Travel Insurance logistic Regression

Requirement:

The goal of the project is to predict wheather the insurance policies are claimed or not based on some features. Usually, insurance policies will have coverage for travelers concerns including flight delays,trip cancellation, or laggage loss. Some of insurance policies will have coverage for medical emergency

Data Source : https://www.kaggle.com/mhdzahier/travel-insurance

Import Libraries

let's import required libraries

In [1]:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report
import numpy as np
from sklearn.linear_model import LogisticRegression
```

let's read travel insurance data

In [44]:

```
data = pd.read_csv("travel insurance.csv")
```

In [45]:

```
data.head()
```

Out[45]:

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales	Commision (in value)	Gender	Age
0	CBH	Travel Agency	Offline	Comprehensive Plan	No	186	MALAYSIA	-29.0	9.57	F	81
1	CBH	Travel Agency	Offline	Comprehensive Plan	No	186	MALAYSIA	-29.0	9.57	F	71
2	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	65	AUSTRALIA	-49.5	29.70	NaN	32
3	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	60	AUSTRALIA	-39.6	23.76	NaN	32
4	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	79	ITALY	-19.8	11.88	NaN	41

Explorartory Data Analysis

The Missing Data

In [46]:

```
data.isnull()
```

Out[46]:

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales	Commision (in value)	Gender	Age
0	False	False	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False	True	False
3	False	False	False	False	False	False	False	False	False	True	False
4	False	False	False	False	False	False	False	False	False	True	False
...	...	...	...	...	...	...	...	...	...	...	...
63321	False	False	False	False	False	False	False	False	False	False	False
63322	False	False	False	False	False	False	False	False	False	False	False
63323	False	False	False	False	False	False	False	False	False	False	False
63324	False	False	False	False	False	False	False	False	False	False	False
63325	False	False	False	False	False	False	False	False	False	False	False

63326 rows × 11 columns

In [47]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 63326 entries, 0 to 63325
Data columns (total 11 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   Agency                63326 non-null  object 
 1   Agency Type           63326 non-null  object 
 2   Distribution Channel  63326 non-null  object 
 3   Product Name          63326 non-null  object 
 4   Claim                 63326 non-null  object 
 5   Duration              63326 non-null  int64  
 6   Destination           63326 non-null  object 
 7   Net Sales             63326 non-null  float64
 8   Commision (in value)  63326 non-null  float64
 9   Gender                18219 non-null  object 
 10  Age                   63326 non-null  int64  
dtypes: float64(2), int64(2), object(7)
memory usage: 5.3+ MB
```

In [48]:

```
data.isnull().sum()
```

Out[48]:

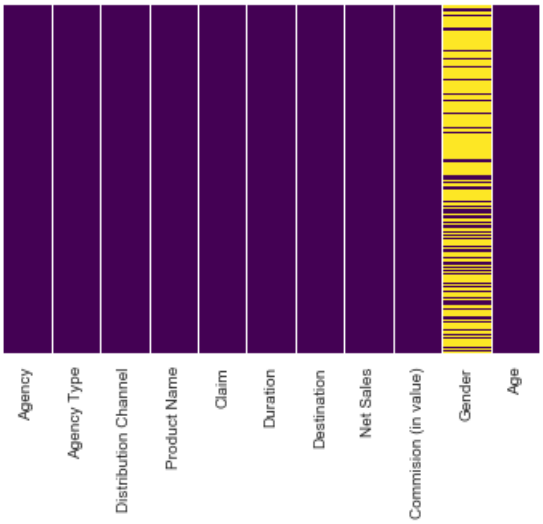
```
Agency                      0
Agency Type                 0
Distribution Channel        0
Product Name                0
Claim                       0
Duration                    0
Destination                 0
Net Sales                   0
Commision (in value)        0
Gender                  45107
Age                         0
dtype: int64
```

In [49]:

```
sns.heatmap(data.isnull(),yticklabels= False,cbar = False,cmap='viridis')
```

