In [25]:

```
#Basic imports
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#Preprocessing and cleaning
from scipy.stats import skew
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import LabelEncoder

#Feature Selection
from sklearn.feature_selection import chi2
from sklearn.feature_selection import f_regression
from sklearn.feature_selection import SelectKBest

#Algorithms
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import LinearSVC
from sklearn.svm import SVC
from sklearn.ensemble import AdaBoostClassifier
from xgboost import XGBClassifier

#Evaluation
from sklearn.metrics import classification_report

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

In [26]:

```
df = pd.read_csv('data.csv')
```

In [27]:

```
df.head()
```

Out[27]:

	ID	Agency	Agency Type	Distribution Channel	Product Name	Claim	Duration	Destination	Net Sales
0	3433	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	0	7	MALAYSIA	0.0
1	4339	EPX	Travel Agency	Online	Cancellation Plan	0	85	SINGAPORE	69.0
2	34590	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	0	11	MALAYSIA	19.8
3	55816	EPX	Travel Agency	Online	2 way Comprehensive Plan	0	16	INDONESIA	20.0
4	13816	EPX	Travel Agency	Online	Cancellation Plan	0	10	KOREA, REPUBLIC OF	15.0

In [28]:

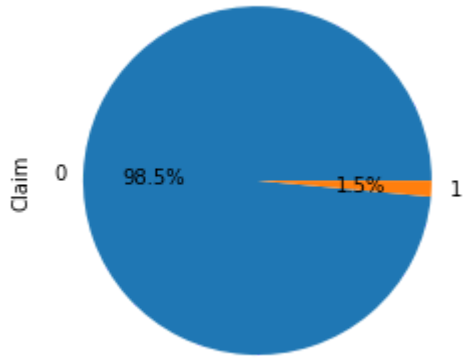
```
df.shape
```

Out[28]:

```
(50553, 12)
```

In [29]:

```
df["Claim"].value_counts().plot.pie(autopct="%1.1f%%")
plt.show()
```



Preprocessing and Cleaning

In [30]:

```
#Remove unwanted column
df.drop("ID", axis=1, inplace=True)
```

In [31]:

```
#Check null values
df.isnull().sum()
```

Out[31]:

```
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                   35953
Age                          0
dtype: int64
```

In [32]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50553 entries, 0 to 50552
Data columns (total 11 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   Agency                50553 non-null  object 
 1   Agency Type           50553 non-null  object 
 2   Distribution Channel  50553 non-null  object 
 3   Product Name          50553 non-null  object 
 4   Claim                 50553 non-null  int64  
 5   Duration              50553 non-null  int64  
 6   Destination           50553 non-null  object 
 7   Net Sales             50553 non-null  float64
 8   Commision (in value)  50553 non-null  float64
 9   Gender                14600 non-null  object 
 10  Age                   50553 non-null  int64  
dtypes: float64(2), int64(3), object(6)
memory usage: 4.2+ MB
```

In [33]:

```
df["Gender"].fillna("unavailable",inplace=True)
```

In [34]:

```
df["Claim"]=df["Claim"].astype(object)
```

In [35]:

```
#Seperating categorical and numerical data
df_cat = df.select_dtypes('object')
df_num = df.select_dtypes(['int64','float64'])
```

In [36]:

```
df_cat.head()
```

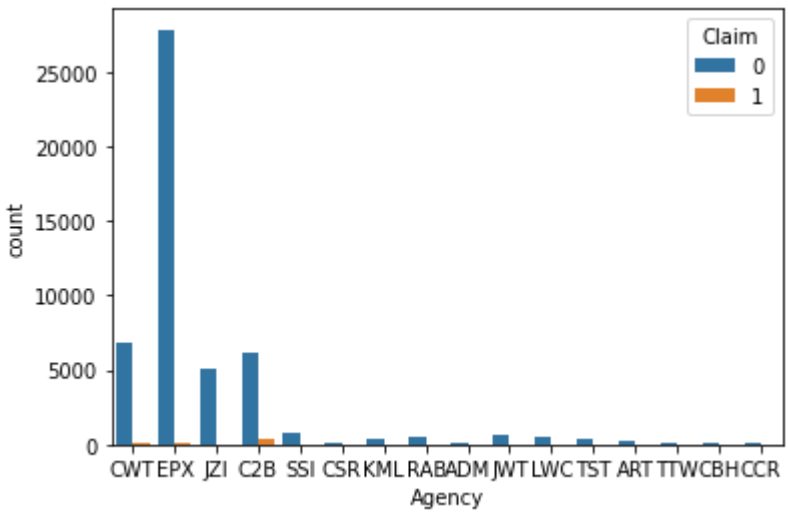
Out[36]:

	Agency	Agency Type	Distribution Channel	Product Name	Claim	Destination	Gender
0	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	0	MALAYSIA	unavailable
1	EPX	Travel Agency	Online	Cancellation Plan	0	SINGAPORE	unavailable
2	CWT	Travel Agency	Online	Rental Vehicle Excess Insurance	0	MALAYSIA	unavailable
3	EPX	Travel Agency	Online	2 way Comprehensive Plan	0	INDONESIA	unavailable
4	EPX	Travel Agency	Online	Cancellation Plan	0	KOREA, REPUBLIC OF	unavailable

In [37]:

```
for col in df_cat:
  print(col)
  plt.figure()
  sns.countplot(data=df_cat, x=col, hue="Claim")
  plt.show()
```

```
Agency
```




```
Agency Type
```

In [38]:

```
#Encoding Categorical data
le = LabelEncoder()
for col in df_cat:
  df_cat[col] = le.fit_transform(df_cat[col])
```

In [39]:

```
df_cat.head()
```

Out[39]:

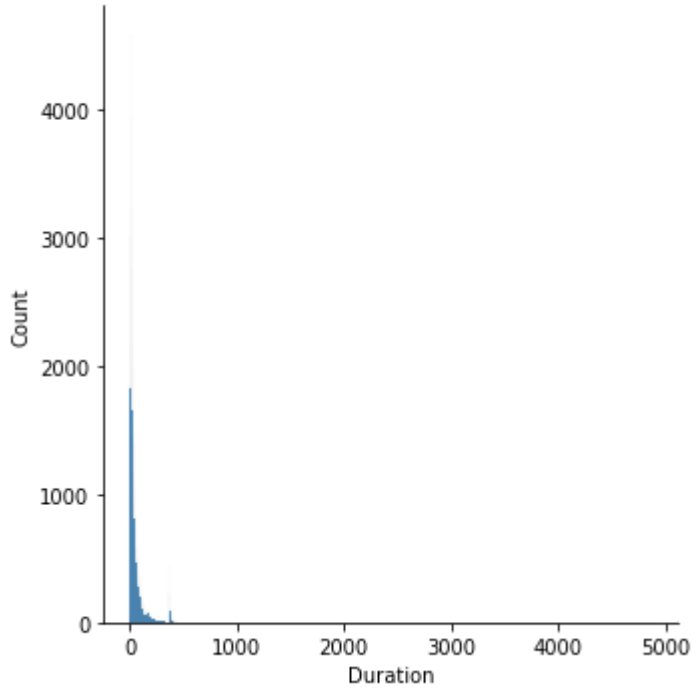
	Agency	Agency Type	Distribution Channel	Product Name	Claim	Destination	Gender
0	6	1	1	16	0	56	2
1	7	1	1	10	0	79	2
2	6	1	1	16	0	56	2
3	7	1	1	1	0	38	2
4	7	1	1	10	0	47	2

In [40]:

```
for col in df_num:
  print(col)
  print(skew(df_num[col]))
  plt.figure()
  sns.displot(df_num[col])
  plt.show()
```

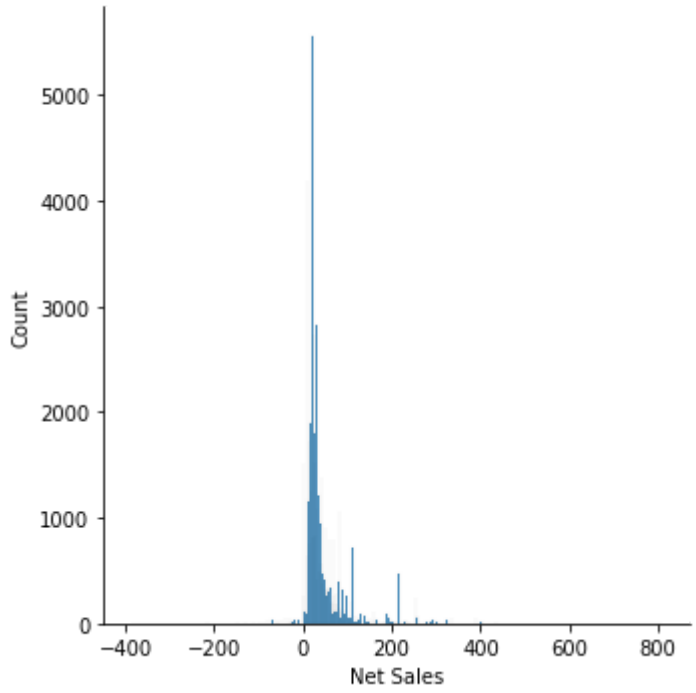
```
Duration
22.872063891229274

<Figure size 432x288 with 0 Axes>
```



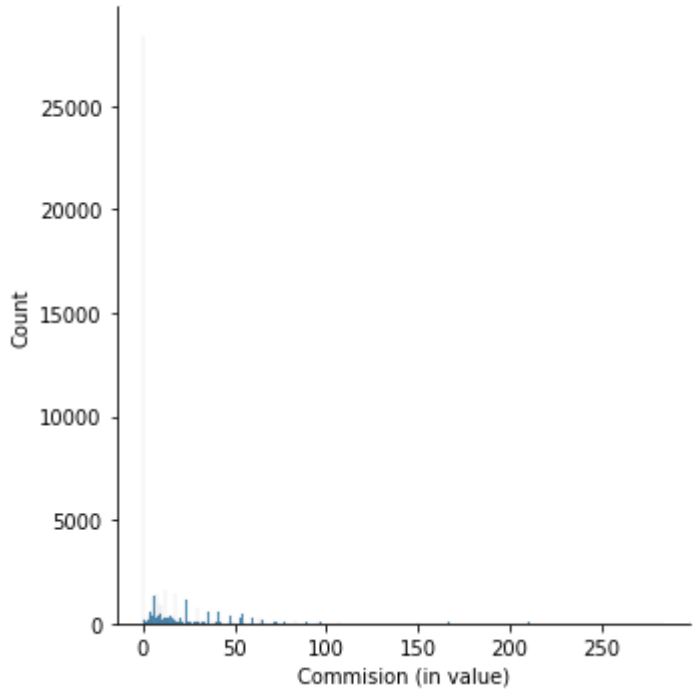

```
Net Sales
3.3281441910342053

<Figure size 432x288 with 0 Axes>
```



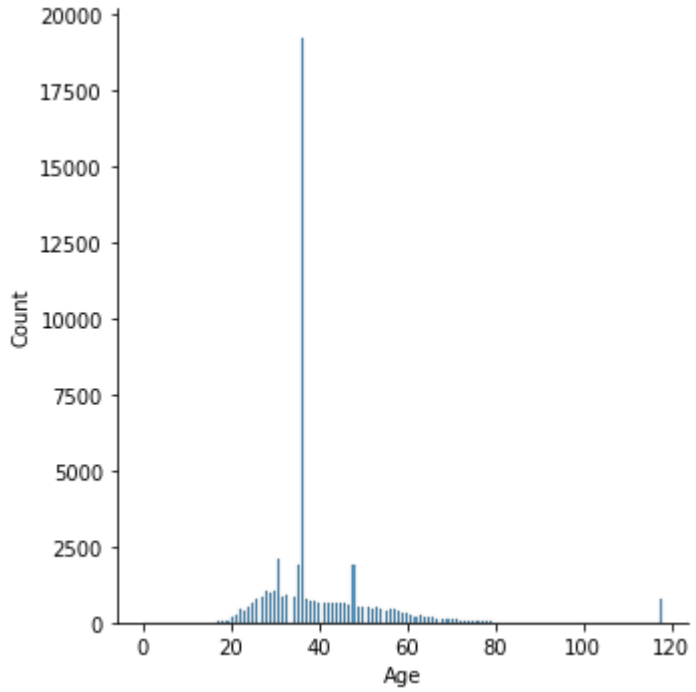
```
Commision (in value)
4.0780684356634636

<Figure size 432x288 with 0 Axes>
```




```
Age
2.9783898494112435

<Figure size 432x288 with 0 Axes>
```



In [41]:

```
#Merging categorical and numerical data
df_new = pd.concat([df_num, df_cat],axis=1)
```

In [42]:

```
df_new.head()
```

Out[42]:

	Duration	Net Sales	Commision (in value)	Age	Agency	Agency Type	Distribution Channel	Product Name	Claim	Destinatio
0	7	0.0	17.82	31	6	1	1	16	0	5
1	85	69.0	0.00	36	7	1	1	10	0	7
2	11	19.8	11.88	75	6	1	1	16	0	5
3	16	20.0	0.00	32	7	1	1	1	0	3
4	10	15.0	0.00	29	7	1	1	10	0	4

In [43]:

```
def create_model(model, X_train, X_test):
  model.fit(X_train, y_train)
  y_pred = model.predict(X_test)
  print(classification_report(y_test, y_pred))
  return model
```

In [44]:

```
#Preparing for training
X = df_new.drop("Claim", axis=1)
y = df_new["Claim"]
```

In [45]:

```
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.3, random_state =1)
```

Baseline Model

In [46]:

```
lr = LogisticRegression()
```

In [47]:

```
create_model(lr,X_train,X_test)
```

```
              precision    recall  f1-score   support

           0       0.99      1.00      0.99     14961
           1       0.00      0.00      0.00       205

    accuracy                           0.99     15166
   macro avg       0.49      0.50      0.50     15166
weighted avg       0.97      0.99      0.98     15166
```

Out[47]:

```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=None, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

Under sampling

In [48]:

```
from imblearn.under_sampling import RandomUnderSampler
```

In [49]:

```
rus = RandomUnderSampler(random_state=1)
```

In [50]:

```
X_sample1, y_sample1 = rus.fit_sample(X_train,y_train)
```

In [51]:

```
pd.Series(y_sample1).value_counts()
```

Out[51]:

```
1    536
0    536
dtype: int64
```

In [52]:

```
lr2 = LogisticRegression()
lr2.fit(X_sample1, y_sample1)
```

Out[52]:

```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=None, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

In [53]:

```
y_pred2 = lr2.predict(X_test)
```

In [54]:

```
print(classification_report(y_test,y_pred2))
```

```
              precision    recall  f1-score   support

           0       0.99      0.83      0.90     14961
           1       0.05      0.62      0.09       205

    accuracy                           0.83     15166
   macro avg       0.52      0.72      0.50     15166
weighted avg       0.98      0.83      0.89     15166
```

Decision Tree Under sampling

In [55]:

```
dt1 = DecisionTreeClassifier()
```

In [56]:

```
dt1.fit(X_sample1,y_sample1)
```

Out[56]:

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=None, max_features=None, max_leaf_nodes=Non
e,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [57]:

```
y_pred = dt1.predict(X_test)
```

In [58]:

```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.99      0.67      0.80     14961
           1       0.03      0.67      0.05       205

    accuracy                           0.67     15166
   macro avg       0.51      0.67      0.43     15166
weighted avg       0.98      0.67      0.79     15166
```

Decision Tree with max_depth=8

In [59]:

```
dt2 = DecisionTreeClassifier(max_depth=8)
```

In [60]:

```
dt2.fit(X_sample1,y_sample1)
```

Out[60]:

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=8, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [61]:

```
y_pred_1 = dt2.predict(X_test)
```

In [62]:

```
print(classification_report(y_test, y_pred_1))
```

```
              precision    recall  f1-score   support

           0       0.99      0.72      0.84     14961
           1       0.03      0.71      0.07       205

    accuracy                           0.72     15166
   macro avg       0.51      0.72      0.45     15166
weighted avg       0.98      0.72      0.83     15166
```

Random Forest Classifier with max_depth=8

In [63]:

```
rf = RandomForestClassifier(max_depth=8)
```

In [64]:

```
rf.fit(X_sample1,y_sample1)
```

Out[64]:

```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=8, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=None, oob_score=False, random_state=None,
                       verbose=0, warm_start=False)
```

In [65]:

```
y_pred_rf = rf.predict(X_test)
```

In [66]:

```
print(classification_report(y_test, y_pred_rf))
```

```
              precision    recall  f1-score   support

           0       0.99      0.77      0.87     14961
           1       0.04      0.69      0.07       205

    accuracy                           0.77     15166
   macro avg       0.52      0.73      0.47     15166
weighted avg       0.98      0.77      0.86     15166
```

Random Forest Classifier with max_features=7

In [67]:

```
rf_f = RandomForestClassifier(max_features=7, random_state=1)
```

In [68]:

```
rf_f.fit(X_sample1,y_sample1)
```

Out[68]:

```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features=7,
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=None, oob_score=False, random_state=1, verbose
=0,
                       warm_start=False)
```

In [69]:

```
y_pred_rf_f = rf_f.predict(X_test)
```

In [70]:

```
print(classification_report(y_test, y_pred_rf_f))
```

```
              precision    recall  f1-score   support

           0       0.99      0.72      0.84     14961
           1       0.03      0.73      0.07       205

    accuracy                           0.72     15166
   macro avg       0.51      0.72      0.45     15166
weighted avg       0.98      0.72      0.83     15166
```

VotingClassifier

In [71]:

```
from sklearn.ensemble import VotingClassifier
```

In [72]:

```
lr_v = LogisticRegression()
dt_v = DecisionTreeClassifier()
dt_v = DecisionTreeClassifier(criterion="entropy")
```

In [73]:

```
model_list = [("Logistic", lr_v), ("Decision",dt_v), ("Decision_entropy", dt_v)]
```

In [74]:

```
vc = VotingClassifier(estimators=model_list)
```

In [75]:

```
vc.fit(X_sample1,y_sample1)
```

Out[75]:

```
VotingClassifier(estimators=[('Logistic',
                              LogisticRegression(C=1.0, class_weight=None,
                                                 dual=False, fit_intercept=T
rue,
                                                 intercept_scaling=1,
                                                 l1_ratio=None, max_iter=10
0,
                                                 multi_class='auto',
                                                 n_jobs=None, penalty='l2',
                                                 random_state=None,
                                                 solver='lbfgs', tol=0.0001,
                                                 verbose=0, warm_start=Fals
e)),
                             ('Decision',
                              DecisionTreeClassifier(ccp_alpha=0.0,
                                                     class_weight=None,
                                                     crite...
                              DecisionTreeClassifier(ccp_alpha=0.0,
                                                     class_weight=None,
                                                     criterion='entropy',
                                                     max_depth=None,
                                                     max_features=None,
                                                     max_leaf_nodes=None,
                                                     min_impurity_decrease=
0.0,
                                                     min_impurity_split=Non
e,
                                                     min_samples_leaf=1,
                                                     min_samples_split=2,
                                                     min_weight_fraction_lea
f=0.0,
                                                     presort='deprecated',
                                                     random_state=None,
                                                     splitter='best'))],
                 flatten_transform=True, n_jobs=None, voting='hard',
                 weights=None)
```

In [76]:

```
y_pred_v = vc.predict(X_test)
```

In [77]:

```
print(classification_report(y_test, y_pred_v))
```

```
              precision    recall  f1-score   support

           0       0.99      0.68      0.81     14961
           1       0.03      0.67      0.05       205

    accuracy                           0.68     15166
   macro avg       0.51      0.68      0.43     15166
weighted avg       0.98      0.68      0.80     15166
```

ADA Boosting

In [78]:

```
ada = AdaBoostClassifier(n_estimators=100)
```

In [79]:

```
ada.fit(X_sample1,y_sample1)
```

Out[79]:

```
AdaBoostClassifier(algorithm='SAMME.R', base_estimator=None, learning_rate=
1.0,
                   n_estimators=100, random_state=None)
```

In [80]:

```
y_pred_ada = ada.predict(X_test)
```

In [81]:

```
print(classification_report(y_test, y_pred_ada))
```

```
              precision    recall  f1-score   support

           0       0.99      0.75      0.86     14961
           1       0.04      0.68      0.07       205

    accuracy                           0.75     15166
   macro avg       0.52      0.72      0.46     15166
weighted avg       0.98      0.75      0.85     15166
```

SVM

In [82]:

```
lsv = LinearSVC(random_state=1)
```

In [83]:

```
lsv.fit(X_sample1,y_sample1)
```

Out[83]:

```
LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
          intercept_scaling=1, loss='squared_hinge', max_iter=1000,
          multi_class='ovr', penalty='l2', random_state=1, tol=0.0001,
          verbose=0)
```

In [84]:

```
y_pred_lsv = lsv.predict(X_test)
```

In [85]:

```
print(classification_report(y_test, y_pred_lsv))
```

```
              precision    recall  f1-score   support

           0       0.99      0.98      0.98     14961
           1       0.11      0.20      0.14       205

    accuracy                           0.97     15166
   macro avg       0.55      0.59      0.56     15166
weighted avg       0.98      0.97      0.97     15166
```

Kernel functions

In [86]:

```
svc1 = SVC(random_state=1,kernel="rbf")
```

In [87]:

```
svc1.fit(X_sample1,y_sample1)
```

Out[87]:

```
SVC(C=1.0, break_ties=False, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma='scale', kernel='rbf',
    max_iter=-1, probability=False, random_state=1, shrinking=True, tol=0.00
1,
    verbose=False)
```

In [88]:

```
y_pred_svc1 = svc1.predict(X_test)
```

In [89]:

```
print(classification_report(y_test, y_pred_svc1))
```

```
              precision    recall  f1-score   support

           0       0.99      0.79      0.88     14961
           1       0.04      0.57      0.07       205

    accuracy                           0.79     15166
   macro avg       0.51      0.68      0.48     15166
weighted avg       0.98      0.79      0.87     15166
```

Over sampling

In [90]:

```
from imblearn.over_sampling import RandomOverSampler
```

In [91]:

```
ros = RandomOverSampler(random_state=1)
```

In [92]:

```
X_sample2, y_sample2 = ros.fit_sample(X_train,y_train)
```

In [93]:

```
pd.Series(y_sample2).value_counts()
```

Out[93]:

```
1    34851
0    34851
dtype: int64
```

In [94]:

```
lr3 = LogisticRegression()
lr3.fit(X_sample2, y_sample2)
```

Out[94]:

```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=None, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

In [95]:

```
y_pred3= lr3.predict(X_test)
```

In [96]:

```
print(classification_report(y_test,y_pred3))
```

```
              precision    recall  f1-score   support

           0       0.99      0.83      0.91     14961
           1       0.05      0.62      0.09       205

    accuracy                           0.83     15166
   macro avg       0.52      0.73      0.50     15166
weighted avg       0.98      0.83      0.90     15166
```

Decision Tree with RandomOverSampler

In [97]:

```
dt3 = DecisionTreeClassifier()
```

In [98]:

```
dt3.fit(X_sample2, y_sample2)
```

Out[98]:

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=None, max_features=None, max_leaf_nodes=Non
e,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [99]:

```
y_pred_dt = dt3.predict(X_test)
```

In [100]:

```
print(classification_report(y_test,y_pred_dt))
```

```
              precision    recall  f1-score   support

           0       0.99      0.99      0.99     14961
           1       0.06      0.06      0.06       205

    accuracy                           0.97     15166
   macro avg       0.52      0.52      0.52     15166
weighted avg       0.97      0.97      0.97     15166
```

In [101]:

```
dt4 = DecisionTreeClassifier(max_depth=8)
```

In [102]:

```
dt4.fit(X_sample2, y_sample2)
```

Out[102]:

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='gini',
                       max_depth=8, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

In [103]:

```
y_pred_dt4 = dt4.predict(X_test)
```

In [104]:

```
print(classification_report(y_test,y_pred_dt4))
```

```
              precision    recall  f1-score   support

           0       0.99      0.77      0.87     14961
           1       0.04      0.63      0.07       205

    accuracy                           0.77     15166
   macro avg       0.51      0.70      0.47     15166
weighted avg       0.98      0.77      0.86     15166
```

Random Forest Classifier with max_depth=6

In [105]:

```
rf_ov = RandomForestClassifier(max_depth=6)
```

In [106]:

```
rf_ov.fit(X_sample2, y_sample2)
```

Out[106]:

```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=6, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=None, oob_score=False, random_state=None,
                       verbose=0, warm_start=False)
```

In [107]:

```
y_pred_rf_ov = rf_ov.predict(X_test)
```

In [108]:

```
print(classification_report(y_test, y_pred_rf_ov))
```

```
              precision    recall  f1-score   support

           0       0.99      0.84      0.91     14961
           1       0.05      0.63      0.09       205

    accuracy                           0.84     15166
   macro avg       0.52      0.74      0.50     15166
weighted avg       0.98      0.84      0.90     15166
```

Random Forest Classifier with max_features=7

In [109]:

```
rf_f_ov = RandomForestClassifier(max_features=7, random_state=1)
```

In [110]:

```
rf_f_ov.fit(X_sample2, y_sample2)
```

Out[110]:

```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features=7,
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=None, oob_score=False, random_state=1, verbose
=0,
                       warm_start=False)
```

In [111]:

```
y_pred_rf_f_ov = rf_f_ov.predict(X_test)
```

In [112]:

```
print(classification_report(y_test, y_pred_rf_f_ov))
```

```
              precision    recall  f1-score   support

           0       0.99      0.99      0.99     14961
           1       0.07      0.04      0.06       205

    accuracy                           0.98     15166
   macro avg       0.53      0.52      0.52     15166
weighted avg       0.97      0.98      0.98     15166
```

VotingClassifier

In [113]:

```
from sklearn.ensemble import VotingClassifier
```

In [114]:

```
lr_v1 = LogisticRegression()
dt_v1 = DecisionTreeClassifier()
dt_v1 = DecisionTreeClassifier(criterion="entropy")
```

In [115]:

```
model_list1 = [("Logistic", lr_v1), ("Decision",dt_v1), ("Decision_entropy", dt_v1)]
```

In [116]:

```
vc_ov = VotingClassifier(estimators=model_list1)
```

In [117]:

```
vc_ov.fit(X_sample2, y_sample2)
```

Out[117]:

```
VotingClassifier(estimators=[('Logistic',
                              LogisticRegression(C=1.0, class_weight=None,
                                                 dual=False, fit_intercept=T
rue,
                                                 intercept_scaling=1,
                                                 l1_ratio=None, max_iter=10
0,
                                                 multi_class='auto',
                                                 n_jobs=None, penalty='l2',
                                                 random_state=None,
                                                 solver='lbfgs', tol=0.0001,
                                                 verbose=0, warm_start=Fals
e)),
                             ('Decision',
                              DecisionTreeClassifier(ccp_alpha=0.0,
                                                     class_weight=None,
                                                     crite...
                              DecisionTreeClassifier(ccp_alpha=0.0,
                                                     class_weight=None,
                                                     criterion='entropy',
                                                     max_depth=None,
                                                     max_features=None,
                                                     max_leaf_nodes=None,
                                                     min_impurity_decrease=
0.0,
                                                     min_impurity_split=Non
e,
                                                     min_samples_leaf=1,
                                                     min_samples_split=2,
                                                     min_weight_fraction_lea
f=0.0,
                                                     presort='deprecated',
                                                     random_state=None,
                                                     splitter='best'))],
                 flatten_transform=True, n_jobs=None, voting='hard',
                 weights=None)
```

In [118]:

```
y_pred_v_ov = vc_ov.predict(X_test)
```

In [119]:

```
print(classification_report(y_test, y_pred_v_ov))
```

```
              precision    recall  f1-score   support

           0       0.99      0.98      0.99     14961
           1       0.05      0.06      0.05       205

    accuracy                           0.97     15166
   macro avg       0.52      0.52      0.52     15166
weighted avg       0.97      0.97      0.97     15166
```

ADA Boosting

In [120]:

```
ada_ov = AdaBoostClassifier(n_estimators=100)
```

In [121]:

```
ada_ov.fit(X_sample2, y_sample2)
```

Out[121]:

```
AdaBoostClassifier(algorithm='SAMME.R', base_estimator=None, learning_rate=
1.0,
                   n_estimators=100, random_state=None)
```

In [122]:

```
y_pred_ada_ov = ada_ov.predict(X_test)
```

In [123]:

```
print(classification_report(y_test, y_pred_ada_ov))
```

```
              precision    recall  f1-score   support

           0       0.99      0.79      0.88     14961
           1       0.04      0.64      0.08       205

    accuracy                           0.79     15166
   macro avg       0.52      0.72      0.48     15166
weighted avg       0.98      0.79      0.87     15166
```

SVM

In [124]:

```
lsv_ov = LinearSVC(random_state=1)
```

In [125]:

```
lsv_ov.fit(X_sample2,y_sample2)
```

Out[125]:

```
LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
          intercept_scaling=1, loss='squared_hinge', max_iter=1000,
          multi_class='ovr', penalty='l2', random_state=1, tol=0.0001,
          verbose=0)
```

In [126]:

```
y_pred_lsv_ov = lsv_ov.predict(X_test)
```

In [127]:

```
print(classification_report(y_test, y_pred_lsv_ov))
```

```
              precision    recall  f1-score   support

           0       0.99      0.81      0.89     14961
           1       0.03      0.38      0.05       205

    accuracy                           0.80     15166
   macro avg       0.51      0.59      0.47     15166
weighted avg       0.98      0.80      0.88     15166
```

Conclusion: As recall was more important than precision in this case, so after trying with models I got the best results of recall which is 0.73 with Random Forest Classifier with max_features=7 (rf_f) model after applying UNDERSAMPLER on data.

In [ ]:

```

```