```
#Import some libraries to perform some calculations, visualization, plotting, remove warnings and other usage of functions

import pandas as pd
import matplotlib.pyplot as plt
import seaborn  as sns
from scipy import stats
import numpy as np
import warnings
warnings.filterwarnings("ignore")
```

```
#Load the train dataset of CAR and stored in variable called car:

car = pd.read_csv('/content/train_qWM28Yl.csv')
car
```

	policy_id	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	...	is_brake_assist	is_power
0	ID00001	0.515874	0.05	0.644231	C1	4990	1	A	M1	CNG	...	No	
1	ID00002	0.672619	0.02	0.375000	C2	27003	1	A	M1	CNG	...	No	
2	ID00003	0.841110	0.02	0.384615	C3	4076	1	A	M1	CNG	...	No	
3	ID00004	0.900277	0.11	0.432692	C4	21622	1	C1	M2	Petrol	...	Yes	
4	ID00005	0.596403	0.11	0.634615	C5	34738	2	A	M3	Petrol	...	No	
...	...	...	...	...	...	...	...	...	...	...	...	...	
58587	ID58588	0.355089	0.13	0.644231	C8	8794	2	A	M3	Petrol	...	No	
58588	ID58589	1.199642	0.02	0.519231	C14	7788	1	A	M1	CNG	...	No	
58589	ID58590	1.162273	0.05	0.451923	C5	34738	1	A	M1	CNG	...	No	
58590	ID58591	1.236307	0.14	0.557692	C8	8794	1	B2	M6	Petrol	...	Yes	
58591	ID58592	0.124429	0.02	0.442308	C8	8794	3	C2	M4	Diesel	...	Yes	

58592 rows × 44 columns

Basic Pandas

```
#This command gives the information of given dataset:

car.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 58592 entries, 0 to 58591
Data columns (total 44 columns):
 #   Column                            Non-Null Count  Dtype  
---  ------                            --------------  -----  
 0   policy_id                         58592 non-null  object 
 1   policy_tenure                     58592 non-null  float64
 2   age_of_car                        58592 non-null  float64
 3   age_of_policyholder               58592 non-null  float64
 4   area_cluster                      58592 non-null  object 
 5   population_density                58592 non-null  int64  
 6   make                              58592 non-null  int64  
 7   segment                           58592 non-null  object 
 8   model                             58592 non-null  object 
 9   fuel_type                         58592 non-null  object 
 10  max_torque                        58592 non-null  object 
 11  max_power                         58592 non-null  object 
 12  engine_type                       58592 non-null  object 
 13  airbags                           58592 non-null  int64  
 14  is_esc                            58592 non-null  object 
 15  is_adjustable_steering            58592 non-null  object 
 16  is_tpms                           58592 non-null  object 
 17  is_parking_sensors                58592 non-null  object 
 18  is_parking_camera                 58592 non-null  object 
 19  rear_brakes_type                  58592 non-null  object 
 20  displacement                      58592 non-null  int64  
 21  cylinder                          58592 non-null  int64  
 22  transmission_type                 58592 non-null  object 
 23  gear_box                          58592 non-null  int64  
 24  steering_type                     58592 non-null  object 
 25  turning_radius                    58592 non-null  float64
 26  length                            58592 non-null  int64  
 27  width                             58592 non-null  int64  
 28  height                            58592 non-null  int64  
 29  gross_weight                      58592 non-null  int64  
 30  is_front_fog_lights               58592 non-null  object 
 31  is_rear_window_wiper              58592 non-null  object 
 32  is_rear_window_washer             58592 non-null  object 
 33  is_rear_window_defogger           58592 non-null  object 
 34  is_brake_assist                   58592 non-null  object 
 35  is_power_door_locks               58592 non-null  object 
 36  is_central_locking                58592 non-null  object 
 37  is_power_steering                 58592 non-null  object 
 38  is_driver_seat_height_adjustable  58592 non-null  object 
 39  is_day_night_rear_view_mirror     58592 non-null  object 
 40  is_ecw                            58592 non-null  object 
 41  is_speed_alert                    58592 non-null  object 
 42  ncap_rating                       58592 non-null  int64  
 43  is_claim                          58592 non-null  int64  
dtypes: float64(4), int64(12), object(28)
memory usage: 19.7+ MB
```

```
#This command gives the static information of given dataset:

car.describe()
```

	policy_tenure	age_of_car	age_of_policyholder	population_density	make	airbags	displacement	cylinder	gear_box	turning_radius
count	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000
mean	0.611246	0.069424	0.469420	18826.858667	1.763722	3.137066	1162.355851	3.626963	5.245443	4.852893
std	0.414156	0.056721	0.122886	17660.174792	1.136988	1.832641	266.304786	0.483616	0.430353	0.228061
min	0.002735	0.000000	0.288462	290.000000	1.000000	1.000000	796.000000	3.000000	5.000000	4.500000

```
#This command shows the first 5 rows of given dataset:

car.head()
```

	policy_id	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	...	is_brake_assist	is_power_doo
0	ID00001	0.515874	0.05	0.644231	C1	4990	1	A	M1	CNG	...	No	
1	ID00002	0.672619	0.02	0.375000	C2	27003	1	A	M1	CNG	...	No	
2	ID00003	0.841110	0.02	0.384615	C3	4076	1	A	M1	CNG	...	No	
3	ID00004	0.900277	0.11	0.432692	C4	21622	1	C1	M2	Petrol	...	Yes	
4	ID00005	0.596403	0.11	0.634615	C5	34738	2	A	M3	Petrol	...	No	

5 rows × 44 columns

```
#This command shows the last 5 rows of given dataset:

car.tail()
```

	policy_id	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	...	is_brake_assist	is_power
58587	ID58588	0.355089	0.13	0.644231	C8	8794	2	A	M3	Petrol	...	No	
58588	ID58589	1.199642	0.02	0.519231	C14	7788	1	A	M1	CNG	...	No	
58589	ID58590	1.162273	0.05	0.451923	C5	34738	1	A	M1	CNG	...	No	
58590	ID58591	1.236307	0.14	0.557692	C8	8794	1	B2	M6	Petrol	...	Yes	
58591	ID58592	0.124429	0.02	0.442308	C8	8794	3	C2	M4	Diesel	...	Yes	

5 rows × 44 columns

```
#This command shows the columns of given dataset:

car.columns
```

```
Index(['policy_id', 'policy_tenure', 'age_of_car', 'age_of_policyholder',
       'area_cluster', 'population_density', 'make', 'segment', 'model',
       'fuel_type', 'max_torque', 'max_power', 'engine_type', 'airbags',
       'is_esc', 'is_adjustable_steering', 'is_tpms', 'is_parking_sensors',
       'is_parking_camera', 'rear_brakes_type', 'displacement', 'cylinder',
       'transmission_type', 'gear_box', 'steering_type', 'turning_radius',
       'length', 'width', 'height', 'gross_weight', 'is_front_fog_lights',
       'is_rear_window_wiper', 'is_rear_window_washer',
       'is_rear_window_defogger', 'is_brake_assist', 'is_power_door_locks',
       'is_central_locking', 'is_power_steering',
       'is_driver_seat_height_adjustable', 'is_day_night_rear_view_mirror',
       'is_ecw', 'is_speed_alert', 'ncap_rating', 'is_claim'],
      dtype='object')
```

```
#This command shows the order pair of given dataset:

car.shape
```

```
(58592, 44)
```

```
#This command gives the missing values of given dataset:

car.isnull().sum()
```

```
policy_id                           0
policy_tenure                       0
age_of_car                          0
age_of_policyholder                 0
area_cluster                        0
population_density                  0
make                                0
segment                             0
model                               0
fuel_type                           0
max_torque                          0
max_power                           0
engine_type                         0
airbags                             0
is_esc                              0
is_adjustable_steering              0
is_tpms                             0
is_parking_sensors                  0
is_parking_camera                   0
rear_brakes_type                    0
displacement                        0
cylinder                            0
transmission_type                   0
gear_box                            0
steering_type                       0
turning_radius                      0
length                              0
width                               0
height                              0
gross_weight                        0
is_front_fog_lights                 0
is_rear_window_wiper                0
is_rear_window_washer               0
is_rear_window_defogger             0
is_brake_assist                     0
is_power_door_locks                 0
is_central_locking                  0
is_power_steering                   0
```

```
is_driver_seat_height_adjustable    0
is_day_night_rear_view_mirror       0
is_ecw                              0
is_speed_alert                      0
ncap_rating                         0
is_claim                            0
dtype: int64
```

```
#This command gives the duplicated values  of given dataset:

car.duplicated().sum()
```

```
0
```

```
#This command groups the target column ("is_claim") into all other columns.
#Following cammand shows the relationship between target and other column:

gp = car.groupby('is_claim').count()
gp
```

	policy_id	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	...	is_rear_window_defog
is_claim												
0	54844	54844	54844	54844	54844	54844	54844	54844	54844	54844	...	54
1	3748	3748	3748	3748	3748	3748	3748	3748	3748	3748	...	3

2 rows × 43 columns

```
#This command counts the value of target column:

car.is_claim.value_counts()
```

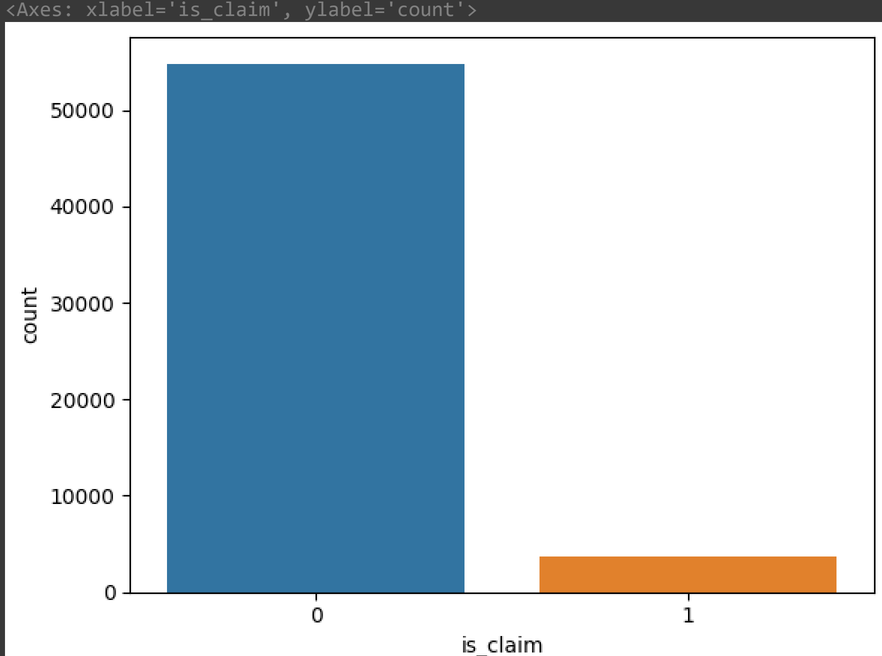
```
0    54844
1     3748
Name: is_claim, dtype: int64
```

Visualization:

```
# This command shows the value of target column in the form of graph:

sns.countplot(x= car['is_claim'], data=car)
```

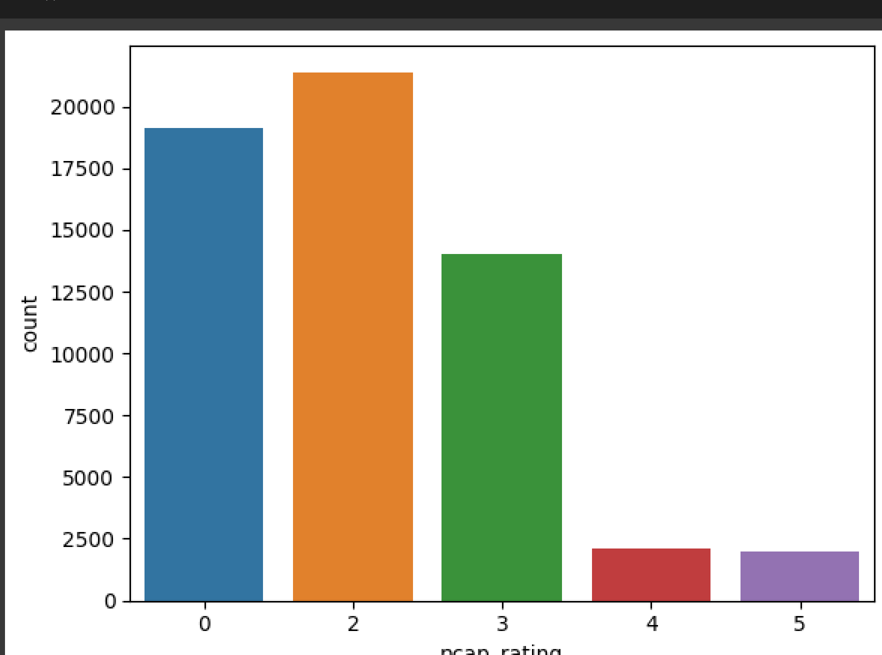
<Axes: xlabel='is_claim', ylabel='count'>



The difference between 0 and 1 is huge, due to class Im-Balancing problem: After some codes this problem will we solved:

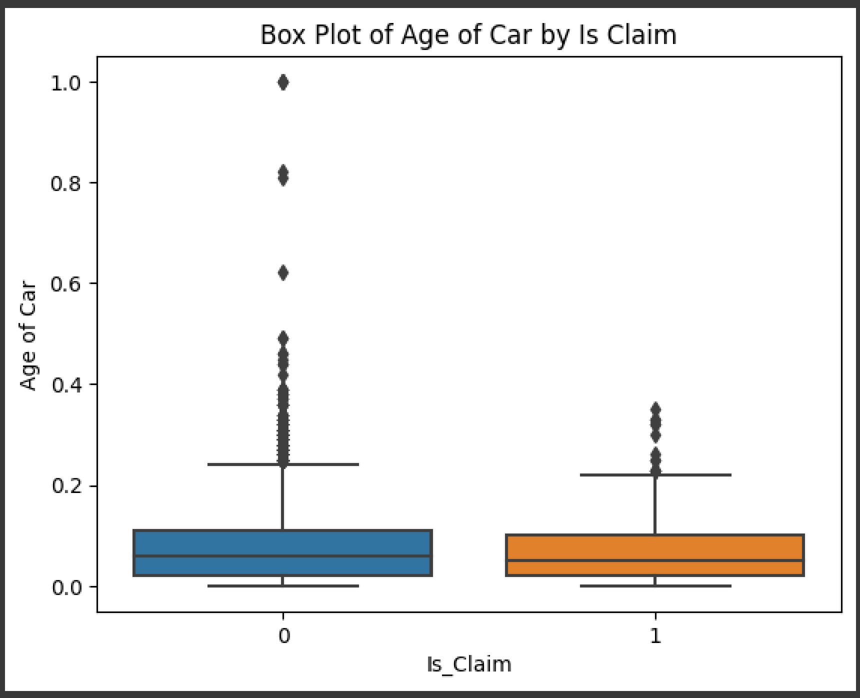
```
#This command shows the ncap_rating in the form of graph:

sns.countplot(x = 'ncap_rating', data = car)
plt.xlabel('ncap_rating')
plt.show()
```



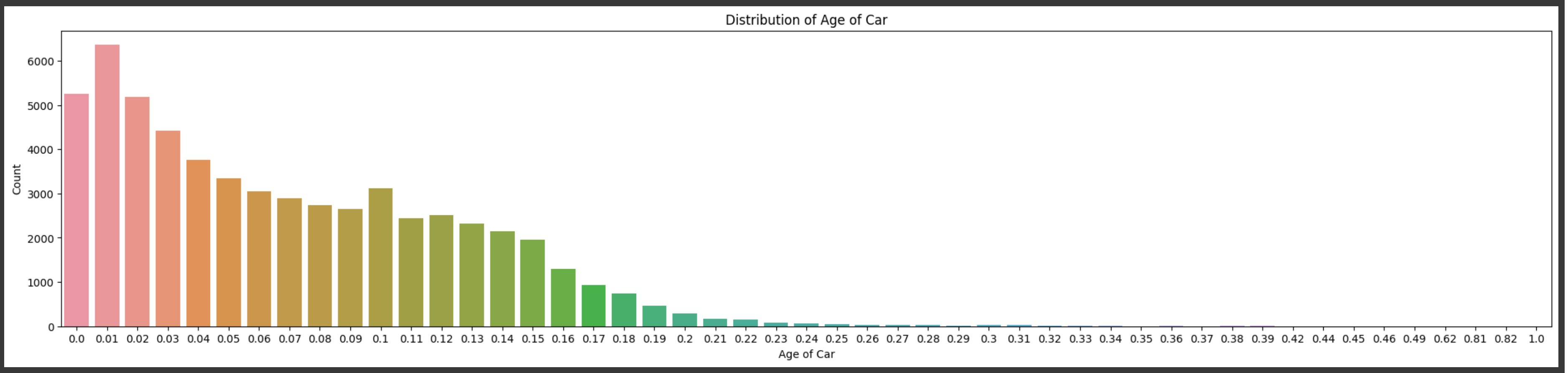
```
#This commad is used to show the outliers in target column:

sns.boxplot(x='is_claim', y='age_of_car', data=car)
plt.xlabel('Is_Claim')
plt.ylabel('Age of Car')
plt.title('Box Plot of Age of Car by Is Claim')
plt.show()
```




```
#This command shows the age_of_car column in graphical view:

plt.figure(figsize = (25,5))
sns.countplot(x='age_of_car', data=car)
plt.xlabel('Age of Car')
plt.ylabel('Count')
plt.title('Distribution of Age of Car')
plt.show()
```



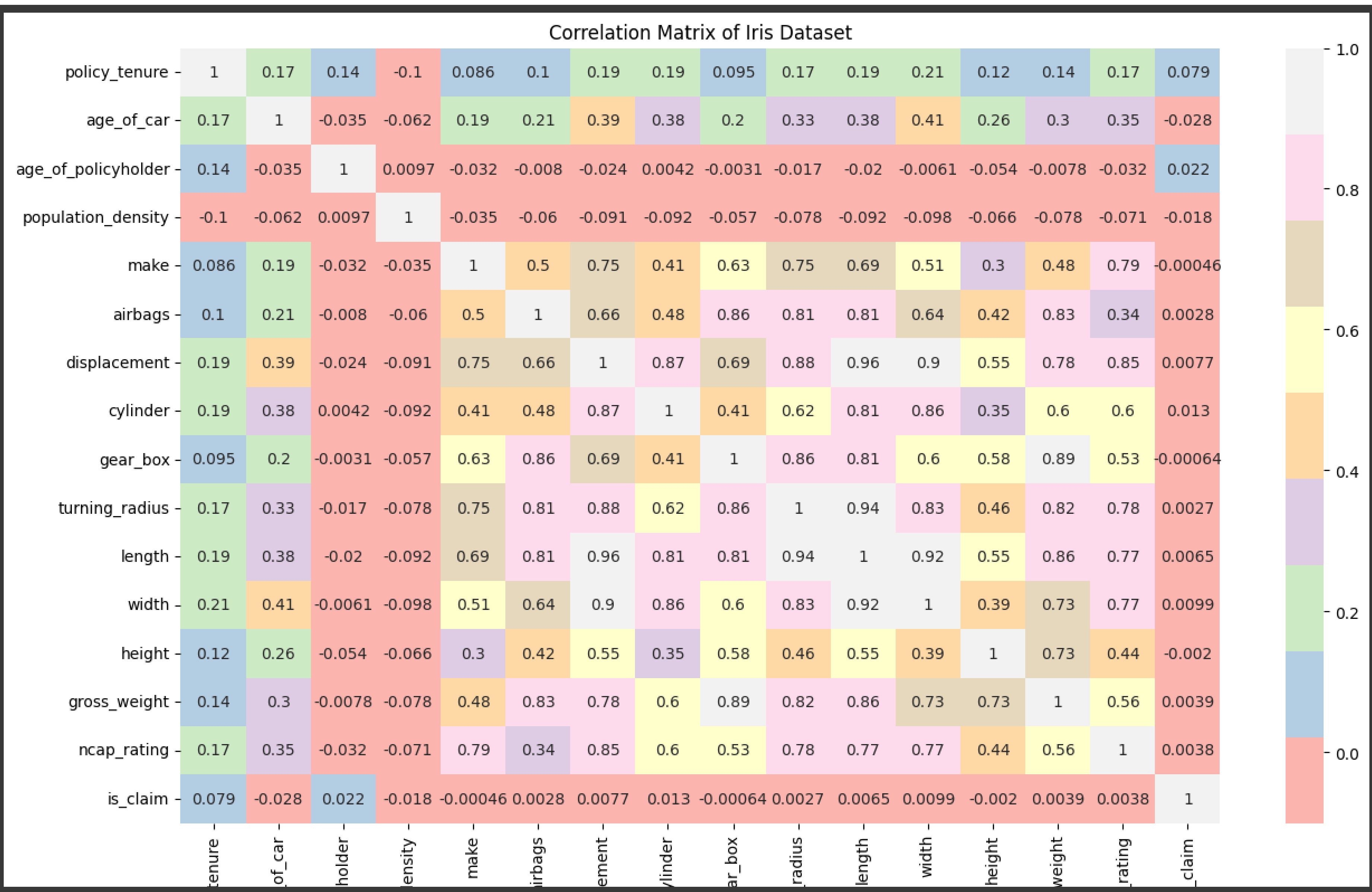

```
#This command is used to identify the co-relation of entire dataset:

car.corr()
```

	policy_tenure	age_of_car	age_of_policyholder	population_density	make	airbags	displacement	cylinder	gear_box	turning_radius	le
policy_tenure	1.000000	0.166312	0.143676	-0.100307	0.086101	0.103981	0.194361	0.191185	0.095305	0.166426	0.19
age_of_car	0.166312	1.000000	-0.035427	-0.062255	0.188122	0.209073	0.393208	0.379522	0.201579	0.332716	0.38
age_of_policyholder	0.143676	-0.035427	1.000000	0.009669	-0.031989	-0.008041	-0.023764	0.004183	-0.003115	-0.016764	-0.02
population_density	-0.100307	-0.062255	0.009669	1.000000	-0.035125	-0.060359	-0.090983	-0.091591	-0.056640	-0.077501	-0.09
make	0.086101	0.188122	-0.031989	-0.035125	1.000000	0.501800	0.753344	0.410672	0.632807	0.753861	0.69
airbags	0.103981	0.209073	-0.008041	-0.060359	0.501800	1.000000	0.661190	0.478594	0.859556	0.810820	0.80
displacement	0.194361	0.393208	-0.023764	-0.090983	0.753344	0.661190	1.000000	0.866231	0.692240	0.875407	0.96
cylinder	0.191185	0.379522	0.004183	-0.091591	0.410672	0.478594	0.866231	1.000000	0.410163	0.615806	0.80
gear_box	0.095305	0.201579	-0.003115	-0.056640	0.632807	0.859556	0.692240	0.410163	1.000000	0.861740	0.80
turning_radius	0.166426	0.332716	-0.016764	-0.077501	0.753861	0.810820	0.875407	0.615806	0.861740	1.000000	0.94
length	0.190869	0.383177	-0.020138	-0.091968	0.692365	0.809094	0.961655	0.805476	0.808975	0.944899	1.00
width	0.213228	0.414104	-0.006135	-0.098156	0.511695	0.639562	0.899302	0.862430	0.601923	0.825603	0.91
height	0.119055	0.259156	-0.053930	-0.065583	0.303274	0.423816	0.554591	0.352118	0.579725	0.460436	0.55
gross_weight	0.141027	0.302127	-0.007758	-0.077816	0.481408	0.828988	0.776210	0.602978	0.894639	0.823097	0.86
ncap_rating	0.173280	0.348853	-0.031628	-0.071150	0.792254	0.341557	0.847065	0.598364	0.529688	0.779302	0.76
is_claim	0.078747	-0.028172	0.022435	-0.017808	-0.000456	0.002789	0.007678	0.013434	-0.000635	0.002724	0.00

```
#This command convert the co-relation into heatmap:
#Graphical view of co-relation from heatmap:

correlation_matrix = car.corr()
plt.figure(figsize = (15,9))
sns.heatmap(correlation_matrix, annot=True, cmap='Pastel1')
plt.title('Correlation Matrix of Iris Dataset')
plt.show()
```



Drop Poilcy_ID Column, Label Encoding at different columns, Split data into train-test model

```
#Import some libraries for label encoding, accurarcy and other:

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder
```

```
#This command is used to drop the policy_id column:

car1 = car
car1= car1.drop('policy_id', axis=1)
```

```
# This command extract the categorical columns:

catFeatures= [col for col in car1.columns if col in
              car1.select_dtypes(include=object).columns]

# # Extracting All Features:
features = [col for col in car1.columns if col not in ['is_claim']]

print(features)
print(catFeatures)
```

```
['policy_tenure', 'age_of_car', 'age_of_policyholder', 'area_cluster', 'population_density', 'make', 'segment', 'model', 'fuel_type', 'max_torque', 'max_power',
['area_cluster', 'segment', 'model', 'fuel_type', 'max_torque', 'max_power', 'engine_type', 'is_esc', 'is_adjustable_steering', 'is_tpms', 'is_parking_sensors',
```

```
# This command is used to Split Features and Target Variable:

X = car1.loc[:, features]
# Checking Dataset Shape (Features):
print(X.shape)
```

```
(58592, 42)
```

```
# This command is used to Split Features and Target Variable:

y=car[['is_claim']]
# Checking Dataset Shape (Features):
print(y.shape)
```

```
(58592, 1)
```

```
# This command is used to put label_Encoding into Categorical columns:

labelEncode = LabelEncoder()

# Iterating Over each categorial features:
for col in catFeatures:
    # storing its numerical value:
    X[col] = labelEncode.fit_transform(car1[col])
```

```
#After apply label_Encoding all categorical columns is converted into numerical columns:

X.head()
```

	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	max_torque	...	is_rear_window_defogger	is_
0	0.515874	0.05	0.644231	0	4990	1	0	0	0	5	...	0	
1	0.672619	0.02	0.375000	11	27003	1	0	0	0	5	...	0	
2	0.841110	0.02	0.384615	15	4076	1	0	0	0	5	...	0	
3	0.900277	0.11	0.432692	16	21622	1	3	3	2	0	...	1	
4	0.596403	0.11	0.634615	17	34738	2	0	4	2	8	...	0	

5 rows × 42 columns

```
y
```

	is_claim
0	0
1	0
2	0
3	0
4	0
...	...
58587	0
58588	0
58589	0
58590	0
58591	0

58592 rows × 1 columns

```
#This command split given dataset into test and train:

X_train, X_test, Y_train, Y_test = train_test_split(X, y, test_size = 0.25)
```

```
#This command shows the order pair of test and train

print("shape of X_train: ", X_train.shape)
print("shape of Y_train: ", Y_train.shape)
print("shape of X_test: ", X_test.shape)
print("shape of Y_test: ", Y_test.shape)
```

```
shape of X_train:  (43944, 42)
shape of Y_train:  (43944, 1)
shape of X_test:  (14648, 42)
shape of Y_test:  (14648, 1)
```

Classification Model --> "Logistic Regression"

```
#Import Logistic Regression libraries:

from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
```

```
#Fit the model:

model.fit(X_train, Y_train)
```

```
▾ LogisticRegression
LogisticRegression()
```

```
#Calculate accuracy score:

y_pred = model.predict(X_test)
score = accuracy_score(Y_test, y_pred)
accuracy = score*100
print(accuracy)
```

```
93.5417804478427
```

Due to class im-blancing problem. Linear Regression Model overfit values

```
# This command is used to draw confussion matrix:

from sklearn.metrics import confusion_matrix
y_pred = model.predict(X_test)
print("Confusion Matrix")
cm = confusion_matrix(Y_test, y_pred)
print(cm)
```

```
Confusion Matrix
[[13702     0]
 [  946     0]]
```

Apply Smote Function

Apply SMOTE function for resolving class imbalancing issue:

Due to this import SMOTE library and again split the data into test and train;

```
from imblearn.over_sampling import SMOTE
sm = SMOTE(random_state=42)
X_re, y_re = sm.fit_resample(X, y)
X_train, X_test, Y_train, Y_test = train_test_split(X_re, y_re, test_size = 0.25)
```

```
#This command shows the order pair of test and train after SMOTE function:

print("shape of X_train: ", X_train.shape)
print("shape of Y_train: ", Y_train.shape)
print("shape of X_test: ", X_test.shape)
print("shape of Y_test: ", Y_test.shape)
```

```
shape of X_train:  (82266, 42)
shape of Y_train:  (82266, 1)
shape of X_test:  (27422, 42)
shape of Y_test:  (27422, 1)
```

Classification Model --> "Logistic Regression"

```
#Import Logistic Regression libraries:

from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
```

```
# Fit the Model:

model.fit(X_train, Y_train)
```

```
▾ LogisticRegression
LogisticRegression()
```

```
#Calculate accuracy score:

y_pred = model.predict(X_test)
score = accuracy_score(Y_test, y_pred)
accuracy = score*100
print(accuracy)
```

```
51.644664867624535
```

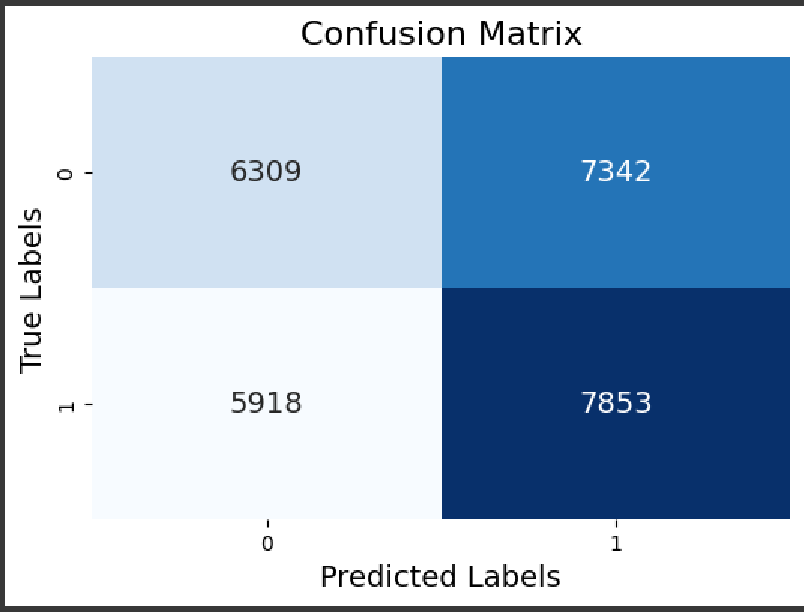
```
# This command is used to draw confussion matrix:

from sklearn.metrics import confusion_matrix
y_pred = model.predict(X_test)
print("Confusion Matrix")
cm = confusion_matrix(Y_test, y_pred)
print(cm)
```

```
Confusion Matrix
[[6309 7342]
 [5918 7853]]
```

```
# This command is used to draw a heatmap of confussion matrix:

plt.figure(figsize = (6, 4))
sns.heatmap(cm, annot = True, fmt = 'd', cmap = 'Blues', cbar = False, annot_kws = {'size' : 14})
plt.xlabel('Predicted Labels', fontsize = 14)
plt.ylabel('True Labels', fontsize = 14)
plt.title('Confusion Matrix', fontsize = 16)
plt.show()
```



Class Im-balancing problem is vanish but model accuracy is very low, for raising the model accuracy we can tune it's parameter by using "HYPERPARAMETER TUNNING".

```
# This command is used to store parameters for hyper parameter tunning:

param_g = {
    'C': [0.001, 0.01, 0.1, 1, 10, 100],
    'penalty': ['l1', 'l2']
}
```

```
#Import library:

from sklearn.model_selection import GridSearchCV
```

```
# This command is used to develop the model:

clf = GridSearchCV(model, param_grid = param_g, cv = 10, verbose = True, n_jobs = -1)
```

```
#Fit the model:

LR_grid = clf.fit(X, y)
```

```
Fitting 10 folds for each of 12 candidates, totalling 120 fits
```

```
# This command is used to show best parameter and best index:

print('Best hyperparameters are: '+str(LR_grid.best_params_))
print('Best index is: '+str(LR_grid.best_index_))
```

```
Best hyperparameters are: {'C': 0.001, 'penalty': 'l2'}
Best index is: 1
```

```
# This command is used to calculate accurary:

score = (LR_grid.best_score_)
accuracy = score*100
print(accuracy)
```

```
93.60322236959911
```

Classification Model --> "Decision Tree"

```
#Import decesion tree classifier library and develop the model:

from sklearn.tree import DecisionTreeClassifier
dtc = DecisionTreeClassifier()
```

```
# Fit model:

dtc.fit(X_train, Y_train)
```

```
▾ DecisionTreeClassifier
DecisionTreeClassifier()
```

```
#This command is used to calculate accuracy of the model:

y_pred = dtc.predict(X_test)
score = accuracy_score(Y_test, y_pred)
accuracy = score*100
print(accuracy)
```

```
91.5031726351105
```

```
# This command is used to draw confussion matrix:

from sklearn.metrics import confusion_matrix
y_pred = dtc.predict(X_test)
print("Confusion Matrix")
cm_dtc = confusion_matrix(Y_test, y_pred)
print(cm_dtc)
```

```
Confusion Matrix
[[12397  1254]
 [ 1076 12695]]
```

```
# This command is used to draw a heatmap of confussion matrix:

plt.figure(figsize = (6, 4))
sns.heatmap(cm_dtc, annot = True, fmt = 'd', cmap = 'Blues', cbar = False, annot_kws = {'size' : 14})
plt.xlabel('Predicted Labels', fontsize = 14)
plt.ylabel('True Labels', fontsize = 14)
plt.title('Confusion Matrix', fontsize = 16)
plt.show()
```