Analyse exploratoire et modèle prédictif - Etude de cas du Titanic

Etape 1 - Data Understanding

“Le transatlantique Titanic, le plus grand paquebot du monde, appartenant à la compagnie anglaise The White Star Line, a heurté la nuit dernière contre un iceberg, près des bancs de Terre-Neuve, et a coulé. Fort heureusement, les secours ont été prompts, et les passagers, au nombre de 2700, y compris l'équipage, ont pu être tous sauvés.” C’est ce que nous pouvions lire le 16 avril 1912 dans l’Echo de Paris, mais aurions-nous pu prédire qui allait survivre ? C’est ce à quoi nous allons tenter de répondre à travers cette analyse.

Pour cela nous allons :

- Analyser et identifier les facteurs favorisant la survie
- Mettre en place un modèle de prédiction permettant de déterminer qui survivra sur nos données de test

Import des libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
!pip install xgboost
%matplotlib inline

from collections import Counter

from sklearn.model_selection import train_test_split, GridSearchCV,
StratifiedKFold, cross_val_score
from sklearn.model_selection import cross_validate, learning_curve
from sklearn.metrics import accuracy_score, precision_score,
recall_score, roc_curve, precision_recall_curve, auc, make_scorer,
confusion_matrix, f1_score, fbeta_score
from sklearn.preprocessing import StandardScaler, MinMaxScaler,
LabelBinarizer

# Importation des classifieurs Naive Bayes, régression logistique,
Bagging, RandomForest, AdaBoost, GradientBoost, arbres de décision,
SVM et XGBoost
from sklearn.naive_bayes import MultinomialNB
from sklearn.ensemble import BaggingClassifier,
RandomForestClassifier, AdaBoostClassifier,
GradientBoostingClassifier, ExtraTreesClassifier, VotingClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.svm import SVC
```

```
from xgboost import XGBClassifier

# On va définir ici le style de tracé (graphique)
plt.style.use('seaborn-notebook')
from matplotlib.ticker import StrMethodFormatter

sns.set(style='white', context='notebook', palette='deep')
```

```
Requirement already satisfied: xgboost in c:\users\kcho\anaconda3\lib\
site-packages (1.7.5)
Requirement already satisfied: scipy in c:\users\kcho\anaconda3\lib\
site-packages (from xgboost) (1.9.1)
Requirement already satisfied: numpy in c:\users\kcho\anaconda3\lib\
site-packages (from xgboost) (1.21.5)
```

Lecture des données d'entraînement et de test

```
# Ici nous allons chercher à nous connecter à nos données en indiquant
notre répertoire
train = pd.read_csv("C:/Users/kcho/Desktop/Titanic/train.csv")
test = pd.read_csv("C:/Users/kcho/Desktop/Titanic/test.csv")
IDtest = test["PassengerId"]
```

Pour réaliser cette étude de cas nous allons utiliser la méthode CRISP-DM c'est à dire :

Etape 2 : Data Understanding

Description du dataset 'train'

```
train.head()
```

```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                 Name     Sex   Age
SibSp  \
0                             Braund, Mr. Owen Harris    male  22.0
1
1  Cumings, Mrs. John Bradley (Florence Briggs Th...  female  38.0
1
2                              Heikkinen, Miss. Laina  female  26.0
0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0
1
4                            Allen, Mr. William Henry    male  35.0
0

   Parch            Ticket     Fare Cabin Embarked
```

```
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
```

Cet aperçu nous permet de mieux comprendre les différentes composantes de notre dataset et d'amener nos premières pistes de réflexions. Voici un résumé pour chacune des colonnes :

- PassengerId : Numéro d'identification unique d'un passager
- Survival : le passager a survécu ou non ; 1 s'il a survécu et 0 s'il n'a pas survécu.
- Pclass : Classe du ticket (1= première classe, 2= seconde classe,3= troisième classe). Peut être considéré comme un élément permettant d'évaluer le statut socio-économique de l'individu.
- Sex : sexe
- Age : âge en années
- Sibsp : Nombre de frères et sœurs / conjoints à bord du Titanic
- Parch : Nombre de parents / enfants à bord du Titanic
- Ticket : Numéro du ticket
- Fare : Tarif passager
- Cabin : Numéro de la cabine
- Embarked : Port d'embarquement (C = Cherbourg, Q = Queenstown, S = Southampton)

On peut les regrouper en fonction de la typologie de variables auxquelles elles appartiennent :

- Variables catégorielles :
  - Nominales (variables ayant deux catégories ou plus, mais qui n'ont pas d'ordre intrinsèque) Cabin Embarked (Port d'embarquement : C (Cherbourg),Q (Queenstown), S (Southampton)
  - Dichotomiques (variable nominale avec seulement deux catégories) Sex (Homme/Femme)
- Ordinales (variables ayant deux catégories ou plus, tout comme les variables nominales. Seules les catégories peuvent également être ordonnées ou classées.)
  - Pclass (statut socio-économique : 1 (Première classe, classe premium), 2 (Seconde classe), 3 (Troisème classe)
- Variables numériques :
  - Discrètes PassengerID(identifiant unique pour chaque passager) SibSp Parch Survived (notre résultat ou variable dépendante : 0 ou 1)
- Continues Age Fare

- Variables textuelles : Ticket (numéro de billet pour le passager) Name (nom du passager)

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  891 non-null    int64
 1   Survived     891 non-null    int64
 2   Pclass       891 non-null    int64
 3   Name         891 non-null    object
 4   Sex          891 non-null    object
 5   Age          714 non-null    float64
 6   SibSp        891 non-null    int64
 7   Parch        891 non-null    int64
 8   Ticket       891 non-null    object
 9   Fare         891 non-null    float64
 10  Cabin        204 non-null    object
 11  Embarked     889 non-null    object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.7+ KB
```

```
train.shape
```

```
(891, 12)
```

```
train.describe()
```

```
       PassengerId    Survived      Pclass         Age       SibSp  \
count   891.000000  891.000000  891.000000  714.000000  891.000000
mean    446.000000    0.383838    2.308642   29.699118    0.523008
std     257.353842    0.486592    0.836071   14.526497    1.102743
min       1.000000    0.000000    1.000000    0.420000    0.000000
25%     223.500000    0.000000    2.000000   20.125000    0.000000
50%     446.000000    0.000000    3.000000   28.000000    0.000000
75%     668.500000    1.000000    3.000000   38.000000    1.000000
max     891.000000    1.000000    3.000000   80.000000    8.000000

            Parch        Fare
count  891.000000  891.000000
mean     0.381594   32.204208
std      0.806057   49.693429
min      0.000000    0.000000
25%      0.000000    7.910400
50%      0.000000   14.454200
75%      0.000000   31.000000
max      6.000000  512.329200
```

Description du dataset 'test'

```
test.head()
```

```
   PassengerId  Pclass                                          Name
Sex  \
0          892       3                              Kelly, Mr. James
male
1          893       3              Wilkes, Mrs. James (Ellen Needs)
female
2          894       2                     Myles, Mr. Thomas Francis
male
3          895       3                              Wirz, Mr. Albert
male
4          896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)
female

    Age  SibSp  Parch   Ticket     Fare Cabin Embarked
0  34.5      0      0   330911   7.8292   NaN        Q
1  47.0      1      0   363272   7.0000   NaN        S
2  62.0      0      0   240276   9.6875   NaN        Q
3  27.0      0      0   315154   8.6625   NaN        S
4  22.0      1      1  3101298  12.2875   NaN        S
```

```
test.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 418 entries, 0 to 417
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  418 non-null    int64
 1   Pclass       418 non-null    int64
 2   Name         418 non-null    object
 3   Sex          418 non-null    object
 4   Age          332 non-null    float64
 5   SibSp        418 non-null    int64
 6   Parch        418 non-null    int64
 7   Ticket       418 non-null    object
 8   Fare         417 non-null    float64
 9   Cabin        91 non-null     object
 10  Embarked     418 non-null    object
dtypes: float64(2), int64(4), object(5)
memory usage: 36.0+ KB
```

```
test.shape
```

```
(418, 11)
```

```
test.describe()
```

```
       PassengerId      Pclass         Age       SibSp       Parch
Fare
count   418.000000  418.000000  332.000000  418.000000  418.000000
417.000000
mean   1100.500000    2.265550   30.272590    0.447368    0.392344
35.627188
std     120.810458    0.841838   14.181209    0.896760    0.981429
55.907576
min     892.000000    1.000000    0.170000    0.000000    0.000000
0.000000
25%     996.250000    1.000000   21.000000    0.000000    0.000000
7.895800
50%    1100.500000    3.000000   27.000000    0.000000    0.000000
14.454200
75%    1204.750000    3.000000   39.000000    1.000000    0.000000
31.500000
max    1309.000000    3.000000   76.000000    8.000000    9.000000
512.329200
```

Les tableaux ci-dessus nous permettent de constater certaines choses :

- Nous avons quelques variables catégorielles qui doivent être converties en données numériques afin que les algorithmes d'apprentissage automatique puissent les traiter.
- Les features ont des échelles très différentes et nous devrons les convertir à peu près à la même échelle.
- Certaines features contiennent des valeurs manquantes (NaN = Not a Number), que nous devons traiter.

Identification des outliners et traitement des valeurs manquantes

Nous allons donc tenter d'approfondir nos analyses concernant les données à notre disposition pour tenter d'identifier :

- Les valeurs aberrantes/outliers
- Les doublons
- Les valeurs manquantes

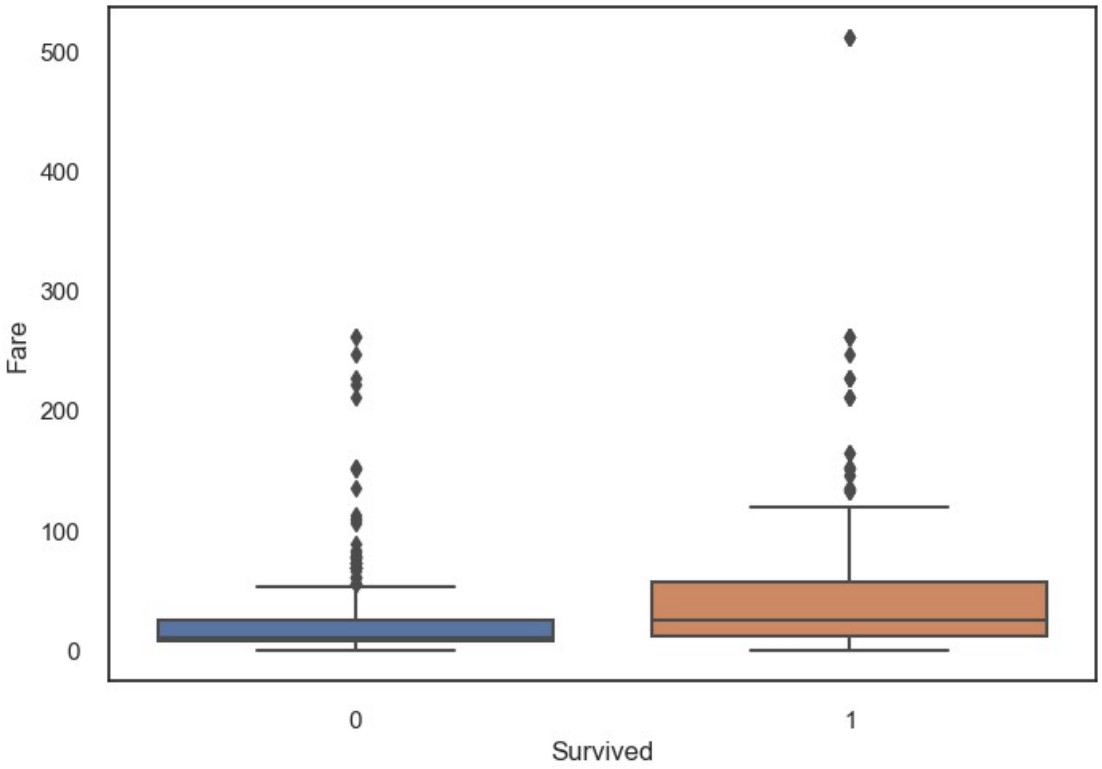
Une fois cela fait il sera possible de déterminer comment les traiter.

Les valeurs manquantes

```
print (train.isnull().sum())
print ('').center(20, "*"))
print (test.isnull().sum())
sns.boxplot(x='Survived',y='Fare',data=train)
missing_values=train.isnull().sum()
missing_values[missing_values>0]/len(train)*100
```

```
PassengerId      0
Survived         0
```

```
Pclass           0
Name             0
Sex              0
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
**********
PassengerId      0
Pclass           0
Name             0
Sex              0
Age             86
SibSp            0
Parch            0
Ticket           0
Fare             1
Cabin          327
Embarked         0
dtype: int64

Age         19.865320
Cabin       77.104377
Embarked     0.224467
dtype: float64
```



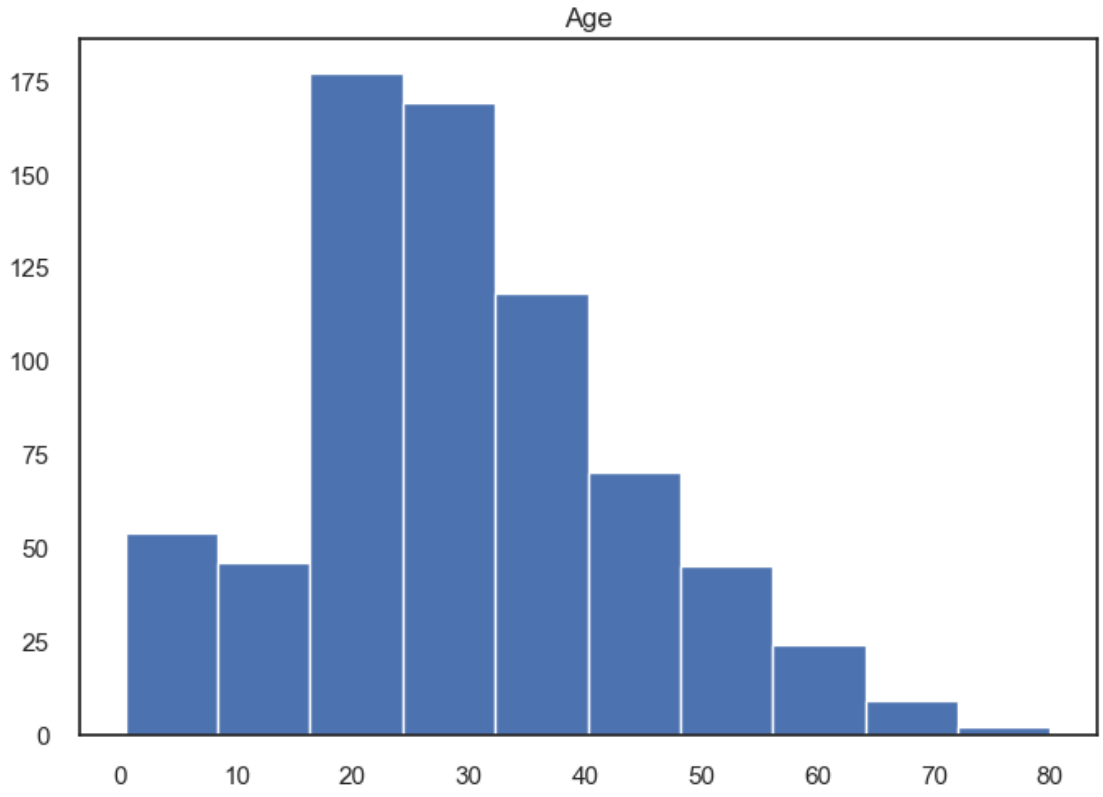
Ici on s'aperçoit que les colonnes 'Age', 'Cabin' et 'Embarked' ont des valeurs manquantes. Pour le dataset de train on constate 19,87% de valeurs manquantes pour l'âge, 77,10% pour le numéro de la Cabine et 0,2% de valeurs manquantes pour le point d'embarquement.

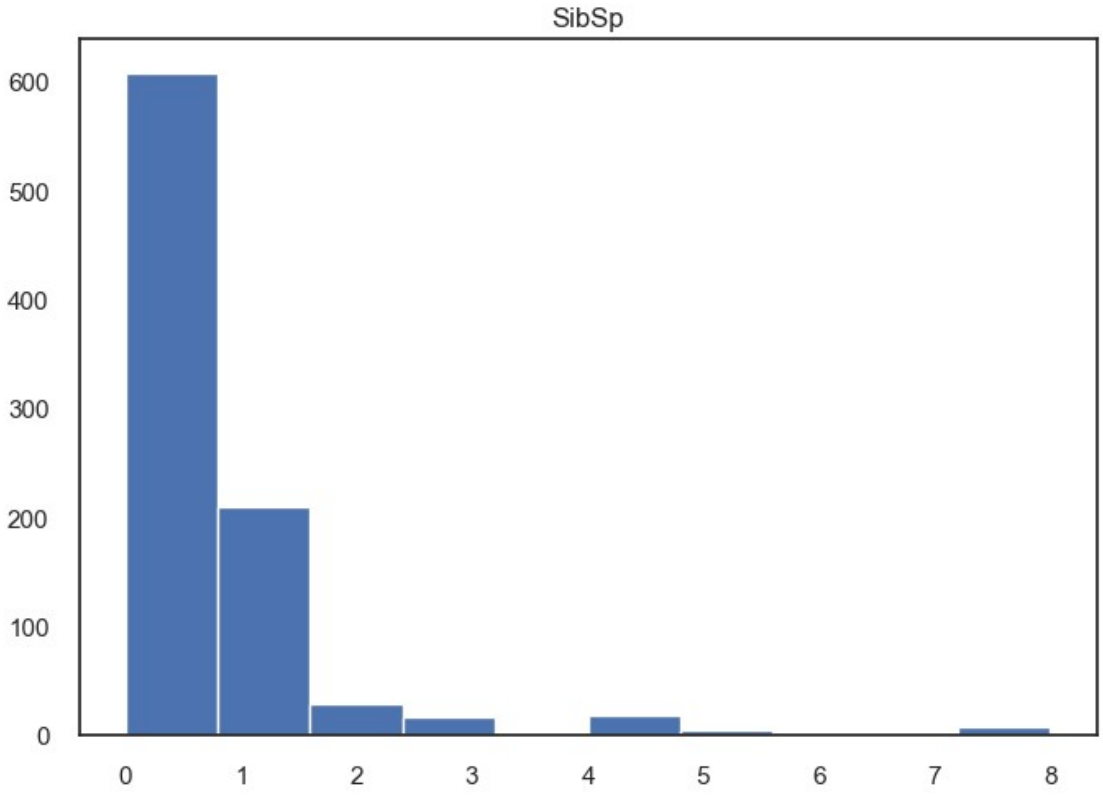
Les données manquantes dans l'ensemble de données d'entraînement peuvent réduire l'ajustement d'un modèle ou conduire à un modèle biaisé car nous n'avons pas correctement analysé le comportement et la relation avec d'autres variables. Cela peut conduire à des prédictions ou classifications erronées. Pour éviter cette problématique il est nécessaire de traiter ces valeurs manquantes en prennant en compte le contexte.

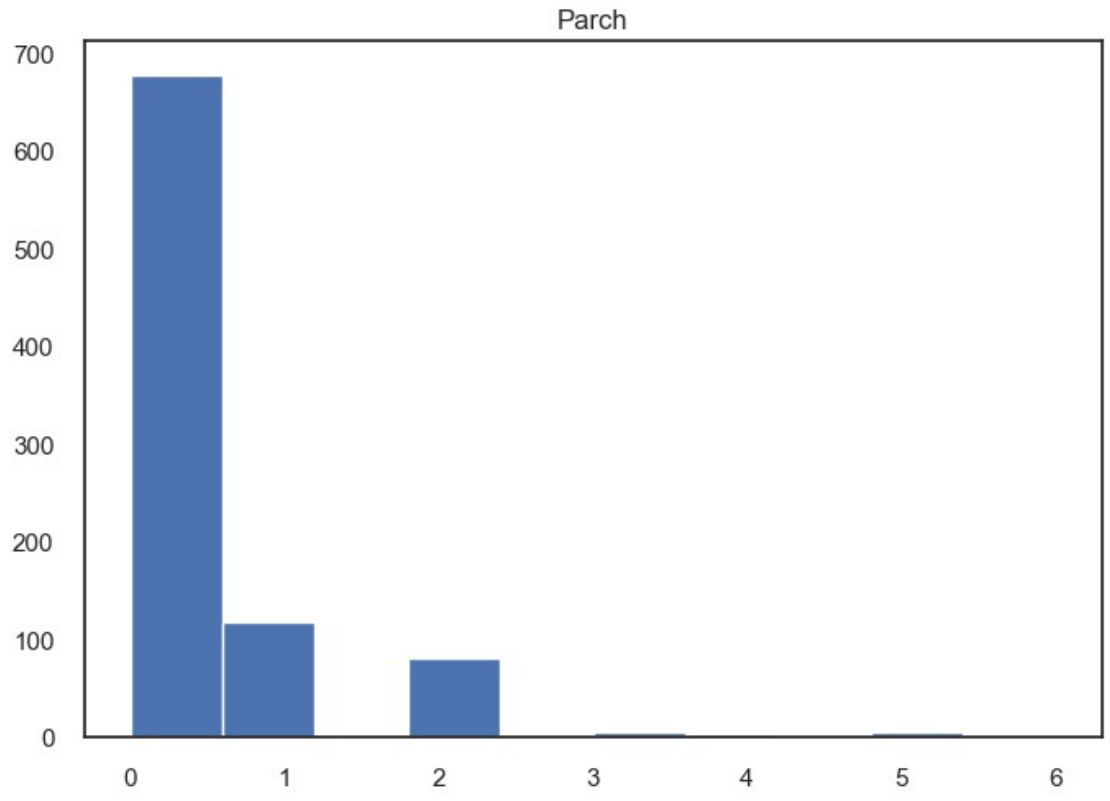
Identification des outliers pour les variables numériques

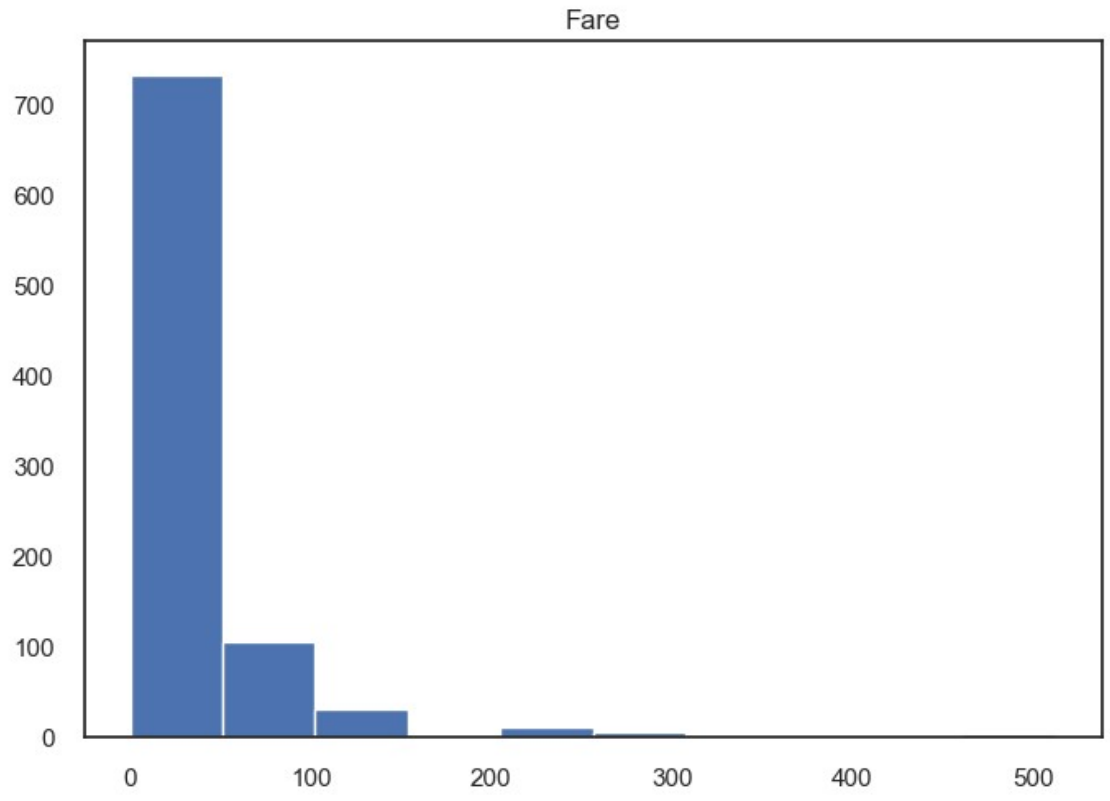
J'ai voulu utiliser la méthode de Tukey pour identifier des outliers. Cependant la méthode de Tukey est opérationnelle lorsque nous sommes en proie à une distribution qui n'est pas normale. Nous allons donc commencer par afficher la distribution pour les variables numériques "Age", "SibSp", "Parch", et "Fare" afin de vérifier qu'elles ne répondent pas à une distribution normale.

```
import matplotlib.pyplot as plt

for col in ["Age", "SibSp", "Parch", "Fare"]:
    plt.hist(train[col])
    plt.title(col)
    plt.show()
```


Age
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80


SibSp
600
500
400
300
200
100
0
0
1
2
3
4
5
6
7
8


Parch
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6


Fare
700
600
500
400
300
200
100
0
0
100
200
300
400
500

Afficher les histogrammes pour les variables numériques peut nous permettre de déterminer la direction dans laquelle ces variables sont distribuées, les valeurs aberrantes apparaîtront en dehors de la distribution globale des données. Si l'histogramme est asymétrique à droite ou à gauche, cela indique la présence de valeurs extrêmes ou de valeurs aberrantes. Ici nous pouvons donc déduire que certaines valeurs sont aberrantes (excepté pour l'age). L'âge n'est pas un problème car même avec une valeur min à 0,17 on peut très bien en déduire qu'il s'agit d'un bébé. Pour traiter les valeurs aberrantes on peut réaliser la méthode de Tukey cependant il faut vérifier que la distribution n'est pas normale c'est le but de l'étape suivante.

```
from scipy.stats import shapiro
import pandas as pd

# spécifier les colonnes à tester
cols_to_test = ["Survived", "PassengerId", "Pclass", "Age", "SibSp",
"Parch", "Fare"]

# effectuer le test de Shapiro-Wilk sur chaque colonne
for col in cols_to_test:
    # extraire la colonne du dataframe
    data = train[col]

    # effectuer le test de Shapiro-Wilk sur la colonne
    stat, p = shapiro(data)

    # afficher le résultat du test
    print("Colonne : ", col)
    print("Statistiques du test de Shapiro-Wilk : ", stat)
    print("p-value : ", p)

    # interpréter le résultat du test
    alpha = 0.05
    if p > alpha:
        print("La distribution des données est normale (on ne peut pas
rejeter H0)")
    else:
        print("La distribution des données n'est pas normale (on
rejette H0)")
```

```
Colonne :  Survived
Statistiques du test de Shapiro-Wilk :  0.616659939289093
p-value :  1.7945308393836472e-40
La distribution des données n'est pas normale (on rejette H0)
Colonne :  PassengerId
Statistiques du test de Shapiro-Wilk :  0.9547972679138184
p-value :  6.309874531781976e-16
La distribution des données n'est pas normale (on rejette H0)
Colonne :  Pclass
Statistiques du test de Shapiro-Wilk :  0.718337893486023
```

```
p-value :  3.3958319924210316e-36
La distribution des données n'est pas normale (on rejette H0)
Colonne :  Age
Statistiques du test de Shapiro-Wilk :  nan
p-value :  1.0
La distribution des données est normale (on ne peut pas rejeter H0)
Colonne :  SibSp
Statistiques du test de Shapiro-Wilk :  0.5129655003547668
p-value :  5.74532370373175e-44
La distribution des données n'est pas normale (on rejette H0)
Colonne :  Parch
Statistiques du test de Shapiro-Wilk :  0.5328145027160645
p-value :  2.382207389352189e-43
La distribution des données n'est pas normale (on rejette H0)
Colonne :  Fare
Statistiques du test de Shapiro-Wilk :  0.5218917727470398
p-value :  1.0789998175301091e-43
La distribution des données n'est pas normale (on rejette H0)
```

On constate donc que les différentes distributions des variables que nous avions identifiés ne sont pas normales. Nous pouvons donc utiliser la méthode de Tukey pour identifier les outliers.

```
# Détection des outliers

def detect_outliers(df,n,features):
    outlier_indices = []

    # Iterer sur chacune des colonnes du dataset
    for col in features:
        # Premier quartile (25%)
        Q1 = np.percentile(df[col], 25)
        # Troisème quartile (75%)
        Q3 = np.percentile(df[col],75)
        # Intervalle interquartile (le fameux IQR)
        IQR = Q3 - Q1

        # Niveau de la valeur aberrante que je fixe selon Turkey
        outlier_step = 1.5 * IQR

        # Déterminer une liste d'indices de valeurs aberrantes pour
col
        outlier_list_col = df[(df[col] < Q1 - outlier_step) | (df[col]
> Q3 + outlier_step )].index

        # Ajouter les indices de valeurs aberrantes trouvés pour col à
la liste des indices de valeurs aberrantes
        outlier_indices.extend(outlier_list_col)

    # Sélectionner les observations contenant plus de 2 valeurs
```

```
aberrantes
    outlier_indices = Counter(outlier_indices)
    multiple_outliers = list( k for k, v in outlier_indices.items() if
v > n )

    return multiple_outliers

# Détection des outliers des colonnes Age, SibSp , Parch and Fare :
uniquement pour les valeurs numériques
Outliers_to_drop = detect_outliers(train,2,
["Age","SibSp","Parch","Fare"])

train.loc[Outliers_to_drop] # On va afficher les outliers
```

```
     PassengerId  Survived  Pclass                                Name
Sex  \
27            28         0       1     Fortune, Mr. Charles Alexander
male
88            89         1       1         Fortune, Miss. Mabel Helen
female
159          160         0       3         Sage, Master. Thomas Henry
male
180          181         0       3       Sage, Miss. Constance Gladys
female
201          202         0       3                Sage, Mr. Frederick
male
324          325         0       3           Sage, Mr. George John Jr
male
341          342         1       1     Fortune, Miss. Alice Elizabeth
female
792          793         0       3            Sage, Miss. Stella Anna
female
846          847         0       3           Sage, Mr. Douglas Bullen
male
863          864         0       3  Sage, Miss. Dorothy Edith "Dolly"
female

      Age  SibSp  Parch    Ticket    Fare        Cabin Embarked
27   19.0      3      2     19950  263.00  C23 C25 C27        S
88   23.0      3      2     19950  263.00  C23 C25 C27        S
159   NaN      8      2  CA. 2343   69.55          NaN        S
180   NaN      8      2  CA. 2343   69.55          NaN        S
201   NaN      8      2  CA. 2343   69.55          NaN        S
324   NaN      8      2  CA. 2343   69.55          NaN        S
341  24.0      3      2     19950  263.00  C23 C25 C27        S
792   NaN      8      2  CA. 2343   69.55          NaN        S
846   NaN      8      2  CA. 2343   69.55          NaN        S
863   NaN      8      2  CA. 2343   69.55          NaN        S
```

Après quelques recherches sur internet concernant les informations sur le prix des billets que l'on aurait pu croire comme aberrantes avec une valeur de 512 (valeur max) sont finalement plausibles car certains voyageurs prennaient des appartements en plus etc... Nous détectons tout de même 10 valeurs aberrantes. Les 28, 89 et 342 passagers ont un 'Fare' élevé par rapport aux quartiles. Les 7 autres ont des valeurs très élevées de SibSP. Nous pouvons donc supprimer ces outliers, c'est le rôle de la ligne suivante.

```
# Suppression des outliers
train = train.drop(Outliers_to_drop, axis = 0).reset_index(drop=True)
```

Identification des doublons

Une fois les outliers identifiées nous pouvons passer aux doublons. La ligne de code ci-dessous va nous permettre de compter les enregistrements en double.

```
# Trouver le nombre d'enregistrements en doublon
print('train - Nombre denregistrements en double:',
train.duplicated().sum())
print('test - Nombre denregistrements en double:',
test.duplicated().sum())
```

```
train - Nombre denregistrements en double: 0
test - Nombre denregistrements en double: 0
```

Dans notre cas on constate l'absence de doublons ce qui est plutôt positif pour nous car aucun retraitement ne sera à effectuer.

Traitement des valeurs manquantes

Une des étapes les plus délicates pour permettre à notre modèle d'avoir une bonne fiabilité ainsi que pour mener une analyse exploratoire digne de ce nom correspond au traitement des valeurs manquantes. Un mauvais traitement dans les valeurs manquantes (sans prise en compte du contexte) amènera à des données biaisées et à un manque de fiabilité de notre modèle. Nous allons faire en sorte de prendre en maximum le contexte des données pour déterminer comment traiter ces données manquantes.

Traitement des valeurs manquantes pour l'Age

Nous avons dans les premières lignes de l'exploration de notre jeu de données constatés que l'age possèdaient de nombreuses lignes avec des valeurs manquantes. Il existe plusieurs manières de traiter ces lignes vides, la plus courante étant de calculer la moyenne d'âge et de l'imputer aux lignes manquantes. Cependant, on constate ici une diversité dans les profils de notre base de données. Si bien que j'ai décidé d'utiliser le titre présent dans le nom pour déterminer l'age de la ligne. Je m'explique, au lieu de calculer la moyenne sur toute la base de données je vais calculer la moyenne des âges des personnes possédants le même titre que la personne dont l'age est manquant. Ainsi nous gagnons en fiabilité, il est rare d'avoir un titre de 'Capt' lorsque l'on a 4 ans. Je suis donc parti du principe qu'il était de même pour les autres titres.

```
# Comme le test n'a qu'une seule valeur manquante, remplissons-la avec
la moyenne.
test['Fare'].fillna(test['Fare'].mean(), inplace=True)

# Concatenation des données d'entrainement et de test pour le
traitement
data_df = pd.concat([train, test], ignore_index=True)

# Extraction des titres à partir des noms des passagers
data_df['Title'] = data_df['Name'].str.extract(' ([A-Za-z]+)\.',
expand=True)

# Remplacement des titres rares par les plus courants
mapping = {'Mlle': 'Miss', 'Major': 'Mr', 'Col': 'Mr', 'Sir': 'Mr',
'Don': 'Mr', 'Mme': 'Miss',
           'Jonkheer': 'Mr', 'Lady': 'Mrs', 'Capt': 'Mr', 'Countess':
'Mrs', 'Ms': 'Miss', 'Dona': 'Mrs'}
data_df.replace({'Title': mapping}, inplace=True)

# Affichage des différents titres et leur nombre d'occurrences
print(data_df['Title'].value_counts())

# Imputation de l'âge manquant en utilisant la moyenne de l'âge par
titre
titles = ['Mr', 'Miss', 'Mrs', 'Master', 'Rev', 'Dr']
for title in titles:
    age_to_impute = data_df.groupby('Title')['Age'].mean()[title]
    data_df.loc[(data_df['Age'].isnull()) & (data_df['Title'] ==
title), 'Age'] = age_to_impute

# Séparation des données d'entrainement et de test mises à jour
train = data_df.iloc[:len(train)]
test = data_df.iloc[len(train):]

# Vérification du nombre de valeurs nulles dans les données
d'entrainement et de test
print(train.isnull().sum())
print(test.isnull().sum())
```

```
Mr        763
Miss      260
Mrs       200
Master     60
Rev         8
Dr          8
Name: Title, dtype: int64
PassengerId      0
Survived         0
Pclass           0
Name             0
```

```
Sex              0
Age              0
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          680
Embarked         2
Title            0
dtype: int64
PassengerId      0
Survived       418
Pclass           0
Name             0
Sex              0
Age              0
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          327
Embarked         0
Title            0
dtype: int64
```

Nous voilà avec un traitement des données manquantes pour l'âge :

```
train.head()
```

```
   PassengerId  Survived  Pclass  \
0            1       0.0       3
1            2       1.0       1
2            3       1.0       3
3            4       1.0       1
4            5       0.0       3

                                                 Name     Sex   Age
SibSp  \
0                             Braund, Mr. Owen Harris    male  22.0
1
1  Cumings, Mrs. John Bradley (Florence Briggs Th...  female  38.0
1
2                              Heikkinen, Miss. Laina  female  26.0
0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0
1
4                            Allen, Mr. William Henry    male  35.0
0

   Parch            Ticket     Fare Cabin Embarked Title
0      0         A/5 21171   7.2500   NaN        S    Mr
```

```
1      0          PC 17599  71.2833   C85        C   Mrs
2      0  STON/O2. 3101282   7.9250   NaN        S  Miss
3      0            113803  53.1000  C123        S   Mrs
4      0            373450   8.0500   NaN        S    Mr
```

Traitement des valeurs manquantes pour le numéro de Cabine et suppresion de la colonne 'Ticket'

Au vue du nombre de données manquantes qui correspondent à 77% des données totales il est préférable de supprimer cette colonne. De plus, le numéro de cabine est difficilement exploitable en l'état car a une partie numérique et alphabétique. Par la même occasion nous allons supprimer la colonne 'Ticket' qui n'a aucune valeur dans notre analyse

```
print("Avant", train.shape, test.shape)

train = train.drop(['Ticket', 'Cabin'], axis=1)
test = test.drop(['Ticket', 'Cabin'], axis=1)

("Après", train.shape, test.shape)
```

```
Avant (881, 13) (418, 13)

('Après', (881, 11), (418, 11))
```

Traitement du sexe en changeant la catégorie

Afin de faciliter l'exploitation de nos données concernant le sexe ainsi que le traitement de notre modèle il est préférable de modifier le type de cette variable. De base, nous avions des chaines de caractère. Nous allons donc attribuer une valeur à chacun des 2 sexes (0 pour l'homme, 1 pour la femme).

```
# Mapper chaque valeur de la variable "Sexe" à une valeur numérique
sex_mapping = {"male": 0, "female": 1}
train['Sex'] = train['Sex'].map(sex_mapping)
test['Sex'] = test['Sex'].map(sex_mapping)

train.head()
```

```
   PassengerId  Survived  Pclass  \
0            1       0.0       3
1            2       1.0       1
2            3       1.0       3
3            4       1.0       1
4            5       0.0       3

                                                Name  Sex   Age  SibSp
Parch  \
0                            Braund, Mr. Owen Harris    0  22.0      1
0
1  Cumings, Mrs. John Bradley (Florence Briggs Th...    1  38.0      1
0
```

```
2                             Heikkinen, Miss. Laina    1  26.0      0
0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    1  35.0      1
0
4                           Allen, Mr. William Henry    0  35.0      0
0

      Fare Embarked Title
0   7.2500        S    Mr
1  71.2833        C   Mrs
2   7.9250        S  Miss
3  53.1000        S   Mrs
4   8.0500        S    Mr
```

Traitement des valeurs du port d'embarquement

Pour traiter le faible nombre de valeurs manquantes pour le port d'embarquement j'ai décidé de remplacer les valeurs manquantes par la valeur la plus récurrente. La première ligne va nous permettre de déterminer la valeur la plus récurrente et la deuxième ligne complétera les valeurs manquantes du port d'embarquement en attribuant cette valeur.

```
freq_port = train.Embarked.dropna().mode()[0]
freq_port
```

```
'S'
```

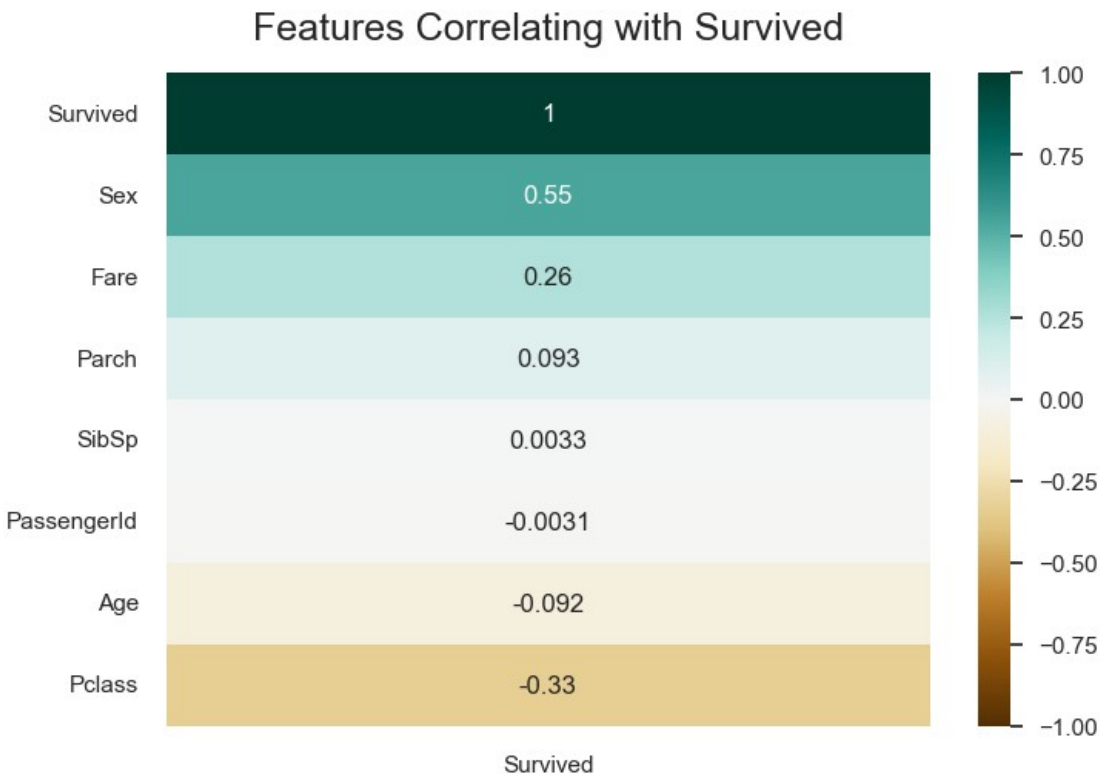
```
for dataset in [train, test]:
    dataset['Embarked'] = dataset['Embarked'].fillna(freq_port)

train[['Embarked', 'Survived']].groupby(['Embarked'],
as_index=False).mean().sort_values(by='Survived', ascending=False)
```

```
  Embarked  Survived
0        C  0.553571
1        Q  0.389610
2        S  0.341195
```

Analyse des résultats et interprétation

Cette partie va nous permettre d'identifier des liens entre les variables et notre chance de survie. J'ai commencé par faire une heatmap permettant d'identifier les facteurs corrélés à notre survie. Cette heatmap servira de base à nos hypothèses et de pistes à explorer.

```
heatmap = sns.heatmap(train.corr()
[['Survived']].sort_values(by='Survived', ascending=False), vmin=-1,
vmax=1, annot=True, cmap='BrBG')
heatmap.set_title('Features Correlating with Survived',
fontdict={'fontsize':18}, pad=16);
```

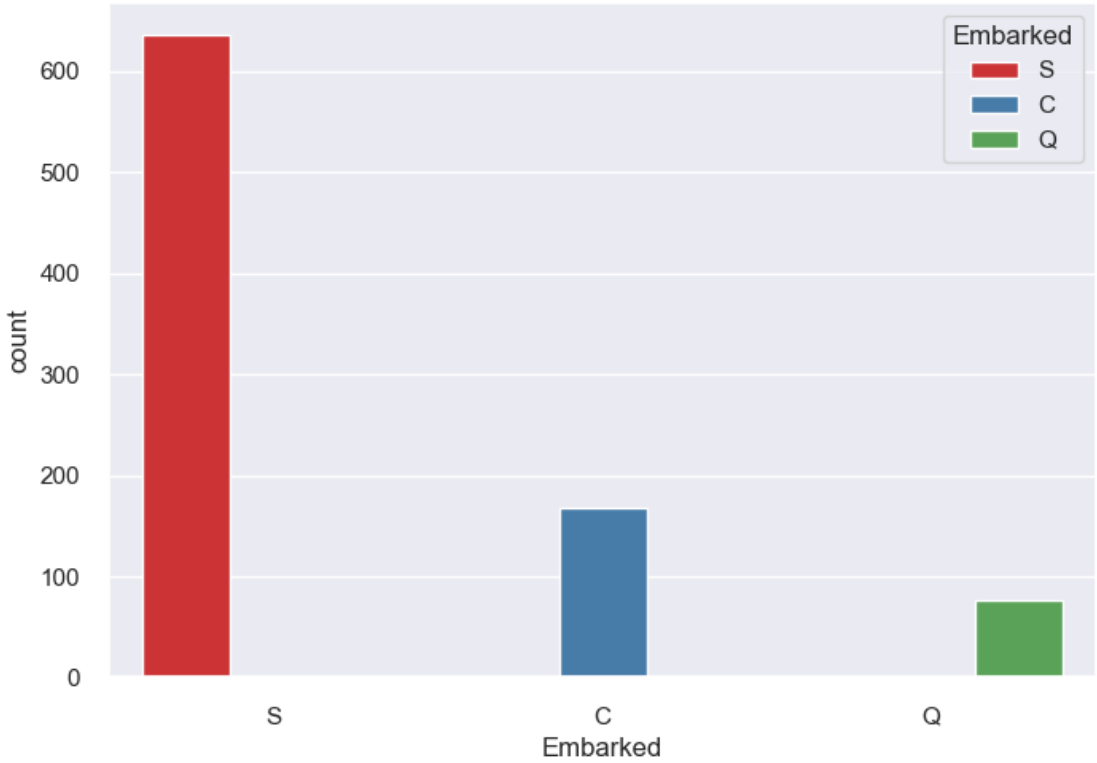


Hypothèse 1 : Combien de personnes ont embarqué depuis différents ports ? Y a-t-il une corrélation entre le port d'embarquement et la survie ?

```
train['Embarked'].value_counts()/len(train)
```

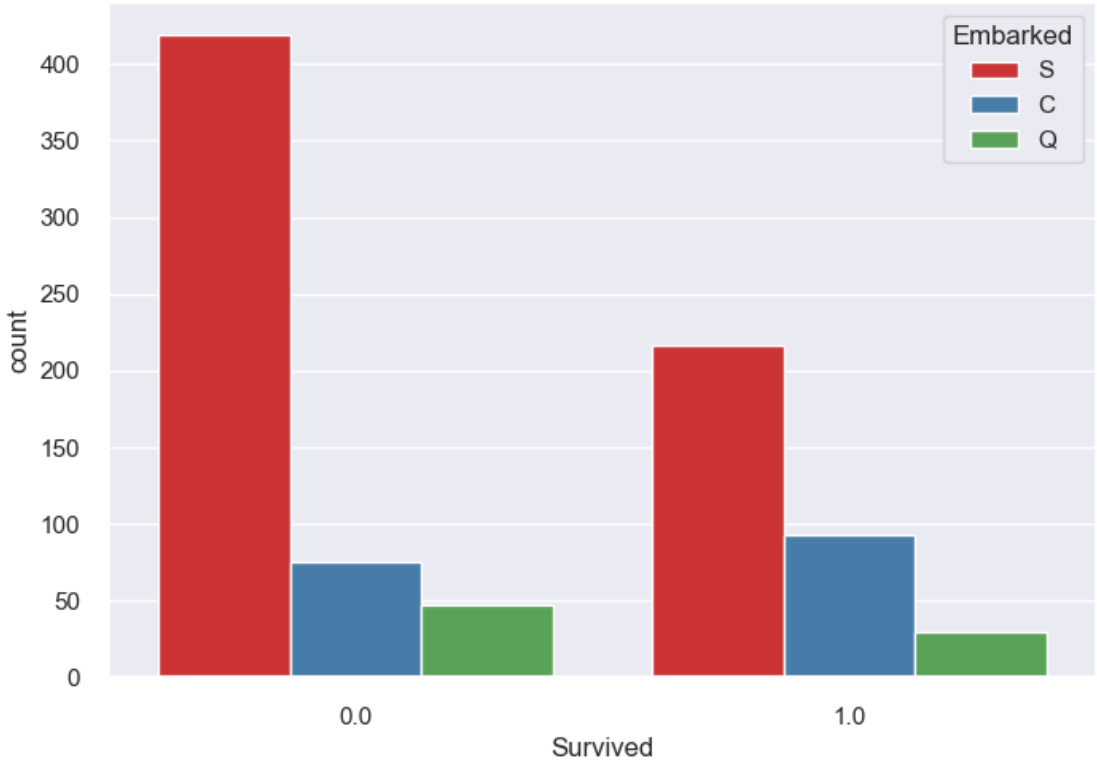
```
S    0.721907
C    0.190692
Q    0.087401
Name: Embarked, dtype: float64
```

```
sns.set(style="darkgrid")
sns.countplot( x='Embarked', data=train, hue="Embarked",
palette="Set1");
```



On constate qu'il y a une forte proportion des voyageurs qui ont embarqués par le port de Southampton.

```
sns.set(style="darkgrid")
sns.countplot( x='Survived', data=train, hue="Embarked",
palette="Set1");
```




```
train.groupby('Embarked').mean()
```

```
          PassengerId  Survived    Pclass       Sex        Age
SibSp  \
Embarked

C          445.357143  0.553571  1.886905  0.434524  31.005678
0.386905
Q          417.896104  0.389610  2.909091  0.467532  27.794655
0.428571
S          450.561321  0.341195  2.345912  0.314465  29.843663
0.476415

              Parch       Fare
Embarked
C          0.363095  59.954144
Q          0.168831  13.276030
S          0.386792  25.665957
```

Cependant on remarque que l'espérance de vie est meilleure pour les voyageurs ayant embarqués sur le port de Cherbourg. Après quelques recherches sur internet cette espérance peut être expliquée par un autre facteur : le niveau de vie. En effet, les habitants de Cherbourg ont un meilleur niveau de vie que les habitants des 2 autres ports, cela implique également un investissement plus important dans l'achat de billet et donc sûrement une classe plus importante. Cette hypothèse est également confirmée par le prix du billet que l'on constate à 59,95 vs 13 et 25.

Q2: Est-ce que la survie dépend du sexe ?

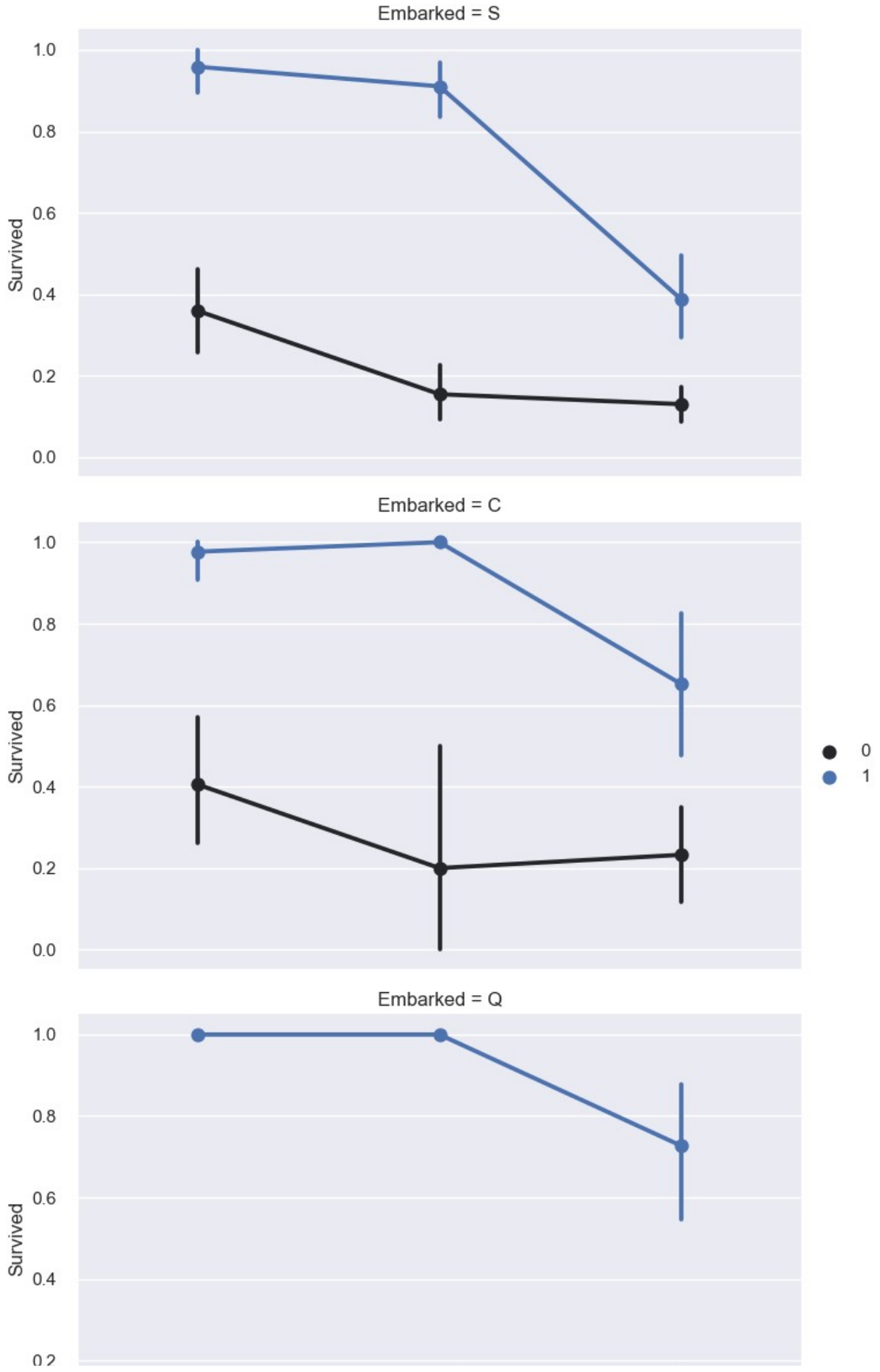
```
train.groupby('Sex').mean()
```

```
     PassengerId  Survived    Pclass        Age     SibSp     Parch
Fare
Sex

0     455.386364  0.190559  2.388112  31.015567  0.372378  0.220280
24.800851
1     430.660194  0.747573  2.158576  27.795493  0.608414  0.627832
42.822048
```

Le résultat est sans équivoque. Le cas du titanic est l'exemple parfait du dicton "les femmes et les enfants d'abord". Avec 75% de survie constatée chez les femmes le résultat est sans appel. Cependant, il est possible de vérifier si ces résultats ne peuvnet pas être croisés avec d'autres données.

```
FacetGrid = sns.FacetGrid(train, row='Embarked', size=4.5, aspect=1.6)
FacetGrid.map(sns.pointplot, 'Pclass', 'Survived', 'Sex', order=None,
hue_order=None )
FacetGrid.add_legend();
```

```
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\axisgrid.py:337:
UserWarning: The `size` parameter has been renamed to `height`; please
update your code.
  warnings.warn(msg, UserWarning)
```


Embarked = S
Embarked = C
Embarked = Q
Survived
1.0
0.8
0.6
0.4
0.2
0.0
0
1

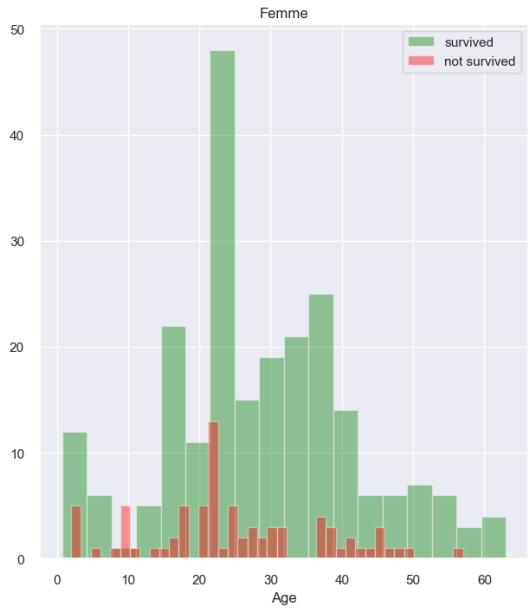
Il semble y avoir une corrélation entre le port d'embarquement et la survie, selon le sexe des passagers. Les femmes qui ont embarqué au port Q et au port S ont une plus grande chance de survie. C'est le contraire si elles ont embarqué au port C. Les hommes ont une probabilité de survie élevée s'ils ont embarqué au port C, mais une faible probabilité s'ils ont embarqué au port Q ou S. Le niveau de la classe de voyage (Pclass) est également corrélé à la survie.

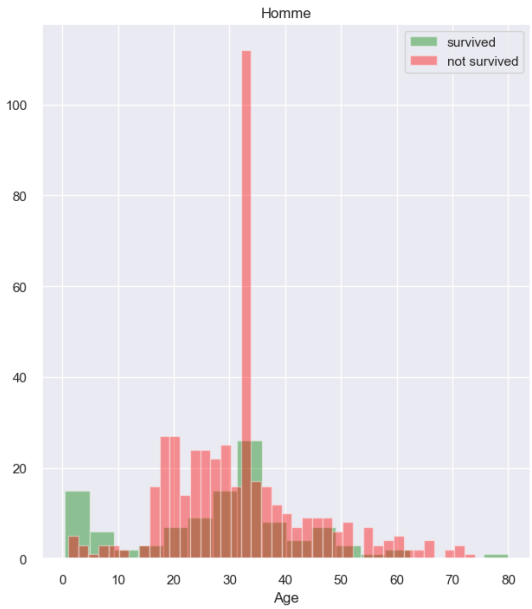
```
train[["Sex","Survived"]].groupby('Sex').mean()
```

```
     Survived
Sex
0    0.190559
1    0.747573
```

```
survived = 'survived'
not_survived = 'not survived'
fig, axes = plt.subplots(nrows=1, ncols=2,figsize=(16, 8))
femme = train[train['Sex']==1]
homme = train[train['Sex']==0]
ax = sns.distplot(femme[femme['Survived']==1].Age.dropna(), bins=18,
label = survived, ax = axes[0], kde =False, color="green")
ax = sns.distplot(femme[femme['Survived']==0].Age.dropna(), bins=40,
label = not_survived, ax = axes[0], kde =False, color="red")
ax.legend()
ax.set_title('Femme')
ax = sns.distplot(homme[homme['Survived']==1].Age.dropna(), bins=18,
label = survived, ax = axes[1], kde = False, color="green")
ax = sns.distplot(homme[homme['Survived']==0].Age.dropna(), bins=40,
label = not_survived, ax = axes[1], kde = False, color="red")
ax.legend()
_ = ax.set_title('Homme');
```

```
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning: `distplot` is a deprecated
function and will be removed in a future version. Please adapt your
code to use either `displot` (a figure-level function with similar
flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

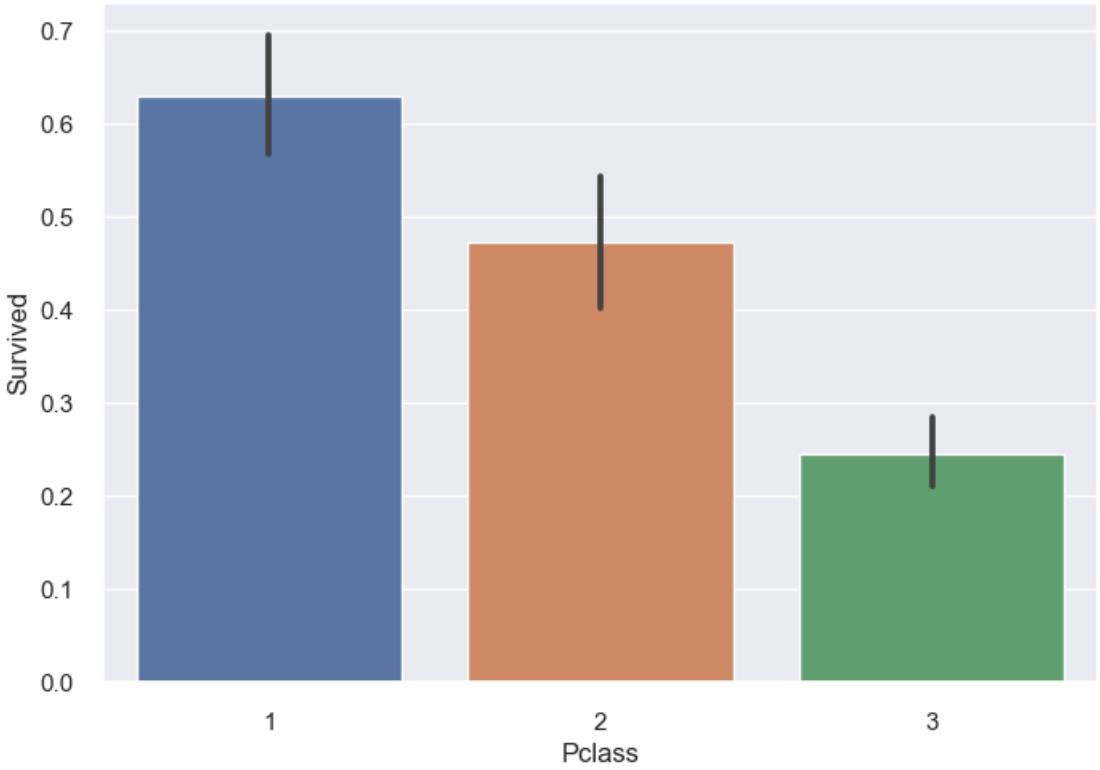




On peut voir que les hommes ont une forte probabilité de survie quand ils ont entre 18 et 30 ans, ce qui est également un peu vrai pour les femmes mais pas complètement. Pour les femmes, les chances de survie sont plus élevées entre 14 et 40 ans. Sachant que les femmes ont généralement une plus forte probabilité de survie. Pour les hommes, la probabilité de survie est très élevé pour les bébés/nourrissons et pour les jeunes hommes mais c'est également le cas pour les femmes.

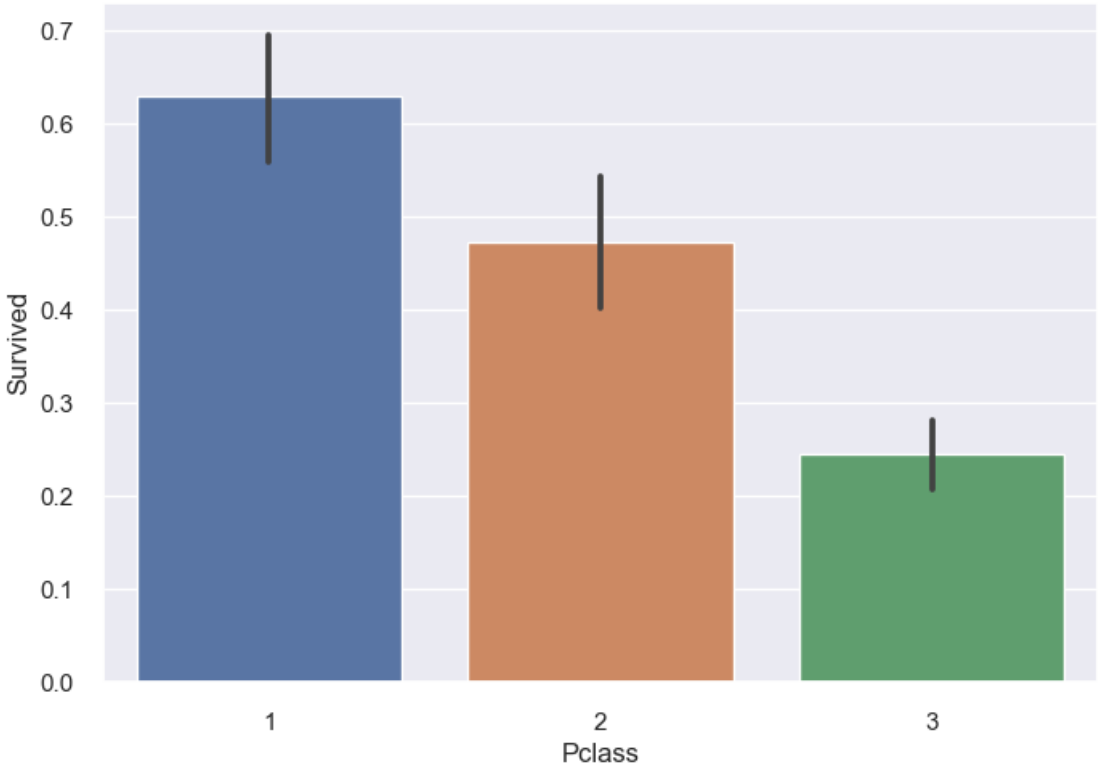
Q3 : Est-ce que la classe détermine la probabilité de survie ?

```
sns.barplot(x='Pclass', y='Survived', data=train);
```



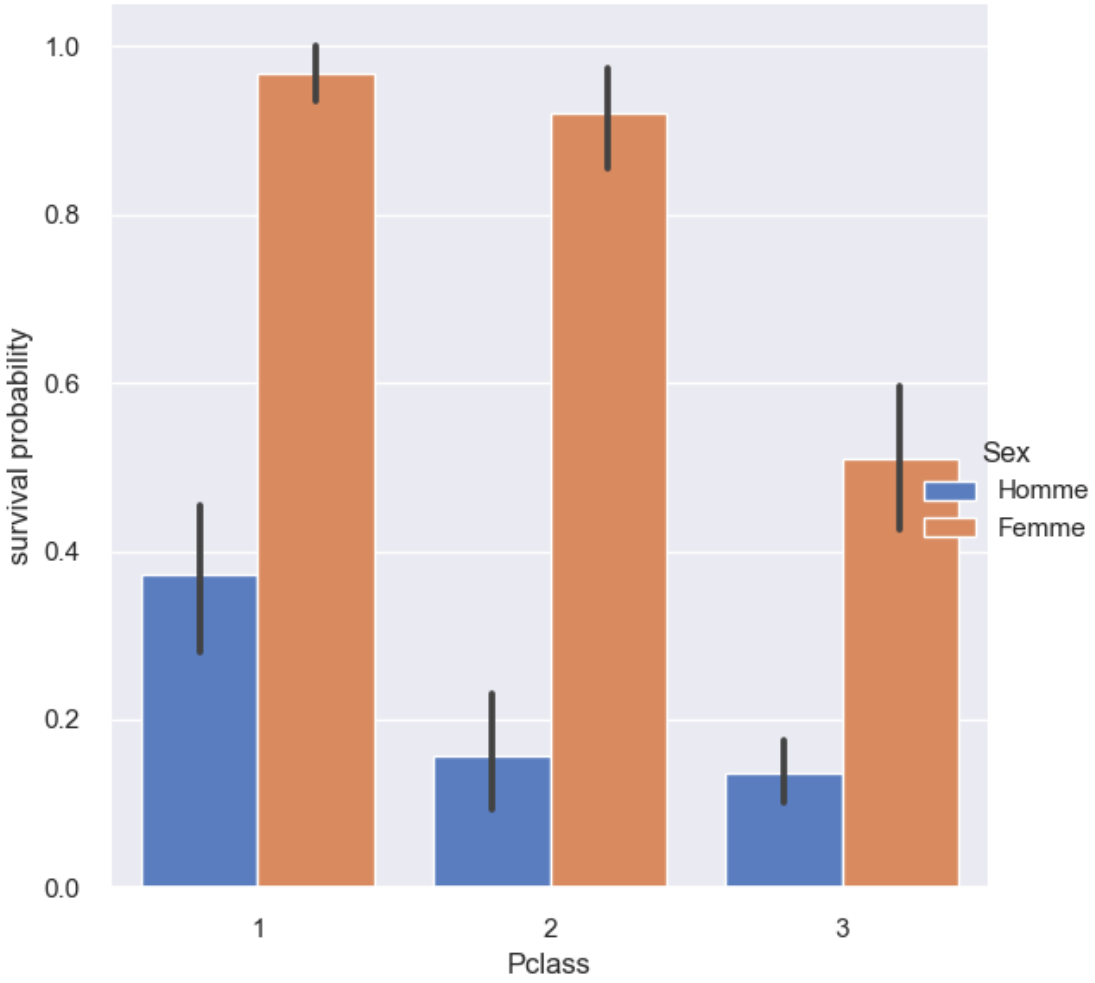

```
#draw a bar plot of survival by Pclass
sns.barplot(x="Pclass", y="Survived", data=train)

#print percentage of people by Pclass that survived
print("Pourcentage de la première classe qui ont survécu:",
train["Survived"][train["Pclass"] == 1].value_counts(normalize = True)
[1]*100)

print("Pourcentage de la deuxième classe qui ont survécu",
train["Survived"][train["Pclass"] == 2].value_counts(normalize = True)
[1]*100)

print("Pourcentage de la troisième classe qui ont survécu",
train["Survived"][train["Pclass"] == 3].value_counts(normalize = True)
[1]*100)
```

```
Pourcentage de la première classe qui ont survécu: 62.91079812206573
Pourcentage de la deuxième classe qui ont survécu 47.28260869565217
Pourcentage de la troisième classe qui ont survécu 24.586776859504134
```



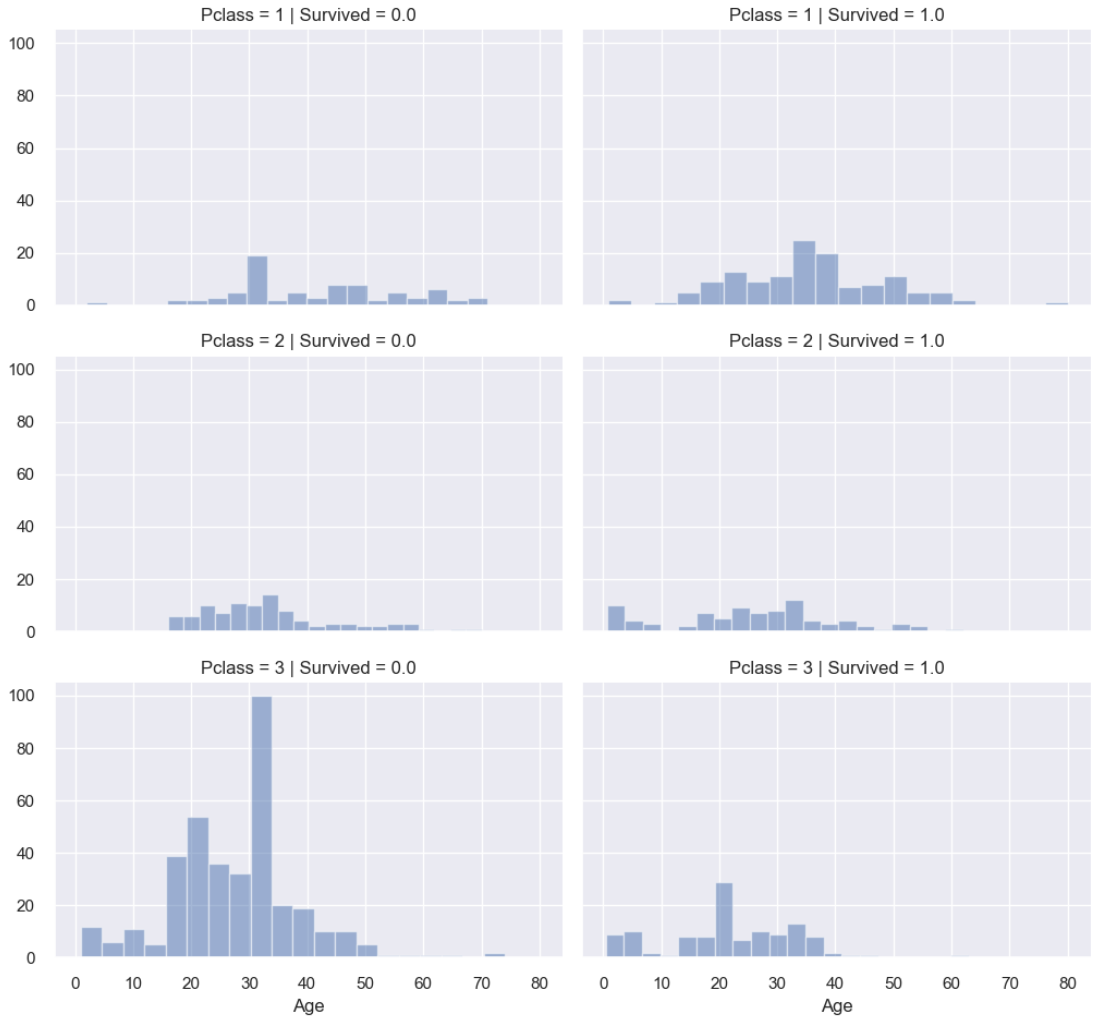

```
g = sns.factorplot(x="Pclass", y="Survived", hue="Sex", data=train,
                   size=6, kind="bar", palette="muted")
g.despine(left=True)
new_labels = ['Homme', 'Femme']
for t, l in zip(g._legend.texts, new_labels): t.set_text(l)
g = g.set_ylabels("survival probability")
```

```
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\categorical.py:3717:
UserWarning: The `factorplot` function has been renamed to `catplot`.
The original name will be removed in a future release. Please update
your code. Note that the default `kind` in `factorplot` (`'point'`)
has changed `'strip'` in `catplot`.
  warnings.warn(msg)
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\categorical.py:3723:
UserWarning: The `size` parameter has been renamed to `height`; please
update your code.
  warnings.warn(msg, UserWarning)
```




```
grid = sns.FacetGrid(train, col='Survived', row='Pclass', size=3.2,
aspect=1.6)
grid.map(plt.hist, 'Age', alpha=.5, bins=20)
grid.add_legend();
```

```
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\axisgrid.py:337:
UserWarning: The `size` parameter has been renamed to `height`; please
update your code.
  warnings.warn(msg, UserWarning)
```



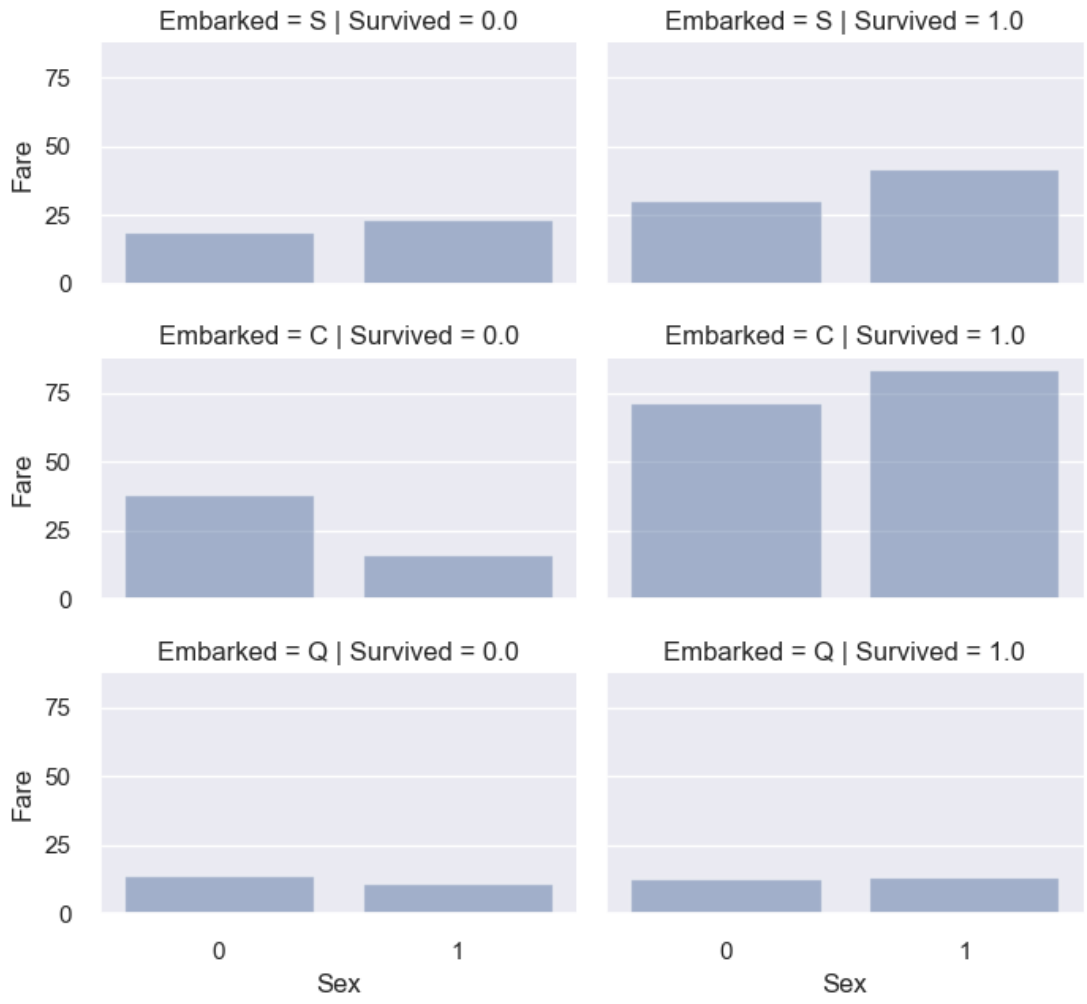
Ici, nous constatons clairement que la classe (Pclass) a une influence sur les chances de survie d'une personne, en particulier si cette personne est en première classe (1). Le graphique ci-dessus confirme notre hypothèse sur la classe 1, mais nous pouvons également constater une forte probabilité qu'une personne en classe 3 ne survivra pas.

Q4 : Est-ce que le prix du billet détermine la probabilité de survivre ?

```
# grid = sns.FacetGrid(train_df, col='Embarked', hue='Survived',
palette={0: 'k', 1: 'w'})
grid = sns.FacetGrid(train, row='Embarked', col='Survived', size=2.2,
aspect=1.6)
grid.map(sns.barplot, 'Sex', 'Fare', alpha=.5, ci=None)
grid.add_legend()
```

```
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\axisgrid.py:337:
UserWarning: The `size` parameter has been renamed to `height`; please
update your code.
  warnings.warn(msg, UserWarning)
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\axisgrid.py:670:
UserWarning: Using the barplot function without specifying `order` is
```

```
likely to produce an incorrect plot.
  warnings.warn(warning)

<seaborn.axisgrid.FacetGrid at 0x1dc4c008940>
```



Nous constatons donc que oui, le prix du billet influence bien les chances de survie puisque les tarifs les plus élevés sont ceux qui ont survécu peu importe le port d'embarquement.

Q5 - Est-ce que le titre donne une meilleure chance de survie ?

```
train[['Title', 'Survived']].groupby(['Title'], as_index=False).mean()
```

```
    Title  Survived
0      Dr  0.428571
1  Master  0.589744
2    Miss  0.712707
3      Mr  0.161228
4     Mrs  0.795276
5     Rev  0.000000
```

En effet, on constate que le titre a également son rôle a joué. Mais davantage car il est lié au sexe ou au niveau de vie de l'individu qui le porte.

Q6 : Les passagers qui voyagent seuls ont-ils de meilleures chances de survie ?

SibSp et Parch auraient plus de sens en tant que features combinée, qui montre le nombre total de parents qu'une personne a sur le Titanic. Je vais la créer ci-dessous ainsi qu'une fonctionnalité qui montre si quelqu'un est seul ou non.

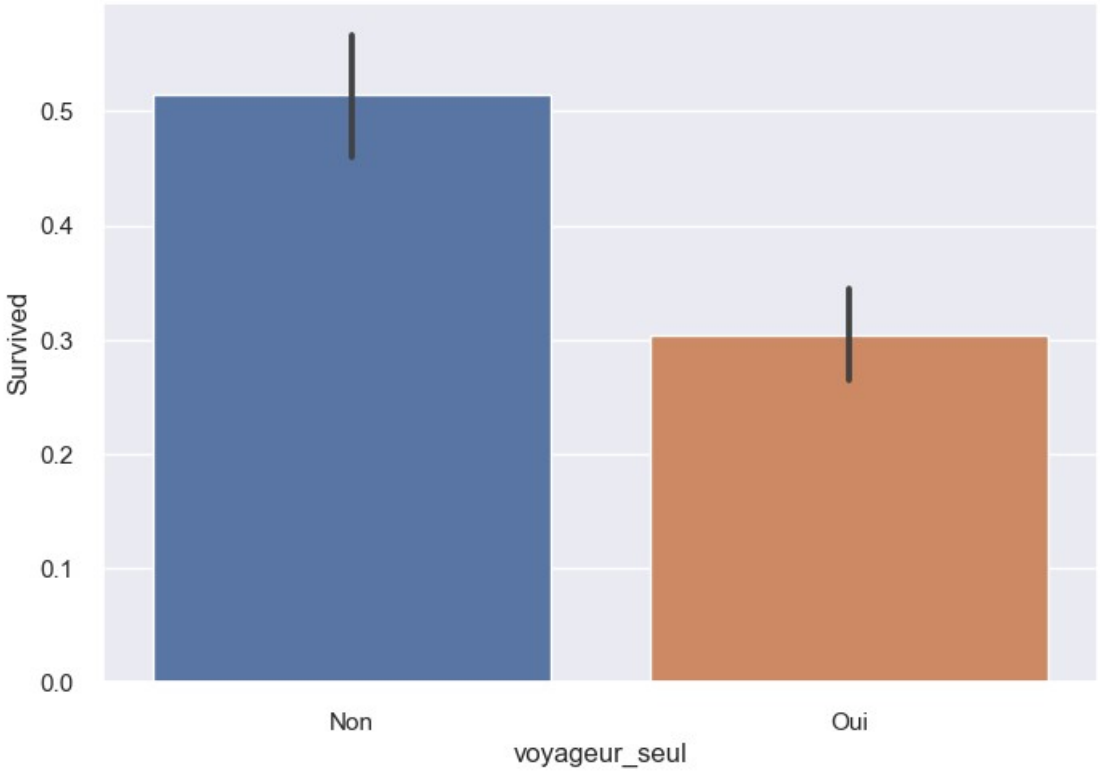
```
data = [train, test]
for dataset in data:
    dataset['relatives'] = dataset['SibSp'] + dataset['Parch']
    dataset.loc[dataset['relatives'] > 0, 'voyageur_seul'] = 'Non'
    dataset.loc[dataset['relatives'] == 0, 'voyageur_seul'] = 'Oui'
train['voyageur_seul'].value_counts()
```

```
Oui    537
Non    344
Name: voyageur_seul, dtype: int64
```

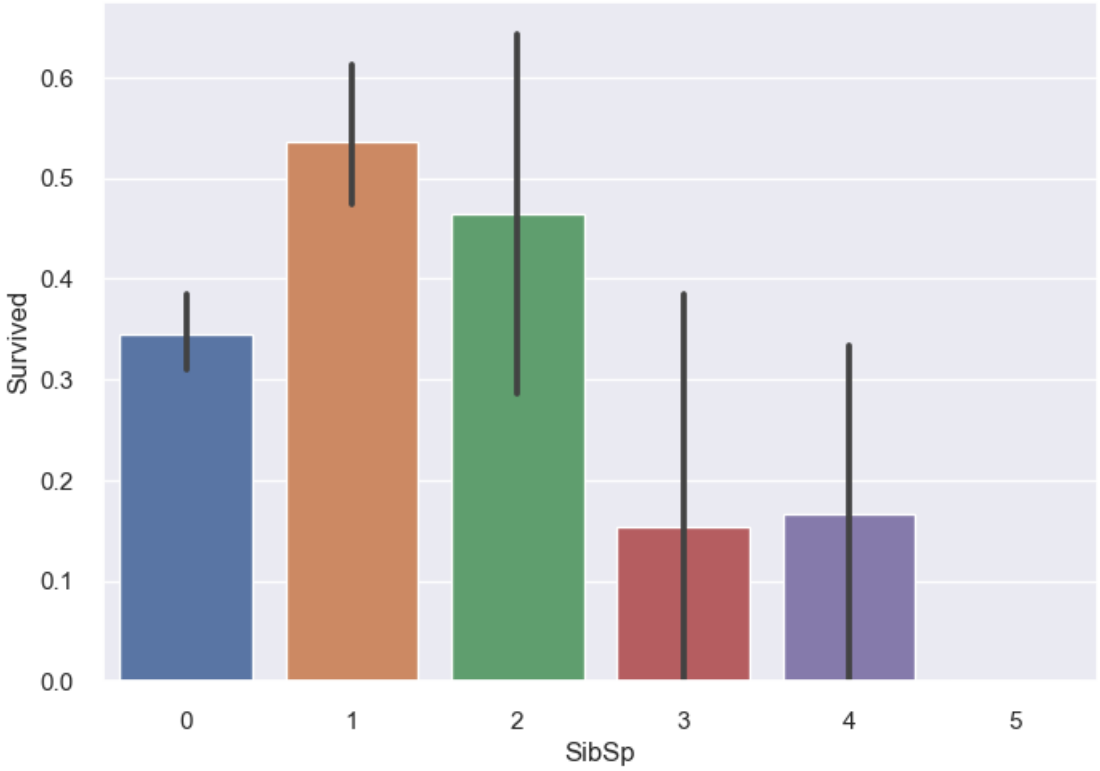
```
train['relatives'].value_counts()
```

```
0    537
1    161
2    102
3     29
5     19
4     15
6     12
7      6
Name: relatives, dtype: int64
```

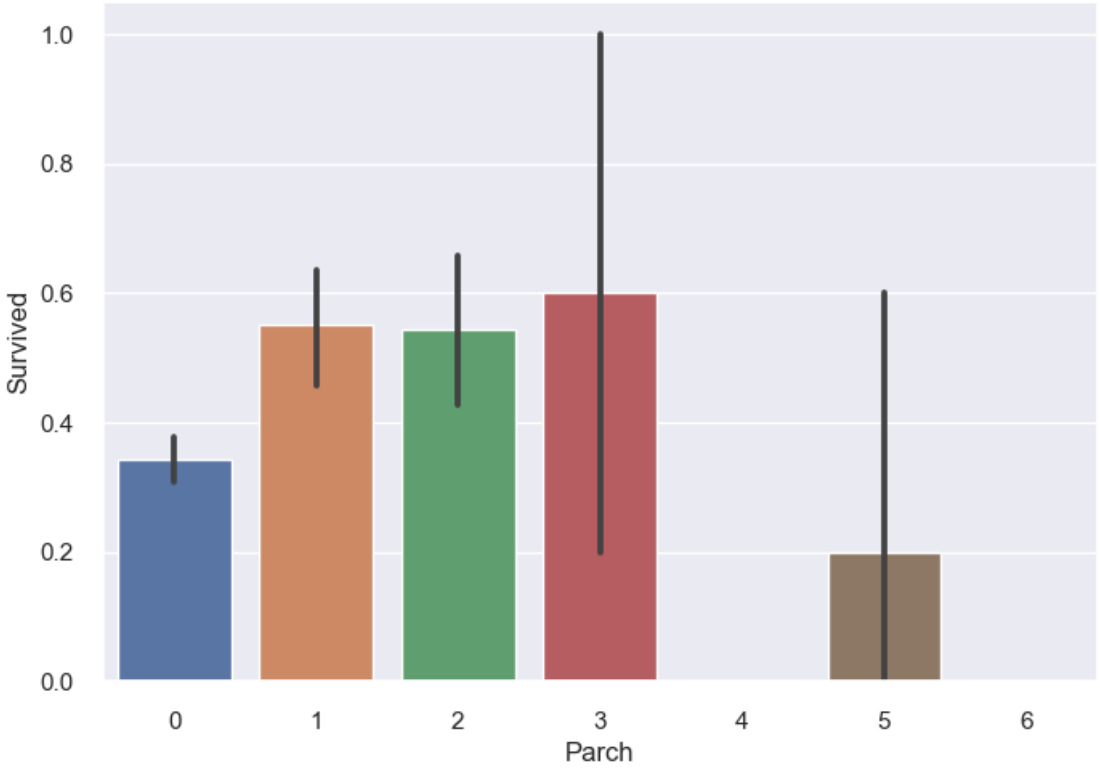
```
sns.barplot(x='voyageur_seul', y='Survived', data=train);
```




```
sns.barplot(x='SibSp', y='Survived', data=train);
```

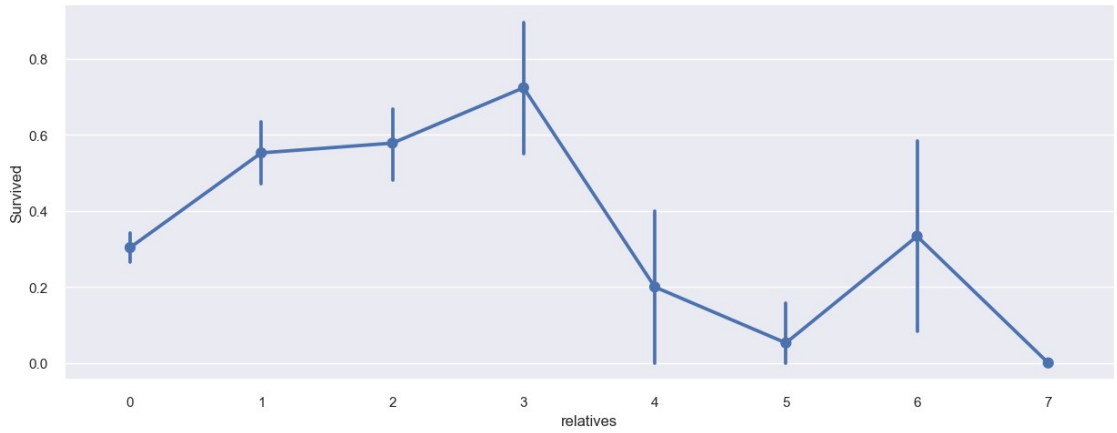


```
sns.barplot(x='Parch', y='Survived', data=train);
```



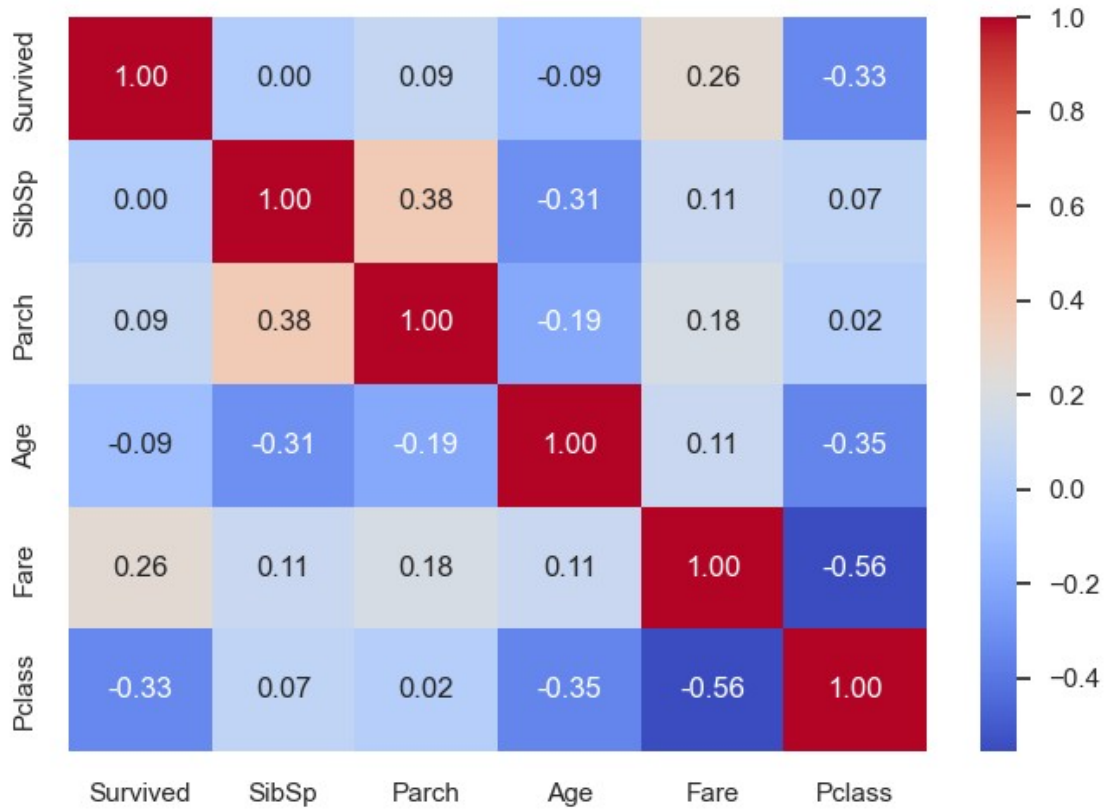

```
axes = sns.factorplot('relatives','Survived',
                      data=train, aspect = 2.5, );
```

```
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\categorical.py:3717:
UserWarning: The `factorplot` function has been renamed to `catplot`.
The original name will be removed in a future release. Please update
your code. Note that the default `kind` in `factorplot` (``'point'``)
has changed ``'strip'`` in `catplot`.
  warnings.warn(msg)
C:\Users\kcho\Anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variables as keyword args: x, y.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result in
an error or misinterpretation.
  warnings.warn(
```



On peut constater ici que l'on a une probabilité de survie élevée avec 1 à 3 personnes, mais une probabilité plus faible si on a moins de 1 ou plus de 3 personnes avec nous (sauf pour certains cas avec 6 personnes apparentées). Donc non, il était préférable pour vous de ne pas être seul lorsque le titanic a coulé.

```
# Matrice de corrélation entre les valeurs numériques (SibSp, Parch, Age, Fare, Title, Pclass) et Survived.
g = sns.heatmap(train[["Survived","SibSp","Parch","Age","Fare","Pclass","voyageur_seul", "Title"]].corr(),annot=True, fmt = ".2f", cmap = "coolwarm")
```



L'avantage de cette matrice corrélation est qu'il est facile d'interpréter nos résultats et qu'elle permet de récapituler les différents constats que nous avons pu établir au préalable. A savoir l'impact de :

- La classe sur l'espérance de survie (une meilleure classe est égale à plus de chance de survie)
- Le prix du billet sur l'espérance de survie (plus le billet est cher plus vous avez de chance de survivre)
- Le sexe et l'âge (les enfants et les femmes ont davantage de chance de survivre)
- Le nombre de personnes avec qui vous voyagez (être seul n'est pas favorable mais être trop nombreux non plus).

Etape 3 : Data Preparation

Feature engineering

Maintenant que nous avons réalisé nos analyses nous allons devoir traiter certaines variables afin qu'elles soient interprétables pour notre modèle. C'est notamment le cas pour :

- Le port d'embarquement qu'il faut convertir en valeur numérique
- Le titre qu'il faut également convertir en valeur numérique

Conversion de la variable du port d'embarquement en attribuant des valeurs numériques

```
ports = {"S": 0, "C": 1, "Q": 2}
data = [train, test]

for dataset in data:
    dataset['Embarked'] = dataset['Embarked'].map(ports)

# Vérification que la modification est bien appliquée pour le dataset de train
train.head()
```

```
   PassengerId  Survived  Pclass  \
0            1       0.0       3
1            2       1.0       1
2            3       1.0       3
3            4       1.0       1
4            5       0.0       3

                                                Name  Sex   Age  SibSp
Parch  \
0                            Braund, Mr. Owen Harris    0  22.0      1
0
1  Cumings, Mrs. John Bradley (Florence Briggs Th...    1  38.0      1
0
2                             Heikkinen, Miss. Laina    1  26.0      0
0
```

```
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    1  35.0      1
0
4                           Allen, Mr. William Henry    0  35.0      0
0

      Fare  Embarked Title  relatives voyageur_seul
0   7.2500         0    Mr          1           Non
1  71.2833         1   Mrs          1           Non
2   7.9250         0  Miss          0           Oui
3  53.1000         0   Mrs          1           Non
4   8.0500         0    Mr          0           Oui
```

```
# Vérification que la modification est bien appliquée pour le dataset de test
test.head()
```

```
     PassengerId  Survived  Pclass  \
881          892       NaN       3
882          893       NaN       3
883          894       NaN       2
884          895       NaN       3
885          896       NaN       3

                                          Name  Sex   Age  SibSp
Parch  \
881                              Kelly, Mr. James    0  34.5      0
0
882              Wilkes, Mrs. James (Ellen Needs)    1  47.0      1
0
883                     Myles, Mr. Thomas Francis    0  62.0      0
0
884                              Wirz, Mr. Albert    0  27.0      0
0
885  Hirvonen, Mrs. Alexander (Helga E Lindqvist)    1  22.0      1
1

        Fare  Embarked Title  relatives voyageur_seul
881   7.8292         2    Mr          0           Oui
882   7.0000         0   Mrs          1           Non
883   9.6875         2    Mr          0           Oui
884   8.6625         0    Mr          0           Oui
885  12.2875         0   Mrs          2           Non
```

Conversion de la variable du titre en attribuant des valeurs numériques

```
title_mapping = {"Mr": 1, "Miss": 2, "Mrs": 3, "Master": 4, "Rev": 5, "Dr": 6}
data = [train, test]

for dataset in data:
    dataset['Title'] = dataset['Title'].map(title_mapping)
```

```
# Vérification que la modification est bien appliquée pour le dataset de train
train.head()
```

```
   PassengerId  Survived  Pclass  \
0            1       0.0       3
1            2       1.0       1
2            3       1.0       3
3            4       1.0       1
4            5       0.0       3

                                                Name  Sex   Age  SibSp
Parch  \
0                            Braund, Mr. Owen Harris    0  22.0      1
0
1  Cumings, Mrs. John Bradley (Florence Briggs Th...    1  38.0      1
0
2                             Heikkinen, Miss. Laina    1  26.0      0
0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    1  35.0      1
0
4                           Allen, Mr. William Henry    0  35.0      0
0

      Fare  Embarked  Title  relatives voyageur_seul
0   7.2500         0      1          1           Non
1  71.2833         1      3          1           Non
2   7.9250         0      2          0           Oui
3  53.1000         0      3          1           Non
4   8.0500         0      1          0           Oui
```

```
# Vérification que la modification est bien appliquée pour le dataset de test
test.head()
```

```
     PassengerId  Survived  Pclass  \
881          892       NaN       3
882          893       NaN       3
883          894       NaN       2
884          895       NaN       3
885          896       NaN       3

                                         Name  Sex   Age  SibSp
Parch  \
881                          Kelly, Mr. James    0  34.5      0
0
882              Wilkes, Mrs. James (Ellen Needs)    1  47.0      1
0
883                    Myles, Mr. Thomas Francis    0  62.0      0
0
```

```
884                              Wirz, Mr. Albert    0  27.0      0
0
885  Hirvonen, Mrs. Alexander (Helga E Lindqvist)    1  22.0      1
1
```

	Fare	Embarked	Title	relatives	voyageur_seul
881	7.8292	2	1	0	Oui
882	7.0000	0	3	1	Non
883	9.6875	2	1	0	Oui
884	8.6625	0	1	0	Oui
885	12.2875	0	3	2	Non

Préparation du modèle de Machine learning

Ces lignes permettent de préparer les données pour un modèle de machine learning en supprimant certaines colonnes, en extrayant la variable cible "Survived" et en remplaçant les valeurs manquantes dans le jeu de données de test.

```
!pip install catboost
```

```
Requirement already satisfied: catboost in c:\users\kcho\anaconda3\
lib\site-packages (1.1.1)
Requirement already satisfied: six in c:\users\kcho\anaconda3\lib\
site-packages (from catboost) (1.16.0)
Requirement already satisfied: matplotlib in c:\users\kcho\anaconda3\
lib\site-packages (from catboost) (3.5.2)
Requirement already satisfied: scipy in c:\users\kcho\anaconda3\lib\
site-packages (from catboost) (1.9.1)
Requirement already satisfied: pandas>=0.24.0 in c:\users\kcho\
anaconda3\lib\site-packages (from catboost) (1.4.4)
Requirement already satisfied: numpy>=1.16.0 in c:\users\kcho\
anaconda3\lib\site-packages (from catboost) (1.21.5)
Requirement already satisfied: graphviz in c:\users\kcho\anaconda3\
lib\site-packages (from catboost) (0.20.1)
Requirement already satisfied: plotly in c:\users\kcho\anaconda3\lib\
site-packages (from catboost) (5.9.0)
Requirement already satisfied: python-dateutil>=2.8.1 in c:\users\
kcho\anaconda3\lib\site-packages (from pandas>=0.24.0->catboost)
(2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\kcho\
anaconda3\lib\site-packages (from pandas>=0.24.0->catboost) (2022.1)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\kcho\
anaconda3\lib\site-packages (from matplotlib->catboost) (1.4.2)
Requirement already satisfied: pillow>=6.2.0 in c:\users\kcho\
anaconda3\lib\site-packages (from matplotlib->catboost) (9.2.0)
Requirement already satisfied: pyparsing>=2.2.1 in c:\users\kcho\
anaconda3\lib\site-packages (from matplotlib->catboost) (3.0.9)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\kcho\
anaconda3\lib\site-packages (from matplotlib->catboost) (4.25.0)
Requirement already satisfied: cycler>=0.10 in c:\users\kcho\
anaconda3\lib\site-packages (from matplotlib->catboost) (0.11.0)
```

```
Requirement already satisfied: packaging>=20.0 in c:\users\kcho\
anaconda3\lib\site-packages (from matplotlib->catboost) (21.3)
Requirement already satisfied: tenacity>=6.2.0 in c:\users\kcho\
anaconda3\lib\site-packages (from plotly->catboost) (8.0.1)
```

```
X_train = train.drop(["Survived","Name","voyageur_seul"], axis=1)
Y_train = train["Survived"]
X_test  = test.drop(["PassengerId","Name","voyageur_seul"],
axis=1).copy()
X_test["Survived"] = X_test["Survived"].fillna(-1)
X_train.shape, Y_train.shape, X_test.shape
```

```
((881, 10), (881,), (418, 10))
```

Une fois les données préparées il suffit de mettre en place le modèle désiré et de sélectionner le plus pertinent. J'ai décidé de fonctionner en deux étapes: 1) La première méthode ne divise pas les données en jeux de validation et d'entraînement. En effet, dans la première méthode le modèle se base sur l'accuracy (la précision) il est construit en utilisant l'ensemble des données d'entraînement (X_train et Y_train) sans diviser les données en ensembles de validation et d'entraînement distincts.

2) La deuxième méthode utilise la validation croisée avec StratifiedShuffleSplit, qui divise les données en plusieurs jeux de validation et d'entraînement pour évaluer la performance du modèle de manière plus fiable. Dans cette méthode je vais réaliser une validation croisée sur trois splits différents de mes données d'entraînement

Cela permettra d'avoir 2 points de vue différents sur nos modèles et de croiser les méthodologies.

Etape 4 : Modeling

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import LogisticRegression, Perceptron,
SGDClassifier
from sklearn.svm import SVC, LinearSVC
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
#Pour ignorer les warnings
import warnings
warnings.filterwarnings('ignore')
print('-'*25)
# Logistic Regression
logreg = LogisticRegression()
logreg.fit(X_train, Y_train)
Y_pred = logreg.predict(X_test)
acc_log = round(logreg.score(X_train, Y_train) * 100, 2)
acc_log
```

```
-------------------------
```

```
81.27
```

```
# Gradient Boosting Classifier
from sklearn.ensemble import GradientBoostingClassifier
gbk = GradientBoostingClassifier()
gbk.fit(X_train, Y_train)
Y_pred = gbk.predict(X_test)
acc_gbk = round(gbk.score(X_train, Y_train) * 100, 2)
acc_gbk
```

```
90.47
```

```
# Support Vector Machines
#Pour ignorer les warnings
import warnings
warnings.filterwarnings('ignore')
print('-'*25)
svc = SVC()
svc.fit(X_train, Y_train)
Y_pred = svc.predict(X_test)
acc_svc = round(svc.score(X_train, Y_train) * 100, 2)
acc_svc
```

```
-------------------------
```

```
66.17
```

```
# KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors = 3)
knn.fit(X_train, Y_train)
Y_pred = knn.predict(X_test)
acc_knn = round(knn.score(X_train, Y_train) * 100, 2)
acc_knn
```

```
80.25
```

```
# Gaussian Naive Bayes
gaussian = GaussianNB()
gaussian.fit(X_train, Y_train)
Y_pred = gaussian.predict(X_test)
acc_gaussian = round(gaussian.score(X_train, Y_train) * 100, 2)
acc_gaussian
```

```
80.7
```

```
#Perceptron
perceptron = Perceptron()
knn = KNeighborsClassifier(n_neighbors = 3)
perceptron.fit(X_train, Y_train)
Y_pred = perceptron.predict(X_test)
```

```
acc_perceptron = round(perceptron.score(X_train, Y_train) * 100, 2)
acc_perceptron
```

```
66.63
```

```
# Stochastic Gradient Descent
sgd = SGDClassifier()
sgd.fit(X_train, Y_train)
Y_pred = sgd.predict(X_test)
acc_sgd = round(sgd.score(X_train, Y_train) * 100, 2)
acc_sgd
```

```
70.83
```

Avec cette première méthodologie on obtient un modèle à 90,47% avec le 'Gradient Boosting Classifier'. Ce serait donc le modèle le plus performant sans split les données d'entrainement. Cependant, dans cette méthodologie nous avons un risque d'overfitting. Voyons les résultats de notre deuxième méthode.

```
from sklearn.model_selection import train_test_split

# Supprimer les colonnes inutiles et la colonne "Survived" du jeu de
test
X_train = train.drop(["Survived","Name","voyageur_seul"], axis=1)
Y_train = train["Survived"]
X_test  = test.drop(["PassengerId","Name","voyageur_seul"],
axis=1).copy()

# Remplacer les valeurs manquantes de la colonne "Survived" par -1
X_test["Survived"] = X_test["Survived"].fillna(-1)

# Diviser les données d'entraînement en jeux d'entraînement et de
validation
x_train, x_val, y_train, y_val = train_test_split(X_train, Y_train,
test_size = 0.22, random_state = 0)

# Afficher les dimensions des jeux de données
print(x_train.shape, y_train.shape)
print(x_val.shape, y_val.shape)
print(X_test.shape)
```

```
(687, 10) (687,)
(194, 10) (194,)
(418, 10)
```

```
import pandas as pd
from sklearn.model_selection import train_test_split,
StratifiedShuffleSplit
from sklearn.metrics import accuracy_score
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
```

```
from catboost import CatBoostClassifier
from xgboost import XGBClassifier
from sklearn.ensemble import RandomForestClassifier,
AdaBoostClassifier, GradientBoostingClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis,
QuadraticDiscriminantAnalysis
from sklearn.linear_model import LogisticRegression

# Supprimer les colonnes inutiles et la colonne "Survived" du jeu de
test
X_train = train.drop(["Survived","Name","voyageur_seul"], axis=1)
Y_train = train["Survived"]
X_test  = test.drop(["PassengerId","Name","voyageur_seul"],
axis=1).copy()

# Remplacer les valeurs manquantes de la colonne "Survived" par -1
X_test["Survived"] = X_test["Survived"].fillna(-1)

# Diviser les données d'entraînement en jeux d'entraînement et de
validation
x_train, x_val, y_train, y_val = train_test_split(X_train, Y_train,
test_size = 0.22, random_state = 0)

# Afficher les dimensions des jeux de données
print(x_train.shape, y_train.shape)
print(x_val.shape, y_val.shape)
print(X_test.shape)

# Définir les classifieurs à tester
classifiers = [
    KNeighborsClassifier(3),
    DecisionTreeClassifier(),
    CatBoostClassifier(),
    XGBClassifier(),
    RandomForestClassifier(),
    AdaBoostClassifier(),
    GradientBoostingClassifier(),
    GaussianNB(),
    LinearDiscriminantAnalysis(),
    QuadraticDiscriminantAnalysis(),
    LogisticRegression()
]

# Définir le split pour la validation croisée
SSplit = StratifiedShuffleSplit(n_splits=3, test_size=0.2,
random_state=42)

# Boucle sur les splits et les classifieurs pour obtenir la précision
```

```
moyenne sur la validation
for train_index, test_index in SSplit.split(X_train, Y_train):
    x_train, x_test = X_train.iloc[train_index],
X_train.iloc[test_index]
    y_train, y_test = Y_train.iloc[train_index],
Y_train.iloc[test_index]
    for clf in classifiers:
        clf.fit(x_train, y_train)
        y_pred = clf.predict(x_test)
        acc = accuracy_score(y_test, y_pred)
        print(clf.__class__.__name__, acc)
```

```
(687, 10) (687,)
(194, 10) (194,)
(418, 10)
KNeighborsClassifier 0.6271186440677966
DecisionTreeClassifier 0.7570621468926554
Learning rate set to 0.008868
0:    learn: 0.6876345 total: 159ms    remaining: 2m 38s
1:    learn: 0.6807430 total: 164ms    remaining: 1m 21s
2:    learn: 0.6742153 total: 168ms    remaining: 56s
3:    learn: 0.6692265 total: 172ms    remaining: 42.9s
4:    learn: 0.6632676 total: 175ms    remaining: 34.8s
5:    learn: 0.6578032 total: 179ms    remaining: 29.6s
6:    learn: 0.6522321 total: 183ms    remaining: 26s
7:    learn: 0.6472208 total: 188ms    remaining: 23.3s
8:    learn: 0.6409945 total: 192ms    remaining: 21.1s
9:    learn: 0.6358152 total: 196ms    remaining: 19.4s
10:   learn: 0.6308981 total: 200ms    remaining: 18s
11:   learn: 0.6255336 total: 203ms    remaining: 16.7s
12:   learn: 0.6201626 total: 208ms    remaining: 15.8s
13:   learn: 0.6160845 total: 211ms    remaining: 14.8s
14:   learn: 0.6126223 total: 216ms    remaining: 14.2s
15:   learn: 0.6072698 total: 220ms    remaining: 13.5s
16:   learn: 0.6043400 total: 221ms    remaining: 12.8s
17:   learn: 0.5998674 total: 223ms    remaining: 12.2s
18:   learn: 0.5947621 total: 227ms    remaining: 11.7s
19:   learn: 0.5903407 total: 230ms    remaining: 11.3s
20:   learn: 0.5857013 total: 233ms    remaining: 10.8s
21:   learn: 0.5812081 total: 235ms    remaining: 10.4s
22:   learn: 0.5770776 total: 237ms    remaining: 10.1s
23:   learn: 0.5725599 total: 240ms    remaining: 9.78s
24:   learn: 0.5679553 total: 243ms    remaining: 9.49s
25:   learn: 0.5643452 total: 247ms    remaining: 9.24s
26:   learn: 0.5606193 total: 249ms    remaining: 8.99s
27:   learn: 0.5565539 total: 252ms    remaining: 8.74s
28:   learn: 0.5536149 total: 253ms    remaining: 8.48s
29:   learn: 0.5502625 total: 256ms    remaining: 8.28s
30:   learn: 0.5475714 total: 258ms    remaining: 8.06s
31:   learn: 0.5442990 total: 260ms    remaining: 7.87s
```

```
32:   learn: 0.5406243 total: 262ms    remaining: 7.69s
33:   learn: 0.5366663 total: 265ms    remaining: 7.52s
34:   learn: 0.5338638 total: 267ms    remaining: 7.35s
35:   learn: 0.5303346 total: 268ms    remaining: 7.19s
36:   learn: 0.5274484 total: 270ms    remaining: 7.03s
37:   learn: 0.5242543 total: 272ms    remaining: 6.88s
38:   learn: 0.5213025 total: 273ms    remaining: 6.74s
39:   learn: 0.5178292 total: 275ms    remaining: 6.6s
40:   learn: 0.5146263 total: 276ms    remaining: 6.46s
41:   learn: 0.5115093 total: 277ms    remaining: 6.33s
42:   learn: 0.5093625 total: 278ms    remaining: 6.19s
43:   learn: 0.5066109 total: 279ms    remaining: 6.07s
44:   learn: 0.5045657 total: 280ms    remaining: 5.95s
45:   learn: 0.5012580 total: 281ms    remaining: 5.83s
46:   learn: 0.4994221 total: 282ms    remaining: 5.72s
47:   learn: 0.4969550 total: 284ms    remaining: 5.62s
48:   learn: 0.4946426 total: 285ms    remaining: 5.52s
49:   learn: 0.4916587 total: 286ms    remaining: 5.43s
50:   learn: 0.4893670 total: 287ms    remaining: 5.33s
51:   learn: 0.4866575 total: 288ms    remaining: 5.25s
52:   learn: 0.4841664 total: 289ms    remaining: 5.17s
53:   learn: 0.4817765 total: 290ms    remaining: 5.08s
54:   learn: 0.4799871 total: 291ms    remaining: 5s
55:   learn: 0.4778663 total: 292ms    remaining: 4.92s
56:   learn: 0.4756447 total: 293ms    remaining: 4.85s
57:   learn: 0.4737095 total: 294ms    remaining: 4.78s
58:   learn: 0.4715085 total: 295ms    remaining: 4.71s
59:   learn: 0.4691802 total: 296ms    remaining: 4.64s
60:   learn: 0.4671501 total: 297ms    remaining: 4.58s
61:   learn: 0.4650707 total: 298ms    remaining: 4.51s
62:   learn: 0.4632244 total: 300ms    remaining: 4.46s
63:   learn: 0.4615025 total: 301ms    remaining: 4.4s
64:   learn: 0.4596317 total: 302ms    remaining: 4.34s
65:   learn: 0.4572857 total: 303ms    remaining: 4.29s
66:   learn: 0.4554530 total: 304ms    remaining: 4.23s
67:   learn: 0.4536620 total: 305ms    remaining: 4.18s
68:   learn: 0.4517288 total: 306ms    remaining: 4.13s
69:   learn: 0.4508738 total: 307ms    remaining: 4.08s
70:   learn: 0.4496018 total: 308ms    remaining: 4.03s
71:   learn: 0.4483113 total: 309ms    remaining: 3.98s
72:   learn: 0.4464253 total: 310ms    remaining: 3.93s
73:   learn: 0.4445877 total: 311ms    remaining: 3.89s
74:   learn: 0.4428659 total: 312ms    remaining: 3.85s
75:   learn: 0.4412685 total: 313ms    remaining: 3.81s
76:   learn: 0.4395486 total: 314ms    remaining: 3.77s
77:   learn: 0.4377778 total: 315ms    remaining: 3.73s
78:   learn: 0.4359573 total: 316ms    remaining: 3.69s
79:   learn: 0.4346263 total: 318ms    remaining: 3.65s
80:   learn: 0.4331642 total: 319ms    remaining: 3.62s
81:   learn: 0.4318115 total: 320ms    remaining: 3.58s
```

```
82:   learn: 0.4304380 total: 321ms    remaining: 3.54s
83:   learn: 0.4290257 total: 322ms    remaining: 3.51s
84:   learn: 0.4272044 total: 323ms    remaining: 3.48s
85:   learn: 0.4257980 total: 324ms    remaining: 3.44s
86:   learn: 0.4244439 total: 325ms    remaining: 3.41s
87:   learn: 0.4230733 total: 326ms    remaining: 3.38s
88:   learn: 0.4217092 total: 327ms    remaining: 3.35s
89:   learn: 0.4206474 total: 328ms    remaining: 3.32s
90:   learn: 0.4195955 total: 330ms    remaining: 3.29s
91:   learn: 0.4189570 total: 330ms    remaining: 3.26s
92:   learn: 0.4175745 total: 331ms    remaining: 3.23s
93:   learn: 0.4162211 total: 333ms    remaining: 3.2s
94:   learn: 0.4150249 total: 334ms    remaining: 3.18s
95:   learn: 0.4144265 total: 334ms    remaining: 3.15s
96:   learn: 0.4138552 total: 335ms    remaining: 3.12s
97:   learn: 0.4124314 total: 336ms    remaining: 3.09s
98:   learn: 0.4112505 total: 337ms    remaining: 3.07s
99:   learn: 0.4098213 total: 338ms    remaining: 3.04s
100:  learn: 0.4086181 total: 339ms    remaining: 3.02s
101:  learn: 0.4076537 total: 340ms    remaining: 3s
102:  learn: 0.4065596 total: 341ms    remaining: 2.97s
103:  learn: 0.4057499 total: 343ms    remaining: 2.95s
104:  learn: 0.4045914 total: 344ms    remaining: 2.93s
105:  learn: 0.4035569 total: 345ms    remaining: 2.91s
106:  learn: 0.4027702 total: 346ms    remaining: 2.89s
107:  learn: 0.4016276 total: 347ms    remaining: 2.87s
108:  learn: 0.4006069 total: 348ms    remaining: 2.85s
109:  learn: 0.3995212 total: 349ms    remaining: 2.83s
110:  learn: 0.3991677 total: 350ms    remaining: 2.8s
111:  learn: 0.3988728 total: 350ms    remaining: 2.78s
112:  learn: 0.3978033 total: 352ms    remaining: 2.76s
113:  learn: 0.3969629 total: 353ms    remaining: 2.74s
114:  learn: 0.3962718 total: 354ms    remaining: 2.72s
115:  learn: 0.3954235 total: 355ms    remaining: 2.7s
116:  learn: 0.3944935 total: 356ms    remaining: 2.68s
117:  learn: 0.3935942 total: 357ms    remaining: 2.67s
118:  learn: 0.3924847 total: 358ms    remaining: 2.65s
119:  learn: 0.3913119 total: 359ms    remaining: 2.63s
120:  learn: 0.3907915 total: 361ms    remaining: 2.62s
121:  learn: 0.3899448 total: 362ms    remaining: 2.6s
122:  learn: 0.3888502 total: 363ms    remaining: 2.59s
123:  learn: 0.3879629 total: 364ms    remaining: 2.57s
124:  learn: 0.3874862 total: 365ms    remaining: 2.55s
125:  learn: 0.3866184 total: 366ms    remaining: 2.54s
126:  learn: 0.3856205 total: 368ms    remaining: 2.53s
127:  learn: 0.3849803 total: 369ms    remaining: 2.51s
128:  learn: 0.3841749 total: 370ms    remaining: 2.5s
129:  learn: 0.3836430 total: 372ms    remaining: 2.49s
130:  learn: 0.3828995 total: 373ms    remaining: 2.47s
131:  learn: 0.3823970 total: 374ms    remaining: 2.46s
```

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132:  learn: 0.3818064 total: 375ms    remaining: 2.44s
133:  learn: 0.3808935 total: 377ms    remaining: 2.43s
134:  learn: 0.3803004 total: 377ms    remaining: 2.42s
135:  learn: 0.3797978 total: 378ms    remaining: 2.4s
136:  learn: 0.3791098 total: 379ms    remaining: 2.39s
137:  learn: 0.3786171 total: 380ms    remaining: 2.38s
138:  learn: 0.3777810 total: 382ms    remaining: 2.36s
139:  learn: 0.3771210 total: 383ms    remaining: 2.35s
140:  learn: 0.3765150 total: 384ms    remaining: 2.34s
141:  learn: 0.3760764 total: 385ms    remaining: 2.33s
142:  learn: 0.3751620 total: 386ms    remaining: 2.31s
143:  learn: 0.3744371 total: 387ms    remaining: 2.3s
144:  learn: 0.3742100 total: 388ms    remaining: 2.29s
145:  learn: 0.3737232 total: 389ms    remaining: 2.28s
146:  learn: 0.3735272 total: 390ms    remaining: 2.26s
147:  learn: 0.3730844 total: 391ms    remaining: 2.25s
148:  learn: 0.3728755 total: 391ms    remaining: 2.23s
149:  learn: 0.3727426 total: 392ms    remaining: 2.22s
150:  learn: 0.3722777 total: 393ms    remaining: 2.21s
151:  learn: 0.3716137 total: 394ms    remaining: 2.2s
152:  learn: 0.3711061 total: 395ms    remaining: 2.19s
153:  learn: 0.3703470 total: 396ms    remaining: 2.18s
154:  learn: 0.3697570 total: 397ms    remaining: 2.17s
155:  learn: 0.3692293 total: 398ms    remaining: 2.15s
156:  learn: 0.3685617 total: 400ms    remaining: 2.15s
157:  learn: 0.3681336 total: 401ms    remaining: 2.13s
158:  learn: 0.3676328 total: 402ms    remaining: 2.13s
159:  learn: 0.3672211 total: 403ms    remaining: 2.12s
160:  learn: 0.3666599 total: 404ms    remaining: 2.1s
161:  learn: 0.3659616 total: 405ms    remaining: 2.1s
162:  learn: 0.3655880 total: 406ms    remaining: 2.08s
163:  learn: 0.3650488 total: 407ms    remaining: 2.08s
164:  learn: 0.3644368 total: 408ms    remaining: 2.06s
165:  learn: 0.3639191 total: 409ms    remaining: 2.06s
166:  learn: 0.3631752 total: 410ms    remaining: 2.05s
167:  learn: 0.3624144 total: 411ms    remaining: 2.04s
168:  learn: 0.3619156 total: 413ms    remaining: 2.03s
169:  learn: 0.3615359 total: 414ms    remaining: 2.02s
170:  learn: 0.3611140 total: 415ms    remaining: 2.01s
171:  learn: 0.3606117 total: 416ms    remaining: 2s
172:  learn: 0.3601121 total: 417ms    remaining: 2s
173:  learn: 0.3597707 total: 418ms    remaining: 1.99s
174:  learn: 0.3591929 total: 420ms    remaining: 1.98s
175:  learn: 0.3587417 total: 421ms    remaining: 1.97s
176:  learn: 0.3581675 total: 422ms    remaining: 1.96s
177:  learn: 0.3577543 total: 423ms    remaining: 1.95s
178:  learn: 0.3573791 total: 424ms    remaining: 1.94s
179:  learn: 0.3569552 total: 425ms    remaining: 1.93s
180:  learn: 0.3563848 total: 426ms    remaining: 1.93s
181:  learn: 0.3560692 total: 427ms    remaining: 1.92s
```

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182:  learn: 0.3555918  total: 428ms    remaining: 1.91s
183:  learn: 0.3549578  total: 429ms    remaining: 1.9s
184:  learn: 0.3543673  total: 430ms    remaining: 1.9s
185:  learn: 0.3537208  total: 431ms    remaining: 1.89s
186:  learn: 0.3533928  total: 432ms    remaining: 1.88s
187:  learn: 0.3531995  total: 433ms    remaining: 1.87s
188:  learn: 0.3528117  total: 434ms    remaining: 1.86s
189:  learn: 0.3523020  total: 435ms    remaining: 1.85s
190:  learn: 0.3518490  total: 436ms    remaining: 1.85s
191:  learn: 0.3513932  total: 437ms    remaining: 1.84s
192:  learn: 0.3512093  total: 438ms    remaining: 1.83s
193:  learn: 0.3508016  total: 439ms    remaining: 1.82s
194:  learn: 0.3504249  total: 440ms    remaining: 1.82s
195:  learn: 0.3500837  total: 441ms    remaining: 1.81s
196:  learn: 0.3497886  total: 443ms    remaining: 1.8s
197:  learn: 0.3491737  total: 444ms    remaining: 1.8s
198:  learn: 0.3487621  total: 445ms    remaining: 1.79s
199:  learn: 0.3482980  total: 446ms    remaining: 1.78s
200:  learn: 0.3478327  total: 447ms    remaining: 1.78s
201:  learn: 0.3475068  total: 448ms    remaining: 1.77s
202:  learn: 0.3472267  total: 449ms    remaining: 1.76s
203:  learn: 0.3470229  total: 450ms    remaining: 1.76s
204:  learn: 0.3466196  total: 451ms    remaining: 1.75s
205:  learn: 0.3462051  total: 452ms    remaining: 1.74s
206:  learn: 0.3456513  total: 453ms    remaining: 1.74s
207:  learn: 0.3453850  total: 454ms    remaining: 1.73s
208:  learn: 0.3449378  total: 455ms    remaining: 1.72s
209:  learn: 0.3445625  total: 457ms    remaining: 1.72s
210:  learn: 0.3440663  total: 458ms    remaining: 1.71s
211:  learn: 0.3436035  total: 459ms    remaining: 1.71s
212:  learn: 0.3432416  total: 460ms    remaining: 1.7s
213:  learn: 0.3429064  total: 461ms    remaining: 1.69s
214:  learn: 0.3425190  total: 462ms    remaining: 1.69s
215:  learn: 0.3421932  total: 463ms    remaining: 1.68s
216:  learn: 0.3417754  total: 464ms    remaining: 1.68s
217:  learn: 0.3413550  total: 465ms    remaining: 1.67s
218:  learn: 0.3410293  total: 466ms    remaining: 1.66s
219:  learn: 0.3407385  total: 467ms    remaining: 1.66s
220:  learn: 0.3402984  total: 469ms    remaining: 1.65s
221:  learn: 0.3398180  total: 470ms    remaining: 1.65s
222:  learn: 0.3396001  total: 471ms    remaining: 1.64s
223:  learn: 0.3394925  total: 471ms    remaining: 1.63s
224:  learn: 0.3390697  total: 472ms    remaining: 1.63s
225:  learn: 0.3387002  total: 474ms    remaining: 1.62s
226:  learn: 0.3383099  total: 475ms    remaining: 1.62s
227:  learn: 0.3379072  total: 476ms    remaining: 1.61s
228:  learn: 0.3376272  total: 477ms    remaining: 1.61s
229:  learn: 0.3372956  total: 478ms    remaining: 1.6s
230:  learn: 0.3370567  total: 479ms    remaining: 1.59s
231:  learn: 0.3365284  total: 480ms    remaining: 1.59s
```

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232:  learn: 0.3361011 total: 481ms    remaining: 1.58s
233:  learn: 0.3358794 total: 482ms    remaining: 1.58s
234:  learn: 0.3355836 total: 483ms    remaining: 1.57s
235:  learn: 0.3350956 total: 485ms    remaining: 1.57s
236:  learn: 0.3347569 total: 486ms    remaining: 1.56s
237:  learn: 0.3346212 total: 486ms    remaining: 1.56s
238:  learn: 0.3343919 total: 488ms    remaining: 1.55s
239:  learn: 0.3340189 total: 489ms    remaining: 1.55s
240:  learn: 0.3338057 total: 490ms    remaining: 1.54s
241:  learn: 0.3335504 total: 491ms    remaining: 1.54s
242:  learn: 0.3333538 total: 492ms    remaining: 1.53s
243:  learn: 0.3332282 total: 493ms    remaining: 1.53s
244:  learn: 0.3328619 total: 494ms    remaining: 1.52s
245:  learn: 0.3327734 total: 495ms    remaining: 1.52s
246:  learn: 0.3325563 total: 496ms    remaining: 1.51s
247:  learn: 0.3324260 total: 497ms    remaining: 1.51s
248:  learn: 0.3322084 total: 498ms    remaining: 1.5s
249:  learn: 0.3319955 total: 499ms    remaining: 1.5s
250:  learn: 0.3317345 total: 500ms    remaining: 1.49s
251:  learn: 0.3312747 total: 501ms    remaining: 1.49s
252:  learn: 0.3310044 total: 503ms    remaining: 1.48s
253:  learn: 0.3307465 total: 504ms    remaining: 1.48s
254:  learn: 0.3305515 total: 505ms    remaining: 1.47s
255:  learn: 0.3303315 total: 506ms    remaining: 1.47s
256:  learn: 0.3299366 total: 507ms    remaining: 1.47s
257:  learn: 0.3295273 total: 508ms    remaining: 1.46s
258:  learn: 0.3293176 total: 509ms    remaining: 1.46s
259:  learn: 0.3290579 total: 511ms    remaining: 1.45s
260:  learn: 0.3287197 total: 512ms    remaining: 1.45s
261:  learn: 0.3285452 total: 513ms    remaining: 1.44s
262:  learn: 0.3281282 total: 514ms    remaining: 1.44s
263:  learn: 0.3278113 total: 515ms    remaining: 1.44s
264:  learn: 0.3276742 total: 516ms    remaining: 1.43s
265:  learn: 0.3274620 total: 517ms    remaining: 1.43s
266:  learn: 0.3271727 total: 518ms    remaining: 1.42s
267:  learn: 0.3269910 total: 519ms    remaining: 1.42s
268:  learn: 0.3266813 total: 520ms    remaining: 1.41s
269:  learn: 0.3263746 total: 521ms    remaining: 1.41s
270:  learn: 0.3260875 total: 523ms    remaining: 1.41s
271:  learn: 0.3258574 total: 524ms    remaining: 1.4s
272:  learn: 0.3255621 total: 525ms    remaining: 1.4s
273:  learn: 0.3253723 total: 526ms    remaining: 1.39s
274:  learn: 0.3252049 total: 527ms    remaining: 1.39s
275:  learn: 0.3248147 total: 528ms    remaining: 1.39s
276:  learn: 0.3244314 total: 529ms    remaining: 1.38s
277:  learn: 0.3239023 total: 530ms    remaining: 1.38s
278:  learn: 0.3235372 total: 531ms    remaining: 1.37s
279:  learn: 0.3233247 total: 532ms    remaining: 1.37s
280:  learn: 0.3230410 total: 533ms    remaining: 1.36s
281:  learn: 0.3225505 total: 534ms    remaining: 1.36s
```

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282:  learn: 0.3223712  total: 536ms    remaining: 1.36s
283:  learn: 0.3220545  total: 537ms    remaining: 1.35s
284:  learn: 0.3218314  total: 538ms    remaining: 1.35s
285:  learn: 0.3216914  total: 539ms    remaining: 1.34s
286:  learn: 0.3213958  total: 540ms    remaining: 1.34s
287:  learn: 0.3213262  total: 541ms    remaining: 1.34s
288:  learn: 0.3210669  total: 542ms    remaining: 1.33s
289:  learn: 0.3209159  total: 543ms    remaining: 1.33s
290:  learn: 0.3207474  total: 544ms    remaining: 1.32s
291:  learn: 0.3205049  total: 545ms    remaining: 1.32s
292:  learn: 0.3203520  total: 546ms    remaining: 1.32s
293:  learn: 0.3198916  total: 547ms    remaining: 1.31s
294:  learn: 0.3196215  total: 548ms    remaining: 1.31s
295:  learn: 0.3193914  total: 549ms    remaining: 1.31s
296:  learn: 0.3190634  total: 551ms    remaining: 1.3s
297:  learn: 0.3189799  total: 551ms    remaining: 1.3s
298:  learn: 0.3187733  total: 552ms    remaining: 1.29s
299:  learn: 0.3185828  total: 553ms    remaining: 1.29s
300:  learn: 0.3182178  total: 554ms    remaining: 1.29s
301:  learn: 0.3178510  total: 555ms    remaining: 1.28s
302:  learn: 0.3176262  total: 556ms    remaining: 1.28s
303:  learn: 0.3172477  total: 558ms    remaining: 1.28s
304:  learn: 0.3169203  total: 559ms    remaining: 1.27s
305:  learn: 0.3166962  total: 560ms    remaining: 1.27s
306:  learn: 0.3163750  total: 561ms    remaining: 1.27s
307:  learn: 0.3161532  total: 563ms    remaining: 1.26s
308:  learn: 0.3158431  total: 564ms    remaining: 1.26s
309:  learn: 0.3155832  total: 565ms    remaining: 1.26s
310:  learn: 0.3151581  total: 566ms    remaining: 1.25s
311:  learn: 0.3150483  total: 567ms    remaining: 1.25s
312:  learn: 0.3148079  total: 568ms    remaining: 1.25s
313:  learn: 0.3147742  total: 569ms    remaining: 1.24s
314:  learn: 0.3145382  total: 570ms    remaining: 1.24s
315:  learn: 0.3142561  total: 571ms    remaining: 1.24s
316:  learn: 0.3140898  total: 572ms    remaining: 1.23s
317:  learn: 0.3138026  total: 574ms    remaining: 1.23s
318:  learn: 0.3136243  total: 575ms    remaining: 1.23s
319:  learn: 0.3134282  total: 576ms    remaining: 1.22s
320:  learn: 0.3132380  total: 577ms    remaining: 1.22s
321:  learn: 0.3129178  total: 578ms    remaining: 1.22s
322:  learn: 0.3126597  total: 580ms    remaining: 1.21s
323:  learn: 0.3124670  total: 581ms    remaining: 1.21s
324:  learn: 0.3122192  total: 582ms    remaining: 1.21s
325:  learn: 0.3118689  total: 584ms    remaining: 1.21s
326:  learn: 0.3114576  total: 585ms    remaining: 1.2s
327:  learn: 0.3113954  total: 586ms    remaining: 1.2s
328:  learn: 0.3111561  total: 587ms    remaining: 1.2s
329:  learn: 0.3110031  total: 588ms    remaining: 1.19s
330:  learn: 0.3108094  total: 589ms    remaining: 1.19s
331:  learn: 0.3106324  total: 590ms    remaining: 1.19s
```

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332:  learn: 0.3105819 total: 591ms    remaining: 1.18s
333:  learn: 0.3103032 total: 592ms    remaining: 1.18s
334:  learn: 0.3101801 total: 593ms    remaining: 1.18s
335:  learn: 0.3098927 total: 594ms    remaining: 1.17s
336:  learn: 0.3097370 total: 595ms    remaining: 1.17s
337:  learn: 0.3094752 total: 596ms    remaining: 1.17s
338:  learn: 0.3093019 total: 597ms    remaining: 1.16s
339:  learn: 0.3089682 total: 598ms    remaining: 1.16s
340:  learn: 0.3087573 total: 599ms    remaining: 1.16s
341:  learn: 0.3085553 total: 601ms    remaining: 1.16s
342:  learn: 0.3083492 total: 602ms    remaining: 1.15s
343:  learn: 0.3082295 total: 603ms    remaining: 1.15s
344:  learn: 0.3080869 total: 604ms    remaining: 1.15s
345:  learn: 0.3079561 total: 605ms    remaining: 1.14s
346:  learn: 0.3077581 total: 606ms    remaining: 1.14s
347:  learn: 0.3075954 total: 608ms    remaining: 1.14s
348:  learn: 0.3073633 total: 609ms    remaining: 1.14s
349:  learn: 0.3071244 total: 610ms    remaining: 1.13s
350:  learn: 0.3069759 total: 611ms    remaining: 1.13s
351:  learn: 0.3069193 total: 612ms    remaining: 1.13s
352:  learn: 0.3067710 total: 613ms    remaining: 1.12s
353:  learn: 0.3065316 total: 614ms    remaining: 1.12s
354:  learn: 0.3063945 total: 615ms    remaining: 1.12s
355:  learn: 0.3062643 total: 617ms    remaining: 1.11s
356:  learn: 0.3061088 total: 618ms    remaining: 1.11s
357:  learn: 0.3060126 total: 619ms    remaining: 1.11s
358:  learn: 0.3058731 total: 620ms    remaining: 1.11s
359:  learn: 0.3056737 total: 621ms    remaining: 1.1s
360:  learn: 0.3055820 total: 622ms    remaining: 1.1s
361:  learn: 0.3054359 total: 624ms    remaining: 1.1s
362:  learn: 0.3052647 total: 625ms    remaining: 1.1s
363:  learn: 0.3051427 total: 626ms    remaining: 1.09s
364:  learn: 0.3051375 total: 627ms    remaining: 1.09s
365:  learn: 0.3049650 total: 628ms    remaining: 1.09s
366:  learn: 0.3047413 total: 629ms    remaining: 1.08s
367:  learn: 0.3046491 total: 630ms    remaining: 1.08s
368:  learn: 0.3044941 total: 631ms    remaining: 1.08s
369:  learn: 0.3042168 total: 633ms    remaining: 1.08s
370:  learn: 0.3039899 total: 634ms    remaining: 1.07s
371:  learn: 0.3038928 total: 635ms    remaining: 1.07s
372:  learn: 0.3036832 total: 636ms    remaining: 1.07s
373:  learn: 0.3035958 total: 637ms    remaining: 1.07s
374:  learn: 0.3034011 total: 639ms    remaining: 1.06s
375:  learn: 0.3031654 total: 640ms    remaining: 1.06s
376:  learn: 0.3028097 total: 641ms    remaining: 1.06s
377:  learn: 0.3026997 total: 642ms    remaining: 1.06s
378:  learn: 0.3025556 total: 643ms    remaining: 1.05s
379:  learn: 0.3024166 total: 645ms    remaining: 1.05s
380:  learn: 0.3022141 total: 646ms    remaining: 1.05s
381:  learn: 0.3019745 total: 647ms    remaining: 1.05s
```

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382:  learn: 0.3017566 total: 648ms    remaining: 1.04s
383:  learn: 0.3015132 total: 650ms    remaining: 1.04s
384:  learn: 0.3013992 total: 651ms    remaining: 1.04s
385:  learn: 0.3013017 total: 652ms    remaining: 1.04s
386:  learn: 0.3012003 total: 653ms    remaining: 1.03s
387:  learn: 0.3011121 total: 654ms    remaining: 1.03s
388:  learn: 0.3009300 total: 655ms    remaining: 1.03s
389:  learn: 0.3007469 total: 657ms    remaining: 1.03s
390:  learn: 0.3005088 total: 658ms    remaining: 1.02s
391:  learn: 0.3003508 total: 659ms    remaining: 1.02s
392:  learn: 0.3001869 total: 660ms    remaining: 1.02s
393:  learn: 0.2998014 total: 661ms    remaining: 1.02s
394:  learn: 0.2997297 total: 663ms    remaining: 1.01s
395:  learn: 0.2996149 total: 664ms    remaining: 1.01s
396:  learn: 0.2994864 total: 665ms    remaining: 1.01s
397:  learn: 0.2993451 total: 667ms    remaining: 1.01s
398:  learn: 0.2991250 total: 668ms    remaining: 1s
399:  learn: 0.2990132 total: 669ms    remaining: 1s
400:  learn: 0.2988676 total: 670ms    remaining: 1s
401:  learn: 0.2987918 total: 671ms    remaining: 999ms
402:  learn: 0.2986386 total: 673ms    remaining: 996ms
403:  learn: 0.2984183 total: 674ms    remaining: 994ms
404:  learn: 0.2982102 total: 675ms    remaining: 992ms
405:  learn: 0.2981085 total: 676ms    remaining: 989ms
406:  learn: 0.2979686 total: 677ms    remaining: 987ms
407:  learn: 0.2978653 total: 679ms    remaining: 985ms
408:  learn: 0.2976954 total: 680ms    remaining: 983ms
409:  learn: 0.2976909 total: 681ms    remaining: 979ms
410:  learn: 0.2974187 total: 682ms    remaining: 977ms
411:  learn: 0.2972762 total: 683ms    remaining: 974ms
412:  learn: 0.2970651 total: 684ms    remaining: 972ms
413:  learn: 0.2968038 total: 685ms    remaining: 969ms
414:  learn: 0.2966515 total: 686ms    remaining: 967ms
415:  learn: 0.2964391 total: 687ms    remaining: 964ms
416:  learn: 0.2963617 total: 688ms    remaining: 962ms
417:  learn: 0.2963026 total: 689ms    remaining: 959ms
418:  learn: 0.2962495 total: 690ms    remaining: 957ms
419:  learn: 0.2959880 total: 691ms    remaining: 954ms
420:  learn: 0.2958772 total: 692ms    remaining: 952ms
421:  learn: 0.2957639 total: 693ms    remaining: 949ms
422:  learn: 0.2956134 total: 694ms    remaining: 947ms
423:  learn: 0.2954505 total: 696ms    remaining: 945ms
424:  learn: 0.2951666 total: 697ms    remaining: 943ms
425:  learn: 0.2949745 total: 698ms    remaining: 940ms
426:  learn: 0.2948320 total: 699ms    remaining: 938ms
427:  learn: 0.2947465 total: 700ms    remaining: 936ms
428:  learn: 0.2945349 total: 701ms    remaining: 933ms
429:  learn: 0.2943568 total: 702ms    remaining: 931ms
430:  learn: 0.2941839 total: 703ms    remaining: 928ms
431:  learn: 0.2940996 total: 704ms    remaining: 926ms
```

```
432:  learn: 0.2939522  total: 705ms    remaining: 924ms
433:  learn: 0.2938261  total: 707ms    remaining: 921ms
434:  learn: 0.2937250  total: 708ms    remaining: 919ms
435:  learn: 0.2935627  total: 709ms    remaining: 917ms
436:  learn: 0.2934491  total: 710ms    remaining: 914ms
437:  learn: 0.2932997  total: 711ms    remaining: 912ms
438:  learn: 0.2931554  total: 712ms    remaining: 910ms
439:  learn: 0.2930386  total: 713ms    remaining: 907ms
440:  learn: 0.2928955  total: 714ms    remaining: 905ms
441:  learn: 0.2927159  total: 715ms    remaining: 903ms
442:  learn: 0.2924824  total: 716ms    remaining: 900ms
443:  learn: 0.2923426  total: 717ms    remaining: 898ms
444:  learn: 0.2921932  total: 718ms    remaining: 896ms
445:  learn: 0.2919562  total: 719ms    remaining: 893ms
446:  learn: 0.2918463  total: 720ms    remaining: 891ms
447:  learn: 0.2916619  total: 721ms    remaining: 889ms
448:  learn: 0.2916089  total: 722ms    remaining: 887ms
449:  learn: 0.2914102  total: 724ms    remaining: 884ms
450:  learn: 0.2913047  total: 725ms    remaining: 882ms
451:  learn: 0.2912124  total: 726ms    remaining: 880ms
452:  learn: 0.2911985  total: 726ms    remaining: 877ms
453:  learn: 0.2910419  total: 728ms    remaining: 875ms
454:  learn: 0.2907297  total: 729ms    remaining: 873ms
455:  learn: 0.2906583  total: 730ms    remaining: 870ms
456:  learn: 0.2905371  total: 731ms    remaining: 868ms
457:  learn: 0.2903506  total: 732ms    remaining: 866ms
458:  learn: 0.2900588  total: 733ms    remaining: 864ms
459:  learn: 0.2897980  total: 734ms    remaining: 862ms
460:  learn: 0.2895638  total: 735ms    remaining: 859ms
461:  learn: 0.2894620  total: 736ms    remaining: 857ms
462:  learn: 0.2893259  total: 737ms    remaining: 855ms
463:  learn: 0.2892212  total: 738ms    remaining: 853ms
464:  learn: 0.2890953  total: 739ms    remaining: 851ms
465:  learn: 0.2889110  total: 740ms    remaining: 848ms
466:  learn: 0.2888270  total: 741ms    remaining: 846ms
467:  learn: 0.2886048  total: 743ms    remaining: 844ms
468:  learn: 0.2884337  total: 744ms    remaining: 842ms
469:  learn: 0.2882807  total: 745ms    remaining: 840ms
470:  learn: 0.2881861  total: 746ms    remaining: 838ms
471:  learn: 0.2880843  total: 747ms    remaining: 835ms
472:  learn: 0.2879964  total: 748ms    remaining: 833ms
473:  learn: 0.2879016  total: 749ms    remaining: 831ms
474:  learn: 0.2877837  total: 750ms    remaining: 829ms
475:  learn: 0.2875961  total: 752ms    remaining: 827ms
476:  learn: 0.2873824  total: 753ms    remaining: 825ms
477:  learn: 0.2873253  total: 754ms    remaining: 823ms
478:  learn: 0.2872130  total: 755ms    remaining: 821ms
479:  learn: 0.2872020  total: 756ms    remaining: 819ms
480:  learn: 0.2870749  total: 757ms    remaining: 817ms
481:  learn: 0.2869184  total: 758ms    remaining: 815ms
```

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482:  learn: 0.2869051  total: 759ms    remaining: 813ms
483:  learn: 0.2865232  total: 761ms    remaining: 811ms
484:  learn: 0.2863903  total: 762ms    remaining: 809ms
485:  learn: 0.2863322  total: 763ms    remaining: 807ms
486:  learn: 0.2861515  total: 764ms    remaining: 805ms
487:  learn: 0.2860506  total: 765ms    remaining: 803ms
488:  learn: 0.2859932  total: 766ms    remaining: 801ms
489:  learn: 0.2857773  total: 767ms    remaining: 799ms
490:  learn: 0.2856001  total: 769ms    remaining: 797ms
491:  learn: 0.2853269  total: 770ms    remaining: 795ms
492:  learn: 0.2852585  total: 771ms    remaining: 793ms
493:  learn: 0.2851706  total: 772ms    remaining: 790ms
494:  learn: 0.2848798  total: 773ms    remaining: 788ms
495:  learn: 0.2845948  total: 774ms    remaining: 786ms
496:  learn: 0.2844485  total: 775ms    remaining: 784ms
497:  learn: 0.2843435  total: 776ms    remaining: 782ms
498:  learn: 0.2841396  total: 777ms    remaining: 780ms
499:  learn: 0.2839963  total: 778ms    remaining: 778ms
500:  learn: 0.2838915  total: 779ms    remaining: 776ms
501:  learn: 0.2836828  total: 781ms    remaining: 775ms
502:  learn: 0.2834128  total: 782ms    remaining: 773ms
503:  learn: 0.2831508  total: 783ms    remaining: 771ms
504:  learn: 0.2830937  total: 784ms    remaining: 769ms
505:  learn: 0.2829742  total: 785ms    remaining: 766ms
506:  learn: 0.2829005  total: 786ms    remaining: 764ms
507:  learn: 0.2827831  total: 787ms    remaining: 762ms
508:  learn: 0.2825507  total: 788ms    remaining: 760ms
509:  learn: 0.2822233  total: 789ms    remaining: 758ms
510:  learn: 0.2821068  total: 790ms    remaining: 756ms
511:  learn: 0.2820328  total: 792ms    remaining: 754ms
512:  learn: 0.2818520  total: 793ms    remaining: 753ms
513:  learn: 0.2816538  total: 794ms    remaining: 751ms
514:  learn: 0.2814916  total: 795ms    remaining: 749ms
515:  learn: 0.2813534  total: 796ms    remaining: 747ms
516:  learn: 0.2811897  total: 798ms    remaining: 745ms
517:  learn: 0.2810259  total: 799ms    remaining: 743ms
518:  learn: 0.2808441  total: 800ms    remaining: 741ms
519:  learn: 0.2804831  total: 801ms    remaining: 739ms
520:  learn: 0.2803145  total: 802ms    remaining: 737ms
521:  learn: 0.2802872  total: 803ms    remaining: 735ms
522:  learn: 0.2800868  total: 804ms    remaining: 733ms
523:  learn: 0.2799501  total: 805ms    remaining: 732ms
524:  learn: 0.2798232  total: 806ms    remaining: 730ms
525:  learn: 0.2796790  total: 807ms    remaining: 728ms
526:  learn: 0.2796292  total: 809ms    remaining: 726ms
527:  learn: 0.2795535  total: 810ms    remaining: 724ms
528:  learn: 0.2795015  total: 811ms    remaining: 722ms
529:  learn: 0.2793855  total: 812ms    remaining: 720ms
530:  learn: 0.2792725  total: 813ms    remaining: 718ms
531:  learn: 0.2789925  total: 814ms    remaining: 716ms
```

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532:  learn: 0.2788297 total: 815ms    remaining: 714ms
533:  learn: 0.2786404 total: 816ms    remaining: 712ms
534:  learn: 0.2785495 total: 817ms    remaining: 710ms
535:  learn: 0.2783808 total: 818ms    remaining: 708ms
536:  learn: 0.2782732 total: 819ms    remaining: 706ms
537:  learn: 0.2781755 total: 820ms    remaining: 705ms
538:  learn: 0.2780623 total: 822ms    remaining: 703ms
539:  learn: 0.2779734 total: 823ms    remaining: 701ms
540:  learn: 0.2777852 total: 824ms    remaining: 699ms
541:  learn: 0.2776460 total: 825ms    remaining: 697ms
542:  learn: 0.2775375 total: 826ms    remaining: 695ms
543:  learn: 0.2775270 total: 827ms    remaining: 693ms
544:  learn: 0.2774932 total: 828ms    remaining: 691ms
545:  learn: 0.2773363 total: 829ms    remaining: 689ms
546:  learn: 0.2772262 total: 830ms    remaining: 687ms
547:  learn: 0.2770449 total: 831ms    remaining: 685ms
548:  learn: 0.2770286 total: 831ms    remaining: 683ms
549:  learn: 0.2769840 total: 833ms    remaining: 681ms
550:  learn: 0.2769244 total: 834ms    remaining: 679ms
551:  learn: 0.2766433 total: 835ms    remaining: 677ms
552:  learn: 0.2764763 total: 836ms    remaining: 676ms
553:  learn: 0.2764150 total: 837ms    remaining: 674ms
554:  learn: 0.2760964 total: 838ms    remaining: 672ms
555:  learn: 0.2760402 total: 839ms    remaining: 670ms
556:  learn: 0.2759402 total: 841ms    remaining: 669ms
557:  learn: 0.2757471 total: 842ms    remaining: 667ms
558:  learn: 0.2755368 total: 843ms    remaining: 665ms
559:  learn: 0.2753457 total: 844ms    remaining: 663ms
560:  learn: 0.2751454 total: 845ms    remaining: 661ms
561:  learn: 0.2750492 total: 846ms    remaining: 659ms
562:  learn: 0.2747186 total: 847ms    remaining: 657ms
563:  learn: 0.2745879 total: 848ms    remaining: 656ms
564:  learn: 0.2744241 total: 849ms    remaining: 654ms
565:  learn: 0.2742751 total: 850ms    remaining: 652ms
566:  learn: 0.2741441 total: 851ms    remaining: 650ms
567:  learn: 0.2739561 total: 853ms    remaining: 648ms
568:  learn: 0.2738927 total: 854ms    remaining: 647ms
569:  learn: 0.2738844 total: 854ms    remaining: 644ms
570:  learn: 0.2737857 total: 855ms    remaining: 643ms
571:  learn: 0.2737828 total: 856ms    remaining: 640ms
572:  learn: 0.2737764 total: 856ms    remaining: 638ms
573:  learn: 0.2737431 total: 857ms    remaining: 636ms
574:  learn: 0.2737167 total: 858ms    remaining: 634ms
575:  learn: 0.2735610 total: 859ms    remaining: 632ms
576:  learn: 0.2734135 total: 860ms    remaining: 630ms
577:  learn: 0.2733480 total: 861ms    remaining: 628ms
578:  learn: 0.2733031 total: 862ms    remaining: 627ms
579:  learn: 0.2731152 total: 863ms    remaining: 625ms
580:  learn: 0.2729505 total: 864ms    remaining: 623ms
581:  learn: 0.2729338 total: 865ms    remaining: 621ms
```

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582:  learn: 0.2727412 total: 866ms    remaining: 619ms
583:  learn: 0.2725728 total: 867ms    remaining: 617ms
584:  learn: 0.2724652 total: 868ms    remaining: 616ms
585:  learn: 0.2724056 total: 869ms    remaining: 614ms
586:  learn: 0.2723132 total: 870ms    remaining: 612ms
587:  learn: 0.2722219 total: 871ms    remaining: 610ms
588:  learn: 0.2720845 total: 872ms    remaining: 609ms
589:  learn: 0.2719919 total: 873ms    remaining: 607ms
590:  learn: 0.2718494 total: 874ms    remaining: 605ms
591:  learn: 0.2717411 total: 875ms    remaining: 603ms
592:  learn: 0.2715362 total: 877ms    remaining: 602ms
593:  learn: 0.2714751 total: 878ms    remaining: 600ms
594:  learn: 0.2713778 total: 879ms    remaining: 598ms
595:  learn: 0.2713157 total: 880ms    remaining: 597ms
596:  learn: 0.2711926 total: 882ms    remaining: 595ms
597:  learn: 0.2710710 total: 883ms    remaining: 593ms
598:  learn: 0.2707937 total: 884ms    remaining: 592ms
599:  learn: 0.2707437 total: 885ms    remaining: 590ms
600:  learn: 0.2706816 total: 886ms    remaining: 588ms
601:  learn: 0.2705517 total: 887ms    remaining: 586ms
602:  learn: 0.2703887 total: 888ms    remaining: 585ms
603:  learn: 0.2702526 total: 889ms    remaining: 583ms
604:  learn: 0.2701392 total: 890ms    remaining: 581ms
605:  learn: 0.2700641 total: 891ms    remaining: 579ms
606:  learn: 0.2699101 total: 892ms    remaining: 578ms
607:  learn: 0.2697939 total: 893ms    remaining: 576ms
608:  learn: 0.2697029 total: 894ms    remaining: 574ms
609:  learn: 0.2695446 total: 895ms    remaining: 572ms
610:  learn: 0.2694273 total: 896ms    remaining: 571ms
611:  learn: 0.2693746 total: 898ms    remaining: 569ms
612:  learn: 0.2692476 total: 899ms    remaining: 567ms
613:  learn: 0.2691395 total: 900ms    remaining: 566ms
614:  learn: 0.2691275 total: 901ms    remaining: 564ms
615:  learn: 0.2689695 total: 902ms    remaining: 562ms
616:  learn: 0.2688712 total: 903ms    remaining: 560ms
617:  learn: 0.2686902 total: 904ms    remaining: 559ms
618:  learn: 0.2685000 total: 905ms    remaining: 557ms
619:  learn: 0.2684378 total: 906ms    remaining: 555ms
620:  learn: 0.2683964 total: 907ms    remaining: 554ms
621:  learn: 0.2682949 total: 908ms    remaining: 552ms
622:  learn: 0.2682056 total: 909ms    remaining: 550ms
623:  learn: 0.2680687 total: 910ms    remaining: 549ms
624:  learn: 0.2678877 total: 912ms    remaining: 547ms
625:  learn: 0.2678153 total: 913ms    remaining: 545ms
626:  learn: 0.2677482 total: 914ms    remaining: 543ms
627:  learn: 0.2675881 total: 915ms    remaining: 542ms
628:  learn: 0.2675779 total: 916ms    remaining: 540ms
629:  learn: 0.2674355 total: 917ms    remaining: 538ms
630:  learn: 0.2672659 total: 918ms    remaining: 537ms
631:  learn: 0.2671528 total: 919ms    remaining: 535ms
```

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632:  learn: 0.2670248 total: 920ms    remaining: 533ms
633:  learn: 0.2668984 total: 921ms    remaining: 532ms
634:  learn: 0.2668630 total: 922ms    remaining: 530ms
635:  learn: 0.2668243 total: 923ms    remaining: 528ms
636:  learn: 0.2666984 total: 924ms    remaining: 527ms
637:  learn: 0.2664953 total: 925ms    remaining: 525ms
638:  learn: 0.2664830 total: 926ms    remaining: 523ms
639:  learn: 0.2663852 total: 927ms    remaining: 521ms
640:  learn: 0.2663214 total: 928ms    remaining: 520ms
641:  learn: 0.2661172 total: 929ms    remaining: 518ms
642:  learn: 0.2659580 total: 930ms    remaining: 517ms
643:  learn: 0.2657898 total: 932ms    remaining: 515ms
644:  learn: 0.2656415 total: 933ms    remaining: 513ms
645:  learn: 0.2655408 total: 934ms    remaining: 512ms
646:  learn: 0.2654472 total: 935ms    remaining: 510ms
647:  learn: 0.2653830 total: 936ms    remaining: 508ms
648:  learn: 0.2653544 total: 937ms    remaining: 507ms
649:  learn: 0.2651561 total: 938ms    remaining: 505ms
650:  learn: 0.2651294 total: 939ms    remaining: 503ms
651:  learn: 0.2650272 total: 940ms    remaining: 502ms
652:  learn: 0.2648289 total: 941ms    remaining: 500ms
653:  learn: 0.2646397 total: 943ms    remaining: 499ms
654:  learn: 0.2645555 total: 944ms    remaining: 497ms
655:  learn: 0.2644886 total: 945ms    remaining: 496ms
656:  learn: 0.2643325 total: 946ms    remaining: 494ms
657:  learn: 0.2641979 total: 947ms    remaining: 492ms
658:  learn: 0.2641110 total: 949ms    remaining: 491ms
659:  learn: 0.2639966 total: 950ms    remaining: 489ms
660:  learn: 0.2638560 total: 951ms    remaining: 488ms
661:  learn: 0.2637950 total: 952ms    remaining: 486ms
662:  learn: 0.2635745 total: 954ms    remaining: 485ms
663:  learn: 0.2633955 total: 955ms    remaining: 483ms
664:  learn: 0.2633289 total: 956ms    remaining: 482ms
665:  learn: 0.2632407 total: 957ms    remaining: 480ms
666:  learn: 0.2628989 total: 959ms    remaining: 479ms
667:  learn: 0.2627849 total: 960ms    remaining: 477ms
668:  learn: 0.2627580 total: 961ms    remaining: 476ms
669:  learn: 0.2627493 total: 962ms    remaining: 474ms
670:  learn: 0.2625771 total: 963ms    remaining: 472ms
671:  learn: 0.2625286 total: 964ms    remaining: 471ms
672:  learn: 0.2623108 total: 965ms    remaining: 469ms
673:  learn: 0.2621464 total: 967ms    remaining: 468ms
674:  learn: 0.2620528 total: 968ms    remaining: 466ms
675:  learn: 0.2619343 total: 969ms    remaining: 465ms
676:  learn: 0.2618715 total: 971ms    remaining: 463ms
677:  learn: 0.2617903 total: 972ms    remaining: 462ms
678:  learn: 0.2616414 total: 973ms    remaining: 460ms
679:  learn: 0.2615714 total: 974ms    remaining: 459ms
680:  learn: 0.2613384 total: 976ms    remaining: 457ms
681:  learn: 0.2612207 total: 977ms    remaining: 455ms
```

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682:  learn: 0.2611655 total: 978ms    remaining: 454ms
683:  learn: 0.2611424 total: 979ms    remaining: 452ms
684:  learn: 0.2609129 total: 980ms    remaining: 451ms
685:  learn: 0.2608248 total: 981ms    remaining: 449ms
686:  learn: 0.2607539 total: 982ms    remaining: 448ms
687:  learn: 0.2605881 total: 984ms    remaining: 446ms
688:  learn: 0.2604945 total: 985ms    remaining: 445ms
689:  learn: 0.2603538 total: 986ms    remaining: 443ms
690:  learn: 0.2601888 total: 987ms    remaining: 441ms
691:  learn: 0.2600230 total: 988ms    remaining: 440ms
692:  learn: 0.2599317 total: 990ms    remaining: 438ms
693:  learn: 0.2598461 total: 991ms    remaining: 437ms
694:  learn: 0.2597169 total: 992ms    remaining: 435ms
695:  learn: 0.2596696 total: 993ms    remaining: 434ms
696:  learn: 0.2595348 total: 994ms    remaining: 432ms
697:  learn: 0.2594641 total: 996ms    remaining: 431ms
698:  learn: 0.2593100 total: 997ms    remaining: 429ms
699:  learn: 0.2592259 total: 998ms    remaining: 428ms
700:  learn: 0.2590057 total: 999ms    remaining: 426ms
701:  learn: 0.2588644 total: 1s  remaining: 425ms
702:  learn: 0.2586694 total: 1s  remaining: 423ms
703:  learn: 0.2585821 total: 1s  remaining: 422ms
704:  learn: 0.2584748 total: 1s  remaining: 420ms
705:  learn: 0.2584100 total: 1s  remaining: 419ms
706:  learn: 0.2581573 total: 1.01s    remaining: 417ms
707:  learn: 0.2581257 total: 1.01s    remaining: 415ms
708:  learn: 0.2579806 total: 1.01s    remaining: 414ms
709:  learn: 0.2579033 total: 1.01s    remaining: 413ms
710:  learn: 0.2577256 total: 1.01s    remaining: 411ms
711:  learn: 0.2576251 total: 1.01s    remaining: 409ms
712:  learn: 0.2575644 total: 1.01s    remaining: 408ms
713:  learn: 0.2575276 total: 1.01s    remaining: 407ms
714:  learn: 0.2574276 total: 1.01s    remaining: 405ms
715:  learn: 0.2571744 total: 1.02s    remaining: 403ms
716:  learn: 0.2570284 total: 1.02s    remaining: 402ms
717:  learn: 0.2568191 total: 1.02s    remaining: 400ms
718:  learn: 0.2567509 total: 1.02s    remaining: 399ms
719:  learn: 0.2566524 total: 1.02s    remaining: 397ms
720:  learn: 0.2564715 total: 1.02s    remaining: 396ms
721:  learn: 0.2563750 total: 1.02s    remaining: 394ms
722:  learn: 0.2562377 total: 1.02s    remaining: 393ms
723:  learn: 0.2559470 total: 1.03s    remaining: 391ms
724:  learn: 0.2557814 total: 1.03s    remaining: 390ms
725:  learn: 0.2556923 total: 1.03s    remaining: 388ms
726:  learn: 0.2556201 total: 1.03s    remaining: 387ms
727:  learn: 0.2555404 total: 1.03s    remaining: 385ms
728:  learn: 0.2551288 total: 1.03s    remaining: 384ms
729:  learn: 0.2550246 total: 1.03s    remaining: 382ms
730:  learn: 0.2548656 total: 1.03s    remaining: 381ms
731:  learn: 0.2546677 total: 1.04s    remaining: 379ms
```

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732:  learn: 0.2546023  total: 1.04s    remaining: 378ms
733:  learn: 0.2544015  total: 1.04s    remaining: 376ms
734:  learn: 0.2542098  total: 1.04s    remaining: 375ms
735:  learn: 0.2541598  total: 1.04s    remaining: 373ms
736:  learn: 0.2539980  total: 1.04s    remaining: 372ms
737:  learn: 0.2538045  total: 1.04s    remaining: 370ms
738:  learn: 0.2536761  total: 1.04s    remaining: 369ms
739:  learn: 0.2535649  total: 1.04s    remaining: 367ms
740:  learn: 0.2533721  total: 1.05s    remaining: 366ms
741:  learn: 0.2531222  total: 1.05s    remaining: 364ms
742:  learn: 0.2529690  total: 1.05s    remaining: 363ms
743:  learn: 0.2528476  total: 1.05s    remaining: 361ms
744:  learn: 0.2527876  total: 1.05s    remaining: 360ms
745:  learn: 0.2527458  total: 1.05s    remaining: 358ms
746:  learn: 0.2526671  total: 1.05s    remaining: 357ms
747:  learn: 0.2525247  total: 1.05s    remaining: 355ms
748:  learn: 0.2522877  total: 1.05s    remaining: 354ms
749:  learn: 0.2521111  total: 1.06s    remaining: 352ms
750:  learn: 0.2519966  total: 1.06s    remaining: 351ms
751:  learn: 0.2518218  total: 1.06s    remaining: 349ms
752:  learn: 0.2516593  total: 1.06s    remaining: 348ms
753:  learn: 0.2514735  total: 1.06s    remaining: 346ms
754:  learn: 0.2512251  total: 1.06s    remaining: 345ms
755:  learn: 0.2510757  total: 1.06s    remaining: 343ms
756:  learn: 0.2509674  total: 1.06s    remaining: 342ms
757:  learn: 0.2508991  total: 1.06s    remaining: 340ms
758:  learn: 0.2507350  total: 1.07s    remaining: 339ms
759:  learn: 0.2506940  total: 1.07s    remaining: 337ms
760:  learn: 0.2506073  total: 1.07s    remaining: 336ms
761:  learn: 0.2504536  total: 1.07s    remaining: 334ms
762:  learn: 0.2502268  total: 1.07s    remaining: 333ms
763:  learn: 0.2500350  total: 1.07s    remaining: 331ms
764:  learn: 0.2497202  total: 1.07s    remaining: 330ms
765:  learn: 0.2496300  total: 1.07s    remaining: 328ms
766:  learn: 0.2494863  total: 1.07s    remaining: 327ms
767:  learn: 0.2494105  total: 1.08s    remaining: 325ms
768:  learn: 0.2492500  total: 1.08s    remaining: 324ms
769:  learn: 0.2490294  total: 1.08s    remaining: 322ms
770:  learn: 0.2489212  total: 1.08s    remaining: 321ms
771:  learn: 0.2487565  total: 1.08s    remaining: 319ms
772:  learn: 0.2486635  total: 1.08s    remaining: 318ms
773:  learn: 0.2486225  total: 1.08s    remaining: 316ms
774:  learn: 0.2485568  total: 1.08s    remaining: 315ms
775:  learn: 0.2484964  total: 1.08s    remaining: 313ms
776:  learn: 0.2484105  total: 1.08s    remaining: 312ms
777:  learn: 0.2483971  total: 1.09s    remaining: 310ms
778:  learn: 0.2483212  total: 1.09s    remaining: 309ms
779:  learn: 0.2480628  total: 1.09s    remaining: 307ms
780:  learn: 0.2479293  total: 1.09s    remaining: 306ms
781:  learn: 0.2478074  total: 1.09s    remaining: 304ms
```

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782:  learn: 0.2476280 total: 1.09s    remaining: 303ms
783:  learn: 0.2475183 total: 1.09s    remaining: 301ms
784:  learn: 0.2474896 total: 1.09s    remaining: 300ms
785:  learn: 0.2473191 total: 1.09s    remaining: 298ms
786:  learn: 0.2471159 total: 1.1s     remaining: 297ms
787:  learn: 0.2469860 total: 1.1s     remaining: 295ms
788:  learn: 0.2468684 total: 1.1s     remaining: 294ms
789:  learn: 0.2467679 total: 1.1s     remaining: 292ms
790:  learn: 0.2467334 total: 1.1s     remaining: 291ms
791:  learn: 0.2466588 total: 1.1s     remaining: 289ms
792:  learn: 0.2464861 total: 1.1s     remaining: 288ms
793:  learn: 0.2464377 total: 1.1s     remaining: 287ms
794:  learn: 0.2463846 total: 1.1s     remaining: 285ms
795:  learn: 0.2462875 total: 1.11s    remaining: 284ms
796:  learn: 0.2460676 total: 1.11s    remaining: 282ms
797:  learn: 0.2459485 total: 1.11s    remaining: 281ms
798:  learn: 0.2457155 total: 1.11s    remaining: 279ms
799:  learn: 0.2455968 total: 1.11s    remaining: 278ms
800:  learn: 0.2455518 total: 1.11s    remaining: 276ms
801:  learn: 0.2455306 total: 1.11s    remaining: 275ms
802:  learn: 0.2454067 total: 1.11s    remaining: 274ms
803:  learn: 0.2453291 total: 1.12s    remaining: 272ms
804:  learn: 0.2452964 total: 1.12s    remaining: 271ms
805:  learn: 0.2451130 total: 1.12s    remaining: 269ms
806:  learn: 0.2450070 total: 1.12s    remaining: 268ms
807:  learn: 0.2448364 total: 1.12s    remaining: 266ms
808:  learn: 0.2446487 total: 1.12s    remaining: 265ms
809:  learn: 0.2445169 total: 1.12s    remaining: 263ms
810:  learn: 0.2443359 total: 1.12s    remaining: 262ms
811:  learn: 0.2441593 total: 1.12s    remaining: 260ms
812:  learn: 0.2438949 total: 1.13s    remaining: 259ms
813:  learn: 0.2436882 total: 1.13s    remaining: 258ms
814:  learn: 0.2435102 total: 1.13s    remaining: 256ms
815:  learn: 0.2434499 total: 1.13s    remaining: 255ms
816:  learn: 0.2433605 total: 1.13s    remaining: 253ms
817:  learn: 0.2433385 total: 1.13s    remaining: 252ms
818:  learn: 0.2431975 total: 1.13s    remaining: 250ms
819:  learn: 0.2430615 total: 1.13s    remaining: 249ms
820:  learn: 0.2430167 total: 1.14s    remaining: 248ms
821:  learn: 0.2428698 total: 1.14s    remaining: 246ms
822:  learn: 0.2427126 total: 1.14s    remaining: 245ms
823:  learn: 0.2426008 total: 1.14s    remaining: 243ms
824:  learn: 0.2423095 total: 1.14s    remaining: 242ms
825:  learn: 0.2421419 total: 1.14s    remaining: 240ms
826:  learn: 0.2421044 total: 1.14s    remaining: 239ms
827:  learn: 0.2420334 total: 1.14s    remaining: 238ms
828:  learn: 0.2420139 total: 1.14s    remaining: 236ms
829:  learn: 0.2419432 total: 1.15s    remaining: 235ms
830:  learn: 0.2418596 total: 1.15s    remaining: 233ms
831:  learn: 0.2417638 total: 1.15s    remaining: 232ms
```

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832:  learn: 0.2417258  total: 1.15s    remaining: 230ms
833:  learn: 0.2416627  total: 1.15s    remaining: 229ms
834:  learn: 0.2415637  total: 1.15s    remaining: 228ms
835:  learn: 0.2414328  total: 1.15s    remaining: 226ms
836:  learn: 0.2412808  total: 1.15s    remaining: 225ms
837:  learn: 0.2412493  total: 1.16s    remaining: 223ms
838:  learn: 0.2411331  total: 1.16s    remaining: 222ms
839:  learn: 0.2410392  total: 1.16s    remaining: 220ms
840:  learn: 0.2409342  total: 1.16s    remaining: 219ms
841:  learn: 0.2408703  total: 1.16s    remaining: 218ms
842:  learn: 0.2406896  total: 1.16s    remaining: 216ms
843:  learn: 0.2406863  total: 1.16s    remaining: 215ms
844:  learn: 0.2405770  total: 1.16s    remaining: 213ms
845:  learn: 0.2402585  total: 1.16s    remaining: 212ms
846:  learn: 0.2400693  total: 1.16s    remaining: 210ms
847:  learn: 0.2398947  total: 1.17s    remaining: 209ms
848:  learn: 0.2398274  total: 1.17s    remaining: 208ms
849:  learn: 0.2396481  total: 1.17s    remaining: 206ms
850:  learn: 0.2395498  total: 1.17s    remaining: 205ms
851:  learn: 0.2393746  total: 1.17s    remaining: 203ms
852:  learn: 0.2391500  total: 1.17s    remaining: 202ms
853:  learn: 0.2390939  total: 1.17s    remaining: 200ms
854:  learn: 0.2389444  total: 1.17s    remaining: 199ms
855:  learn: 0.2389170  total: 1.18s    remaining: 198ms
856:  learn: 0.2387142  total: 1.18s    remaining: 196ms
857:  learn: 0.2385299  total: 1.18s    remaining: 195ms
858:  learn: 0.2384900  total: 1.18s    remaining: 193ms
859:  learn: 0.2383844  total: 1.18s    remaining: 192ms
860:  learn: 0.2383063  total: 1.18s    remaining: 191ms
861:  learn: 0.2381956  total: 1.18s    remaining: 189ms
862:  learn: 0.2379947  total: 1.18s    remaining: 188ms
863:  learn: 0.2378190  total: 1.18s    remaining: 186ms
864:  learn: 0.2376854  total: 1.19s    remaining: 185ms
865:  learn: 0.2375093  total: 1.19s    remaining: 184ms
866:  learn: 0.2373939  total: 1.19s    remaining: 182ms
867:  learn: 0.2373587  total: 1.19s    remaining: 181ms
868:  learn: 0.2372052  total: 1.19s    remaining: 179ms
869:  learn: 0.2370795  total: 1.19s    remaining: 178ms
870:  learn: 0.2370005  total: 1.19s    remaining: 177ms
871:  learn: 0.2369056  total: 1.19s    remaining: 175ms
872:  learn: 0.2367597  total: 1.19s    remaining: 174ms
873:  learn: 0.2366507  total: 1.19s    remaining: 172ms
874:  learn: 0.2364214  total: 1.2s     remaining: 171ms
875:  learn: 0.2362273  total: 1.2s     remaining: 169ms
876:  learn: 0.2359033  total: 1.2s     remaining: 168ms
877:  learn: 0.2356485  total: 1.2s     remaining: 167ms
878:  learn: 0.2355897  total: 1.2s     remaining: 165ms
879:  learn: 0.2354254  total: 1.2s     remaining: 164ms
880:  learn: 0.2353365  total: 1.2s     remaining: 162ms
881:  learn: 0.2352332  total: 1.2s     remaining: 161ms
```

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882:  learn: 0.2352101  total: 1.2s     remaining: 160ms
883:  learn: 0.2351064  total: 1.21s    remaining: 158ms
884:  learn: 0.2350604  total: 1.21s    remaining: 157ms
885:  learn: 0.2349475  total: 1.21s    remaining: 155ms
886:  learn: 0.2348154  total: 1.21s    remaining: 154ms
887:  learn: 0.2347000  total: 1.21s    remaining: 153ms
888:  learn: 0.2346437  total: 1.21s    remaining: 151ms
889:  learn: 0.2344569  total: 1.21s    remaining: 150ms
890:  learn: 0.2343003  total: 1.21s    remaining: 148ms
891:  learn: 0.2342363  total: 1.21s    remaining: 147ms
892:  learn: 0.2341695  total: 1.22s    remaining: 146ms
893:  learn: 0.2340450  total: 1.22s    remaining: 144ms
894:  learn: 0.2338540  total: 1.22s    remaining: 143ms
895:  learn: 0.2336970  total: 1.22s    remaining: 141ms
896:  learn: 0.2334717  total: 1.22s    remaining: 140ms
897:  learn: 0.2333919  total: 1.22s    remaining: 139ms
898:  learn: 0.2332529  total: 1.22s    remaining: 137ms
899:  learn: 0.2330534  total: 1.22s    remaining: 136ms
900:  learn: 0.2328798  total: 1.23s    remaining: 135ms
901:  learn: 0.2327488  total: 1.23s    remaining: 133ms
902:  learn: 0.2326178  total: 1.23s    remaining: 132ms
903:  learn: 0.2323906  total: 1.23s    remaining: 130ms
904:  learn: 0.2322779  total: 1.23s    remaining: 129ms
905:  learn: 0.2322441  total: 1.23s    remaining: 128ms
906:  learn: 0.2320913  total: 1.23s    remaining: 127ms
907:  learn: 0.2319098  total: 1.24s    remaining: 125ms
908:  learn: 0.2317647  total: 1.24s    remaining: 124ms
909:  learn: 0.2317487  total: 1.24s    remaining: 122ms
910:  learn: 0.2313502  total: 1.24s    remaining: 121ms
911:  learn: 0.2312721  total: 1.24s    remaining: 120ms
912:  learn: 0.2311402  total: 1.24s    remaining: 118ms
913:  learn: 0.2310397  total: 1.24s    remaining: 117ms
914:  learn: 0.2308837  total: 1.24s    remaining: 116ms
915:  learn: 0.2307918  total: 1.24s    remaining: 114ms
916:  learn: 0.2306730  total: 1.25s    remaining: 113ms
917:  learn: 0.2306215  total: 1.25s    remaining: 111ms
918:  learn: 0.2304735  total: 1.25s    remaining: 110ms
919:  learn: 0.2303457  total: 1.25s    remaining: 109ms
920:  learn: 0.2302128  total: 1.25s    remaining: 107ms
921:  learn: 0.2300617  total: 1.25s    remaining: 106ms
922:  learn: 0.2300093  total: 1.25s    remaining: 104ms
923:  learn: 0.2299289  total: 1.25s    remaining: 103ms
924:  learn: 0.2298887  total: 1.25s    remaining: 102ms
925:  learn: 0.2298333  total: 1.25s    remaining: 100ms
926:  learn: 0.2297427  total: 1.26s    remaining: 99ms
927:  learn: 0.2295622  total: 1.26s    remaining: 97.6ms
928:  learn: 0.2294343  total: 1.26s    remaining: 96.2ms
929:  learn: 0.2293159  total: 1.26s    remaining: 94.8ms
930:  learn: 0.2292119  total: 1.26s    remaining: 93.5ms
931:  learn: 0.2290784  total: 1.26s    remaining: 92.1ms
```

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932:  learn: 0.2289761  total: 1.26s    remaining: 90.7ms
933:  learn: 0.2288671  total: 1.26s    remaining: 89.3ms
934:  learn: 0.2287203  total: 1.26s    remaining: 88ms
935:  learn: 0.2284555  total: 1.27s    remaining: 86.6ms
936:  learn: 0.2282975  total: 1.27s    remaining: 85.2ms
937:  learn: 0.2282164  total: 1.27s    remaining: 83.9ms
938:  learn: 0.2280274  total: 1.27s    remaining: 82.5ms
939:  learn: 0.2279391  total: 1.27s    remaining: 81.1ms
940:  learn: 0.2277252  total: 1.27s    remaining: 79.8ms
941:  learn: 0.2275239  total: 1.27s    remaining: 78.4ms
942:  learn: 0.2273632  total: 1.27s    remaining: 77ms
943:  learn: 0.2272362  total: 1.27s    remaining: 75.6ms
944:  learn: 0.2270936  total: 1.28s    remaining: 74.3ms
945:  learn: 0.2270633  total: 1.28s    remaining: 72.9ms
946:  learn: 0.2269759  total: 1.28s    remaining: 71.5ms
947:  learn: 0.2268530  total: 1.28s    remaining: 70.2ms
948:  learn: 0.2268141  total: 1.28s    remaining: 68.8ms
949:  learn: 0.2266856  total: 1.28s    remaining: 67.4ms
950:  learn: 0.2265550  total: 1.28s    remaining: 66.1ms
951:  learn: 0.2263794  total: 1.28s    remaining: 64.7ms
952:  learn: 0.2263364  total: 1.28s    remaining: 63.4ms
953:  learn: 0.2262343  total: 1.28s    remaining: 62ms
954:  learn: 0.2261701  total: 1.29s    remaining: 60.6ms
955:  learn: 0.2260021  total: 1.29s    remaining: 59.3ms
956:  learn: 0.2259695  total: 1.29s    remaining: 57.9ms
957:  learn: 0.2257524  total: 1.29s    remaining: 56.6ms
958:  learn: 0.2256709  total: 1.29s    remaining: 55.2ms
959:  learn: 0.2255001  total: 1.29s    remaining: 53.8ms
960:  learn: 0.2254080  total: 1.29s    remaining: 52.5ms
961:  learn: 0.2253334  total: 1.29s    remaining: 51.1ms
962:  learn: 0.2252761  total: 1.29s    remaining: 49.8ms
963:  learn: 0.2251488  total: 1.3s     remaining: 48.4ms
964:  learn: 0.2250980  total: 1.3s     remaining: 47.1ms
965:  learn: 0.2250503  total: 1.3s     remaining: 45.7ms
966:  learn: 0.2248367  total: 1.3s     remaining: 44.3ms
967:  learn: 0.2247590  total: 1.3s     remaining: 43ms
968:  learn: 0.2245670  total: 1.3s     remaining: 41.6ms
969:  learn: 0.2244541  total: 1.3s     remaining: 40.3ms
970:  learn: 0.2243388  total: 1.3s     remaining: 38.9ms
971:  learn: 0.2241968  total: 1.3s     remaining: 37.6ms
972:  learn: 0.2241178  total: 1.3s     remaining: 36.2ms
973:  learn: 0.2240699  total: 1.31s    remaining: 34.9ms
974:  learn: 0.2240145  total: 1.31s    remaining: 33.5ms
975:  learn: 0.2239140  total: 1.31s    remaining: 32.2ms
976:  learn: 0.2237721  total: 1.31s    remaining: 30.8ms
977:  learn: 0.2236618  total: 1.31s    remaining: 29.5ms
978:  learn: 0.2235987  total: 1.31s    remaining: 28.1ms
979:  learn: 0.2234872  total: 1.31s    remaining: 26.8ms
980:  learn: 0.2233653  total: 1.31s    remaining: 25.5ms
981:  learn: 0.2232242  total: 1.31s    remaining: 24.1ms
```

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982:  learn: 0.2230473 total: 1.32s    remaining: 22.8ms
983:  learn: 0.2228389 total: 1.32s    remaining: 21.4ms
984:  learn: 0.2226484 total: 1.32s    remaining: 20.1ms
985:  learn: 0.2225353 total: 1.32s    remaining: 18.7ms
986:  learn: 0.2223530 total: 1.32s    remaining: 17.4ms
987:  learn: 0.2222903 total: 1.32s    remaining: 16.1ms
988:  learn: 0.2222430 total: 1.32s    remaining: 14.7ms
989:  learn: 0.2220876 total: 1.32s    remaining: 13.4ms
990:  learn: 0.2219554 total: 1.32s    remaining: 12ms
991:  learn: 0.2218233 total: 1.33s    remaining: 10.7ms
992:  learn: 0.2217934 total: 1.33s    remaining: 9.36ms
993:  learn: 0.2216399 total: 1.33s    remaining: 8.02ms
994:  learn: 0.2215151 total: 1.33s    remaining: 6.68ms
995:  learn: 0.2214273 total: 1.33s    remaining: 5.35ms
996:  learn: 0.2213406 total: 1.33s    remaining: 4.01ms
997:  learn: 0.2211041 total: 1.33s    remaining: 2.67ms
998:  learn: 0.2210022 total: 1.33s    remaining: 1.34ms
999:  learn: 0.2209473 total: 1.34s    remaining: 0us
CatBoostClassifier 0.768361581920904
XGBClassifier 0.7627118644067796
RandomForestClassifier 0.7796610169491526
AdaBoostClassifier 0.751412429378531
GradientBoostingClassifier 0.7853107344632768
GaussianNB 0.768361581920904
LinearDiscriminantAnalysis 0.7627118644067796
QuadraticDiscriminantAnalysis 0.6779661016949152
LogisticRegression 0.7570621468926554
KNeighborsClassifier 0.6214689265536724
DecisionTreeClassifier 0.7231638418079096
Learning rate set to 0.008868
0:    learn: 0.6880164 total: 1.53ms   remaining: 1.53s
1:    learn: 0.6812401 total: 2.79ms   remaining: 1.39s
2:    learn: 0.6746189 total: 5.32ms   remaining: 1.77s
3:    learn: 0.6686892 total: 7.18ms   remaining: 1.79s
4:    learn: 0.6631211 total: 9.22ms   remaining: 1.83s
5:    learn: 0.6578657 total: 11.5ms   remaining: 1.9s
6:    learn: 0.6528034 total: 13.6ms   remaining: 1.93s
7:    learn: 0.6476654 total: 15.4ms   remaining: 1.91s
8:    learn: 0.6415194 total: 17.5ms   remaining: 1.93s
9:    learn: 0.6357033 total: 20.4ms   remaining: 2.02s
10:   learn: 0.6301146 total: 22.8ms   remaining: 2.05s
11:   learn: 0.6258775 total: 24.8ms   remaining: 2.04s
12:   learn: 0.6209869 total: 26.9ms   remaining: 2.04s
13:   learn: 0.6159476 total: 28.7ms   remaining: 2.02s
14:   learn: 0.6112243 total: 30.9ms   remaining: 2.03s
15:   learn: 0.6056932 total: 32.6ms   remaining: 2s
16:   learn: 0.6013220 total: 34.8ms   remaining: 2.01s
17:   learn: 0.5968393 total: 36.9ms   remaining: 2.01s
18:   learn: 0.5933068 total: 38.8ms   remaining: 2s
19:   learn: 0.5901904 total: 40.4ms   remaining: 1.98s
```

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20:   learn: 0.5861373 total: 42.2ms   remaining: 1.97s
21:   learn: 0.5818557 total: 43.8ms   remaining: 1.94s
22:   learn: 0.5778689 total: 45.8ms   remaining: 1.94s
23:   learn: 0.5736258 total: 47.8ms   remaining: 1.94s
24:   learn: 0.5699699 total: 50.8ms   remaining: 1.98s
25:   learn: 0.5661548 total: 53.5ms   remaining: 2s
26:   learn: 0.5622501 total: 55.4ms   remaining: 2s
27:   learn: 0.5594771 total: 57.1ms   remaining: 1.98s
28:   learn: 0.5562377 total: 58.6ms   remaining: 1.96s
29:   learn: 0.5535232 total: 59.6ms   remaining: 1.93s
30:   learn: 0.5502556 total: 61.3ms   remaining: 1.92s
31:   learn: 0.5468683 total: 63.1ms   remaining: 1.91s
32:   learn: 0.5430286 total: 64.7ms   remaining: 1.9s
33:   learn: 0.5399244 total: 66ms     remaining: 1.87s
34:   learn: 0.5363612 total: 67.3ms   remaining: 1.85s
35:   learn: 0.5334350 total: 68.6ms   remaining: 1.84s
36:   learn: 0.5301897 total: 69.8ms   remaining: 1.82s
37:   learn: 0.5273102 total: 71.1ms   remaining: 1.8s
38:   learn: 0.5238757 total: 72.4ms   remaining: 1.78s
39:   learn: 0.5206809 total: 73.6ms   remaining: 1.77s
40:   learn: 0.5177189 total: 74.8ms   remaining: 1.75s
41:   learn: 0.5156119 total: 75.7ms   remaining: 1.73s
42:   learn: 0.5128818 total: 77ms     remaining: 1.71s
43:   learn: 0.5108172 total: 78.5ms   remaining: 1.71s
44:   learn: 0.5076676 total: 79.9ms   remaining: 1.7s
45:   learn: 0.5052232 total: 81.2ms   remaining: 1.68s
46:   learn: 0.5028901 total: 82.4ms   remaining: 1.67s
47:   learn: 0.5006514 total: 83.4ms   remaining: 1.65s
48:   learn: 0.4978518 total: 84.6ms   remaining: 1.64s
49:   learn: 0.4952243 total: 85.6ms   remaining: 1.63s
50:   learn: 0.4929438 total: 86.7ms   remaining: 1.61s
51:   learn: 0.4909148 total: 87.5ms   remaining: 1.59s
52:   learn: 0.4881385 total: 88.6ms   remaining: 1.58s
53:   learn: 0.4862921 total: 89.3ms   remaining: 1.56s
54:   learn: 0.4840657 total: 90.3ms   remaining: 1.55s
55:   learn: 0.4815406 total: 91.3ms   remaining: 1.54s
56:   learn: 0.4796170 total: 92.6ms   remaining: 1.53s
57:   learn: 0.4776783 total: 93.6ms   remaining: 1.52s
58:   learn: 0.4749412 total: 94.7ms   remaining: 1.51s
59:   learn: 0.4731496 total: 95.7ms   remaining: 1.5s
60:   learn: 0.4714512 total: 96.8ms   remaining: 1.49s
61:   learn: 0.4697476 total: 97.8ms   remaining: 1.48s
62:   learn: 0.4680603 total: 98.8ms   remaining: 1.47s
63:   learn: 0.4663280 total: 99.8ms   remaining: 1.46s
64:   learn: 0.4640538 total: 101ms    remaining: 1.45s
65:   learn: 0.4622676 total: 102ms    remaining: 1.44s
66:   learn: 0.4600642 total: 103ms    remaining: 1.43s
67:   learn: 0.4582886 total: 104ms    remaining: 1.42s
68:   learn: 0.4563404 total: 105ms    remaining: 1.42s
69:   learn: 0.4548616 total: 106ms    remaining: 1.41s
```

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70:   learn: 0.4528790 total: 107ms    remaining: 1.4s
71:   learn: 0.4516001 total: 108ms    remaining: 1.4s
72:   learn: 0.4498088 total: 109ms    remaining: 1.39s
73:   learn: 0.4482278 total: 111ms    remaining: 1.38s
74:   learn: 0.4464368 total: 112ms    remaining: 1.38s
75:   learn: 0.4446978 total: 113ms    remaining: 1.37s
76:   learn: 0.4431580 total: 114ms    remaining: 1.36s
77:   learn: 0.4415307 total: 115ms    remaining: 1.36s
78:   learn: 0.4396799 total: 116ms    remaining: 1.35s
79:   learn: 0.4385775 total: 116ms    remaining: 1.34s
80:   learn: 0.4368785 total: 118ms    remaining: 1.33s
81:   learn: 0.4360153 total: 119ms    remaining: 1.33s
82:   learn: 0.4346010 total: 120ms    remaining: 1.32s
83:   learn: 0.4328785 total: 121ms    remaining: 1.31s
84:   learn: 0.4322810 total: 121ms    remaining: 1.3s
85:   learn: 0.4308527 total: 122ms    remaining: 1.3s
86:   learn: 0.4296734 total: 124ms    remaining: 1.3s
87:   learn: 0.4285950 total: 125ms    remaining: 1.29s
88:   learn: 0.4272177 total: 126ms    remaining: 1.29s
89:   learn: 0.4263662 total: 127ms    remaining: 1.29s
90:   learn: 0.4252078 total: 129ms    remaining: 1.28s
91:   learn: 0.4236837 total: 130ms    remaining: 1.28s
92:   learn: 0.4232491 total: 130ms    remaining: 1.27s
93:   learn: 0.4224292 total: 132ms    remaining: 1.27s
94:   learn: 0.4213532 total: 133ms    remaining: 1.26s
95:   learn: 0.4201208 total: 134ms    remaining: 1.26s
96:   learn: 0.4189001 total: 135ms    remaining: 1.26s
97:   learn: 0.4177125 total: 136ms    remaining: 1.26s
98:   learn: 0.4168731 total: 138ms    remaining: 1.25s
99:   learn: 0.4157131 total: 139ms    remaining: 1.25s
100:  learn: 0.4144382 total: 140ms    remaining: 1.25s
101:  learn: 0.4133251 total: 141ms    remaining: 1.24s
102:  learn: 0.4122654 total: 142ms    remaining: 1.24s
103:  learn: 0.4110384 total: 144ms    remaining: 1.24s
104:  learn: 0.4101427 total: 145ms    remaining: 1.23s
105:  learn: 0.4091415 total: 146ms    remaining: 1.23s
106:  learn: 0.4088000 total: 147ms    remaining: 1.22s
107:  learn: 0.4075091 total: 148ms    remaining: 1.22s
108:  learn: 0.4066285 total: 149ms    remaining: 1.22s
109:  learn: 0.4058134 total: 150ms    remaining: 1.22s
110:  learn: 0.4051110 total: 151ms    remaining: 1.21s
111:  learn: 0.4045179 total: 152ms    remaining: 1.21s
112:  learn: 0.4034566 total: 154ms    remaining: 1.21s
113:  learn: 0.4031774 total: 154ms    remaining: 1.2s
114:  learn: 0.4020953 total: 155ms    remaining: 1.19s
115:  learn: 0.4010331 total: 156ms    remaining: 1.19s
116:  learn: 0.4000567 total: 158ms    remaining: 1.19s
117:  learn: 0.3992525 total: 159ms    remaining: 1.19s
118:  learn: 0.3983463 total: 160ms    remaining: 1.18s
119:  learn: 0.3975980 total: 161ms    remaining: 1.18s
```

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120:  learn: 0.3965790  total: 162ms    remaining: 1.18s
121:  learn: 0.3956132  total: 163ms    remaining: 1.17s
122:  learn: 0.3953334  total: 164ms    remaining: 1.17s
123:  learn: 0.3950115  total: 164ms    remaining: 1.16s
124:  learn: 0.3944474  total: 165ms    remaining: 1.15s
125:  learn: 0.3936409  total: 166ms    remaining: 1.15s
126:  learn: 0.3928557  total: 167ms    remaining: 1.15s
127:  learn: 0.3919412  total: 168ms    remaining: 1.15s
128:  learn: 0.3913859  total: 169ms    remaining: 1.14s
129:  learn: 0.3906032  total: 170ms    remaining: 1.14s
130:  learn: 0.3904082  total: 171ms    remaining: 1.13s
131:  learn: 0.3898606  total: 172ms    remaining: 1.13s
132:  learn: 0.3890750  total: 173ms    remaining: 1.13s
133:  learn: 0.3882931  total: 174ms    remaining: 1.13s
134:  learn: 0.3876467  total: 175ms    remaining: 1.12s
135:  learn: 0.3867948  total: 176ms    remaining: 1.12s
136:  learn: 0.3860944  total: 177ms    remaining: 1.12s
137:  learn: 0.3854843  total: 179ms    remaining: 1.11s
138:  learn: 0.3846755  total: 180ms    remaining: 1.11s
139:  learn: 0.3837812  total: 181ms    remaining: 1.11s
140:  learn: 0.3830248  total: 182ms    remaining: 1.11s
141:  learn: 0.3823155  total: 183ms    remaining: 1.1s
142:  learn: 0.3818840  total: 184ms    remaining: 1.1s
143:  learn: 0.3817317  total: 184ms    remaining: 1.1s
144:  learn: 0.3814683  total: 185ms    remaining: 1.09s
145:  learn: 0.3805663  total: 186ms    remaining: 1.09s
146:  learn: 0.3799996  total: 187ms    remaining: 1.09s
147:  learn: 0.3795612  total: 188ms    remaining: 1.08s
148:  learn: 0.3791122  total: 189ms    remaining: 1.08s
149:  learn: 0.3784301  total: 190ms    remaining: 1.07s
150:  learn: 0.3779556  total: 191ms    remaining: 1.07s
151:  learn: 0.3772910  total: 192ms    remaining: 1.07s
152:  learn: 0.3771614  total: 193ms    remaining: 1.07s
153:  learn: 0.3770871  total: 193ms    remaining: 1.06s
154:  learn: 0.3765378  total: 194ms    remaining: 1.06s
155:  learn: 0.3757459  total: 195ms    remaining: 1.06s
156:  learn: 0.3751337  total: 196ms    remaining: 1.05s
157:  learn: 0.3742800  total: 198ms    remaining: 1.05s
158:  learn: 0.3736142  total: 199ms    remaining: 1.05s
159:  learn: 0.3730927  total: 200ms    remaining: 1.05s
160:  learn: 0.3723746  total: 201ms    remaining: 1.05s
161:  learn: 0.3717223  total: 202ms    remaining: 1.04s
162:  learn: 0.3711129  total: 203ms    remaining: 1.04s
163:  learn: 0.3704839  total: 204ms    remaining: 1.04s
164:  learn: 0.3700136  total: 205ms    remaining: 1.04s
165:  learn: 0.3692099  total: 206ms    remaining: 1.03s
166:  learn: 0.3686016  total: 207ms    remaining: 1.03s
167:  learn: 0.3680041  total: 208ms    remaining: 1.03s
168:  learn: 0.3675535  total: 209ms    remaining: 1.03s
169:  learn: 0.3671099  total: 211ms    remaining: 1.03s
```

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170:  learn: 0.3669162 total: 211ms    remaining: 1.02s
171:  learn: 0.3663064 total: 213ms    remaining: 1.02s
172:  learn: 0.3659477 total: 214ms    remaining: 1.02s
173:  learn: 0.3654920 total: 215ms    remaining: 1.02s
174:  learn: 0.3652255 total: 216ms    remaining: 1.02s
175:  learn: 0.3647230 total: 217ms    remaining: 1.02s
176:  learn: 0.3644106 total: 218ms    remaining: 1.01s
177:  learn: 0.3640085 total: 219ms    remaining: 1.01s
178:  learn: 0.3635638 total: 220ms    remaining: 1.01s
179:  learn: 0.3632982 total: 221ms    remaining: 1.01s
180:  learn: 0.3629183 total: 222ms    remaining: 1.01s
181:  learn: 0.3624403 total: 224ms    remaining: 1s
182:  learn: 0.3618946 total: 225ms    remaining: 1s
183:  learn: 0.3615385 total: 226ms    remaining: 1s
184:  learn: 0.3612955 total: 227ms    remaining: 999ms
185:  learn: 0.3609290 total: 228ms    remaining: 997ms
186:  learn: 0.3604802 total: 229ms    remaining: 994ms
187:  learn: 0.3600494 total: 230ms    remaining: 993ms
188:  learn: 0.3596971 total: 231ms    remaining: 991ms
189:  learn: 0.3592033 total: 232ms    remaining: 989ms
190:  learn: 0.3588986 total: 233ms    remaining: 987ms
191:  learn: 0.3586197 total: 234ms    remaining: 985ms
192:  learn: 0.3582250 total: 235ms    remaining: 983ms
193:  learn: 0.3578338 total: 236ms    remaining: 981ms
194:  learn: 0.3573629 total: 237ms    remaining: 979ms
195:  learn: 0.3569408 total: 238ms    remaining: 978ms
196:  learn: 0.3565250 total: 239ms    remaining: 976ms
197:  learn: 0.3561153 total: 241ms    remaining: 975ms
198:  learn: 0.3556896 total: 242ms    remaining: 974ms
199:  learn: 0.3551831 total: 243ms    remaining: 973ms
200:  learn: 0.3548180 total: 244ms    remaining: 972ms
201:  learn: 0.3545673 total: 246ms    remaining: 970ms
202:  learn: 0.3542023 total: 247ms    remaining: 969ms
203:  learn: 0.3538260 total: 248ms    remaining: 968ms
204:  learn: 0.3533602 total: 250ms    remaining: 968ms
205:  learn: 0.3527948 total: 251ms    remaining: 967ms
206:  learn: 0.3524561 total: 252ms    remaining: 966ms
207:  learn: 0.3522795 total: 253ms    remaining: 964ms
208:  learn: 0.3520207 total: 254ms    remaining: 963ms
209:  learn: 0.3516552 total: 256ms    remaining: 963ms
210:  learn: 0.3512702 total: 257ms    remaining: 962ms
211:  learn: 0.3509055 total: 258ms    remaining: 960ms
212:  learn: 0.3507223 total: 260ms    remaining: 959ms
213:  learn: 0.3503337 total: 261ms    remaining: 958ms
214:  learn: 0.3500300 total: 262ms    remaining: 957ms
215:  learn: 0.3495725 total: 263ms    remaining: 955ms
216:  learn: 0.3490359 total: 264ms    remaining: 954ms
217:  learn: 0.3487918 total: 266ms    remaining: 953ms
218:  learn: 0.3483618 total: 267ms    remaining: 952ms
219:  learn: 0.3481485 total: 268ms    remaining: 951ms
```

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220:  learn: 0.3478398 total: 269ms    remaining: 949ms
221:  learn: 0.3474382 total: 270ms    remaining: 947ms
222:  learn: 0.3473810 total: 271ms    remaining: 944ms
223:  learn: 0.3470785 total: 272ms    remaining: 942ms
224:  learn: 0.3467125 total: 273ms    remaining: 940ms
225:  learn: 0.3462758 total: 274ms    remaining: 938ms
226:  learn: 0.3460070 total: 275ms    remaining: 936ms
227:  learn: 0.3454793 total: 276ms    remaining: 935ms
228:  learn: 0.3452051 total: 277ms    remaining: 933ms
229:  learn: 0.3448308 total: 278ms    remaining: 931ms
230:  learn: 0.3445102 total: 279ms    remaining: 929ms
231:  learn: 0.3442532 total: 280ms    remaining: 927ms
232:  learn: 0.3439274 total: 281ms    remaining: 926ms
233:  learn: 0.3435779 total: 283ms    remaining: 925ms
234:  learn: 0.3432578 total: 284ms    remaining: 924ms
235:  learn: 0.3429004 total: 285ms    remaining: 922ms
236:  learn: 0.3424940 total: 286ms    remaining: 921ms
237:  learn: 0.3422176 total: 287ms    remaining: 920ms
238:  learn: 0.3419570 total: 289ms    remaining: 919ms
239:  learn: 0.3417599 total: 290ms    remaining: 918ms
240:  learn: 0.3412952 total: 291ms    remaining: 917ms
241:  learn: 0.3410716 total: 292ms    remaining: 916ms
242:  learn: 0.3407563 total: 294ms    remaining: 915ms
243:  learn: 0.3404119 total: 295ms    remaining: 913ms
244:  learn: 0.3399836 total: 296ms    remaining: 912ms
245:  learn: 0.3397572 total: 298ms    remaining: 912ms
246:  learn: 0.3394732 total: 299ms    remaining: 911ms
247:  learn: 0.3392116 total: 300ms    remaining: 910ms
248:  learn: 0.3388919 total: 301ms    remaining: 909ms
249:  learn: 0.3386209 total: 303ms    remaining: 908ms
250:  learn: 0.3383446 total: 304ms    remaining: 907ms
251:  learn: 0.3380639 total: 305ms    remaining: 906ms
252:  learn: 0.3377769 total: 306ms    remaining: 904ms
253:  learn: 0.3373818 total: 307ms    remaining: 903ms
254:  learn: 0.3373347 total: 308ms    remaining: 900ms
255:  learn: 0.3370209 total: 309ms    remaining: 899ms
256:  learn: 0.3367897 total: 311ms    remaining: 898ms
257:  learn: 0.3364851 total: 312ms    remaining: 897ms
258:  learn: 0.3363028 total: 313ms    remaining: 896ms
259:  learn: 0.3359948 total: 314ms    remaining: 894ms
260:  learn: 0.3356693 total: 315ms    remaining: 893ms
261:  learn: 0.3354163 total: 317ms    remaining: 892ms
262:  learn: 0.3353036 total: 318ms    remaining: 891ms
263:  learn: 0.3348378 total: 319ms    remaining: 889ms
264:  learn: 0.3345521 total: 320ms    remaining: 888ms
265:  learn: 0.3342642 total: 321ms    remaining: 886ms
266:  learn: 0.3338828 total: 322ms    remaining: 885ms
267:  learn: 0.3335027 total: 324ms    remaining: 884ms
268:  learn: 0.3333216 total: 325ms    remaining: 882ms
269:  learn: 0.3332161 total: 326ms    remaining: 881ms
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270:  learn: 0.3329598 total: 327ms    remaining: 880ms
271:  learn: 0.3329445 total: 328ms    remaining: 877ms
272:  learn: 0.3326367 total: 329ms    remaining: 876ms
273:  learn: 0.3321254 total: 330ms    remaining: 874ms
274:  learn: 0.3320028 total: 331ms    remaining: 873ms
275:  learn: 0.3316514 total: 332ms    remaining: 872ms
276:  learn: 0.3314412 total: 333ms    remaining: 870ms
277:  learn: 0.3311999 total: 335ms    remaining: 869ms
278:  learn: 0.3308155 total: 336ms    remaining: 867ms
279:  learn: 0.3305294 total: 337ms    remaining: 866ms
280:  learn: 0.3303569 total: 338ms    remaining: 865ms
281:  learn: 0.3300811 total: 339ms    remaining: 863ms
282:  learn: 0.3297790 total: 340ms    remaining: 862ms
283:  learn: 0.3293852 total: 342ms    remaining: 861ms
284:  learn: 0.3289787 total: 343ms    remaining: 860ms
285:  learn: 0.3287313 total: 344ms    remaining: 858ms
286:  learn: 0.3285320 total: 345ms    remaining: 857ms
287:  learn: 0.3283031 total: 346ms    remaining: 856ms
288:  learn: 0.3279472 total: 347ms    remaining: 855ms
289:  learn: 0.3275603 total: 349ms    remaining: 854ms
290:  learn: 0.3273547 total: 350ms    remaining: 852ms
291:  learn: 0.3271099 total: 351ms    remaining: 851ms
292:  learn: 0.3269242 total: 352ms    remaining: 850ms
293:  learn: 0.3268127 total: 353ms    remaining: 848ms
294:  learn: 0.3266805 total: 354ms    remaining: 847ms
295:  learn: 0.3262826 total: 356ms    remaining: 846ms
296:  learn: 0.3260335 total: 357ms    remaining: 845ms
297:  learn: 0.3258841 total: 358ms    remaining: 844ms
298:  learn: 0.3257118 total: 359ms    remaining: 842ms
299:  learn: 0.3255664 total: 360ms    remaining: 841ms
300:  learn: 0.3252224 total: 362ms    remaining: 840ms
301:  learn: 0.3249666 total: 363ms    remaining: 838ms
302:  learn: 0.3247177 total: 364ms    remaining: 837ms
303:  learn: 0.3244619 total: 365ms    remaining: 836ms
304:  learn: 0.3242113 total: 366ms    remaining: 835ms
305:  learn: 0.3240996 total: 367ms    remaining: 833ms
306:  learn: 0.3238485 total: 369ms    remaining: 832ms
307:  learn: 0.3235510 total: 370ms    remaining: 831ms
308:  learn: 0.3233339 total: 371ms    remaining: 830ms
309:  learn: 0.3229732 total: 372ms    remaining: 828ms
310:  learn: 0.3226095 total: 373ms    remaining: 827ms
311:  learn: 0.3224904 total: 375ms    remaining: 826ms
312:  learn: 0.3222974 total: 376ms    remaining: 825ms
313:  learn: 0.3221165 total: 377ms    remaining: 824ms
314:  learn: 0.3218115 total: 378ms    remaining: 823ms
315:  learn: 0.3216342 total: 380ms    remaining: 821ms
316:  learn: 0.3212564 total: 381ms    remaining: 820ms
317:  learn: 0.3209850 total: 382ms    remaining: 819ms
318:  learn: 0.3208627 total: 383ms    remaining: 818ms
319:  learn: 0.3207223 total: 384ms    remaining: 816ms
```

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320:  learn: 0.3203558 total: 386ms    remaining: 816ms
321:  learn: 0.3201481 total: 387ms    remaining: 814ms
322:  learn: 0.3198708 total: 388ms    remaining: 813ms
323:  learn: 0.3197044 total: 389ms    remaining: 812ms
324:  learn: 0.3194309 total: 390ms    remaining: 810ms
325:  learn: 0.3192326 total: 391ms    remaining: 809ms
326:  learn: 0.3192209 total: 392ms    remaining: 807ms
327:  learn: 0.3189983 total: 393ms    remaining: 805ms
328:  learn: 0.3188531 total: 394ms    remaining: 804ms
329:  learn: 0.3187661 total: 395ms    remaining: 803ms
330:  learn: 0.3186256 total: 396ms    remaining: 801ms
331:  learn: 0.3185185 total: 397ms    remaining: 800ms
332:  learn: 0.3184549 total: 398ms    remaining: 798ms
333:  learn: 0.3182414 total: 399ms    remaining: 797ms
334:  learn: 0.3179541 total: 401ms    remaining: 795ms
335:  learn: 0.3177061 total: 402ms    remaining: 794ms
336:  learn: 0.3173855 total: 403ms    remaining: 792ms
337:  learn: 0.3170704 total: 404ms    remaining: 791ms
338:  learn: 0.3167098 total: 405ms    remaining: 790ms
339:  learn: 0.3165262 total: 406ms    remaining: 789ms
340:  learn: 0.3164586 total: 408ms    remaining: 788ms
341:  learn: 0.3162547 total: 409ms    remaining: 786ms
342:  learn: 0.3161084 total: 410ms    remaining: 785ms
343:  learn: 0.3157277 total: 411ms    remaining: 784ms
344:  learn: 0.3155119 total: 412ms    remaining: 782ms
345:  learn: 0.3154387 total: 413ms    remaining: 781ms
346:  learn: 0.3151264 total: 414ms    remaining: 779ms
347:  learn: 0.3149625 total: 415ms    remaining: 778ms
348:  learn: 0.3147510 total: 416ms    remaining: 776ms
349:  learn: 0.3145026 total: 417ms    remaining: 775ms
350:  learn: 0.3143769 total: 418ms    remaining: 773ms
351:  learn: 0.3142974 total: 419ms    remaining: 772ms
352:  learn: 0.3141369 total: 420ms    remaining: 770ms
353:  learn: 0.3139165 total: 421ms    remaining: 769ms
354:  learn: 0.3137551 total: 422ms    remaining: 767ms
355:  learn: 0.3134449 total: 424ms    remaining: 766ms
356:  learn: 0.3133380 total: 425ms    remaining: 765ms
357:  learn: 0.3130830 total: 426ms    remaining: 763ms
358:  learn: 0.3127776 total: 427ms    remaining: 762ms
359:  learn: 0.3125669 total: 428ms    remaining: 761ms
360:  learn: 0.3123247 total: 429ms    remaining: 759ms
361:  learn: 0.3120994 total: 430ms    remaining: 758ms
362:  learn: 0.3119059 total: 431ms    remaining: 756ms
363:  learn: 0.3117170 total: 432ms    remaining: 755ms
364:  learn: 0.3115830 total: 433ms    remaining: 753ms
365:  learn: 0.3113500 total: 434ms    remaining: 751ms
366:  learn: 0.3111200 total: 435ms    remaining: 750ms
367:  learn: 0.3106743 total: 436ms    remaining: 748ms
368:  learn: 0.3104890 total: 437ms    remaining: 747ms
369:  learn: 0.3102003 total: 438ms    remaining: 746ms
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370:  learn: 0.3100858 total: 439ms    remaining: 744ms
371:  learn: 0.3099230 total: 440ms    remaining: 743ms
372:  learn: 0.3096710 total: 441ms    remaining: 741ms
373:  learn: 0.3095257 total: 442ms    remaining: 740ms
374:  learn: 0.3092878 total: 444ms    remaining: 740ms
375:  learn: 0.3092368 total: 445ms    remaining: 738ms
376:  learn: 0.3089719 total: 446ms    remaining: 737ms
377:  learn: 0.3086803 total: 447ms    remaining: 736ms
378:  learn: 0.3085956 total: 448ms    remaining: 734ms
379:  learn: 0.3084620 total: 449ms    remaining: 733ms
380:  learn: 0.3082092 total: 450ms    remaining: 732ms
381:  learn: 0.3080439 total: 452ms    remaining: 731ms
382:  learn: 0.3078539 total: 453ms    remaining: 730ms
383:  learn: 0.3075764 total: 454ms    remaining: 729ms
384:  learn: 0.3074006 total: 456ms    remaining: 728ms
385:  learn: 0.3072999 total: 457ms    remaining: 726ms
386:  learn: 0.3070762 total: 458ms    remaining: 725ms
387:  learn: 0.3068486 total: 459ms    remaining: 724ms
388:  learn: 0.3066811 total: 460ms    remaining: 722ms
389:  learn: 0.3066388 total: 461ms    remaining: 721ms
390:  learn: 0.3065199 total: 462ms    remaining: 719ms
391:  learn: 0.3062344 total: 463ms    remaining: 718ms
392:  learn: 0.3060364 total: 464ms    remaining: 716ms
393:  learn: 0.3055455 total: 465ms    remaining: 715ms
394:  learn: 0.3053841 total: 466ms    remaining: 713ms
395:  learn: 0.3051015 total: 467ms    remaining: 712ms
396:  learn: 0.3050133 total: 468ms    remaining: 711ms
397:  learn: 0.3047426 total: 469ms    remaining: 709ms
398:  learn: 0.3046345 total: 470ms    remaining: 708ms
399:  learn: 0.3045047 total: 471ms    remaining: 707ms
400:  learn: 0.3043759 total: 473ms    remaining: 706ms
401:  learn: 0.3042747 total: 474ms    remaining: 705ms
402:  learn: 0.3040822 total: 475ms    remaining: 704ms
403:  learn: 0.3038633 total: 477ms    remaining: 704ms
404:  learn: 0.3038207 total: 478ms    remaining: 702ms
405:  learn: 0.3036439 total: 479ms    remaining: 701ms
406:  learn: 0.3034306 total: 481ms    remaining: 700ms
407:  learn: 0.3032954 total: 482ms    remaining: 700ms
408:  learn: 0.3032023 total: 484ms    remaining: 699ms
409:  learn: 0.3031439 total: 485ms    remaining: 698ms
410:  learn: 0.3030291 total: 486ms    remaining: 697ms
411:  learn: 0.3028215 total: 488ms    remaining: 696ms
412:  learn: 0.3027091 total: 489ms    remaining: 695ms
413:  learn: 0.3025396 total: 490ms    remaining: 694ms
414:  learn: 0.3024190 total: 492ms    remaining: 693ms
415:  learn: 0.3021695 total: 493ms    remaining: 692ms
416:  learn: 0.3019233 total: 495ms    remaining: 691ms
417:  learn: 0.3017844 total: 496ms    remaining: 691ms
418:  learn: 0.3017101 total: 498ms    remaining: 690ms
419:  learn: 0.3016230 total: 499ms    remaining: 689ms
```

```
420:  learn: 0.3015154 total: 500ms    remaining: 688ms
421:  learn: 0.3012776 total: 502ms    remaining: 687ms
422:  learn: 0.3011385 total: 503ms    remaining: 686ms
423:  learn: 0.3008060 total: 504ms    remaining: 685ms
424:  learn: 0.3006762 total: 506ms    remaining: 684ms
425:  learn: 0.3004932 total: 507ms    remaining: 684ms
426:  learn: 0.3002973 total: 509ms    remaining: 683ms
427:  learn: 0.3001416 total: 510ms    remaining: 682ms
428:  learn: 0.2998770 total: 512ms    remaining: 681ms
429:  learn: 0.2996876 total: 513ms    remaining: 680ms
430:  learn: 0.2996316 total: 514ms    remaining: 679ms
431:  learn: 0.2995215 total: 516ms    remaining: 678ms
432:  learn: 0.2994051 total: 517ms    remaining: 677ms
433:  learn: 0.2992563 total: 519ms    remaining: 677ms
434:  learn: 0.2990509 total: 520ms    remaining: 676ms
435:  learn: 0.2988158 total: 522ms    remaining: 675ms
436:  learn: 0.2985982 total: 523ms    remaining: 674ms
437:  learn: 0.2984794 total: 525ms    remaining: 674ms
438:  learn: 0.2983152 total: 527ms    remaining: 673ms
439:  learn: 0.2981815 total: 528ms    remaining: 672ms
440:  learn: 0.2979708 total: 529ms    remaining: 671ms
441:  learn: 0.2978813 total: 531ms    remaining: 670ms
442:  learn: 0.2977570 total: 532ms    remaining: 669ms
443:  learn: 0.2974651 total: 533ms    remaining: 668ms
444:  learn: 0.2973446 total: 535ms    remaining: 667ms
445:  learn: 0.2971238 total: 536ms    remaining: 666ms
446:  learn: 0.2969618 total: 537ms    remaining: 665ms
447:  learn: 0.2968061 total: 539ms    remaining: 664ms
448:  learn: 0.2965811 total: 540ms    remaining: 663ms
449:  learn: 0.2964329 total: 541ms    remaining: 662ms
450:  learn: 0.2963474 total: 543ms    remaining: 660ms
451:  learn: 0.2961483 total: 544ms    remaining: 659ms
452:  learn: 0.2959590 total: 545ms    remaining: 658ms
453:  learn: 0.2957898 total: 547ms    remaining: 657ms
454:  learn: 0.2955572 total: 548ms    remaining: 656ms
455:  learn: 0.2953209 total: 549ms    remaining: 655ms
456:  learn: 0.2950828 total: 551ms    remaining: 654ms
457:  learn: 0.2947755 total: 552ms    remaining: 653ms
458:  learn: 0.2945870 total: 554ms    remaining: 652ms
459:  learn: 0.2943506 total: 555ms    remaining: 652ms
460:  learn: 0.2941662 total: 556ms    remaining: 651ms
461:  learn: 0.2939446 total: 558ms    remaining: 649ms
462:  learn: 0.2938263 total: 559ms    remaining: 648ms
463:  learn: 0.2934967 total: 560ms    remaining: 647ms
464:  learn: 0.2933762 total: 561ms    remaining: 646ms
465:  learn: 0.2931705 total: 562ms    remaining: 644ms
466:  learn: 0.2930421 total: 564ms    remaining: 643ms
467:  learn: 0.2928829 total: 565ms    remaining: 642ms
468:  learn: 0.2927065 total: 566ms    remaining: 641ms
469:  learn: 0.2925626 total: 567ms    remaining: 640ms
```

```
470:  learn: 0.2924440 total: 568ms    remaining: 638ms
471:  learn: 0.2923141 total: 569ms    remaining: 637ms
472:  learn: 0.2921300 total: 570ms    remaining: 636ms
473:  learn: 0.2920087 total: 571ms    remaining: 634ms
474:  learn: 0.2918381 total: 572ms    remaining: 633ms
475:  learn: 0.2917661 total: 573ms    remaining: 631ms
476:  learn: 0.2916738 total: 574ms    remaining: 630ms
477:  learn: 0.2914708 total: 576ms    remaining: 629ms
478:  learn: 0.2914428 total: 577ms    remaining: 627ms
479:  learn: 0.2913638 total: 578ms    remaining: 626ms
480:  learn: 0.2910835 total: 579ms    remaining: 625ms
481:  learn: 0.2909237 total: 580ms    remaining: 623ms
482:  learn: 0.2907887 total: 581ms    remaining: 622ms
483:  learn: 0.2905288 total: 582ms    remaining: 621ms
484:  learn: 0.2904471 total: 583ms    remaining: 619ms
485:  learn: 0.2903324 total: 584ms    remaining: 618ms
486:  learn: 0.2901446 total: 585ms    remaining: 616ms
487:  learn: 0.2900386 total: 586ms    remaining: 615ms
488:  learn: 0.2899610 total: 587ms    remaining: 613ms
489:  learn: 0.2899479 total: 588ms    remaining: 612ms
490:  learn: 0.2898536 total: 589ms    remaining: 610ms
491:  learn: 0.2897564 total: 590ms    remaining: 609ms
492:  learn: 0.2896436 total: 591ms    remaining: 608ms
493:  learn: 0.2894953 total: 592ms    remaining: 606ms
494:  learn: 0.2893945 total: 593ms    remaining: 605ms
495:  learn: 0.2892071 total: 594ms    remaining: 604ms
496:  learn: 0.2890487 total: 595ms    remaining: 602ms
497:  learn: 0.2889768 total: 596ms    remaining: 601ms
498:  learn: 0.2887964 total: 597ms    remaining: 600ms
499:  learn: 0.2886974 total: 598ms    remaining: 598ms
500:  learn: 0.2884764 total: 600ms    remaining: 597ms
501:  learn: 0.2881587 total: 601ms    remaining: 596ms
502:  learn: 0.2880498 total: 602ms    remaining: 594ms
503:  learn: 0.2879449 total: 603ms    remaining: 593ms
504:  learn: 0.2876875 total: 604ms    remaining: 592ms
505:  learn: 0.2876502 total: 604ms    remaining: 590ms
506:  learn: 0.2873240 total: 605ms    remaining: 589ms
507:  learn: 0.2872192 total: 607ms    remaining: 587ms
508:  learn: 0.2871276 total: 608ms    remaining: 586ms
509:  learn: 0.2870056 total: 609ms    remaining: 585ms
510:  learn: 0.2868900 total: 610ms    remaining: 583ms
511:  learn: 0.2867174 total: 611ms    remaining: 582ms
512:  learn: 0.2865920 total: 612ms    remaining: 581ms
513:  learn: 0.2864810 total: 613ms    remaining: 580ms
514:  learn: 0.2862513 total: 614ms    remaining: 578ms
515:  learn: 0.2862025 total: 615ms    remaining: 577ms
516:  learn: 0.2860979 total: 616ms    remaining: 576ms
517:  learn: 0.2858757 total: 617ms    remaining: 574ms
518:  learn: 0.2856733 total: 618ms    remaining: 573ms
519:  learn: 0.2855086 total: 619ms    remaining: 572ms
```

```
520:  learn: 0.2853805 total: 620ms    remaining: 570ms
521:  learn: 0.2853475 total: 621ms    remaining: 569ms
522:  learn: 0.2851783 total: 623ms    remaining: 568ms
523:  learn: 0.2850073 total: 624ms    remaining: 566ms
524:  learn: 0.2849192 total: 625ms    remaining: 565ms
525:  learn: 0.2847624 total: 626ms    remaining: 564ms
526:  learn: 0.2847038 total: 627ms    remaining: 563ms
527:  learn: 0.2845731 total: 628ms    remaining: 561ms
528:  learn: 0.2844424 total: 629ms    remaining: 560ms
529:  learn: 0.2842317 total: 630ms    remaining: 559ms
530:  learn: 0.2841665 total: 631ms    remaining: 557ms
531:  learn: 0.2840004 total: 632ms    remaining: 556ms
532:  learn: 0.2838778 total: 633ms    remaining: 555ms
533:  learn: 0.2836761 total: 635ms    remaining: 554ms
534:  learn: 0.2834812 total: 636ms    remaining: 553ms
535:  learn: 0.2834107 total: 637ms    remaining: 552ms
536:  learn: 0.2830781 total: 639ms    remaining: 551ms
537:  learn: 0.2829439 total: 640ms    remaining: 549ms
538:  learn: 0.2828658 total: 641ms    remaining: 548ms
539:  learn: 0.2827123 total: 642ms    remaining: 547ms
540:  learn: 0.2826051 total: 643ms    remaining: 545ms
541:  learn: 0.2824891 total: 644ms    remaining: 544ms
542:  learn: 0.2823749 total: 645ms    remaining: 543ms
543:  learn: 0.2822332 total: 647ms    remaining: 542ms
544:  learn: 0.2820824 total: 648ms    remaining: 541ms
545:  learn: 0.2820248 total: 649ms    remaining: 540ms
546:  learn: 0.2819661 total: 650ms    remaining: 538ms
547:  learn: 0.2818783 total: 651ms    remaining: 537ms
548:  learn: 0.2817277 total: 652ms    remaining: 536ms
549:  learn: 0.2815418 total: 653ms    remaining: 534ms
550:  learn: 0.2814651 total: 654ms    remaining: 533ms
551:  learn: 0.2813969 total: 655ms    remaining: 532ms
552:  learn: 0.2812659 total: 656ms    remaining: 530ms
553:  learn: 0.2810805 total: 657ms    remaining: 529ms
554:  learn: 0.2810358 total: 658ms    remaining: 528ms
555:  learn: 0.2809553 total: 659ms    remaining: 527ms
556:  learn: 0.2808521 total: 660ms    remaining: 525ms
557:  learn: 0.2806743 total: 661ms    remaining: 524ms
558:  learn: 0.2805240 total: 662ms    remaining: 523ms
559:  learn: 0.2803754 total: 663ms    remaining: 521ms
560:  learn: 0.2802780 total: 664ms    remaining: 520ms
561:  learn: 0.2799617 total: 666ms    remaining: 519ms
562:  learn: 0.2798730 total: 667ms    remaining: 517ms
563:  learn: 0.2797697 total: 668ms    remaining: 516ms
564:  learn: 0.2796258 total: 669ms    remaining: 515ms
565:  learn: 0.2795089 total: 670ms    remaining: 514ms
566:  learn: 0.2791900 total: 671ms    remaining: 512ms
567:  learn: 0.2789350 total: 672ms    remaining: 511ms
568:  learn: 0.2788021 total: 673ms    remaining: 510ms
569:  learn: 0.2786787 total: 674ms    remaining: 508ms
```

```
570:  learn: 0.2785682 total: 675ms    remaining: 507ms
571:  learn: 0.2784621 total: 676ms    remaining: 506ms
572:  learn: 0.2781576 total: 677ms    remaining: 505ms
573:  learn: 0.2780676 total: 679ms    remaining: 504ms
574:  learn: 0.2778748 total: 680ms    remaining: 502ms
575:  learn: 0.2776601 total: 681ms    remaining: 501ms
576:  learn: 0.2774941 total: 682ms    remaining: 500ms
577:  learn: 0.2772731 total: 683ms    remaining: 498ms
578:  learn: 0.2771309 total: 684ms    remaining: 497ms
579:  learn: 0.2769466 total: 685ms    remaining: 496ms
580:  learn: 0.2767731 total: 686ms    remaining: 495ms
581:  learn: 0.2766957 total: 687ms    remaining: 493ms
582:  learn: 0.2766795 total: 688ms    remaining: 492ms
583:  learn: 0.2763837 total: 689ms    remaining: 491ms
584:  learn: 0.2762478 total: 690ms    remaining: 489ms
585:  learn: 0.2761109 total: 691ms    remaining: 488ms
586:  learn: 0.2759555 total: 692ms    remaining: 487ms
587:  learn: 0.2758492 total: 693ms    remaining: 486ms
588:  learn: 0.2757249 total: 694ms    remaining: 485ms
589:  learn: 0.2756533 total: 696ms    remaining: 483ms
590:  learn: 0.2754917 total: 697ms    remaining: 482ms
591:  learn: 0.2752560 total: 698ms    remaining: 481ms
592:  learn: 0.2751118 total: 699ms    remaining: 480ms
593:  learn: 0.2748521 total: 700ms    remaining: 478ms
594:  learn: 0.2747562 total: 701ms    remaining: 477ms
595:  learn: 0.2746801 total: 702ms    remaining: 476ms
596:  learn: 0.2745964 total: 703ms    remaining: 475ms
597:  learn: 0.2744800 total: 704ms    remaining: 473ms
598:  learn: 0.2743623 total: 705ms    remaining: 472ms
599:  learn: 0.2742467 total: 706ms    remaining: 471ms
600:  learn: 0.2739664 total: 708ms    remaining: 470ms
601:  learn: 0.2736107 total: 709ms    remaining: 469ms
602:  learn: 0.2732819 total: 710ms    remaining: 467ms
603:  learn: 0.2732178 total: 711ms    remaining: 466ms
604:  learn: 0.2731500 total: 711ms    remaining: 464ms
605:  learn: 0.2731400 total: 712ms    remaining: 463ms
606:  learn: 0.2729941 total: 713ms    remaining: 462ms
607:  learn: 0.2728469 total: 714ms    remaining: 460ms
608:  learn: 0.2726916 total: 715ms    remaining: 459ms
609:  learn: 0.2725960 total: 716ms    remaining: 458ms
610:  learn: 0.2724135 total: 717ms    remaining: 457ms
611:  learn: 0.2722375 total: 718ms    remaining: 455ms
612:  learn: 0.2720174 total: 719ms    remaining: 454ms
613:  learn: 0.2718891 total: 720ms    remaining: 453ms
614:  learn: 0.2718097 total: 722ms    remaining: 452ms
615:  learn: 0.2716724 total: 723ms    remaining: 451ms
616:  learn: 0.2716390 total: 724ms    remaining: 449ms
617:  learn: 0.2715139 total: 725ms    remaining: 448ms
618:  learn: 0.2713239 total: 726ms    remaining: 447ms
619:  learn: 0.2711652 total: 727ms    remaining: 446ms
```

```
620:  learn: 0.2709143 total: 728ms    remaining: 444ms
621:  learn: 0.2707125 total: 729ms    remaining: 443ms
622:  learn: 0.2706136 total: 730ms    remaining: 442ms
623:  learn: 0.2704797 total: 731ms    remaining: 441ms
624:  learn: 0.2702626 total: 732ms    remaining: 439ms
625:  learn: 0.2702061 total: 733ms    remaining: 438ms
626:  learn: 0.2700538 total: 734ms    remaining: 437ms
627:  learn: 0.2700184 total: 736ms    remaining: 436ms
628:  learn: 0.2699641 total: 737ms    remaining: 435ms
629:  learn: 0.2699230 total: 738ms    remaining: 433ms
630:  learn: 0.2697051 total: 739ms    remaining: 432ms
631:  learn: 0.2696156 total: 740ms    remaining: 431ms
632:  learn: 0.2695664 total: 741ms    remaining: 430ms
633:  learn: 0.2694881 total: 742ms    remaining: 428ms
634:  learn: 0.2693589 total: 743ms    remaining: 427ms
635:  learn: 0.2692986 total: 744ms    remaining: 426ms
636:  learn: 0.2692579 total: 745ms    remaining: 425ms
637:  learn: 0.2690917 total: 747ms    remaining: 424ms
638:  learn: 0.2690531 total: 748ms    remaining: 422ms
639:  learn: 0.2689798 total: 749ms    remaining: 421ms
640:  learn: 0.2687904 total: 750ms    remaining: 420ms
641:  learn: 0.2686620 total: 751ms    remaining: 419ms
642:  learn: 0.2685987 total: 752ms    remaining: 417ms
643:  learn: 0.2683440 total: 753ms    remaining: 416ms
644:  learn: 0.2682057 total: 754ms    remaining: 415ms
645:  learn: 0.2680997 total: 755ms    remaining: 414ms
646:  learn: 0.2679586 total: 756ms    remaining: 412ms
647:  learn: 0.2679489 total: 757ms    remaining: 411ms
648:  learn: 0.2677788 total: 758ms    remaining: 410ms
649:  learn: 0.2677011 total: 759ms    remaining: 409ms
650:  learn: 0.2673878 total: 760ms    remaining: 407ms
651:  learn: 0.2671701 total: 761ms    remaining: 406ms
652:  learn: 0.2671270 total: 762ms    remaining: 405ms
653:  learn: 0.2669664 total: 763ms    remaining: 404ms
654:  learn: 0.2669276 total: 764ms    remaining: 402ms
655:  learn: 0.2668421 total: 765ms    remaining: 401ms
656:  learn: 0.2667520 total: 766ms    remaining: 400ms
657:  learn: 0.2665753 total: 767ms    remaining: 399ms
658:  learn: 0.2665102 total: 768ms    remaining: 398ms
659:  learn: 0.2663194 total: 770ms    remaining: 396ms
660:  learn: 0.2661777 total: 771ms    remaining: 395ms
661:  learn: 0.2661076 total: 772ms    remaining: 394ms
662:  learn: 0.2659972 total: 773ms    remaining: 393ms
663:  learn: 0.2659162 total: 774ms    remaining: 392ms
664:  learn: 0.2657366 total: 775ms    remaining: 391ms
665:  learn: 0.2656861 total: 776ms    remaining: 389ms
666:  learn: 0.2656121 total: 778ms    remaining: 388ms
667:  learn: 0.2655602 total: 779ms    remaining: 387ms
668:  learn: 0.2654520 total: 780ms    remaining: 386ms
669:  learn: 0.2653358 total: 781ms    remaining: 385ms
```

```
670:  learn: 0.2652445 total: 782ms    remaining: 383ms
671:  learn: 0.2650594 total: 783ms    remaining: 382ms
672:  learn: 0.2648604 total: 784ms    remaining: 381ms
673:  learn: 0.2647421 total: 785ms    remaining: 380ms
674:  learn: 0.2646801 total: 786ms    remaining: 379ms
675:  learn: 0.2645674 total: 787ms    remaining: 377ms
676:  learn: 0.2643981 total: 788ms    remaining: 376ms
677:  learn: 0.2642416 total: 789ms    remaining: 375ms
678:  learn: 0.2641832 total: 790ms    remaining: 374ms
679:  learn: 0.2641015 total: 791ms    remaining: 372ms
680:  learn: 0.2639785 total: 792ms    remaining: 371ms
681:  learn: 0.2638178 total: 793ms    remaining: 370ms
682:  learn: 0.2636934 total: 795ms    remaining: 369ms
683:  learn: 0.2635639 total: 796ms    remaining: 368ms
684:  learn: 0.2634576 total: 797ms    remaining: 366ms
685:  learn: 0.2632859 total: 798ms    remaining: 365ms
686:  learn: 0.2631738 total: 799ms    remaining: 364ms
687:  learn: 0.2631172 total: 800ms    remaining: 363ms
688:  learn: 0.2629941 total: 801ms    remaining: 362ms
689:  learn: 0.2629899 total: 802ms    remaining: 360ms
690:  learn: 0.2629562 total: 803ms    remaining: 359ms
691:  learn: 0.2628691 total: 804ms    remaining: 358ms
692:  learn: 0.2627801 total: 805ms    remaining: 357ms
693:  learn: 0.2626803 total: 806ms    remaining: 355ms
694:  learn: 0.2626171 total: 807ms    remaining: 354ms
695:  learn: 0.2624236 total: 808ms    remaining: 353ms
696:  learn: 0.2622726 total: 809ms    remaining: 352ms
697:  learn: 0.2621951 total: 811ms    remaining: 351ms
698:  learn: 0.2620319 total: 812ms    remaining: 350ms
699:  learn: 0.2620274 total: 812ms    remaining: 348ms
700:  learn: 0.2619390 total: 813ms    remaining: 347ms
701:  learn: 0.2618882 total: 814ms    remaining: 346ms
702:  learn: 0.2616418 total: 815ms    remaining: 345ms
703:  learn: 0.2616054 total: 817ms    remaining: 343ms
704:  learn: 0.2613875 total: 818ms    remaining: 342ms
705:  learn: 0.2611796 total: 819ms    remaining: 341ms
706:  learn: 0.2610540 total: 820ms    remaining: 340ms
707:  learn: 0.2609187 total: 821ms    remaining: 339ms
708:  learn: 0.2608527 total: 822ms    remaining: 337ms
709:  learn: 0.2607384 total: 823ms    remaining: 336ms
710:  learn: 0.2606821 total: 824ms    remaining: 335ms
711:  learn: 0.2605454 total: 825ms    remaining: 334ms
712:  learn: 0.2604424 total: 827ms    remaining: 333ms
713:  learn: 0.2602757 total: 828ms    remaining: 332ms
714:  learn: 0.2601070 total: 829ms    remaining: 331ms
715:  learn: 0.2599413 total: 830ms    remaining: 329ms
716:  learn: 0.2599356 total: 831ms    remaining: 328ms
717:  learn: 0.2598370 total: 832ms    remaining: 327ms
718:  learn: 0.2596874 total: 833ms    remaining: 326ms
719:  learn: 0.2595191 total: 835ms    remaining: 325ms
```

```
720:  learn: 0.2593830 total: 836ms    remaining: 324ms
721:  learn: 0.2592962 total: 837ms    remaining: 322ms
722:  learn: 0.2592145 total: 838ms    remaining: 321ms
723:  learn: 0.2590640 total: 839ms    remaining: 320ms
724:  learn: 0.2589291 total: 841ms    remaining: 319ms
725:  learn: 0.2587427 total: 842ms    remaining: 318ms
726:  learn: 0.2586253 total: 843ms    remaining: 316ms
727:  learn: 0.2584372 total: 844ms    remaining: 315ms
728:  learn: 0.2582830 total: 845ms    remaining: 314ms
729:  learn: 0.2580879 total: 846ms    remaining: 313ms
730:  learn: 0.2578774 total: 847ms    remaining: 312ms
731:  learn: 0.2577816 total: 848ms    remaining: 311ms
732:  learn: 0.2576847 total: 849ms    remaining: 309ms
733:  learn: 0.2575616 total: 850ms    remaining: 308ms
734:  learn: 0.2574482 total: 851ms    remaining: 307ms
735:  learn: 0.2572729 total: 853ms    remaining: 306ms
736:  learn: 0.2571999 total: 854ms    remaining: 305ms
737:  learn: 0.2570985 total: 855ms    remaining: 303ms
738:  learn: 0.2569779 total: 856ms    remaining: 302ms
739:  learn: 0.2568881 total: 857ms    remaining: 301ms
740:  learn: 0.2567843 total: 858ms    remaining: 300ms
741:  learn: 0.2566197 total: 859ms    remaining: 299ms
742:  learn: 0.2565751 total: 860ms    remaining: 297ms
743:  learn: 0.2563994 total: 861ms    remaining: 296ms
744:  learn: 0.2563160 total: 862ms    remaining: 295ms
745:  learn: 0.2561781 total: 863ms    remaining: 294ms
746:  learn: 0.2560407 total: 864ms    remaining: 293ms
747:  learn: 0.2558361 total: 866ms    remaining: 292ms
748:  learn: 0.2555400 total: 867ms    remaining: 290ms
749:  learn: 0.2554754 total: 868ms    remaining: 289ms
750:  learn: 0.2553420 total: 869ms    remaining: 288ms
751:  learn: 0.2551557 total: 870ms    remaining: 287ms
752:  learn: 0.2551071 total: 871ms    remaining: 286ms
753:  learn: 0.2549333 total: 872ms    remaining: 285ms
754:  learn: 0.2549056 total: 873ms    remaining: 283ms
755:  learn: 0.2547694 total: 875ms    remaining: 282ms
756:  learn: 0.2546761 total: 876ms    remaining: 281ms
757:  learn: 0.2544058 total: 877ms    remaining: 280ms
758:  learn: 0.2541508 total: 878ms    remaining: 279ms
759:  learn: 0.2539713 total: 879ms    remaining: 278ms
760:  learn: 0.2539333 total: 880ms    remaining: 276ms
761:  learn: 0.2538241 total: 881ms    remaining: 275ms
762:  learn: 0.2536758 total: 882ms    remaining: 274ms
763:  learn: 0.2536129 total: 883ms    remaining: 273ms
764:  learn: 0.2534618 total: 884ms    remaining: 272ms
765:  learn: 0.2532567 total: 885ms    remaining: 270ms
766:  learn: 0.2531076 total: 886ms    remaining: 269ms
767:  learn: 0.2530303 total: 887ms    remaining: 268ms
768:  learn: 0.2529256 total: 888ms    remaining: 267ms
769:  learn: 0.2528111 total: 889ms    remaining: 266ms
```

```
770:  learn: 0.2527149 total: 891ms    remaining: 265ms
771:  learn: 0.2525119 total: 892ms    remaining: 263ms
772:  learn: 0.2523567 total: 893ms    remaining: 262ms
773:  learn: 0.2523031 total: 894ms    remaining: 261ms
774:  learn: 0.2520968 total: 895ms    remaining: 260ms
775:  learn: 0.2519345 total: 896ms    remaining: 259ms
776:  learn: 0.2518150 total: 897ms    remaining: 257ms
777:  learn: 0.2517216 total: 898ms    remaining: 256ms
778:  learn: 0.2515069 total: 899ms    remaining: 255ms
779:  learn: 0.2514049 total: 900ms    remaining: 254ms
780:  learn: 0.2512942 total: 901ms    remaining: 253ms
781:  learn: 0.2512218 total: 902ms    remaining: 252ms
782:  learn: 0.2510006 total: 904ms    remaining: 250ms
783:  learn: 0.2508483 total: 905ms    remaining: 249ms
784:  learn: 0.2506916 total: 906ms    remaining: 248ms
785:  learn: 0.2506056 total: 907ms    remaining: 247ms
786:  learn: 0.2505524 total: 908ms    remaining: 246ms
787:  learn: 0.2505224 total: 909ms    remaining: 245ms
788:  learn: 0.2504572 total: 910ms    remaining: 243ms
789:  learn: 0.2503461 total: 911ms    remaining: 242ms
790:  learn: 0.2500365 total: 912ms    remaining: 241ms
791:  learn: 0.2500042 total: 913ms    remaining: 240ms
792:  learn: 0.2499079 total: 914ms    remaining: 239ms
793:  learn: 0.2497181 total: 915ms    remaining: 237ms
794:  learn: 0.2496569 total: 916ms    remaining: 236ms
795:  learn: 0.2494773 total: 917ms    remaining: 235ms
796:  learn: 0.2494209 total: 918ms    remaining: 234ms
797:  learn: 0.2493562 total: 920ms    remaining: 233ms
798:  learn: 0.2493414 total: 921ms    remaining: 232ms
799:  learn: 0.2490434 total: 922ms    remaining: 230ms
800:  learn: 0.2489843 total: 923ms    remaining: 229ms
801:  learn: 0.2489669 total: 924ms    remaining: 228ms
802:  learn: 0.2487523 total: 925ms    remaining: 227ms
803:  learn: 0.2486269 total: 926ms    remaining: 226ms
804:  learn: 0.2485313 total: 927ms    remaining: 225ms
805:  learn: 0.2483841 total: 928ms    remaining: 223ms
806:  learn: 0.2482091 total: 929ms    remaining: 222ms
807:  learn: 0.2479668 total: 930ms    remaining: 221ms
808:  learn: 0.2477781 total: 931ms    remaining: 220ms
809:  learn: 0.2476877 total: 932ms    remaining: 219ms
810:  learn: 0.2474415 total: 933ms    remaining: 218ms
811:  learn: 0.2472368 total: 934ms    remaining: 216ms
812:  learn: 0.2470912 total: 936ms    remaining: 215ms
813:  learn: 0.2468119 total: 937ms    remaining: 214ms
814:  learn: 0.2467887 total: 937ms    remaining: 213ms
815:  learn: 0.2466634 total: 939ms    remaining: 212ms
816:  learn: 0.2464522 total: 940ms    remaining: 210ms
817:  learn: 0.2463966 total: 941ms    remaining: 209ms
818:  learn: 0.2462798 total: 942ms    remaining: 208ms
819:  learn: 0.2462039 total: 943ms    remaining: 207ms
```

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820:  learn: 0.2460665 total: 944ms    remaining: 206ms
821:  learn: 0.2459539 total: 945ms    remaining: 205ms
822:  learn: 0.2458032 total: 946ms    remaining: 203ms
823:  learn: 0.2457074 total: 947ms    remaining: 202ms
824:  learn: 0.2456424 total: 948ms    remaining: 201ms
825:  learn: 0.2456370 total: 949ms    remaining: 200ms
826:  learn: 0.2455679 total: 950ms    remaining: 199ms
827:  learn: 0.2454133 total: 951ms    remaining: 198ms
828:  learn: 0.2452047 total: 952ms    remaining: 196ms
829:  learn: 0.2451268 total: 953ms    remaining: 195ms
830:  learn: 0.2450915 total: 954ms    remaining: 194ms
831:  learn: 0.2449433 total: 955ms    remaining: 193ms
832:  learn: 0.2447596 total: 956ms    remaining: 192ms
833:  learn: 0.2446150 total: 957ms    remaining: 191ms
834:  learn: 0.2445573 total: 958ms    remaining: 189ms
835:  learn: 0.2443515 total: 960ms    remaining: 188ms
836:  learn: 0.2442855 total: 961ms    remaining: 187ms
837:  learn: 0.2441522 total: 962ms    remaining: 186ms
838:  learn: 0.2440404 total: 963ms    remaining: 185ms
839:  learn: 0.2439442 total: 964ms    remaining: 184ms
840:  learn: 0.2437763 total: 965ms    remaining: 182ms
841:  learn: 0.2436774 total: 966ms    remaining: 181ms
842:  learn: 0.2434158 total: 967ms    remaining: 180ms
843:  learn: 0.2432738 total: 968ms    remaining: 179ms
844:  learn: 0.2431843 total: 969ms    remaining: 178ms
845:  learn: 0.2431187 total: 970ms    remaining: 177ms
846:  learn: 0.2430861 total: 971ms    remaining: 175ms
847:  learn: 0.2429194 total: 972ms    remaining: 174ms
848:  learn: 0.2428444 total: 973ms    remaining: 173ms
849:  learn: 0.2427630 total: 975ms    remaining: 172ms
850:  learn: 0.2426257 total: 976ms    remaining: 171ms
851:  learn: 0.2425098 total: 977ms    remaining: 170ms
852:  learn: 0.2424195 total: 978ms    remaining: 169ms
853:  learn: 0.2422847 total: 979ms    remaining: 167ms
854:  learn: 0.2422445 total: 980ms    remaining: 166ms
855:  learn: 0.2421657 total: 981ms    remaining: 165ms
856:  learn: 0.2420706 total: 982ms    remaining: 164ms
857:  learn: 0.2419537 total: 983ms    remaining: 163ms
858:  learn: 0.2417033 total: 984ms    remaining: 162ms
859:  learn: 0.2415351 total: 985ms    remaining: 160ms
860:  learn: 0.2413290 total: 987ms    remaining: 159ms
861:  learn: 0.2412348 total: 988ms    remaining: 158ms
862:  learn: 0.2412023 total: 989ms    remaining: 157ms
863:  learn: 0.2411131 total: 990ms    remaining: 156ms
864:  learn: 0.2410273 total: 991ms    remaining: 155ms
865:  learn: 0.2408921 total: 992ms    remaining: 154ms
866:  learn: 0.2408645 total: 993ms    remaining: 152ms
867:  learn: 0.2407656 total: 994ms    remaining: 151ms
868:  learn: 0.2405992 total: 995ms    remaining: 150ms
869:  learn: 0.2403500 total: 996ms    remaining: 149ms
```

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870:  learn: 0.2402359 total: 997ms    remaining: 148ms
871:  learn: 0.2401656 total: 998ms    remaining: 147ms
872:  learn: 0.2400362 total: 1000ms   remaining: 145ms
873:  learn: 0.2398798 total: 1s  remaining: 144ms
874:  learn: 0.2397636 total: 1s  remaining: 143ms
875:  learn: 0.2396239 total: 1s  remaining: 142ms
876:  learn: 0.2394194 total: 1s  remaining: 141ms
877:  learn: 0.2391638 total: 1s  remaining: 140ms
878:  learn: 0.2390855 total: 1.01s    remaining: 138ms
879:  learn: 0.2389484 total: 1.01s    remaining: 137ms
880:  learn: 0.2388972 total: 1.01s    remaining: 136ms
881:  learn: 0.2388127 total: 1.01s    remaining: 135ms
882:  learn: 0.2387144 total: 1.01s    remaining: 134ms
883:  learn: 0.2386629 total: 1.01s    remaining: 133ms
884:  learn: 0.2384804 total: 1.01s    remaining: 132ms
885:  learn: 0.2382766 total: 1.01s    remaining: 130ms
886:  learn: 0.2381646 total: 1.01s    remaining: 129ms
887:  learn: 0.2381027 total: 1.01s    remaining: 128ms
888:  learn: 0.2380618 total: 1.02s    remaining: 127ms
889:  learn: 0.2379588 total: 1.02s    remaining: 126ms
890:  learn: 0.2379188 total: 1.02s    remaining: 125ms
891:  learn: 0.2377370 total: 1.02s    remaining: 124ms
892:  learn: 0.2377210 total: 1.02s    remaining: 122ms
893:  learn: 0.2375177 total: 1.02s    remaining: 121ms
894:  learn: 0.2374506 total: 1.02s    remaining: 120ms
895:  learn: 0.2373041 total: 1.02s    remaining: 119ms
896:  learn: 0.2372508 total: 1.03s    remaining: 118ms
897:  learn: 0.2371463 total: 1.03s    remaining: 117ms
898:  learn: 0.2369746 total: 1.03s    remaining: 116ms
899:  learn: 0.2368592 total: 1.03s    remaining: 115ms
900:  learn: 0.2366306 total: 1.03s    remaining: 113ms
901:  learn: 0.2364911 total: 1.03s    remaining: 112ms
902:  learn: 0.2363427 total: 1.03s    remaining: 111ms
903:  learn: 0.2362097 total: 1.03s    remaining: 110ms
904:  learn: 0.2360218 total: 1.04s    remaining: 109ms
905:  learn: 0.2358233 total: 1.04s    remaining: 108ms
906:  learn: 0.2356791 total: 1.04s    remaining: 107ms
907:  learn: 0.2354232 total: 1.04s    remaining: 105ms
908:  learn: 0.2351683 total: 1.04s    remaining: 104ms
909:  learn: 0.2349373 total: 1.04s    remaining: 103ms
910:  learn: 0.2347011 total: 1.04s    remaining: 102ms
911:  learn: 0.2346382 total: 1.04s    remaining: 101ms
912:  learn: 0.2345413 total: 1.04s    remaining: 99.6ms
913:  learn: 0.2343468 total: 1.05s    remaining: 98.4ms
914:  learn: 0.2342849 total: 1.05s    remaining: 97.3ms
915:  learn: 0.2341245 total: 1.05s    remaining: 96.2ms
916:  learn: 0.2338879 total: 1.05s    remaining: 95ms
917:  learn: 0.2337795 total: 1.05s    remaining: 93.9ms
918:  learn: 0.2335903 total: 1.05s    remaining: 92.7ms
919:  learn: 0.2335241 total: 1.05s    remaining: 91.6ms
```

```
920:  learn: 0.2334891 total: 1.05s    remaining: 90.4ms
921:  learn: 0.2333580 total: 1.05s    remaining: 89.3ms
922:  learn: 0.2332662 total: 1.06s    remaining: 88.1ms
923:  learn: 0.2331495 total: 1.06s    remaining: 87ms
924:  learn: 0.2330820 total: 1.06s    remaining: 85.8ms
925:  learn: 0.2329118 total: 1.06s    remaining: 84.7ms
926:  learn: 0.2327572 total: 1.06s    remaining: 83.5ms
927:  learn: 0.2326596 total: 1.06s    remaining: 82.4ms
928:  learn: 0.2324980 total: 1.06s    remaining: 81.2ms
929:  learn: 0.2323805 total: 1.06s    remaining: 80.1ms
930:  learn: 0.2322011 total: 1.06s    remaining: 78.9ms
931:  learn: 0.2321366 total: 1.06s    remaining: 77.8ms
932:  learn: 0.2320562 total: 1.07s    remaining: 76.6ms
933:  learn: 0.2319021 total: 1.07s    remaining: 75.5ms
934:  learn: 0.2317488 total: 1.07s    remaining: 74.3ms
935:  learn: 0.2317135 total: 1.07s    remaining: 73.2ms
936:  learn: 0.2315967 total: 1.07s    remaining: 72ms
937:  learn: 0.2314549 total: 1.07s    remaining: 70.9ms
938:  learn: 0.2313193 total: 1.07s    remaining: 69.7ms
939:  learn: 0.2312718 total: 1.07s    remaining: 68.6ms
940:  learn: 0.2312041 total: 1.08s    remaining: 67.5ms
941:  learn: 0.2311543 total: 1.08s    remaining: 66.3ms
942:  learn: 0.2310167 total: 1.08s    remaining: 65.2ms
943:  learn: 0.2308443 total: 1.08s    remaining: 64.1ms
944:  learn: 0.2307152 total: 1.08s    remaining: 63ms
945:  learn: 0.2306242 total: 1.08s    remaining: 61.8ms
946:  learn: 0.2305363 total: 1.08s    remaining: 60.7ms
947:  learn: 0.2304728 total: 1.08s    remaining: 59.5ms
948:  learn: 0.2304081 total: 1.09s    remaining: 58.4ms
949:  learn: 0.2303331 total: 1.09s    remaining: 57.2ms
950:  learn: 0.2301387 total: 1.09s    remaining: 56.1ms
951:  learn: 0.2300741 total: 1.09s    remaining: 54.9ms
952:  learn: 0.2300053 total: 1.09s    remaining: 53.8ms
953:  learn: 0.2299343 total: 1.09s    remaining: 52.6ms
954:  learn: 0.2299119 total: 1.09s    remaining: 51.5ms
955:  learn: 0.2298127 total: 1.09s    remaining: 50.4ms
956:  learn: 0.2295869 total: 1.09s    remaining: 49.2ms
957:  learn: 0.2295045 total: 1.1s     remaining: 48.1ms
958:  learn: 0.2294078 total: 1.1s     remaining: 46.9ms
959:  learn: 0.2293798 total: 1.1s     remaining: 45.8ms
960:  learn: 0.2293412 total: 1.1s     remaining: 44.6ms
961:  learn: 0.2293031 total: 1.1s     remaining: 43.5ms
962:  learn: 0.2292408 total: 1.1s     remaining: 42.3ms
963:  learn: 0.2292068 total: 1.1s     remaining: 41.2ms
964:  learn: 0.2290316 total: 1.1s     remaining: 40ms
965:  learn: 0.2288702 total: 1.1s     remaining: 38.9ms
966:  learn: 0.2287124 total: 1.11s    remaining: 37.7ms
967:  learn: 0.2286139 total: 1.11s    remaining: 36.6ms
968:  learn: 0.2285335 total: 1.11s    remaining: 35.5ms
969:  learn: 0.2284299 total: 1.11s    remaining: 34.3ms
```

```
970:  learn: 0.2283485 total: 1.11s    remaining: 33.2ms
971:  learn: 0.2281887 total: 1.11s    remaining: 32ms
972:  learn: 0.2280311 total: 1.11s    remaining: 30.9ms
973:  learn: 0.2278267 total: 1.11s    remaining: 29.7ms
974:  learn: 0.2276932 total: 1.11s    remaining: 28.6ms
975:  learn: 0.2274811 total: 1.12s    remaining: 27.5ms
976:  learn: 0.2274291 total: 1.12s    remaining: 26.3ms
977:  learn: 0.2271427 total: 1.12s    remaining: 25.2ms
978:  learn: 0.2270628 total: 1.12s    remaining: 24ms
979:  learn: 0.2269176 total: 1.12s    remaining: 22.9ms
980:  learn: 0.2268599 total: 1.12s    remaining: 21.8ms
981:  learn: 0.2266739 total: 1.12s    remaining: 20.6ms
982:  learn: 0.2266000 total: 1.13s    remaining: 19.5ms
983:  learn: 0.2265728 total: 1.13s    remaining: 18.3ms
984:  learn: 0.2264859 total: 1.13s    remaining: 17.2ms
985:  learn: 0.2264372 total: 1.13s    remaining: 16ms
986:  learn: 0.2262088 total: 1.13s    remaining: 14.9ms
987:  learn: 0.2261301 total: 1.13s    remaining: 13.7ms
988:  learn: 0.2260315 total: 1.13s    remaining: 12.6ms
989:  learn: 0.2258827 total: 1.13s    remaining: 11.4ms
990:  learn: 0.2256661 total: 1.13s    remaining: 10.3ms
991:  learn: 0.2256172 total: 1.14s    remaining: 9.15ms
992:  learn: 0.2254649 total: 1.14s    remaining: 8.01ms
993:  learn: 0.2252541 total: 1.14s    remaining: 6.87ms
994:  learn: 0.2252085 total: 1.14s    remaining: 5.72ms
995:  learn: 0.2249247 total: 1.14s    remaining: 4.58ms
996:  learn: 0.2247095 total: 1.14s    remaining: 3.43ms
997:  learn: 0.2246382 total: 1.14s    remaining: 2.29ms
998:  learn: 0.2245394 total: 1.14s    remaining: 1.14ms
999:  learn: 0.2244039 total: 1.14s    remaining: 0us
CatBoostClassifier 0.7796610169491526
XGBClassifier 0.7853107344632768
RandomForestClassifier 0.7909604519774012
AdaBoostClassifier 0.8022598870056498
GradientBoostingClassifier 0.8022598870056498
GaussianNB 0.7853107344632768
LinearDiscriminantAnalysis 0.7627118644067796
QuadraticDiscriminantAnalysis 0.6384180790960452
LogisticRegression 0.768361581920904
KNeighborsClassifier 0.6214689265536724
DecisionTreeClassifier 0.751412429378531
Learning rate set to 0.008868
0:    learn: 0.6891847 total: 908us    remaining: 908ms
1:    learn: 0.6841888 total: 2.67ms   remaining: 1.33s
2:    learn: 0.6785777 total: 5.27ms   remaining: 1.75s
3:    learn: 0.6735664 total: 7.82ms   remaining: 1.95s
4:    learn: 0.6686720 total: 10.2ms   remaining: 2.03s
5:    learn: 0.6630009 total: 12.9ms   remaining: 2.13s
6:    learn: 0.6601707 total: 14.3ms   remaining: 2.04s
7:    learn: 0.6549171 total: 17.1ms   remaining: 2.12s
```

```
8:    learn: 0.6510633 total: 18.9ms   remaining: 2.08s
9:    learn: 0.6472312 total: 21.7ms   remaining: 2.15s
10:   learn: 0.6425404 total: 24.6ms   remaining: 2.21s
11:   learn: 0.6376149 total: 27.3ms   remaining: 2.25s
12:   learn: 0.6330337 total: 30.5ms   remaining: 2.32s
13:   learn: 0.6287021 total: 33.6ms   remaining: 2.37s
14:   learn: 0.6250344 total: 36.1ms   remaining: 2.37s
15:   learn: 0.6204148 total: 39.5ms   remaining: 2.43s
16:   learn: 0.6165300 total: 42.1ms   remaining: 2.43s
17:   learn: 0.6126330 total: 44.3ms   remaining: 2.42s
18:   learn: 0.6086515 total: 46.9ms   remaining: 2.42s
19:   learn: 0.6045588 total: 49.8ms   remaining: 2.44s
20:   learn: 0.6000668 total: 52.5ms   remaining: 2.45s
21:   learn: 0.5962643 total: 55.4ms   remaining: 2.46s
22:   learn: 0.5931716 total: 57.2ms   remaining: 2.43s
23:   learn: 0.5889325 total: 59.9ms   remaining: 2.44s
24:   learn: 0.5852310 total: 62ms     remaining: 2.42s
25:   learn: 0.5817614 total: 64.6ms   remaining: 2.42s
26:   learn: 0.5780738 total: 67ms     remaining: 2.41s
27:   learn: 0.5746508 total: 69.5ms   remaining: 2.41s
28:   learn: 0.5715961 total: 71.6ms   remaining: 2.4s
29:   learn: 0.5687009 total: 73.2ms   remaining: 2.37s
30:   learn: 0.5653271 total: 75.5ms   remaining: 2.36s
31:   learn: 0.5622048 total: 77.5ms   remaining: 2.34s
32:   learn: 0.5597117 total: 79.5ms   remaining: 2.33s
33:   learn: 0.5564756 total: 81.5ms   remaining: 2.31s
34:   learn: 0.5532409 total: 83.5ms   remaining: 2.3s
35:   learn: 0.5501484 total: 85.2ms   remaining: 2.28s
36:   learn: 0.5468661 total: 86.9ms   remaining: 2.26s
37:   learn: 0.5438399 total: 88.9ms   remaining: 2.25s
38:   learn: 0.5412654 total: 90.7ms   remaining: 2.23s
39:   learn: 0.5387013 total: 92.1ms   remaining: 2.21s
40:   learn: 0.5363697 total: 93.5ms   remaining: 2.19s
41:   learn: 0.5338987 total: 94.9ms   remaining: 2.16s
42:   learn: 0.5308075 total: 96.1ms   remaining: 2.14s
43:   learn: 0.5280196 total: 97.4ms   remaining: 2.12s
44:   learn: 0.5260513 total: 98.4ms   remaining: 2.09s
45:   learn: 0.5241572 total: 99.6ms   remaining: 2.06s
46:   learn: 0.5218170 total: 101ms    remaining: 2.04s
47:   learn: 0.5193777 total: 102ms    remaining: 2.02s
48:   learn: 0.5172677 total: 103ms    remaining: 2s
49:   learn: 0.5149584 total: 104ms    remaining: 1.99s
50:   learn: 0.5128314 total: 106ms    remaining: 1.97s
51:   learn: 0.5103563 total: 107ms    remaining: 1.95s
52:   learn: 0.5090705 total: 107ms    remaining: 1.92s
53:   learn: 0.5066079 total: 108ms    remaining: 1.9s
54:   learn: 0.5041227 total: 110ms    remaining: 1.88s
55:   learn: 0.5017171 total: 111ms    remaining: 1.86s
56:   learn: 0.5001640 total: 112ms    remaining: 1.85s
57:   learn: 0.4981989 total: 113ms    remaining: 1.83s
```

```
58:   learn: 0.4972920 total: 113ms    remaining: 1.81s
59:   learn: 0.4957859 total: 114ms    remaining: 1.79s
60:   learn: 0.4939801 total: 116ms    remaining: 1.78s
61:   learn: 0.4924126 total: 117ms    remaining: 1.76s
62:   learn: 0.4902632 total: 118ms    remaining: 1.75s
63:   learn: 0.4885534 total: 119ms    remaining: 1.74s
64:   learn: 0.4866835 total: 120ms    remaining: 1.73s
65:   learn: 0.4847875 total: 121ms    remaining: 1.72s
66:   learn: 0.4830564 total: 122ms    remaining: 1.7s
67:   learn: 0.4816817 total: 123ms    remaining: 1.68s
68:   learn: 0.4807981 total: 123ms    remaining: 1.67s
69:   learn: 0.4790491 total: 125ms    remaining: 1.65s
70:   learn: 0.4778532 total: 125ms    remaining: 1.64s
71:   learn: 0.4766677 total: 126ms    remaining: 1.63s
72:   learn: 0.4753024 total: 127ms    remaining: 1.61s
73:   learn: 0.4734972 total: 128ms    remaining: 1.6s
74:   learn: 0.4719748 total: 129ms    remaining: 1.59s
75:   learn: 0.4705283 total: 130ms    remaining: 1.58s
76:   learn: 0.4693899 total: 131ms    remaining: 1.57s
77:   learn: 0.4678052 total: 132ms    remaining: 1.56s
78:   learn: 0.4662320 total: 134ms    remaining: 1.56s
79:   learn: 0.4645593 total: 135ms    remaining: 1.55s
80:   learn: 0.4633661 total: 136ms    remaining: 1.54s
81:   learn: 0.4619096 total: 137ms    remaining: 1.53s
82:   learn: 0.4605013 total: 138ms    remaining: 1.52s
83:   learn: 0.4592706 total: 139ms    remaining: 1.52s
84:   learn: 0.4579791 total: 140ms    remaining: 1.51s
85:   learn: 0.4565174 total: 141ms    remaining: 1.5s
86:   learn: 0.4551459 total: 143ms    remaining: 1.5s
87:   learn: 0.4539837 total: 144ms    remaining: 1.49s
88:   learn: 0.4527822 total: 145ms    remaining: 1.48s
89:   learn: 0.4514073 total: 146ms    remaining: 1.48s
90:   learn: 0.4502453 total: 147ms    remaining: 1.47s
91:   learn: 0.4492721 total: 149ms    remaining: 1.47s
92:   learn: 0.4486106 total: 150ms    remaining: 1.46s
93:   learn: 0.4473796 total: 151ms    remaining: 1.45s
94:   learn: 0.4463864 total: 152ms    remaining: 1.45s
95:   learn: 0.4454481 total: 153ms    remaining: 1.44s
96:   learn: 0.4442772 total: 155ms    remaining: 1.44s
97:   learn: 0.4430899 total: 156ms    remaining: 1.43s
98:   learn: 0.4419622 total: 157ms    remaining: 1.43s
99:   learn: 0.4415820 total: 157ms    remaining: 1.42s
100:  learn: 0.4404469 total: 158ms    remaining: 1.41s
101:  learn: 0.4396727 total: 160ms    remaining: 1.4s
102:  learn: 0.4385091 total: 161ms    remaining: 1.4s
103:  learn: 0.4374265 total: 162ms    remaining: 1.39s
104:  learn: 0.4362588 total: 163ms    remaining: 1.39s
105:  learn: 0.4352385 total: 164ms    remaining: 1.38s
106:  learn: 0.4341939 total: 165ms    remaining: 1.38s
107:  learn: 0.4331734 total: 166ms    remaining: 1.37s
```

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108:  learn: 0.4322647 total: 168ms    remaining: 1.37s
109:  learn: 0.4311342 total: 169ms    remaining: 1.36s
110:  learn: 0.4302402 total: 170ms    remaining: 1.36s
111:  learn: 0.4292052 total: 171ms    remaining: 1.35s
112:  learn: 0.4283988 total: 172ms    remaining: 1.35s
113:  learn: 0.4275608 total: 173ms    remaining: 1.34s
114:  learn: 0.4271133 total: 174ms    remaining: 1.34s
115:  learn: 0.4262821 total: 175ms    remaining: 1.33s
116:  learn: 0.4253894 total: 176ms    remaining: 1.33s
117:  learn: 0.4245938 total: 177ms    remaining: 1.32s
118:  learn: 0.4238228 total: 178ms    remaining: 1.32s
119:  learn: 0.4228494 total: 179ms    remaining: 1.31s
120:  learn: 0.4217907 total: 181ms    remaining: 1.31s
121:  learn: 0.4209402 total: 182ms    remaining: 1.31s
122:  learn: 0.4202223 total: 183ms    remaining: 1.3s
123:  learn: 0.4194541 total: 184ms    remaining: 1.3s
124:  learn: 0.4187060 total: 185ms    remaining: 1.29s
125:  learn: 0.4180266 total: 186ms    remaining: 1.29s
126:  learn: 0.4172938 total: 187ms    remaining: 1.28s
127:  learn: 0.4165851 total: 188ms    remaining: 1.28s
128:  learn: 0.4160213 total: 189ms    remaining: 1.28s
129:  learn: 0.4152651 total: 190ms    remaining: 1.27s
130:  learn: 0.4144369 total: 191ms    remaining: 1.27s
131:  learn: 0.4140831 total: 192ms    remaining: 1.26s
132:  learn: 0.4138937 total: 193ms    remaining: 1.26s
133:  learn: 0.4134233 total: 194ms    remaining: 1.25s
134:  learn: 0.4125138 total: 195ms    remaining: 1.25s
135:  learn: 0.4116480 total: 197ms    remaining: 1.25s
136:  learn: 0.4108575 total: 198ms    remaining: 1.25s
137:  learn: 0.4103721 total: 199ms    remaining: 1.24s
138:  learn: 0.4095092 total: 200ms    remaining: 1.24s
139:  learn: 0.4089626 total: 202ms    remaining: 1.24s
140:  learn: 0.4081433 total: 203ms    remaining: 1.24s
141:  learn: 0.4075759 total: 204ms    remaining: 1.23s
142:  learn: 0.4068442 total: 205ms    remaining: 1.23s
143:  learn: 0.4061206 total: 207ms    remaining: 1.23s
144:  learn: 0.4056250 total: 208ms    remaining: 1.23s
145:  learn: 0.4053141 total: 209ms    remaining: 1.22s
146:  learn: 0.4046649 total: 210ms    remaining: 1.22s
147:  learn: 0.4039421 total: 212ms    remaining: 1.22s
148:  learn: 0.4035949 total: 213ms    remaining: 1.21s
149:  learn: 0.4032564 total: 214ms    remaining: 1.21s
150:  learn: 0.4027511 total: 215ms    remaining: 1.21s
151:  learn: 0.4021329 total: 216ms    remaining: 1.21s
152:  learn: 0.4014729 total: 218ms    remaining: 1.2s
153:  learn: 0.4007014 total: 219ms    remaining: 1.2s
154:  learn: 0.4003424 total: 220ms    remaining: 1.2s
155:  learn: 0.3997302 total: 221ms    remaining: 1.2s
156:  learn: 0.3992062 total: 223ms    remaining: 1.2s
157:  learn: 0.3986892 total: 224ms    remaining: 1.19s
```

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158:  learn: 0.3980489 total: 225ms    remaining: 1.19s
159:  learn: 0.3973670 total: 227ms    remaining: 1.19s
160:  learn: 0.3972001 total: 227ms    remaining: 1.18s
161:  learn: 0.3965986 total: 229ms    remaining: 1.19s
162:  learn: 0.3961176 total: 231ms    remaining: 1.19s
163:  learn: 0.3955542 total: 232ms    remaining: 1.18s
164:  learn: 0.3950021 total: 234ms    remaining: 1.18s
165:  learn: 0.3943741 total: 235ms    remaining: 1.18s
166:  learn: 0.3943070 total: 235ms    remaining: 1.17s
167:  learn: 0.3938904 total: 237ms    remaining: 1.17s
168:  learn: 0.3934086 total: 238ms    remaining: 1.17s
169:  learn: 0.3930194 total: 239ms    remaining: 1.17s
170:  learn: 0.3926344 total: 240ms    remaining: 1.16s
171:  learn: 0.3924741 total: 241ms    remaining: 1.16s
172:  learn: 0.3919212 total: 242ms    remaining: 1.16s
173:  learn: 0.3914598 total: 243ms    remaining: 1.15s
174:  learn: 0.3909539 total: 244ms    remaining: 1.15s
175:  learn: 0.3907986 total: 245ms    remaining: 1.15s
176:  learn: 0.3901993 total: 247ms    remaining: 1.15s
177:  learn: 0.3896565 total: 248ms    remaining: 1.14s
178:  learn: 0.3891472 total: 249ms    remaining: 1.14s
179:  learn: 0.3887162 total: 250ms    remaining: 1.14s
180:  learn: 0.3884848 total: 251ms    remaining: 1.14s
181:  learn: 0.3879916 total: 253ms    remaining: 1.14s
182:  learn: 0.3875168 total: 254ms    remaining: 1.13s
183:  learn: 0.3870791 total: 255ms    remaining: 1.13s
184:  learn: 0.3866275 total: 256ms    remaining: 1.13s
185:  learn: 0.3860551 total: 257ms    remaining: 1.13s
186:  learn: 0.3855967 total: 259ms    remaining: 1.12s
187:  learn: 0.3849838 total: 260ms    remaining: 1.12s
188:  learn: 0.3845189 total: 261ms    remaining: 1.12s
189:  learn: 0.3842532 total: 262ms    remaining: 1.12s
190:  learn: 0.3839082 total: 263ms    remaining: 1.11s
191:  learn: 0.3833063 total: 264ms    remaining: 1.11s
192:  learn: 0.3828456 total: 266ms    remaining: 1.11s
193:  learn: 0.3821833 total: 267ms    remaining: 1.11s
194:  learn: 0.3819471 total: 268ms    remaining: 1.11s
195:  learn: 0.3815611 total: 269ms    remaining: 1.1s
196:  learn: 0.3811245 total: 271ms    remaining: 1.1s
197:  learn: 0.3808025 total: 272ms    remaining: 1.1s
198:  learn: 0.3804752 total: 273ms    remaining: 1.1s
199:  learn: 0.3801234 total: 274ms    remaining: 1.1s
200:  learn: 0.3797631 total: 275ms    remaining: 1.09s
201:  learn: 0.3795090 total: 276ms    remaining: 1.09s
202:  learn: 0.3791801 total: 278ms    remaining: 1.09s
203:  learn: 0.3789077 total: 279ms    remaining: 1.09s
204:  learn: 0.3785419 total: 280ms    remaining: 1.08s
205:  learn: 0.3783618 total: 281ms    remaining: 1.08s
206:  learn: 0.3777795 total: 282ms    remaining: 1.08s
207:  learn: 0.3775141 total: 283ms    remaining: 1.08s
```

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208:  learn: 0.3772101  total: 284ms    remaining: 1.07s
209:  learn: 0.3771215  total: 285ms    remaining: 1.07s
210:  learn: 0.3767508  total: 286ms    remaining: 1.07s
211:  learn: 0.3764776  total: 287ms    remaining: 1.07s
212:  learn: 0.3760442  total: 288ms    remaining: 1.06s
213:  learn: 0.3756058  total: 289ms    remaining: 1.06s
214:  learn: 0.3753412  total: 291ms    remaining: 1.06s
215:  learn: 0.3749155  total: 292ms    remaining: 1.06s
216:  learn: 0.3745148  total: 293ms    remaining: 1.06s
217:  learn: 0.3742877  total: 294ms    remaining: 1.06s
218:  learn: 0.3739980  total: 296ms    remaining: 1.05s
219:  learn: 0.3738420  total: 297ms    remaining: 1.05s
220:  learn: 0.3734116  total: 298ms    remaining: 1.05s
221:  learn: 0.3732388  total: 299ms    remaining: 1.05s
222:  learn: 0.3729248  total: 300ms    remaining: 1.05s
223:  learn: 0.3725846  total: 302ms    remaining: 1.04s
224:  learn: 0.3722593  total: 303ms    remaining: 1.04s
225:  learn: 0.3718396  total: 304ms    remaining: 1.04s
226:  learn: 0.3712978  total: 306ms    remaining: 1.04s
227:  learn: 0.3709566  total: 307ms    remaining: 1.04s
228:  learn: 0.3707232  total: 308ms    remaining: 1.04s
229:  learn: 0.3705248  total: 309ms    remaining: 1.03s
230:  learn: 0.3703073  total: 310ms    remaining: 1.03s
231:  learn: 0.3698823  total: 312ms    remaining: 1.03s
232:  learn: 0.3696498  total: 313ms    remaining: 1.03s
233:  learn: 0.3692643  total: 314ms    remaining: 1.03s
234:  learn: 0.3688662  total: 315ms    remaining: 1.03s
235:  learn: 0.3685698  total: 317ms    remaining: 1.02s
236:  learn: 0.3683605  total: 318ms    remaining: 1.02s
237:  learn: 0.3679622  total: 319ms    remaining: 1.02s
238:  learn: 0.3675277  total: 320ms    remaining: 1.02s
239:  learn: 0.3673201  total: 321ms    remaining: 1.02s
240:  learn: 0.3670947  total: 323ms    remaining: 1.01s
241:  learn: 0.3669761  total: 324ms    remaining: 1.01s
242:  learn: 0.3666478  total: 325ms    remaining: 1.01s
243:  learn: 0.3663271  total: 326ms    remaining: 1.01s
244:  learn: 0.3660937  total: 328ms    remaining: 1.01s
245:  learn: 0.3656099  total: 329ms    remaining: 1.01s
246:  learn: 0.3652853  total: 330ms    remaining: 1.01s
247:  learn: 0.3650363  total: 331ms    remaining: 1s
248:  learn: 0.3647886  total: 333ms    remaining: 1s
249:  learn: 0.3644490  total: 334ms    remaining: 1s
250:  learn: 0.3640655  total: 335ms    remaining: 1s
251:  learn: 0.3637663  total: 337ms    remaining: 999ms
252:  learn: 0.3635387  total: 338ms    remaining: 998ms
253:  learn: 0.3632869  total: 340ms    remaining: 997ms
254:  learn: 0.3631305  total: 341ms    remaining: 996ms
255:  learn: 0.3628503  total: 342ms    remaining: 995ms
256:  learn: 0.3624078  total: 344ms    remaining: 993ms
257:  learn: 0.3621944  total: 345ms    remaining: 992ms
```

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258:  learn: 0.3618020 total: 346ms    remaining: 990ms
259:  learn: 0.3613651 total: 348ms    remaining: 990ms
260:  learn: 0.3613029 total: 349ms    remaining: 987ms
261:  learn: 0.3609917 total: 350ms    remaining: 986ms
262:  learn: 0.3607027 total: 351ms    remaining: 985ms
263:  learn: 0.3604423 total: 353ms    remaining: 984ms
264:  learn: 0.3601980 total: 354ms    remaining: 982ms
265:  learn: 0.3597529 total: 355ms    remaining: 981ms
266:  learn: 0.3594916 total: 357ms    remaining: 979ms
267:  learn: 0.3592331 total: 358ms    remaining: 978ms
268:  learn: 0.3590047 total: 359ms    remaining: 976ms
269:  learn: 0.3585202 total: 361ms    remaining: 975ms
270:  learn: 0.3584895 total: 361ms    remaining: 972ms
271:  learn: 0.3583410 total: 363ms    remaining: 971ms
272:  learn: 0.3582640 total: 364ms    remaining: 968ms
273:  learn: 0.3579264 total: 365ms    remaining: 967ms
274:  learn: 0.3576659 total: 366ms    remaining: 966ms
275:  learn: 0.3573040 total: 368ms    remaining: 965ms
276:  learn: 0.3570501 total: 369ms    remaining: 964ms
277:  learn: 0.3567223 total: 370ms    remaining: 962ms
278:  learn: 0.3564497 total: 372ms    remaining: 961ms
279:  learn: 0.3561521 total: 373ms    remaining: 959ms
280:  learn: 0.3559575 total: 374ms    remaining: 958ms
281:  learn: 0.3556795 total: 376ms    remaining: 956ms
282:  learn: 0.3554220 total: 377ms    remaining: 955ms
283:  learn: 0.3550084 total: 378ms    remaining: 953ms
284:  learn: 0.3546703 total: 379ms    remaining: 951ms
285:  learn: 0.3544498 total: 380ms    remaining: 949ms
286:  learn: 0.3542218 total: 381ms    remaining: 947ms
287:  learn: 0.3539577 total: 383ms    remaining: 946ms
288:  learn: 0.3536710 total: 384ms    remaining: 945ms
289:  learn: 0.3535581 total: 385ms    remaining: 943ms
290:  learn: 0.3533620 total: 386ms    remaining: 942ms
291:  learn: 0.3530231 total: 388ms    remaining: 940ms
292:  learn: 0.3527044 total: 389ms    remaining: 939ms
293:  learn: 0.3523814 total: 390ms    remaining: 937ms
294:  learn: 0.3521791 total: 392ms    remaining: 936ms
295:  learn: 0.3520127 total: 393ms    remaining: 934ms
296:  learn: 0.3518519 total: 394ms    remaining: 933ms
297:  learn: 0.3514354 total: 395ms    remaining: 931ms
298:  learn: 0.3513134 total: 397ms    remaining: 930ms
299:  learn: 0.3511024 total: 398ms    remaining: 929ms
300:  learn: 0.3508094 total: 399ms    remaining: 927ms
301:  learn: 0.3506672 total: 400ms    remaining: 926ms
302:  learn: 0.3505458 total: 402ms    remaining: 924ms
303:  learn: 0.3502571 total: 403ms    remaining: 922ms
304:  learn: 0.3499437 total: 404ms    remaining: 921ms
305:  learn: 0.3498609 total: 405ms    remaining: 919ms
306:  learn: 0.3496578 total: 406ms    remaining: 917ms
307:  learn: 0.3494694 total: 408ms    remaining: 916ms
```

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308:  learn: 0.3491366 total: 409ms    remaining: 914ms
309:  learn: 0.3489069 total: 410ms    remaining: 912ms
310:  learn: 0.3487562 total: 411ms    remaining: 910ms
311:  learn: 0.3485389 total: 412ms    remaining: 908ms
312:  learn: 0.3482745 total: 413ms    remaining: 906ms
313:  learn: 0.3480658 total: 414ms    remaining: 904ms
314:  learn: 0.3476300 total: 415ms    remaining: 902ms
315:  learn: 0.3473751 total: 416ms    remaining: 901ms
316:  learn: 0.3472260 total: 417ms    remaining: 899ms
317:  learn: 0.3470459 total: 418ms    remaining: 897ms
318:  learn: 0.3466224 total: 419ms    remaining: 895ms
319:  learn: 0.3464060 total: 420ms    remaining: 893ms
320:  learn: 0.3461431 total: 421ms    remaining: 891ms
321:  learn: 0.3459477 total: 422ms    remaining: 889ms
322:  learn: 0.3455832 total: 424ms    remaining: 888ms
323:  learn: 0.3454434 total: 424ms    remaining: 885ms
324:  learn: 0.3453738 total: 425ms    remaining: 883ms
325:  learn: 0.3451958 total: 426ms    remaining: 881ms
326:  learn: 0.3449878 total: 428ms    remaining: 880ms
327:  learn: 0.3447958 total: 429ms    remaining: 878ms
328:  learn: 0.3445806 total: 430ms    remaining: 877ms
329:  learn: 0.3443215 total: 431ms    remaining: 875ms
330:  learn: 0.3440819 total: 432ms    remaining: 874ms
331:  learn: 0.3439704 total: 434ms    remaining: 872ms
332:  learn: 0.3437333 total: 435ms    remaining: 871ms
333:  learn: 0.3435632 total: 436ms    remaining: 869ms
334:  learn: 0.3434190 total: 437ms    remaining: 868ms
335:  learn: 0.3431951 total: 438ms    remaining: 866ms
336:  learn: 0.3430201 total: 440ms    remaining: 865ms
337:  learn: 0.3424404 total: 441ms    remaining: 863ms
338:  learn: 0.3423213 total: 442ms    remaining: 862ms
339:  learn: 0.3421082 total: 443ms    remaining: 860ms
340:  learn: 0.3417115 total: 444ms    remaining: 858ms
341:  learn: 0.3415353 total: 445ms    remaining: 857ms
342:  learn: 0.3413704 total: 446ms    remaining: 855ms
343:  learn: 0.3411171 total: 447ms    remaining: 853ms
344:  learn: 0.3409340 total: 449ms    remaining: 852ms
345:  learn: 0.3407991 total: 450ms    remaining: 850ms
346:  learn: 0.3405682 total: 451ms    remaining: 848ms
347:  learn: 0.3404391 total: 452ms    remaining: 847ms
348:  learn: 0.3402516 total: 453ms    remaining: 845ms
349:  learn: 0.3400337 total: 454ms    remaining: 844ms
350:  learn: 0.3398857 total: 455ms    remaining: 842ms
351:  learn: 0.3398084 total: 457ms    remaining: 841ms
352:  learn: 0.3397063 total: 458ms    remaining: 839ms
353:  learn: 0.3395095 total: 459ms    remaining: 837ms
354:  learn: 0.3394504 total: 460ms    remaining: 836ms
355:  learn: 0.3393101 total: 461ms    remaining: 834ms
356:  learn: 0.3392142 total: 463ms    remaining: 833ms
357:  learn: 0.3389874 total: 464ms    remaining: 832ms
```

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358:  learn: 0.3387465 total: 465ms    remaining: 830ms
359:  learn: 0.3385856 total: 466ms    remaining: 828ms
360:  learn: 0.3383858 total: 467ms    remaining: 827ms
361:  learn: 0.3382453 total: 468ms    remaining: 825ms
362:  learn: 0.3380994 total: 469ms    remaining: 823ms
363:  learn: 0.3379139 total: 470ms    remaining: 822ms
364:  learn: 0.3377954 total: 472ms    remaining: 820ms
365:  learn: 0.3376466 total: 473ms    remaining: 819ms
366:  learn: 0.3373913 total: 474ms    remaining: 817ms
367:  learn: 0.3373117 total: 475ms    remaining: 816ms
368:  learn: 0.3371782 total: 476ms    remaining: 814ms
369:  learn: 0.3370803 total: 477ms    remaining: 812ms
370:  learn: 0.3369205 total: 478ms    remaining: 811ms
371:  learn: 0.3367627 total: 479ms    remaining: 809ms
372:  learn: 0.3364157 total: 480ms    remaining: 808ms
373:  learn: 0.3362601 total: 482ms    remaining: 807ms
374:  learn: 0.3361093 total: 483ms    remaining: 805ms
375:  learn: 0.3357754 total: 485ms    remaining: 804ms
376:  learn: 0.3355617 total: 486ms    remaining: 803ms
377:  learn: 0.3352941 total: 487ms    remaining: 802ms
378:  learn: 0.3351488 total: 488ms    remaining: 800ms
379:  learn: 0.3350285 total: 489ms    remaining: 799ms
380:  learn: 0.3349464 total: 491ms    remaining: 797ms
381:  learn: 0.3345806 total: 492ms    remaining: 796ms
382:  learn: 0.3344544 total: 493ms    remaining: 794ms
383:  learn: 0.3342133 total: 494ms    remaining: 793ms
384:  learn: 0.3340801 total: 495ms    remaining: 791ms
385:  learn: 0.3338895 total: 497ms    remaining: 790ms
386:  learn: 0.3335692 total: 498ms    remaining: 788ms
387:  learn: 0.3334583 total: 499ms    remaining: 787ms
388:  learn: 0.3333303 total: 500ms    remaining: 785ms
389:  learn: 0.3331336 total: 501ms    remaining: 784ms
390:  learn: 0.3330599 total: 502ms    remaining: 782ms
391:  learn: 0.3328421 total: 503ms    remaining: 781ms
392:  learn: 0.3326594 total: 505ms    remaining: 779ms
393:  learn: 0.3321096 total: 506ms    remaining: 778ms
394:  learn: 0.3319975 total: 507ms    remaining: 776ms
395:  learn: 0.3319460 total: 508ms    remaining: 775ms
396:  learn: 0.3318180 total: 509ms    remaining: 773ms
397:  learn: 0.3316034 total: 510ms    remaining: 772ms
398:  learn: 0.3313877 total: 512ms    remaining: 770ms
399:  learn: 0.3312236 total: 513ms    remaining: 769ms
400:  learn: 0.3309724 total: 514ms    remaining: 768ms
401:  learn: 0.3308071 total: 515ms    remaining: 766ms
402:  learn: 0.3306357 total: 516ms    remaining: 765ms
403:  learn: 0.3303940 total: 517ms    remaining: 763ms
404:  learn: 0.3301571 total: 519ms    remaining: 762ms
405:  learn: 0.3299658 total: 520ms    remaining: 760ms
406:  learn: 0.3297664 total: 521ms    remaining: 759ms
407:  learn: 0.3294795 total: 522ms    remaining: 757ms
```

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408:  learn: 0.3292911 total: 523ms    remaining: 756ms
409:  learn: 0.3291431 total: 524ms    remaining: 754ms
410:  learn: 0.3288974 total: 525ms    remaining: 753ms
411:  learn: 0.3288080 total: 527ms    remaining: 752ms
412:  learn: 0.3286337 total: 528ms    remaining: 750ms
413:  learn: 0.3285594 total: 529ms    remaining: 749ms
414:  learn: 0.3283826 total: 530ms    remaining: 748ms
415:  learn: 0.3283100 total: 532ms    remaining: 746ms
416:  learn: 0.3282894 total: 532ms    remaining: 744ms
417:  learn: 0.3280826 total: 533ms    remaining: 743ms
418:  learn: 0.3277869 total: 535ms    remaining: 741ms
419:  learn: 0.3277444 total: 535ms    remaining: 739ms
420:  learn: 0.3275523 total: 536ms    remaining: 738ms
421:  learn: 0.3274364 total: 538ms    remaining: 736ms
422:  learn: 0.3270693 total: 539ms    remaining: 735ms
423:  learn: 0.3269683 total: 540ms    remaining: 734ms
424:  learn: 0.3266426 total: 542ms    remaining: 733ms
425:  learn: 0.3263957 total: 543ms    remaining: 732ms
426:  learn: 0.3261205 total: 544ms    remaining: 730ms
427:  learn: 0.3259851 total: 545ms    remaining: 729ms
428:  learn: 0.3258623 total: 546ms    remaining: 727ms
429:  learn: 0.3257519 total: 548ms    remaining: 726ms
430:  learn: 0.3256922 total: 549ms    remaining: 724ms
431:  learn: 0.3255776 total: 550ms    remaining: 723ms
432:  learn: 0.3252185 total: 551ms    remaining: 722ms
433:  learn: 0.3249955 total: 553ms    remaining: 721ms
434:  learn: 0.3248400 total: 554ms    remaining: 719ms
435:  learn: 0.3247005 total: 555ms    remaining: 718ms
436:  learn: 0.3246476 total: 556ms    remaining: 717ms
437:  learn: 0.3245610 total: 557ms    remaining: 715ms
438:  learn: 0.3244578 total: 559ms    remaining: 714ms
439:  learn: 0.3242470 total: 560ms    remaining: 713ms
440:  learn: 0.3238941 total: 561ms    remaining: 711ms
441:  learn: 0.3237691 total: 562ms    remaining: 710ms
442:  learn: 0.3236131 total: 564ms    remaining: 709ms
443:  learn: 0.3233938 total: 565ms    remaining: 707ms
444:  learn: 0.3232571 total: 566ms    remaining: 706ms
445:  learn: 0.3232050 total: 567ms    remaining: 704ms
446:  learn: 0.3230482 total: 568ms    remaining: 703ms
447:  learn: 0.3227290 total: 570ms    remaining: 702ms
448:  learn: 0.3226829 total: 571ms    remaining: 700ms
449:  learn: 0.3226036 total: 572ms    remaining: 699ms
450:  learn: 0.3223890 total: 573ms    remaining: 698ms
451:  learn: 0.3222225 total: 574ms    remaining: 696ms
452:  learn: 0.3220120 total: 575ms    remaining: 695ms
453:  learn: 0.3218883 total: 577ms    remaining: 694ms
454:  learn: 0.3217250 total: 578ms    remaining: 692ms
455:  learn: 0.3215063 total: 579ms    remaining: 691ms
456:  learn: 0.3214133 total: 580ms    remaining: 689ms
457:  learn: 0.3213429 total: 581ms    remaining: 688ms
```

```
458:  learn: 0.3212170 total: 582ms    remaining: 686ms
459:  learn: 0.3210729 total: 584ms    remaining: 685ms
460:  learn: 0.3208730 total: 585ms    remaining: 684ms
461:  learn: 0.3207365 total: 586ms    remaining: 682ms
462:  learn: 0.3206445 total: 587ms    remaining: 681ms
463:  learn: 0.3203203 total: 588ms    remaining: 680ms
464:  learn: 0.3202628 total: 590ms    remaining: 678ms
465:  learn: 0.3201342 total: 591ms    remaining: 677ms
466:  learn: 0.3200351 total: 592ms    remaining: 676ms
467:  learn: 0.3198889 total: 593ms    remaining: 674ms
468:  learn: 0.3198002 total: 594ms    remaining: 673ms
469:  learn: 0.3197450 total: 596ms    remaining: 672ms
470:  learn: 0.3195282 total: 597ms    remaining: 670ms
471:  learn: 0.3193913 total: 598ms    remaining: 669ms
472:  learn: 0.3190423 total: 599ms    remaining: 667ms
473:  learn: 0.3188634 total: 600ms    remaining: 666ms
474:  learn: 0.3187394 total: 601ms    remaining: 664ms
475:  learn: 0.3185333 total: 602ms    remaining: 663ms
476:  learn: 0.3183336 total: 603ms    remaining: 662ms
477:  learn: 0.3182168 total: 605ms    remaining: 660ms
478:  learn: 0.3181457 total: 606ms    remaining: 659ms
479:  learn: 0.3179881 total: 607ms    remaining: 658ms
480:  learn: 0.3179384 total: 608ms    remaining: 656ms
481:  learn: 0.3178192 total: 610ms    remaining: 655ms
482:  learn: 0.3177251 total: 611ms    remaining: 654ms
483:  learn: 0.3175635 total: 612ms    remaining: 652ms
484:  learn: 0.3175448 total: 613ms    remaining: 651ms
485:  learn: 0.3174432 total: 614ms    remaining: 649ms
486:  learn: 0.3171945 total: 615ms    remaining: 648ms
487:  learn: 0.3170560 total: 616ms    remaining: 646ms
488:  learn: 0.3169792 total: 617ms    remaining: 645ms
489:  learn: 0.3168589 total: 619ms    remaining: 644ms
490:  learn: 0.3167824 total: 620ms    remaining: 642ms
491:  learn: 0.3166617 total: 621ms    remaining: 641ms
492:  learn: 0.3164893 total: 622ms    remaining: 640ms
493:  learn: 0.3164470 total: 623ms    remaining: 638ms
494:  learn: 0.3162993 total: 624ms    remaining: 637ms
495:  learn: 0.3161748 total: 626ms    remaining: 636ms
496:  learn: 0.3159602 total: 627ms    remaining: 634ms
497:  learn: 0.3158299 total: 628ms    remaining: 633ms
498:  learn: 0.3156253 total: 629ms    remaining: 632ms
499:  learn: 0.3154902 total: 631ms    remaining: 631ms
500:  learn: 0.3152830 total: 632ms    remaining: 629ms
501:  learn: 0.3152133 total: 633ms    remaining: 628ms
502:  learn: 0.3150709 total: 634ms    remaining: 626ms
503:  learn: 0.3148985 total: 635ms    remaining: 625ms
504:  learn: 0.3148411 total: 636ms    remaining: 623ms
505:  learn: 0.3147743 total: 637ms    remaining: 622ms
506:  learn: 0.3146440 total: 638ms    remaining: 621ms
507:  learn: 0.3144483 total: 639ms    remaining: 619ms
```

```
508:  learn: 0.3143099 total: 640ms    remaining: 618ms
509:  learn: 0.3141583 total: 642ms    remaining: 616ms
510:  learn: 0.3139890 total: 643ms    remaining: 615ms
511:  learn: 0.3138991 total: 644ms    remaining: 614ms
512:  learn: 0.3138285 total: 645ms    remaining: 612ms
513:  learn: 0.3136375 total: 646ms    remaining: 611ms
514:  learn: 0.3134986 total: 648ms    remaining: 610ms
515:  learn: 0.3133246 total: 649ms    remaining: 609ms
516:  learn: 0.3131003 total: 650ms    remaining: 608ms
517:  learn: 0.3129414 total: 651ms    remaining: 606ms
518:  learn: 0.3128366 total: 653ms    remaining: 605ms
519:  learn: 0.3127386 total: 654ms    remaining: 604ms
520:  learn: 0.3126725 total: 655ms    remaining: 602ms
521:  learn: 0.3125827 total: 656ms    remaining: 601ms
522:  learn: 0.3124347 total: 658ms    remaining: 600ms
523:  learn: 0.3123538 total: 659ms    remaining: 599ms
524:  learn: 0.3122283 total: 660ms    remaining: 598ms
525:  learn: 0.3120139 total: 662ms    remaining: 596ms
526:  learn: 0.3118944 total: 663ms    remaining: 595ms
527:  learn: 0.3117635 total: 664ms    remaining: 594ms
528:  learn: 0.3116930 total: 665ms    remaining: 592ms
529:  learn: 0.3116255 total: 666ms    remaining: 591ms
530:  learn: 0.3113908 total: 668ms    remaining: 590ms
531:  learn: 0.3113047 total: 669ms    remaining: 588ms
532:  learn: 0.3111867 total: 670ms    remaining: 587ms
533:  learn: 0.3110786 total: 671ms    remaining: 586ms
534:  learn: 0.3107507 total: 672ms    remaining: 584ms
535:  learn: 0.3105413 total: 674ms    remaining: 583ms
536:  learn: 0.3103884 total: 675ms    remaining: 582ms
537:  learn: 0.3100859 total: 676ms    remaining: 580ms
538:  learn: 0.3099393 total: 677ms    remaining: 579ms
539:  learn: 0.3097421 total: 678ms    remaining: 578ms
540:  learn: 0.3095225 total: 679ms    remaining: 576ms
541:  learn: 0.3093987 total: 681ms    remaining: 575ms
542:  learn: 0.3092455 total: 682ms    remaining: 574ms
543:  learn: 0.3090817 total: 683ms    remaining: 573ms
544:  learn: 0.3088957 total: 684ms    remaining: 571ms
545:  learn: 0.3087945 total: 685ms    remaining: 570ms
546:  learn: 0.3086295 total: 686ms    remaining: 568ms
547:  learn: 0.3085280 total: 687ms    remaining: 567ms
548:  learn: 0.3083743 total: 688ms    remaining: 566ms
549:  learn: 0.3082915 total: 690ms    remaining: 564ms
550:  learn: 0.3081592 total: 691ms    remaining: 563ms
551:  learn: 0.3078083 total: 692ms    remaining: 562ms
552:  learn: 0.3076618 total: 693ms    remaining: 560ms
553:  learn: 0.3073871 total: 694ms    remaining: 559ms
554:  learn: 0.3072279 total: 695ms    remaining: 557ms
555:  learn: 0.3071605 total: 697ms    remaining: 556ms
556:  learn: 0.3070497 total: 698ms    remaining: 555ms
557:  learn: 0.3069238 total: 699ms    remaining: 554ms
```

```
558:  learn: 0.3068547 total: 700ms    remaining: 552ms
559:  learn: 0.3065087 total: 701ms    remaining: 551ms
560:  learn: 0.3064324 total: 702ms    remaining: 550ms
561:  learn: 0.3061194 total: 704ms    remaining: 548ms
562:  learn: 0.3058439 total: 705ms    remaining: 547ms
563:  learn: 0.3056819 total: 706ms    remaining: 546ms
564:  learn: 0.3055472 total: 707ms    remaining: 544ms
565:  learn: 0.3054278 total: 708ms    remaining: 543ms
566:  learn: 0.3053949 total: 709ms    remaining: 541ms
567:  learn: 0.3052315 total: 710ms    remaining: 540ms
568:  learn: 0.3051412 total: 711ms    remaining: 539ms
569:  learn: 0.3050873 total: 713ms    remaining: 538ms
570:  learn: 0.3049417 total: 714ms    remaining: 536ms
571:  learn: 0.3047298 total: 715ms    remaining: 535ms
572:  learn: 0.3045841 total: 716ms    remaining: 534ms
573:  learn: 0.3044043 total: 718ms    remaining: 533ms
574:  learn: 0.3042653 total: 719ms    remaining: 531ms
575:  learn: 0.3041355 total: 720ms    remaining: 530ms
576:  learn: 0.3040772 total: 721ms    remaining: 529ms
577:  learn: 0.3039535 total: 722ms    remaining: 527ms
578:  learn: 0.3038509 total: 723ms    remaining: 526ms
579:  learn: 0.3036299 total: 724ms    remaining: 525ms
580:  learn: 0.3035086 total: 726ms    remaining: 523ms
581:  learn: 0.3034401 total: 727ms    remaining: 522ms
582:  learn: 0.3033837 total: 728ms    remaining: 521ms
583:  learn: 0.3033108 total: 729ms    remaining: 519ms
584:  learn: 0.3032185 total: 730ms    remaining: 518ms
585:  learn: 0.3030992 total: 732ms    remaining: 517ms
586:  learn: 0.3030359 total: 733ms    remaining: 516ms
587:  learn: 0.3028897 total: 734ms    remaining: 514ms
588:  learn: 0.3027559 total: 735ms    remaining: 513ms
589:  learn: 0.3026810 total: 737ms    remaining: 512ms
590:  learn: 0.3025290 total: 738ms    remaining: 511ms
591:  learn: 0.3022956 total: 739ms    remaining: 509ms
592:  learn: 0.3020918 total: 740ms    remaining: 508ms
593:  learn: 0.3019113 total: 742ms    remaining: 507ms
594:  learn: 0.3017793 total: 743ms    remaining: 506ms
595:  learn: 0.3016911 total: 745ms    remaining: 505ms
596:  learn: 0.3016208 total: 746ms    remaining: 503ms
597:  learn: 0.3014232 total: 747ms    remaining: 502ms
598:  learn: 0.3012238 total: 748ms    remaining: 501ms
599:  learn: 0.3010808 total: 749ms    remaining: 500ms
600:  learn: 0.3009601 total: 751ms    remaining: 498ms
601:  learn: 0.3008784 total: 752ms    remaining: 497ms
602:  learn: 0.3007067 total: 753ms    remaining: 496ms
603:  learn: 0.3005875 total: 754ms    remaining: 494ms
604:  learn: 0.3005391 total: 756ms    remaining: 493ms
605:  learn: 0.3004909 total: 757ms    remaining: 492ms
606:  learn: 0.3003184 total: 758ms    remaining: 491ms
607:  learn: 0.3002551 total: 759ms    remaining: 490ms
```

```
608:  learn: 0.3001127 total: 761ms    remaining: 488ms
609:  learn: 0.3000497 total: 762ms    remaining: 487ms
610:  learn: 0.2999603 total: 763ms    remaining: 486ms
611:  learn: 0.2997439 total: 764ms    remaining: 485ms
612:  learn: 0.2994950 total: 766ms    remaining: 483ms
613:  learn: 0.2994156 total: 767ms    remaining: 482ms
614:  learn: 0.2993616 total: 768ms    remaining: 481ms
615:  learn: 0.2993086 total: 769ms    remaining: 480ms
616:  learn: 0.2991587 total: 770ms    remaining: 478ms
617:  learn: 0.2990114 total: 772ms    remaining: 477ms
618:  learn: 0.2988590 total: 773ms    remaining: 476ms
619:  learn: 0.2988147 total: 774ms    remaining: 474ms
620:  learn: 0.2987496 total: 776ms    remaining: 473ms
621:  learn: 0.2985155 total: 777ms    remaining: 472ms
622:  learn: 0.2983876 total: 778ms    remaining: 471ms
623:  learn: 0.2982134 total: 779ms    remaining: 470ms
624:  learn: 0.2981043 total: 780ms    remaining: 468ms
625:  learn: 0.2979067 total: 782ms    remaining: 467ms
626:  learn: 0.2976977 total: 783ms    remaining: 466ms
627:  learn: 0.2975735 total: 784ms    remaining: 464ms
628:  learn: 0.2972906 total: 785ms    remaining: 463ms
629:  learn: 0.2971895 total: 786ms    remaining: 462ms
630:  learn: 0.2971536 total: 787ms    remaining: 460ms
631:  learn: 0.2970549 total: 788ms    remaining: 459ms
632:  learn: 0.2969357 total: 790ms    remaining: 458ms
633:  learn: 0.2967004 total: 791ms    remaining: 457ms
634:  learn: 0.2965052 total: 792ms    remaining: 455ms
635:  learn: 0.2964399 total: 793ms    remaining: 454ms
636:  learn: 0.2962924 total: 795ms    remaining: 453ms
637:  learn: 0.2961700 total: 796ms    remaining: 452ms
638:  learn: 0.2960367 total: 797ms    remaining: 450ms
639:  learn: 0.2958258 total: 798ms    remaining: 449ms
640:  learn: 0.2956834 total: 799ms    remaining: 448ms
641:  learn: 0.2955441 total: 801ms    remaining: 446ms
642:  learn: 0.2953390 total: 802ms    remaining: 445ms
643:  learn: 0.2952228 total: 803ms    remaining: 444ms
644:  learn: 0.2951187 total: 804ms    remaining: 443ms
645:  learn: 0.2951123 total: 805ms    remaining: 441ms
646:  learn: 0.2949967 total: 806ms    remaining: 440ms
647:  learn: 0.2948746 total: 808ms    remaining: 439ms
648:  learn: 0.2946809 total: 809ms    remaining: 437ms
649:  learn: 0.2946197 total: 810ms    remaining: 436ms
650:  learn: 0.2945313 total: 811ms    remaining: 435ms
651:  learn: 0.2943072 total: 812ms    remaining: 434ms
652:  learn: 0.2941429 total: 814ms    remaining: 432ms
653:  learn: 0.2940243 total: 815ms    remaining: 431ms
654:  learn: 0.2937791 total: 816ms    remaining: 430ms
655:  learn: 0.2937214 total: 817ms    remaining: 429ms
656:  learn: 0.2934581 total: 818ms    remaining: 427ms
657:  learn: 0.2933341 total: 820ms    remaining: 426ms
```

```
658:  learn: 0.2932649 total: 821ms    remaining: 425ms
659:  learn: 0.2931890 total: 822ms    remaining: 424ms
660:  learn: 0.2930906 total: 823ms    remaining: 422ms
661:  learn: 0.2930255 total: 825ms    remaining: 421ms
662:  learn: 0.2927790 total: 826ms    remaining: 420ms
663:  learn: 0.2925049 total: 827ms    remaining: 419ms
664:  learn: 0.2924663 total: 828ms    remaining: 417ms
665:  learn: 0.2924591 total: 829ms    remaining: 416ms
666:  learn: 0.2924069 total: 830ms    remaining: 415ms
667:  learn: 0.2923343 total: 831ms    remaining: 413ms
668:  learn: 0.2921755 total: 833ms    remaining: 412ms
669:  learn: 0.2921204 total: 834ms    remaining: 411ms
670:  learn: 0.2921080 total: 835ms    remaining: 409ms
671:  learn: 0.2919634 total: 836ms    remaining: 408ms
672:  learn: 0.2917062 total: 837ms    remaining: 407ms
673:  learn: 0.2915786 total: 838ms    remaining: 406ms
674:  learn: 0.2913586 total: 840ms    remaining: 404ms
675:  learn: 0.2911533 total: 841ms    remaining: 403ms
676:  learn: 0.2910705 total: 842ms    remaining: 402ms
677:  learn: 0.2909346 total: 843ms    remaining: 400ms
678:  learn: 0.2907216 total: 844ms    remaining: 399ms
679:  learn: 0.2903871 total: 846ms    remaining: 398ms
680:  learn: 0.2902416 total: 847ms    remaining: 397ms
681:  learn: 0.2901095 total: 848ms    remaining: 395ms
682:  learn: 0.2900668 total: 849ms    remaining: 394ms
683:  learn: 0.2899794 total: 850ms    remaining: 393ms
684:  learn: 0.2898825 total: 852ms    remaining: 392ms
685:  learn: 0.2897903 total: 853ms    remaining: 390ms
686:  learn: 0.2896940 total: 854ms    remaining: 389ms
687:  learn: 0.2896201 total: 855ms    remaining: 388ms
688:  learn: 0.2894728 total: 857ms    remaining: 387ms
689:  learn: 0.2893479 total: 858ms    remaining: 385ms
690:  learn: 0.2893079 total: 859ms    remaining: 384ms
691:  learn: 0.2891154 total: 860ms    remaining: 383ms
692:  learn: 0.2890364 total: 862ms    remaining: 382ms
693:  learn: 0.2888350 total: 863ms    remaining: 380ms
694:  learn: 0.2886879 total: 864ms    remaining: 379ms
695:  learn: 0.2886221 total: 865ms    remaining: 378ms
696:  learn: 0.2884440 total: 866ms    remaining: 377ms
697:  learn: 0.2882611 total: 868ms    remaining: 375ms
698:  learn: 0.2881064 total: 869ms    remaining: 374ms
699:  learn: 0.2880351 total: 870ms    remaining: 373ms
700:  learn: 0.2879358 total: 871ms    remaining: 372ms
701:  learn: 0.2879006 total: 873ms    remaining: 370ms
702:  learn: 0.2875541 total: 874ms    remaining: 369ms
703:  learn: 0.2874282 total: 875ms    remaining: 368ms
704:  learn: 0.2873612 total: 876ms    remaining: 367ms
705:  learn: 0.2873041 total: 877ms    remaining: 365ms
706:  learn: 0.2872114 total: 878ms    remaining: 364ms
707:  learn: 0.2871548 total: 880ms    remaining: 363ms
```

```
708:  learn: 0.2869580 total: 881ms    remaining: 362ms
709:  learn: 0.2868795 total: 882ms    remaining: 360ms
710:  learn: 0.2867359 total: 883ms    remaining: 359ms
711:  learn: 0.2866749 total: 885ms    remaining: 358ms
712:  learn: 0.2865603 total: 886ms    remaining: 357ms
713:  learn: 0.2865533 total: 887ms    remaining: 355ms
714:  learn: 0.2863543 total: 888ms    remaining: 354ms
715:  learn: 0.2862406 total: 889ms    remaining: 353ms
716:  learn: 0.2861044 total: 890ms    remaining: 351ms
717:  learn: 0.2859354 total: 891ms    remaining: 350ms
718:  learn: 0.2858698 total: 893ms    remaining: 349ms
719:  learn: 0.2857739 total: 894ms    remaining: 348ms
720:  learn: 0.2855619 total: 895ms    remaining: 346ms
721:  learn: 0.2855149 total: 896ms    remaining: 345ms
722:  learn: 0.2854305 total: 897ms    remaining: 344ms
723:  learn: 0.2853251 total: 898ms    remaining: 342ms
724:  learn: 0.2852329 total: 899ms    remaining: 341ms
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726:  learn: 0.2848847 total: 902ms    remaining: 339ms
727:  learn: 0.2848334 total: 903ms    remaining: 337ms
728:  learn: 0.2847217 total: 904ms    remaining: 336ms
729:  learn: 0.2846403 total: 906ms    remaining: 335ms
730:  learn: 0.2845227 total: 907ms    remaining: 334ms
731:  learn: 0.2844041 total: 908ms    remaining: 333ms
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733:  learn: 0.2842661 total: 911ms    remaining: 330ms
734:  learn: 0.2840790 total: 912ms    remaining: 329ms
735:  learn: 0.2839715 total: 914ms    remaining: 328ms
736:  learn: 0.2838564 total: 915ms    remaining: 326ms
737:  learn: 0.2836387 total: 916ms    remaining: 325ms
738:  learn: 0.2834485 total: 918ms    remaining: 324ms
739:  learn: 0.2832770 total: 919ms    remaining: 323ms
740:  learn: 0.2831471 total: 920ms    remaining: 322ms
741:  learn: 0.2830581 total: 922ms    remaining: 321ms
742:  learn: 0.2829893 total: 926ms    remaining: 320ms
743:  learn: 0.2829462 total: 927ms    remaining: 319ms
744:  learn: 0.2828959 total: 928ms    remaining: 318ms
745:  learn: 0.2828175 total: 930ms    remaining: 317ms
746:  learn: 0.2827353 total: 931ms    remaining: 315ms
747:  learn: 0.2826596 total: 932ms    remaining: 314ms
748:  learn: 0.2824571 total: 934ms    remaining: 313ms
749:  learn: 0.2822426 total: 935ms    remaining: 312ms
750:  learn: 0.2819998 total: 937ms    remaining: 311ms
751:  learn: 0.2818924 total: 938ms    remaining: 309ms
752:  learn: 0.2817835 total: 939ms    remaining: 308ms
753:  learn: 0.2817091 total: 940ms    remaining: 307ms
754:  learn: 0.2816008 total: 941ms    remaining: 305ms
755:  learn: 0.2815398 total: 942ms    remaining: 304ms
756:  learn: 0.2813368 total: 943ms    remaining: 303ms
757:  learn: 0.2813054 total: 945ms    remaining: 302ms
```

```
758:  learn: 0.2811147 total: 946ms    remaining: 300ms
759:  learn: 0.2810125 total: 947ms    remaining: 299ms
760:  learn: 0.2807730 total: 948ms    remaining: 298ms
761:  learn: 0.2806183 total: 949ms    remaining: 296ms
762:  learn: 0.2805500 total: 950ms    remaining: 295ms
763:  learn: 0.2804019 total: 951ms    remaining: 294ms
764:  learn: 0.2803600 total: 953ms    remaining: 293ms
765:  learn: 0.2802171 total: 954ms    remaining: 291ms
766:  learn: 0.2801026 total: 955ms    remaining: 290ms
767:  learn: 0.2799640 total: 956ms    remaining: 289ms
768:  learn: 0.2797337 total: 957ms    remaining: 287ms
769:  learn: 0.2795687 total: 958ms    remaining: 286ms
770:  learn: 0.2793717 total: 959ms    remaining: 285ms
771:  learn: 0.2791305 total: 960ms    remaining: 284ms
772:  learn: 0.2790669 total: 961ms    remaining: 282ms
773:  learn: 0.2789361 total: 962ms    remaining: 281ms
774:  learn: 0.2788200 total: 963ms    remaining: 280ms
775:  learn: 0.2787140 total: 964ms    remaining: 278ms
776:  learn: 0.2786085 total: 966ms    remaining: 277ms
777:  learn: 0.2785076 total: 967ms    remaining: 276ms
778:  learn: 0.2784212 total: 968ms    remaining: 275ms
779:  learn: 0.2781982 total: 969ms    remaining: 273ms
780:  learn: 0.2779387 total: 970ms    remaining: 272ms
781:  learn: 0.2778627 total: 972ms    remaining: 271ms
782:  learn: 0.2775292 total: 973ms    remaining: 270ms
783:  learn: 0.2773341 total: 974ms    remaining: 268ms
784:  learn: 0.2772910 total: 975ms    remaining: 267ms
785:  learn: 0.2772225 total: 977ms    remaining: 266ms
786:  learn: 0.2771997 total: 978ms    remaining: 265ms
787:  learn: 0.2770498 total: 979ms    remaining: 263ms
788:  learn: 0.2770021 total: 980ms    remaining: 262ms
789:  learn: 0.2768778 total: 981ms    remaining: 261ms
790:  learn: 0.2766980 total: 982ms    remaining: 260ms
791:  learn: 0.2765805 total: 983ms    remaining: 258ms
792:  learn: 0.2764227 total: 984ms    remaining: 257ms
793:  learn: 0.2762402 total: 986ms    remaining: 256ms
794:  learn: 0.2761577 total: 987ms    remaining: 254ms
795:  learn: 0.2761343 total: 988ms    remaining: 253ms
796:  learn: 0.2760725 total: 989ms    remaining: 252ms
797:  learn: 0.2759986 total: 990ms    remaining: 251ms
798:  learn: 0.2759539 total: 991ms    remaining: 249ms
799:  learn: 0.2758543 total: 992ms    remaining: 248ms
800:  learn: 0.2756390 total: 993ms    remaining: 247ms
801:  learn: 0.2755203 total: 994ms    remaining: 245ms
802:  learn: 0.2753195 total: 995ms    remaining: 244ms
803:  learn: 0.2752500 total: 997ms    remaining: 243ms
804:  learn: 0.2750348 total: 998ms    remaining: 242ms
805:  learn: 0.2748967 total: 999ms    remaining: 240ms
806:  learn: 0.2747339 total: 1s  remaining: 239ms
807:  learn: 0.2745800 total: 1s  remaining: 238ms
```

```
808:  learn: 0.2743992 total: 1s  remaining: 237ms
809:  learn: 0.2742530 total: 1s  remaining: 235ms
810:  learn: 0.2738793 total: 1s  remaining: 234ms
811:  learn: 0.2738637 total: 1s  remaining: 233ms
812:  learn: 0.2735662 total: 1.01s    remaining: 232ms
813:  learn: 0.2732897 total: 1.01s    remaining: 230ms
814:  learn: 0.2732112 total: 1.01s    remaining: 229ms
815:  learn: 0.2731731 total: 1.01s    remaining: 228ms
816:  learn: 0.2730058 total: 1.01s    remaining: 227ms
817:  learn: 0.2729857 total: 1.01s    remaining: 225ms
818:  learn: 0.2726881 total: 1.01s    remaining: 224ms
819:  learn: 0.2725572 total: 1.01s    remaining: 223ms
820:  learn: 0.2724899 total: 1.02s    remaining: 222ms
821:  learn: 0.2724753 total: 1.02s    remaining: 220ms
822:  learn: 0.2724538 total: 1.02s    remaining: 219ms
823:  learn: 0.2722989 total: 1.02s    remaining: 218ms
824:  learn: 0.2721260 total: 1.02s    remaining: 217ms
825:  learn: 0.2720698 total: 1.02s    remaining: 215ms
826:  learn: 0.2720167 total: 1.02s    remaining: 214ms
827:  learn: 0.2719527 total: 1.02s    remaining: 213ms
828:  learn: 0.2718132 total: 1.03s    remaining: 212ms
829:  learn: 0.2717227 total: 1.03s    remaining: 210ms
830:  learn: 0.2715446 total: 1.03s    remaining: 209ms
831:  learn: 0.2712558 total: 1.03s    remaining: 208ms
832:  learn: 0.2710664 total: 1.03s    remaining: 207ms
833:  learn: 0.2710050 total: 1.03s    remaining: 205ms
834:  learn: 0.2707714 total: 1.03s    remaining: 204ms
835:  learn: 0.2705595 total: 1.03s    remaining: 203ms
836:  learn: 0.2705130 total: 1.03s    remaining: 202ms
837:  learn: 0.2704491 total: 1.04s    remaining: 200ms
838:  learn: 0.2703404 total: 1.04s    remaining: 199ms
839:  learn: 0.2701341 total: 1.04s    remaining: 198ms
840:  learn: 0.2699012 total: 1.04s    remaining: 197ms
841:  learn: 0.2697901 total: 1.04s    remaining: 195ms
842:  learn: 0.2697523 total: 1.04s    remaining: 194ms
843:  learn: 0.2695152 total: 1.04s    remaining: 193ms
844:  learn: 0.2694292 total: 1.04s    remaining: 192ms
845:  learn: 0.2692494 total: 1.04s    remaining: 190ms
846:  learn: 0.2691653 total: 1.05s    remaining: 189ms
847:  learn: 0.2689055 total: 1.05s    remaining: 188ms
848:  learn: 0.2687525 total: 1.05s    remaining: 187ms
849:  learn: 0.2684902 total: 1.05s    remaining: 185ms
850:  learn: 0.2683601 total: 1.05s    remaining: 184ms
851:  learn: 0.2682907 total: 1.05s    remaining: 183ms
852:  learn: 0.2682024 total: 1.05s    remaining: 181ms
853:  learn: 0.2680706 total: 1.05s    remaining: 180ms
854:  learn: 0.2680370 total: 1.05s    remaining: 179ms
855:  learn: 0.2677745 total: 1.06s    remaining: 178ms
856:  learn: 0.2676921 total: 1.06s    remaining: 176ms
857:  learn: 0.2675330 total: 1.06s    remaining: 175ms
```

```
858:  learn: 0.2674718 total: 1.06s    remaining: 174ms
859:  learn: 0.2673975 total: 1.06s    remaining: 173ms
860:  learn: 0.2671942 total: 1.06s    remaining: 172ms
861:  learn: 0.2671170 total: 1.06s    remaining: 170ms
862:  learn: 0.2670050 total: 1.06s    remaining: 169ms
863:  learn: 0.2667091 total: 1.07s    remaining: 168ms
864:  learn: 0.2665806 total: 1.07s    remaining: 167ms
865:  learn: 0.2663707 total: 1.07s    remaining: 165ms
866:  learn: 0.2661744 total: 1.07s    remaining: 164ms
867:  learn: 0.2658307 total: 1.07s    remaining: 163ms
868:  learn: 0.2656907 total: 1.07s    remaining: 162ms
869:  learn: 0.2655668 total: 1.07s    remaining: 160ms
870:  learn: 0.2654370 total: 1.07s    remaining: 159ms
871:  learn: 0.2651729 total: 1.07s    remaining: 158ms
872:  learn: 0.2650358 total: 1.08s    remaining: 157ms
873:  learn: 0.2649904 total: 1.08s    remaining: 155ms
874:  learn: 0.2648583 total: 1.08s    remaining: 154ms
875:  learn: 0.2647956 total: 1.08s    remaining: 153ms
876:  learn: 0.2646713 total: 1.08s    remaining: 152ms
877:  learn: 0.2645564 total: 1.08s    remaining: 150ms
878:  learn: 0.2644539 total: 1.08s    remaining: 149ms
879:  learn: 0.2643767 total: 1.08s    remaining: 148ms
880:  learn: 0.2642899 total: 1.09s    remaining: 147ms
881:  learn: 0.2642379 total: 1.09s    remaining: 146ms
882:  learn: 0.2641061 total: 1.09s    remaining: 144ms
883:  learn: 0.2639867 total: 1.09s    remaining: 143ms
884:  learn: 0.2637994 total: 1.09s    remaining: 142ms
885:  learn: 0.2637070 total: 1.09s    remaining: 141ms
886:  learn: 0.2635766 total: 1.09s    remaining: 139ms
887:  learn: 0.2634078 total: 1.09s    remaining: 138ms
888:  learn: 0.2630710 total: 1.1s     remaining: 137ms
889:  learn: 0.2629329 total: 1.1s     remaining: 136ms
890:  learn: 0.2627645 total: 1.1s     remaining: 134ms
891:  learn: 0.2623560 total: 1.1s     remaining: 133ms
892:  learn: 0.2622197 total: 1.1s     remaining: 132ms
893:  learn: 0.2621702 total: 1.1s     remaining: 131ms
894:  learn: 0.2619083 total: 1.1s     remaining: 130ms
895:  learn: 0.2617486 total: 1.1s     remaining: 128ms
896:  learn: 0.2616822 total: 1.11s    remaining: 127ms
897:  learn: 0.2614630 total: 1.11s    remaining: 126ms
898:  learn: 0.2614122 total: 1.11s    remaining: 125ms
899:  learn: 0.2613363 total: 1.11s    remaining: 123ms
900:  learn: 0.2611625 total: 1.11s    remaining: 122ms
901:  learn: 0.2610566 total: 1.11s    remaining: 121ms
902:  learn: 0.2608765 total: 1.11s    remaining: 120ms
903:  learn: 0.2607020 total: 1.11s    remaining: 118ms
904:  learn: 0.2606574 total: 1.12s    remaining: 117ms
905:  learn: 0.2605492 total: 1.12s    remaining: 116ms
906:  learn: 0.2603357 total: 1.12s    remaining: 115ms
907:  learn: 0.2602494 total: 1.12s    remaining: 114ms
```

```
908:  learn: 0.2601571 total: 1.12s    remaining: 112ms
909:  learn: 0.2600430 total: 1.12s    remaining: 111ms
910:  learn: 0.2598180 total: 1.13s    remaining: 110ms
911:  learn: 0.2596993 total: 1.13s    remaining: 109ms
912:  learn: 0.2594967 total: 1.13s    remaining: 107ms
913:  learn: 0.2592450 total: 1.13s    remaining: 106ms
914:  learn: 0.2590811 total: 1.13s    remaining: 105ms
915:  learn: 0.2589220 total: 1.13s    remaining: 104ms
916:  learn: 0.2588398 total: 1.13s    remaining: 103ms
917:  learn: 0.2587244 total: 1.13s    remaining: 101ms
918:  learn: 0.2585033 total: 1.14s    remaining: 100ms
919:  learn: 0.2584129 total: 1.14s    remaining: 98.8ms
920:  learn: 0.2583053 total: 1.14s    remaining: 97.6ms
921:  learn: 0.2580748 total: 1.14s    remaining: 96.4ms
922:  learn: 0.2578209 total: 1.14s    remaining: 95.1ms
923:  learn: 0.2577125 total: 1.14s    remaining: 93.9ms
924:  learn: 0.2576082 total: 1.14s    remaining: 92.6ms
925:  learn: 0.2575392 total: 1.14s    remaining: 91.4ms
926:  learn: 0.2574001 total: 1.14s    remaining: 90.2ms
927:  learn: 0.2573420 total: 1.15s    remaining: 88.9ms
928:  learn: 0.2572156 total: 1.15s    remaining: 87.7ms
929:  learn: 0.2571459 total: 1.15s    remaining: 86.4ms
930:  learn: 0.2570807 total: 1.15s    remaining: 85.2ms
931:  learn: 0.2570117 total: 1.15s    remaining: 83.9ms
932:  learn: 0.2568931 total: 1.15s    remaining: 82.7ms
933:  learn: 0.2567877 total: 1.15s    remaining: 81.5ms
934:  learn: 0.2565823 total: 1.15s    remaining: 80.2ms
935:  learn: 0.2564549 total: 1.16s    remaining: 79ms
936:  learn: 0.2563429 total: 1.16s    remaining: 77.8ms
937:  learn: 0.2562683 total: 1.16s    remaining: 76.5ms
938:  learn: 0.2560084 total: 1.16s    remaining: 75.3ms
939:  learn: 0.2559510 total: 1.16s    remaining: 74.1ms
940:  learn: 0.2557881 total: 1.16s    remaining: 72.8ms
941:  learn: 0.2556791 total: 1.16s    remaining: 71.6ms
942:  learn: 0.2555061 total: 1.16s    remaining: 70.4ms
943:  learn: 0.2553946 total: 1.17s    remaining: 69.1ms
944:  learn: 0.2551057 total: 1.17s    remaining: 67.9ms
945:  learn: 0.2550033 total: 1.17s    remaining: 66.7ms
946:  learn: 0.2549210 total: 1.17s    remaining: 65.4ms
947:  learn: 0.2548279 total: 1.17s    remaining: 64.2ms
948:  learn: 0.2546973 total: 1.17s    remaining: 63ms
949:  learn: 0.2545613 total: 1.17s    remaining: 61.7ms
950:  learn: 0.2543664 total: 1.17s    remaining: 60.5ms
951:  learn: 0.2542400 total: 1.18s    remaining: 59.3ms
952:  learn: 0.2541024 total: 1.18s    remaining: 58ms
953:  learn: 0.2540113 total: 1.18s    remaining: 56.8ms
954:  learn: 0.2538711 total: 1.18s    remaining: 55.6ms
955:  learn: 0.2538111 total: 1.18s    remaining: 54.3ms
956:  learn: 0.2535217 total: 1.18s    remaining: 53.1ms
957:  learn: 0.2534513 total: 1.18s    remaining: 51.8ms
```

```
958:  learn: 0.2534063 total: 1.18s    remaining: 50.6ms
959:  learn: 0.2531553 total: 1.18s    remaining: 49.4ms
960:  learn: 0.2530905 total: 1.19s    remaining: 48.1ms
961:  learn: 0.2529667 total: 1.19s    remaining: 46.9ms
962:  learn: 0.2528879 total: 1.19s    remaining: 45.7ms
963:  learn: 0.2527820 total: 1.19s    remaining: 44.4ms
964:  learn: 0.2526543 total: 1.19s    remaining: 43.2ms
965:  learn: 0.2525587 total: 1.19s    remaining: 41.9ms
966:  learn: 0.2524315 total: 1.19s    remaining: 40.7ms
967:  learn: 0.2522056 total: 1.19s    remaining: 39.5ms
968:  learn: 0.2521500 total: 1.19s    remaining: 38.2ms
969:  learn: 0.2518540 total: 1.2s     remaining: 37ms
970:  learn: 0.2516816 total: 1.2s     remaining: 35.7ms
971:  learn: 0.2515683 total: 1.2s     remaining: 34.5ms
972:  learn: 0.2513571 total: 1.2s     remaining: 33.3ms
973:  learn: 0.2513160 total: 1.2s     remaining: 32ms
974:  learn: 0.2511086 total: 1.2s     remaining: 30.8ms
975:  learn: 0.2509188 total: 1.2s     remaining: 29.6ms
976:  learn: 0.2507934 total: 1.2s     remaining: 28.3ms
977:  learn: 0.2506073 total: 1.2s     remaining: 27.1ms
978:  learn: 0.2504236 total: 1.21s    remaining: 25.9ms
979:  learn: 0.2502241 total: 1.21s    remaining: 24.6ms
980:  learn: 0.2501372 total: 1.21s    remaining: 23.4ms
981:  learn: 0.2500945 total: 1.21s    remaining: 22.2ms
982:  learn: 0.2499606 total: 1.21s    remaining: 20.9ms
983:  learn: 0.2498605 total: 1.21s    remaining: 19.7ms
984:  learn: 0.2497973 total: 1.21s    remaining: 18.5ms
985:  learn: 0.2496701 total: 1.21s    remaining: 17.2ms
986:  learn: 0.2496223 total: 1.21s    remaining: 16ms
987:  learn: 0.2494697 total: 1.21s    remaining: 14.8ms
988:  learn: 0.2492557 total: 1.22s    remaining: 13.5ms
989:  learn: 0.2491489 total: 1.22s    remaining: 12.3ms
990:  learn: 0.2489995 total: 1.22s    remaining: 11.1ms
991:  learn: 0.2489068 total: 1.22s    remaining: 9.83ms
992:  learn: 0.2487814 total: 1.22s    remaining: 8.6ms
993:  learn: 0.2487155 total: 1.22s    remaining: 7.37ms
994:  learn: 0.2485461 total: 1.22s    remaining: 6.14ms
995:  learn: 0.2483557 total: 1.22s    remaining: 4.91ms
996:  learn: 0.2482135 total: 1.22s    remaining: 3.69ms
997:  learn: 0.2480934 total: 1.23s    remaining: 2.46ms
998:  learn: 0.2480278 total: 1.23s    remaining: 1.23ms
999:  learn: 0.2479338 total: 1.23s    remaining: 0us
CatBoostClassifier 0.8192090395480226
XGBClassifier 0.8361581920903954
RandomForestClassifier 0.847457627118644
AdaBoostClassifier 0.7740112994350282
GradientBoostingClassifier 0.8135593220338984
GaussianNB 0.807909604519774
LinearDiscriminantAnalysis 0.8305084745762712
```

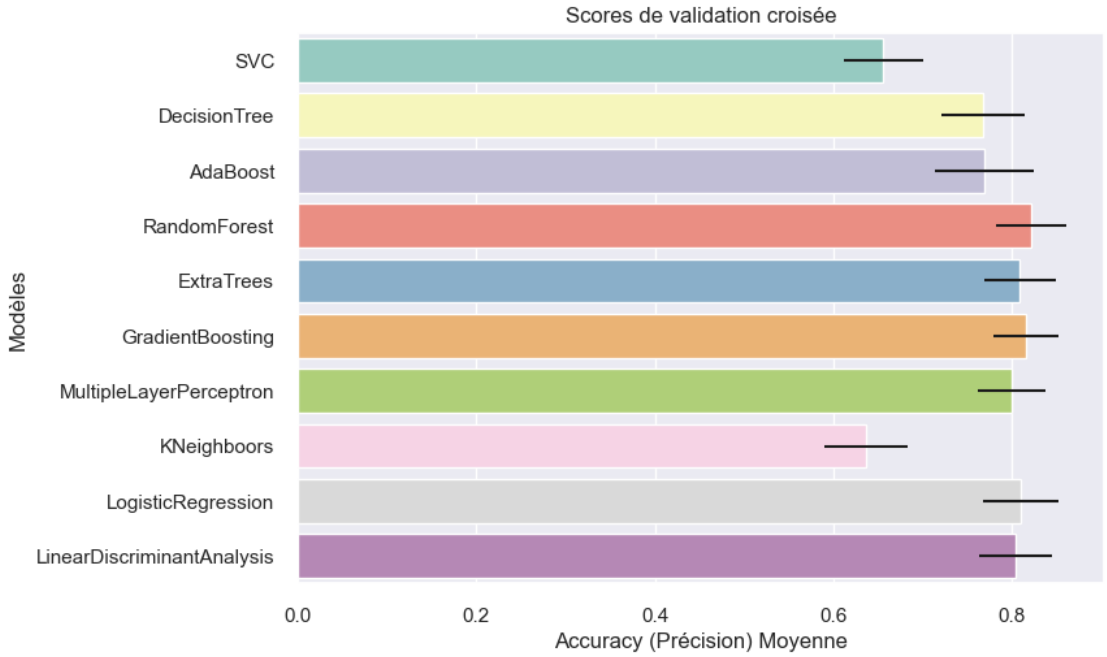
```
QuadraticDiscriminantAnalysis 0.7853107344632768
LogisticRegression 0.8192090395480226
```

Etape 5 : Evaluation

L'objectif de cette étape va être d'évaluer notre modèle et de l'optimiser un maximum c'est à dire de choisir les meilleurs valeurs pour nos hyperparamètres (les hyperparamètres sont des paramètres que l'on choisit avant d'entraîner un modèle de machine learning, et qui affectent le processus d'apprentissage et la performance du modèle). Ces paramètres sont essentiels car leur optimisation permet d'obtenir les meilleurs paramètres pour un modèle d'apprentissage automatique et donc d'obtenir des prédictions plus précises et plus fiables.

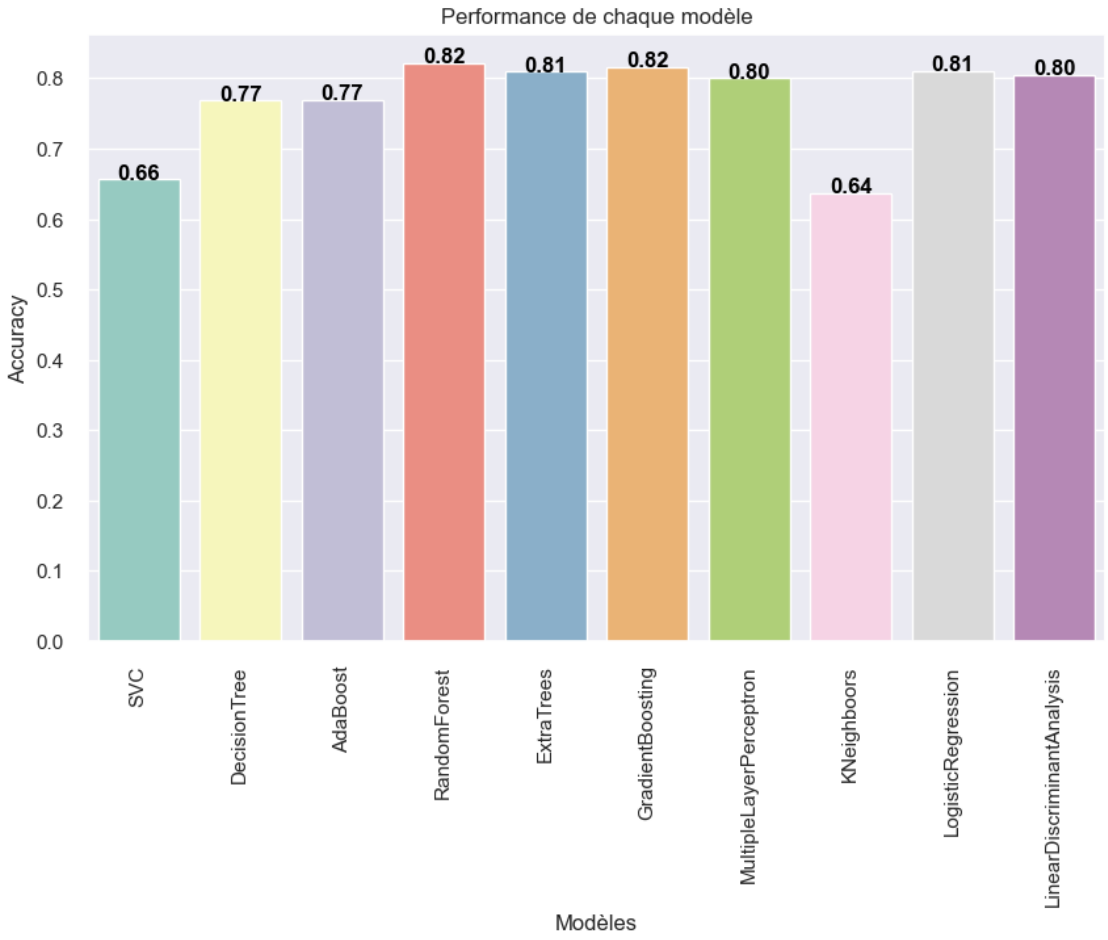
```
from sklearn.model_selection import KFold

kfold = KFold(n_splits=10, shuffle=True, random_state=42)

# Étape de modélisation : Tester différents algorithmes
random_state = 2
classifiers = []
classifiers.append(SVC(random_state=random_state))
classifiers.append(DecisionTreeClassifier(random_state=random_state))
classifiers.append(AdaBoostClassifier(DecisionTreeClassifier(random_st
ate=random_state),random_state=random_state,learning_rate=0.1))
classifiers.append(RandomForestClassifier(random_state=random_state))
classifiers.append(ExtraTreesClassifier(random_state=random_state))
classifiers.append(GradientBoostingClassifier(random_state=random_stat
e))
classifiers.append(MLPClassifier(random_state=random_state))
classifiers.append(KNeighborsClassifier())
classifiers.append(LogisticRegression(random_state=random_state))
classifiers.append(LinearDiscriminantAnalysis())

cv_results = []
for classifier in classifiers :
    cv_results.append(cross_val_score(classifier, X_train, y=Y_train,
scoring="accuracy", cv=kfold, n_jobs=4))

cv_means = []
cv_std = []
for cv_result in cv_results:
    cv_means.append(cv_result.mean())
    cv_std.append(cv_result.std())

cv_res = pd.DataFrame({
    "Accuracy (Précision) Moyenne": cv_means,
    "CrossValerrors": cv_std,
    "Modèles": [
        "SVC", "DecisionTree", "AdaBoost", "RandomForest",
```

```
"ExtraTrees",
        "GradientBoosting", "MultipleLayerPerceptron", "KNeighboors",
        "LogisticRegression", "LinearDiscriminantAnalysis"
    ]
})

g = sns.barplot(
    "Accuracy (Précision) Moyenne", "Modèles", data=cv_res,
palette="Set3",
    orient="h", **{'xerr': cv_std}
)
g.set_xlabel("Accuracy (Précision) Moyenne")
g = g.set_title("Scores de validation croisée")
```




```
import matplotlib.pyplot as plt
import seaborn as sns

# Définir les modèles et leurs noms
classifiers = [SVC(random_state=random_state),
               DecisionTreeClassifier(random_state=random_state),

AdaBoostClassifier(DecisionTreeClassifier(random_state=random_state),
random_state=random_state, learning_rate=0.1),
               RandomForestClassifier(random_state=random_state),
               ExtraTreesClassifier(random_state=random_state),
               GradientBoostingClassifier(random_state=random_state),
               MLPClassifier(random_state=random_state),
               KNeighborsClassifier(),
               LogisticRegression(random_state=random_state),
               LinearDiscriminantAnalysis()]
```

```
model_names = ["SVC", "DecisionTree", "AdaBoost", "RandomForest",
"ExtraTrees",
               "GradientBoosting", "MultipleLayerPerceptron",
"KNeighboors",
               "LogisticRegression", "LinearDiscriminantAnalysis"]

# Calculer la performance de chaque modèle
performance = []
for classifier in classifiers:
    cv_results = cross_val_score(classifier, X_train, y=Y_train,
scoring="accuracy", cv=kfold, n_jobs=4)
    performance.append(cv_results.mean())

# Créer un graphique
plt.figure(figsize=(10, 6))
sns.barplot(x=model_names, y=performance, palette="Set3")
plt.xticks(rotation=90)
plt.xlabel("Modèles")
plt.ylabel("Accuracy")
plt.title("Performance de chaque modèle")

# Ajouter les légendes correspondant à la valeur de chaque modèle
for i, v in enumerate(performance):
    plt.text(i, v, "{:.2f}".format(v), color='black', ha='center',
fontweight='bold')

plt.show()
```



L'avantage de cette deuxième option réside dans sa méthode de calcul. En effet, ici pour chaque split une précision sera calculée et la précision du modèle correspondra à la moyenne des précisions du modèle sur chacune des données splitées. Cela permet de nous rassurer sur la performance du modèle, de limiter l'overfitting et d'annoncer que la random forest semble être le modèle le plus précis avec 84% de précision. Nous pouvons toutefois l'améliorer en modifiant ses hyperparamètres.

Je me suis permis d'ajouter ce tableau qui contient l'importance de chaque feature dans le modèle de forêt aléatoire (random_forest) pour voir le poids de chaque feature dans le modèle.

```
from sklearn.ensemble import RandomForestClassifier
random_forest = RandomForestClassifier(n_estimators=100, max_depth=5,
random_state=42)

# entraîner le modèle sur les données d'entraînement
random_forest.fit(X_train, Y_train)
importances = pd.DataFrame({'feature': X_train.columns, 'importance':
np.round(random_forest.feature_importances_, 3)})
importances = importances.sort_values('importance', ascending=
False).set_index('feature')
```

```
importances.head(15)
```

```
             importance
feature
Sex               0.261
Title             0.258
Fare              0.136
Pclass            0.103
relatives         0.068
Age               0.065
PassengerId       0.049
SibSp             0.031
Embarked          0.015
Parch             0.013
```

```
from sklearn.model_selection import GridSearchCV

# Définir les hyperparamètres à tester pour la Random Forest
rf_param_grid = {
    'n_estimators': [100, 300, 500, 800, 1200],
    'max_depth': [5, 8, 15, 25, 30],
    'min_samples_split': [2, 5, 10, 15, 100],
    'min_samples_leaf': [1, 2, 5, 10]
}

# Instancier la Random Forest
rf = RandomForestClassifier()

# Recherche par grille pour optimiser les hyperparamètres de la Random
Forest
rf_grid_search = GridSearchCV(estimator = rf, param_grid =
rf_param_grid,
                          cv = 5, n_jobs = -1, verbose = 2)

# Entraîner la Random Forest avec les hyperparamètres optimisés
rf_grid_search.fit(x_train, y_train)

# Afficher les hyperparamètres optimisés
print("Meilleurs hyperparamètres pour la Random Forest: ",
rf_grid_search.best_params_)

# Afficher la précision de la Random Forest avec les hyperparamètres
optimisés
y_pred = rf_grid_search.predict(x_val)
acc = accuracy_score(y_val, y_pred)
print("Précision de la Random Forest avec les hyperparamètres
optimisés: ", acc)
```

```
Fitting 5 folds for each of 500 candidates, totalling 2500 fits
Meilleurs hyperparamètres pour la Random Forest:  {'max_depth': 30,
'min_samples_leaf': 2, 'min_samples_split': 15, 'n_estimators': 100}
Précision de la Random Forest avec les hyperparamètres optimisés:
0.8865979381443299
```

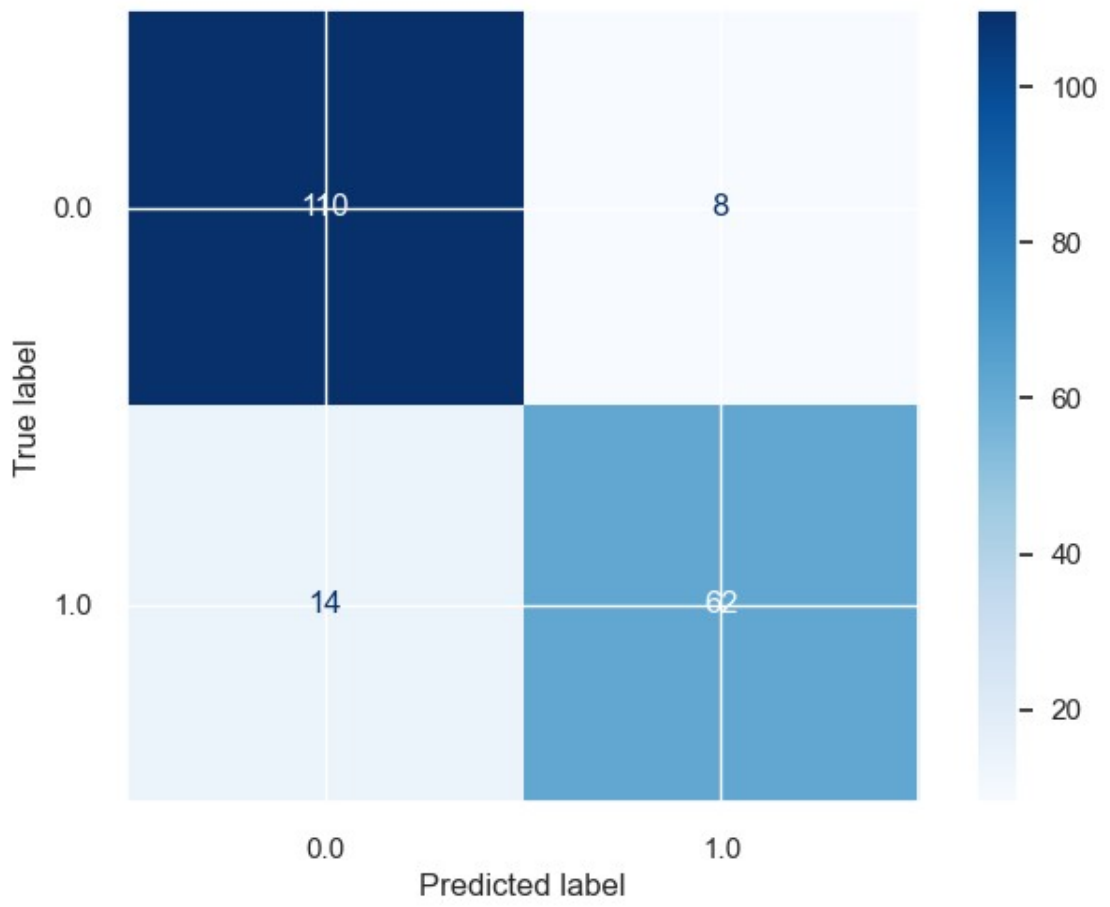
Le modèle le plus performant que nous pouvons obtenir se base sur la Random Forest est à une précision de 91,75%. Les meilleurs hyperparamètres sont : une max_depth de 30, un min_samples_leaf de 2, un min_samples_split de 2 et un n_estimators de 100. Voilà le modèle le plus performant que j'ai pu obtenir.

```
from sklearn.metrics import f1_score

# Prédire les valeurs cibles pour le jeu de validation
y_pred = rf_grid_search.predict(x_val)

# Calculer le score F1 avec les hyperparamètres optimisés pour la
Random Forest
f1 = f1_score(y_val, y_pred, average='weighted')

print("Score F1 de la Random Forest avec les hyperparamètres
optimisés: ", f1)
```

```
Score F1 de la Random Forest avec les hyperparamètres optimisés:
0.8856735694752924
```

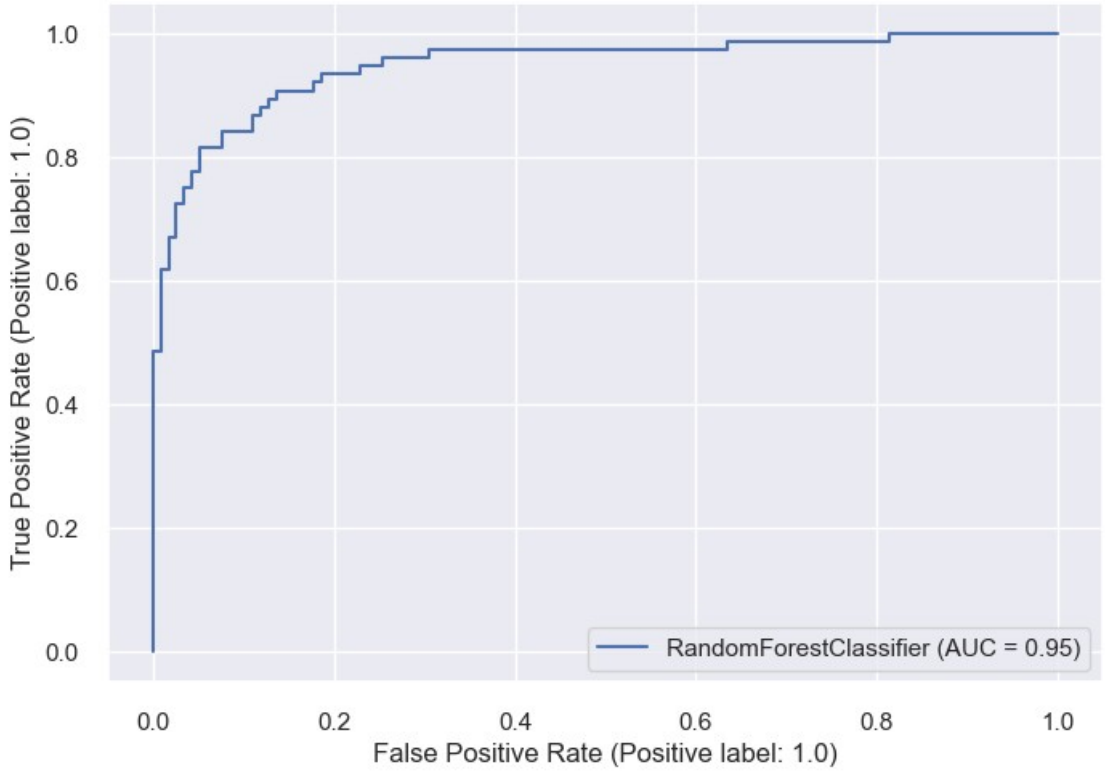
```
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix

# Utiliser le modèle optimisé pour prédire les classes sur le jeu de
validation
y_pred = rf_grid_search.predict(x_val)

# Calculer la matrice de confusion
conf_matrix = confusion_matrix(y_val, y_pred)

# Afficher la matrice de confusion sous forme de matrice
print("Matrice de confusion : ")
print(np.array2string(conf_matrix, separator=', '))

# Afficher la matrice de confusion sous forme graphique
plot_confusion_matrix(rf_grid_search, x_val, y_val, cmap=plt.cm.Blues)
plt.show()
```

```
Matrice de confusion :
[[110,   8],
 [ 14,  62]]
```

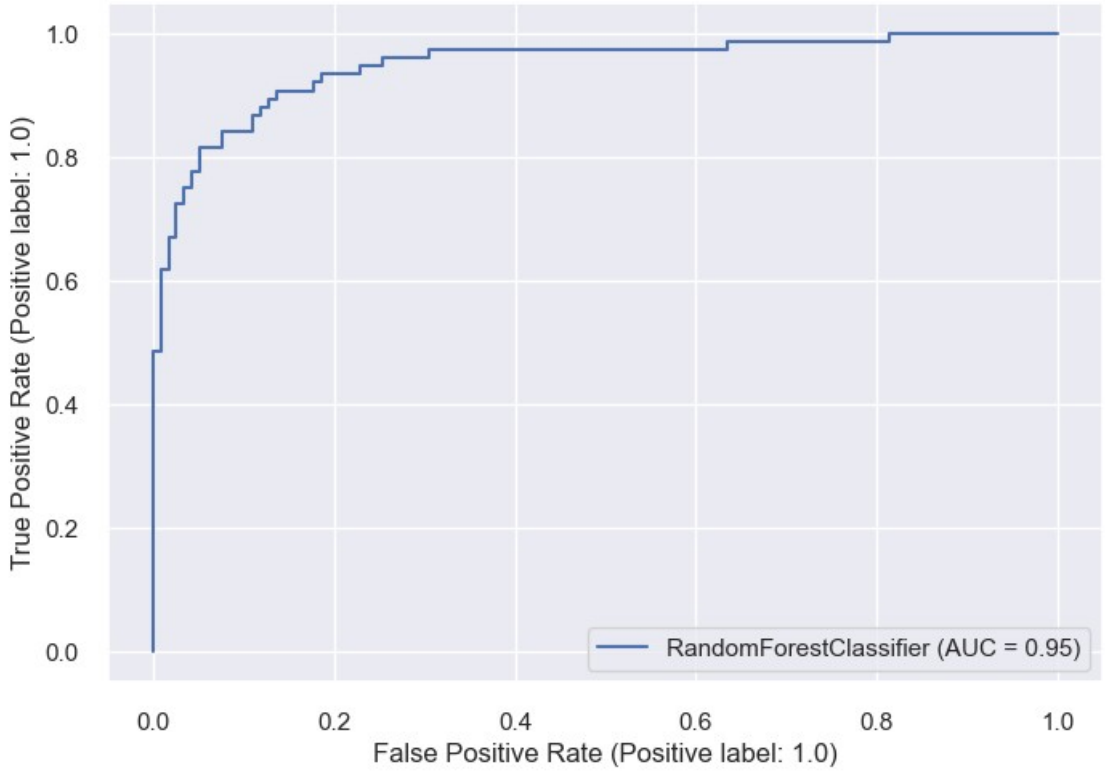


Dans cet exemple, la matrice de confusion montre que le modèle a prédit 110 cas de la classe 0 (pas de survie) correctement et 62 cas de la classe 1 (survie) correctement. Cependant, il a également fait 14 erreurs en prédisant une survie alors qu'il n'y en avait pas et 8 erreurs en prédisant l'absence de survie alors qu'il y en avait une.

```
from sklearn.metrics import plot_roc_curve

# Obtenir le meilleur modèle après la recherche par grille
best_rf = rf_grid_search.best_estimator_

# Afficher la courbe ROC pour le meilleur modèle
plot_roc_curve(best_rf, x_val, y_val)
plt.show()
```




```
# Obtenir le meilleur modèle après la recherche par grille
best_rf = rf_grid_search.best_estimator_

# Afficher la courbe ROC pour le meilleur modèle
plot_roc_curve(best_rf, x_val, y_val)
plt.show()

# Obtenir les valeurs des faux positifs, des vrais positifs et des
seuils
fpr, tpr, thresholds = roc_curve(y_val, best_rf.predict_proba(x_val)
[:,1])

# Afficher les valeurs des faux positifs et des vrais positifs
print("Faux positifs : ", fpr)
print("Vrais positifs : ", tpr)
```




```
Faux positifs :  [0.         0.         0.         0.00847458
0.00847458 0.01694915
 0.01694915 0.02542373 0.02542373 0.03389831 0.03389831 0.04237288
 0.04237288 0.05084746 0.05084746 0.07627119 0.07627119 0.11016949
 0.11016949 0.11864407 0.11864407 0.12711864 0.12711864 0.13559322
 0.13559322 0.1779661  0.1779661  0.18644068 0.18644068 0.22881356
 0.22881356 0.25423729 0.25423729 0.30508475 0.30508475 0.63559322
 0.63559322 0.81355932 0.81355932 0.88135593 0.89830508 1.        ]
Vrais positifs :  [0.         0.01315789 0.48684211 0.48684211
0.61842105 0.61842105
 0.67105263 0.67105263 0.72368421 0.72368421 0.75       0.75
 0.77631579 0.77631579 0.81578947 0.81578947 0.84210526 0.84210526
 0.86842105 0.86842105 0.88157895 0.88157895 0.89473684 0.89473684
 0.90789474 0.90789474 0.92105263 0.92105263 0.93421053 0.93421053
 0.94736842 0.94736842 0.96052632 0.96052632 0.97368421 0.97368421
 0.98684211 0.98684211 1.         1.         1.         1.        ]
```

Un AUC de 0,95 est un excellent score et indique que le modèle est très performant pour la classification binaire. Pour finir, il est donc possible de conclure que le modèle de Random Forest étudié a tendance à bien prédire les passagers décédés ainsi que la prédiction des passagers ayant survécu.