```
import pandas as pd
from google.colab import drive
import matplotlib.pyplot as plt
import numpy as np


drive.mount('/content/gdrive/', force_remount = True)
df = pd.read_csv("/content/gdrive/MyDrive/Econ441B/fraudTest.csv")
df.head()
```

```
Mounted at /content/gdrive/
```

	Unnamed: 0	trans_date_trans_time	cc_num	merchant	categor
0	0	2020-06-21 12:14:25	2291163933867244	fraud_Kirlin and Sons	personal_ca
1	1	2020-06-21 12:14:33	3573030041201292	fraud_Sporer-Keebler	personal_ca
2	2	2020-06-21 12:14:53	3598215285024754	fraud_Swaniawski, Nitzsche and Welch	health_fitnes
3	3	2020-06-21 12:15:15	3591919803438423	fraud_Haley Group	misc_pc
4	4	2020-06-21 12:15:17	3526826139003047	fraud_Johnston-Casper	trav

5 rows × 23 columns

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 555719 entries, 0 to 555718
Data columns (total 23 columns):
 #   Column                 Non-Null Count   Dtype
---  ------                 --------------   -----
 0   Unnamed: 0             555719 non-null  int64
 1   trans_date_trans_time  555719 non-null  object
 2   cc_num                 555719 non-null  int64
 3   merchant               555719 non-null  object
 4   category               555719 non-null  object
 5   amt                    555719 non-null  float64
 6   first                  555719 non-null  object
 7   last                   555719 non-null  object
```

```
 8   gender                 555719 non-null  object
 9   street                 555719 non-null  object
 10  city                   555719 non-null  object
 11  state                  555719 non-null  object
 12  zip                    555719 non-null  int64
 13  lat                    555719 non-null  float64
 14  long                   555719 non-null  float64
 15  city_pop               555719 non-null  int64
 16  job                    555719 non-null  object
 17  dob                    555719 non-null  object
 18  trans_num              555719 non-null  object
 19  unix_time              555719 non-null  int64
 20  merch_lat              555719 non-null  float64
 21  merch_long             555719 non-null  float64
 22  is_fraud               555719 non-null  int64
dtypes: float64(5), int64(6), object(12)
memory usage: 97.5+ MB
```

```
df_select = df[["trans_date_trans_time", "category", "amt", "city_pop", "is_fraud"]]
df_select.columns
```

```
Index(['trans_date_trans_time', 'category', 'amt', 'city_pop', 'is_fraud'],
dtype='object')
```

```
df_select["trans_date_trans_time"] = pd.to_datetime(df_select["trans_date_trans_time"])
```

```
<ipython-input-6-99f721e4ce0f>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
  df_select["trans_date_trans_time"] = pd.to_datetime(df_select["trans_date_trans_tim
```

```
df_select["time_var"] = [i.second for i in df_select["trans_date_trans_time"]]
```

```
<ipython-input-7-fa4370ef92e9>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
  df_select["time_var"] = [i.second for i in df_select["trans_date_trans_time"]]
```

```
X = pd.get_dummies(df_select, ["category"]).drop(["trans_date_trans_time", "is_fraud"], ax
y = df["is_fraud"]
```

```
X.head()
```

	amt	city_pop	time_var	category_entertainment	category_food_dining	catego
0	2.86	333497	25	0	0	
1	29.84	302	33	0	0	
2	41.28	34496	53	0	0	
3	60.05	54767	15	0	0	

1.) Use scikit learn preprocessing to split the data into 70/30 in out of sample

```
from sklearn.model_selection import train_test_split
X_Train, X_Test, Y_Train, Y_Test = train_test_split(X, y, train_size=0.7, random_state=1)
X_Train
```

	amt	city_pop	time_var	category_entertainment	category_food_dining
382669	196.46	50835	27	0	0
363902	18.86	24645	30	0	0
31195	19.42	2504700	15	0	0
305241	4.45	2328	7	0	1
250566	56.04	4508	53	1	0
...	...	...	...	...	...
371403	1.28	69	33	0	1
491263	5.87	1563	59	0	0
470924	8.11	13602	21	0	0
491755	2.03	21902	13	0	0
128037	3.90	2807	36	0	0

389003 rows × 17 columns

2.) Make three sets of training data (Oversample, Undersample and SMOTE)

```
from imblearn.over_sampling import RandomOverSampler
from imblearn.under_sampling import RandomUnderSampler
from imblearn.over_sampling import SMOTE


ros = RandomOverSampler(random_state=0)
```

```
ros.fit(X_Train,Y_Train)
X_resampled, y_resampled = ros.fit_resample(X_Train,Y_Train)


rus = RandomUnderSampler(random_state=0)
rus.fit(X_Train,Y_Train)
X_resampled1, y_resampled1 = rus.fit_resample(X_Train,Y_Train)


oversample = SMOTE()
X_SMOTE, y_SMOTE = oversample.fit_resample(X_Train,Y_Train)
```

3.) Train three logistic regression models

```
from sklearn.linear_model import LogisticRegression
model_ros = LogisticRegression()
model_ros.fit(X_resampled, y_resampled)
```

```
LogisticRegression()
```

```
model_rus = LogisticRegression()
model_rus.fit(X_resampled1, y_resampled1)
```

```
LogisticRegression()
```

```
model_smote = LogisticRegression()
model_smote.fit(X_SMOTE, y_SMOTE)
```

```
LogisticRegression()
```

4.) Test the three models

```
y_pred_ros = model_ros.predict(X_Test)
y_pred_rus = model_rus.predict(X_Test)
y_pred_smote = model_smote.predict(X_Test)
```

5.) Which performed best in Out of Sample metrics?

