Out[32]:
```
0.7935323383084577
```

In [33]:
```
confusion_matrix(y_train,y_pred_train)
```

Out[33]:
```
array([[  0,  83],
       [  0, 319]])
```

In [34]:
```
print('Classification Report:\n',classification_report(y_train,y_pr
```

```
Classification Report:
               precision    recall  f1-score   support

           0       0.00      0.00      0.00        83
           1       0.79      1.00      0.88       319

    accuracy                           0.79       402
   macro avg       0.40      0.50      0.44       402
weighted avg       0.63      0.79      0.70       402


/opt/anaconda3/lib/python3.9/site-packages/sklearn/metrics/_classi
fication.py:1344: UndefinedMetricWarning: Precision and F-score ar
e ill-defined and being set to 0.0 in labels with no predicted sam
ples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/opt/anaconda3/lib/python3.9/site-packages/sklearn/metrics/_classi
fication.py:1344: UndefinedMetricWarning: Precision and F-score ar
e ill-defined and being set to 0.0 in labels with no predicted sam
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/opt/anaconda3/lib/python3.9/site-packages/sklearn/metrics/_classi
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e ill-defined and being set to 0.0 in labels with no predicted sam
ples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

In [35]:
```
accuracy_score(y_test,y_pred_test)
```

Out[35]:
```
0.7929292929292929
```

In [36]:
```
confusion_matrix(y_test,y_pred_test)
```

Out[36]:
```
array([[  0,  41],
       [  0, 157]])
```

In [37]:
```
print('Classification Report:\n',classification_report(y_test,y_pre
```

```
Classification Report:
               precision    recall  f1-score   support

           0       0.00      0.00      0.00        41
           1       0.79      1.00      0.88       157

    accuracy                           0.79       198
   macro avg       0.40      0.50      0.44       198
weighted avg       0.63      0.79      0.70       198


/opt/anaconda3/lib/python3.9/site-packages/sklearn/metrics/_classi
fication.py:1344: UndefinedMetricWarning: Precision and F-score ar
e ill-defined and being set to 0.0 in labels with no predicted sam
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  _warn_prf(average, modifier, msg_start, len(result))
/opt/anaconda3/lib/python3.9/site-packages/sklearn/metrics/_classi
fication.py:1344: UndefinedMetricWarning: Precision and F-score ar
e ill-defined and being set to 0.0 in labels with no predicted sam
ples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

In [ ]: