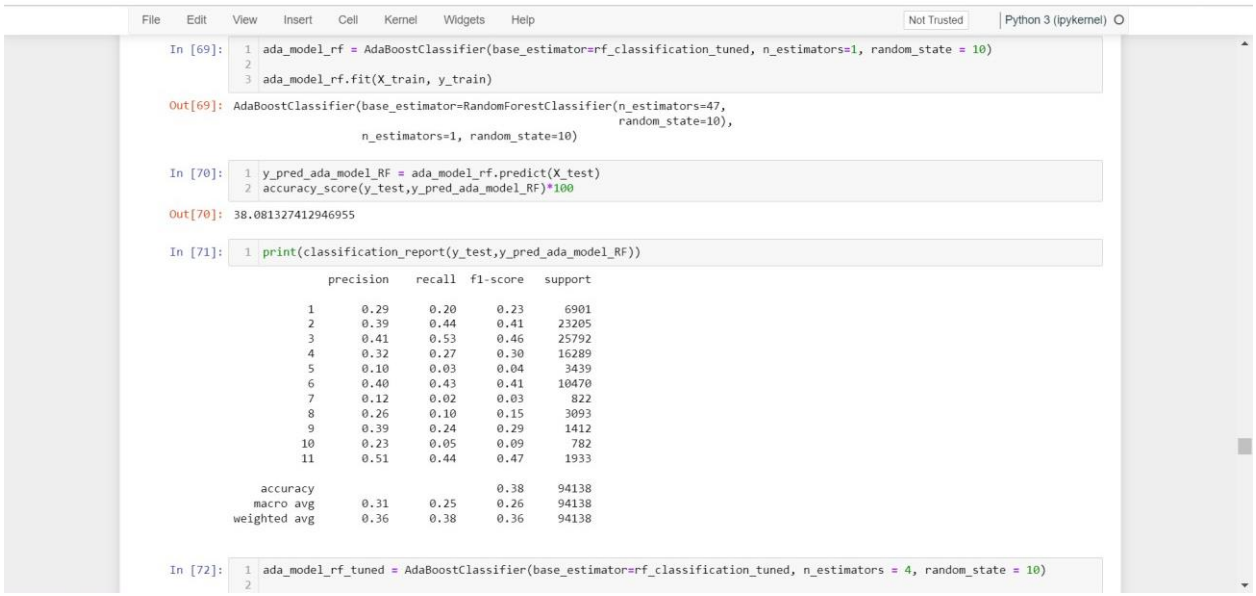
Analytics for Hospitals Health-Care Data
TEAM ID: PNT2022TMID16326

ADA BOOST DECISION TREE



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In [69]:
```
ada_model_rf = AdaBoostClassifier(base_estimator=rf_classification_tuned, n_estimators=1, random_state = 10)

ada_model_rf.fit(X_train, y_train)
```

Out[69]:
```
AdaBoostClassifier(base_estimator=RandomForestClassifier(n_estimators=47,
                                                         random_state=10),
                   n_estimators=1, random_state=10)
```

In [70]:
```
y_pred_ada_model_RF = ada_model_rf.predict(X_test)
accuracy_score(y_test,y_pred_ada_model_RF)*100
```

Out[70]: 38.081327412946955

In [71]:
```
print(classification_report(y_test,y_pred_ada_model_RF))
```

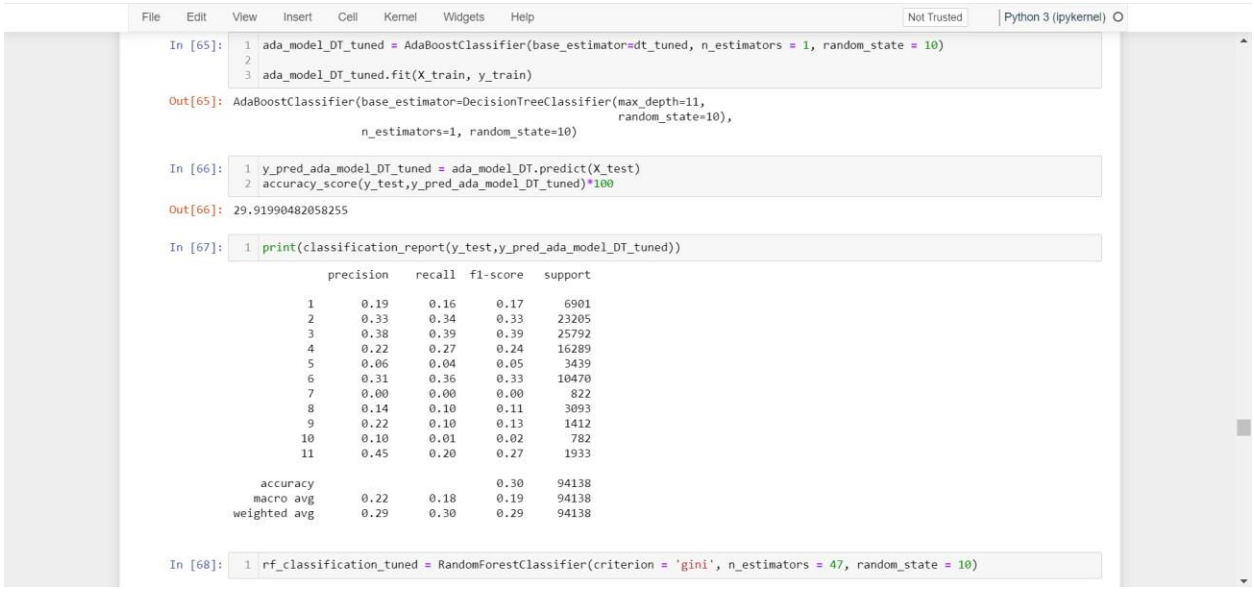
```
              precision    recall  f1-score   support

           1       0.29      0.20      0.23      6901
           2       0.39      0.44      0.41     23205
           3       0.41      0.53      0.46     25792
           4       0.32      0.27      0.30     16289
           5       0.10      0.03      0.04      3439
           6       0.40      0.43      0.41     10470
           7       0.12      0.02      0.03       822
           8       0.26      0.10      0.15      3093
           9       0.39      0.24      0.29      1412
          10       0.23      0.05      0.09       782
          11       0.51      0.44      0.47      1933

    accuracy                           0.38     94138
   macro avg       0.31      0.25      0.26     94138
weighted avg       0.36      0.38      0.36     94138
```

In [72]:
```
ada_model_rf_tuned = AdaBoostClassifier(base_estimator=rf_classification_tuned, n_estimators = 4, random_state = 10)

```



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In [65]:
```
ada_model_DT_tuned = AdaBoostClassifier(base_estimator=dt_tuned, n_estimators = 1, random_state = 10)

ada_model_DT_tuned.fit(X_train, y_train)
```

Out[65]:
```
AdaBoostClassifier(base_estimator=DecisionTreeClassifier(max_depth=11,
                                                         random_state=10),
                   n_estimators=1, random_state=10)
```

In [66]:
```
y_pred_ada_model_DT_tuned = ada_model_DT.predict(X_test)
accuracy_score(y_test,y_pred_ada_model_DT_tuned)*100
```

Out[66]: 29.91990482058255

In [67]:
```
print(classification_report(y_test,y_pred_ada_model_DT_tuned))
```

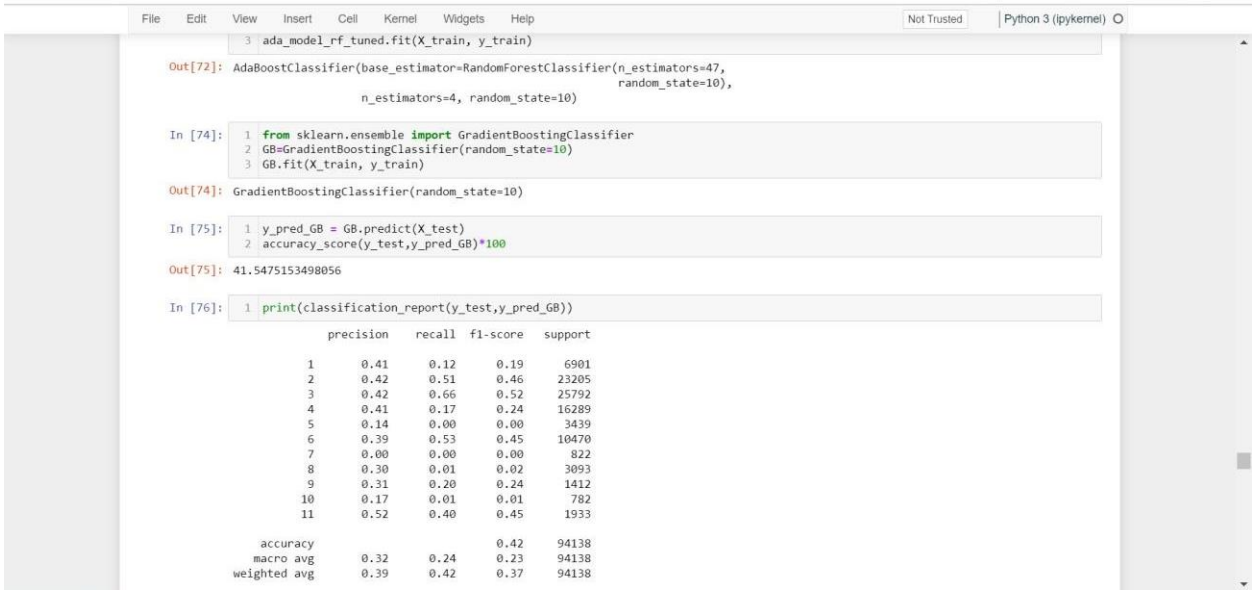
```
              precision    recall  f1-score   support

           1       0.19      0.16      0.17      6901
           2       0.33      0.34      0.33     23205
           3       0.38      0.39      0.39     25792
           4       0.22      0.27      0.24     16289
           5       0.06      0.04      0.05      3439
           6       0.31      0.36      0.33     10470
           7       0.00      0.00      0.00       822
           8       0.14      0.10      0.11      3093
           9       0.22      0.10      0.13      1412
          10       0.10      0.01      0.02       782
          11       0.45      0.20      0.27      1933

    accuracy                           0.30     94138
   macro avg       0.22      0.18      0.19     94138
weighted avg       0.29      0.30      0.29     94138
```

In [68]:
```
rf_classification_tuned = RandomForestClassifier(criterion = 'gini', n_estimators = 47, random_state = 10)
```

GRADIENT BOOST



```
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In [72]:
ada_model_rf_tuned.fit(X_train, y_train)

Out[72]:
AdaBoostClassifier(base_estimator=RandomForestClassifier(n_estimators=47,
                                                         random_state=10),
                   n_estimators=4, random_state=10)

In [74]:
from sklearn.ensemble import GradientBoostingClassifier
GB=GradientBoostingClassifier(random_state=10)
GB.fit(X_train, y_train)

Out[74]:
GradientBoostingClassifier(random_state=10)

In [75]:
y_pred_GB = GB.predict(X_test)
accuracy_score(y_test,y_pred_GB)*100

Out[75]:
41.5475153498056

In [76]:
print(classification_report(y_test,y_pred_GB))

              precision    recall  f1-score   support

           1       0.41      0.12      0.19      6901
           2       0.42      0.51      0.46     23205
           3       0.42      0.66      0.52     25792
           4       0.41      0.17      0.24     16289
           5       0.14      0.00      0.00      3439
           6       0.39      0.53      0.45     10470
           7       0.00      0.00      0.00       822
           8       0.30      0.01      0.02      3093
           9       0.31      0.20      0.24      1412
          10       0.17      0.01      0.01       782
          11       0.52      0.40      0.45      1933

    accuracy                           0.42     94138
   macro avg       0.32      0.24      0.23     94138
weighted avg       0.39      0.42      0.37     94138
```
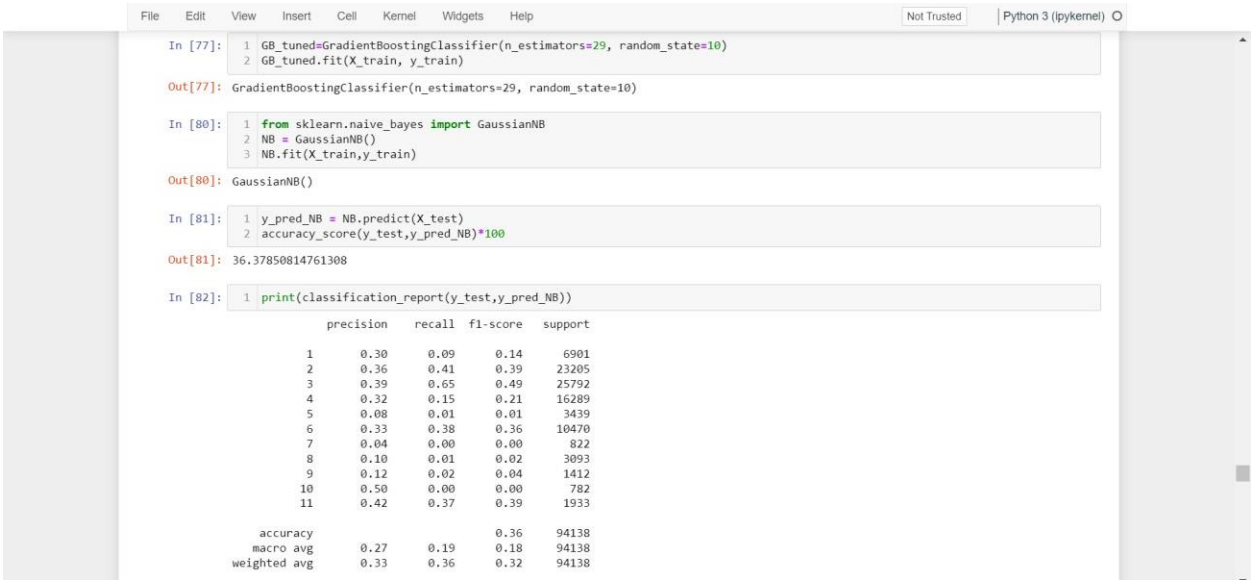

NAIVE BAYES



```
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In [77]:
GB_tuned=GradientBoostingClassifier(n_estimators=29, random_state=10)
GB_tuned.fit(X_train, y_train)

Out[77]:
GradientBoostingClassifier(n_estimators=29, random_state=10)

In [80]:
from sklearn.naive_bayes import GaussianNB
NB = GaussianNB()
NB.fit(X_train,y_train)

Out[80]:
GaussianNB()

In [81]:
y_pred_NB = NB.predict(X_test)
accuracy_score(y_test,y_pred_NB)*100

Out[81]:
36.37850814761308

In [82]:
print(classification_report(y_test,y_pred_NB))

              precision    recall  f1-score   support

           1       0.30      0.09      0.14      6901
           2       0.36      0.41      0.39     23205
           3       0.39      0.65      0.49     25792
           4       0.32      0.15      0.21     16289
           5       0.08      0.01      0.01      3439
           6       0.33      0.38      0.36     10470
           7       0.04      0.00      0.00       822
           8       0.10      0.01      0.02      3093
           9       0.12      0.02      0.04      1412
          10       0.50      0.00      0.00       782
          11       0.42      0.37      0.39      1933

    accuracy                           0.36     94138
   macro avg       0.27      0.19      0.18     94138
weighted avg       0.33      0.36      0.32     94138
```
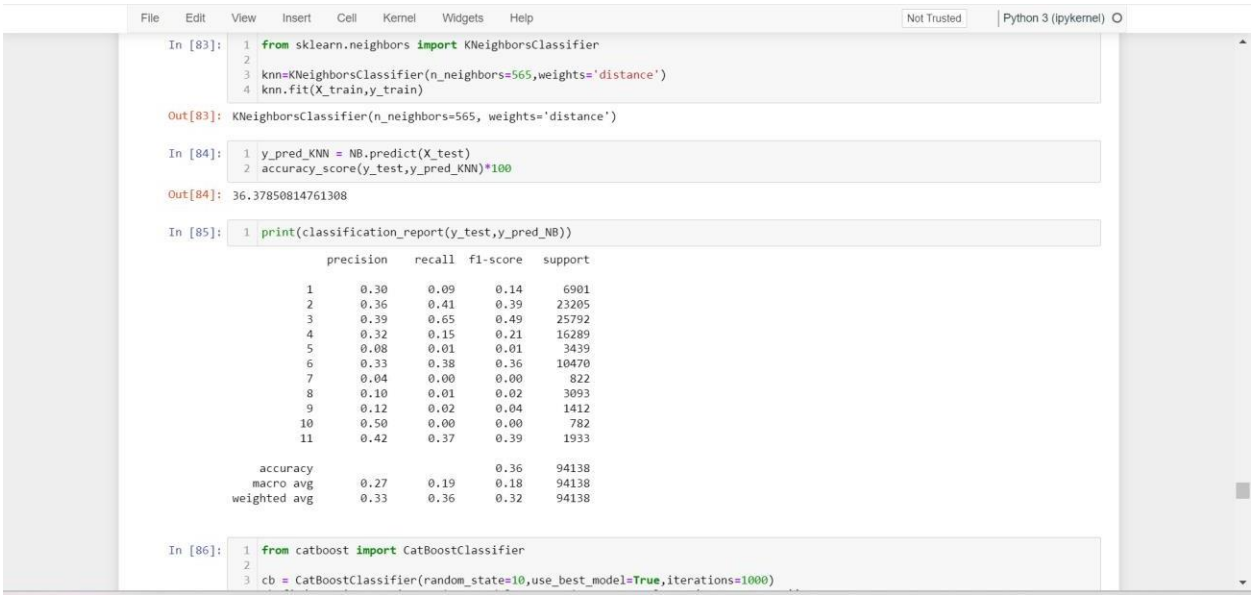

KNN



```
In [83]:
from sklearn.neighbors import KNeighborsClassifier

knn=KNeighborsClassifier(n_neighbors=565,weights='distance')
knn.fit(X_train,y_train)
```

```
Out[83]: KNeighborsClassifier(n_neighbors=565, weights='distance')
```

```
In [84]:
y_pred_KNN = NB.predict(X_test)
accuracy_score(y_test,y_pred_KNN)*100
```

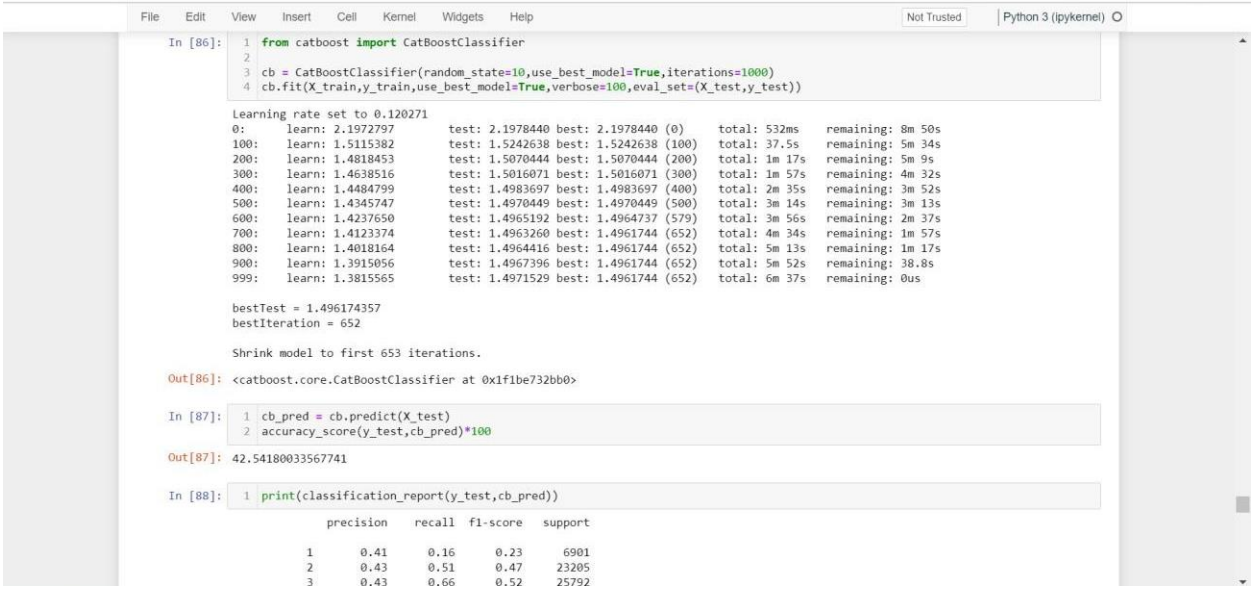
```
Out[84]: 36.37850814761308
```

```
In [85]:
print(classification_report(y_test,y_pred_NB))
```

```
              precision    recall  f1-score   support

           1       0.30      0.09      0.14      6901
           2       0.36      0.41      0.39     23205
           3       0.39      0.65      0.49     25792
           4       0.32      0.15      0.21     16289
           5       0.08      0.01      0.01      3439
           6       0.33      0.38      0.36     10470
           7       0.04      0.00      0.00       822
           8       0.10      0.01      0.02      3093
           9       0.12      0.02      0.04      1412
          10       0.50      0.00      0.00       782
          11       0.42      0.37      0.39      1933

    accuracy                           0.36     94138
   macro avg       0.27      0.19      0.18     94138
weighted avg       0.33      0.36      0.32     94138
```

```
In [86]:
from catboost import CatBoostClassifier

cb = CatBoostClassifier(random_state=10,use_best_model=True,iterations=1000)
```

CAT BOOST



```
In [86]:
from catboost import CatBoostClassifier

cb = CatBoostClassifier(random_state=10,use_best_model=True,iterations=1000)
cb.fit(X_train,y_train,use_best_model=True,verbose=100,eval_set=(X_test,y_test))
```

```
Learning rate set to 0.120271
0:      learn: 2.1972797        test: 2.1978440 best: 2.1978440 (0)     total: 532ms    remaining: 8m 50s
100:    learn: 1.5115382        test: 1.5242638 best: 1.5242638 (100)   total: 37.5s    remaining: 5m 34s
200:    learn: 1.4818453        test: 1.5070444 best: 1.5070444 (200)   total: 1m 17s   remaining: 5m 9s
300:    learn: 1.4638516        test: 1.5016071 best: 1.5016071 (300)   total: 1m 57s   remaining: 4m 32s
400:    learn: 1.4484799        test: 1.4983697 best: 1.4983697 (400)   total: 2m 35s   remaining: 3m 52s
500:    learn: 1.4345747        test: 1.4970449 best: 1.4970449 (500)   total: 3m 14s   remaining: 3m 13s
600:    learn: 1.4237650        test: 1.4965192 best: 1.4964737 (579)   total: 3m 56s   remaining: 2m 37s
700:    learn: 1.4123374        test: 1.4963260 best: 1.4961744 (652)   total: 4m 34s   remaining: 1m 57s
800:    learn: 1.4018164        test: 1.4964416 best: 1.4961744 (652)   total: 5m 13s   remaining: 1m 17s
900:    learn: 1.3915056        test: 1.4967396 best: 1.4961744 (652)   total: 5m 52s   remaining: 38.8s
999:    learn: 1.3815565        test: 1.4971529 best: 1.4961744 (652)   total: 6m 37s   remaining: 0us

bestTest = 1.496174357
bestIteration = 652

Shrink model to first 653 iterations.
```

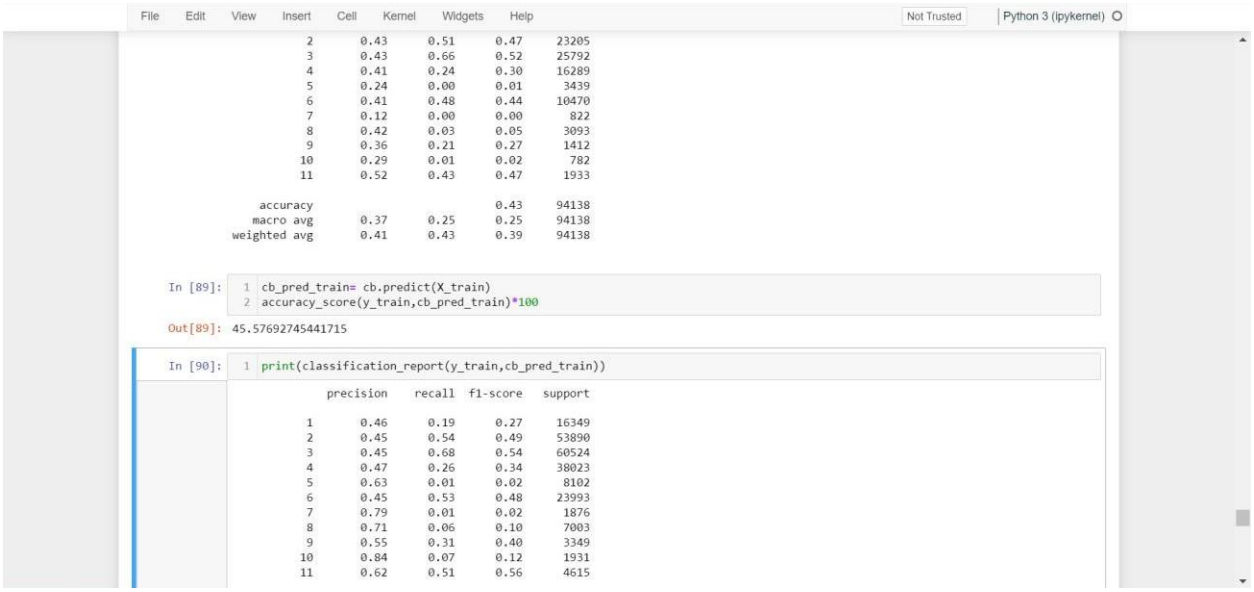
```
Out[86]: <catboost.core.CatBoostClassifier at 0x1f1be732bb0>
```

```
In [87]:
cb_pred = cb.predict(X_test)
accuracy_score(y_test,cb_pred)*100
```

```
Out[87]: 42.54180033567741
```

```
In [88]:
print(classification_report(y_test,cb_pred))
```

```
              precision    recall  f1-score   support

           1       0.41      0.16      0.23      6901
           2       0.43      0.51      0.47     23205
           3       0.43      0.66      0.52     25792
```



```
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                2       0.43      0.51      0.47     23205
                3       0.43      0.66      0.52     25792
                4       0.41      0.24      0.30     16289
                5       0.24      0.00      0.01      3439
                6       0.41      0.48      0.44     10470
                7       0.12      0.00      0.00       822
                8       0.42      0.03      0.05      3093
                9       0.36      0.21      0.27      1412
               10       0.29      0.01      0.02       782
               11       0.52      0.43      0.47      1933

         accuracy                           0.43     94138
        macro avg       0.37      0.25      0.25     94138
     weighted avg       0.41      0.43      0.39     94138

In [89]:
1 cb_pred_train= cb.predict(X_train)
2 accuracy_score(y_train,cb_pred_train)*100

Out[89]: 45.57692745441715

In [90]:
1 print(classification_report(y_train,cb_pred_train))

              precision    recall  f1-score   support

           1       0.46      0.19      0.27     16349
           2       0.45      0.54      0.49     53890
           3       0.45      0.68      0.54     60524
           4       0.47      0.26      0.34     38023
           5       0.63      0.01      0.02      8102
           6       0.45      0.53      0.48     23993
           7       0.79      0.01      0.02      1876
           8       0.71      0.06      0.10      7003
           9       0.55      0.31      0.40      3349
          10       0.84      0.07      0.12      1931
          11       0.62      0.51      0.56      4615
```

SUBMISSION

```
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         accuracy                           0.46    219655
        macro avg       0.58      0.29      0.30    219655
     weighted avg       0.48      0.46      0.42    219655

In [91]:
1 ls  =  df_full_test.columns.tolist()
2
3 in_data  =  df_full_test[ls]
4
5 out_data =  cb.predict (in_data)

In [92]:
1 test = pd.read_csv("D:/HealthCare/test_data.csv")
2 submit =  pd.DataFrame()

In [93]:
1 submit ['case_id']  =  test['case_id']
2 submit ['Stay']     =  out_data
3
4 stay_decode         =  {  1 : '0-10', 2 : '11-20', 3 : '21-30', 4 : '31-40', 5 : '41-50', 6 : '51-60', 7 : '61-70',8 : '71-8
5                           10 : '91-100', 11 : 'More than 100 Days' }
6
7 submit ['Stay']     =  submit ['Stay'].map(stay_decode)
8
9 submit.head(15)
```

Out[93]:

	case_id	Stay
0	318439	0-10
1	318440	51-60
2	318441	21-30
3	318442	21-30
4	318443	51-60
5	318444	21-30

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2	318441	21-30
3	318442	21-30
4	318443	51-60
5	318444	21-30
6	318445	21-30
7	318446	21-30
8	318447	21-30
9	318448	21-30
10	318449	21-30
11	318450	51-60
12	318451	21-30
13	318452	21-30
14	318453	31-40

In [94]:
```
count = submit ['Stay'].value_counts()
count
```

Out[94]:
```
21-30                 85076
51-60                 23685
11-20                 12285
31-40                  6693
0-10                   5242
More than 100 Days     2407
81-90                  1329
71-80                   174
41-50                   127
91-100                   32
61-70                     7
Name: Stay, dtype: int64
```

HOSPITAL PATIENT STAY

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In [95]:
```
sns.barplot(x=count.index.values, y=count.values,data=submit)
```

Out[95]: <AxesSubplot:>