HR-Analytics-Challenge

January 27, 2020

[10]:

```
Collecting package metadata (current_repodata.json): ...working... done
Solving environment: ...working... done

# All requested packages already installed.


Note: you may need to restart the kernel to use updated packages.
```

[11]:

```
import numpy as np
import pandas as pd

import matplotlib.pyplot as plt


from sklearn.preprocessing import LabelEncoder

from sklearn.model_selection import train_test_split

from sklearn.metrics import␣
 ↪confusion_matrix,roc_auc_score,mean_squared_error,f1_score,recall_score,precision_score
from sklearn.metrics.classification import accuracy_score, log_loss
from sklearn.model_selection import StratifiedKFold
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import Normalizer
from numpy import argmax
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import RandomizedSearchCV
from sklearn.ensemble import RandomForestClassifier,VotingClassifier
from xgboost import XGBClassifier
from catboost import CatBoostClassifier, Pool, cv
from lightgbm import LGBMClassifier
```

[12]:

```
SEED = 0
```

[13]:
```
# load datasets
train = pd.read_csv("hr_train.csv")
test = pd.read_csv("hr_test.csv")
train.head()
```

[13]:

	employee_id	department	region	education	gender	recruitment_channel	no_of_trainings	age	previous_year_rating	length_of_service	KPIs_met >80%	awards_won?	avg_training_score	is_promoted
0	65438	Sales & Marketing	region_7	Master's & above	f	sourcing	1	35	5.0	8	1	0	49	0
1	65141	Operations	region_22	Bachelor's	m	other	1	30	5.0	4	0	0	60	0
2	7513	Sales & Marketing	region_19	Bachelor's	m	sourcing	1	34	3.0	7	0	0	50	0
3	2542	Sales & Marketing	region_23	Bachelor's	m	other	2	39	1.0	10	0	0	50	0
4	48945	Technology	region_26	Bachelor's	m	other	1	45	3.0	2	0	0	73	0

[7]:
```
test.head()
```

[7]:

	employee_id	department	region	education	gender	recruitment_channel	no_of_trainings	age	previous_year_rating	length_of_service	KPIs_met >80%	awards_won?	avg_training_score
0	8724	Technology	region_26	Bachelor's	m	sourcing	1	24	NaN	1	1	0	77
1	74430	HR	region_4	Bachelor's	f	other	1	31	3.0	5	0	0	51
2	72255	Sales & Marketing	region_13	Bachelor's	m	other	1	31	1.0	4	0	0	47
3	38562	Procurement	region_2	Bachelor's	f	other	3	31	2.0	9	0	0	65
4	64486	Finance	region_29	Bachelor's	m	sourcing	1	30	4.0	7	0	0	61

```
   length_of_service  KPIs_met >80%  awards_won?  avg_training_score
0                  1              1            0                  77
1                  5              0            0                  51
2                  4              0            0                  47
3                  9              0            0                  65
4                  7              0            0                  61
```

[9]:
```
train.describe()
```

[9]:
```
        employee_id  no_of_trainings           age  previous_year_rating  \
count  54808.000000     54808.000000  54808.000000          50684.000000
mean   39195.830627         1.253011     34.803915              3.329256
std    22586.581449         0.609264      7.660169              1.259993
min        1.000000         1.000000     20.000000              1.000000
25%    19669.750000         1.000000     29.000000              3.000000
50%    39225.500000         1.000000     33.000000              3.000000
75%    58730.500000         1.000000     39.000000              4.000000
max    78298.000000        10.000000     60.000000              5.000000

       length_of_service  KPIs_met >80%   awards_won?  avg_training_score  \
count       54808.000000   54808.000000  54808.000000        54808.000000
mean            5.865512       0.351974      0.023172           63.386750
std             4.265094       0.477590      0.150450           13.371559
min             1.000000       0.000000      0.000000           39.000000
25%             3.000000       0.000000      0.000000           51.000000
50%             5.000000       0.000000      0.000000           60.000000
75%             7.000000       1.000000      0.000000           76.000000
max            37.000000       1.000000      1.000000           99.000000

        is_promoted
count  54808.000000
mean       0.085170
std        0.279137
min        0.000000
25%        0.000000
50%        0.000000
75%        0.000000
max        1.000000
```

[13]:
```
train.isna().sum()
```

[13]:
```
employee_id              0
department               0
region                   0
education             2409
gender                   0
recruitment_channel      0
no_of_trainings          0
```

```
age                          0
previous_year_rating      4124
length_of_service            0
KPIs_met >80%                0
awards_won?                  0
avg_training_score           0
is_promoted                  0
dtype: int64
```

[15]:
```
values={"previous_year_rating":3,"education":"0"}
train.fillna(value=values,inplace=True)
```

[17]:
```
categorical_features_indices = np.array([0,1,2,3,4,6,8,10,11])
data_xs = train.drop(['employee_id',"is_promoted"],axis=1)
```

[18]:
```
x_train,x_test,y_train,y_test = train_test_split(data_xs,train["is_promoted"],␣
↪test_size = 0.3,random_state=20)
```

[19]:
```
def model_evalution(model):
  print("######################## model Evalution started␣
↪########################")
  train_pre = model.predict(x_train)
  test_pre = model.predict(x_test)
  train_pro = model.predict_proba(x_train)
  test_pro = model.predict_proba(x_test)

  print("Train Accuracy: {0} \t Test Accuracy: {1}".
↪format(accuracy_score(y_train, train_pre),accuracy_score(y_test,test_pre)))
  print("Train Loss: {0} \t Test Loss: {1}".format(mean_squared_error(y_train,␣
↪train_pre),mean_squared_error(y_test,test_pre)))
  print("Train AUC: {0} \t Test AUC: {1}".format(roc_auc_score(y_train,␣
↪train_pro[:,1]),roc_auc_score(y_test,test_pro[:,1])))
  print("Train F1: {0} \t Test F1: {1}".format(f1_score(y_train,␣
↪train_pre),f1_score(y_test,test_pre)))
  print("Train recall: {0} \t Test recall: {1}".format(recall_score(y_train,␣
↪train_pre),recall_score(y_test,test_pre)))
  print("Train precision: {0} \t Test Precision: {1}".
↪format(precision_score(y_train, train_pre),precision_score(y_test,test_pre)))
  print("Train Confusion Matrix: \n{0} \n Test Confusion Matrix: \n{1}".
↪format(confusion_matrix(y_train,␣
↪train_pre),confusion_matrix(y_test,test_pre)))
  #f1_score
```

[20]:
```
catboost_model =␣
↪CatBoostClassifier(iterations=400,verbose=True,eval_metric="F1",learning_rate=0.
↪2,class_weights=[1,3],depth=3,l2_leaf_reg=100,bagging_temperature=0.5)
catboost_model.fit(x_train,␣
↪y_train,cat_features=categorical_features_indices,eval_set=(x_test,␣
↪y_test),use_best_model=False)
```

```
model_evalution(catboost_model)
```

```
0:      learn: 0.2017291        test: 0.2112933 best: 0.2112933 (0)     total:
86.1ms   remaining: 34.4s
1:      learn: 0.2017291        test: 0.2112933 best: 0.2112933 (0)     total:
101ms    remaining: 20.2s
2:      learn: 0.2884808        test: 0.2778105 best: 0.2778105 (2)     total:
135ms    remaining: 17.9s
3:      learn: 0.4029994        test: 0.4097015 best: 0.4097015 (3)     total:
162ms    remaining: 16.1s
4:      learn: 0.4983911        test: 0.5069238 best: 0.5069238 (4)     total:
195ms    remaining: 15.4s
5:      learn: 0.5049527        test: 0.5081157 best: 0.5081157 (5)     total:
212ms    remaining: 13.9s
6:      learn: 0.5095344        test: 0.5093343 best: 0.5093343 (6)     total:
232ms    remaining: 13s
7:      learn: 0.5085426        test: 0.5093343 best: 0.5093343 (6)     total:
253ms    remaining: 12.4s
8:      learn: 0.5082101        test: 0.5094240 best: 0.5094240 (8)     total:
267ms    remaining: 11.6s
9:      learn: 0.5045180        test: 0.5145563 best: 0.5145563 (9)     total:
300ms    remaining: 11.7s
10:     learn: 0.5097400        test: 0.5201044 best: 0.5201044 (10)    total:
328ms    remaining: 11.6s
11:     learn: 0.5129683        test: 0.5201044 best: 0.5201044 (10)    total:
353ms    remaining: 11.4s
12:     learn: 0.5077951        test: 0.5201950 best: 0.5201950 (12)    total:
367ms    remaining: 10.9s
13:     learn: 0.5099200        test: 0.5230503 best: 0.5230503 (13)    total:
394ms    remaining: 10.9s
14:     learn: 0.5153076        test: 0.5230503 best: 0.5230503 (13)    total:
421ms    remaining: 10.8s
15:     learn: 0.5145002        test: 0.5235947 best: 0.5235947 (15)    total:
449ms    remaining: 10.8s
16:     learn: 0.5156733        test: 0.5230075 best: 0.5235947 (15)    total:
480ms    remaining: 10.8s
17:     learn: 0.5156871        test: 0.5231892 best: 0.5235947 (15)    total:
501ms    remaining: 10.6s
18:     learn: 0.5160388        test: 0.5214671 best: 0.5235947 (15)    total:
525ms    remaining: 10.5s
19:     learn: 0.5209739        test: 0.5232316 best: 0.5235947 (15)    total:
546ms    remaining: 10.4s
20:     learn: 0.5195568        test: 0.5247662 best: 0.5247662 (20)    total:
569ms    remaining: 10.3s
21:     learn: 0.5226359        test: 0.5261523 best: 0.5261523 (21)    total:
598ms    remaining: 10.3s
22:     learn: 0.5223881        test: 0.5253886 best: 0.5261523 (21)    total:
```

```
628ms    remaining: 10.3s
23:     learn: 0.5276404        test: 0.5278683 best: 0.5278683 (23)    total:
645ms    remaining: 10.1s
24:     learn: 0.5271273        test: 0.5293815 best: 0.5293815 (24)    total:
684ms    remaining: 10.3s
25:     learn: 0.5279372        test: 0.5271664 best: 0.5293815 (24)    total:
701ms    remaining: 10.1s
26:     learn: 0.5278222        test: 0.5262253 best: 0.5293815 (24)    total:
730ms    remaining: 10.1s
27:     learn: 0.5277838        test: 0.5262253 best: 0.5293815 (24)    total:
752ms    remaining: 9.99s
28:     learn: 0.5300752        test: 0.5321508 best: 0.5321508 (28)    total:
767ms    remaining: 9.81s
29:     learn: 0.5303556        test: 0.5308284 best: 0.5321508 (28)    total:
793ms    remaining: 9.78s
30:     learn: 0.5300369        test: 0.5313993 best: 0.5321508 (28)    total:
825ms    remaining: 9.82s
31:     learn: 0.5300369        test: 0.5314900 best: 0.5321508 (28)    total:
861ms    remaining: 9.9s
32:     learn: 0.5313877        test: 0.5313087 best: 0.5321508 (28)    total:
889ms    remaining: 9.89s
33:     learn: 0.5313877        test: 0.5309190 best: 0.5321508 (28)    total:
917ms    remaining: 9.87s
34:     learn: 0.5326800        test: 0.5314900 best: 0.5321508 (28)    total:
944ms    remaining: 9.84s
35:     learn: 0.5330739        test: 0.5307377 best: 0.5321508 (28)    total:
962ms    remaining: 9.72s
36:     learn: 0.5326032        test: 0.5307377 best: 0.5321508 (28)    total:
995ms    remaining: 9.76s
37:     learn: 0.5326032        test: 0.5307377 best: 0.5321508 (28)    total:
1.01s    remaining: 9.63s
38:     learn: 0.5343028        test: 0.5300752 best: 0.5321508 (28)    total:
1.05s    remaining: 9.7s
39:     learn: 0.5346962        test: 0.5326291 best: 0.5326291 (39)    total:
1.07s    remaining: 9.63s
40:     learn: 0.5374677        test: 0.5323569 best: 0.5326291 (39)    total:
1.09s    remaining: 9.53s
41:     learn: 0.5365608        test: 0.5331064 best: 0.5331064 (41)    total:
1.11s    remaining: 9.49s
42:     learn: 0.5367536        test: 0.5316973 best: 0.5331064 (41)    total:
1.14s    remaining: 9.46s
43:     learn: 0.5371076        test: 0.5324476 best: 0.5331064 (41)    total:
1.16s    remaining: 9.42s
44:     learn: 0.5363610        test: 0.5330157 best: 0.5331064 (41)    total:
1.19s    remaining: 9.39s
45:     learn: 0.5371913        test: 0.5333107 best: 0.5333107 (45)    total:
1.21s    remaining: 9.29s
46:     learn: 0.5375511        test: 0.5334920 best: 0.5334920 (46)    total:
```

```
1.24s    remaining: 9.29s
47:     learn: 0.5375126        test: 0.5355507 best: 0.5355507 (47)    total:
1.26s    remaining: 9.27s
48:     learn: 0.5368829        test: 0.5352782 best: 0.5355507 (47)    total:
1.29s    remaining: 9.28s
49:     learn: 0.5366064        test: 0.5354598 best: 0.5355507 (47)    total:
1.32s    remaining: 9.22s
50:     learn: 0.5375959        test: 0.5354598 best: 0.5355507 (47)    total:
1.34s    remaining: 9.16s
51:     learn: 0.5376344        test: 0.5354598 best: 0.5355507 (47)    total:
1.37s    remaining: 9.15s
52:     learn: 0.5391329        test: 0.5371467 best: 0.5371467 (52)    total:
1.38s    remaining: 9.06s
53:     learn: 0.5406989        test: 0.5349153 best: 0.5371467 (52)    total:
1.41s    remaining: 9.03s
54:     learn: 0.5403433        test: 0.5350059 best: 0.5371467 (52)    total:
1.44s    remaining: 9.04s
55:     learn: 0.5413631        test: 0.5350254 best: 0.5371467 (52)    total:
1.49s    remaining: 9.15s
56:     learn: 0.5424212        test: 0.5396665 best: 0.5396665 (56)    total:
1.52s    remaining: 9.17s
57:     learn: 0.5449514        test: 0.5410579 best: 0.5410579 (57)    total:
1.56s    remaining: 9.18s
58:     learn: 0.5455319        test: 0.5398691 best: 0.5410579 (57)    total:
1.6s     remaining: 9.24s
59:     learn: 0.5468451        test: 0.5399698 best: 0.5410579 (57)    total:
1.64s    remaining: 9.27s
60:     learn: 0.5479626        test: 0.5401509 best: 0.5410579 (57)    total:
1.66s    remaining: 9.2s
61:     learn: 0.5496862        test: 0.5442700 best: 0.5442700 (61)    total:
1.68s    remaining: 9.18s
62:     learn: 0.5496862        test: 0.5442700 best: 0.5442700 (61)    total:
1.71s    remaining: 9.13s
63:     learn: 0.5497249        test: 0.5434492 best: 0.5442700 (61)    total:
1.73s    remaining: 9.06s
64:     learn: 0.5494149        test: 0.5456366 best: 0.5456366 (64)    total:
1.76s    remaining: 9.06s
65:     learn: 0.5503346        test: 0.5445445 best: 0.5456366 (64)    total:
1.79s    remaining: 9.04s
66:     learn: 0.5502921        test: 0.5459090 best: 0.5459090 (66)    total:
1.81s    remaining: 9.01s
67:     learn: 0.5546607        test: 0.5478088 best: 0.5478088 (67)    total:
1.85s    remaining: 9.04s
68:     learn: 0.5542793        test: 0.5487078 best: 0.5487078 (68)    total:
1.89s    remaining: 9.04s
69:     learn: 0.5546607        test: 0.5494287 best: 0.5494287 (69)    total:
1.92s    remaining: 9.07s
70:     learn: 0.5540853        test: 0.5504223 best: 0.5504223 (70)    total:
```

```
1.96s    remaining: 9.09s
71:     learn: 0.5542017        test: 0.5511420 best: 0.5511420 (71)    total:
2s       remaining: 9.1s
72:     learn: 0.5540077        test: 0.5502400 best: 0.5511420 (71)    total:
2.02s    remaining: 9.04s
73:     learn: 0.5553691        test: 0.5513138 best: 0.5513138 (73)    total:
2.03s    remaining: 8.96s
74:     learn: 0.5559279        test: 0.5521229 best: 0.5521229 (74)    total:
2.06s    remaining: 8.93s
75:     learn: 0.5561057        test: 0.5531915 best: 0.5531915 (75)    total:
2.09s    remaining: 8.89s
76:     learn: 0.5561445        test: 0.5523841 best: 0.5531915 (75)    total:
2.11s    remaining: 8.86s
77:     learn: 0.5568562        test: 0.5524752 best: 0.5531915 (75)    total:
2.14s    remaining: 8.82s
78:     learn: 0.5567786        test: 0.5531003 best: 0.5531915 (75)    total:
2.16s    remaining: 8.79s
79:     learn: 0.5568174        test: 0.5531003 best: 0.5531915 (75)    total:
2.2s     remaining: 8.8s
80:     learn: 0.5579256        test: 0.5517583 best: 0.5531915 (75)    total:
2.24s    remaining: 8.81s
81:     learn: 0.5591099        test: 0.5524625 best: 0.5531915 (75)    total:
2.28s    remaining: 8.84s
82:     learn: 0.5591099        test: 0.5524625 best: 0.5531915 (75)    total:
2.31s    remaining: 8.81s
83:     learn: 0.5591203        test: 0.5547878 best: 0.5547878 (83)    total:
2.33s    remaining: 8.78s
84:     learn: 0.5599054        test: 0.5564675 best: 0.5564675 (84)    total:
2.36s    remaining: 8.75s
85:     learn: 0.5597607        test: 0.5564675 best: 0.5564675 (84)    total:
2.39s    remaining: 8.74s
86:     learn: 0.5600223        test: 0.5564675 best: 0.5564675 (84)    total:
2.42s    remaining: 8.7s
87:     learn: 0.5616791        test: 0.5565589 best: 0.5565589 (87)    total:
2.44s    remaining: 8.66s
88:     learn: 0.5619272        test: 0.5564675 best: 0.5565589 (87)    total:
2.46s    remaining: 8.59s
89:     learn: 0.5630987        test: 0.5566502 best: 0.5566502 (89)    total:
2.49s    remaining: 8.57s
90:     learn: 0.5626822        test: 0.5559389 best: 0.5566502 (89)    total:
2.53s    remaining: 8.58s
91:     learn: 0.5639676        test: 0.5566502 best: 0.5566502 (89)    total:
2.56s    remaining: 8.58s
92:     learn: 0.5637863        test: 0.5586885 best: 0.5586885 (92)    total:
2.61s    remaining: 8.62s
93:     learn: 0.5634877        test: 0.5586885 best: 0.5586885 (92)    total:
2.63s    remaining: 8.57s
94:     learn: 0.5634486        test: 0.5586885 best: 0.5586885 (92)    total:
```

```
2.66s    remaining: 8.53s
95:     learn: 0.5632534        test: 0.5587561 best: 0.5587561 (95)    total:
2.69s    remaining: 8.51s
96:     learn: 0.5635520        test: 0.5597381 best: 0.5597381 (96)    total:
2.72s    remaining: 8.5s
97:     learn: 0.5632925        test: 0.5593054 best: 0.5597381 (96)    total:
2.77s    remaining: 8.53s
98:     learn: 0.5635130        test: 0.5593054 best: 0.5597381 (96)    total:
2.81s    remaining: 8.55s
99:     learn: 0.5644860        test: 0.5585970 best: 0.5597381 (96)    total:
2.85s    remaining: 8.55s
100:    learn: 0.5668050        test: 0.5585970 best: 0.5597381 (96)    total:
2.88s    remaining: 8.54s
101:    learn: 0.5659124        test: 0.5601048 best: 0.5601048 (101)   total:
2.92s    remaining: 8.52s
102:    learn: 0.5661709        test: 0.5593970 best: 0.5601048 (101)   total:
2.93s    remaining: 8.45s
103:    learn: 0.5650038        test: 0.5611511 best: 0.5611511 (103)   total:
2.96s    remaining: 8.42s
104:    learn: 0.5652234        test: 0.5611511 best: 0.5611511 (103)   total:
2.99s    remaining: 8.4s
105:    learn: 0.5651452        test: 0.5611511 best: 0.5611511 (103)   total:
3s       remaining: 8.33s
106:    learn: 0.5651061        test: 0.5612428 best: 0.5612428 (106)   total:
3.02s    remaining: 8.27s
107:    learn: 0.5655058        test: 0.5612428 best: 0.5612428 (106)   total:
3.04s    remaining: 8.22s
108:    learn: 0.5659986        test: 0.5609676 best: 0.5612428 (106)   total:
3.06s    remaining: 8.17s
109:    learn: 0.5659595        test: 0.5616729 best: 0.5616729 (109)   total:
3.08s    remaining: 8.13s
110:    learn: 0.5662567        test: 0.5601700 best: 0.5616729 (109)   total:
3.11s    remaining: 8.09s
111:    learn: 0.5662567        test: 0.5601700 best: 0.5616729 (109)   total:
3.13s    remaining: 8.06s
112:    learn: 0.5661394        test: 0.5621022 best: 0.5621022 (112)   total:
3.15s    remaining: 8.01s
113:    learn: 0.5661394        test: 0.5627141 best: 0.5627141 (113)   total:
3.18s    remaining: 7.97s
114:    learn: 0.5661003        test: 0.5627141 best: 0.5627141 (113)   total:
3.19s    remaining: 7.92s
115:    learn: 0.5668117        test: 0.5619187 best: 0.5627141 (113)   total:
3.22s    remaining: 7.88s
116:    learn: 0.5667725        test: 0.5619187 best: 0.5627141 (113)   total:
3.23s    remaining: 7.82s
117:    learn: 0.5666552        test: 0.5619187 best: 0.5627141 (113)   total:
3.25s    remaining: 7.77s
118:    learn: 0.5681771        test: 0.5629581 best: 0.5629581 (118)   total:
```

```
3.27s    remaining: 7.72s
119:    learn: 0.5675676        test: 0.5643613 best: 0.5643613 (119)   total:
3.28s    remaining: 7.66s
120:    learn: 0.5679421        test: 0.5641776 best: 0.5643613 (119)   total:
3.3s     remaining: 7.6s
121:    learn: 0.5681599        test: 0.5642694 best: 0.5643613 (119)   total:
3.31s    remaining: 7.55s
122:    learn: 0.5681207        test: 0.5656697 best: 0.5656697 (122)   total:
3.33s    remaining: 7.51s
123:    learn: 0.5678246        test: 0.5632932 best: 0.5656697 (122)   total:
3.35s    remaining: 7.47s
124:    learn: 0.5677855        test: 0.5632932 best: 0.5656697 (122)   total:
3.37s    remaining: 7.41s
125:    learn: 0.5676067        test: 0.5646026 best: 0.5656697 (122)   total:
3.38s    remaining: 7.35s
126:    learn: 0.5676067        test: 0.5646026 best: 0.5656697 (122)   total:
3.39s    remaining: 7.3s
127:    learn: 0.5676067        test: 0.5646026 best: 0.5656697 (122)   total:
3.41s    remaining: 7.24s
128:    learn: 0.5676067        test: 0.5646026 best: 0.5656697 (122)   total:
3.42s    remaining: 7.2s
129:    learn: 0.5679421        test: 0.5646026 best: 0.5656697 (122)   total:
3.44s    remaining: 7.14s
130:    learn: 0.5679029        test: 0.5642694 best: 0.5656697 (122)   total:
3.47s    remaining: 7.12s
131:    learn: 0.5681771        test: 0.5665529 best: 0.5665529 (131)   total:
3.49s    remaining: 7.09s
132:    learn: 0.5681771        test: 0.5665529 best: 0.5665529 (131)   total:
3.5s     remaining: 7.03s
133:    learn: 0.5681771        test: 0.5665529 best: 0.5665529 (131)   total:
3.52s    remaining: 6.98s
134:    learn: 0.5681771        test: 0.5665529 best: 0.5665529 (131)   total:
3.53s    remaining: 6.93s
135:    learn: 0.5685125        test: 0.5665529 best: 0.5665529 (131)   total:
3.55s    remaining: 6.89s
136:    learn: 0.5682163        test: 0.5665529 best: 0.5665529 (131)   total:
3.56s    remaining: 6.84s
137:    learn: 0.5685125        test: 0.5665529 best: 0.5665529 (131)   total:
3.58s    remaining: 6.79s
138:    learn: 0.5685125        test: 0.5665529 best: 0.5665529 (131)   total:
3.6s     remaining: 6.75s
139:    learn: 0.5684733        test: 0.5665529 best: 0.5665529 (131)   total:
3.61s    remaining: 6.71s
140:    learn: 0.5684733        test: 0.5665529 best: 0.5665529 (131)   total:
3.63s    remaining: 6.66s
141:    learn: 0.5695392        test: 0.5661848 best: 0.5665529 (131)   total:
3.65s    remaining: 6.63s
142:    learn: 0.5695392        test: 0.5668831 best: 0.5668831 (142)   total:
```

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3.66s    remaining: 6.58s
143:    learn: 0.5695392        test: 0.5661848 best: 0.5668831 (142)   total:
3.67s    remaining: 6.53s
144:    learn: 0.5698347        test: 0.5668831 best: 0.5668831 (142)   total:
3.69s    remaining: 6.49s
145:    learn: 0.5705826        test: 0.5665152 best: 0.5668831 (142)   total:
3.71s    remaining: 6.46s
146:    learn: 0.5705826        test: 0.5665152 best: 0.5668831 (142)   total:
3.73s    remaining: 6.42s
147:    learn: 0.5705826        test: 0.5665152 best: 0.5668831 (142)   total:
3.75s    remaining: 6.39s
148:    learn: 0.5706219        test: 0.5665152 best: 0.5668831 (142)   total:
3.77s    remaining: 6.35s
149:    learn: 0.5703077        test: 0.5638108 best: 0.5668831 (142)   total:
3.8s     remaining: 6.33s
150:    learn: 0.5701115        test: 0.5657254 best: 0.5668831 (142)   total:
3.81s    remaining: 6.29s
151:    learn: 0.5700330        test: 0.5657254 best: 0.5668831 (142)   total:
3.83s    remaining: 6.25s
152:    learn: 0.5700330        test: 0.5657254 best: 0.5668831 (142)   total:
3.85s    remaining: 6.21s
153:    learn: 0.5700536        test: 0.5661479 best: 0.5668831 (142)   total:
3.86s    remaining: 6.17s
154:    learn: 0.5698577        test: 0.5653584 best: 0.5668831 (142)   total:
3.89s    remaining: 6.15s
155:    learn: 0.5701525        test: 0.5653584 best: 0.5668831 (142)   total:
3.91s    remaining: 6.12s
156:    learn: 0.5698577        test: 0.5653584 best: 0.5668831 (142)   total:
3.93s    remaining: 6.09s
157:    learn: 0.5701525        test: 0.5653584 best: 0.5668831 (142)   total:
3.95s    remaining: 6.05s
158:    learn: 0.5701525        test: 0.5653584 best: 0.5668831 (142)   total:
3.97s    remaining: 6.01s
159:    learn: 0.5698186        test: 0.5660561 best: 0.5668831 (142)   total:
3.98s    remaining: 5.97s
160:    learn: 0.5698186        test: 0.5660561 best: 0.5668831 (142)   total:
4s       remaining: 5.94s
161:    learn: 0.5698186        test: 0.5660561 best: 0.5668831 (142)   total:
4.02s    remaining: 5.9s
162:    learn: 0.5708402        test: 0.5665695 best: 0.5668831 (142)   total:
4.04s    remaining: 5.87s
163:    learn: 0.5708794        test: 0.5664777 best: 0.5668831 (142)   total:
4.06s    remaining: 5.84s
164:    learn: 0.5708794        test: 0.5664777 best: 0.5668831 (142)   total:
4.08s    remaining: 5.81s
165:    learn: 0.5712718        test: 0.5666613 best: 0.5668831 (142)   total:
4.09s    remaining: 5.77s
166:    learn: 0.5712718        test: 0.5666613 best: 0.5668831 (142)   total:
```

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4.1s    remaining: 5.73s
167:    learn: 0.5712718        test: 0.5671738 best: 0.5671738 (167)   total:
4.12s   remaining: 5.69s
168:    learn: 0.5712718        test: 0.5671738 best: 0.5671738 (167)   total:
4.13s   remaining: 5.65s
169:    learn: 0.5713698        test: 0.5671738 best: 0.5671738 (167)   total:
4.15s   remaining: 5.61s
170:    learn: 0.5716049        test: 0.5665695 best: 0.5671738 (167)   total:
4.16s   remaining: 5.58s
171:    learn: 0.5716049        test: 0.5665695 best: 0.5671738 (167)   total:
4.17s   remaining: 5.54s
172:    learn: 0.5716049        test: 0.5665695 best: 0.5671738 (167)   total:
4.19s   remaining: 5.5s
173:    learn: 0.5716049        test: 0.5665695 best: 0.5671738 (167)   total:
4.21s   remaining: 5.46s
174:    learn: 0.5709976        test: 0.5683802 best: 0.5683802 (174)   total:
4.22s   remaining: 5.43s
175:    learn: 0.5709976        test: 0.5683802 best: 0.5683802 (174)   total:
4.24s   remaining: 5.4s
176:    learn: 0.5716244        test: 0.5698595 best: 0.5698595 (176)   total:
4.27s   remaining: 5.38s
177:    learn: 0.5714677        test: 0.5690742 best: 0.5698595 (176)   total:
4.29s   remaining: 5.35s
178:    learn: 0.5714677        test: 0.5690742 best: 0.5698595 (176)   total:
4.3s    remaining: 5.31s
179:    learn: 0.5714677        test: 0.5690742 best: 0.5698595 (176)   total:
4.32s   remaining: 5.28s
180:    learn: 0.5714677        test: 0.5690742 best: 0.5698595 (176)   total:
4.33s   remaining: 5.25s
181:    learn: 0.5714677        test: 0.5689822 best: 0.5698595 (176)   total:
4.36s   remaining: 5.22s
182:    learn: 0.5715069        test: 0.5689822 best: 0.5698595 (176)   total:
4.38s   remaining: 5.2s
183:    learn: 0.5714677        test: 0.5689822 best: 0.5698595 (176)   total:
4.41s   remaining: 5.18s
184:    learn: 0.5714677        test: 0.5689822 best: 0.5698595 (176)   total:
4.43s   remaining: 5.15s
185:    learn: 0.5714677        test: 0.5689822 best: 0.5698595 (176)   total:
4.45s   remaining: 5.12s
186:    learn: 0.5714677        test: 0.5689822 best: 0.5698595 (176)   total:
4.47s   remaining: 5.09s
187:    learn: 0.5714677        test: 0.5689822 best: 0.5698595 (176)   total:
4.48s   remaining: 5.06s
188:    learn: 0.5711349        test: 0.5688903 best: 0.5698595 (176)   total:
4.5s    remaining: 5.03s
189:    learn: 0.5711740        test: 0.5693996 best: 0.5698595 (176)   total:
4.54s   remaining: 5.01s
190:    learn: 0.5712132        test: 0.5693996 best: 0.5698595 (176)   total:
```

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4.55s    remaining: 4.98s
191:    learn: 0.5711740        test: 0.5693996 best: 0.5698595 (176)   total:
4.56s    remaining: 4.95s
192:    learn: 0.5705080        test: 0.5689822 best: 0.5698595 (176)   total:
4.59s    remaining: 4.92s
193:    learn: 0.5730522        test: 0.5688488 best: 0.5698595 (176)   total:
4.61s    remaining: 4.89s
194:    learn: 0.5730522        test: 0.5688488 best: 0.5698595 (176)   total:
4.63s    remaining: 4.87s
195:    learn: 0.5731699        test: 0.5689405 best: 0.5698595 (176)   total:
4.66s    remaining: 4.85s
196:    learn: 0.5735989        test: 0.5690821 best: 0.5698595 (176)   total:
4.67s    remaining: 4.81s
197:    learn: 0.5738916        test: 0.5690821 best: 0.5698595 (176)   total:
4.69s    remaining: 4.79s
198:    learn: 0.5738916        test: 0.5690821 best: 0.5698595 (176)   total:
4.7s     remaining: 4.75s
199:    learn: 0.5739309        test: 0.5690821 best: 0.5698595 (176)   total:
4.72s    remaining: 4.72s
200:    learn: 0.5741843        test: 0.5686654 best: 0.5698595 (176)   total:
4.73s    remaining: 4.68s
201:    learn: 0.5741843        test: 0.5686654 best: 0.5698595 (176)   total:
4.75s    remaining: 4.65s
202:    learn: 0.5741843        test: 0.5686654 best: 0.5698595 (176)   total:
4.76s    remaining: 4.62s
203:    learn: 0.5741843        test: 0.5686654 best: 0.5698595 (176)   total:
4.78s    remaining: 4.59s
204:    learn: 0.5741843        test: 0.5686654 best: 0.5698595 (176)   total:
4.79s    remaining: 4.56s
205:    learn: 0.5737133        test: 0.5699565 best: 0.5699565 (205)   total:
4.82s    remaining: 4.54s
206:    learn: 0.5740057        test: 0.5699565 best: 0.5699565 (205)   total:
4.84s    remaining: 4.51s
207:    learn: 0.5740057        test: 0.5699565 best: 0.5699565 (205)   total:
4.86s    remaining: 4.49s
208:    learn: 0.5743373        test: 0.5699565 best: 0.5699565 (205)   total:
4.88s    remaining: 4.46s
209:    learn: 0.5743373        test: 0.5699565 best: 0.5699565 (205)   total:
4.9s     remaining: 4.43s
210:    learn: 0.5738097        test: 0.5712448 best: 0.5712448 (210)   total:
4.92s    remaining: 4.41s
211:    learn: 0.5752303        test: 0.5724382 best: 0.5724382 (211)   total:
4.95s    remaining: 4.39s
212:    learn: 0.5752303        test: 0.5723462 best: 0.5724382 (211)   total:
4.97s    remaining: 4.36s
213:    learn: 0.5752303        test: 0.5723462 best: 0.5724382 (211)   total:
4.99s    remaining: 4.33s
214:    learn: 0.5753649        test: 0.5724382 best: 0.5724382 (211)   total:
```

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5s       remaining: 4.3s
215:    learn: 0.5753256        test: 0.5724382 best: 0.5724382 (211)   total:
5.02s    remaining: 4.27s
216:    learn: 0.5753649        test: 0.5724382 best: 0.5724382 (211)   total:
5.03s    remaining: 4.25s
217:    learn: 0.5753256        test: 0.5724382 best: 0.5724382 (211)   total:
5.05s    remaining: 4.21s
218:    learn: 0.5756563        test: 0.5714286 best: 0.5724382 (211)   total:
5.07s    remaining: 4.19s
219:    learn: 0.5756563        test: 0.5714286 best: 0.5724382 (211)   total:
5.08s    remaining: 4.16s
220:    learn: 0.5756171        test: 0.5714286 best: 0.5724382 (211)   total:
5.1s     remaining: 4.13s
221:    learn: 0.5756171        test: 0.5714286 best: 0.5724382 (211)   total:
5.12s    remaining: 4.11s
222:    learn: 0.5756171        test: 0.5714286 best: 0.5724382 (211)   total:
5.15s    remaining: 4.09s
223:    learn: 0.5759476        test: 0.5721177 best: 0.5724382 (211)   total:
5.18s    remaining: 4.07s
224:    learn: 0.5759476        test: 0.5721177 best: 0.5724382 (211)   total:
5.21s    remaining: 4.05s
225:    learn: 0.5759084        test: 0.5721177 best: 0.5724382 (211)   total:
5.23s    remaining: 4.03s
226:    learn: 0.5759084        test: 0.5721177 best: 0.5724382 (211)   total:
5.25s    remaining: 4s
227:    learn: 0.5758691        test: 0.5721177 best: 0.5724382 (211)   total:
5.27s    remaining: 3.98s
228:    learn: 0.5765459        test: 0.5732607 best: 0.5732607 (228)   total:
5.29s    remaining: 3.95s
229:    learn: 0.5765459        test: 0.5732607 best: 0.5732607 (228)   total:
5.31s    remaining: 3.93s
230:    learn: 0.5765066        test: 0.5732607 best: 0.5732607 (228)   total:
5.33s    remaining: 3.9s
231:    learn: 0.5765066        test: 0.5725742 best: 0.5732607 (228)   total:
5.35s    remaining: 3.87s
232:    learn: 0.5765066        test: 0.5725742 best: 0.5732607 (228)   total:
5.37s    remaining: 3.85s
233:    learn: 0.5765066        test: 0.5725742 best: 0.5732607 (228)   total:
5.38s    remaining: 3.81s
234:    learn: 0.5765066        test: 0.5725742 best: 0.5732607 (228)   total:
5.39s    remaining: 3.79s
235:    learn: 0.5765066        test: 0.5725742 best: 0.5732607 (228)   total:
5.4s     remaining: 3.75s
236:    learn: 0.5764674        test: 0.5725742 best: 0.5732607 (228)   total:
5.42s    remaining: 3.73s
237:    learn: 0.5752026        test: 0.5721625 best: 0.5732607 (228)   total:
5.44s    remaining: 3.71s
238:    learn: 0.5752026        test: 0.5721625 best: 0.5732607 (228)   total:
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5.46s    remaining: 3.68s
239:    learn: 0.5752417        test: 0.5721625 best: 0.5732607 (228)   total:
5.48s    remaining: 3.65s
240:    learn: 0.5752809        test: 0.5721625 best: 0.5732607 (228)   total:
5.5s     remaining: 3.63s
241:    learn: 0.5747549        test: 0.5735365 best: 0.5735365 (241)   total:
5.51s    remaining: 3.6s
242:    learn: 0.5750851        test: 0.5742225 best: 0.5742225 (242)   total:
5.54s    remaining: 3.58s
243:    learn: 0.5750851        test: 0.5742225 best: 0.5742225 (242)   total:
5.56s    remaining: 3.56s
244:    learn: 0.5754152        test: 0.5741305 best: 0.5742225 (242)   total:
5.58s    remaining: 3.53s
245:    learn: 0.5752026        test: 0.5741305 best: 0.5742225 (242)   total:
5.59s    remaining: 3.5s
246:    learn: 0.5751242        test: 0.5746316 best: 0.5746316 (246)   total:
5.61s    remaining: 3.47s
247:    learn: 0.5752026        test: 0.5744476 best: 0.5746316 (246)   total:
5.63s    remaining: 3.45s
248:    learn: 0.5752417        test: 0.5744476 best: 0.5746316 (246)   total:
5.65s    remaining: 3.42s
249:    learn: 0.5752417        test: 0.5735789 best: 0.5746316 (246)   total:
5.66s    remaining: 3.4s
250:    learn: 0.5752417        test: 0.5728933 best: 0.5746316 (246)   total:
5.67s    remaining: 3.37s
251:    learn: 0.5752417        test: 0.5728933 best: 0.5746316 (246)   total:
5.7s     remaining: 3.35s
252:    learn: 0.5743464        test: 0.5734870 best: 0.5746316 (246)   total:
5.71s    remaining: 3.32s
253:    learn: 0.5746767        test: 0.5734870 best: 0.5746316 (246)   total:
5.72s    remaining: 3.29s
254:    learn: 0.5746767        test: 0.5734870 best: 0.5746316 (246)   total:
5.74s    remaining: 3.27s
255:    learn: 0.5753145        test: 0.5725264 best: 0.5746316 (246)   total:
5.76s    remaining: 3.24s
256:    learn: 0.5753536        test: 0.5725264 best: 0.5746316 (246)   total:
5.78s    remaining: 3.21s
257:    learn: 0.5756443        test: 0.5726181 best: 0.5746316 (246)   total:
5.8s     remaining: 3.19s
258:    learn: 0.5756443        test: 0.5727098 best: 0.5746316 (246)   total:
5.82s    remaining: 3.17s
259:    learn: 0.5755269        test: 0.5722071 best: 0.5746316 (246)   total:
5.83s    remaining: 3.14s
260:    learn: 0.5759739        test: 0.5727098 best: 0.5746316 (246)   total:
5.85s    remaining: 3.11s
261:    learn: 0.5759739        test: 0.5727098 best: 0.5746316 (246)   total:
5.86s    remaining: 3.09s
262:    learn: 0.5757782        test: 0.5728015 best: 0.5746316 (246)   total:
```

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5.88s    remaining: 3.06s
263:    learn: 0.5760294        test: 0.5728015 best: 0.5746316 (246)   total:
5.9s     remaining: 3.04s
264:    learn: 0.5760522        test: 0.5728933 best: 0.5746316 (246)   total:
5.93s    remaining: 3.02s
265:    learn: 0.5754319        test: 0.5719321 best: 0.5746316 (246)   total:
5.94s    remaining: 2.99s
266:    learn: 0.5756668        test: 0.5733035 best: 0.5746316 (246)   total:
5.96s    remaining: 2.97s
267:    learn: 0.5756668        test: 0.5732117 best: 0.5746316 (246)   total:
5.97s    remaining: 2.94s
268:    learn: 0.5756277        test: 0.5732117 best: 0.5746316 (246)   total:
5.99s    remaining: 2.92s
269:    learn: 0.5751803        test: 0.5746722 best: 0.5746722 (269)   total:
6s       remaining: 2.89s
270:    learn: 0.5761697        test: 0.5736211 best: 0.5746722 (269)   total:
6.03s    remaining: 2.87s
271:    learn: 0.5756668        test: 0.5715658 best: 0.5746722 (269)   total:
6.06s    remaining: 2.85s
272:    learn: 0.5759575        test: 0.5715658 best: 0.5746722 (269)   total:
6.09s    remaining: 2.83s
273:    learn: 0.5762481        test: 0.5716573 best: 0.5746722 (269)   total:
6.11s    remaining: 2.81s
274:    learn: 0.5762089        test: 0.5715658 best: 0.5746722 (269)   total:
6.14s    remaining: 2.79s
275:    learn: 0.5762089        test: 0.5715658 best: 0.5746722 (269)   total:
6.16s    remaining: 2.77s
276:    learn: 0.5762089        test: 0.5715658 best: 0.5746722 (269)   total:
6.18s    remaining: 2.74s
277:    learn: 0.5762481        test: 0.5714743 best: 0.5746722 (269)   total:
6.2s     remaining: 2.72s
278:    learn: 0.5756503        test: 0.5712454 best: 0.5746722 (269)   total:
6.23s    remaining: 2.7s
279:    learn: 0.5759020        test: 0.5713370 best: 0.5746722 (269)   total:
6.24s    remaining: 2.67s
280:    learn: 0.5759020        test: 0.5712454 best: 0.5746722 (269)   total:
6.26s    remaining: 2.65s
281:    learn: 0.5759020        test: 0.5713370 best: 0.5746722 (269)   total:
6.27s    remaining: 2.62s
282:    learn: 0.5759020        test: 0.5719321 best: 0.5746722 (269)   total:
6.3s     remaining: 2.6s
283:    learn: 0.5759020        test: 0.5719321 best: 0.5746722 (269)   total:
6.31s    remaining: 2.58s
284:    learn: 0.5759020        test: 0.5719321 best: 0.5746722 (269)   total:
6.34s    remaining: 2.56s
285:    learn: 0.5761143        test: 0.5719321 best: 0.5746722 (269)   total:
6.37s    remaining: 2.54s
286:    learn: 0.5761143        test: 0.5719321 best: 0.5746722 (269)   total:
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6.38s    remaining: 2.51s
287:    learn: 0.5761143        test: 0.5719321 best: 0.5746722 (269)   total:
6.4s     remaining: 2.49s
288:    learn: 0.5761143        test: 0.5710623 best: 0.5746722 (269)   total:
6.42s    remaining: 2.46s
289:    learn: 0.5762712        test: 0.5725264 best: 0.5746722 (269)   total:
6.45s    remaining: 2.44s
290:    learn: 0.5760196        test: 0.5724348 best: 0.5746722 (269)   total:
6.47s    remaining: 2.42s
291:    learn: 0.5767505        test: 0.5717489 best: 0.5746722 (269)   total:
6.5s     remaining: 2.4s
292:    learn: 0.5767897        test: 0.5711538 best: 0.5746722 (269)   total:
6.52s    remaining: 2.38s
293:    learn: 0.5767897        test: 0.5711538 best: 0.5746722 (269)   total:
6.54s    remaining: 2.36s
294:    learn: 0.5767897        test: 0.5711538 best: 0.5746722 (269)   total:
6.55s    remaining: 2.33s
295:    learn: 0.5768289        test: 0.5710623 best: 0.5746722 (269)   total:
6.57s    remaining: 2.31s
296:    learn: 0.5774093        test: 0.5723431 best: 0.5746722 (269)   total:
6.58s    remaining: 2.28s
297:    learn: 0.5776208        test: 0.5721600 best: 0.5746722 (269)   total:
6.6s     remaining: 2.26s
298:    learn: 0.5771347        test: 0.5717941 best: 0.5746722 (269)   total:
6.62s    remaining: 2.24s
299:    learn: 0.5770563        test: 0.5717941 best: 0.5746722 (269)   total:
6.64s    remaining: 2.21s
300:    learn: 0.5790830        test: 0.5729799 best: 0.5746722 (269)   total:
6.67s    remaining: 2.19s
301:    learn: 0.5791223        test: 0.5729799 best: 0.5746722 (269)   total:
6.68s    remaining: 2.17s
302:    learn: 0.5791223        test: 0.5729799 best: 0.5746722 (269)   total:
6.7s     remaining: 2.15s
303:    learn: 0.5790045        test: 0.5728884 best: 0.5746722 (269)   total:
6.73s    remaining: 2.12s
304:    learn: 0.5790045        test: 0.5727969 best: 0.5746722 (269)   total:
6.75s    remaining: 2.1s
305:    learn: 0.5790045        test: 0.5727969 best: 0.5746722 (269)   total:
6.77s    remaining: 2.08s
306:    learn: 0.5790045        test: 0.5727969 best: 0.5746722 (269)   total:
6.79s    remaining: 2.06s
307:    learn: 0.5790045        test: 0.5728884 best: 0.5746722 (269)   total:
6.81s    remaining: 2.03s
308:    learn: 0.5793721        test: 0.5729799 best: 0.5746722 (269)   total:
6.82s    remaining: 2.01s
309:    learn: 0.5790437        test: 0.5728884 best: 0.5746722 (269)   total:
6.84s    remaining: 1.99s
310:    learn: 0.5790830        test: 0.5729799 best: 0.5746722 (269)   total:
```

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6.85s    remaining: 1.96s
311:    learn: 0.5793328        test: 0.5730714 best: 0.5746722 (269)   total:
6.87s    remaining: 1.94s
312:    learn: 0.5793328        test: 0.5730714 best: 0.5746722 (269)   total:
6.89s    remaining: 1.91s
313:    learn: 0.5793328        test: 0.5730714 best: 0.5746722 (269)   total:
6.91s    remaining: 1.89s
314:    learn: 0.5793328        test: 0.5730714 best: 0.5746722 (269)   total:
6.93s    remaining: 1.87s
315:    learn: 0.5793328        test: 0.5730714 best: 0.5746722 (269)   total:
6.94s    remaining: 1.84s
316:    learn: 0.5791223        test: 0.5730714 best: 0.5746722 (269)   total:
6.95s    remaining: 1.82s
317:    learn: 0.5791616        test: 0.5730714 best: 0.5746722 (269)   total:
6.98s    remaining: 1.8s
318:    learn: 0.5791223        test: 0.5730714 best: 0.5746722 (269)   total:
7s       remaining: 1.78s
319:    learn: 0.5792009        test: 0.5730714 best: 0.5746722 (269)   total:
7.01s    remaining: 1.75s
320:    learn: 0.5791223        test: 0.5730714 best: 0.5746722 (269)   total:
7.03s    remaining: 1.73s
321:    learn: 0.5795293        test: 0.5730714 best: 0.5746722 (269)   total:
7.04s    remaining: 1.71s
322:    learn: 0.5795293        test: 0.5730714 best: 0.5746722 (269)   total:
7.06s    remaining: 1.68s
323:    learn: 0.5795293        test: 0.5730714 best: 0.5746722 (269)   total:
7.07s    remaining: 1.66s
324:    learn: 0.5795293        test: 0.5730714 best: 0.5746722 (269)   total:
7.09s    remaining: 1.64s
325:    learn: 0.5794114        test: 0.5730714 best: 0.5746722 (269)   total:
7.1s     remaining: 1.61s
326:    learn: 0.5794114        test: 0.5730714 best: 0.5746722 (269)   total:
7.12s    remaining: 1.59s
327:    learn: 0.5794507        test: 0.5730714 best: 0.5746722 (269)   total:
7.13s    remaining: 1.56s
328:    learn: 0.5794114        test: 0.5730714 best: 0.5746722 (269)   total:
7.14s    remaining: 1.54s
329:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.17s    remaining: 1.52s
330:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.18s    remaining: 1.5s
331:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.2s     remaining: 1.47s
332:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.21s    remaining: 1.45s
333:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.24s    remaining: 1.43s
334:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
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7.25s    remaining: 1.41s
335:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.27s    remaining: 1.38s
336:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.29s    remaining: 1.36s
337:    learn: 0.5803172        test: 0.5735717 best: 0.5746722 (269)   total:
7.3s     remaining: 1.34s
338:    learn: 0.5803959        test: 0.5735717 best: 0.5746722 (269)   total:
7.32s    remaining: 1.32s
339:    learn: 0.5807632        test: 0.5742543 best: 0.5746722 (269)   total:
7.33s    remaining: 1.29s
340:    learn: 0.5793861        test: 0.5731143 best: 0.5746722 (269)   total:
7.35s    remaining: 1.27s
341:    learn: 0.5791757        test: 0.5732057 best: 0.5746722 (269)   total:
7.37s    remaining: 1.25s
342:    learn: 0.5792150        test: 0.5732057 best: 0.5746722 (269)   total:
7.38s    remaining: 1.23s
343:    learn: 0.5787690        test: 0.5733886 best: 0.5746722 (269)   total:
7.41s    remaining: 1.21s
344:    learn: 0.5787690        test: 0.5733886 best: 0.5746722 (269)   total:
7.42s    remaining: 1.18s
345:    learn: 0.5787690        test: 0.5733886 best: 0.5746722 (269)   total:
7.44s    remaining: 1.16s
346:    learn: 0.5787690        test: 0.5733886 best: 0.5746722 (269)   total:
7.46s    remaining: 1.14s
347:    learn: 0.5794785        test: 0.5730230 best: 0.5746722 (269)   total:
7.49s    remaining: 1.12s
348:    learn: 0.5794785        test: 0.5730230 best: 0.5746722 (269)   total:
7.51s    remaining: 1.1s
349:    learn: 0.5798063        test: 0.5717928 best: 0.5746722 (269)   total:
7.53s    remaining: 1.07s
350:    learn: 0.5798063        test: 0.5717928 best: 0.5746722 (269)   total:
7.55s    remaining: 1.05s
351:    learn: 0.5798063        test: 0.5717928 best: 0.5746722 (269)   total:
7.57s    remaining: 1.03s
352:    learn: 0.5799241        test: 0.5717017 best: 0.5746722 (269)   total:
7.6s     remaining: 1.01s
353:    learn: 0.5805142        test: 0.5721108 best: 0.5746722 (269)   total:
7.62s    remaining: 990ms
354:    learn: 0.5805142        test: 0.5721108 best: 0.5746722 (269)   total:
7.63s    remaining: 967ms
355:    learn: 0.5801475        test: 0.5742448 best: 0.5746722 (269)   total:
7.66s    remaining: 946ms
356:    learn: 0.5801475        test: 0.5742448 best: 0.5746722 (269)   total:
7.67s    remaining: 924ms
357:    learn: 0.5801475        test: 0.5742448 best: 0.5746722 (269)   total:
7.69s    remaining: 902ms
358:    learn: 0.5801475        test: 0.5742448 best: 0.5746722 (269)   total:
```

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7.7s    remaining: 880ms
359:    learn: 0.5801475        test: 0.5735645 best: 0.5746722 (269)   total:
7.72s    remaining: 858ms
360:    learn: 0.5801475        test: 0.5735645 best: 0.5746722 (269)   total:
7.74s    remaining: 836ms
361:    learn: 0.5799513        test: 0.5750159 best: 0.5750159 (361)   total:
7.77s    remaining: 816ms
362:    learn: 0.5799513        test: 0.5750159 best: 0.5750159 (361)   total:
7.8s    remaining: 795ms
363:    learn: 0.5799513        test: 0.5750159 best: 0.5750159 (361)   total:
7.83s    remaining: 774ms
364:    learn: 0.5799513        test: 0.5749245 best: 0.5750159 (361)   total:
7.84s    remaining: 752ms
365:    learn: 0.5799513        test: 0.5750159 best: 0.5750159 (361)   total:
7.86s    remaining: 730ms
366:    learn: 0.5799513        test: 0.5744275 best: 0.5750159 (361)   total:
7.89s    remaining: 710ms
367:    learn: 0.5796631        test: 0.5744275 best: 0.5750159 (361)   total:
7.92s    remaining: 689ms
368:    learn: 0.5792572        test: 0.5751987 best: 0.5751987 (368)   total:
7.95s    remaining: 668ms
369:    learn: 0.5795063        test: 0.5751987 best: 0.5751987 (368)   total:
7.99s    remaining: 648ms
370:    learn: 0.5795455        test: 0.5751987 best: 0.5751987 (368)   total:
8.02s    remaining: 627ms
371:    learn: 0.5806975        test: 0.5757865 best: 0.5757865 (371)   total:
8.06s    remaining: 607ms
372:    learn: 0.5810637        test: 0.5751073 best: 0.5757865 (371)   total:
8.09s    remaining: 586ms
373:    learn: 0.5808938        test: 0.5749245 best: 0.5757865 (371)   total:
8.11s    remaining: 564ms
374:    learn: 0.5811816        test: 0.5749245 best: 0.5757865 (371)   total:
8.13s    remaining: 542ms
375:    learn: 0.5806059        test: 0.5750159 best: 0.5757865 (371)   total:
8.17s    remaining: 522ms
376:    learn: 0.5811423        test: 0.5743867 best: 0.5757865 (371)   total:
8.19s    remaining: 500ms
377:    learn: 0.5817175        test: 0.5744783 best: 0.5757865 (371)   total:
8.22s    remaining: 478ms
378:    learn: 0.5817175        test: 0.5743867 best: 0.5757865 (371)   total:
8.24s    remaining: 457ms
379:    learn: 0.5818747        test: 0.5743867 best: 0.5757865 (371)   total:
8.28s    remaining: 436ms
380:    learn: 0.5818747        test: 0.5743867 best: 0.5757865 (371)   total:
8.3s    remaining: 414ms
381:    learn: 0.5819534        test: 0.5742953 best: 0.5757865 (371)   total:
8.32s    remaining: 392ms
382:    learn: 0.5819534        test: 0.5743867 best: 0.5757865 (371)   total:
```

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8.34s    remaining: 370ms
383:    learn: 0.5819018        test: 0.5743867 best: 0.5757865 (371)   total:
8.37s    remaining: 349ms
384:    learn: 0.5817838        test: 0.5742953 best: 0.5757865 (371)   total:
8.41s    remaining: 328ms
385:    learn: 0.5817444        test: 0.5742953 best: 0.5757865 (371)   total:
8.46s    remaining: 307ms
386:    learn: 0.5821501        test: 0.5743867 best: 0.5757865 (371)   total:
8.49s    remaining: 285ms
387:    learn: 0.5817051        test: 0.5742038 best: 0.5757865 (371)   total:
8.53s    remaining: 264ms
388:    learn: 0.5817051        test: 0.5742038 best: 0.5757865 (371)   total:
8.56s    remaining: 242ms
389:    learn: 0.5817051        test: 0.5742038 best: 0.5757865 (371)   total:
8.6s     remaining: 220ms
390:    learn: 0.5817444        test: 0.5742038 best: 0.5757865 (371)   total:
8.62s    remaining: 198ms
391:    learn: 0.5817838        test: 0.5729316 best: 0.5757865 (371)   total:
8.65s    remaining: 177ms
392:    learn: 0.5815871        test: 0.5728403 best: 0.5757865 (371)   total:
8.67s    remaining: 154ms
393:    learn: 0.5833614        test: 0.5754732 best: 0.5757865 (371)   total:
8.7s     remaining: 132ms
394:    learn: 0.5828386        test: 0.5746102 best: 0.5757865 (371)   total:
8.73s    remaining: 111ms
395:    learn: 0.5828780        test: 0.5766481 best: 0.5766481 (395)   total:
8.77s    remaining: 88.6ms
396:    learn: 0.5825911        test: 0.5768314 best: 0.5768314 (396)   total:
8.79s    remaining: 66.5ms
397:    learn: 0.5831647        test: 0.5767398 best: 0.5768314 (396)   total:
8.82s    remaining: 44.3ms
398:    learn: 0.5836875        test: 0.5747419 best: 0.5768314 (396)   total:
8.85s    remaining: 22.2ms
399:    learn: 0.5839741        test: 0.5747419 best: 0.5768314 (396)   total:
8.88s    remaining: 0us

bestTest = 0.5768314
bestIteration = 396

######################## model Evalution started ########################
Train Accuracy: 0.9383813371562623       Test Accuracy: 0.9340144742443593
Train Loss: 0.06161866284373778          Test Loss: 0.06598552575564069
Train AUC: 0.9237024777661802    Test AUC: 0.9118033373251186
Train F1: 0.5515933232169954     Test F1: 0.526407682234832
Train recall: 0.44478433771795656        Test recall: 0.43102215868477484
Train precision: 0.72591113330005        Test Precision: 0.6760089686098655
Train Confusion Matrix:
[[34547   549]
```

```
 [ 1815  1454]]
 Test Confusion Matrix:
[[14755   289]
 [  796   603]]
```

[24]:
```
values={"previous_year_rating":3,"education":"0"}
test.fillna(value=values,inplace=True)
```

[26]:
```
data_test_xs = test.drop(['employee_id'],axis=1)
y_test_pre = catboost_model.predict(data_test_xs)
```

[27]:
```
test["is_promoted"] = y_test_pre
```

[34]:
```
test.to_csv("analytics_submission.
 ↪csv",columns=["employee_id","is_promoted"],index=False)
```

[35]:
```
submission = pd.read_csv("analytics_submission.csv")
submission['is_promoted'].value_counts()
```

[35]:
```
0.0    22328
1.0     1162
Name: is_promoted, dtype: int64
```