```
from sklearn.metrics import classification_report

# Create a classification report for each model
report_ros = classification_report(Y_Test, y_pred_ros)
report_rus = classification_report(Y_Test, y_pred_rus)
report_smote = classification_report(Y_Test, y_pred_smote)
```

```
print("Oversampled Model Report:\n", report_ros)
print("Undersampled Model Report:\n", report_rus)
print("SMOTE Model Report:\n", report_smote)
```

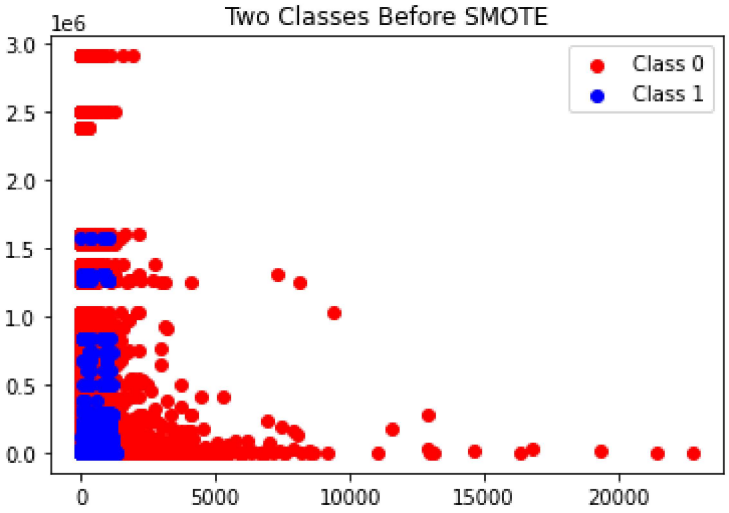
```
     Oversampled Model Report:
                   precision    recall  f1-score   support

                0       1.00      0.81      0.90    166081
                1       0.02      0.76      0.03       635

            accuracy                           0.81    166716
           macro avg       0.51      0.79      0.46    166716
        weighted avg       1.00      0.81      0.89    166716

     Undersampled Model Report:
                   precision    recall  f1-score   support

                0       1.00      0.81      0.89    166081
                1       0.02      0.77      0.03       635

            accuracy                           0.81    166716
           macro avg       0.51      0.79      0.46    166716
        weighted avg       1.00      0.81      0.89    166716

     SMOTE Model Report:
                   precision    recall  f1-score   support

                0       1.00      0.82      0.90    166081
                1       0.02      0.76      0.03       635

            accuracy                           0.82    166716
           macro avg       0.51      0.79      0.47    166716
        weighted avg       1.00      0.82      0.90    166716
```

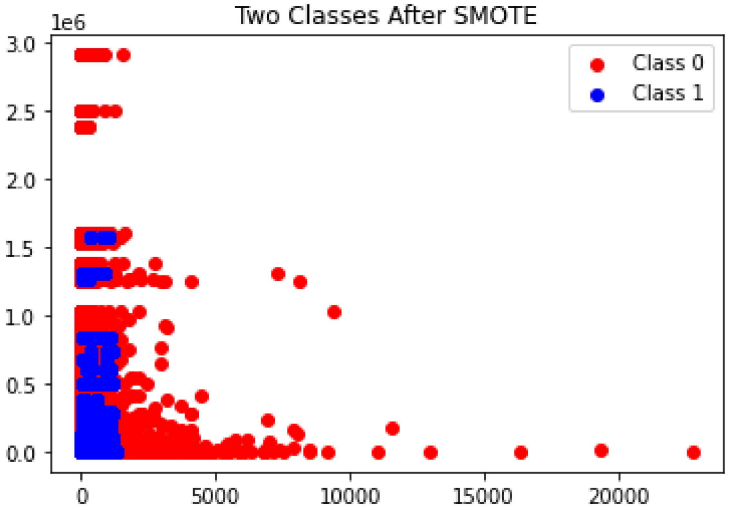
It can be seen from the above resutls that SMOTE performed the best since it has the highest accuracy.

6.) Pick two features and plot the two classes before and after SMOTE

```
import matplotlib.pyplot as plt
from imblearn.over_sampling import SMOTE

# Pick two features
X1 = df[['amt', 'city_pop']]
y1 = df['is_fraud']

# Apply SMOTE to oversample the minority class
smote = SMOTE(sampling_strategy='minority')
X1_resampled, y1_resampled = smote.fit_resample(X1, y1)

# Plot the two classes before SMOTE
plt.scatter(X[y==0]['amt'], X[y==0]['city_pop'], color='red', label='Class 0')
```

```
plt.scatter(X[y==1]['amt'], X[y==1]['city_pop'], color='blue', label='Class 1')
plt.legend()
plt.title("Two Classes Before SMOTE")
plt.show()

# Plot the two classes after SMOTE
plt.scatter(X_resampled[y_resampled==0]['amt'], X_resampled[y_resampled==0]['city_pop'], c
plt.scatter(X_resampled[y_resampled==1]['amt'], X_resampled[y_resampled==1]['city_pop'], c
plt.legend()
plt.title("Two Classes After SMOTE")
plt.show()
```





Colab paid products - Cancel contracts here

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