Out[49]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21c5c17b2e8>
```



Observation : We are missing too much of Gender data

Data Visiualization

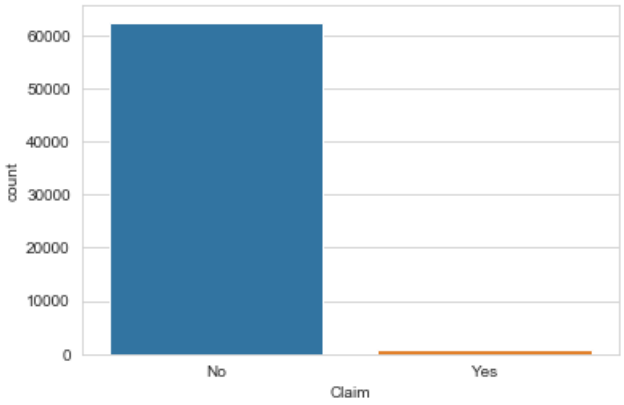
let's visiualize the data

In [50]:

```
sns.set_style('whitegrid')
sns.countplot(x = 'Claim',data = data)
```

Out[50]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x21c575f0b38>
```



In [51]:

```
data.head()
```

Out[51]:

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales	Commision (in value)	Gender	Age
0	CBH	Travel Agency	Offline	Comprehensive Plan	No	186	MALAYSIA	-29.0	9.57	F	81
1	CBH	Travel Agency	Offline	Comprehensive Plan	No	186	MALAYSIA	-29.0	9.57	F	71
2	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	65	AUSTRALIA	-49.5	29.70	NaN	32

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales	Commision (in value)	Gender	Age
3	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	60	AUSTRALIA	-39.6	23.76	NaN	32
4	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	79	ITALY	-19.8	11.88	NaN	41

observation : There are less amount of claimed or more amount of Unclaim

In [52]:

```
def cleanYesNo(s):
    # Claim = s[0]
     if s == "No":
         return 0
     else:
         return 1
```

In [53]:

```
data['Claim0'] = data['Claim'].apply(cleanYesNo)
```

In [54]:

```
data.head(26)
```

Out[54]:

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales	Commision (in value)	Gender	Age	Claim0
0	CBH	Travel Agency	Offline	Comprehensive Plan	No	186	MALAYSIA	-29.00	9.57	F	81	0
1	CBH	Travel Agency	Offline	Comprehensive Plan	No	186	MALAYSIA	-29.00	9.57	F	71	0
2	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	65	AUSTRALIA	-49.50	29.70	NaN	32	0
3	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	60	AUSTRALIA	-39.60	23.76	NaN	32	0
4	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	79	ITALY	-19.80	11.88	NaN	41	0
5	JZI	Airlines	Online	Value Plan	No	66	UNITED STATES	-121.00	42.35	F	44	0
6	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	47	UNITED STATES	-39.60	23.76	NaN	32	0
7	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	63	AUSTRALIA	-108.90	65.34	NaN	29	0
8	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	57	THAILAND	-19.80	11.88	NaN	44	0
9	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	186	AUSTRALIA	-99.00	59.40	NaN	37	0
10	JZI	Airlines	Online	Basic Plan	No	33	KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF	-26.00	9.10	NaN	118	0
11	JZI	Airlines	Online	Basic Plan	No	1	MALAYSIA	-18.00	6.30	M	47	0
12	KML	Travel Agency	Online	Premier Plan	No	53	NORWAY	-130.00	49.40	F	48	0
13	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	5	MALAYSIA	-39.60	23.76	NaN	64	0
14	EPX	Travel Agency	Online	2 way Comprehensive Plan	No	39	VIET NAM	-25.00	0.00	NaN	36	0
15	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	6	DENMARK	-19.80	11.88	NaN	53	0
16	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	48	DENMARK	-79.20	47.52	NaN	43	0
17	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	11	UNITED STATES	-29.70	17.82	NaN	58	0

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales	Commision (in value)	Gender	Age	Claim0
18	JZI	Airlines	Online	Basic Plan	No	3	MALAYSIA	-18.00	6.30	M	47	0
19	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	14	THAILAND	-69.30	41.58	NaN	37	0
20	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	No	136	NORWAY	-108.90	65.34	NaN	32	0
21	C2B	Airlines	Online	Bronze Plan	No	12	SINGAPORE	46.15	11.54	F	44	0
22	C2B	Airlines	Online	Bronze Plan	No	7	SINGAPORE	17.55	4.39	F	25	0
23	C2B	Airlines	Online	Bronze Plan	Yes	12	SINGAPORE	94.00	23.50	M	34	1
24	C2B	Airlines	Online	Silver Plan	No	190	SINGAPORE	294.75	73.69	M	26	0
25	C2B	Airlines	Online	Annual Silver Plan	No	364	SINGAPORE	389.00	97.25	F	30	0

In [55]:

```
data.drop(['Claim','Gender'],axis=1,inplace=True)
```

In [56]:

```
data.groupby(["Agency"]).mean()
```

Out[56]:

Agency	Duration	Net Sales	Commision (in value)	Age	Claim0
ADM	54.914634	53.256098	38.254878	23.804878	0.000000
ART	30.359517	28.691601	10.553927	60.314199	0.003021
C2B	95.219910	78.865811	20.533124	37.749244	0.066167
CBH	91.950495	27.168317	10.030693	57.128713	0.009901
CCR	62.809278	30.654639	10.313351	67.572165	0.015464
CSR	79.895349	32.802326	10.824767	57.511628	0.011628
CWT	41.450350	43.040769	32.380615	40.291841	0.010023
EPX	39.158860	32.564993	0.000000	36.933740	0.005553
JWT	29.371162	53.012016	21.640053	118.000000	0.005340
JZI	34.156423	32.338442	11.766669	44.603571	0.004898
KML	40.426020	55.448980	21.812194	47.918367	0.020408
LWC	150.252540	111.510813	74.265791	39.992743	0.052250
RAB	23.870345	17.817931	7.226483	42.689655	0.001379
SSI	122.757576	6.365208	1.784886	49.193182	0.006629
TST	40.594697	29.318182	10.523201	50.467803	0.003788
TTW	369.316327	93.204082	0.000000	40.642857	0.040816

In [57]:

```
data.groupby(['Agency Type']).mean()
```

Out[57]:

Agency Type	Duration	Net Sales	Commision (in value)	Age	Claim0
Airlines	67.728991	53.015767	15.526401	45.00275	0.033855
Travel Agency	42.309795	36.015604	7.634419	38.05459	0.007325

In [58]:

```
data[data["Duration"] <0]
```

Out[58]:

	Agency	Agency Type	Distribution Channel	Product Name	Duration	Destination	Net Sales	Commision (in value)	Age	Claim0
14943	JZI	Airlines	Online	Basic Plan	-2	BANGLADESH	22.0	7.7	118	0
52587	JZI	Airlines	Online	Basic Plan	-1	MALAYSIA	18.0	6.3	118	0
52588	JZI	Airlines	Online	Basic Plan	-1	BRUNEI DARUSSALAM	18.0	6.3	118	0
56668	JZI	Airlines	Online	Basic Plan	-1	INDONESIA	18.0	6.3	118	0
59528	JZI	Airlines	Online	Basic Plan	-1	CHINA	22.0	7.7	118	0

In [59]:

```
data[data['Age']>100]
```

Out[59]:

	Agency	Agency Type	Distribution Channel	Product Name	Duration	Destination	Net Sales	Commision (in value)	Age	Claim0
10	JZI	Airlines	Online	Basic Plan	33	KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF	-26.0	9.10	118	0
105	JWT	Airlines	Online	Value Plan	11	INDIA	50.0	20.00	118	0
220	JWT	Airlines	Online	Value Plan	4	INDIA	62.0	24.80	118	0
367	JWT	Airlines	Online	Value Plan	16	INDIA	50.0	20.00	118	0
402	CCR	Travel Agency	Offline	Comprehensive Plan	5	MALAYSIA	29.0	9.57	118	0
...	...	...	...	...	...	...	...	...	...	...
62920	JWT	Airlines	Online	Value Plan	2	INDIA	31.0	12.40	118	0
62953	ART	Airlines	Online	Value Plan	14	FRANCE	59.0	20.65	118	0
63096	ART	Airlines	Online	Value Plan	42	HONG KONG	61.0	21.35	118	0
63182	JWT	Airlines	Online	Value Plan	21	INDIA	39.0	15.60	118	0
63183	JWT	Airlines	Online	Value Plan	49	INDIA	31.0	12.40	118	0

984 rows × 10 columns

In [60]:

```
data.loc[data['Duration'] < 0, 'Duration'] = 49.317
data.loc[data['Age'] > 100, 'Age'] = 39.969981
```

In [61]:

```
data.describe()
```

Out[61]:

	Duration	Net Sales	Commision (in value)	Age	Claim0
count	63326.000000	63326.000000	63326.000000	63326.000000	63326.000000
mean	49.321062	40.702018	9.809992	38.757500	0.014639
std	101.790576	48.845637	19.804388	10.019733	0.120102
min	0.000000	-389.000000	0.000000	0.000000	0.000000
25%	9.000000	18.000000	0.000000	35.000000	0.000000
50%	22.000000	26.530000	0.000000	36.000000	0.000000
75%	53.000000	48.000000	11.550000	42.000000	0.000000
max	4881.000000	810.000000	283.500000	88.000000	1.000000

In [62]:

```
print("Claimed")
print(data[data['Claim0']==1]['Claim0'].count())
print("Not Claimed")
print(data[data['Claim0']==0]['Claim0'].count())
```

```
Claimed
927
Not Claimed
62399
```

Observation : Imbalanced dataset appears here. Oversampling method will be performed to deal with imbalanced dataset

Train and Test Splitting data

In [63]:

```
X = data.drop(columns=['Claim0'])
y = data['Claim0']
```

In [64]:

```
X_train,X_test,Y_train,y_test =  train_test_split(X,y,test_size=0.33,random_state=30)
```

In [65]:

```
X_train.shape
```

Out[65]:

```
(42428, 9)
```

In [66]:

```
Y_train.shape
```

Out[66]:

```
(42428,)
```

In [67]:

```
X_test.shape
```

Out[67]:

```
(20898, 9)
```

In [68]:

```
y_test.shape
```

Out[68]:

```
(20898,)
```

In [69]:

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

Oversampling

oversampling should be performed in that number of claimed policies is much less than number of non-claimed policies.So oversampling is used to address the line

In [70]:

```
updated_x = X_train.drop(columns=["Agency","Agency Type","Distribution Channel","Product Name","Destination"])
```

In [71]:

```
updated_x
```

Out[71]:

	Duration	Net Sales	Commision (in value)	Age
51485	16.0	39.0	9.75	22.0
36964	4.0	9.9	5.94	61.0
11382	14.0	27.0	0.00	36.0
17039	69.0	93.6	23.40	24.0
7038	10.0	10.0	0.00	36.0
...	...	...	...	...
33268	41.0	0.0	0.00	36.0
44845	105.0	73.0	0.00	36.0
48045	9.0	49.5	29.70	31.0
4517	9.0	20.0	0.00	27.0
38693	24.0	62.0	0.00	36.0

42428 rows × 4 columns

In [72]:

```
Y_train
```

Out[72]:

```
51485    0
36964    0
11382    0
17039    0
7038     0
        ..
33268    0
44845    0
48045    0
4517     0
38693    0
Name: Claim0, Length: 42428, dtype: int64
```

In [31]:

```
pip install imblearn
```

```
Requirement already satisfied: imblearn in c:\anaconda3\lib\site-packages (0.0)
Requirement already satisfied: imbalanced-learn in c:\anaconda3\lib\site-packages (from imblearn)
(0.7.0)
Requirement already satisfied: scikit-learn>=0.23 in c:\anaconda3\lib\site-packages (from
imbalanced-learn->imblearn) (0.24.0)
Requirement already satisfied: scipy>=0.19.1 in c:\anaconda3\lib\site-packages (from imbalanced-
learn->imblearn) (1.5.0)
Requirement already satisfied: joblib>=0.11 in c:\anaconda3\lib\site-packages (from imbalanced-
learn->imblearn) (0.16.0)
Requirement already satisfied: numpy>=1.13.3 in c:\anaconda3\lib\site-packages (from imbalanced-
learn->imblearn) (1.19.1)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\anaconda3\lib\site-packages (from
```

```
scikit-learn>=0.23->imbalanced-learn->imblearn) (2.1.0)
Note: you may need to restart the kernel to use updated packages.
```

In [73]:

```
from imblearn.over_sampling import RandomOverSampler
ros = RandomOverSampler(random_state=0)
x_resampled,y_resampled = ros.fit_resample(updated_x,Y_train)
```

In [74]:

```
x_resampled
```

Out[74]:

	Duration	Net Sales	Commision (in value)	Age
0	16.0	39.00	9.75	22.0
1	4.0	9.90	5.94	61.0
2	14.0	27.00	0.00	36.0
3	69.0	93.60	23.40	24.0
4	10.0	10.00	0.00	36.0
...	...	...	...	...
83635	379.0	256.20	166.53	33.0
83636	365.0	449.25	112.31	37.0
83637	20.0	40.00	0.00	28.0
83638	21.0	69.50	17.38	83.0
83639	15.0	29.90	7.47	26.0

83640 rows × 4 columns

In [75]:

```
y_resampled.shape
```

Out[75]:

```
(83640,)
```

In [76]:

```
x_test_updated = X_test.drop(columns = ["Agency", "Agency Type", "Distribution Channel", "Product N
ame", "Destination"])
```

In [77]:

```
x_test_updated
```

Out[77]:

	Duration	Net Sales	Commision (in value)	Age
47929	1.0	20.00	0.00	36.0
37647	7.0	25.00	0.00	35.0
775	9.0	35.25	8.81	28.0
10951	382.0	291.75	72.94	29.0
14366	364.0	291.75	72.94	31.0
...	...	...	...	...
62250	29.0	19.80	11.88	39.0
369	3.0	15.00	6.00	48.0

	Duration	Net Sales	Commision (in value)	Age
60091	3.0	80.70	17.82	34.0
33141	63.0	80.00	0.00	52.0
5890	14.0	15.00	0.00	36.0

20898 rows × 4 columns

In [78]:

```
from sklearn.linear_model import LogisticRegression
clf = LogisticRegression(random_state=0).fit(x_resampled,y_resampled)
y_pred = clf.predict(x_test_updated)
y_pred
```

Out[78]:

```
array([0, 0, 0, ..., 0, 1, 0], dtype=int64)
```

In [79]:

```
clf.score(x_resampled,y_resampled)
```

Out[79]:

```
0.6451578192252511
```

In [80]:

```
from sklearn.metrics import confusion_matrix
print(confusion_matrix(y_test,y_pred))
```

```
[[16459  4120]
 [  158   161]]
```

In [81]:

```
from sklearn.metrics import classification_report
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.99      0.80      0.88     20579
           1       0.04      0.50      0.07       319

    accuracy                           0.80     20898
   macro avg       0.51      0.65      0.48     20898
weighted avg       0.98      0.80      0.87     20898
```

In [ ]: