Heart_Failure

October 14, 2024

0.1 Heart Failure Clinical Records

The dataset can be found in the following link:

https://archive.ics.uci.edu/dataset/519/heart+failure+clinical+records

[2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[3]:
```
df = pd.read_csv(r"../Data/heart_failure_clinical_records_dataset.csv")
```

[4]:
```
df.head()
```

[4]:

	age	anaemia	creatinine_phosphokinase	diabetes	ejection_fraction	high_blood_pressure	platelets	serum_creatinine	serum_sodium	sex	smoking	time	DEATH_EVENT
0	75.0	0	582	0	20	1	265000.00	1.9	130	1	0	4	1
1	55.0	0	7861	0	38	0	263358.03	1.1	136	1	0	6	1
2	65.0	0	146	0	20	0	162000.00	1.3	129	1	1	7	1
3	50.0	1	111	0	20	0	210000.00	1.9	137	1	0	7	1
4	65.0	1	160	1	20	0	327000.00	2.7	116	0	0	8	1

[5]:
```
df.info(memory_usage="deep")
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 299 entries, 0 to 298
Data columns (total 13 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   age                       299 non-null    float64
 1   anaemia                   299 non-null    int64
 2   creatinine_phosphokinase  299 non-null    int64
 3   diabetes                  299 non-null    int64
 4   ejection_fraction         299 non-null    int64
 5   high_blood_pressure       299 non-null    int64
 6   platelets                 299 non-null    float64
 7   serum_creatinine          299 non-null    float64
 8   serum_sodium              299 non-null    int64
 9   sex                       299 non-null    int64
 10  smoking                   299 non-null    int64
 11  time                      299 non-null    int64
 12  DEATH_EVENT               299 non-null    int64
dtypes: float64(3), int64(10)
memory usage: 30.5 KB
```

[6]:
```
df.shape
```

[6]:
```
(299, 13)
```

[7]:
```
df.isna().sum()
```

[7]:
```
age                         0
anaemia                     0
creatinine_phosphokinase    0
diabetes                    0
ejection_fraction           0
high_blood_pressure         0
platelets                   0
serum_creatinine            0
serum_sodium                0
sex                         0
smoking                     0
time                        0
DEATH_EVENT                 0
dtype: int64
```

[8]:
```
df.duplicated().sum()
```

[8]:
```
0
```

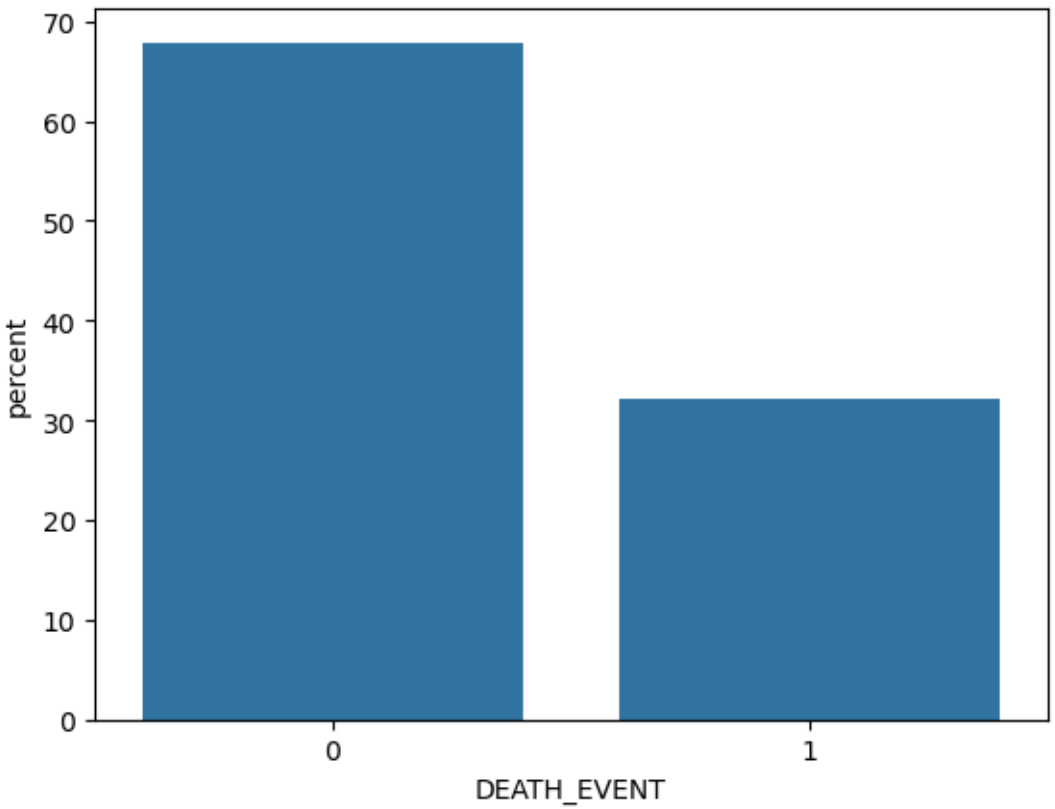
[9]:
```
df.columns
```

[9]:
```
Index(['age', 'anaemia', 'creatinine_phosphokinase', 'diabetes',
       'ejection_fraction', 'high_blood_pressure', 'platelets',
       'serum_creatinine', 'serum_sodium', 'sex', 'smoking', 'time',
       'DEATH_EVENT'],
      dtype='object')
```

[10]:
```
df['DEATH_EVENT'].value_counts(normalize=True)*100
```

[10]:
```
DEATH_EVENT
0    67.892977
1    32.107023
Name: proportion, dtype: float64
```

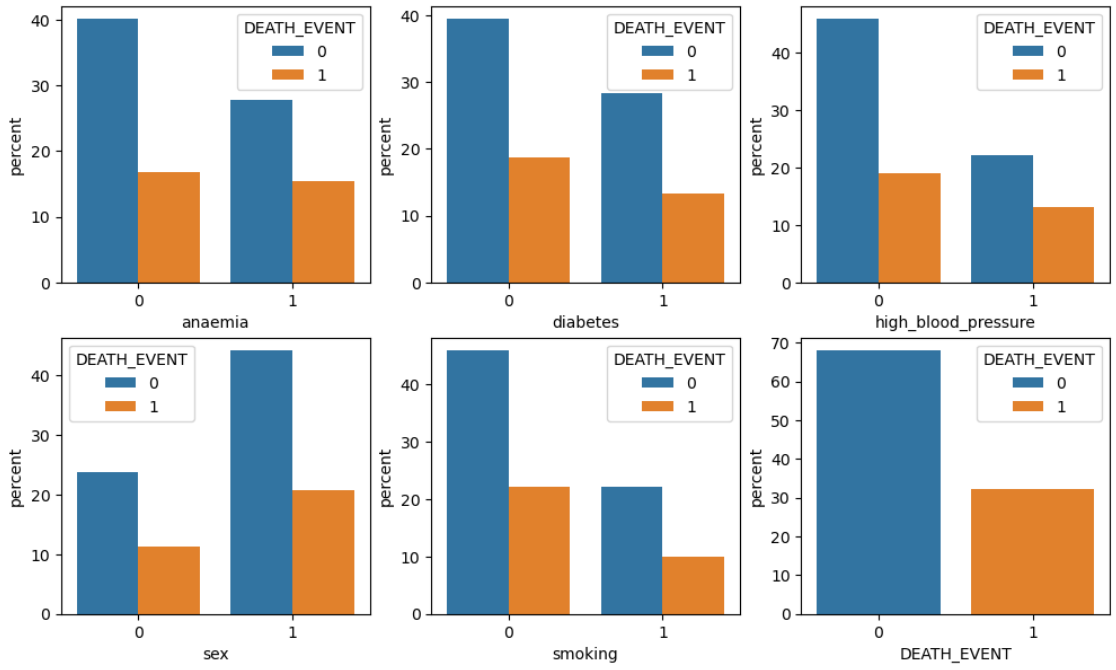
[11]:
```
sns.countplot(data=df, x='DEATH_EVENT', stat='percent');

# Around 68% of the patients with heart failure died while 32% didn't die,␣
 ↪therefore the data is imbalanced in this respect.
# Resampling techniques will be employed to mitigate this effect.
```



[12]:
```
df.columns
```

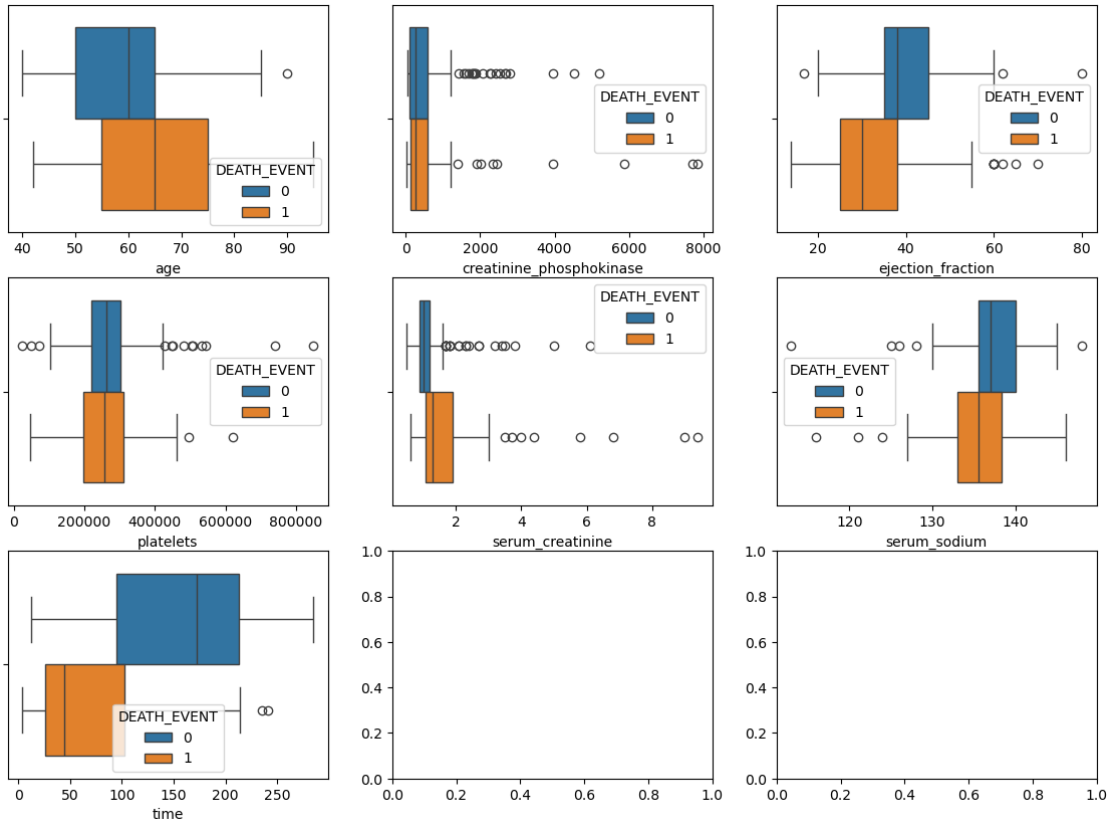
[12]:
```
Index(['age', 'anaemia', 'creatinine_phosphokinase', 'diabetes',
       'ejection_fraction', 'high_blood_pressure', 'platelets',
       'serum_creatinine', 'serum_sodium', 'sex', 'smoking', 'time',
       'DEATH_EVENT'],
      dtype='object')
```

[13]:
```
fig, axes = plt.subplots(2,3, figsize=(12,7))

features = list(df.columns)
features.remove('age')
features.remove('creatinine_phosphokinase')
features.remove('ejection_fraction')
features.remove('platelets')
features.remove('serum_creatinine')
features.remove('serum_sodium')
features.remove('time')

for i, feature in enumerate(features,0):
    plt.subplot(2, 3, i+1)
    sns.countplot(data=df, x=feature, stat='percent', hue='DEATH_EVENT',␣
 ↪hue_order=[0, 1])
```



From the plots above, it can be seen that the majority of people with heart failure who died did not have anemia, diabetes, or high blood pressure, and most were non-smokers and male. This trend is similar for those with heart failure who did not die.

[14]:
```
fig, axes = plt.subplots(3,3, figsize=(14,10))

num_columns =['age', 'creatinine_phosphokinase', 'ejection_fraction',␣
 ↪'platelets', 'serum_creatinine', 'serum_sodium', 'time']

for i, feature in enumerate(num_columns,0):
    plt.subplot(3, 3, i+1)
    sns.boxplot(data=df, x=feature, hue='DEATH_EVENT', hue_order=[0, 1])
```



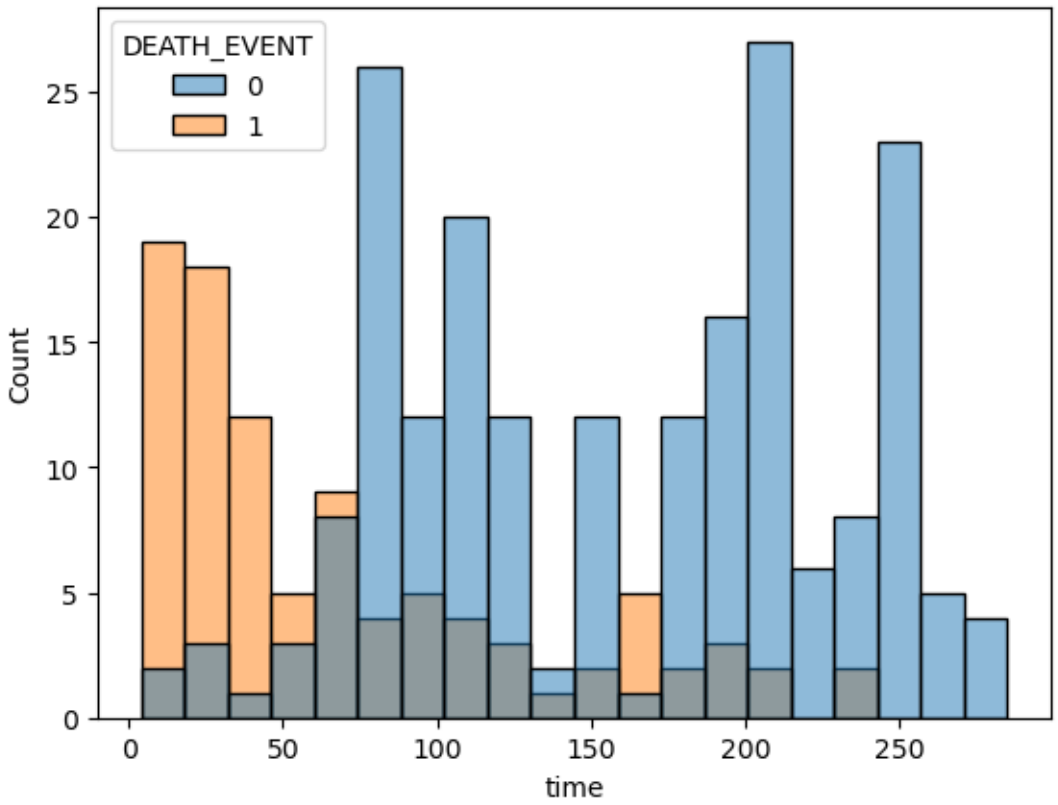
The figures above clearly show that patients with heart failure who died generally had higher age, lower ejection fraction, higher serum creatinine levels, lower serum sodium levels, and shorter follow-up times.

[15]:
```
# finding outliers is not straight forward when dealing with multi-feature data.
 ↪ We will apply an outlier finder algorithm in later sections.

filt = (df['serum_creatinine']>5.5) & (df['creatinine_phosphokinase']>4000) &␣
 ↪(df['ejection_fraction']>60)

df[filt]
```

[15]:
```
Empty DataFrame
Columns: [age, anaemia, creatinine_phosphokinase, diabetes, ejection_fraction,
high_blood_pressure, platelets, serum_creatinine, serum_sodium, sex, smoking,
time, DEATH_EVENT]
Index: []
```

[16]:
```
# We can see that majority of cases who died of heart failure have less than 50␣
↪days of follow-up time.

sns.histplot(data=df, x='time', hue='DEATH_EVENT', bins=20)
```

[16]:
```
<Axes: xlabel='time', ylabel='Count'>
```



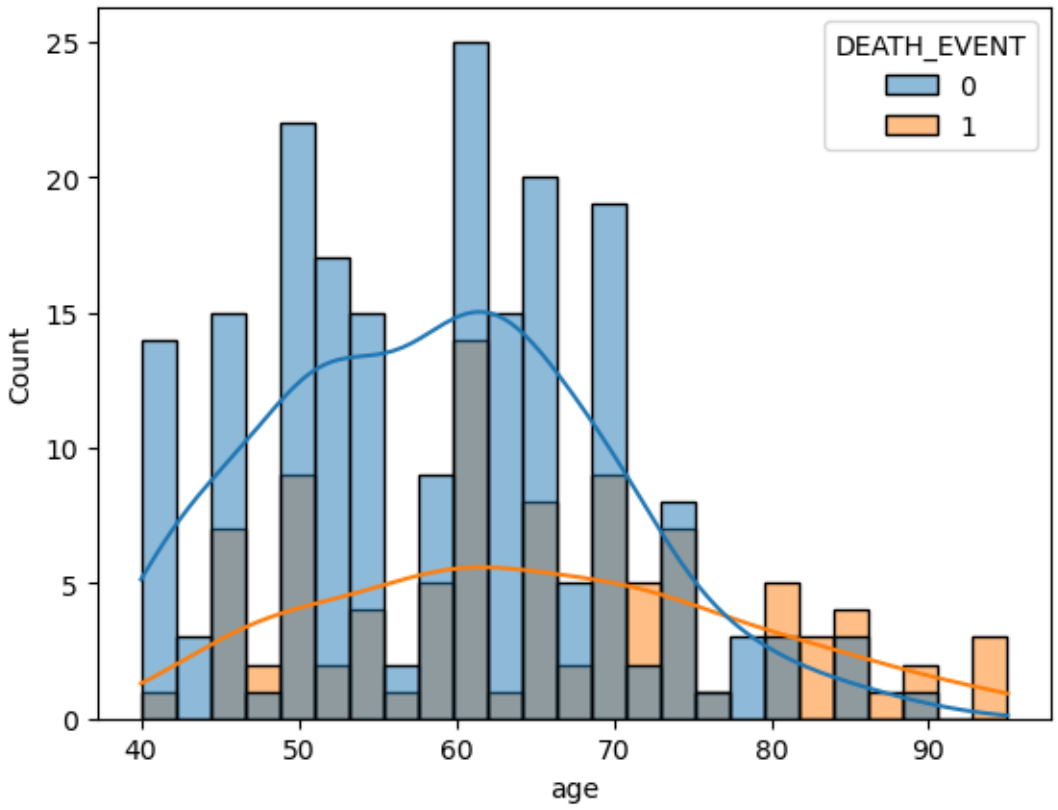
[17]:
```
# The patients consisted of 105 women and 194 men. As mentioned in the related␣
↪paper.

df['sex'].value_counts()
```

[17]:
```
sex
1    194
0    105
```

```
Name: count, dtype: int64
```

[18]:
```
# The distribution of AGE feature.

sns.histplot(df, x='age', kde=True, bins=25, hue='DEATH_EVENT')

# The age distribution is almost the same for patients with heart failure who␣
 ↪died or not died. While the median of age is higher for patients who died␣
 ↪(from previous plots).
```

[18]:
```
<Axes: xlabel='age', ylabel='Count'>
```



[19]:
```
df.columns
```

[19]:
```
Index(['age', 'anaemia', 'creatinine_phosphokinase', 'diabetes',
       'ejection_fraction', 'high_blood_pressure', 'platelets',
       'serum_creatinine', 'serum_sodium', 'sex', 'smoking', 'time',
       'DEATH_EVENT'],
      dtype='object')
```

[20]:
```
cat_columns = list(df.columns)

cat_columns.remove('age')
cat_columns.remove('creatinine_phosphokinase')
cat_columns.remove('ejection_fraction')
cat_columns.remove('serum_creatinine')
cat_columns.remove('serum_sodium')
cat_columns.remove('platelets')
cat_columns.remove('time')
cat_columns.remove('DEATH_EVENT')

cat_columns
```

[20]:
```
['anaemia', 'diabetes', 'high_blood_pressure', 'sex', 'smoking']
```

[21]:
```
# Before we proceed with one-hot encoding of categorical features, we make a␣
 ↪copy of our data. This form of data will be used later for CatBoost model.

df2 = df.copy()
```

[22]:
```
# One-hot encode the categorical features

df = pd.get_dummies(df, columns=cat_columns, drop_first=True, dtype=int)

df.head()
```

[22]:

	age	creatinine_phosphokinase	ejection_fraction	platelets	\
0	75.0	582	20	265000.00	
1	55.0	7861	38	263358.03	
2	65.0	146	20	162000.00	
3	50.0	111	20	210000.00	
4	65.0	160	20	327000.00	

	serum_creatinine	serum_sodium	time	DEATH_EVENT	anaemia_1	diabetes_1	\
0	1.9	130	4	1	0	0	
1	1.1	136	6	1	0	0	
2	1.3	129	7	1	0	0	
3	1.9	137	7	1	1	0	
4	2.7	116	8	1	1	1	

	high_blood_pressure_1	sex_1	smoking_1
0	1	1	0
1	0	1	0
2	0	1	1
3	0	1	0
4	0	0	0

[23]:
```
X = df.drop('DEATH_EVENT', axis=1)

y = df['DEATH_EVENT']
```

[24]:
```
X.shape
```

[24]: (299, 12)

[25]:
```
from sklearn.model_selection import train_test_split
```

[26]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
↪random_state=42)
```

[27]:
```
X_train.shape
```

[27]: (209, 12)

[28]:
```
from sklearn.preprocessing import StandardScaler
```

[29]:
```
scaler = StandardScaler()
```

[30]:
```
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

0.1.1 Outlier detection

For analyzing and detecting the outliers in our dataset, we will use t-SNE method to reduce the dimensionality of our data and visualize it in 2d and 3d. Outliers may appear as points that are distant from the main clusters.

[31]:
```
from sklearn.manifold import TSNE
```

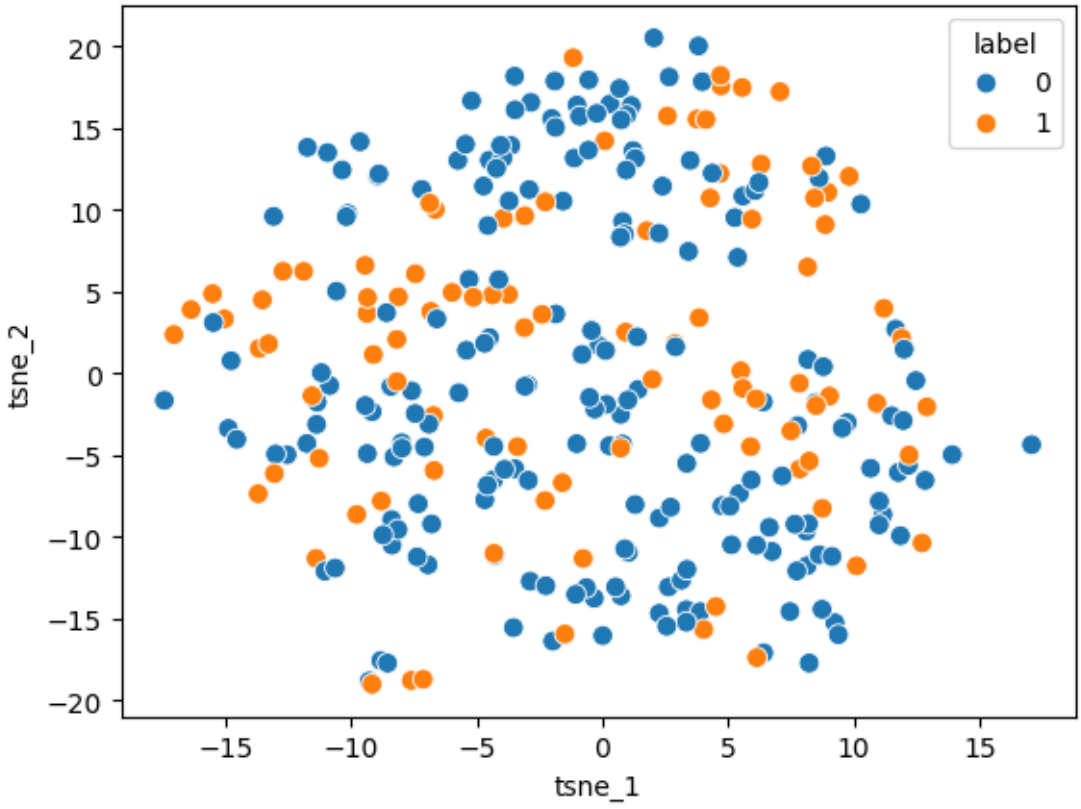
[32]:
```
# Because TSNE uses the concept of distance in their algorithm, we use the data␣
↪after scaling.

tsne = TSNE(n_components=2)

X_total = np.concatenate((X_train, X_test), axis=0)
y_total = np.concatenate((y_train, y_test), axis=0)

tsne_result = tsne.fit_transform(X_total)
tsne_result.shape
```

[32]: (299, 2)

[33]:

```
tsne_result_df = pd.DataFrame({'tsne_1': tsne_result[:,0], 'tsne_2':␣
 ↪tsne_result[:,1], 'label': y_total})

fig, ax = plt.subplots(1)

sns.scatterplot(data=tsne_result_df, x='tsne_1', y='tsne_2', hue='label',␣
 ↪ax=ax, s=60)
```

[33]: <Axes: xlabel='tsne_1', ylabel='tsne_2'>



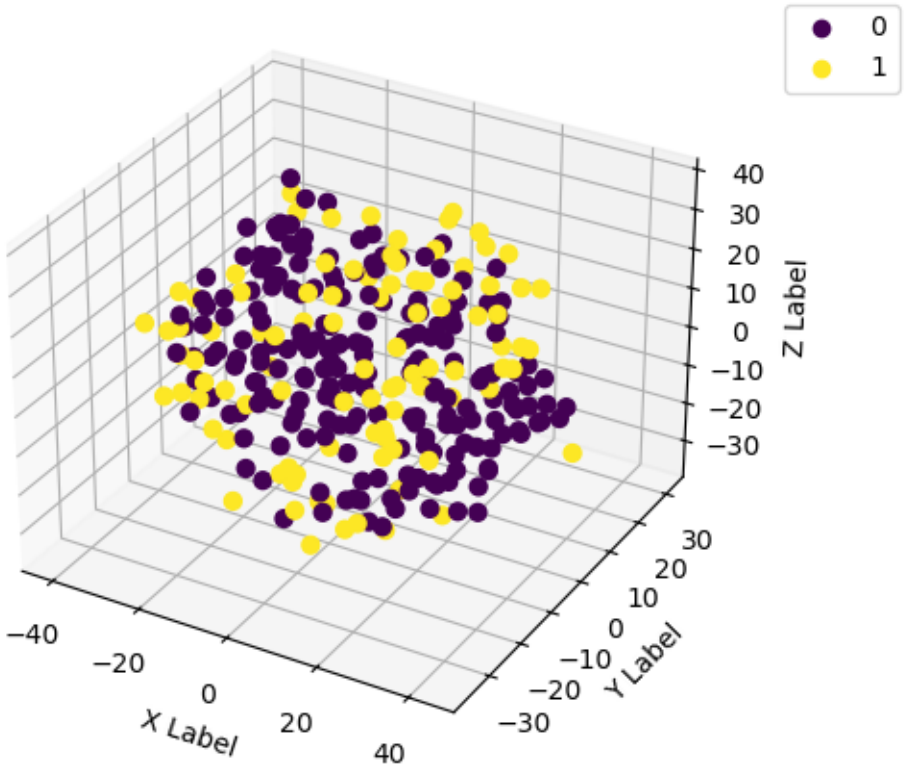
From the plot above, our data points look coherent and no points can be considered as an outlier in our dataset.

[34]:
```
# We also calculate the t-SNE for 3 components to verify our previous finding␣
 ↪using 2d projection.

tsne_3d = TSNE(n_components=3)

tsne_result_3d = tsne_3d.fit_transform(X_total)
tsne_result_3d.shape
```

[34]: (299, 3)

[35]:
```
# 3d plot

from mpl_toolkits.mplot3d import Axes3D

x = tsne_result_3d[:,0]
y = tsne_result_3d[:,1]
z = tsne_result_3d[:,2]

fig = plt.figure(figsize=(4,4))
ax = Axes3D(fig, auto_add_to_figure=False)
fig.add_axes(ax)

sc = ax.scatter(x, y, z, s=40, c=y_total, marker='o', alpha=1)
ax.set_xlabel('X Label')
ax.set_ylabel('Y Label')
ax.set_zlabel('Z Label')

plt.legend(*sc.legend_elements(), bbox_to_anchor=(1.05, 1), loc=2)
```

[35]: <matplotlib.legend.Legend at 0x1f1b65b1e10>



[36]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, confusion_matrix,␣
↪ConfusionMatrixDisplay, roc_auc_score, precision_score, recall_score,␣
↪f1_score
```

[37]:
```
from sklearn.model_selection import cross_val_score
```

[38]:
```
def cross_validate_model(model, X, y):

    aucs = cross_val_score(model, X, y, cv=5, scoring='roc_auc')
    auc_mean = aucs.mean()

    precisions = cross_val_score(model, X, y, cv=5, scoring='precision')
    precision_mean = precisions.mean()

    recalls = cross_val_score(model, X, y, cv=5, scoring='recall')
    recall_mean = recalls.mean()

    f1s = cross_val_score(model, X, y, cv=5, scoring='f1')
    f1_mean = f1s.mean()

    print(f'Mean AUC: {auc_mean:.3f}')
    print(f'Mean Precision: {precision_mean:.3f}')
    print(f'Mean Recall: {recall_mean:.3f}')
    print(f'Mean F1: {f1_mean:.3f}')

    return auc_mean, recall_mean, precision_mean, f1_mean
```

[39]:
```
# Train a Decision Tree model on the resampled data
dt_clf = DecisionTreeClassifier(random_state=42)

cross_validate_model(dt_clf, X_train, y_train);
```

```
Mean AUC: 0.732
Mean Precision: 0.634
Mean Recall: 0.611
Mean F1: 0.608
```

0.1.2 Resampling

[40]:
```
from imblearn.under_sampling import RandomUnderSampler, ClusterCentroids
from imblearn.over_sampling import SMOTE, BorderlineSMOTE, SVMSMOTE, ADASYN
from imblearn.pipeline import Pipeline
```

[41]:
```
# Define the resampling techniques
# Oversample the minority class to match the majority

#over_sampler = SMOTE(sampling_strategy=1.0, random_state=42)
#over_sampler = BorderlineSMOTE(sampling_strategy=1.0, random_state=42)
#over_sampler = SVMSMOTE(sampling_strategy=1.0, random_state=42)
over_sampler = ADASYN(sampling_strategy=1.0, random_state=42)

pipeline = Pipeline(steps=[('over', over_sampler)])
```

[42]:
```
import os

# UserWarning: KMeans is known to have a memory leak on Windows with MKL,
# when there are less chunks than available threads.
# You can avoid it by setting the environment variable OMP_NUM_THREADS=1.

os.environ['OMP_NUM_THREADS'] = '1'
```

[43]:
```
# Resample the training data
X_resampled, y_resampled = pipeline.fit_resample(X_train, y_train)
```

[44]:
```
# Train a Decision Tree model on the resampled data
dt_clf = DecisionTreeClassifier(random_state=42)

cross_validate_model(dt_clf, X_resampled, y_resampled);
```

```
Mean AUC: 0.831
Mean Precision: 0.815
Mean Recall: 0.848
Mean F1: 0.825
```

[45]:
```
# Setting up a grid of hyperparameters to search over

# Decision Tree Regressor Parameters
dt_param = {'criterion':['entropy', 'gini'],      # ['entropy', 'gini',␣
 ↪'log_loss']
            'max_features':[None,'sqrt','log2'],  # [None,'sqrt','log2']
            'max_depth':[None,8,16,24],           # [None,8,16,24]
            'min_samples_split': [2,5,8]}         # [2,5,8]
```

[46]:
```
from sklearn.model_selection import GridSearchCV
```

[47]:
```
def model_tunning(model, param_grid, X_train, y_train):
    print(f'Model: {model}')

    gs = GridSearchCV(model, param_grid=param_grid, cv=5, scoring='recall',␣
 ↪verbose=3, n_jobs=-1) # scoring='roc_auc', recall
```

```
    best_est = gs.fit(X_train, y_train)

    df_cv = pd.DataFrame(gs.cv_results_)

    print(f'Best params: {gs.best_params_}')

    return best_est, df_cv
```

[48]:
```
dt_best_estimator, df_dt_cv = model_tunning(dt_clf, dt_param, X_resampled,␣
↪y_resampled)
```

```
Model: DecisionTreeClassifier(random_state=42)
Fitting 5 folds for each of 72 candidates, totalling 360 fits
Best params: {'criterion': 'entropy', 'max_depth': 8, 'max_features': None,
'min_samples_split': 2}
```

[49]:
```
df_dt_cv = df_dt_cv.
↪drop(['std_fit_time','mean_score_time','std_score_time','params'], axis=1)

df_dt_cv = df_dt_cv.sort_values('rank_test_score')

df_dt_cv.head(10)
```

[49]:

	mean_fit_time	param_criterion	param_max_depth	param_max_features	\
9	0.004001	entropy	8	None	
54	0.005000	gini	16	None	
45	0.003000	gini	8	None	
36	0.003401	gini	None	None	
63	0.003402	gini	24	None	
27	0.004599	entropy	24	None	
18	0.003800	entropy	16	None	
0	0.005407	entropy	None	None	
37	0.003406	gini	None	None	
64	0.003801	gini	24	None	

	param_min_samples_split	split0_test_score	split1_test_score	\
9	2	0.821429	0.785714	
54	2	0.785714	0.750000	
45	2	0.785714	0.750000	
36	2	0.785714	0.750000	
63	2	0.785714	0.750000	
27	2	0.821429	0.821429	
18	2	0.821429	0.821429	
0	2	0.821429	0.821429	
37	5	0.821429	0.678571	
64	5	0.821429	0.678571	

```
    split2_test_score  split3_test_score  split4_test_score  mean_test_score  \
9            0.888889           0.962963           0.814815         0.854762
54           0.851852           1.000000           0.851852         0.847884
45           0.851852           1.000000           0.851852         0.847884
36           0.851852           1.000000           0.851852         0.847884
63           0.851852           1.000000           0.851852         0.847884
27           0.888889           0.925926           0.777778         0.847090
18           0.888889           0.925926           0.777778         0.847090
0            0.888889           0.925926           0.777778         0.847090
37           0.888889           0.962963           0.851852         0.840741
64           0.888889           0.962963           0.851852         0.840741

    std_test_score  rank_test_score
9         0.063791                1
54        0.085577                2
45        0.085577                2
36        0.085577                2
63        0.085577                2
27        0.053073                6
18        0.053073                6
0         0.053073                6
37        0.093864                9
64        0.093864                9
```

[50]:
```
dt_best_params_dict = dt_best_estimator.best_params_

dt_best_params_dict
```

[50]:
```
{'criterion': 'entropy',
 'max_depth': 8,
 'max_features': None,
 'min_samples_split': 2}
```

[51]:
```
# Evaluate the tunned model using cross_val_score:

dt_clf_tunned = DecisionTreeClassifier(**dt_best_params_dict, random_state=42)

cross_validate_model(dt_clf_tunned, X_resampled, y_resampled);
```

```
Mean AUC: 0.848
Mean Precision: 0.822
Mean Recall: 0.855
Mean F1: 0.835
```

[52]:
```
from sklearn.metrics import classification_report, confusion_matrix,␣
↪roc_auc_score, precision_score, recall_score, f1_score
```

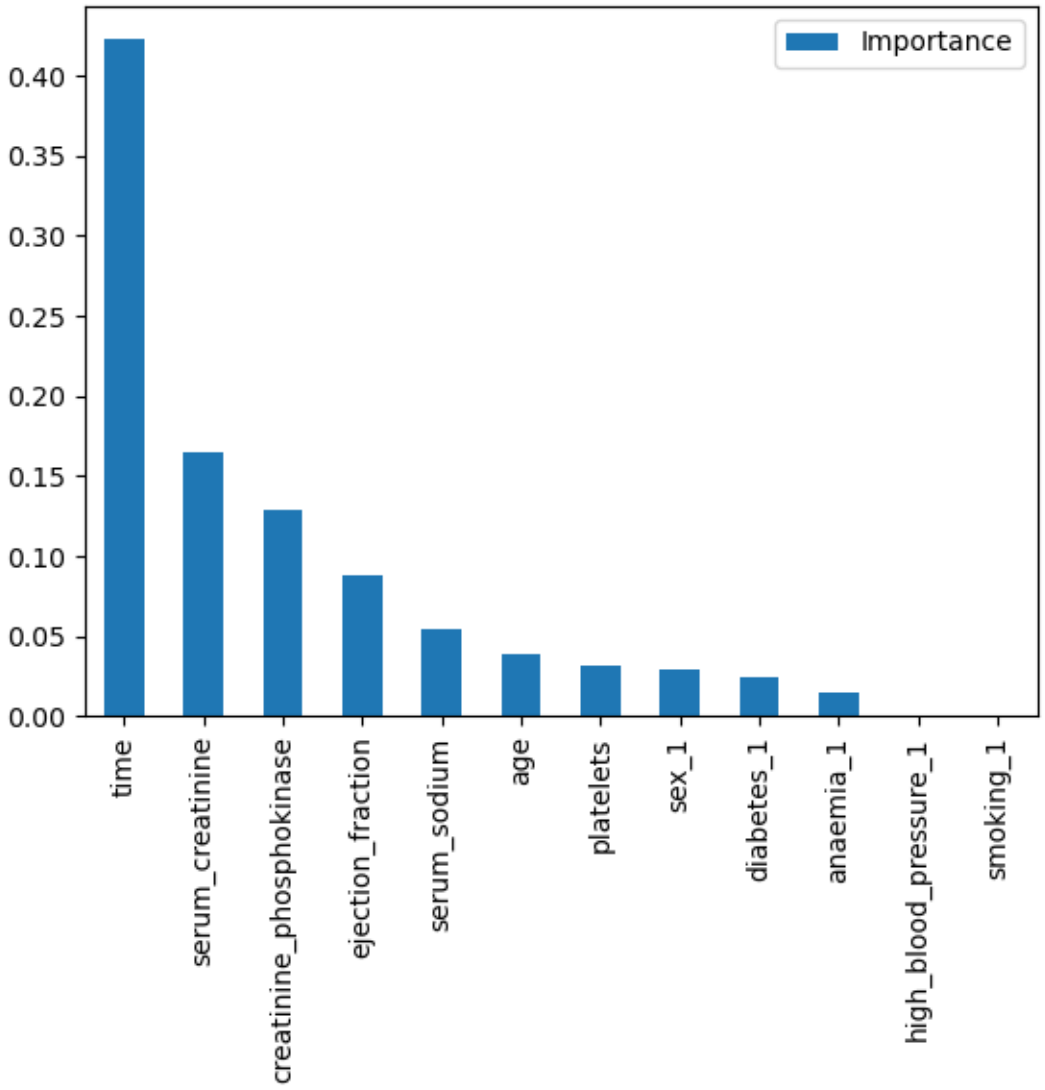
[53]:
```python
def evaluate_model(model, X_test, y_test):
    y_pred = model.predict(X_test)
    y_pred_proba = model.predict_proba(X_test)

    auc_value = roc_auc_score(y_test, y_pred_proba[:,-1])
    precision = precision_score(y_test, y_pred)
    recall = recall_score(y_test, y_pred)
    f1 = f1_score(y_test, y_pred)

    print(f'AUC: {auc_value:.3f}')
    print(f'Precision: {precision:.3f}')
    print(f'Recall: {recall:.3f}')
    print(f'F1: {f1:.3f}')

    print(f'====================================')

    print('Classification Report:')
    print(classification_report(y_test, y_pred))

    print(f'====================================')

    print('Confusion Matrix:')
    print(confusion_matrix(y_test, y_pred))
```

[54]:
```python
# Model evaluation for the best decision tree

evaluate_model(dt_best_estimator, X_test, y_test)
```

```
AUC: 0.754
Precision: 0.767
Recall: 0.622
F1: 0.687
====================================
Classification Report:
              precision    recall  f1-score   support

           0       0.77      0.87      0.81        53
           1       0.77      0.62      0.69        37

    accuracy                           0.77        90
   macro avg       0.77      0.74      0.75        90
weighted avg       0.77      0.77      0.76        90

====================================
Confusion Matrix:
[[46  7]
 [14 23]]
```

[55]:
```
def draw_feature_importance(gs_best_estimator, X):

    feature_imp = pd.DataFrame(gs_best_estimator.best_estimator_.
 ↪feature_importances_, index=X.columns, columns=['Importance'])

    feature_imp = feature_imp.sort_values('Importance', ascending=False)

    feature_imp.plot(kind='bar')
```

[56]:
```
draw_feature_importance(dt_best_estimator, X)
```



The next model that we will be examining is `RandomForestClassifier` from `sklearn`. We will first get the baseline performance of the model using `cross_val_score`. We then search for the

best hyperparameters of the model using `GridSearchCV`. Finally, we will evaluate and report the performance of the best found model on the holdout Test set.

[57]:
```
# Evaluate the base model using cross_val_score:

rf_clf = RandomForestClassifier(random_state=42)

cross_validate_model(rf_clf, X_resampled, y_resampled);
```

```
Mean AUC: 0.967
Mean Precision: 0.888
Mean Recall: 0.905
Mean F1: 0.891
```

0.1.3 Random Forest Model Tunning

In this part, we will search for the best hyperparameters for our Random Forest model using `GridSearchCV`.

[58]:
```
# Setting up a grid of hyperparameters to search over

# Random Forest parameters
rf_param = {
            'max_depth': [None,8,16,24],          # None,8,16,24
            'max_features':[None,'sqrt','log2'],  # None,'sqrt','log2'
            'min_samples_split': [2,5,8],         # 2,5,8
            'n_estimators':[80,120,240,300,600]   # 80,120,240,300,600,1200
           }
```

[59]:
```
rf_best_estimator, df_rf_cv = model_tunning(rf_clf, rf_param, X_resampled,␣
↪y_resampled)
```

```
Model: RandomForestClassifier(random_state=42)
Fitting 5 folds for each of 180 candidates, totalling 900 fits
Best params: {'max_depth': 8, 'max_features': 'sqrt', 'min_samples_split': 2,
'n_estimators': 80}

c:\ProgramData\Anaconda3\envs\new\Lib\site-packages\numpy\ma\core.py:2820:
RuntimeWarning: invalid value encountered in cast
  _data = np.array(data, dtype=dtype, copy=copy,
```

[60]:
```
df_rf_cv = df_rf_cv.
↪drop(['std_fit_time','mean_score_time','std_score_time','params'], axis=1)

df_rf_cv = df_rf_cv.sort_values('rank_test_score')

# Have a look at first 10 best models according to performance score
df_rf_cv.head(10)
```

[60]:

	mean_fit_time	param_max_depth	param_max_features	\
60	0.217839	8	sqrt	
75	0.222558	8	log2	
160	0.279301	24	sqrt	
130	0.349155	16	log2	
25	0.230530	None	sqrt	
40	0.217469	None	log2	
175	0.246557	24	log2	
115	0.204015	16	sqrt	
120	0.241362	16	log2	
15	0.233887	None	sqrt	

	param_min_samples_split	param_n_estimators	split0_test_score	\
60	2	80	0.928571	
75	2	80	0.928571	
160	8	80	0.964286	
130	8	80	0.964286	
25	8	80	0.964286	
40	8	80	0.964286	
175	8	80	0.964286	
115	8	80	0.964286	
120	2	80	0.928571	
15	2	80	0.928571	

	split1_test_score	split2_test_score	split3_test_score	\
60	0.857143	0.962963	1.0	
75	0.857143	0.962963	1.0	
160	0.857143	0.962963	1.0	
130	0.857143	0.962963	1.0	
25	0.857143	0.962963	1.0	
40	0.857143	0.962963	1.0	
175	0.857143	0.962963	1.0	
115	0.857143	0.962963	1.0	
120	0.821429	0.962963	1.0	
15	0.821429	0.962963	1.0	

	split4_test_score	mean_test_score	std_test_score	rank_test_score
60	0.814815	0.912698	0.067923	1
75	0.814815	0.912698	0.067923	1
160	0.777778	0.912434	0.082582	3
130	0.777778	0.912434	0.082582	3
25	0.777778	0.912434	0.082582	3
40	0.777778	0.912434	0.082582	3
175	0.777778	0.912434	0.082582	3
115	0.777778	0.912434	0.082582	3
120	0.814815	0.905556	0.074908	9
15	0.814815	0.905556	0.074908	9

[61]:
```
# Best hyperparameters found:

rf_best_params_dict = rf_best_estimator.best_params_

rf_best_params_dict
```

[61]:
```
{'max_depth': 8,
 'max_features': 'sqrt',
 'min_samples_split': 2,
 'n_estimators': 80}
```

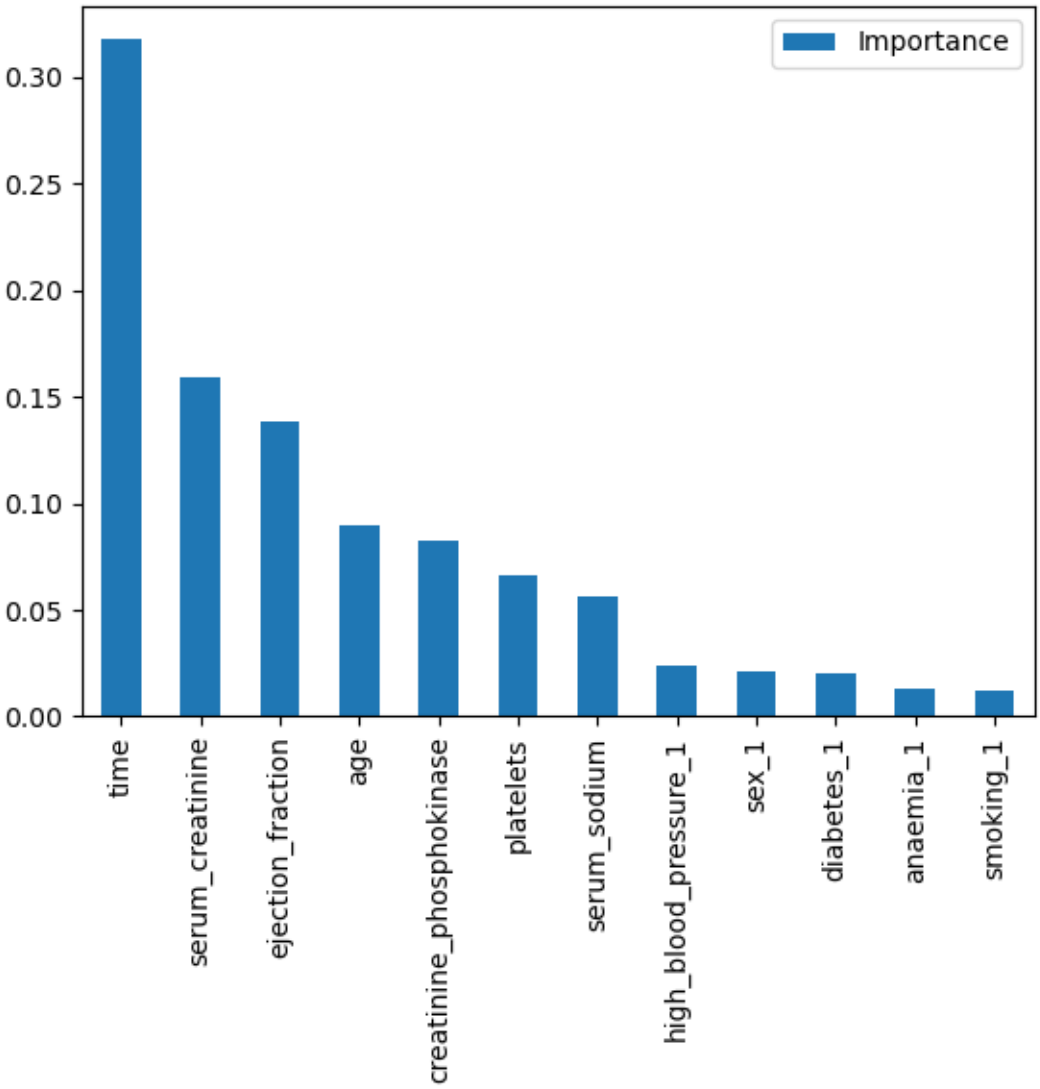
[62]:
```
# Evaluate the tunned model using cross_val_score:

rf_clf_tunned = RandomForestClassifier(**rf_best_params_dict, random_state=42)

cross_validate_model(rf_clf_tunned, X_resampled, y_resampled);
```

```
Mean AUC: 0.964
Mean Precision: 0.887
Mean Recall: 0.913
Mean F1: 0.896
```

[63]:
```
# Evaluate the performance of the model on holdout test set.

evaluate_model(rf_best_estimator, X_test, y_test)
```

```
AUC: 0.873
Precision: 0.800
Recall: 0.649
F1: 0.716
==================================
Classification Report:
              precision    recall  f1-score   support

           0       0.78      0.89      0.83        53
           1       0.80      0.65      0.72        37

    accuracy                           0.79        90
   macro avg       0.79      0.77      0.77        90
weighted avg       0.79      0.79      0.78        90

==================================
Confusion Matrix:
[[47  6]
 [13 24]]
```

[64]:
```
draw_feature_importance(rf_best_estimator, X)
```



0.1.4 XGBoost

In this section, we will be using `XGBClassifier` from `xgboost` package. We will first get the baseline performance of the model using `cross_val_score`. We then search for the best hyperparameters of the model using `GridSearchCV`. Finally, we will evaluate and report the performance of the best found model on the Test set.

[65]:
```
# import the necessary libraries

from xgboost import XGBClassifier
```

[66]:
```
```

```
# Evaluate the model before tunning. The mean performance evaluation metrics,␣
 ↪namely recall and AUC, will be recorded.

xgb_clf = XGBClassifier(objective='binary:logistic', random_state=42)

cross_validate_model(rf_clf, X_resampled, y_resampled);
```

```
Mean AUC: 0.967
Mean Precision: 0.888
Mean Recall: 0.905
Mean F1: 0.891
```

[67]:
```
# Setting up a grid of hyperparameters to search over

# XGBoost parameters
xgb_param = {
            'max_depth':[0,8,16,24],       # 0,8,16,24
            'learning_rate':[.1,.3,.6,1],  # .1,.3,.6,1
            'n_estimators':[16,32,64,128]   # 16,32,64,128
            }
```

[68]:
```
xgb_best_estimator, df_xgb_cv = model_tunning(xgb_clf, xgb_param, X_resampled,␣
 ↪y_resampled)
```

```
Model: XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, random_state=42, …)
Fitting 5 folds for each of 64 candidates, totalling 320 fits

c:\ProgramData\Anaconda3\envs\new\Lib\site-
packages\joblib\externals\loky\process_executor.py:752: UserWarning: A worker
stopped while some jobs were given to the executor. This can be caused by a too
short worker timeout or by a memory leak.
  warnings.warn(

Best params: {'learning_rate': 1, 'max_depth': 0, 'n_estimators': 32}
```

[69]:
```
df_xgb_cv = df_xgb_cv.
 ↪drop(['std_fit_time','mean_score_time','std_score_time','params'], axis=1)
```

```
df_xgb_cv = df_xgb_cv.sort_values('rank_test_score')

# Have a look at first 10 best models according to performance score
df_xgb_cv.head(10)
```

[69]:

	mean_fit_time	param_learning_rate	param_max_depth	param_n_estimators	\
49	0.020338	1.0	0	32	
62	0.029154	1.0	24	64	
53	0.023847	1.0	8	32	
61	0.020614	1.0	24	32	
50	0.028257	1.0	0	64	
54	0.029261	1.0	8	64	
57	0.021398	1.0	16	32	
58	0.027999	1.0	16	64	
63	0.043781	1.0	24	128	
55	0.056684	1.0	8	128	

	split0_test_score	split1_test_score	split2_test_score	\
49	0.821429	0.857143	0.962963	
62	0.821429	0.857143	0.962963	
53	0.821429	0.857143	0.962963	
61	0.821429	0.857143	0.962963	
50	0.821429	0.857143	0.962963	
54	0.821429	0.857143	0.962963	
57	0.821429	0.857143	0.962963	
58	0.821429	0.857143	0.962963	
63	0.821429	0.821429	0.962963	
55	0.821429	0.821429	0.962963	

	split3_test_score	split4_test_score	mean_test_score	std_test_score	\
49	1.0	0.925926	0.913492	0.065934	
62	1.0	0.925926	0.913492	0.065934	
53	1.0	0.925926	0.913492	0.065934	
61	1.0	0.925926	0.913492	0.065934	
50	1.0	0.925926	0.913492	0.065934	
54	1.0	0.925926	0.913492	0.065934	
57	1.0	0.925926	0.913492	0.065934	
58	1.0	0.925926	0.913492	0.065934	
63	1.0	0.925926	0.906349	0.073187	
55	1.0	0.925926	0.906349	0.073187	

	rank_test_score
49	1
62	1
53	1
61	1
50	1

```
54                1
57                1
58                1
63                9
55                9
```

[70]:
```
# Best hyperparameters found:

xgb_best_params_dict = xgb_best_estimator.best_params_

xgb_best_params_dict
```

[70]:
```
{'learning_rate': 1, 'max_depth': 0, 'n_estimators': 32}
```

[71]:
```
# Evaluate the tunned model using cross_val_score:

xgb_clf_tunned = XGBClassifier(**xgb_best_params_dict, objective='binary:
 ↪logistic', random_state=42)

cross_validate_model(xgb_clf_tunned, X_resampled, y_resampled);
```

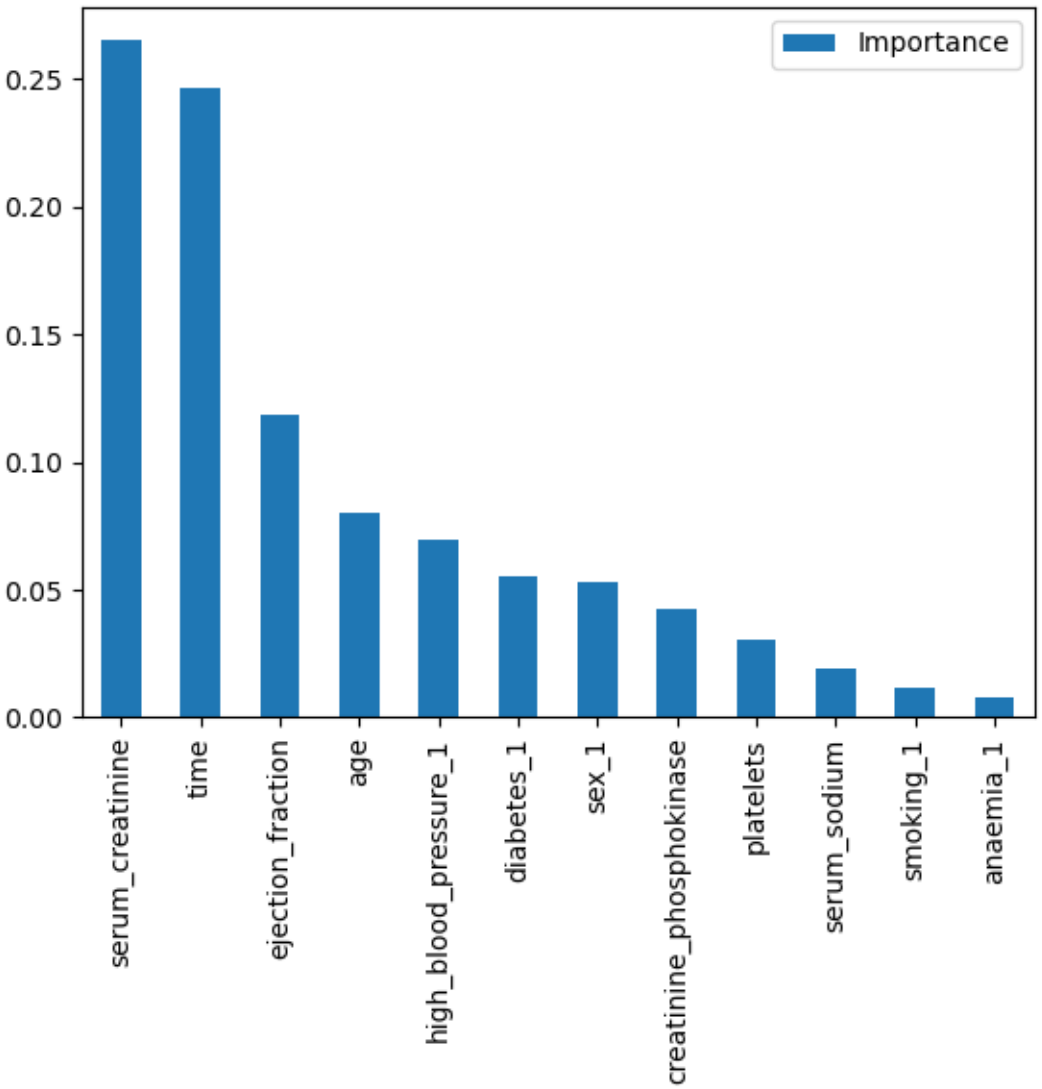
```
Mean AUC: 0.942
Mean Precision: 0.859
Mean Recall: 0.913
Mean F1: 0.883
```

[72]:
```
# Evaluate the performance of the model on holdout test set.

evaluate_model(xgb_best_estimator, X_test, y_test)
```

```
AUC: 0.854
Precision: 0.733
Recall: 0.595
F1: 0.657
==================================
Classification Report:
              precision    recall  f1-score   support

           0       0.75      0.85      0.80        53
           1       0.73      0.59      0.66        37

    accuracy                           0.74        90
   macro avg       0.74      0.72      0.73        90
weighted avg       0.74      0.74      0.74        90

==================================
Confusion Matrix:
```

```
[[45  8]
 [15 22]]
```

[73]:
```
draw_feature_importance(xgb_best_estimator, X)
```



0.1.5 CatBoost Model

In this section, we will be using `CatBoostClassifier` from `catboost` package. Catboost accepts categorical features natively, and we don't need to one-hot encode the categorical features. Also, because we are using a tree-based method, no scaling is required. We will first get the baseline performance of the model using `cross_val_score`. We then search for the best hyperparameters of the model using `GridSearchCV`. Finally, we will evaluate and report the performance of the best found model on the Test set.

[74]:
```
cat_columns
```

[74]:
```
['anaemia', 'diabetes', 'high_blood_pressure', 'sex', 'smoking']
```

[75]:
```
df2.head()
```

[75]:

	age	anaemia	creatinine_phosphokinase	diabetes	ejection_fraction	\
0	75.0	0	582	0	20	
1	55.0	0	7861	0	38	
2	65.0	0	146	0	20	
3	50.0	1	111	0	20	
4	65.0	1	160	1	20	

	high_blood_pressure	platelets	serum_creatinine	serum_sodium	sex	\
0	1	265000.00	1.9	130	1	
1	0	263358.03	1.1	136	1	
2	0	162000.00	1.3	129	1	
3	0	210000.00	1.9	137	1	
4	0	327000.00	2.7	116	0	

	smoking	time	DEATH_EVENT
0	0	4	1
1	0	6	1
2	1	7	1
3	0	7	1
4	0	8	1

[76]:
```
X = df2.drop('DEATH_EVENT', axis=1)
y = df2['DEATH_EVENT']
```

[77]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=.3,␣
↪random_state=42)
```

[78]:
```
from catboost import CatBoostClassifier
```

Because we are using categorical features natively, we cannot use SMOTE or ADASYN functions for oversampling. In order to compensate for the imbalanced dataset, the `auto_class_weights` parameter in the constructor of `CatBoostClassifier` is used. This way, each sample will be multiplied by a weight according to their class weight, computed automatically by catboost. For calculating class weights we could have used `compute_class_weight` from scikit-learn library and pass the weights to `class_weight` parameter in the `CatBoostClassifier` constructor.

[79]:
```
cat_model = CatBoostClassifier(cat_features=cat_columns,␣
↪auto_class_weights='Balanced', iterations=1000, random_seed=42, verbose=200)

cross_validate_model(cat_model, X_train, y_train);
```

```
Learning rate set to 0.004798
```

```
0:      learn: 0.6890301        total: 132ms    remaining: 2m 11s
200:    learn: 0.2748345        total: 425ms    remaining: 1.69s
400:    learn: 0.1662396        total: 713ms    remaining: 1.06s
600:    learn: 0.1154453        total: 1s       remaining: 667ms
800:    learn: 0.0856613        total: 1.3s     remaining: 324ms
999:    learn: 0.0654719        total: 1.57s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6900336        total: 1.42ms   remaining: 1.41s
200:    learn: 0.3095815        total: 284ms    remaining: 1.13s
400:    learn: 0.1956148        total: 598ms    remaining: 894ms
600:    learn: 0.1381696        total: 967ms    remaining: 642ms
800:    learn: 0.1029476        total: 1.31s    remaining: 326ms
999:    learn: 0.0780168        total: 1.62s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6895176        total: 1.67ms   remaining: 1.67s
200:    learn: 0.3132545        total: 343ms    remaining: 1.36s
400:    learn: 0.2039758        total: 693ms    remaining: 1.03s
600:    learn: 0.1475525        total: 1.03s    remaining: 687ms
800:    learn: 0.1115306        total: 1.34s    remaining: 332ms
999:    learn: 0.0863591        total: 1.64s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890010        total: 1.43ms   remaining: 1.43s
200:    learn: 0.2728832        total: 282ms    remaining: 1.12s
400:    learn: 0.1644155        total: 555ms    remaining: 829ms
600:    learn: 0.1125052        total: 893ms    remaining: 593ms
800:    learn: 0.0826196        total: 1.23s    remaining: 305ms
999:    learn: 0.0624936        total: 1.58s    remaining: 0us
Learning rate set to 0.00481
0:      learn: 0.6884000        total: 1.86ms   remaining: 1.86s
200:    learn: 0.3030279        total: 338ms    remaining: 1.34s
400:    learn: 0.1891978        total: 706ms    remaining: 1.05s
600:    learn: 0.1325773        total: 1.13s    remaining: 752ms
800:    learn: 0.0977016        total: 1.5s     remaining: 372ms
999:    learn: 0.0745761        total: 1.82s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890301        total: 1.47ms   remaining: 1.47s
200:    learn: 0.2748345        total: 323ms    remaining: 1.28s
400:    learn: 0.1662396        total: 714ms    remaining: 1.07s
600:    learn: 0.1154453        total: 1.03s    remaining: 685ms
800:    learn: 0.0856613        total: 1.33s    remaining: 332ms
999:    learn: 0.0654719        total: 1.7s     remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6900336        total: 1.6ms    remaining: 1.59s
200:    learn: 0.3095815        total: 351ms    remaining: 1.39s
400:    learn: 0.1956148        total: 672ms    remaining: 1s
600:    learn: 0.1381696        total: 977ms    remaining: 649ms
800:    learn: 0.1029476        total: 1.26s    remaining: 314ms
999:    learn: 0.0780168        total: 1.55s    remaining: 0us
```

```
Learning rate set to 0.004798
0:      learn: 0.6895176        total: 1.48ms   remaining: 1.48s
200:    learn: 0.3132545        total: 292ms    remaining: 1.16s
400:    learn: 0.2039758        total: 692ms    remaining: 1.03s
600:    learn: 0.1475525        total: 1.03s    remaining: 683ms
800:    learn: 0.1115306        total: 1.29s    remaining: 322ms
999:    learn: 0.0863591        total: 1.56s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890010        total: 1.48ms   remaining: 1.48s
200:    learn: 0.2728832        total: 275ms    remaining: 1.09s
400:    learn: 0.1644155        total: 561ms    remaining: 838ms
600:    learn: 0.1125052        total: 851ms    remaining: 565ms
800:    learn: 0.0826196        total: 1.15s    remaining: 286ms
999:    learn: 0.0624936        total: 1.47s    remaining: 0us
Learning rate set to 0.00481
0:      learn: 0.6884000        total: 1.56ms   remaining: 1.56s
200:    learn: 0.3030279        total: 287ms    remaining: 1.14s
400:    learn: 0.1891978        total: 572ms    remaining: 854ms
600:    learn: 0.1325773        total: 854ms    remaining: 567ms
800:    learn: 0.0977016        total: 1.14s    remaining: 282ms
999:    learn: 0.0745761        total: 1.41s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890301        total: 1.44ms   remaining: 1.43s
200:    learn: 0.2748345        total: 271ms    remaining: 1.08s
400:    learn: 0.1662396        total: 532ms    remaining: 795ms
600:    learn: 0.1154453        total: 798ms    remaining: 530ms
800:    learn: 0.0856613        total: 1.16s    remaining: 289ms
999:    learn: 0.0654719        total: 1.47s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6900336        total: 1.4ms    remaining: 1.39s
200:    learn: 0.3095815        total: 295ms    remaining: 1.17s
400:    learn: 0.1956148        total: 578ms    remaining: 863ms
600:    learn: 0.1381696        total: 895ms    remaining: 594ms
800:    learn: 0.1029476        total: 1.19s    remaining: 295ms
999:    learn: 0.0780168        total: 1.47s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6895176        total: 1.39ms   remaining: 1.39s
200:    learn: 0.3132545        total: 276ms    remaining: 1.1s
400:    learn: 0.2039758        total: 553ms    remaining: 826ms
600:    learn: 0.1475525        total: 830ms    remaining: 551ms
800:    learn: 0.1115306        total: 1.09s    remaining: 272ms
999:    learn: 0.0863591        total: 1.34s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890010        total: 1.4ms    remaining: 1.4s
200:    learn: 0.2728832        total: 272ms    remaining: 1.08s
400:    learn: 0.1644155        total: 551ms    remaining: 823ms
600:    learn: 0.1125052        total: 841ms    remaining: 558ms
800:    learn: 0.0826196        total: 1.22s    remaining: 302ms
```

```
999:    learn: 0.0624936        total: 1.54s    remaining: 0us
Learning rate set to 0.00481
0:      learn: 0.6884000        total: 2.15ms   remaining: 2.15s
200:    learn: 0.3030279        total: 340ms    remaining: 1.35s
400:    learn: 0.1891978        total: 632ms    remaining: 944ms
600:    learn: 0.1325773        total: 934ms    remaining: 620ms
800:    learn: 0.0977016        total: 1.23s    remaining: 305ms
999:    learn: 0.0745761        total: 1.51s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890301        total: 1.59ms   remaining: 1.59s
200:    learn: 0.2748345        total: 272ms    remaining: 1.08s
400:    learn: 0.1662396        total: 536ms    remaining: 801ms
600:    learn: 0.1154453        total: 844ms    remaining: 560ms
800:    learn: 0.0856613        total: 1.15s    remaining: 287ms
999:    learn: 0.0654719        total: 1.47s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6900336        total: 1.47ms   remaining: 1.47s
200:    learn: 0.3095815        total: 289ms    remaining: 1.15s
400:    learn: 0.1956148        total: 585ms    remaining: 874ms
600:    learn: 0.1381696        total: 1.01s    remaining: 671ms
800:    learn: 0.1029476        total: 1.3s     remaining: 323ms
999:    learn: 0.0780168        total: 1.58s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6895176        total: 1.64ms   remaining: 1.64s
200:    learn: 0.3132545        total: 305ms    remaining: 1.21s
400:    learn: 0.2039758        total: 596ms    remaining: 890ms
600:    learn: 0.1475525        total: 877ms    remaining: 582ms
800:    learn: 0.1115306        total: 1.19s    remaining: 295ms
999:    learn: 0.0863591        total: 1.46s    remaining: 0us
Learning rate set to 0.004798
0:      learn: 0.6890010        total: 1.45ms   remaining: 1.45s
200:    learn: 0.2728832        total: 294ms    remaining: 1.17s
400:    learn: 0.1644155        total: 598ms    remaining: 893ms
600:    learn: 0.1125052        total: 883ms    remaining: 586ms
800:    learn: 0.0826196        total: 1.17s    remaining: 290ms
999:    learn: 0.0624936        total: 1.48s    remaining: 0us
Learning rate set to 0.00481
0:      learn: 0.6884000        total: 1.44ms   remaining: 1.44s
200:    learn: 0.3030279        total: 283ms    remaining: 1.12s
400:    learn: 0.1891978        total: 565ms    remaining: 844ms
600:    learn: 0.1325773        total: 882ms    remaining: 586ms
800:    learn: 0.0977016        total: 1.22s    remaining: 304ms
999:    learn: 0.0745761        total: 1.52s    remaining: 0us
Mean AUC: 0.932
Mean Precision: 0.803
Mean Recall: 0.797
Mean F1: 0.794
```

[80]:
```
# Setting up a grid of hyperparameters to search over

# CatBoost Parameters
cb_param = {
            'learning_rate':[.1], # .01,.1,.3,.6,1
            'depth':[3],          # 3,4,8,10
            'subsample': [0.7],   # 0.5,0.7,0.9,1.0
            'iterations': [100],  # 100,500,1000
           }
```

[81]:
```
cb_best_estimator, df_cb_cv = model_tunning(cat_model, cb_param, X_train,␣
 ↪y_train)
```

```
Model: <catboost.core.CatBoostClassifier object at 0x000001F1B8036550>
Fitting 5 folds for each of 1 candidates, totalling 5 fits
0:      learn: 0.6537586        total: 426us    remaining: 42.2ms
99:     learn: 0.2074862        total: 39.5ms   remaining: 0us
Best params: {'depth': 3, 'iterations': 100, 'learning_rate': 0.1, 'subsample':
0.7}
```

[82]:
```
df_cb_cv = df_cb_cv.
 ↪drop(['std_fit_time','mean_score_time','std_score_time','params'], axis=1)

df_cb_cv = df_cb_cv.sort_values('rank_test_score')

# Have a look at first 10 best models according to performance score
df_cb_cv.head(10)
```

[82]:

	mean_fit_time	param_depth	param_iterations	param_learning_rate	param_subsample	split0_test_score	split1_test_score	split2_test_score	split3_test_score	split4_test_score	mean_test_score	std_test_score	rank_test_score
0	0.2856	3	100	0.1	0.7	0.833333	0.916667	1.0	0.666667	0.909091	0.865152	0.112407	1

[83]:
```
# Best hyperparameters found:

cb_best_params_dict = cb_best_estimator.best_params_

cb_best_params_dict
```

[83]:
```
{'depth': 3, 'iterations': 100, 'learning_rate': 0.1, 'subsample': 0.7}
```

[84]:
```
# Evaluate the tunned model using cross_val_score:

cb_clf_tunned = CatBoostClassifier(**cb_best_params_dict, random_state=42)

cross_validate_model(cb_clf_tunned, X_train, y_train);
```

```
0:      learn: 0.6456347        total: 666us    remaining: 66ms
1:      learn: 0.6062180        total: 1.45ms   remaining: 70.8ms
2:      learn: 0.5680702        total: 1.94ms   remaining: 62.7ms
3:      learn: 0.5329261        total: 2.4ms    remaining: 57.7ms
4:      learn: 0.5043676        total: 2.87ms   remaining: 54.6ms
5:      learn: 0.4759388        total: 3.9ms    remaining: 61ms
6:      learn: 0.4539430        total: 4.46ms   remaining: 59.2ms
7:      learn: 0.4319193        total: 6.41ms   remaining: 73.7ms
8:      learn: 0.4194466        total: 6.96ms   remaining: 70.4ms
9:      learn: 0.4013858        total: 7.42ms   remaining: 66.8ms
10:     learn: 0.3896873        total: 7.85ms   remaining: 63.5ms
11:     learn: 0.3768529        total: 8.22ms   remaining: 60.3ms
12:     learn: 0.3663755        total: 8.64ms   remaining: 57.8ms
13:     learn: 0.3550723        total: 9.42ms   remaining: 57.9ms
14:     learn: 0.3445702        total: 9.95ms   remaining: 56.4ms
15:     learn: 0.3382772        total: 10.4ms   remaining: 54.9ms
16:     learn: 0.3305414        total: 10.9ms   remaining: 53.1ms
17:     learn: 0.3264405        total: 11.4ms   remaining: 51.7ms
18:     learn: 0.3176503        total: 11.8ms   remaining: 50.4ms
19:     learn: 0.3095673        total: 12.2ms   remaining: 48.7ms
20:     learn: 0.3046515        total: 12.5ms   remaining: 47.1ms
21:     learn: 0.2992104        total: 13ms     remaining: 46ms
22:     learn: 0.2935967        total: 13.3ms   remaining: 44.7ms
23:     learn: 0.2888063        total: 13.8ms   remaining: 43.7ms
24:     learn: 0.2861582        total: 14.3ms   remaining: 42.9ms
25:     learn: 0.2805254        total: 14.8ms   remaining: 42.2ms
26:     learn: 0.2761742        total: 15.3ms   remaining: 41.3ms
27:     learn: 0.2733214        total: 15.7ms   remaining: 40.4ms
28:     learn: 0.2699129        total: 16.1ms   remaining: 39.5ms
29:     learn: 0.2663464        total: 16.6ms   remaining: 38.8ms
30:     learn: 0.2637635        total: 17.1ms   remaining: 38.1ms
31:     learn: 0.2612950        total: 17.6ms   remaining: 37.5ms
32:     learn: 0.2587305        total: 18.1ms   remaining: 36.8ms
33:     learn: 0.2567078        total: 18.6ms   remaining: 36ms
34:     learn: 0.2518482        total: 19ms     remaining: 35.3ms
35:     learn: 0.2501773        total: 19.5ms   remaining: 34.6ms
36:     learn: 0.2467570        total: 20.4ms   remaining: 34.7ms
37:     learn: 0.2439625        total: 20.9ms   remaining: 34.2ms
38:     learn: 0.2416617        total: 21.3ms   remaining: 33.4ms
39:     learn: 0.2397189        total: 21.8ms   remaining: 32.7ms
40:     learn: 0.2391196        total: 22.2ms   remaining: 31.9ms
```

```
41:     learn: 0.2376450        total: 22.7ms   remaining: 31.3ms
42:     learn: 0.2360441        total: 23.1ms   remaining: 30.6ms
43:     learn: 0.2346937        total: 23.4ms   remaining: 29.8ms
44:     learn: 0.2317247        total: 23.9ms   remaining: 29.2ms
45:     learn: 0.2286115        total: 24.3ms   remaining: 28.5ms
46:     learn: 0.2281559        total: 24.9ms   remaining: 28ms
47:     learn: 0.2255365        total: 25.4ms   remaining: 27.5ms
48:     learn: 0.2226056        total: 26.3ms   remaining: 27.4ms
49:     learn: 0.2206780        total: 26.8ms   remaining: 26.8ms
50:     learn: 0.2186788        total: 27.2ms   remaining: 26.1ms
51:     learn: 0.2162263        total: 27.7ms   remaining: 25.6ms
52:     learn: 0.2158720        total: 28.1ms   remaining: 24.9ms
53:     learn: 0.2122348        total: 28.5ms   remaining: 24.2ms
54:     learn: 0.2118906        total: 29ms     remaining: 23.7ms
55:     learn: 0.2099857        total: 29.4ms   remaining: 23.1ms
56:     learn: 0.2079409        total: 29.7ms   remaining: 22.4ms
57:     learn: 0.2076515        total: 30.1ms   remaining: 21.8ms
58:     learn: 0.2061229        total: 30.5ms   remaining: 21.2ms
59:     learn: 0.2052302        total: 31ms     remaining: 20.7ms
60:     learn: 0.2026678        total: 31.5ms   remaining: 20.2ms
61:     learn: 0.2002947        total: 32.1ms   remaining: 19.7ms
62:     learn: 0.1989098        total: 32.5ms   remaining: 19.1ms
63:     learn: 0.1981136        total: 32.9ms   remaining: 18.5ms
64:     learn: 0.1953551        total: 33.3ms   remaining: 17.9ms
65:     learn: 0.1935116        total: 33.7ms   remaining: 17.4ms
66:     learn: 0.1925583        total: 34.1ms   remaining: 16.8ms
67:     learn: 0.1896664        total: 34.5ms   remaining: 16.2ms
68:     learn: 0.1883006        total: 34.8ms   remaining: 15.7ms
69:     learn: 0.1880252        total: 35.2ms   remaining: 15.1ms
70:     learn: 0.1858537        total: 35.7ms   remaining: 14.6ms
71:     learn: 0.1856119        total: 36ms     remaining: 14ms
72:     learn: 0.1838157        total: 36.5ms   remaining: 13.5ms
73:     learn: 0.1821406        total: 37ms     remaining: 13ms
74:     learn: 0.1814560        total: 37.5ms   remaining: 12.5ms
75:     learn: 0.1791394        total: 38ms     remaining: 12ms
76:     learn: 0.1786920        total: 38.4ms   remaining: 11.5ms
77:     learn: 0.1782643        total: 39ms     remaining: 11ms
78:     learn: 0.1780689        total: 39.4ms   remaining: 10.5ms
79:     learn: 0.1771111        total: 39.8ms   remaining: 9.94ms
80:     learn: 0.1762211        total: 40.2ms   remaining: 9.42ms
81:     learn: 0.1756083        total: 40.5ms   remaining: 8.9ms
82:     learn: 0.1741184        total: 41ms     remaining: 8.39ms
83:     learn: 0.1738867        total: 41.3ms   remaining: 7.88ms
84:     learn: 0.1735345        total: 41.7ms   remaining: 7.37ms
85:     learn: 0.1710406        total: 42.1ms   remaining: 6.86ms
86:     learn: 0.1708243        total: 42.5ms   remaining: 6.35ms
87:     learn: 0.1706236        total: 42.9ms   remaining: 5.84ms
88:     learn: 0.1686447        total: 43.5ms   remaining: 5.38ms
```

```
89:     learn: 0.1684296        total: 44.7ms   remaining: 4.97ms
90:     learn: 0.1682179        total: 45ms     remaining: 4.45ms
91:     learn: 0.1678717        total: 45.4ms   remaining: 3.95ms
92:     learn: 0.1675340        total: 45.8ms   remaining: 3.45ms
93:     learn: 0.1661034        total: 46.1ms   remaining: 2.94ms
94:     learn: 0.1658958        total: 46.6ms   remaining: 2.45ms
95:     learn: 0.1636801        total: 46.9ms   remaining: 1.95ms
96:     learn: 0.1633572        total: 47.2ms   remaining: 1.46ms
97:     learn: 0.1622704        total: 47.6ms   remaining: 970us
98:     learn: 0.1620816        total: 47.9ms   remaining: 483us
99:     learn: 0.1619043        total: 48.3ms   remaining: 0us
0:      learn: 0.6473279        total: 564us    remaining: 55.9ms
1:      learn: 0.6148093        total: 1.15ms   remaining: 56.5ms
2:      learn: 0.5850323        total: 1.76ms   remaining: 57ms
3:      learn: 0.5570177        total: 2.2ms    remaining: 52.9ms
4:      learn: 0.5322961        total: 2.73ms   remaining: 51.8ms
5:      learn: 0.5040102        total: 3.22ms   remaining: 50.5ms
6:      learn: 0.4834235        total: 3.64ms   remaining: 48.4ms
7:      learn: 0.4676510        total: 4.17ms   remaining: 48ms
8:      learn: 0.4561962        total: 4.64ms   remaining: 46.9ms
9:      learn: 0.4390729        total: 5.03ms   remaining: 45.2ms
10:     learn: 0.4235067        total: 5.47ms   remaining: 44.2ms
11:     learn: 0.4125231        total: 6ms      remaining: 44ms
12:     learn: 0.4046089        total: 6.38ms   remaining: 42.7ms
13:     learn: 0.3930495        total: 6.77ms   remaining: 41.6ms
14:     learn: 0.3840972        total: 7.22ms   remaining: 40.9ms
15:     learn: 0.3757912        total: 7.66ms   remaining: 40.2ms
16:     learn: 0.3688992        total: 8.02ms   remaining: 39.2ms
17:     learn: 0.3647522        total: 16.5ms   remaining: 75.2ms
18:     learn: 0.3590093        total: 16.9ms   remaining: 72ms
19:     learn: 0.3529448        total: 17.4ms   remaining: 69.6ms
20:     learn: 0.3486382        total: 17.9ms   remaining: 67.2ms
21:     learn: 0.3417884        total: 18.3ms   remaining: 64.7ms
22:     learn: 0.3353003        total: 18.6ms   remaining: 62.3ms
23:     learn: 0.3310296        total: 19ms     remaining: 60.1ms
24:     learn: 0.3277651        total: 19.4ms   remaining: 58.2ms
25:     learn: 0.3225300        total: 19.9ms   remaining: 56.6ms
26:     learn: 0.3186351        total: 20.3ms   remaining: 54.9ms
27:     learn: 0.3152152        total: 20.7ms   remaining: 53.3ms
28:     learn: 0.3122304        total: 21.3ms   remaining: 52ms
29:     learn: 0.3095250        total: 22ms     remaining: 51.3ms
30:     learn: 0.3070531        total: 22.4ms   remaining: 49.9ms
31:     learn: 0.3029825        total: 22.8ms   remaining: 48.5ms
32:     learn: 0.3000688        total: 23.3ms   remaining: 47.2ms
33:     learn: 0.2971156        total: 23.7ms   remaining: 46ms
34:     learn: 0.2945908        total: 24.1ms   remaining: 44.8ms
35:     learn: 0.2900502        total: 24.6ms   remaining: 43.7ms
36:     learn: 0.2869694        total: 25ms     remaining: 42.6ms
```

```
37:     learn: 0.2843328        total: 25.5ms   remaining: 41.5ms
38:     learn: 0.2820623        total: 25.9ms   remaining: 40.6ms
39:     learn: 0.2799796        total: 26.8ms   remaining: 40.2ms
40:     learn: 0.2769255        total: 27.4ms   remaining: 39.4ms
41:     learn: 0.2750004        total: 27.8ms   remaining: 38.4ms
42:     learn: 0.2732151        total: 28.3ms   remaining: 37.5ms
43:     learn: 0.2708592        total: 28.8ms   remaining: 36.7ms
44:     learn: 0.2690191        total: 29.4ms   remaining: 35.9ms
45:     learn: 0.2651236        total: 29.8ms   remaining: 35ms
46:     learn: 0.2644959        total: 30.3ms   remaining: 34.2ms
47:     learn: 0.2632556        total: 30.9ms   remaining: 33.4ms
48:     learn: 0.2618660        total: 31.4ms   remaining: 32.6ms
49:     learn: 0.2592735        total: 31.7ms   remaining: 31.7ms
50:     learn: 0.2591002        total: 32.1ms   remaining: 30.9ms
51:     learn: 0.2575135        total: 32.6ms   remaining: 30.1ms
52:     learn: 0.2562371        total: 33.3ms   remaining: 29.5ms
53:     learn: 0.2543259        total: 33.8ms   remaining: 28.8ms
54:     learn: 0.2519242        total: 34.5ms   remaining: 28.2ms
55:     learn: 0.2495607        total: 35ms     remaining: 27.5ms
56:     learn: 0.2493733        total: 35.6ms   remaining: 26.9ms
57:     learn: 0.2467686        total: 36ms     remaining: 26.1ms
58:     learn: 0.2446473        total: 36.4ms   remaining: 25.3ms
59:     learn: 0.2430531        total: 36.9ms   remaining: 24.6ms
60:     learn: 0.2403240        total: 37.3ms   remaining: 23.9ms
61:     learn: 0.2383795        total: 37.8ms   remaining: 23.2ms
62:     learn: 0.2371091        total: 38.5ms   remaining: 22.6ms
63:     learn: 0.2367967        total: 39ms     remaining: 22ms
64:     learn: 0.2348113        total: 39.5ms   remaining: 21.3ms
65:     learn: 0.2346458        total: 39.9ms   remaining: 20.6ms
66:     learn: 0.2344577        total: 40.5ms   remaining: 19.9ms
67:     learn: 0.2342207        total: 41ms     remaining: 19.3ms
68:     learn: 0.2340569        total: 41.6ms   remaining: 18.7ms
69:     learn: 0.2338843        total: 42.6ms   remaining: 18.3ms
70:     learn: 0.2317443        total: 43ms     remaining: 17.6ms
71:     learn: 0.2315699        total: 43.5ms   remaining: 16.9ms
72:     learn: 0.2313977        total: 44.1ms   remaining: 16.3ms
73:     learn: 0.2290429        total: 44.5ms   remaining: 15.6ms
74:     learn: 0.2289038        total: 44.9ms   remaining: 15ms
75:     learn: 0.2286427        total: 45.4ms   remaining: 14.3ms
76:     learn: 0.2283899        total: 45.9ms   remaining: 13.7ms
77:     learn: 0.2282446        total: 46.3ms   remaining: 13.1ms
78:     learn: 0.2280006        total: 46.7ms   remaining: 12.4ms
79:     learn: 0.2278579        total: 47.1ms   remaining: 11.8ms
80:     learn: 0.2259784        total: 47.5ms   remaining: 11.1ms
81:     learn: 0.2258225        total: 47.9ms   remaining: 10.5ms
82:     learn: 0.2232527        total: 48.2ms   remaining: 9.88ms
83:     learn: 0.2230118        total: 48.7ms   remaining: 9.27ms
84:     learn: 0.2228726        total: 49.2ms   remaining: 8.67ms
```

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85:     learn: 0.2208024        total: 49.7ms   remaining: 8.09ms
86:     learn: 0.2206626        total: 50.3ms   remaining: 7.52ms
87:     learn: 0.2205245        total: 50.8ms   remaining: 6.92ms
88:     learn: 0.2189714        total: 51.2ms   remaining: 6.33ms
89:     learn: 0.2173222        total: 51.7ms   remaining: 5.74ms
90:     learn: 0.2171901        total: 52.1ms   remaining: 5.15ms
91:     learn: 0.2169696        total: 52.5ms   remaining: 4.57ms
92:     learn: 0.2167709        total: 53ms     remaining: 3.99ms
93:     learn: 0.2165642        total: 53.4ms   remaining: 3.41ms
94:     learn: 0.2163774        total: 53.8ms   remaining: 2.83ms
95:     learn: 0.2162500        total: 54.3ms   remaining: 2.26ms
96:     learn: 0.2145577        total: 54.7ms   remaining: 1.69ms
97:     learn: 0.2130233        total: 55.1ms   remaining: 1.12ms
98:     learn: 0.2128303        total: 55.9ms   remaining: 565us
99:     learn: 0.2111448        total: 56.5ms   remaining: 0us
0:      learn: 0.6512536        total: 631us    remaining: 62.5ms
1:      learn: 0.6185441        total: 1.05ms   remaining: 51.6ms
2:      learn: 0.5888687        total: 1.7ms    remaining: 55.1ms
3:      learn: 0.5572560        total: 2.31ms   remaining: 55.4ms
4:      learn: 0.5334485        total: 2.78ms   remaining: 52.9ms
5:      learn: 0.5107968        total: 3.54ms   remaining: 55.5ms
6:      learn: 0.4902404        total: 4.67ms   remaining: 62ms
7:      learn: 0.4712948        total: 5.58ms   remaining: 64.1ms
8:      learn: 0.4598448        total: 6.25ms   remaining: 63.2ms
9:      learn: 0.4424620        total: 6.73ms   remaining: 60.6ms
10:     learn: 0.4290555        total: 7.52ms   remaining: 60.8ms
11:     learn: 0.4162750        total: 8.17ms   remaining: 59.9ms
12:     learn: 0.4094101        total: 8.53ms   remaining: 57.1ms
13:     learn: 0.3976256        total: 8.98ms   remaining: 55.1ms
14:     learn: 0.3870403        total: 9.4ms    remaining: 53.3ms
15:     learn: 0.3798596        total: 9.84ms   remaining: 51.7ms
16:     learn: 0.3735979        total: 10.4ms   remaining: 50.7ms
17:     learn: 0.3677921        total: 10.7ms   remaining: 48.9ms
18:     learn: 0.3617737        total: 11.1ms   remaining: 47.2ms
19:     learn: 0.3585577        total: 11.4ms   remaining: 45.5ms
20:     learn: 0.3527014        total: 11.7ms   remaining: 44.2ms
21:     learn: 0.3464449        total: 12.5ms   remaining: 44.5ms
22:     learn: 0.3407151        total: 13.1ms   remaining: 43.9ms
23:     learn: 0.3356881        total: 13.5ms   remaining: 42.8ms
24:     learn: 0.3320706        total: 13.9ms   remaining: 41.7ms
25:     learn: 0.3269884        total: 14.3ms   remaining: 40.8ms
26:     learn: 0.3231148        total: 14.7ms   remaining: 39.8ms
27:     learn: 0.3188511        total: 15.1ms   remaining: 38.9ms
28:     learn: 0.3162184        total: 15.5ms   remaining: 38ms
29:     learn: 0.3133034        total: 15.9ms   remaining: 37.2ms
30:     learn: 0.3110258        total: 16.3ms   remaining: 36.4ms
31:     learn: 0.3086389        total: 16.7ms   remaining: 35.5ms
32:     learn: 0.3072933        total: 17.1ms   remaining: 34.7ms
```

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33:     learn: 0.3055023        total: 17.4ms   remaining: 33.9ms
34:     learn: 0.3013161        total: 17.8ms   remaining: 33ms
35:     learn: 0.2988385        total: 18.1ms   remaining: 32.2ms
36:     learn: 0.2959385        total: 18.5ms   remaining: 31.6ms
37:     learn: 0.2953719        total: 18.9ms   remaining: 30.8ms
38:     learn: 0.2939975        total: 19.2ms   remaining: 30ms
39:     learn: 0.2933114        total: 19.5ms   remaining: 29.3ms
40:     learn: 0.2903487        total: 19.9ms   remaining: 28.7ms
41:     learn: 0.2896947        total: 20.4ms   remaining: 28.1ms
42:     learn: 0.2888224        total: 20.7ms   remaining: 27.4ms
43:     learn: 0.2877821        total: 21ms     remaining: 26.7ms
44:     learn: 0.2852888        total: 21.3ms   remaining: 26.1ms
45:     learn: 0.2819905        total: 21.7ms   remaining: 25.5ms
46:     learn: 0.2806828        total: 22.1ms   remaining: 24.9ms
47:     learn: 0.2800178        total: 22.5ms   remaining: 24.3ms
48:     learn: 0.2776477        total: 22.8ms   remaining: 23.7ms
49:     learn: 0.2763057        total: 23.1ms   remaining: 23.1ms
50:     learn: 0.2734362        total: 23.4ms   remaining: 22.5ms
51:     learn: 0.2715796        total: 23.7ms   remaining: 21.9ms
52:     learn: 0.2704280        total: 24.1ms   remaining: 21.4ms
53:     learn: 0.2686263        total: 24.4ms   remaining: 20.8ms
54:     learn: 0.2672539        total: 24.8ms   remaining: 20.3ms
55:     learn: 0.2666353        total: 25.1ms   remaining: 19.7ms
56:     learn: 0.2639923        total: 25.4ms   remaining: 19.2ms
57:     learn: 0.2626136        total: 25.8ms   remaining: 18.7ms
58:     learn: 0.2606094        total: 26.2ms   remaining: 18.2ms
59:     learn: 0.2589489        total: 26.6ms   remaining: 17.7ms
60:     learn: 0.2572849        total: 27.2ms   remaining: 17.4ms
61:     learn: 0.2554777        total: 27.6ms   remaining: 16.9ms
62:     learn: 0.2543873        total: 28ms     remaining: 16.4ms
63:     learn: 0.2538288        total: 28.4ms   remaining: 16ms
64:     learn: 0.2532557        total: 28.8ms   remaining: 15.5ms
65:     learn: 0.2520963        total: 29.2ms   remaining: 15ms
66:     learn: 0.2495266        total: 29.6ms   remaining: 14.6ms
67:     learn: 0.2464514        total: 30ms     remaining: 14.1ms
68:     learn: 0.2459180        total: 30.4ms   remaining: 13.7ms
69:     learn: 0.2454247        total: 30.8ms   remaining: 13.2ms
70:     learn: 0.2427024        total: 31.1ms   remaining: 12.7ms
71:     learn: 0.2420519        total: 31.5ms   remaining: 12.2ms
72:     learn: 0.2398557        total: 32.3ms   remaining: 11.9ms
73:     learn: 0.2394235        total: 33ms     remaining: 11.6ms
74:     learn: 0.2390066        total: 33.5ms   remaining: 11.2ms
75:     learn: 0.2385638        total: 33.9ms   remaining: 10.7ms
76:     learn: 0.2381927        total: 34.3ms   remaining: 10.2ms
77:     learn: 0.2378339        total: 34.7ms   remaining: 9.78ms
78:     learn: 0.2374863        total: 35.1ms   remaining: 9.33ms
79:     learn: 0.2371319        total: 35.6ms   remaining: 8.89ms
80:     learn: 0.2358949        total: 36ms     remaining: 8.45ms
```

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81:     learn: 0.2355564        total: 36.4ms   remaining: 7.99ms
82:     learn: 0.2344623        total: 36.7ms   remaining: 7.53ms
83:     learn: 0.2328887        total: 37.3ms   remaining: 7.11ms
84:     learn: 0.2325849        total: 37.8ms   remaining: 6.66ms
85:     learn: 0.2317007        total: 38.6ms   remaining: 6.28ms
86:     learn: 0.2302485        total: 39ms     remaining: 5.83ms
87:     learn: 0.2299447        total: 39.5ms   remaining: 5.39ms
88:     learn: 0.2288041        total: 39.9ms   remaining: 4.94ms
89:     learn: 0.2264701        total: 40.4ms   remaining: 4.48ms
90:     learn: 0.2261828        total: 40.8ms   remaining: 4.03ms
91:     learn: 0.2236706        total: 41.1ms   remaining: 3.57ms
92:     learn: 0.2206487        total: 41.5ms   remaining: 3.12ms
93:     learn: 0.2203628        total: 41.8ms   remaining: 2.67ms
94:     learn: 0.2200996        total: 42.2ms   remaining: 2.22ms
95:     learn: 0.2198327        total: 42.6ms   remaining: 1.77ms
96:     learn: 0.2195736        total: 43ms     remaining: 1.33ms
97:     learn: 0.2183557        total: 43.4ms   remaining: 885us
98:     learn: 0.2181031        total: 43.8ms   remaining: 442us
99:     learn: 0.2171520        total: 44.2ms   remaining: 0us
0:      learn: 0.6473232        total: 1.35ms   remaining: 134ms
1:      learn: 0.6107401        total: 2.19ms   remaining: 107ms
2:      learn: 0.5765295        total: 2.77ms   remaining: 89.5ms
3:      learn: 0.5415175        total: 3.17ms   remaining: 76.1ms
4:      learn: 0.5188767        total: 3.55ms   remaining: 67.5ms
5:      learn: 0.4995217        total: 3.99ms   remaining: 62.6ms
6:      learn: 0.4736690        total: 4.32ms   remaining: 57.4ms
7:      learn: 0.4538167        total: 4.67ms   remaining: 53.7ms
8:      learn: 0.4393081        total: 5.02ms   remaining: 50.8ms
9:      learn: 0.4181542        total: 5.8ms    remaining: 52.2ms
10:     learn: 0.3999662        total: 6.26ms   remaining: 50.6ms
11:     learn: 0.3868236        total: 6.93ms   remaining: 50.8ms
12:     learn: 0.3710162        total: 7.62ms   remaining: 51ms
13:     learn: 0.3584300        total: 8.01ms   remaining: 49.2ms
14:     learn: 0.3475143        total: 8.41ms   remaining: 47.6ms
15:     learn: 0.3388738        total: 8.74ms   remaining: 45.9ms
16:     learn: 0.3317221        total: 9.06ms   remaining: 44.3ms
17:     learn: 0.3235178        total: 9.43ms   remaining: 43ms
18:     learn: 0.3146136        total: 9.77ms   remaining: 41.6ms
19:     learn: 0.3057683        total: 10.1ms   remaining: 40.5ms
20:     learn: 0.2986396        total: 10.5ms   remaining: 39.5ms
21:     learn: 0.2917332        total: 11ms     remaining: 39.1ms
22:     learn: 0.2842804        total: 11.3ms   remaining: 38ms
23:     learn: 0.2798060        total: 11.8ms   remaining: 37.4ms
24:     learn: 0.2767540        total: 12.7ms   remaining: 38ms
25:     learn: 0.2726943        total: 13.2ms   remaining: 37.5ms
26:     learn: 0.2664005        total: 13.7ms   remaining: 37ms
27:     learn: 0.2645947        total: 14.1ms   remaining: 36.2ms
28:     learn: 0.2617061        total: 14.6ms   remaining: 35.7ms
```

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29:     learn: 0.2583838        total: 14.9ms   remaining: 34.8ms
30:     learn: 0.2553066        total: 15.3ms   remaining: 34.1ms
31:     learn: 0.2511462        total: 15.8ms   remaining: 33.5ms
32:     learn: 0.2498979        total: 16.3ms   remaining: 33ms
33:     learn: 0.2484001        total: 16.7ms   remaining: 32.4ms
34:     learn: 0.2448236        total: 17.3ms   remaining: 32.1ms
35:     learn: 0.2415654        total: 17.7ms   remaining: 31.4ms
36:     learn: 0.2385654        total: 18.2ms   remaining: 30.9ms
37:     learn: 0.2367398        total: 18.7ms   remaining: 30.6ms
38:     learn: 0.2336337        total: 19.2ms   remaining: 30ms
39:     learn: 0.2311174        total: 19.7ms   remaining: 29.5ms
40:     learn: 0.2299941        total: 20.2ms   remaining: 29ms
41:     learn: 0.2284367        total: 20.6ms   remaining: 28.4ms
42:     learn: 0.2267195        total: 20.9ms   remaining: 27.7ms
43:     learn: 0.2258529        total: 21.3ms   remaining: 27.1ms
44:     learn: 0.2233390        total: 21.6ms   remaining: 26.4ms
45:     learn: 0.2205758        total: 22ms     remaining: 25.8ms
46:     learn: 0.2195096        total: 22.4ms   remaining: 25.2ms
47:     learn: 0.2192029        total: 22.8ms   remaining: 24.7ms
48:     learn: 0.2158608        total: 23.5ms   remaining: 24.4ms
49:     learn: 0.2154905        total: 24.3ms   remaining: 24.3ms
50:     learn: 0.2148586        total: 24.8ms   remaining: 23.8ms
51:     learn: 0.2131128        total: 25.2ms   remaining: 23.2ms
52:     learn: 0.2121610        total: 25.6ms   remaining: 22.7ms
53:     learn: 0.2108324        total: 26ms     remaining: 22.2ms
54:     learn: 0.2085292        total: 26.4ms   remaining: 21.6ms
55:     learn: 0.2073711        total: 26.7ms   remaining: 21ms
56:     learn: 0.2062805        total: 27.1ms   remaining: 20.5ms
57:     learn: 0.2056249        total: 27.5ms   remaining: 19.9ms
58:     learn: 0.2047219        total: 27.9ms   remaining: 19.4ms
59:     learn: 0.2041473        total: 28.3ms   remaining: 18.9ms
60:     learn: 0.2035976        total: 28.7ms   remaining: 18.4ms
61:     learn: 0.2016142        total: 29.2ms   remaining: 17.9ms
62:     learn: 0.2006478        total: 29.6ms   remaining: 17.4ms
63:     learn: 0.1989969        total: 30ms     remaining: 16.9ms
64:     learn: 0.1982754        total: 30.4ms   remaining: 16.4ms
65:     learn: 0.1967238        total: 30.7ms   remaining: 15.8ms
66:     learn: 0.1948992        total: 31.1ms   remaining: 15.3ms
67:     learn: 0.1934120        total: 31.5ms   remaining: 14.8ms
68:     learn: 0.1915395        total: 31.9ms   remaining: 14.3ms
69:     learn: 0.1897706        total: 32.3ms   remaining: 13.8ms
70:     learn: 0.1893261        total: 32.6ms   remaining: 13.3ms
71:     learn: 0.1885469        total: 33ms     remaining: 12.8ms
72:     learn: 0.1881286        total: 33.3ms   remaining: 12.3ms
73:     learn: 0.1877258        total: 33.7ms   remaining: 11.8ms
74:     learn: 0.1865056        total: 34ms     remaining: 11.3ms
75:     learn: 0.1853701        total: 34.4ms   remaining: 10.9ms
76:     learn: 0.1849918        total: 34.9ms   remaining: 10.4ms
```

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77:     learn: 0.1839426        total: 35.3ms   remaining: 9.96ms
78:     learn: 0.1824159        total: 35.8ms   remaining: 9.51ms
79:     learn: 0.1819284        total: 36.1ms   remaining: 9.03ms
80:     learn: 0.1810518        total: 36.5ms   remaining: 8.55ms
81:     learn: 0.1796987        total: 36.8ms   remaining: 8.07ms
82:     learn: 0.1783912        total: 37.1ms   remaining: 7.6ms
83:     learn: 0.1769826        total: 37.4ms   remaining: 7.13ms
84:     learn: 0.1761927        total: 37.8ms   remaining: 6.66ms
85:     learn: 0.1752128        total: 38.1ms   remaining: 6.2ms
86:     learn: 0.1749125        total: 38.4ms   remaining: 5.75ms
87:     learn: 0.1737669        total: 38.8ms   remaining: 5.29ms
88:     learn: 0.1728581        total: 39.1ms   remaining: 4.84ms
89:     learn: 0.1726398        total: 39.6ms   remaining: 4.4ms
90:     learn: 0.1709722        total: 40ms     remaining: 3.96ms
91:     learn: 0.1689873        total: 40.4ms   remaining: 3.51ms
92:     learn: 0.1686568        total: 40.8ms   remaining: 3.07ms
93:     learn: 0.1676243        total: 41.2ms   remaining: 2.63ms
94:     learn: 0.1673603        total: 41.5ms   remaining: 2.18ms
95:     learn: 0.1663550        total: 41.8ms   remaining: 1.74ms
96:     learn: 0.1659042        total: 42.2ms   remaining: 1.3ms
97:     learn: 0.1643982        total: 42.6ms   remaining: 868us
98:     learn: 0.1641549        total: 43ms     remaining: 433us
99:     learn: 0.1622708        total: 43.3ms   remaining: 0us
0:      learn: 0.6506462        total: 569us    remaining: 56.3ms
1:      learn: 0.6173352        total: 1.06ms   remaining: 51.8ms
2:      learn: 0.5818952        total: 1.58ms   remaining: 51ms
3:      learn: 0.5507920        total: 2.06ms   remaining: 49.4ms
4:      learn: 0.5197079        total: 2.56ms   remaining: 48.7ms
5:      learn: 0.4969017        total: 3.01ms   remaining: 47.2ms
6:      learn: 0.4763590        total: 3.4ms    remaining: 45.2ms
7:      learn: 0.4612186        total: 3.81ms   remaining: 43.8ms
8:      learn: 0.4491238        total: 4.25ms   remaining: 43ms
9:      learn: 0.4310028        total: 4.6ms    remaining: 41.4ms
10:     learn: 0.4168179        total: 4.94ms   remaining: 40ms
11:     learn: 0.4059396        total: 5.29ms   remaining: 38.8ms
12:     learn: 0.3999390        total: 5.67ms   remaining: 37.9ms
13:     learn: 0.3875159        total: 6.18ms   remaining: 38ms
14:     learn: 0.3789780        total: 6.86ms   remaining: 38.9ms
15:     learn: 0.3704261        total: 7.68ms   remaining: 40.3ms
16:     learn: 0.3642889        total: 8.26ms   remaining: 40.3ms
17:     learn: 0.3580957        total: 8.71ms   remaining: 39.7ms
18:     learn: 0.3517428        total: 9.08ms   remaining: 38.7ms
19:     learn: 0.3469472        total: 9.45ms   remaining: 37.8ms
20:     learn: 0.3405807        total: 9.8ms    remaining: 36.9ms
21:     learn: 0.3317179        total: 10.2ms   remaining: 36ms
22:     learn: 0.3267873        total: 10.6ms   remaining: 35.4ms
23:     learn: 0.3222957        total: 11ms     remaining: 34.7ms
24:     learn: 0.3185069        total: 11.5ms   remaining: 34.6ms
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25:     learn: 0.3140547        total: 12.1ms   remaining: 34.3ms
26:     learn: 0.3079222        total: 12.5ms   remaining: 33.9ms
27:     learn: 0.3051746        total: 13.3ms   remaining: 34.1ms
28:     learn: 0.3016760        total: 13.7ms   remaining: 33.5ms
29:     learn: 0.2986727        total: 14.1ms   remaining: 32.9ms
30:     learn: 0.2962058        total: 14.4ms   remaining: 32.1ms
31:     learn: 0.2926683        total: 14.9ms   remaining: 31.6ms
32:     learn: 0.2903987        total: 15.3ms   remaining: 31.1ms
33:     learn: 0.2880039        total: 15.7ms   remaining: 30.5ms
34:     learn: 0.2848055        total: 16.1ms   remaining: 29.9ms
35:     learn: 0.2815586        total: 16.5ms   remaining: 29.4ms
36:     learn: 0.2802904        total: 16.9ms   remaining: 28.8ms
37:     learn: 0.2769131        total: 17.4ms   remaining: 28.3ms
38:     learn: 0.2742208        total: 17.7ms   remaining: 27.7ms
39:     learn: 0.2734504        total: 18.4ms   remaining: 27.6ms
40:     learn: 0.2709064        total: 18.9ms   remaining: 27.2ms
41:     learn: 0.2684816        total: 19.3ms   remaining: 26.6ms
42:     learn: 0.2661862        total: 19.6ms   remaining: 25.9ms
43:     learn: 0.2639899        total: 19.9ms   remaining: 25.4ms
44:     learn: 0.2605297        total: 20.2ms   remaining: 24.7ms
45:     learn: 0.2573605        total: 20.5ms   remaining: 24.1ms
46:     learn: 0.2570867        total: 20.8ms   remaining: 23.5ms
47:     learn: 0.2568234        total: 21.2ms   remaining: 23ms
48:     learn: 0.2547602        total: 21.5ms   remaining: 22.4ms
49:     learn: 0.2521169        total: 21.8ms   remaining: 21.8ms
50:     learn: 0.2517241        total: 22.1ms   remaining: 21.3ms
51:     learn: 0.2495326        total: 22.5ms   remaining: 20.7ms
52:     learn: 0.2471033        total: 22.9ms   remaining: 20.3ms
53:     learn: 0.2456991        total: 23.5ms   remaining: 20ms
54:     learn: 0.2453554        total: 24.1ms   remaining: 19.7ms
55:     learn: 0.2432763        total: 24.6ms   remaining: 19.3ms
56:     learn: 0.2430734        total: 24.9ms   remaining: 18.8ms
57:     learn: 0.2413951        total: 25.3ms   remaining: 18.3ms
58:     learn: 0.2390237        total: 25.7ms   remaining: 17.8ms
59:     learn: 0.2375514        total: 26ms     remaining: 17.4ms
60:     learn: 0.2360075        total: 26.4ms   remaining: 16.8ms
61:     learn: 0.2343074        total: 26.7ms   remaining: 16.4ms
62:     learn: 0.2340046        total: 27ms     remaining: 15.8ms
63:     learn: 0.2326884        total: 27.3ms   remaining: 15.4ms
64:     learn: 0.2323543        total: 27.7ms   remaining: 14.9ms
65:     learn: 0.2320346        total: 28ms     remaining: 14.4ms
66:     learn: 0.2317279        total: 28.3ms   remaining: 14ms
67:     learn: 0.2315088        total: 28.8ms   remaining: 13.5ms
68:     learn: 0.2284857        total: 29.2ms   remaining: 13.1ms
69:     learn: 0.2243185        total: 29.5ms   remaining: 12.7ms
70:     learn: 0.2220902        total: 30ms     remaining: 12.3ms
71:     learn: 0.2218012        total: 30.4ms   remaining: 11.8ms
72:     learn: 0.2202206        total: 30.7ms   remaining: 11.4ms
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73:     learn: 0.2185369        total: 31.1ms   remaining: 10.9ms
74:     learn: 0.2166974        total: 31.4ms   remaining: 10.5ms
75:     learn: 0.2164254        total: 31.7ms   remaining: 10ms
76:     learn: 0.2148583        total: 32.1ms   remaining: 9.59ms
77:     learn: 0.2146146        total: 32.5ms   remaining: 9.16ms
78:     learn: 0.2143794        total: 32.8ms   remaining: 8.73ms
79:     learn: 0.2141505        total: 33.2ms   remaining: 8.31ms
80:     learn: 0.2128185        total: 33.6ms   remaining: 7.88ms
81:     learn: 0.2125789        total: 33.9ms   remaining: 7.45ms
82:     learn: 0.2124278        total: 34.3ms   remaining: 7.02ms
83:     learn: 0.2122409        total: 34.6ms   remaining: 6.59ms
84:     learn: 0.2087450        total: 35.4ms   remaining: 6.24ms
85:     learn: 0.2055088        total: 35.7ms   remaining: 5.82ms
86:     learn: 0.2052941        total: 36.1ms   remaining: 5.39ms
87:     learn: 0.2038302        total: 36.5ms   remaining: 4.97ms
88:     learn: 0.2036454        total: 36.8ms   remaining: 4.55ms
89:     learn: 0.2034393        total: 37.1ms   remaining: 4.12ms
90:     learn: 0.2032544        total: 37.4ms   remaining: 3.7ms
91:     learn: 0.2030706        total: 37.8ms   remaining: 3.28ms
92:     learn: 0.2012310        total: 38.1ms   remaining: 2.87ms
93:     learn: 0.2010350        total: 38.5ms   remaining: 2.46ms
94:     learn: 0.2008558        total: 38.8ms   remaining: 2.04ms
95:     learn: 0.2007043        total: 39.1ms   remaining: 1.63ms
96:     learn: 0.1988675        total: 39.5ms   remaining: 1.22ms
97:     learn: 0.1978040        total: 39.9ms   remaining: 815us
98:     learn: 0.1964691        total: 40.3ms   remaining: 407us
99:     learn: 0.1945938        total: 41.3ms   remaining: 0us
0:      learn: 0.6456347        total: 603us    remaining: 59.7ms
1:      learn: 0.6062180        total: 1.39ms   remaining: 67.9ms
2:      learn: 0.5680702        total: 1.81ms   remaining: 58.6ms
3:      learn: 0.5329261        total: 2.24ms   remaining: 53.8ms
4:      learn: 0.5043676        total: 2.73ms   remaining: 51.9ms
5:      learn: 0.4759388        total: 3.42ms   remaining: 53.6ms
6:      learn: 0.4539430        total: 3.92ms   remaining: 52.1ms
7:      learn: 0.4319193        total: 4.33ms   remaining: 49.8ms
8:      learn: 0.4194466        total: 4.78ms   remaining: 48.4ms
9:      learn: 0.4013858        total: 5.13ms   remaining: 46.2ms
10:     learn: 0.3896873        total: 5.5ms    remaining: 44.5ms
11:     learn: 0.3768529        total: 5.93ms   remaining: 43.5ms
12:     learn: 0.3663755        total: 6.35ms   remaining: 42.5ms
13:     learn: 0.3550723        total: 6.72ms   remaining: 41.3ms
14:     learn: 0.3445702        total: 7.03ms   remaining: 39.8ms
15:     learn: 0.3382772        total: 7.45ms   remaining: 39.1ms
16:     learn: 0.3305414        total: 7.8ms    remaining: 38.1ms
17:     learn: 0.3264405        total: 8.2ms    remaining: 37.3ms
18:     learn: 0.3176503        total: 9.08ms   remaining: 38.7ms
19:     learn: 0.3095673        total: 9.78ms   remaining: 39.1ms
20:     learn: 0.3046515        total: 10.1ms   remaining: 38ms
```

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21:     learn: 0.2992104        total: 10.4ms   remaining: 37ms
22:     learn: 0.2935967        total: 10.8ms   remaining: 36.3ms
23:     learn: 0.2888063        total: 11.2ms   remaining: 35.5ms
24:     learn: 0.2861582        total: 11.5ms   remaining: 34.6ms
25:     learn: 0.2805254        total: 11.9ms   remaining: 33.8ms
26:     learn: 0.2761742        total: 12.3ms   remaining: 33.1ms
27:     learn: 0.2733214        total: 12.7ms   remaining: 32.6ms
28:     learn: 0.2699129        total: 13ms     remaining: 31.9ms
29:     learn: 0.2663464        total: 13.8ms   remaining: 32.3ms
30:     learn: 0.2637635        total: 14.3ms   remaining: 31.9ms
31:     learn: 0.2612950        total: 14.9ms   remaining: 31.7ms
32:     learn: 0.2587305        total: 15.4ms   remaining: 31.3ms
33:     learn: 0.2567078        total: 15.8ms   remaining: 30.7ms
34:     learn: 0.2518482        total: 16.1ms   remaining: 30ms
35:     learn: 0.2501773        total: 16.5ms   remaining: 29.3ms
36:     learn: 0.2467570        total: 16.8ms   remaining: 28.5ms
37:     learn: 0.2439625        total: 17.1ms   remaining: 27.8ms
38:     learn: 0.2416617        total: 17.4ms   remaining: 27.1ms
39:     learn: 0.2397189        total: 17.7ms   remaining: 26.6ms
40:     learn: 0.2391196        total: 18ms     remaining: 25.9ms
41:     learn: 0.2376450        total: 18.4ms   remaining: 25.4ms
42:     learn: 0.2360441        total: 18.7ms   remaining: 24.8ms
43:     learn: 0.2346937        total: 19ms     remaining: 24.2ms
44:     learn: 0.2317247        total: 19.4ms   remaining: 23.7ms
45:     learn: 0.2286115        total: 19.8ms   remaining: 23.3ms
46:     learn: 0.2281559        total: 20.2ms   remaining: 22.8ms
47:     learn: 0.2255365        total: 20.5ms   remaining: 22.2ms
48:     learn: 0.2226056        total: 20.9ms   remaining: 21.7ms
49:     learn: 0.2206780        total: 21.2ms   remaining: 21.2ms
50:     learn: 0.2186788        total: 21.6ms   remaining: 20.7ms
51:     learn: 0.2162263        total: 22ms     remaining: 20.3ms
52:     learn: 0.2158720        total: 22.3ms   remaining: 19.7ms
53:     learn: 0.2122348        total: 22.6ms   remaining: 19.2ms
54:     learn: 0.2118906        total: 22.9ms   remaining: 18.7ms
55:     learn: 0.2099857        total: 23.2ms   remaining: 18.3ms
56:     learn: 0.2079409        total: 23.6ms   remaining: 17.8ms
57:     learn: 0.2076515        total: 23.9ms   remaining: 17.3ms
58:     learn: 0.2061229        total: 24.2ms   remaining: 16.8ms
59:     learn: 0.2052302        total: 24.7ms   remaining: 16.5ms
60:     learn: 0.2026678        total: 25ms     remaining: 16ms
61:     learn: 0.2002947        total: 25.5ms   remaining: 15.6ms
62:     learn: 0.1989098        total: 25.8ms   remaining: 15.2ms
63:     learn: 0.1981136        total: 26.3ms   remaining: 14.8ms
64:     learn: 0.1953551        total: 27.1ms   remaining: 14.6ms
65:     learn: 0.1935116        total: 27.6ms   remaining: 14.2ms
66:     learn: 0.1925583        total: 28ms     remaining: 13.8ms
67:     learn: 0.1896664        total: 28.4ms   remaining: 13.3ms
68:     learn: 0.1883006        total: 28.6ms   remaining: 12.9ms
```

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69:     learn: 0.1880252        total: 29ms     remaining: 12.4ms
70:     learn: 0.1858537        total: 29.3ms   remaining: 12ms
71:     learn: 0.1856119        total: 29.5ms   remaining: 11.5ms
72:     learn: 0.1838157        total: 29.8ms   remaining: 11ms
73:     learn: 0.1821406        total: 30.1ms   remaining: 10.6ms
74:     learn: 0.1814560        total: 30.7ms   remaining: 10.2ms
75:     learn: 0.1791394        total: 31.1ms   remaining: 9.82ms
76:     learn: 0.1786920        total: 31.4ms   remaining: 9.38ms
77:     learn: 0.1782643        total: 31.7ms   remaining: 8.95ms
78:     learn: 0.1780689        total: 32.1ms   remaining: 8.52ms
79:     learn: 0.1771111        total: 32.4ms   remaining: 8.11ms
80:     learn: 0.1762211        total: 32.7ms   remaining: 7.68ms
81:     learn: 0.1756083        total: 33ms     remaining: 7.25ms
82:     learn: 0.1741184        total: 33.3ms   remaining: 6.82ms
83:     learn: 0.1738867        total: 33.6ms   remaining: 6.4ms
84:     learn: 0.1735345        total: 33.9ms   remaining: 5.97ms
85:     learn: 0.1710406        total: 34.1ms   remaining: 5.55ms
86:     learn: 0.1708243        total: 34.4ms   remaining: 5.14ms
87:     learn: 0.1706236        total: 34.7ms   remaining: 4.73ms
88:     learn: 0.1686447        total: 35ms     remaining: 4.32ms
89:     learn: 0.1684296        total: 35.2ms   remaining: 3.92ms
90:     learn: 0.1682179        total: 35.5ms   remaining: 3.52ms
91:     learn: 0.1678717        total: 35.9ms   remaining: 3.12ms
92:     learn: 0.1675340        total: 36.2ms   remaining: 2.72ms
93:     learn: 0.1661034        total: 36.6ms   remaining: 2.33ms
94:     learn: 0.1658958        total: 37ms     remaining: 1.95ms
95:     learn: 0.1636801        total: 37.3ms   remaining: 1.55ms
96:     learn: 0.1633572        total: 37.6ms   remaining: 1.16ms
97:     learn: 0.1622704        total: 37.9ms   remaining: 773us
98:     learn: 0.1620816        total: 38.2ms   remaining: 385us
99:     learn: 0.1619043        total: 38.5ms   remaining: 0us
0:      learn: 0.6473279        total: 435us    remaining: 43.1ms
1:      learn: 0.6148093        total: 752us    remaining: 36.9ms
2:      learn: 0.5850323        total: 1.03ms   remaining: 33.4ms
3:      learn: 0.5570177        total: 1.34ms   remaining: 32.1ms
4:      learn: 0.5322961        total: 1.62ms   remaining: 30.8ms
5:      learn: 0.5040102        total: 1.91ms   remaining: 30ms
6:      learn: 0.4834235        total: 2.18ms   remaining: 29ms
7:      learn: 0.4676510        total: 2.48ms   remaining: 28.5ms
8:      learn: 0.4561962        total: 2.78ms   remaining: 28.1ms
9:      learn: 0.4390729        total: 3.05ms   remaining: 27.5ms
10:     learn: 0.4235067        total: 3.42ms   remaining: 27.7ms
11:     learn: 0.4125231        total: 3.78ms   remaining: 27.7ms
12:     learn: 0.4046089        total: 4.36ms   remaining: 29.2ms
13:     learn: 0.3930495        total: 4.75ms   remaining: 29.2ms
14:     learn: 0.3840972        total: 5.07ms   remaining: 28.8ms
15:     learn: 0.3757912        total: 5.43ms   remaining: 28.5ms
16:     learn: 0.3688992        total: 5.71ms   remaining: 27.9ms
```

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17:     learn: 0.3647522        total: 6ms      remaining: 27.4ms
18:     learn: 0.3590093        total: 6.28ms   remaining: 26.8ms
19:     learn: 0.3529448        total: 6.58ms   remaining: 26.3ms
20:     learn: 0.3486382        total: 6.85ms   remaining: 25.8ms
21:     learn: 0.3417884        total: 7.13ms   remaining: 25.3ms
22:     learn: 0.3353003        total: 7.4ms    remaining: 24.8ms
23:     learn: 0.3310296        total: 7.66ms   remaining: 24.3ms
24:     learn: 0.3277651        total: 7.93ms   remaining: 23.8ms
25:     learn: 0.3225300        total: 8.22ms   remaining: 23.4ms
26:     learn: 0.3186351        total: 8.49ms   remaining: 22.9ms
27:     learn: 0.3152152        total: 8.76ms   remaining: 22.5ms
28:     learn: 0.3122304        total: 9.17ms   remaining: 22.5ms
29:     learn: 0.3095250        total: 9.52ms   remaining: 22.2ms
30:     learn: 0.3070531        total: 9.81ms   remaining: 21.8ms
31:     learn: 0.3029825        total: 10.1ms   remaining: 21.5ms
32:     learn: 0.3000688        total: 10.5ms   remaining: 21.4ms
33:     learn: 0.2971156        total: 10.8ms   remaining: 21ms
34:     learn: 0.2945908        total: 11.1ms   remaining: 20.6ms
35:     learn: 0.2900502        total: 11.4ms   remaining: 20.2ms
36:     learn: 0.2869694        total: 11.6ms   remaining: 19.8ms
37:     learn: 0.2843328        total: 11.9ms   remaining: 19.5ms
38:     learn: 0.2820623        total: 12.2ms   remaining: 19.1ms
39:     learn: 0.2799796        total: 12.5ms   remaining: 18.7ms
40:     learn: 0.2769255        total: 12.7ms   remaining: 18.3ms
41:     learn: 0.2750004        total: 13ms     remaining: 18ms
42:     learn: 0.2732151        total: 13.3ms   remaining: 17.6ms
43:     learn: 0.2708592        total: 13.6ms   remaining: 17.3ms
44:     learn: 0.2690191        total: 13.9ms   remaining: 16.9ms
45:     learn: 0.2651236        total: 14.1ms   remaining: 16.6ms
46:     learn: 0.2644959        total: 14.4ms   remaining: 16.3ms
47:     learn: 0.2632556        total: 14.8ms   remaining: 16ms
48:     learn: 0.2618660        total: 15.1ms   remaining: 15.7ms
49:     learn: 0.2592735        total: 15.6ms   remaining: 15.6ms
50:     learn: 0.2591002        total: 15.9ms   remaining: 15.3ms
51:     learn: 0.2575135        total: 16.3ms   remaining: 15.1ms
52:     learn: 0.2562371        total: 16.6ms   remaining: 14.7ms
53:     learn: 0.2543259        total: 17ms     remaining: 14.4ms
54:     learn: 0.2519242        total: 17.3ms   remaining: 14.1ms
55:     learn: 0.2495607        total: 17.6ms   remaining: 13.8ms
56:     learn: 0.2493733        total: 17.8ms   remaining: 13.5ms
57:     learn: 0.2467686        total: 18.1ms   remaining: 13.1ms
58:     learn: 0.2446473        total: 18.4ms   remaining: 12.8ms
59:     learn: 0.2430531        total: 18.7ms   remaining: 12.4ms
60:     learn: 0.2403240        total: 18.9ms   remaining: 12.1ms
61:     learn: 0.2383795        total: 19.2ms   remaining: 11.8ms
62:     learn: 0.2371091        total: 19.5ms   remaining: 11.4ms
63:     learn: 0.2367967        total: 19.7ms   remaining: 11.1ms
64:     learn: 0.2348113        total: 20.1ms   remaining: 10.8ms
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65:     learn: 0.2346458        total: 20.4ms   remaining: 10.5ms
66:     learn: 0.2344577        total: 20.7ms   remaining: 10.2ms
67:     learn: 0.2342207        total: 21.1ms   remaining: 9.92ms
68:     learn: 0.2340569        total: 21.4ms   remaining: 9.62ms
69:     learn: 0.2338843        total: 21.8ms   remaining: 9.34ms
70:     learn: 0.2317443        total: 22.1ms   remaining: 9.03ms
71:     learn: 0.2315699        total: 22.4ms   remaining: 8.7ms
72:     learn: 0.2313977        total: 22.6ms   remaining: 8.37ms
73:     learn: 0.2290429        total: 22.9ms   remaining: 8.06ms
74:     learn: 0.2289038        total: 23.2ms   remaining: 7.73ms
75:     learn: 0.2286427        total: 23.5ms   remaining: 7.42ms
76:     learn: 0.2283899        total: 23.8ms   remaining: 7.1ms
77:     learn: 0.2282446        total: 24ms     remaining: 6.78ms
78:     learn: 0.2280006        total: 24.3ms   remaining: 6.45ms
79:     learn: 0.2278579        total: 24.5ms   remaining: 6.13ms
80:     learn: 0.2259784        total: 24.8ms   remaining: 5.82ms
81:     learn: 0.2258225        total: 25.1ms   remaining: 5.51ms
82:     learn: 0.2232527        total: 25.4ms   remaining: 5.2ms
83:     learn: 0.2230118        total: 25.7ms   remaining: 4.89ms
84:     learn: 0.2228726        total: 26ms     remaining: 4.58ms
85:     learn: 0.2208024        total: 26.3ms   remaining: 4.27ms
86:     learn: 0.2206626        total: 26.6ms   remaining: 3.97ms
87:     learn: 0.2205245        total: 26.9ms   remaining: 3.67ms
88:     learn: 0.2189714        total: 27.3ms   remaining: 3.37ms
89:     learn: 0.2173222        total: 27.6ms   remaining: 3.07ms
90:     learn: 0.2171901        total: 27.9ms   remaining: 2.76ms
91:     learn: 0.2169696        total: 28.1ms   remaining: 2.45ms
92:     learn: 0.2167709        total: 28.4ms   remaining: 2.14ms
93:     learn: 0.2165642        total: 28.7ms   remaining: 1.83ms
94:     learn: 0.2163774        total: 29ms     remaining: 1.52ms
95:     learn: 0.2162500        total: 29.3ms   remaining: 1.22ms
96:     learn: 0.2145577        total: 29.6ms   remaining: 914us
97:     learn: 0.2130233        total: 29.8ms   remaining: 608us
98:     learn: 0.2128303        total: 30.1ms   remaining: 304us
99:     learn: 0.2111448        total: 30.5ms   remaining: 0us
0:      learn: 0.6512536        total: 402us    remaining: 39.9ms
1:      learn: 0.6185441        total: 689us    remaining: 33.8ms
2:      learn: 0.5888687        total: 948us    remaining: 30.7ms
3:      learn: 0.5572560        total: 1.2ms    remaining: 28.8ms
4:      learn: 0.5334485        total: 1.48ms   remaining: 28.1ms
5:      learn: 0.5107968        total: 1.76ms   remaining: 27.5ms
6:      learn: 0.4902404        total: 2.01ms   remaining: 26.7ms
7:      learn: 0.4712948        total: 2.26ms   remaining: 26ms
8:      learn: 0.4598448        total: 2.65ms   remaining: 26.7ms
9:      learn: 0.4424620        total: 3.06ms   remaining: 27.5ms
10:     learn: 0.4290555        total: 3.35ms   remaining: 27.1ms
11:     learn: 0.4162750        total: 3.74ms   remaining: 27.4ms
12:     learn: 0.4094101        total: 4.13ms   remaining: 27.6ms
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13:     learn: 0.3976256        total: 4.47ms   remaining: 27.5ms
14:     learn: 0.3870403        total: 4.83ms   remaining: 27.4ms
15:     learn: 0.3798596        total: 5.19ms   remaining: 27.3ms
16:     learn: 0.3735979        total: 5.53ms   remaining: 27ms
17:     learn: 0.3677921        total: 5.86ms   remaining: 26.7ms
18:     learn: 0.3617737        total: 6.21ms   remaining: 26.5ms
19:     learn: 0.3585577        total: 6.57ms   remaining: 26.3ms
20:     learn: 0.3527014        total: 6.92ms   remaining: 26ms
21:     learn: 0.3464449        total: 7.28ms   remaining: 25.8ms
22:     learn: 0.3407151        total: 7.66ms   remaining: 25.6ms
23:     learn: 0.3356881        total: 8.06ms   remaining: 25.5ms
24:     learn: 0.3320706        total: 8.41ms   remaining: 25.2ms
25:     learn: 0.3269884        total: 8.8ms    remaining: 25ms
26:     learn: 0.3231148        total: 9.13ms   remaining: 24.7ms
27:     learn: 0.3188511        total: 9.57ms   remaining: 24.6ms
28:     learn: 0.3162184        total: 10ms     remaining: 24.5ms
29:     learn: 0.3133034        total: 10.3ms   remaining: 24ms
30:     learn: 0.3110258        total: 10.6ms   remaining: 23.5ms
31:     learn: 0.3086389        total: 10.8ms   remaining: 23ms
32:     learn: 0.3072933        total: 11.1ms   remaining: 22.6ms
33:     learn: 0.3055023        total: 11.4ms   remaining: 22.1ms
34:     learn: 0.3013161        total: 11.6ms   remaining: 21.6ms
35:     learn: 0.2988385        total: 11.9ms   remaining: 21.2ms
36:     learn: 0.2959385        total: 12.2ms   remaining: 20.7ms
37:     learn: 0.2953719        total: 12.5ms   remaining: 20.3ms
38:     learn: 0.2939975        total: 12.7ms   remaining: 19.9ms
39:     learn: 0.2933114        total: 13ms     remaining: 19.5ms
40:     learn: 0.2903487        total: 13.2ms   remaining: 19.1ms
41:     learn: 0.2896947        total: 13.5ms   remaining: 18.6ms
42:     learn: 0.2888224        total: 13.8ms   remaining: 18.3ms
43:     learn: 0.2877821        total: 14.3ms   remaining: 18.2ms
44:     learn: 0.2852888        total: 14.7ms   remaining: 18ms
45:     learn: 0.2819905        total: 15ms     remaining: 17.6ms
46:     learn: 0.2806828        total: 15.3ms   remaining: 17.3ms
47:     learn: 0.2800178        total: 15.6ms   remaining: 16.9ms
48:     learn: 0.2776477        total: 15.9ms   remaining: 16.5ms
49:     learn: 0.2763057        total: 16.1ms   remaining: 16.1ms
50:     learn: 0.2734362        total: 16.4ms   remaining: 15.8ms
51:     learn: 0.2715796        total: 16.8ms   remaining: 15.5ms
52:     learn: 0.2704280        total: 17ms     remaining: 15.1ms
53:     learn: 0.2686263        total: 17.3ms   remaining: 14.7ms
54:     learn: 0.2672539        total: 17.6ms   remaining: 14.4ms
55:     learn: 0.2666353        total: 17.8ms   remaining: 14ms
56:     learn: 0.2639923        total: 18.1ms   remaining: 13.6ms
57:     learn: 0.2626136        total: 18.4ms   remaining: 13.3ms
58:     learn: 0.2606094        total: 18.6ms   remaining: 12.9ms
59:     learn: 0.2589489        total: 18.9ms   remaining: 12.6ms
60:     learn: 0.2572849        total: 19.1ms   remaining: 12.2ms
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61:     learn: 0.2554777        total: 19.4ms   remaining: 11.9ms
62:     learn: 0.2543873        total: 19.8ms   remaining: 11.6ms
63:     learn: 0.2538288        total: 20.2ms   remaining: 11.3ms
64:     learn: 0.2532557        total: 20.5ms   remaining: 11ms
65:     learn: 0.2520963        total: 20.8ms   remaining: 10.7ms
66:     learn: 0.2495266        total: 21.1ms   remaining: 10.4ms
67:     learn: 0.2464514        total: 21.4ms   remaining: 10.1ms
68:     learn: 0.2459180        total: 21.6ms   remaining: 9.71ms
69:     learn: 0.2454247        total: 21.9ms   remaining: 9.38ms
70:     learn: 0.2427024        total: 22.2ms   remaining: 9.05ms
71:     learn: 0.2420519        total: 22.4ms   remaining: 8.72ms
72:     learn: 0.2398557        total: 22.7ms   remaining: 8.4ms
73:     learn: 0.2394235        total: 23ms     remaining: 8.07ms
74:     learn: 0.2390066        total: 23.2ms   remaining: 7.74ms
75:     learn: 0.2385638        total: 23.5ms   remaining: 7.41ms
76:     learn: 0.2381927        total: 23.7ms   remaining: 7.08ms
77:     learn: 0.2378339        total: 24ms     remaining: 6.77ms
78:     learn: 0.2374863        total: 24.3ms   remaining: 6.45ms
79:     learn: 0.2371319        total: 24.5ms   remaining: 6.13ms
80:     learn: 0.2358949        total: 24.8ms   remaining: 5.82ms
81:     learn: 0.2355564        total: 25.1ms   remaining: 5.5ms
82:     learn: 0.2344623        total: 25.6ms   remaining: 5.25ms
83:     learn: 0.2328887        total: 25.9ms   remaining: 4.94ms
84:     learn: 0.2325849        total: 26.2ms   remaining: 4.63ms
85:     learn: 0.2317007        total: 26.5ms   remaining: 4.31ms
86:     learn: 0.2302485        total: 26.8ms   remaining: 4ms
87:     learn: 0.2299447        total: 27ms     remaining: 3.69ms
88:     learn: 0.2288041        total: 27.3ms   remaining: 3.38ms
89:     learn: 0.2264701        total: 27.6ms   remaining: 3.06ms
90:     learn: 0.2261828        total: 27.8ms   remaining: 2.75ms
91:     learn: 0.2236706        total: 28.1ms   remaining: 2.44ms
92:     learn: 0.2206487        total: 28.3ms   remaining: 2.13ms
93:     learn: 0.2203628        total: 28.6ms   remaining: 1.83ms
94:     learn: 0.2200996        total: 28.9ms   remaining: 1.52ms
95:     learn: 0.2198327        total: 29.2ms   remaining: 1.22ms
96:     learn: 0.2195736        total: 29.5ms   remaining: 912us
97:     learn: 0.2183557        total: 29.8ms   remaining: 607us
98:     learn: 0.2181031        total: 30ms     remaining: 303us
99:     learn: 0.2171520        total: 30.3ms   remaining: 0us
0:      learn: 0.6473232        total: 391us    remaining: 38.7ms
1:      learn: 0.6107401        total: 887us    remaining: 43.5ms
2:      learn: 0.5765295        total: 1.15ms   remaining: 37.2ms
3:      learn: 0.5415175        total: 1.41ms   remaining: 33.8ms
4:      learn: 0.5188767        total: 1.69ms   remaining: 32.1ms
5:      learn: 0.4995217        total: 1.99ms   remaining: 31.1ms
6:      learn: 0.4736690        total: 2.25ms   remaining: 29.9ms
7:      learn: 0.4538167        total: 2.53ms   remaining: 29.1ms
8:      learn: 0.4393081        total: 2.84ms   remaining: 28.7ms
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9:      learn: 0.4181542        total: 3.16ms   remaining: 28.4ms
10:     learn: 0.3999662        total: 3.52ms   remaining: 28.5ms
11:     learn: 0.3868236        total: 3.84ms   remaining: 28.2ms
12:     learn: 0.3710162        total: 4.13ms   remaining: 27.6ms
13:     learn: 0.3584300        total: 4.44ms   remaining: 27.3ms
14:     learn: 0.3475143        total: 4.7ms    remaining: 26.6ms
15:     learn: 0.3388738        total: 4.96ms   remaining: 26ms
16:     learn: 0.3317221        total: 5.22ms   remaining: 25.5ms
17:     learn: 0.3235178        total: 5.49ms   remaining: 25ms
18:     learn: 0.3146136        total: 5.75ms   remaining: 24.5ms
19:     learn: 0.3057683        total: 6ms      remaining: 24ms
20:     learn: 0.2986396        total: 6.25ms   remaining: 23.5ms
21:     learn: 0.2917332        total: 6.51ms   remaining: 23.1ms
22:     learn: 0.2842804        total: 6.76ms   remaining: 22.6ms
23:     learn: 0.2798060        total: 7.03ms   remaining: 22.3ms
24:     learn: 0.2767540        total: 7.28ms   remaining: 21.8ms
25:     learn: 0.2726943        total: 7.6ms    remaining: 21.6ms
26:     learn: 0.2664005        total: 7.88ms   remaining: 21.3ms
27:     learn: 0.2645947        total: 8.18ms   remaining: 21ms
28:     learn: 0.2617061        total: 8.61ms   remaining: 21.1ms
29:     learn: 0.2583838        total: 8.91ms   remaining: 20.8ms
30:     learn: 0.2553066        total: 9.21ms   remaining: 20.5ms
31:     learn: 0.2511462        total: 9.48ms   remaining: 20.1ms
32:     learn: 0.2498979        total: 9.75ms   remaining: 19.8ms
33:     learn: 0.2484001        total: 10ms     remaining: 19.4ms
34:     learn: 0.2448236        total: 10.3ms   remaining: 19.1ms
35:     learn: 0.2415654        total: 10.5ms   remaining: 18.7ms
36:     learn: 0.2385654        total: 10.8ms   remaining: 18.4ms
37:     learn: 0.2367398        total: 11ms     remaining: 18ms
38:     learn: 0.2336337        total: 11.3ms   remaining: 17.7ms
39:     learn: 0.2311174        total: 11.6ms   remaining: 17.3ms
40:     learn: 0.2299941        total: 11.8ms   remaining: 17ms
41:     learn: 0.2284367        total: 12.1ms   remaining: 16.7ms
42:     learn: 0.2267195        total: 12.3ms   remaining: 16.3ms
43:     learn: 0.2258529        total: 12.6ms   remaining: 16ms
44:     learn: 0.2233390        total: 12.8ms   remaining: 15.7ms
45:     learn: 0.2205758        total: 13.2ms   remaining: 15.5ms
46:     learn: 0.2195096        total: 13.5ms   remaining: 15.3ms
47:     learn: 0.2192029        total: 13.9ms   remaining: 15ms
48:     learn: 0.2158608        total: 14.3ms   remaining: 14.8ms
49:     learn: 0.2154905        total: 14.6ms   remaining: 14.6ms
50:     learn: 0.2148586        total: 14.9ms   remaining: 14.3ms
51:     learn: 0.2131128        total: 15.1ms   remaining: 14ms
52:     learn: 0.2121610        total: 15.4ms   remaining: 13.7ms
53:     learn: 0.2108324        total: 15.7ms   remaining: 13.4ms
54:     learn: 0.2085292        total: 15.9ms   remaining: 13ms
55:     learn: 0.2073711        total: 16.2ms   remaining: 12.7ms
56:     learn: 0.2062805        total: 16.5ms   remaining: 12.4ms
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57:     learn: 0.2056249        total: 16.7ms   remaining: 12.1ms
58:     learn: 0.2047219        total: 17ms     remaining: 11.8ms
59:     learn: 0.2041473        total: 17.2ms   remaining: 11.5ms
60:     learn: 0.2035976        total: 17.5ms   remaining: 11.2ms
61:     learn: 0.2016142        total: 17.7ms   remaining: 10.9ms
62:     learn: 0.2006478        total: 18ms     remaining: 10.6ms
63:     learn: 0.1989969        total: 18.2ms   remaining: 10.3ms
64:     learn: 0.1982754        total: 18.5ms   remaining: 9.97ms
65:     learn: 0.1967238        total: 18.9ms   remaining: 9.73ms
66:     learn: 0.1948992        total: 19.2ms   remaining: 9.45ms
67:     learn: 0.1934120        total: 19.6ms   remaining: 9.21ms
68:     learn: 0.1915395        total: 19.9ms   remaining: 8.95ms
69:     learn: 0.1897706        total: 20.2ms   remaining: 8.67ms
70:     learn: 0.1893261        total: 20.5ms   remaining: 8.37ms
71:     learn: 0.1885469        total: 20.7ms   remaining: 8.07ms
72:     learn: 0.1881286        total: 21ms     remaining: 7.76ms
73:     learn: 0.1877258        total: 21.2ms   remaining: 7.46ms
74:     learn: 0.1865056        total: 21.5ms   remaining: 7.17ms
75:     learn: 0.1853701        total: 21.8ms   remaining: 6.87ms
76:     learn: 0.1849918        total: 22ms     remaining: 6.57ms
77:     learn: 0.1839426        total: 22.3ms   remaining: 6.28ms
78:     learn: 0.1824159        total: 22.5ms   remaining: 5.99ms
79:     learn: 0.1819284        total: 22.8ms   remaining: 5.7ms
80:     learn: 0.1810518        total: 23ms     remaining: 5.4ms
81:     learn: 0.1796987        total: 23.4ms   remaining: 5.14ms
82:     learn: 0.1783912        total: 23.7ms   remaining: 4.85ms
83:     learn: 0.1769826        total: 24ms     remaining: 4.57ms
84:     learn: 0.1761927        total: 24.3ms   remaining: 4.29ms
85:     learn: 0.1752128        total: 24.7ms   remaining: 4.01ms
86:     learn: 0.1749125        total: 25ms     remaining: 3.73ms
87:     learn: 0.1737669        total: 25.3ms   remaining: 3.45ms
88:     learn: 0.1728581        total: 25.6ms   remaining: 3.16ms
89:     learn: 0.1726398        total: 25.9ms   remaining: 2.88ms
90:     learn: 0.1709722        total: 26.3ms   remaining: 2.6ms
91:     learn: 0.1689873        total: 26.5ms   remaining: 2.31ms
92:     learn: 0.1686568        total: 26.8ms   remaining: 2.02ms
93:     learn: 0.1676243        total: 27.1ms   remaining: 1.73ms
94:     learn: 0.1673603        total: 27.4ms   remaining: 1.44ms
95:     learn: 0.1663550        total: 27.7ms   remaining: 1.15ms
96:     learn: 0.1659042        total: 27.9ms   remaining: 863us
97:     learn: 0.1643982        total: 28.7ms   remaining: 586us
98:     learn: 0.1641549        total: 29.1ms   remaining: 294us
99:     learn: 0.1622708        total: 29.4ms   remaining: 0us
0:      learn: 0.6506462        total: 387us    remaining: 38.4ms
1:      learn: 0.6173352        total: 660us    remaining: 32.3ms
2:      learn: 0.5818952        total: 947us    remaining: 30.6ms
3:      learn: 0.5507920        total: 1.28ms   remaining: 30.6ms
4:      learn: 0.5197079        total: 1.6ms    remaining: 30.4ms
```

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5:      learn: 0.4969017        total: 1.94ms   remaining: 30.4ms
6:      learn: 0.4763590        total: 2.3ms    remaining: 30.6ms
7:      learn: 0.4612186        total: 2.6ms    remaining: 29.9ms
8:      learn: 0.4491238        total: 2.96ms   remaining: 29.9ms
9:      learn: 0.4310028        total: 3.25ms   remaining: 29.2ms
10:     learn: 0.4168179        total: 3.54ms   remaining: 28.6ms
11:     learn: 0.4059396        total: 3.8ms    remaining: 27.9ms
12:     learn: 0.3999390        total: 4.06ms   remaining: 27.2ms
13:     learn: 0.3875159        total: 4.34ms   remaining: 26.7ms
14:     learn: 0.3789780        total: 4.61ms   remaining: 26.1ms
15:     learn: 0.3704261        total: 4.87ms   remaining: 25.6ms
16:     learn: 0.3642889        total: 5.16ms   remaining: 25.2ms
17:     learn: 0.3580957        total: 5.42ms   remaining: 24.7ms
18:     learn: 0.3517428        total: 5.7ms    remaining: 24.3ms
19:     learn: 0.3469472        total: 5.97ms   remaining: 23.9ms
20:     learn: 0.3405807        total: 6.23ms   remaining: 23.4ms
21:     learn: 0.3317179        total: 6.58ms   remaining: 23.3ms
22:     learn: 0.3267873        total: 7.07ms   remaining: 23.7ms
23:     learn: 0.3222957        total: 7.36ms   remaining: 23.3ms
24:     learn: 0.3185069        total: 7.7ms    remaining: 23.1ms
25:     learn: 0.3140547        total: 8.02ms   remaining: 22.8ms
26:     learn: 0.3079222        total: 8.3ms    remaining: 22.5ms
27:     learn: 0.3051746        total: 8.59ms   remaining: 22.1ms
28:     learn: 0.3016760        total: 8.86ms   remaining: 21.7ms
29:     learn: 0.2986727        total: 9.12ms   remaining: 21.3ms
30:     learn: 0.2962058        total: 9.4ms    remaining: 20.9ms
31:     learn: 0.2926683        total: 9.65ms   remaining: 20.5ms
32:     learn: 0.2903987        total: 9.93ms   remaining: 20.2ms
33:     learn: 0.2880039        total: 10.2ms   remaining: 19.8ms
34:     learn: 0.2848055        total: 10.4ms   remaining: 19.4ms
35:     learn: 0.2815586        total: 10.7ms   remaining: 19.1ms
36:     learn: 0.2802904        total: 11ms     remaining: 18.7ms
37:     learn: 0.2769131        total: 11.3ms   remaining: 18.4ms
38:     learn: 0.2742208        total: 11.5ms   remaining: 18ms
39:     learn: 0.2734504        total: 11.8ms   remaining: 17.7ms
40:     learn: 0.2709064        total: 12.1ms   remaining: 17.3ms
41:     learn: 0.2684816        total: 12.4ms   remaining: 17.2ms
42:     learn: 0.2661862        total: 12.8ms   remaining: 17ms
43:     learn: 0.2639899        total: 13.2ms   remaining: 16.8ms
44:     learn: 0.2605297        total: 13.5ms   remaining: 16.5ms
45:     learn: 0.2573605        total: 13.8ms   remaining: 16.2ms
46:     learn: 0.2570867        total: 14ms     remaining: 15.8ms
47:     learn: 0.2568234        total: 14.3ms   remaining: 15.5ms
48:     learn: 0.2547602        total: 14.6ms   remaining: 15.2ms
49:     learn: 0.2521169        total: 14.8ms   remaining: 14.8ms
50:     learn: 0.2517241        total: 15.1ms   remaining: 14.5ms
51:     learn: 0.2495326        total: 15.4ms   remaining: 14.2ms
52:     learn: 0.2471033        total: 15.7ms   remaining: 13.9ms
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53:     learn: 0.2456991        total: 15.9ms   remaining: 13.6ms
54:     learn: 0.2453554        total: 16.2ms   remaining: 13.3ms
55:     learn: 0.2432763        total: 16.5ms   remaining: 12.9ms
56:     learn: 0.2430734        total: 16.7ms   remaining: 12.6ms
57:     learn: 0.2413951        total: 17ms     remaining: 12.3ms
58:     learn: 0.2390237        total: 17.3ms   remaining: 12ms
59:     learn: 0.2375514        total: 17.6ms   remaining: 11.7ms
60:     learn: 0.2360075        total: 17.9ms   remaining: 11.5ms
61:     learn: 0.2343074        total: 18.3ms   remaining: 11.2ms
62:     learn: 0.2340046        total: 18.6ms   remaining: 10.9ms
63:     learn: 0.2326884        total: 18.9ms   remaining: 10.6ms
64:     learn: 0.2323543        total: 19.3ms   remaining: 10.4ms
65:     learn: 0.2320346        total: 19.6ms   remaining: 10.1ms
66:     learn: 0.2317279        total: 19.9ms   remaining: 9.8ms
67:     learn: 0.2315088        total: 20.2ms   remaining: 9.48ms
68:     learn: 0.2284857        total: 20.4ms   remaining: 9.18ms
69:     learn: 0.2243185        total: 20.7ms   remaining: 8.88ms
70:     learn: 0.2220902        total: 21ms     remaining: 8.56ms
71:     learn: 0.2218012        total: 21.2ms   remaining: 8.26ms
72:     learn: 0.2202206        total: 21.5ms   remaining: 7.96ms
73:     learn: 0.2185369        total: 21.8ms   remaining: 7.65ms
74:     learn: 0.2166974        total: 22.1ms   remaining: 7.35ms
75:     learn: 0.2164254        total: 22.3ms   remaining: 7.05ms
76:     learn: 0.2148583        total: 22.6ms   remaining: 6.74ms
77:     learn: 0.2146146        total: 22.8ms   remaining: 6.44ms
78:     learn: 0.2143794        total: 23.1ms   remaining: 6.14ms
79:     learn: 0.2141505        total: 23.4ms   remaining: 5.84ms
80:     learn: 0.2128185        total: 23.7ms   remaining: 5.56ms
81:     learn: 0.2125789        total: 24.1ms   remaining: 5.29ms
82:     learn: 0.2124278        total: 24.4ms   remaining: 5.01ms
83:     learn: 0.2122409        total: 24.8ms   remaining: 4.72ms
84:     learn: 0.2087450        total: 25.1ms   remaining: 4.43ms
85:     learn: 0.2055088        total: 25.4ms   remaining: 4.13ms
86:     learn: 0.2052941        total: 25.6ms   remaining: 3.83ms
87:     learn: 0.2038302        total: 25.9ms   remaining: 3.53ms
88:     learn: 0.2036454        total: 26.2ms   remaining: 3.24ms
89:     learn: 0.2034393        total: 26.5ms   remaining: 2.94ms
90:     learn: 0.2032544        total: 26.7ms   remaining: 2.64ms
91:     learn: 0.2030706        total: 27.1ms   remaining: 2.35ms
92:     learn: 0.2012310        total: 27.4ms   remaining: 2.06ms
93:     learn: 0.2010350        total: 27.6ms   remaining: 1.76ms
94:     learn: 0.2008558        total: 27.9ms   remaining: 1.47ms
95:     learn: 0.2007043        total: 28.2ms   remaining: 1.18ms
96:     learn: 0.1988675        total: 28.5ms   remaining: 880us
97:     learn: 0.1978040        total: 28.7ms   remaining: 586us
98:     learn: 0.1964691        total: 29ms     remaining: 293us
99:     learn: 0.1945938        total: 29.4ms   remaining: 0us
0:      learn: 0.6456347        total: 378us    remaining: 37.5ms
```

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1:      learn: 0.6062180        total: 686us    remaining: 33.7ms
2:      learn: 0.5680702        total: 1.25ms   remaining: 40.6ms
3:      learn: 0.5329261        total: 1.58ms   remaining: 38ms
4:      learn: 0.5043676        total: 1.94ms   remaining: 36.9ms
5:      learn: 0.4759388        total: 2.28ms   remaining: 35.7ms
6:      learn: 0.4539430        total: 2.57ms   remaining: 34.1ms
7:      learn: 0.4319193        total: 2.83ms   remaining: 32.5ms
8:      learn: 0.4194466        total: 3.07ms   remaining: 31.1ms
9:      learn: 0.4013858        total: 3.35ms   remaining: 30.2ms
10:     learn: 0.3896873        total: 3.61ms   remaining: 29.2ms
11:     learn: 0.3768529        total: 3.88ms   remaining: 28.5ms
12:     learn: 0.3663755        total: 4.16ms   remaining: 27.8ms
13:     learn: 0.3550723        total: 4.41ms   remaining: 27.1ms
14:     learn: 0.3445702        total: 4.66ms   remaining: 26.4ms
15:     learn: 0.3382772        total: 4.93ms   remaining: 25.9ms
16:     learn: 0.3305414        total: 5.22ms   remaining: 25.5ms
17:     learn: 0.3264405        total: 5.49ms   remaining: 25ms
18:     learn: 0.3176503        total: 5.76ms   remaining: 24.6ms
19:     learn: 0.3095673        total: 6.08ms   remaining: 24.3ms
20:     learn: 0.3046515        total: 6.43ms   remaining: 24.2ms
21:     learn: 0.2992104        total: 6.75ms   remaining: 23.9ms
22:     learn: 0.2935967        total: 7.11ms   remaining: 23.8ms
23:     learn: 0.2888063        total: 7.47ms   remaining: 23.7ms
24:     learn: 0.2861582        total: 7.78ms   remaining: 23.3ms
25:     learn: 0.2805254        total: 8.04ms   remaining: 22.9ms
26:     learn: 0.2761742        total: 8.34ms   remaining: 22.5ms
27:     learn: 0.2733214        total: 8.6ms    remaining: 22.1ms
28:     learn: 0.2699129        total: 8.87ms   remaining: 21.7ms
29:     learn: 0.2663464        total: 9.13ms   remaining: 21.3ms
30:     learn: 0.2637635        total: 9.38ms   remaining: 20.9ms
31:     learn: 0.2612950        total: 9.66ms   remaining: 20.5ms
32:     learn: 0.2587305        total: 9.94ms   remaining: 20.2ms
33:     learn: 0.2567078        total: 10.2ms   remaining: 19.8ms
34:     learn: 0.2518482        total: 10.5ms   remaining: 19.4ms
35:     learn: 0.2501773        total: 10.8ms   remaining: 19.1ms
36:     learn: 0.2467570        total: 11ms     remaining: 18.8ms
37:     learn: 0.2439625        total: 11.3ms   remaining: 18.4ms
38:     learn: 0.2416617        total: 11.6ms   remaining: 18.1ms
39:     learn: 0.2397189        total: 11.9ms   remaining: 17.9ms
40:     learn: 0.2391196        total: 12.2ms   remaining: 17.6ms
41:     learn: 0.2376450        total: 12.6ms   remaining: 17.4ms
42:     learn: 0.2360441        total: 12.9ms   remaining: 17.1ms
43:     learn: 0.2346937        total: 13.3ms   remaining: 16.9ms
44:     learn: 0.2317247        total: 13.6ms   remaining: 16.6ms
45:     learn: 0.2286115        total: 13.9ms   remaining: 16.3ms
46:     learn: 0.2281559        total: 14.1ms   remaining: 15.9ms
47:     learn: 0.2255365        total: 14.4ms   remaining: 15.6ms
48:     learn: 0.2226056        total: 14.7ms   remaining: 15.3ms
```

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49:     learn: 0.2206780        total: 15ms     remaining: 15ms
50:     learn: 0.2186788        total: 15.2ms   remaining: 14.6ms
51:     learn: 0.2162263        total: 15.5ms   remaining: 14.3ms
52:     learn: 0.2158720        total: 15.8ms   remaining: 14ms
53:     learn: 0.2122348        total: 16ms     remaining: 13.7ms
54:     learn: 0.2118906        total: 16.3ms   remaining: 13.3ms
55:     learn: 0.2099857        total: 16.6ms   remaining: 13ms
56:     learn: 0.2079409        total: 16.8ms   remaining: 12.7ms
57:     learn: 0.2076515        total: 17.1ms   remaining: 12.4ms
58:     learn: 0.2061229        total: 17.5ms   remaining: 12.1ms
59:     learn: 0.2052302        total: 17.8ms   remaining: 11.9ms
60:     learn: 0.2026678        total: 18.1ms   remaining: 11.6ms
61:     learn: 0.2002947        total: 18.4ms   remaining: 11.3ms
62:     learn: 0.1989098        total: 18.6ms   remaining: 10.9ms
63:     learn: 0.1981136        total: 19ms     remaining: 10.7ms
64:     learn: 0.1953551        total: 19.3ms   remaining: 10.4ms
65:     learn: 0.1935116        total: 19.7ms   remaining: 10.2ms
66:     learn: 0.1925583        total: 20ms     remaining: 9.86ms
67:     learn: 0.1896664        total: 20.3ms   remaining: 9.55ms
68:     learn: 0.1883006        total: 20.6ms   remaining: 9.23ms
69:     learn: 0.1880252        total: 20.8ms   remaining: 8.92ms
70:     learn: 0.1858537        total: 21.1ms   remaining: 8.61ms
71:     learn: 0.1856119        total: 21.3ms   remaining: 8.29ms
72:     learn: 0.1838157        total: 21.6ms   remaining: 7.98ms
73:     learn: 0.1821406        total: 21.8ms   remaining: 7.67ms
74:     learn: 0.1814560        total: 22.1ms   remaining: 7.37ms
75:     learn: 0.1791394        total: 22.4ms   remaining: 7.06ms
76:     learn: 0.1786920        total: 22.6ms   remaining: 6.76ms
77:     learn: 0.1782643        total: 22.9ms   remaining: 6.47ms
78:     learn: 0.1780689        total: 23.3ms   remaining: 6.18ms
79:     learn: 0.1771111        total: 23.5ms   remaining: 5.88ms
80:     learn: 0.1762211        total: 24ms     remaining: 5.64ms
81:     learn: 0.1756083        total: 24.4ms   remaining: 5.35ms
82:     learn: 0.1741184        total: 24.7ms   remaining: 5.06ms
83:     learn: 0.1738867        total: 25ms     remaining: 4.76ms
84:     learn: 0.1735345        total: 25.2ms   remaining: 4.45ms
85:     learn: 0.1710406        total: 25.5ms   remaining: 4.15ms
86:     learn: 0.1708243        total: 25.7ms   remaining: 3.85ms
87:     learn: 0.1706236        total: 26ms     remaining: 3.54ms
88:     learn: 0.1686447        total: 26.3ms   remaining: 3.25ms
89:     learn: 0.1684296        total: 26.6ms   remaining: 2.96ms
90:     learn: 0.1682179        total: 27ms     remaining: 2.67ms
91:     learn: 0.1678717        total: 27.3ms   remaining: 2.37ms
92:     learn: 0.1675340        total: 27.6ms   remaining: 2.08ms
93:     learn: 0.1661034        total: 27.9ms   remaining: 1.78ms
94:     learn: 0.1658958        total: 28.1ms   remaining: 1.48ms
95:     learn: 0.1636801        total: 28.4ms   remaining: 1.18ms
96:     learn: 0.1633572        total: 28.7ms   remaining: 888us
```

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97:     learn: 0.1622704        total: 29ms     remaining: 592us
98:     learn: 0.1620816        total: 29.3ms   remaining: 296us
99:     learn: 0.1619043        total: 29.6ms   remaining: 0us
0:      learn: 0.6473279        total: 351us    remaining: 34.8ms
1:      learn: 0.6148093        total: 638us    remaining: 31.3ms
2:      learn: 0.5850323        total: 927us    remaining: 30ms
3:      learn: 0.5570177        total: 1.36ms   remaining: 32.6ms
4:      learn: 0.5322961        total: 1.78ms   remaining: 33.9ms
5:      learn: 0.5040102        total: 2.16ms   remaining: 33.8ms
6:      learn: 0.4834235        total: 2.49ms   remaining: 33.1ms
7:      learn: 0.4676510        total: 2.79ms   remaining: 32.1ms
8:      learn: 0.4561962        total: 3.05ms   remaining: 30.9ms
9:      learn: 0.4390729        total: 3.31ms   remaining: 29.8ms
10:     learn: 0.4235067        total: 3.57ms   remaining: 28.9ms
11:     learn: 0.4125231        total: 3.84ms   remaining: 28.1ms
12:     learn: 0.4046089        total: 4.11ms   remaining: 27.5ms
13:     learn: 0.3930495        total: 4.37ms   remaining: 26.9ms
14:     learn: 0.3840972        total: 4.65ms   remaining: 26.3ms
15:     learn: 0.3757912        total: 4.92ms   remaining: 25.8ms
16:     learn: 0.3688992        total: 5.18ms   remaining: 25.3ms
17:     learn: 0.3647522        total: 5.44ms   remaining: 24.8ms
18:     learn: 0.3590093        total: 5.71ms   remaining: 24.3ms
19:     learn: 0.3529448        total: 5.98ms   remaining: 23.9ms
20:     learn: 0.3486382        total: 6.23ms   remaining: 23.5ms
21:     learn: 0.3417884        total: 6.49ms   remaining: 23ms
22:     learn: 0.3353003        total: 6.8ms    remaining: 22.8ms
23:     learn: 0.3310296        total: 7.13ms   remaining: 22.6ms
24:     learn: 0.3277651        total: 7.41ms   remaining: 22.2ms
25:     learn: 0.3225300        total: 7.83ms   remaining: 22.3ms
26:     learn: 0.3186351        total: 8.21ms   remaining: 22.2ms
27:     learn: 0.3152152        total: 8.55ms   remaining: 22ms
28:     learn: 0.3122304        total: 8.85ms   remaining: 21.7ms
29:     learn: 0.3095250        total: 9.11ms   remaining: 21.3ms
30:     learn: 0.3070531        total: 9.37ms   remaining: 20.9ms
31:     learn: 0.3029825        total: 9.64ms   remaining: 20.5ms
32:     learn: 0.3000688        total: 9.9ms    remaining: 20.1ms
33:     learn: 0.2971156        total: 10.2ms   remaining: 19.7ms
34:     learn: 0.2945908        total: 10.4ms   remaining: 19.4ms
35:     learn: 0.2900502        total: 10.7ms   remaining: 19ms
36:     learn: 0.2869694        total: 10.9ms   remaining: 18.6ms
37:     learn: 0.2843328        total: 11.2ms   remaining: 18.3ms
38:     learn: 0.2820623        total: 11.5ms   remaining: 18ms
39:     learn: 0.2799796        total: 11.7ms   remaining: 17.6ms
40:     learn: 0.2769255        total: 12ms     remaining: 17.2ms
41:     learn: 0.2750004        total: 12.3ms   remaining: 17ms
42:     learn: 0.2732151        total: 12.6ms   remaining: 16.7ms
43:     learn: 0.2708592        total: 12.9ms   remaining: 16.5ms
44:     learn: 0.2690191        total: 13.3ms   remaining: 16.3ms
```

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45:     learn: 0.2651236        total: 13.7ms   remaining: 16ms
46:     learn: 0.2644959        total: 14ms     remaining: 15.8ms
47:     learn: 0.2632556        total: 14.2ms   remaining: 15.4ms
48:     learn: 0.2618660        total: 14.5ms   remaining: 15.1ms
49:     learn: 0.2592735        total: 15.2ms   remaining: 15.2ms
50:     learn: 0.2591002        total: 15.7ms   remaining: 15.1ms
51:     learn: 0.2575135        total: 16ms     remaining: 14.8ms
52:     learn: 0.2562371        total: 16.3ms   remaining: 14.5ms
53:     learn: 0.2543259        total: 16.6ms   remaining: 14.2ms
54:     learn: 0.2519242        total: 16.9ms   remaining: 13.8ms
55:     learn: 0.2495607        total: 17.2ms   remaining: 13.5ms
56:     learn: 0.2493733        total: 17.5ms   remaining: 13.2ms
57:     learn: 0.2467686        total: 17.8ms   remaining: 12.9ms
58:     learn: 0.2446473        total: 18.2ms   remaining: 12.6ms
59:     learn: 0.2430531        total: 18.5ms   remaining: 12.3ms
60:     learn: 0.2403240        total: 18.9ms   remaining: 12.1ms
61:     learn: 0.2383795        total: 19.3ms   remaining: 11.8ms
62:     learn: 0.2371091        total: 19.6ms   remaining: 11.5ms
63:     learn: 0.2367967        total: 20ms     remaining: 11.2ms
64:     learn: 0.2348113        total: 20.3ms   remaining: 10.9ms
65:     learn: 0.2346458        total: 20.6ms   remaining: 10.6ms
66:     learn: 0.2344577        total: 20.9ms   remaining: 10.3ms
67:     learn: 0.2342207        total: 21.2ms   remaining: 9.97ms
68:     learn: 0.2340569        total: 21.4ms   remaining: 9.64ms
69:     learn: 0.2338843        total: 21.7ms   remaining: 9.31ms
70:     learn: 0.2317443        total: 22ms     remaining: 8.98ms
71:     learn: 0.2315699        total: 22.3ms   remaining: 8.66ms
72:     learn: 0.2313977        total: 22.6ms   remaining: 8.35ms
73:     learn: 0.2290429        total: 22.8ms   remaining: 8.02ms
74:     learn: 0.2289038        total: 23.1ms   remaining: 7.71ms
75:     learn: 0.2286427        total: 23.6ms   remaining: 7.44ms
76:     learn: 0.2283899        total: 23.9ms   remaining: 7.15ms
77:     learn: 0.2282446        total: 24.3ms   remaining: 6.86ms
78:     learn: 0.2280006        total: 24.6ms   remaining: 6.53ms
79:     learn: 0.2278579        total: 24.9ms   remaining: 6.21ms
80:     learn: 0.2259784        total: 25.1ms   remaining: 5.89ms
81:     learn: 0.2258225        total: 25.4ms   remaining: 5.57ms
82:     learn: 0.2232527        total: 25.6ms   remaining: 5.25ms
83:     learn: 0.2230118        total: 25.9ms   remaining: 4.93ms
84:     learn: 0.2228726        total: 26.1ms   remaining: 4.61ms
85:     learn: 0.2208024        total: 26.4ms   remaining: 4.3ms
86:     learn: 0.2206626        total: 26.7ms   remaining: 3.98ms
87:     learn: 0.2205245        total: 26.9ms   remaining: 3.67ms
88:     learn: 0.2189714        total: 27.2ms   remaining: 3.36ms
89:     learn: 0.2173222        total: 27.4ms   remaining: 3.05ms
90:     learn: 0.2171901        total: 27.8ms   remaining: 2.75ms
91:     learn: 0.2169696        total: 28ms     remaining: 2.44ms
92:     learn: 0.2167709        total: 28.4ms   remaining: 2.13ms
```

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93:     learn: 0.2165642        total: 28.6ms   remaining: 1.83ms
94:     learn: 0.2163774        total: 29ms     remaining: 1.53ms
95:     learn: 0.2162500        total: 29.4ms   remaining: 1.23ms
96:     learn: 0.2145577        total: 29.8ms   remaining: 920us
97:     learn: 0.2130233        total: 30.1ms   remaining: 614us
98:     learn: 0.2128303        total: 30.4ms   remaining: 307us
99:     learn: 0.2111448        total: 30.7ms   remaining: 0us
0:      learn: 0.6512536        total: 367us    remaining: 36.4ms
1:      learn: 0.6185441        total: 958us    remaining: 47ms
2:      learn: 0.5888687        total: 1.43ms   remaining: 46.3ms
3:      learn: 0.5572560        total: 1.81ms   remaining: 43.6ms
4:      learn: 0.5334485        total: 2.15ms   remaining: 40.8ms
5:      learn: 0.5107968        total: 2.5ms    remaining: 39.2ms
6:      learn: 0.4902404        total: 2.94ms   remaining: 39.1ms
7:      learn: 0.4712948        total: 3.3ms    remaining: 38ms
8:      learn: 0.4598448        total: 3.58ms   remaining: 36.2ms
9:      learn: 0.4424620        total: 3.9ms    remaining: 35.1ms
10:     learn: 0.4290555        total: 4.19ms   remaining: 33.9ms
11:     learn: 0.4162750        total: 4.51ms   remaining: 33ms
12:     learn: 0.4094101        total: 4.8ms    remaining: 32.1ms
13:     learn: 0.3976256        total: 5.1ms    remaining: 31.3ms
14:     learn: 0.3870403        total: 5.35ms   remaining: 30.3ms
15:     learn: 0.3798596        total: 5.65ms   remaining: 29.6ms
16:     learn: 0.3735979        total: 5.92ms   remaining: 28.9ms
17:     learn: 0.3677921        total: 6.29ms   remaining: 28.6ms
18:     learn: 0.3617737        total: 6.6ms    remaining: 28.1ms
19:     learn: 0.3585577        total: 6.93ms   remaining: 27.7ms
20:     learn: 0.3527014        total: 7.28ms   remaining: 27.4ms
21:     learn: 0.3464449        total: 7.65ms   remaining: 27.1ms
22:     learn: 0.3407151        total: 7.95ms   remaining: 26.6ms
23:     learn: 0.3356881        total: 8.25ms   remaining: 26.1ms
24:     learn: 0.3320706        total: 8.58ms   remaining: 25.7ms
25:     learn: 0.3269884        total: 8.89ms   remaining: 25.3ms
26:     learn: 0.3231148        total: 9.15ms   remaining: 24.7ms
27:     learn: 0.3188511        total: 9.42ms   remaining: 24.2ms
28:     learn: 0.3162184        total: 9.68ms   remaining: 23.7ms
29:     learn: 0.3133034        total: 9.93ms   remaining: 23.2ms
30:     learn: 0.3110258        total: 10.2ms   remaining: 22.7ms
31:     learn: 0.3086389        total: 10.4ms   remaining: 22.2ms
32:     learn: 0.3072933        total: 10.7ms   remaining: 21.7ms
33:     learn: 0.3055023        total: 11ms     remaining: 21.3ms
34:     learn: 0.3013161        total: 11.2ms   remaining: 20.8ms
35:     learn: 0.2988385        total: 11.5ms   remaining: 20.4ms
36:     learn: 0.2959385        total: 11.8ms   remaining: 20.1ms
37:     learn: 0.2953719        total: 12.1ms   remaining: 19.7ms
38:     learn: 0.2939975        total: 12.4ms   remaining: 19.4ms
39:     learn: 0.2933114        total: 12.7ms   remaining: 19.1ms
40:     learn: 0.2903487        total: 13.1ms   remaining: 18.8ms
```

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41:     learn: 0.2896947        total: 13.4ms   remaining: 18.5ms
42:     learn: 0.2888224        total: 13.7ms   remaining: 18.2ms
43:     learn: 0.2877821        total: 14ms     remaining: 17.8ms
44:     learn: 0.2852888        total: 14.2ms   remaining: 17.4ms
45:     learn: 0.2819905        total: 14.5ms   remaining: 17ms
46:     learn: 0.2806828        total: 14.8ms   remaining: 16.7ms
47:     learn: 0.2800178        total: 15ms     remaining: 16.3ms
48:     learn: 0.2776477        total: 15.3ms   remaining: 15.9ms
49:     learn: 0.2763057        total: 15.6ms   remaining: 15.6ms
50:     learn: 0.2734362        total: 15.8ms   remaining: 15.2ms
51:     learn: 0.2715796        total: 16.1ms   remaining: 14.9ms
52:     learn: 0.2704280        total: 16.4ms   remaining: 14.6ms
53:     learn: 0.2686263        total: 16.8ms   remaining: 14.3ms
54:     learn: 0.2672539        total: 17.1ms   remaining: 14ms
55:     learn: 0.2666353        total: 17.5ms   remaining: 13.7ms
56:     learn: 0.2639923        total: 17.8ms   remaining: 13.4ms
57:     learn: 0.2626136        total: 18.2ms   remaining: 13.2ms
58:     learn: 0.2606094        total: 18.5ms   remaining: 12.8ms
59:     learn: 0.2589489        total: 18.8ms   remaining: 12.6ms
60:     learn: 0.2572849        total: 19.1ms   remaining: 12.2ms
61:     learn: 0.2554777        total: 19.5ms   remaining: 11.9ms
62:     learn: 0.2543873        total: 19.7ms   remaining: 11.6ms
63:     learn: 0.2538288        total: 20ms     remaining: 11.2ms
64:     learn: 0.2532557        total: 20.2ms   remaining: 10.9ms
65:     learn: 0.2520963        total: 20.5ms   remaining: 10.6ms
66:     learn: 0.2495266        total: 20.8ms   remaining: 10.2ms
67:     learn: 0.2464514        total: 21ms     remaining: 9.89ms
68:     learn: 0.2459180        total: 21.3ms   remaining: 9.56ms
69:     learn: 0.2454247        total: 21.5ms   remaining: 9.23ms
70:     learn: 0.2427024        total: 21.8ms   remaining: 8.9ms
71:     learn: 0.2420519        total: 22ms     remaining: 8.57ms
72:     learn: 0.2398557        total: 22.3ms   remaining: 8.24ms
73:     learn: 0.2394235        total: 22.6ms   remaining: 7.93ms
74:     learn: 0.2390066        total: 22.8ms   remaining: 7.61ms
75:     learn: 0.2385638        total: 23.1ms   remaining: 7.3ms
76:     learn: 0.2381927        total: 23.4ms   remaining: 6.99ms
77:     learn: 0.2378339        total: 23.7ms   remaining: 6.69ms
78:     learn: 0.2374863        total: 24ms     remaining: 6.39ms
79:     learn: 0.2371319        total: 24.3ms   remaining: 6.09ms
80:     learn: 0.2358949        total: 24.7ms   remaining: 5.79ms
81:     learn: 0.2355564        total: 25ms     remaining: 5.48ms
82:     learn: 0.2344623        total: 25.3ms   remaining: 5.17ms
83:     learn: 0.2328887        total: 25.5ms   remaining: 4.86ms
84:     learn: 0.2325849        total: 25.8ms   remaining: 4.55ms
85:     learn: 0.2317007        total: 26ms     remaining: 4.24ms
86:     learn: 0.2302485        total: 26.3ms   remaining: 3.93ms
87:     learn: 0.2299447        total: 26.5ms   remaining: 3.62ms
88:     learn: 0.2288041        total: 26.8ms   remaining: 3.31ms
```

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89:     learn: 0.2264701        total: 27ms     remaining: 3ms
90:     learn: 0.2261828        total: 27.3ms   remaining: 2.7ms
91:     learn: 0.2236706        total: 27.5ms   remaining: 2.39ms
92:     learn: 0.2206487        total: 27.8ms   remaining: 2.09ms
93:     learn: 0.2203628        total: 28.1ms   remaining: 1.79ms
94:     learn: 0.2200996        total: 28.3ms   remaining: 1.49ms
95:     learn: 0.2198327        total: 28.7ms   remaining: 1.2ms
96:     learn: 0.2195736        total: 29ms     remaining: 896us
97:     learn: 0.2183557        total: 29.3ms   remaining: 597us
98:     learn: 0.2181031        total: 29.7ms   remaining: 300us
99:     learn: 0.2171520        total: 30.1ms   remaining: 0us
0:      learn: 0.6473232        total: 636us    remaining: 63ms
1:      learn: 0.6107401        total: 1.2ms    remaining: 58.7ms
2:      learn: 0.5765295        total: 1.64ms   remaining: 52.9ms
3:      learn: 0.5415175        total: 2.14ms   remaining: 51.4ms
4:      learn: 0.5188767        total: 2.57ms   remaining: 48.8ms
5:      learn: 0.4995217        total: 2.99ms   remaining: 46.9ms
6:      learn: 0.4736690        total: 3.33ms   remaining: 44.3ms
7:      learn: 0.4538167        total: 3.69ms   remaining: 42.4ms
8:      learn: 0.4393081        total: 4.03ms   remaining: 40.8ms
9:      learn: 0.4181542        total: 4.38ms   remaining: 39.4ms
10:     learn: 0.3999662        total: 4.72ms   remaining: 38.2ms
11:     learn: 0.3868236        total: 5.09ms   remaining: 37.3ms
12:     learn: 0.3710162        total: 5.45ms   remaining: 36.5ms
13:     learn: 0.3584300        total: 5.86ms   remaining: 36ms
14:     learn: 0.3475143        total: 6.25ms   remaining: 35.4ms
15:     learn: 0.3388738        total: 6.65ms   remaining: 34.9ms
16:     learn: 0.3317221        total: 7.08ms   remaining: 34.6ms
17:     learn: 0.3235178        total: 7.56ms   remaining: 34.4ms
18:     learn: 0.3146136        total: 7.92ms   remaining: 33.8ms
19:     learn: 0.3057683        total: 8.35ms   remaining: 33.4ms
20:     learn: 0.2986396        total: 8.71ms   remaining: 32.8ms
21:     learn: 0.2917332        total: 9.05ms   remaining: 32.1ms
22:     learn: 0.2842804        total: 9.38ms   remaining: 31.4ms
23:     learn: 0.2798060        total: 9.73ms   remaining: 30.8ms
24:     learn: 0.2767540        total: 10.1ms   remaining: 30.2ms
25:     learn: 0.2726943        total: 10.4ms   remaining: 29.6ms
26:     learn: 0.2664005        total: 10.7ms   remaining: 29ms
27:     learn: 0.2645947        total: 11.1ms   remaining: 28.4ms
28:     learn: 0.2617061        total: 11.4ms   remaining: 28ms
29:     learn: 0.2583838        total: 11.9ms   remaining: 27.8ms
30:     learn: 0.2553066        total: 12.6ms   remaining: 28ms
31:     learn: 0.2511462        total: 13.1ms   remaining: 27.8ms
32:     learn: 0.2498979        total: 13.5ms   remaining: 27.4ms
33:     learn: 0.2484001        total: 13.9ms   remaining: 26.9ms
34:     learn: 0.2448236        total: 14.3ms   remaining: 26.6ms
35:     learn: 0.2415654        total: 14.7ms   remaining: 26.2ms
36:     learn: 0.2385654        total: 15.1ms   remaining: 25.7ms
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37:     learn: 0.2367398        total: 15.5ms   remaining: 25.2ms
38:     learn: 0.2336337        total: 15.8ms   remaining: 24.7ms
39:     learn: 0.2311174        total: 16.1ms   remaining: 24.2ms
40:     learn: 0.2299941        total: 16.5ms   remaining: 23.7ms
41:     learn: 0.2284367        total: 16.9ms   remaining: 23.4ms
42:     learn: 0.2267195        total: 17.3ms   remaining: 23ms
43:     learn: 0.2258529        total: 17.7ms   remaining: 22.5ms
44:     learn: 0.2233390        total: 18.2ms   remaining: 22.2ms
45:     learn: 0.2205758        total: 18.6ms   remaining: 21.9ms
46:     learn: 0.2195096        total: 19ms     remaining: 21.5ms
47:     learn: 0.2192029        total: 19.5ms   remaining: 21.1ms
48:     learn: 0.2158608        total: 19.9ms   remaining: 20.7ms
49:     learn: 0.2154905        total: 20.3ms   remaining: 20.3ms
50:     learn: 0.2148586        total: 20.7ms   remaining: 19.9ms
51:     learn: 0.2131128        total: 21.1ms   remaining: 19.5ms
52:     learn: 0.2121610        total: 21.4ms   remaining: 19ms
53:     learn: 0.2108324        total: 21.7ms   remaining: 18.5ms
54:     learn: 0.2085292        total: 22.1ms   remaining: 18.1ms
55:     learn: 0.2073711        total: 22.4ms   remaining: 17.6ms
56:     learn: 0.2062805        total: 22.9ms   remaining: 17.2ms
57:     learn: 0.2056249        total: 23.3ms   remaining: 16.9ms
58:     learn: 0.2047219        total: 23.8ms   remaining: 16.5ms
59:     learn: 0.2041473        total: 24.2ms   remaining: 16.2ms
60:     learn: 0.2035976        total: 24.6ms   remaining: 15.7ms
61:     learn: 0.2016142        total: 25ms     remaining: 15.3ms
62:     learn: 0.2006478        total: 25.3ms   remaining: 14.9ms
63:     learn: 0.1989969        total: 25.6ms   remaining: 14.4ms
64:     learn: 0.1982754        total: 26ms     remaining: 14ms
65:     learn: 0.1967238        total: 26.4ms   remaining: 13.6ms
66:     learn: 0.1948992        total: 26.8ms   remaining: 13.2ms
67:     learn: 0.1934120        total: 27.1ms   remaining: 12.8ms
68:     learn: 0.1915395        total: 27.4ms   remaining: 12.3ms
69:     learn: 0.1897706        total: 27.8ms   remaining: 11.9ms
70:     learn: 0.1893261        total: 28.2ms   remaining: 11.5ms
71:     learn: 0.1885469        total: 28.6ms   remaining: 11.1ms
72:     learn: 0.1881286        total: 28.9ms   remaining: 10.7ms
73:     learn: 0.1877258        total: 29.3ms   remaining: 10.3ms
74:     learn: 0.1865056        total: 29.7ms   remaining: 9.91ms
75:     learn: 0.1853701        total: 30.2ms   remaining: 9.53ms
76:     learn: 0.1849918        total: 30.6ms   remaining: 9.15ms
77:     learn: 0.1839426        total: 31.1ms   remaining: 8.77ms
78:     learn: 0.1824159        total: 31.5ms   remaining: 8.38ms
79:     learn: 0.1819284        total: 31.9ms   remaining: 7.96ms
80:     learn: 0.1810518        total: 32.2ms   remaining: 7.55ms
81:     learn: 0.1796987        total: 32.5ms   remaining: 7.13ms
82:     learn: 0.1783912        total: 32.8ms   remaining: 6.72ms
83:     learn: 0.1769826        total: 33.1ms   remaining: 6.31ms
84:     learn: 0.1761927        total: 33.4ms   remaining: 5.9ms
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85:     learn: 0.1752128        total: 33.9ms   remaining: 5.52ms
86:     learn: 0.1749125        total: 34.3ms   remaining: 5.12ms
87:     learn: 0.1737669        total: 34.6ms   remaining: 4.72ms
88:     learn: 0.1728581        total: 35ms     remaining: 4.33ms
89:     learn: 0.1726398        total: 35.4ms   remaining: 3.93ms
90:     learn: 0.1709722        total: 35.7ms   remaining: 3.53ms
91:     learn: 0.1689873        total: 36.1ms   remaining: 3.14ms
92:     learn: 0.1686568        total: 36.5ms   remaining: 2.75ms
93:     learn: 0.1676243        total: 36.9ms   remaining: 2.35ms
94:     learn: 0.1673603        total: 37.2ms   remaining: 1.96ms
95:     learn: 0.1663550        total: 37.5ms   remaining: 1.56ms
96:     learn: 0.1659042        total: 37.9ms   remaining: 1.17ms
97:     learn: 0.1643982        total: 38.2ms   remaining: 779us
98:     learn: 0.1641549        total: 38.5ms   remaining: 388us
99:     learn: 0.1622708        total: 38.8ms   remaining: 0us
0:      learn: 0.6506462        total: 554us    remaining: 54.9ms
1:      learn: 0.6173352        total: 911us    remaining: 44.7ms
2:      learn: 0.5818952        total: 1.29ms   remaining: 41.8ms
3:      learn: 0.5507920        total: 1.6ms    remaining: 38.5ms
4:      learn: 0.5197079        total: 1.92ms   remaining: 36.4ms
5:      learn: 0.4969017        total: 2.22ms   remaining: 34.8ms
6:      learn: 0.4763590        total: 2.52ms   remaining: 33.5ms
7:      learn: 0.4612186        total: 2.84ms   remaining: 32.7ms
8:      learn: 0.4491238        total: 3.21ms   remaining: 32.5ms
9:      learn: 0.4310028        total: 3.69ms   remaining: 33.2ms
10:     learn: 0.4168179        total: 4.09ms   remaining: 33.1ms
11:     learn: 0.4059396        total: 4.51ms   remaining: 33ms
12:     learn: 0.3999390        total: 4.86ms   remaining: 32.5ms
13:     learn: 0.3875159        total: 5.22ms   remaining: 32.1ms
14:     learn: 0.3789780        total: 5.62ms   remaining: 31.9ms
15:     learn: 0.3704261        total: 6.02ms   remaining: 31.6ms
16:     learn: 0.3642889        total: 6.47ms   remaining: 31.6ms
17:     learn: 0.3580957        total: 6.84ms   remaining: 31.2ms
18:     learn: 0.3517428        total: 7.19ms   remaining: 30.7ms
19:     learn: 0.3469472        total: 7.59ms   remaining: 30.4ms
20:     learn: 0.3405807        total: 7.99ms   remaining: 30.1ms
21:     learn: 0.3317179        total: 8.32ms   remaining: 29.5ms
22:     learn: 0.3267873        total: 8.65ms   remaining: 29ms
23:     learn: 0.3222957        total: 8.94ms   remaining: 28.3ms
24:     learn: 0.3185069        total: 9.24ms   remaining: 27.7ms
25:     learn: 0.3140547        total: 9.6ms    remaining: 27.3ms
26:     learn: 0.3079222        total: 9.91ms   remaining: 26.8ms
27:     learn: 0.3051746        total: 10.3ms   remaining: 26.6ms
28:     learn: 0.3016760        total: 10.6ms   remaining: 26ms
29:     learn: 0.2986727        total: 11ms     remaining: 25.6ms
30:     learn: 0.2962058        total: 11.4ms   remaining: 25.4ms
31:     learn: 0.2926683        total: 11.8ms   remaining: 25.1ms
32:     learn: 0.2903987        total: 12.2ms   remaining: 24.8ms
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33:     learn: 0.2880039        total: 12.6ms   remaining: 24.4ms
34:     learn: 0.2848055        total: 12.9ms   remaining: 23.9ms
35:     learn: 0.2815586        total: 13.2ms   remaining: 23.5ms
36:     learn: 0.2802904        total: 14.5ms   remaining: 24.8ms
37:     learn: 0.2769131        total: 15.1ms   remaining: 24.6ms
38:     learn: 0.2742208        total: 15.5ms   remaining: 24.2ms
39:     learn: 0.2734504        total: 16.1ms   remaining: 24.1ms
40:     learn: 0.2709064        total: 16.5ms   remaining: 23.8ms
41:     learn: 0.2684816        total: 17.1ms   remaining: 23.6ms
42:     learn: 0.2661862        total: 17.6ms   remaining: 23.3ms
43:     learn: 0.2639899        total: 18ms     remaining: 22.9ms
44:     learn: 0.2605297        total: 18.4ms   remaining: 22.5ms
45:     learn: 0.2573605        total: 18.7ms   remaining: 22ms
46:     learn: 0.2570867        total: 19.1ms   remaining: 21.5ms
47:     learn: 0.2568234        total: 19.4ms   remaining: 21ms
48:     learn: 0.2547602        total: 19.8ms   remaining: 20.6ms
49:     learn: 0.2521169        total: 20.1ms   remaining: 20.1ms
50:     learn: 0.2517241        total: 20.4ms   remaining: 19.6ms
51:     learn: 0.2495326        total: 20.7ms   remaining: 19.1ms
52:     learn: 0.2471033        total: 21ms     remaining: 18.6ms
53:     learn: 0.2456991        total: 21.3ms   remaining: 18.2ms
54:     learn: 0.2453554        total: 21.7ms   remaining: 17.8ms
55:     learn: 0.2432763        total: 22.2ms   remaining: 17.4ms
56:     learn: 0.2430734        total: 22.6ms   remaining: 17.1ms
57:     learn: 0.2413951        total: 23ms     remaining: 16.7ms
58:     learn: 0.2390237        total: 23.4ms   remaining: 16.2ms
59:     learn: 0.2375514        total: 23.8ms   remaining: 15.8ms
60:     learn: 0.2360075        total: 24.2ms   remaining: 15.5ms
61:     learn: 0.2343074        total: 24.6ms   remaining: 15.1ms
62:     learn: 0.2340046        total: 24.9ms   remaining: 14.6ms
63:     learn: 0.2326884        total: 25.2ms   remaining: 14.2ms
64:     learn: 0.2323543        total: 25.5ms   remaining: 13.7ms
65:     learn: 0.2320346        total: 25.8ms   remaining: 13.3ms
66:     learn: 0.2317279        total: 26.1ms   remaining: 12.9ms
67:     learn: 0.2315088        total: 26.4ms   remaining: 12.4ms
68:     learn: 0.2284857        total: 26.8ms   remaining: 12.1ms
69:     learn: 0.2243185        total: 27.2ms   remaining: 11.6ms
70:     learn: 0.2220902        total: 27.7ms   remaining: 11.3ms
71:     learn: 0.2218012        total: 28.4ms   remaining: 11ms
72:     learn: 0.2202206        total: 28.9ms   remaining: 10.7ms
73:     learn: 0.2185369        total: 29.2ms   remaining: 10.3ms
74:     learn: 0.2166974        total: 29.6ms   remaining: 9.85ms
75:     learn: 0.2164254        total: 29.9ms   remaining: 9.44ms
76:     learn: 0.2148583        total: 30.3ms   remaining: 9.04ms
77:     learn: 0.2146146        total: 30.6ms   remaining: 8.63ms
78:     learn: 0.2143794        total: 31ms     remaining: 8.23ms
79:     learn: 0.2141505        total: 31.3ms   remaining: 7.83ms
80:     learn: 0.2128185        total: 31.6ms   remaining: 7.42ms
```

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81:     learn: 0.2125789        total: 32.1ms   remaining: 7.04ms
82:     learn: 0.2124278        total: 32.4ms   remaining: 6.64ms
83:     learn: 0.2122409        total: 32.9ms   remaining: 6.26ms
84:     learn: 0.2087450        total: 33.2ms   remaining: 5.86ms
85:     learn: 0.2055088        total: 33.6ms   remaining: 5.46ms
86:     learn: 0.2052941        total: 34.1ms   remaining: 5.09ms
87:     learn: 0.2038302        total: 34.5ms   remaining: 4.7ms
88:     learn: 0.2036454        total: 34.8ms   remaining: 4.31ms
89:     learn: 0.2034393        total: 35.3ms   remaining: 3.92ms
90:     learn: 0.2032544        total: 35.6ms   remaining: 3.52ms
91:     learn: 0.2030706        total: 35.9ms   remaining: 3.12ms
92:     learn: 0.2012310        total: 36.3ms   remaining: 2.73ms
93:     learn: 0.2010350        total: 36.7ms   remaining: 2.34ms
94:     learn: 0.2008558        total: 37ms     remaining: 1.95ms
95:     learn: 0.2007043        total: 37.3ms   remaining: 1.55ms
96:     learn: 0.1988675        total: 37.6ms   remaining: 1.16ms
97:     learn: 0.1978040        total: 37.8ms   remaining: 772us
98:     learn: 0.1964691        total: 38.1ms   remaining: 385us
99:     learn: 0.1945938        total: 38.5ms   remaining: 0us
0:      learn: 0.6456347        total: 727us    remaining: 72.1ms
1:      learn: 0.6062180        total: 1.3ms    remaining: 63.8ms
2:      learn: 0.5680702        total: 1.68ms   remaining: 54.3ms
3:      learn: 0.5329261        total: 2.13ms   remaining: 51.2ms
4:      learn: 0.5043676        total: 2.55ms   remaining: 48.4ms
5:      learn: 0.4759388        total: 2.9ms    remaining: 45.4ms
6:      learn: 0.4539430        total: 3.25ms   remaining: 43.2ms
7:      learn: 0.4319193        total: 3.57ms   remaining: 41.1ms
8:      learn: 0.4194466        total: 3.9ms    remaining: 39.4ms
9:      learn: 0.4013858        total: 4.24ms   remaining: 38.1ms
10:     learn: 0.3896873        total: 4.58ms   remaining: 37.1ms
11:     learn: 0.3768529        total: 4.98ms   remaining: 36.5ms
12:     learn: 0.3663755        total: 5.36ms   remaining: 35.9ms
13:     learn: 0.3550723        total: 5.71ms   remaining: 35ms
14:     learn: 0.3445702        total: 6.04ms   remaining: 34.2ms
15:     learn: 0.3382772        total: 6.4ms    remaining: 33.6ms
16:     learn: 0.3305414        total: 6.74ms   remaining: 32.9ms
17:     learn: 0.3264405        total: 7.1ms    remaining: 32.3ms
18:     learn: 0.3176503        total: 7.39ms   remaining: 31.5ms
19:     learn: 0.3095673        total: 7.67ms   remaining: 30.7ms
20:     learn: 0.3046515        total: 8.06ms   remaining: 30.3ms
21:     learn: 0.2992104        total: 8.38ms   remaining: 29.7ms
22:     learn: 0.2935967        total: 8.7ms    remaining: 29.1ms
23:     learn: 0.2888063        total: 9.06ms   remaining: 28.7ms
24:     learn: 0.2861582        total: 9.39ms   remaining: 28.2ms
25:     learn: 0.2805254        total: 9.8ms    remaining: 27.9ms
26:     learn: 0.2761742        total: 10.2ms   remaining: 27.5ms
27:     learn: 0.2733214        total: 10.5ms   remaining: 27ms
28:     learn: 0.2699129        total: 10.9ms   remaining: 26.7ms
```

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29:     learn: 0.2663464        total: 11.4ms   remaining: 26.5ms
30:     learn: 0.2637635        total: 11.9ms   remaining: 26.5ms
31:     learn: 0.2612950        total: 12.3ms   remaining: 26.1ms
32:     learn: 0.2587305        total: 12.6ms   remaining: 25.7ms
33:     learn: 0.2567078        total: 13ms     remaining: 25.2ms
34:     learn: 0.2518482        total: 13.3ms   remaining: 24.7ms
35:     learn: 0.2501773        total: 13.6ms   remaining: 24.2ms
36:     learn: 0.2467570        total: 14ms     remaining: 23.9ms
37:     learn: 0.2439625        total: 14.4ms   remaining: 23.5ms
38:     learn: 0.2416617        total: 14.8ms   remaining: 23.2ms
39:     learn: 0.2397189        total: 15.2ms   remaining: 22.8ms
40:     learn: 0.2391196        total: 15.5ms   remaining: 22.4ms
41:     learn: 0.2376450        total: 15.9ms   remaining: 22ms
42:     learn: 0.2360441        total: 16.4ms   remaining: 21.7ms
43:     learn: 0.2346937        total: 16.7ms   remaining: 21.3ms
44:     learn: 0.2317247        total: 17.1ms   remaining: 20.9ms
45:     learn: 0.2286115        total: 17.4ms   remaining: 20.4ms
46:     learn: 0.2281559        total: 17.7ms   remaining: 19.9ms
47:     learn: 0.2255365        total: 17.9ms   remaining: 19.4ms
48:     learn: 0.2226056        total: 18.2ms   remaining: 18.9ms
49:     learn: 0.2206780        total: 18.5ms   remaining: 18.5ms
50:     learn: 0.2186788        total: 18.8ms   remaining: 18ms
51:     learn: 0.2162263        total: 19ms     remaining: 17.6ms
52:     learn: 0.2158720        total: 19.3ms   remaining: 17.1ms
53:     learn: 0.2122348        total: 19.6ms   remaining: 16.7ms
54:     learn: 0.2118906        total: 19.9ms   remaining: 16.3ms
55:     learn: 0.2099857        total: 20.2ms   remaining: 15.9ms
56:     learn: 0.2079409        total: 20.6ms   remaining: 15.5ms
57:     learn: 0.2076515        total: 20.9ms   remaining: 15.2ms
58:     learn: 0.2061229        total: 21.3ms   remaining: 14.8ms
59:     learn: 0.2052302        total: 21.6ms   remaining: 14.4ms
60:     learn: 0.2026678        total: 22.1ms   remaining: 14.1ms
61:     learn: 0.2002947        total: 22.4ms   remaining: 13.7ms
62:     learn: 0.1989098        total: 22.8ms   remaining: 13.4ms
63:     learn: 0.1981136        total: 23ms     remaining: 13ms
64:     learn: 0.1953551        total: 23.4ms   remaining: 12.6ms
65:     learn: 0.1935116        total: 23.7ms   remaining: 12.2ms
66:     learn: 0.1925583        total: 24.1ms   remaining: 11.9ms
67:     learn: 0.1896664        total: 24.4ms   remaining: 11.5ms
68:     learn: 0.1883006        total: 24.7ms   remaining: 11.1ms
69:     learn: 0.1880252        total: 25ms     remaining: 10.7ms
70:     learn: 0.1858537        total: 25.2ms   remaining: 10.3ms
71:     learn: 0.1856119        total: 25.6ms   remaining: 9.95ms
72:     learn: 0.1838157        total: 25.9ms   remaining: 9.56ms
73:     learn: 0.1821406        total: 26.1ms   remaining: 9.18ms
74:     learn: 0.1814560        total: 26.4ms   remaining: 8.81ms
75:     learn: 0.1791394        total: 26.8ms   remaining: 8.46ms
76:     learn: 0.1786920        total: 27.2ms   remaining: 8.14ms
```

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77:     learn: 0.1782643        total: 27.7ms   remaining: 7.8ms
78:     learn: 0.1780689        total: 28ms     remaining: 7.45ms
79:     learn: 0.1771111        total: 28.4ms   remaining: 7.09ms
80:     learn: 0.1762211        total: 28.7ms   remaining: 6.74ms
81:     learn: 0.1756083        total: 29ms     remaining: 6.37ms
82:     learn: 0.1741184        total: 29.3ms   remaining: 6.01ms
83:     learn: 0.1738867        total: 29.7ms   remaining: 5.65ms
84:     learn: 0.1735345        total: 30ms     remaining: 5.29ms
85:     learn: 0.1710406        total: 30.3ms   remaining: 4.93ms
86:     learn: 0.1708243        total: 30.6ms   remaining: 4.57ms
87:     learn: 0.1706236        total: 30.9ms   remaining: 4.21ms
88:     learn: 0.1686447        total: 31.1ms   remaining: 3.85ms
89:     learn: 0.1684296        total: 31.4ms   remaining: 3.49ms
90:     learn: 0.1682179        total: 31.7ms   remaining: 3.13ms
91:     learn: 0.1678717        total: 32ms     remaining: 2.78ms
92:     learn: 0.1675340        total: 32.4ms   remaining: 2.44ms
93:     learn: 0.1661034        total: 32.9ms   remaining: 2.1ms
94:     learn: 0.1658958        total: 33.2ms   remaining: 1.75ms
95:     learn: 0.1636801        total: 33.6ms   remaining: 1.4ms
96:     learn: 0.1633572        total: 34ms     remaining: 1.05ms
97:     learn: 0.1622704        total: 34.3ms   remaining: 700us
98:     learn: 0.1620816        total: 34.6ms   remaining: 349us
99:     learn: 0.1619043        total: 34.9ms   remaining: 0us
0:      learn: 0.6473279        total: 408us    remaining: 40.4ms
1:      learn: 0.6148093        total: 738us    remaining: 36.2ms
2:      learn: 0.5850323        total: 1.05ms   remaining: 34.1ms
3:      learn: 0.5570177        total: 1.35ms   remaining: 32.5ms
4:      learn: 0.5322961        total: 1.68ms   remaining: 31.8ms
5:      learn: 0.5040102        total: 1.99ms   remaining: 31.2ms
6:      learn: 0.4834235        total: 2.31ms   remaining: 30.7ms
7:      learn: 0.4676510        total: 2.69ms   remaining: 30.9ms
8:      learn: 0.4561962        total: 3.01ms   remaining: 30.5ms
9:      learn: 0.4390729        total: 3.33ms   remaining: 29.9ms
10:     learn: 0.4235067        total: 3.67ms   remaining: 29.7ms
11:     learn: 0.4125231        total: 4.04ms   remaining: 29.7ms
12:     learn: 0.4046089        total: 4.43ms   remaining: 29.7ms
13:     learn: 0.3930495        total: 4.81ms   remaining: 29.6ms
14:     learn: 0.3840972        total: 5.13ms   remaining: 29.1ms
15:     learn: 0.3757912        total: 5.42ms   remaining: 28.4ms
16:     learn: 0.3688992        total: 5.71ms   remaining: 27.9ms
17:     learn: 0.3647522        total: 6.02ms   remaining: 27.4ms
18:     learn: 0.3590093        total: 6.36ms   remaining: 27.1ms
19:     learn: 0.3529448        total: 6.63ms   remaining: 26.5ms
20:     learn: 0.3486382        total: 6.93ms   remaining: 26.1ms
21:     learn: 0.3417884        total: 7.21ms   remaining: 25.6ms
22:     learn: 0.3353003        total: 7.48ms   remaining: 25ms
23:     learn: 0.3310296        total: 7.75ms   remaining: 24.5ms
24:     learn: 0.3277651        total: 8.02ms   remaining: 24.1ms
```

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25:     learn: 0.3225300        total: 8.29ms   remaining: 23.6ms
26:     learn: 0.3186351        total: 8.56ms   remaining: 23.1ms
27:     learn: 0.3152152        total: 8.87ms   remaining: 22.8ms
28:     learn: 0.3122304        total: 9.2ms    remaining: 22.5ms
29:     learn: 0.3095250        total: 9.51ms   remaining: 22.2ms
30:     learn: 0.3070531        total: 9.93ms   remaining: 22.1ms
31:     learn: 0.3029825        total: 10.3ms   remaining: 21.8ms
32:     learn: 0.3000688        total: 10.6ms   remaining: 21.5ms
33:     learn: 0.2971156        total: 10.9ms   remaining: 21.1ms
34:     learn: 0.2945908        total: 11.2ms   remaining: 20.9ms
35:     learn: 0.2900502        total: 11.5ms   remaining: 20.5ms
36:     learn: 0.2869694        total: 11.8ms   remaining: 20.2ms
37:     learn: 0.2843328        total: 12.2ms   remaining: 19.9ms
38:     learn: 0.2820623        total: 12.5ms   remaining: 19.5ms
39:     learn: 0.2799796        total: 12.8ms   remaining: 19.2ms
40:     learn: 0.2769255        total: 13.1ms   remaining: 18.8ms
41:     learn: 0.2750004        total: 13.3ms   remaining: 18.4ms
42:     learn: 0.2732151        total: 13.6ms   remaining: 18ms
43:     learn: 0.2708592        total: 13.9ms   remaining: 17.7ms
44:     learn: 0.2690191        total: 14.2ms   remaining: 17.3ms
45:     learn: 0.2651236        total: 14.5ms   remaining: 17ms
46:     learn: 0.2644959        total: 14.8ms   remaining: 16.7ms
47:     learn: 0.2632556        total: 15.2ms   remaining: 16.4ms
48:     learn: 0.2618660        total: 15.6ms   remaining: 16.2ms
49:     learn: 0.2592735        total: 15.9ms   remaining: 15.9ms
50:     learn: 0.2591002        total: 16.3ms   remaining: 15.6ms
51:     learn: 0.2575135        total: 16.6ms   remaining: 15.3ms
52:     learn: 0.2562371        total: 16.9ms   remaining: 14.9ms
53:     learn: 0.2543259        total: 17.2ms   remaining: 14.6ms
54:     learn: 0.2519242        total: 17.5ms   remaining: 14.3ms
55:     learn: 0.2495607        total: 17.9ms   remaining: 14ms
56:     learn: 0.2493733        total: 18.1ms   remaining: 13.7ms
57:     learn: 0.2467686        total: 18.5ms   remaining: 13.4ms
58:     learn: 0.2446473        total: 18.8ms   remaining: 13.1ms
59:     learn: 0.2430531        total: 19.2ms   remaining: 12.8ms
60:     learn: 0.2403240        total: 19.5ms   remaining: 12.5ms
61:     learn: 0.2383795        total: 19.8ms   remaining: 12.1ms
62:     learn: 0.2371091        total: 20.2ms   remaining: 11.9ms
63:     learn: 0.2367967        total: 20.6ms   remaining: 11.6ms
64:     learn: 0.2348113        total: 21ms     remaining: 11.3ms
65:     learn: 0.2346458        total: 21.3ms   remaining: 11ms
66:     learn: 0.2344577        total: 21.6ms   remaining: 10.7ms
67:     learn: 0.2342207        total: 21.9ms   remaining: 10.3ms
68:     learn: 0.2340569        total: 22.2ms   remaining: 9.97ms
69:     learn: 0.2338843        total: 22.5ms   remaining: 9.63ms
70:     learn: 0.2317443        total: 22.8ms   remaining: 9.29ms
71:     learn: 0.2315699        total: 23.1ms   remaining: 8.97ms
72:     learn: 0.2313977        total: 23.4ms   remaining: 8.64ms
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73:     learn: 0.2290429        total: 23.7ms   remaining: 8.31ms
74:     learn: 0.2289038        total: 23.9ms   remaining: 7.97ms
75:     learn: 0.2286427        total: 24.2ms   remaining: 7.63ms
76:     learn: 0.2283899        total: 24.4ms   remaining: 7.3ms
77:     learn: 0.2282446        total: 24.7ms   remaining: 6.97ms
78:     learn: 0.2280006        total: 25ms     remaining: 6.64ms
79:     learn: 0.2278579        total: 25.2ms   remaining: 6.31ms
80:     learn: 0.2259784        total: 25.6ms   remaining: 6ms
81:     learn: 0.2258225        total: 25.9ms   remaining: 5.68ms
82:     learn: 0.2232527        total: 26.3ms   remaining: 5.39ms
83:     learn: 0.2230118        total: 26.7ms   remaining: 5.09ms
84:     learn: 0.2228726        total: 27.1ms   remaining: 4.78ms
85:     learn: 0.2208024        total: 27.4ms   remaining: 4.46ms
86:     learn: 0.2206626        total: 27.6ms   remaining: 4.13ms
87:     learn: 0.2205245        total: 27.9ms   remaining: 3.8ms
88:     learn: 0.2189714        total: 28.2ms   remaining: 3.48ms
89:     learn: 0.2173222        total: 28.4ms   remaining: 3.16ms
90:     learn: 0.2171901        total: 28.7ms   remaining: 2.84ms
91:     learn: 0.2169696        total: 29ms     remaining: 2.52ms
92:     learn: 0.2167709        total: 29.3ms   remaining: 2.2ms
93:     learn: 0.2165642        total: 29.5ms   remaining: 1.88ms
94:     learn: 0.2163774        total: 29.8ms   remaining: 1.57ms
95:     learn: 0.2162500        total: 30.1ms   remaining: 1.25ms
96:     learn: 0.2145577        total: 30.3ms   remaining: 937us
97:     learn: 0.2130233        total: 30.6ms   remaining: 624us
98:     learn: 0.2128303        total: 30.8ms   remaining: 311us
99:     learn: 0.2111448        total: 31.2ms   remaining: 0us
0:      learn: 0.6512536        total: 379us    remaining: 37.6ms
1:      learn: 0.6185441        total: 689us    remaining: 33.8ms
2:      learn: 0.5888687        total: 987us    remaining: 31.9ms
3:      learn: 0.5572560        total: 1.27ms   remaining: 30.4ms
4:      learn: 0.5334485        total: 1.56ms   remaining: 29.6ms
5:      learn: 0.5107968        total: 1.96ms   remaining: 30.8ms
6:      learn: 0.4902404        total: 2.33ms   remaining: 30.9ms
7:      learn: 0.4712948        total: 2.65ms   remaining: 30.4ms
8:      learn: 0.4598448        total: 2.95ms   remaining: 29.9ms
9:      learn: 0.4424620        total: 3.22ms   remaining: 29ms
10:     learn: 0.4290555        total: 3.5ms    remaining: 28.3ms
11:     learn: 0.4162750        total: 3.76ms   remaining: 27.6ms
12:     learn: 0.4094101        total: 4.36ms   remaining: 29.2ms
13:     learn: 0.3976256        total: 4.99ms   remaining: 30.7ms
14:     learn: 0.3870403        total: 5.31ms   remaining: 30.1ms
15:     learn: 0.3798596        total: 5.59ms   remaining: 29.4ms
16:     learn: 0.3735979        total: 5.88ms   remaining: 28.7ms
17:     learn: 0.3677921        total: 6.21ms   remaining: 28.3ms
18:     learn: 0.3617737        total: 6.49ms   remaining: 27.7ms
19:     learn: 0.3585577        total: 6.78ms   remaining: 27.1ms
20:     learn: 0.3527014        total: 7.11ms   remaining: 26.8ms
```

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21:     learn: 0.3464449        total: 7.41ms   remaining: 26.3ms
22:     learn: 0.3407151        total: 7.74ms   remaining: 25.9ms
23:     learn: 0.3356881        total: 8.03ms   remaining: 25.4ms
24:     learn: 0.3320706        total: 8.36ms   remaining: 25.1ms
25:     learn: 0.3269884        total: 8.75ms   remaining: 24.9ms
26:     learn: 0.3231148        total: 9.06ms   remaining: 24.5ms
27:     learn: 0.3188511        total: 9.37ms   remaining: 24.1ms
28:     learn: 0.3162184        total: 9.66ms   remaining: 23.7ms
29:     learn: 0.3133034        total: 9.96ms   remaining: 23.2ms
30:     learn: 0.3110258        total: 10.3ms   remaining: 22.8ms
31:     learn: 0.3086389        total: 10.5ms   remaining: 22.3ms
32:     learn: 0.3072933        total: 10.8ms   remaining: 21.9ms
33:     learn: 0.3055023        total: 11.1ms   remaining: 21.5ms
34:     learn: 0.3013161        total: 11.4ms   remaining: 21.1ms
35:     learn: 0.2988385        total: 11.6ms   remaining: 20.7ms
36:     learn: 0.2959385        total: 11.9ms   remaining: 20.3ms
37:     learn: 0.2953719        total: 12.2ms   remaining: 19.9ms
38:     learn: 0.2939975        total: 12.5ms   remaining: 19.5ms
39:     learn: 0.2933114        total: 12.8ms   remaining: 19.2ms
40:     learn: 0.2903487        total: 13.1ms   remaining: 18.9ms
41:     learn: 0.2896947        total: 13.5ms   remaining: 18.7ms
42:     learn: 0.2888224        total: 13.8ms   remaining: 18.3ms
43:     learn: 0.2877821        total: 14.1ms   remaining: 17.9ms
44:     learn: 0.2852888        total: 14.4ms   remaining: 17.6ms
45:     learn: 0.2819905        total: 14.7ms   remaining: 17.2ms
46:     learn: 0.2806828        total: 14.9ms   remaining: 16.8ms
47:     learn: 0.2800178        total: 15.2ms   remaining: 16.5ms
48:     learn: 0.2776477        total: 15.5ms   remaining: 16.1ms
49:     learn: 0.2763057        total: 15.7ms   remaining: 15.7ms
50:     learn: 0.2734362        total: 16ms     remaining: 15.4ms
51:     learn: 0.2715796        total: 16.4ms   remaining: 15.1ms
52:     learn: 0.2704280        total: 16.7ms   remaining: 14.8ms
53:     learn: 0.2686263        total: 17ms     remaining: 14.5ms
54:     learn: 0.2672539        total: 17.4ms   remaining: 14.2ms
55:     learn: 0.2666353        total: 17.7ms   remaining: 13.9ms
56:     learn: 0.2639923        total: 18ms     remaining: 13.6ms
57:     learn: 0.2626136        total: 18.3ms   remaining: 13.2ms
58:     learn: 0.2606094        total: 18.6ms   remaining: 13ms
59:     learn: 0.2589489        total: 18.9ms   remaining: 12.6ms
60:     learn: 0.2572849        total: 19.2ms   remaining: 12.3ms
61:     learn: 0.2554777        total: 19.5ms   remaining: 11.9ms
62:     learn: 0.2543873        total: 19.8ms   remaining: 11.6ms
63:     learn: 0.2538288        total: 20.2ms   remaining: 11.4ms
64:     learn: 0.2532557        total: 20.5ms   remaining: 11ms
65:     learn: 0.2520963        total: 20.8ms   remaining: 10.7ms
66:     learn: 0.2495266        total: 21.1ms   remaining: 10.4ms
67:     learn: 0.2464514        total: 21.4ms   remaining: 10.1ms
68:     learn: 0.2459180        total: 21.6ms   remaining: 9.73ms
```

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69:     learn: 0.2454247        total: 21.9ms   remaining: 9.39ms
70:     learn: 0.2427024        total: 22.2ms   remaining: 9.06ms
71:     learn: 0.2420519        total: 22.4ms   remaining: 8.73ms
72:     learn: 0.2398557        total: 22.7ms   remaining: 8.4ms
73:     learn: 0.2394235        total: 23ms     remaining: 8.07ms
74:     learn: 0.2390066        total: 23.2ms   remaining: 7.75ms
75:     learn: 0.2385638        total: 23.5ms   remaining: 7.43ms
76:     learn: 0.2381927        total: 24ms     remaining: 7.16ms
77:     learn: 0.2378339        total: 24.3ms   remaining: 6.86ms
78:     learn: 0.2374863        total: 24.9ms   remaining: 6.61ms
79:     learn: 0.2371319        total: 25.2ms   remaining: 6.3ms
80:     learn: 0.2358949        total: 25.5ms   remaining: 5.99ms
81:     learn: 0.2355564        total: 25.8ms   remaining: 5.67ms
82:     learn: 0.2344623        total: 26.1ms   remaining: 5.34ms
83:     learn: 0.2328887        total: 26.4ms   remaining: 5.02ms
84:     learn: 0.2325849        total: 26.6ms   remaining: 4.7ms
85:     learn: 0.2317007        total: 26.9ms   remaining: 4.38ms
86:     learn: 0.2302485        total: 27.2ms   remaining: 4.06ms
87:     learn: 0.2299447        total: 27.4ms   remaining: 3.74ms
88:     learn: 0.2288041        total: 27.7ms   remaining: 3.43ms
89:     learn: 0.2264701        total: 28ms     remaining: 3.11ms
90:     learn: 0.2261828        total: 28.2ms   remaining: 2.79ms
91:     learn: 0.2236706        total: 28.5ms   remaining: 2.48ms
92:     learn: 0.2206487        total: 28.8ms   remaining: 2.17ms
93:     learn: 0.2203628        total: 29.1ms   remaining: 1.85ms
94:     learn: 0.2200996        total: 29.4ms   remaining: 1.55ms
95:     learn: 0.2198327        total: 29.7ms   remaining: 1.24ms
96:     learn: 0.2195736        total: 30.1ms   remaining: 930us
97:     learn: 0.2183557        total: 30.4ms   remaining: 621us
98:     learn: 0.2181031        total: 30.8ms   remaining: 310us
99:     learn: 0.2171520        total: 31.1ms   remaining: 0us
0:      learn: 0.6473232        total: 498us    remaining: 49.4ms
1:      learn: 0.6107401        total: 1.55ms   remaining: 75.8ms
2:      learn: 0.5765295        total: 2.21ms   remaining: 71.4ms
3:      learn: 0.5415175        total: 2.73ms   remaining: 65.5ms
4:      learn: 0.5188767        total: 3.14ms   remaining: 59.7ms
5:      learn: 0.4995217        total: 3.5ms    remaining: 54.9ms
6:      learn: 0.4736690        total: 3.79ms   remaining: 50.3ms
7:      learn: 0.4538167        total: 4.28ms   remaining: 49.3ms
8:      learn: 0.4393081        total: 4.81ms   remaining: 48.7ms
9:      learn: 0.4181542        total: 5.53ms   remaining: 49.8ms
10:     learn: 0.3999662        total: 5.89ms   remaining: 47.6ms
11:     learn: 0.3868236        total: 6.18ms   remaining: 45.3ms
12:     learn: 0.3710162        total: 6.45ms   remaining: 43.2ms
13:     learn: 0.3584300        total: 6.73ms   remaining: 41.3ms
14:     learn: 0.3475143        total: 7.02ms   remaining: 39.8ms
15:     learn: 0.3388738        total: 7.3ms    remaining: 38.3ms
16:     learn: 0.3317221        total: 7.6ms    remaining: 37.1ms
```

```
17:     learn: 0.3235178        total: 7.88ms   remaining: 35.9ms
18:     learn: 0.3146136        total: 8.18ms   remaining: 34.9ms
19:     learn: 0.3057683        total: 8.46ms   remaining: 33.8ms
20:     learn: 0.2986396        total: 8.73ms   remaining: 32.8ms
21:     learn: 0.2917332        total: 9.02ms   remaining: 32ms
22:     learn: 0.2842804        total: 9.31ms   remaining: 31.2ms
23:     learn: 0.2798060        total: 9.58ms   remaining: 30.3ms
24:     learn: 0.2767540        total: 9.94ms   remaining: 29.8ms
25:     learn: 0.2726943        total: 10.2ms   remaining: 29.1ms
26:     learn: 0.2664005        total: 10.6ms   remaining: 28.6ms
27:     learn: 0.2645947        total: 11ms     remaining: 28.2ms
28:     learn: 0.2617061        total: 11.3ms   remaining: 27.7ms
29:     learn: 0.2583838        total: 11.6ms   remaining: 27.2ms
30:     learn: 0.2553066        total: 11.9ms   remaining: 26.6ms
31:     learn: 0.2511462        total: 12.2ms   remaining: 26ms
32:     learn: 0.2498979        total: 12.5ms   remaining: 25.4ms
33:     learn: 0.2484001        total: 12.8ms   remaining: 24.8ms
34:     learn: 0.2448236        total: 13.1ms   remaining: 24.4ms
35:     learn: 0.2415654        total: 13.5ms   remaining: 24ms
36:     learn: 0.2385654        total: 13.9ms   remaining: 23.7ms
37:     learn: 0.2367398        total: 14.2ms   remaining: 23.2ms
38:     learn: 0.2336337        total: 14.6ms   remaining: 22.8ms
39:     learn: 0.2311174        total: 14.9ms   remaining: 22.3ms
40:     learn: 0.2299941        total: 15.2ms   remaining: 21.8ms
41:     learn: 0.2284367        total: 15.5ms   remaining: 21.4ms
42:     learn: 0.2267195        total: 16ms     remaining: 21.2ms
43:     learn: 0.2258529        total: 16.3ms   remaining: 20.8ms
44:     learn: 0.2233390        total: 16.6ms   remaining: 20.3ms
45:     learn: 0.2205758        total: 16.9ms   remaining: 19.8ms
46:     learn: 0.2195096        total: 17.2ms   remaining: 19.4ms
47:     learn: 0.2192029        total: 17.4ms   remaining: 18.9ms
48:     learn: 0.2158608        total: 17.7ms   remaining: 18.4ms
49:     learn: 0.2154905        total: 18ms     remaining: 18ms
50:     learn: 0.2148586        total: 18.3ms   remaining: 17.5ms
51:     learn: 0.2131128        total: 18.5ms   remaining: 17.1ms
52:     learn: 0.2121610        total: 18.8ms   remaining: 16.7ms
53:     learn: 0.2108324        total: 19.1ms   remaining: 16.2ms
54:     learn: 0.2085292        total: 19.3ms   remaining: 15.8ms
55:     learn: 0.2073711        total: 19.6ms   remaining: 15.4ms
56:     learn: 0.2062805        total: 19.9ms   remaining: 15ms
57:     learn: 0.2056249        total: 20.2ms   remaining: 14.6ms
58:     learn: 0.2047219        total: 20.5ms   remaining: 14.2ms
59:     learn: 0.2041473        total: 20.7ms   remaining: 13.8ms
60:     learn: 0.2035976        total: 21.1ms   remaining: 13.5ms
61:     learn: 0.2016142        total: 21.5ms   remaining: 13.2ms
62:     learn: 0.2006478        total: 21.9ms   remaining: 12.9ms
63:     learn: 0.1989969        total: 22.2ms   remaining: 12.5ms
64:     learn: 0.1982754        total: 22.5ms   remaining: 12.1ms
```

```
65:     learn: 0.1967238        total: 22.7ms   remaining: 11.7ms
66:     learn: 0.1948992        total: 23ms     remaining: 11.3ms
67:     learn: 0.1934120        total: 23.3ms   remaining: 11ms
68:     learn: 0.1915395        total: 23.6ms   remaining: 10.6ms
69:     learn: 0.1897706        total: 23.9ms   remaining: 10.2ms
70:     learn: 0.1893261        total: 24.2ms   remaining: 9.88ms
71:     learn: 0.1885469        total: 24.5ms   remaining: 9.52ms
72:     learn: 0.1881286        total: 24.8ms   remaining: 9.16ms
73:     learn: 0.1877258        total: 25ms     remaining: 8.8ms
74:     learn: 0.1865056        total: 25.3ms   remaining: 8.45ms
75:     learn: 0.1853701        total: 25.6ms   remaining: 8.09ms
76:     learn: 0.1849918        total: 25.9ms   remaining: 7.75ms
77:     learn: 0.1839426        total: 26.3ms   remaining: 7.41ms
78:     learn: 0.1824159        total: 26.6ms   remaining: 7.08ms
79:     learn: 0.1819284        total: 27ms     remaining: 6.75ms
80:     learn: 0.1810518        total: 27.4ms   remaining: 6.43ms
81:     learn: 0.1796987        total: 27.8ms   remaining: 6.1ms
82:     learn: 0.1783912        total: 28.1ms   remaining: 5.76ms
83:     learn: 0.1769826        total: 28.5ms   remaining: 5.42ms
84:     learn: 0.1761927        total: 28.7ms   remaining: 5.07ms
85:     learn: 0.1752128        total: 29ms     remaining: 4.72ms
86:     learn: 0.1749125        total: 29.3ms   remaining: 4.38ms
87:     learn: 0.1737669        total: 29.6ms   remaining: 4.03ms
88:     learn: 0.1728581        total: 29.8ms   remaining: 3.69ms
89:     learn: 0.1726398        total: 30.1ms   remaining: 3.35ms
90:     learn: 0.1709722        total: 30.4ms   remaining: 3ms
91:     learn: 0.1689873        total: 30.7ms   remaining: 2.67ms
92:     learn: 0.1686568        total: 30.9ms   remaining: 2.33ms
93:     learn: 0.1676243        total: 31.2ms   remaining: 1.99ms
94:     learn: 0.1673603        total: 31.5ms   remaining: 1.66ms
95:     learn: 0.1663550        total: 31.8ms   remaining: 1.32ms
96:     learn: 0.1659042        total: 32.1ms   remaining: 991us
97:     learn: 0.1643982        total: 32.4ms   remaining: 661us
98:     learn: 0.1641549        total: 32.7ms   remaining: 330us
99:     learn: 0.1622708        total: 33.1ms   remaining: 0us
0:      learn: 0.6506462        total: 807us    remaining: 79.9ms
1:      learn: 0.6173352        total: 1.18ms   remaining: 57.7ms
2:      learn: 0.5818952        total: 1.48ms   remaining: 48ms
3:      learn: 0.5507920        total: 1.77ms   remaining: 42.5ms
4:      learn: 0.5197079        total: 2.11ms   remaining: 40.2ms
5:      learn: 0.4969017        total: 2.41ms   remaining: 37.8ms
6:      learn: 0.4763590        total: 2.71ms   remaining: 36ms
7:      learn: 0.4612186        total: 2.99ms   remaining: 34.4ms
8:      learn: 0.4491238        total: 3.25ms   remaining: 32.9ms
9:      learn: 0.4310028        total: 3.55ms   remaining: 31.9ms
10:     learn: 0.4168179        total: 3.98ms   remaining: 32.2ms
11:     learn: 0.4059396        total: 4.34ms   remaining: 31.9ms
12:     learn: 0.3999390        total: 4.76ms   remaining: 31.9ms
```

```
13:     learn: 0.3875159        total: 5.31ms   remaining: 32.6ms
14:     learn: 0.3789780        total: 5.83ms   remaining: 33ms
15:     learn: 0.3704261        total: 6.19ms   remaining: 32.5ms
16:     learn: 0.3642889        total: 6.54ms   remaining: 31.9ms
17:     learn: 0.3580957        total: 6.87ms   remaining: 31.3ms
18:     learn: 0.3517428        total: 7.19ms   remaining: 30.7ms
19:     learn: 0.3469472        total: 7.53ms   remaining: 30.1ms
20:     learn: 0.3405807        total: 7.83ms   remaining: 29.5ms
21:     learn: 0.3317179        total: 8.13ms   remaining: 28.8ms
22:     learn: 0.3267873        total: 8.4ms    remaining: 28.1ms
23:     learn: 0.3222957        total: 8.7ms    remaining: 27.5ms
24:     learn: 0.3185069        total: 8.96ms   remaining: 26.9ms
25:     learn: 0.3140547        total: 9.24ms   remaining: 26.3ms
26:     learn: 0.3079222        total: 9.51ms   remaining: 25.7ms
27:     learn: 0.3051746        total: 9.82ms   remaining: 25.3ms
28:     learn: 0.3016760        total: 10.1ms   remaining: 24.8ms
29:     learn: 0.2986727        total: 10.5ms   remaining: 24.5ms
30:     learn: 0.2962058        total: 10.8ms   remaining: 24.1ms
31:     learn: 0.2926683        total: 11.2ms   remaining: 23.8ms
32:     learn: 0.2903987        total: 11.5ms   remaining: 23.4ms
33:     learn: 0.2880039        total: 11.9ms   remaining: 23.1ms
34:     learn: 0.2848055        total: 12.2ms   remaining: 22.7ms
35:     learn: 0.2815586        total: 12.6ms   remaining: 22.3ms
36:     learn: 0.2802904        total: 12.9ms   remaining: 21.9ms
37:     learn: 0.2769131        total: 13.2ms   remaining: 21.5ms
38:     learn: 0.2742208        total: 13.5ms   remaining: 21.1ms
39:     learn: 0.2734504        total: 13.8ms   remaining: 20.7ms
40:     learn: 0.2709064        total: 14.1ms   remaining: 20.3ms
41:     learn: 0.2684816        total: 14.4ms   remaining: 19.9ms
42:     learn: 0.2661862        total: 14.7ms   remaining: 19.4ms
43:     learn: 0.2639899        total: 15ms     remaining: 19.1ms
44:     learn: 0.2605297        total: 15.4ms   remaining: 18.8ms
45:     learn: 0.2573605        total: 15.7ms   remaining: 18.4ms
46:     learn: 0.2570867        total: 16.1ms   remaining: 18.1ms
47:     learn: 0.2568234        total: 16.4ms   remaining: 17.8ms
48:     learn: 0.2547602        total: 17ms     remaining: 17.6ms
49:     learn: 0.2521169        total: 17.7ms   remaining: 17.7ms
50:     learn: 0.2517241        total: 18.1ms   remaining: 17.4ms
51:     learn: 0.2495326        total: 18.4ms   remaining: 17ms
52:     learn: 0.2471033        total: 18.8ms   remaining: 16.7ms
53:     learn: 0.2456991        total: 19.1ms   remaining: 16.3ms
54:     learn: 0.2453554        total: 19.4ms   remaining: 15.9ms
55:     learn: 0.2432763        total: 19.7ms   remaining: 15.5ms
56:     learn: 0.2430734        total: 20ms     remaining: 15.1ms
57:     learn: 0.2413951        total: 20.3ms   remaining: 14.7ms
58:     learn: 0.2390237        total: 20.5ms   remaining: 14.3ms
59:     learn: 0.2375514        total: 20.8ms   remaining: 13.9ms
60:     learn: 0.2360075        total: 21.1ms   remaining: 13.5ms
```

```
61:     learn: 0.2343074        total: 21.3ms   remaining: 13.1ms
62:     learn: 0.2340046        total: 21.7ms   remaining: 12.7ms
63:     learn: 0.2326884        total: 22ms     remaining: 12.4ms
64:     learn: 0.2323543        total: 22.3ms   remaining: 12ms
65:     learn: 0.2320346        total: 22.6ms   remaining: 11.6ms
66:     learn: 0.2317279        total: 22.9ms   remaining: 11.3ms
67:     learn: 0.2315088        total: 23.3ms   remaining: 10.9ms
68:     learn: 0.2284857        total: 23.6ms   remaining: 10.6ms
69:     learn: 0.2243185        total: 24ms     remaining: 10.3ms
70:     learn: 0.2220902        total: 24.2ms   remaining: 9.9ms
71:     learn: 0.2218012        total: 24.5ms   remaining: 9.54ms
72:     learn: 0.2202206        total: 24.9ms   remaining: 9.2ms
73:     learn: 0.2185369        total: 25.2ms   remaining: 8.86ms
74:     learn: 0.2166974        total: 25.5ms   remaining: 8.51ms
75:     learn: 0.2164254        total: 25.8ms   remaining: 8.16ms
76:     learn: 0.2148583        total: 26.2ms   remaining: 7.83ms
77:     learn: 0.2146146        total: 26.5ms   remaining: 7.48ms
78:     learn: 0.2143794        total: 26.9ms   remaining: 7.14ms
79:     learn: 0.2141505        total: 27.2ms   remaining: 6.81ms
80:     learn: 0.2128185        total: 27.6ms   remaining: 6.48ms
81:     learn: 0.2125789        total: 28.1ms   remaining: 6.16ms
82:     learn: 0.2124278        total: 28.4ms   remaining: 5.82ms
83:     learn: 0.2122409        total: 28.7ms   remaining: 5.47ms
84:     learn: 0.2087450        total: 29.1ms   remaining: 5.13ms
85:     learn: 0.2055088        total: 29.4ms   remaining: 4.78ms
86:     learn: 0.2052941        total: 29.7ms   remaining: 4.44ms
87:     learn: 0.2038302        total: 30ms     remaining: 4.09ms
88:     learn: 0.2036454        total: 30.3ms   remaining: 3.74ms
89:     learn: 0.2034393        total: 30.6ms   remaining: 3.4ms
90:     learn: 0.2032544        total: 30.9ms   remaining: 3.06ms
91:     learn: 0.2030706        total: 31.2ms   remaining: 2.71ms
92:     learn: 0.2012310        total: 31.6ms   remaining: 2.38ms
93:     learn: 0.2010350        total: 31.9ms   remaining: 2.03ms
94:     learn: 0.2008558        total: 32.1ms   remaining: 1.69ms
95:     learn: 0.2007043        total: 32.5ms   remaining: 1.35ms
96:     learn: 0.1988675        total: 32.9ms   remaining: 1.02ms
97:     learn: 0.1978040        total: 33.4ms   remaining: 681us
98:     learn: 0.1964691        total: 34.1ms   remaining: 344us
99:     learn: 0.1945938        total: 34.4ms   remaining: 0us
Mean AUC: 0.937
Mean Precision: 0.829
Mean Recall: 0.714
Mean F1: 0.763
```

[85]:
```
# Evaluate the performance of the model on holdout test set.

evaluate_model(cb_best_estimator, X_test, y_test)
```

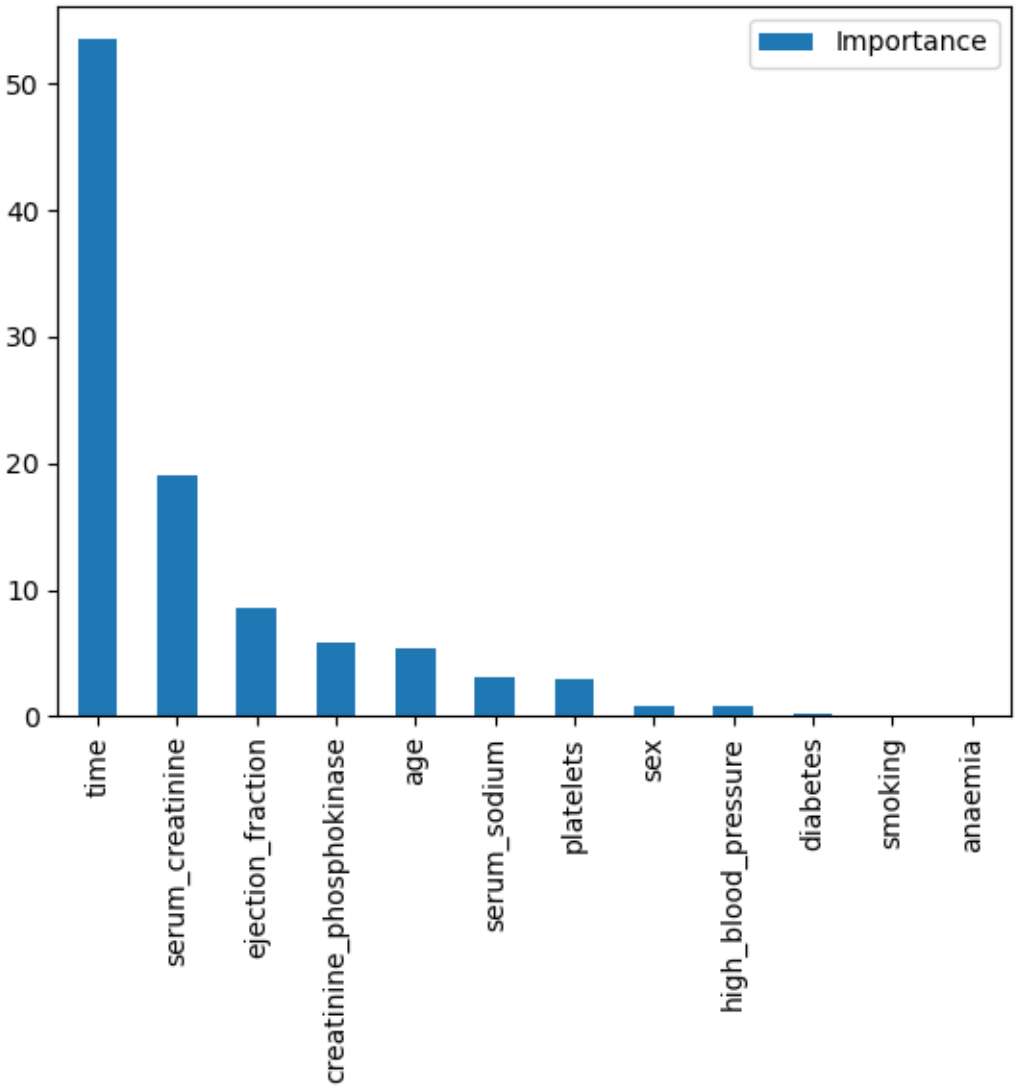
```
AUC: 0.861
Precision: 0.800
Recall: 0.649
F1: 0.716
==================================
Classification Report:
              precision    recall  f1-score   support

           0       0.78      0.89      0.83        53
           1       0.80      0.65      0.72        37

    accuracy                           0.79        90
   macro avg       0.79      0.77      0.77        90
weighted avg       0.79      0.79      0.78        90

==================================
Confusion Matrix:
[[47  6]
 [13 24]]
```

[86]:
```
draw_feature_importance(cb_best_estimator, X)
```


Importance
50
40
30
20
10
0
time
serum_creatinine
ejection_fraction
creatinine_phosphokinase
age
serum_sodium
platelets
sex
high_blood_pressure
diabetes
smoking
anaemia

[ ]: