titanic-classification

December 13, 2023

0.1 Import Modules

[152]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

0.2 Loading the dataset

[153]:
```
train_df = pd.read_csv(r"C:\Users\LENOVO\Desktop\Bharat␣
 ↪Intern\Dataset_Downloads\Titanic\train.csv")
test_df =pd.read_csv(r"C:\Users\LENOVO\Desktop\Bharat␣
 ↪Intern\Dataset_Downloads\Titanic\test.csv")
```

0.3 BASIC INSPECTIONS ON THE DATASET:

0.4 Displaying first 5 examples in train dataframe

[154]:
```
train_df.head()
```

[154]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th…	female	38.0	1
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1
4	5	0	3	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
```

0.5 Displaying first 5 examples in test dataframe

[155]:
```
test_df.head()
```

[155]:
```
   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
```

0.6 checking for the information of the train dataset

[156]:
```
train_df.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
```

0.7 checking for the information of the test dataset

[157]:
```
test_df.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: 36.1+ KB
```

0.8 Describing the train dataset

[158]:
```
train_df.describe()
```

[158]:

	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
```

0.9 Describing the test dataset

[159]:
```
test_df.describe()
```

[159]:

	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

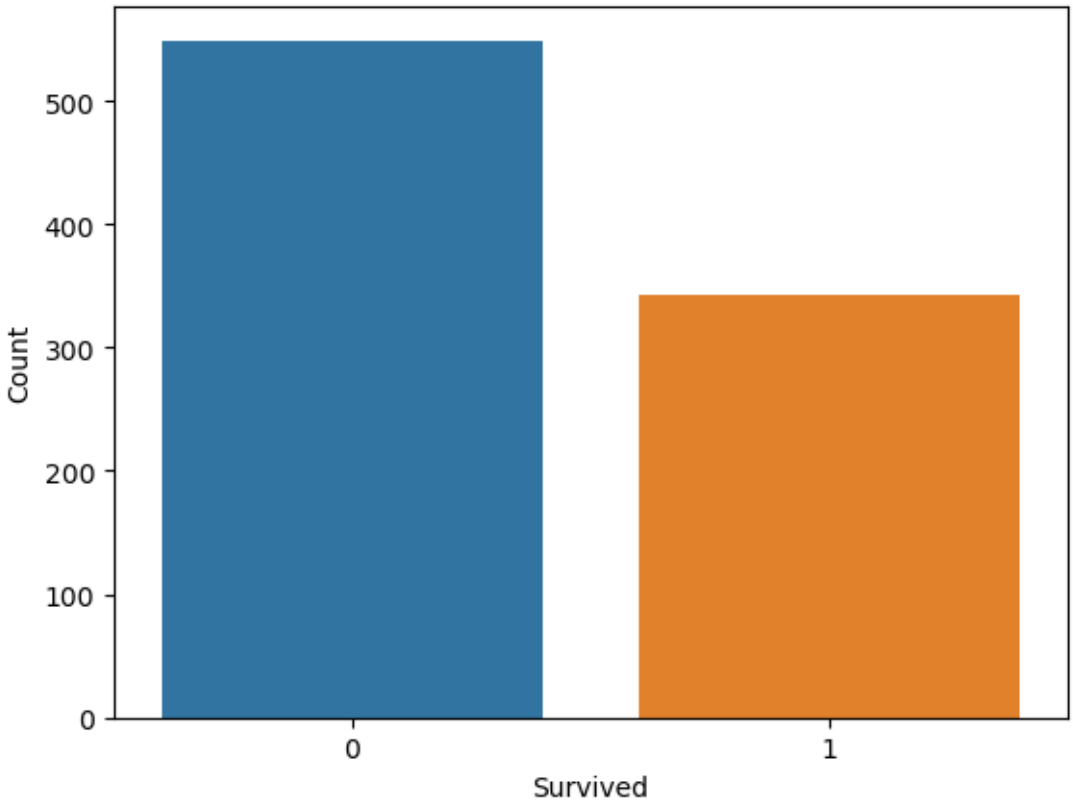
0.10 Checking the datatypes of the Dataset

[160]:
```
train_df.dtypes
```

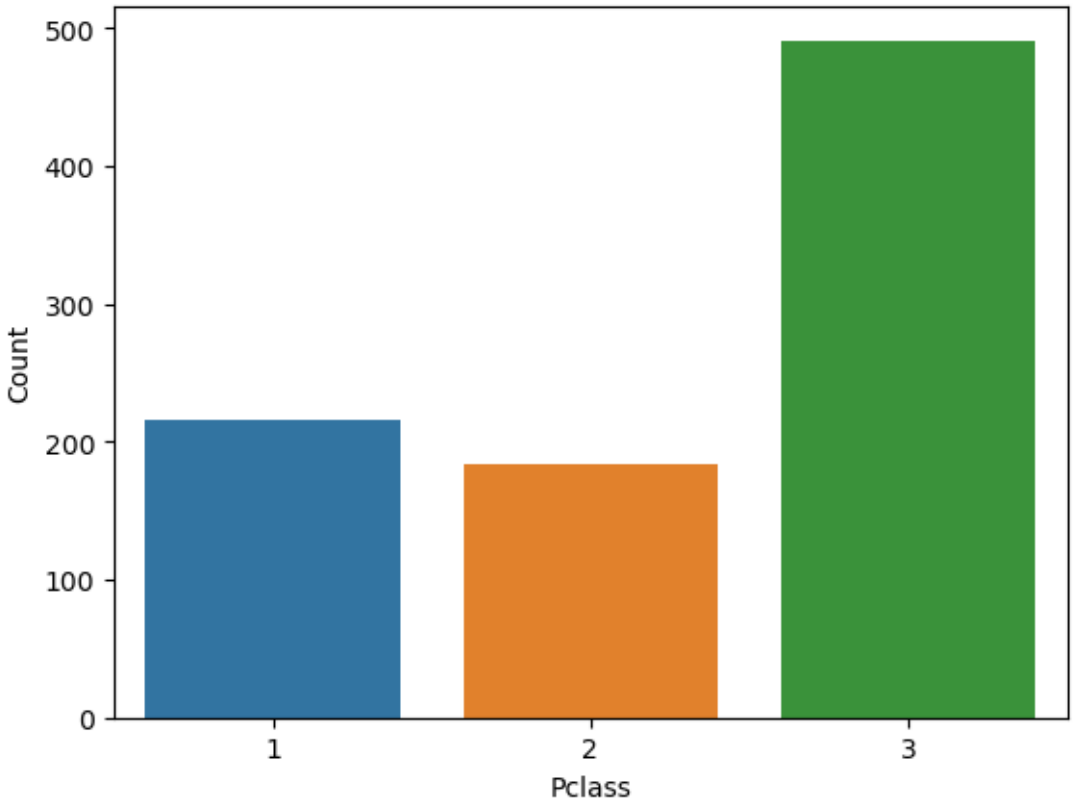
[160]:
```
PassengerId      int64
Survived         int64
Pclass           int64
Name            object
Sex             object
Age            float64
SibSp            int64
Parch            int64
Ticket          object
Fare           float64
Cabin           object
Embarked        object
dtype: object
```

0.11 Data Analysis:

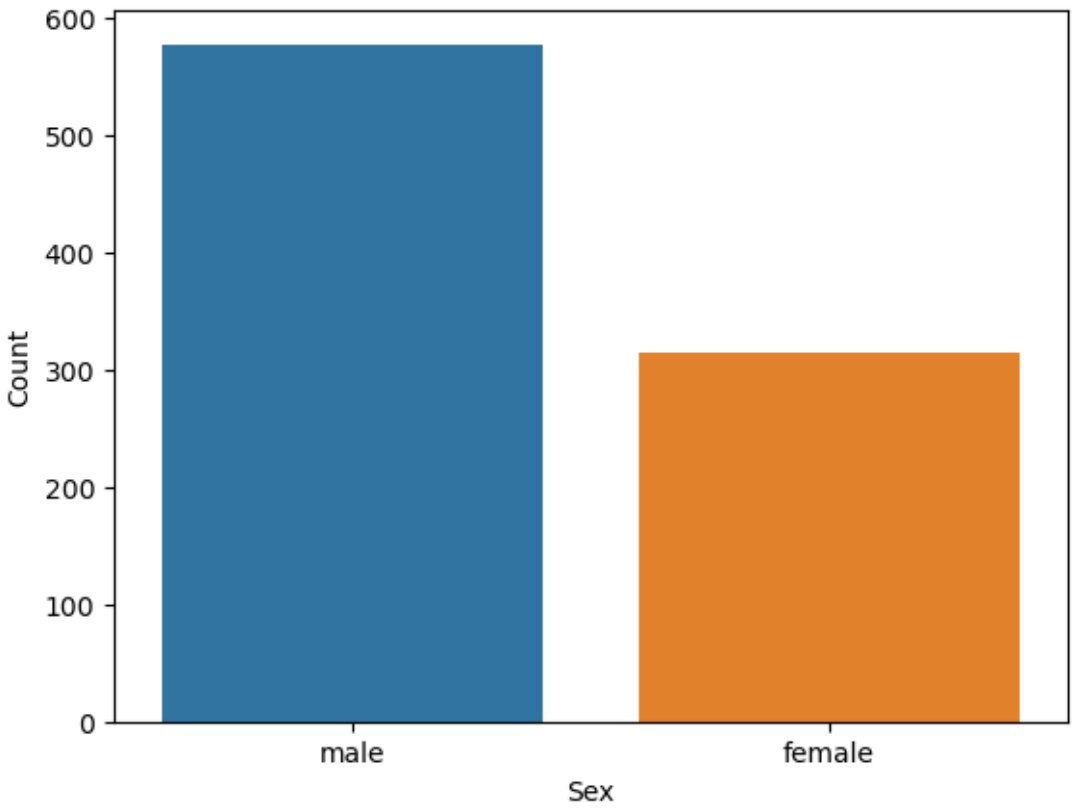
[161]:
```
# categorial attributes:

sns.countplot(x='Survived', data=train_df)
plt.ylabel('Count')
plt.show()
```



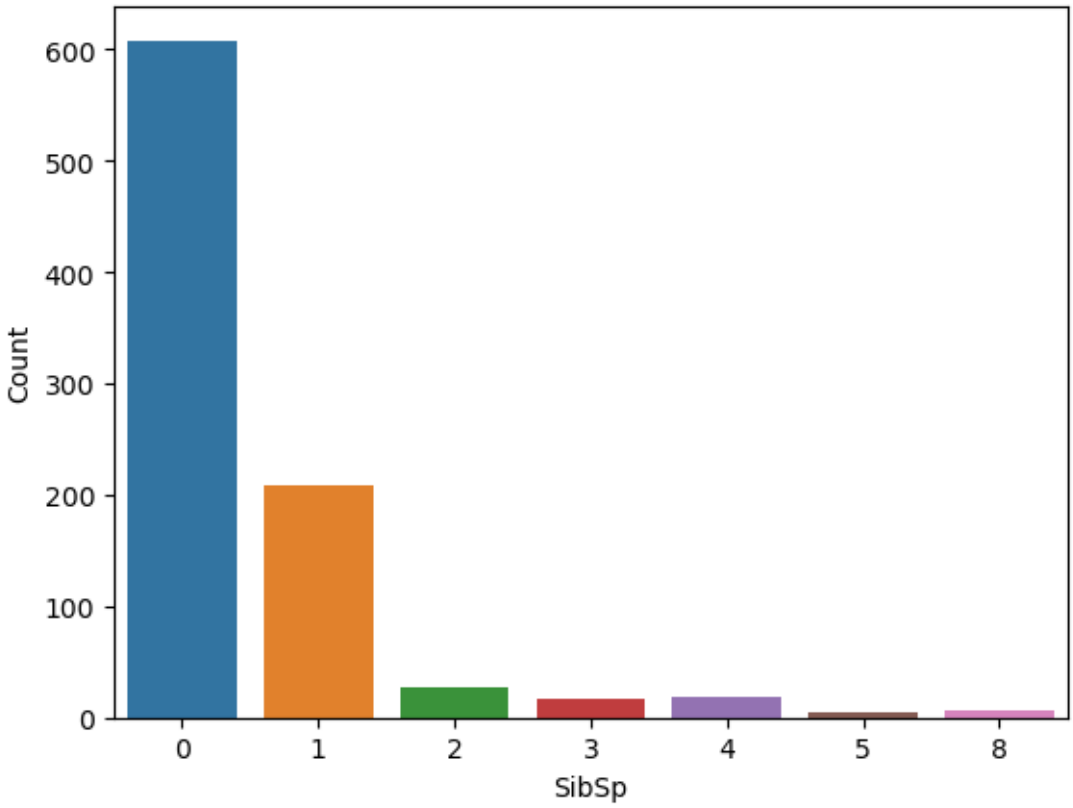
[162]:
```
sns.countplot(x='Pclass', data=train_df)
plt.ylabel('Count')
plt.show()
```



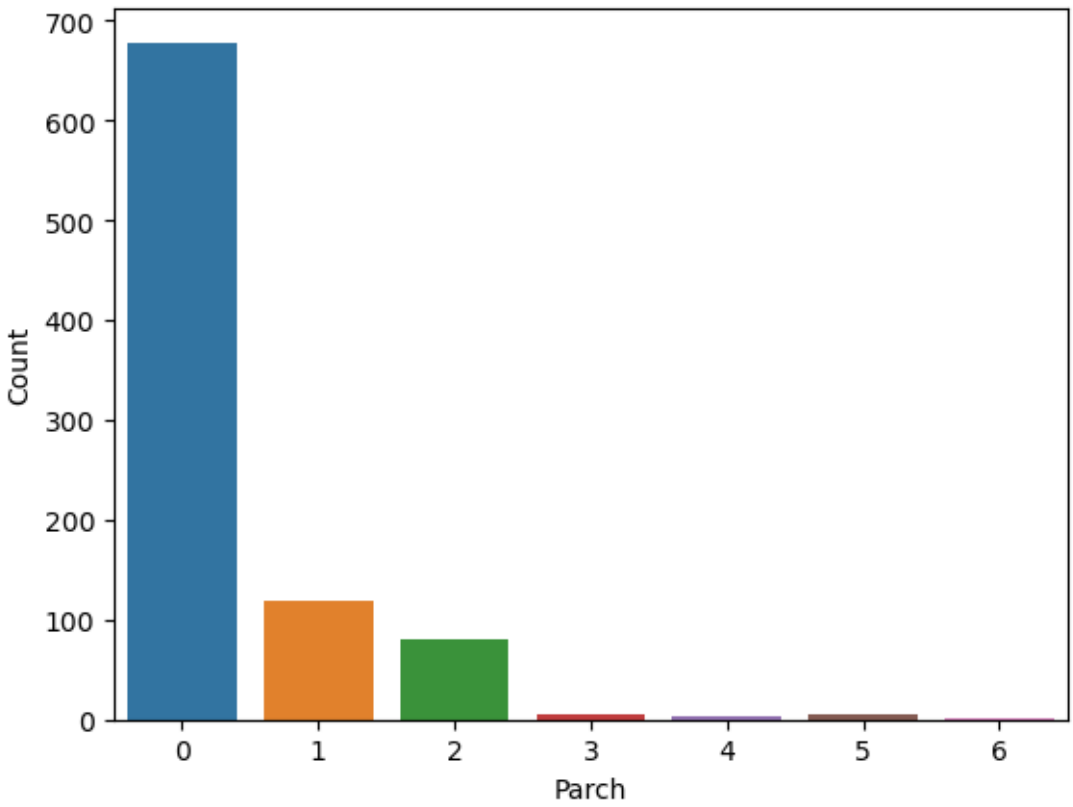
[163]:
```
sns.countplot(x='Sex', data=train_df)
plt.ylabel('Count')
plt.show()
```



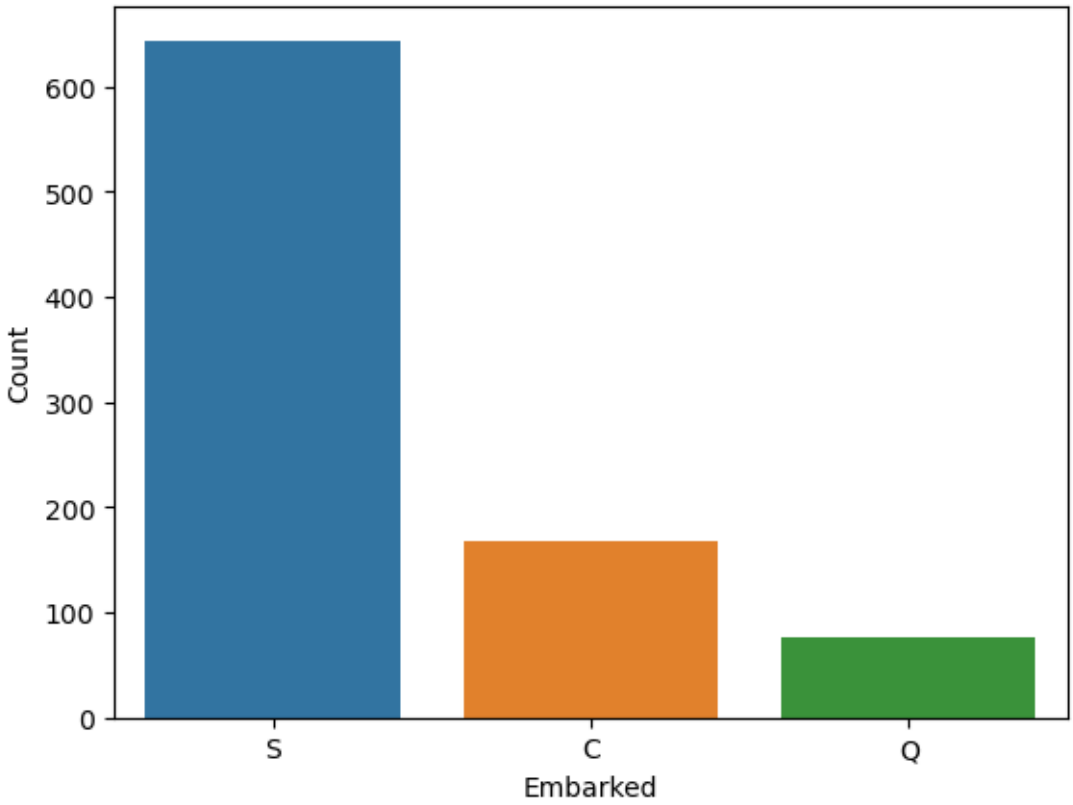
[164]:
```
sns.countplot(x='SibSp', data=train_df)
plt.ylabel('Count')
plt.show()
```



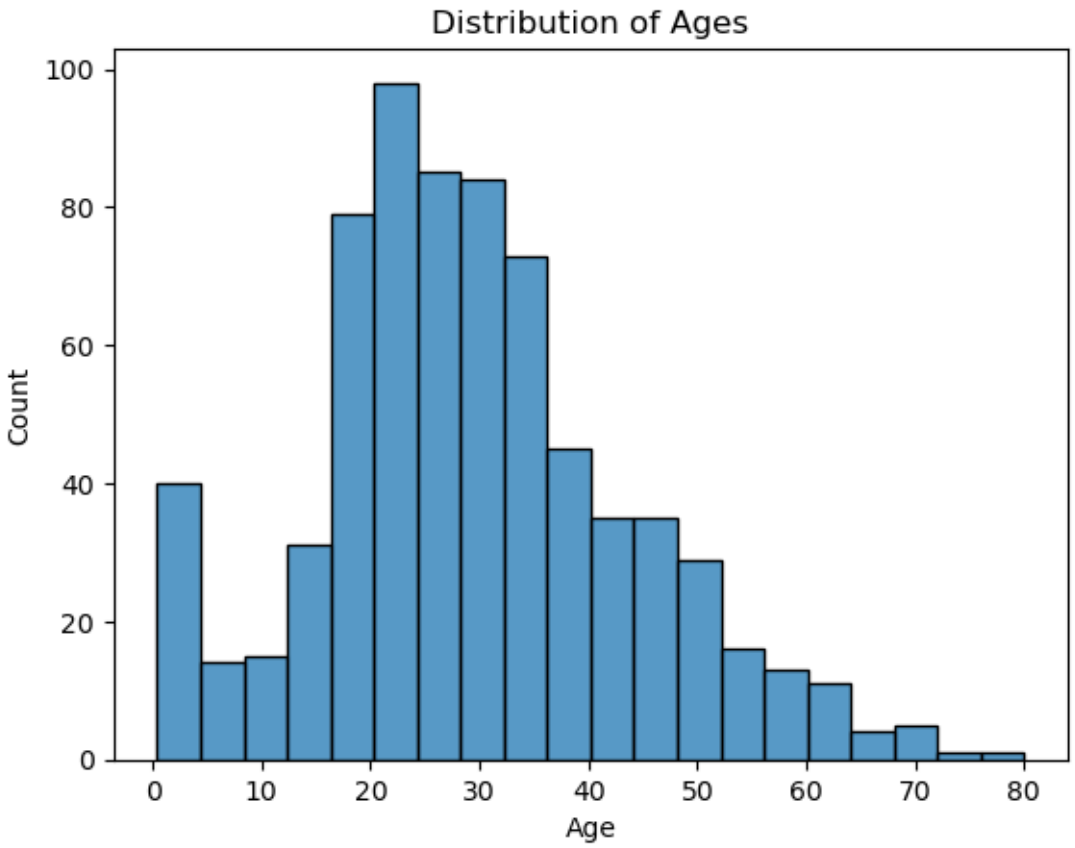
[165]:
```
sns.countplot(x='Parch', data=train_df)
plt.ylabel('Count')
plt.show()
```



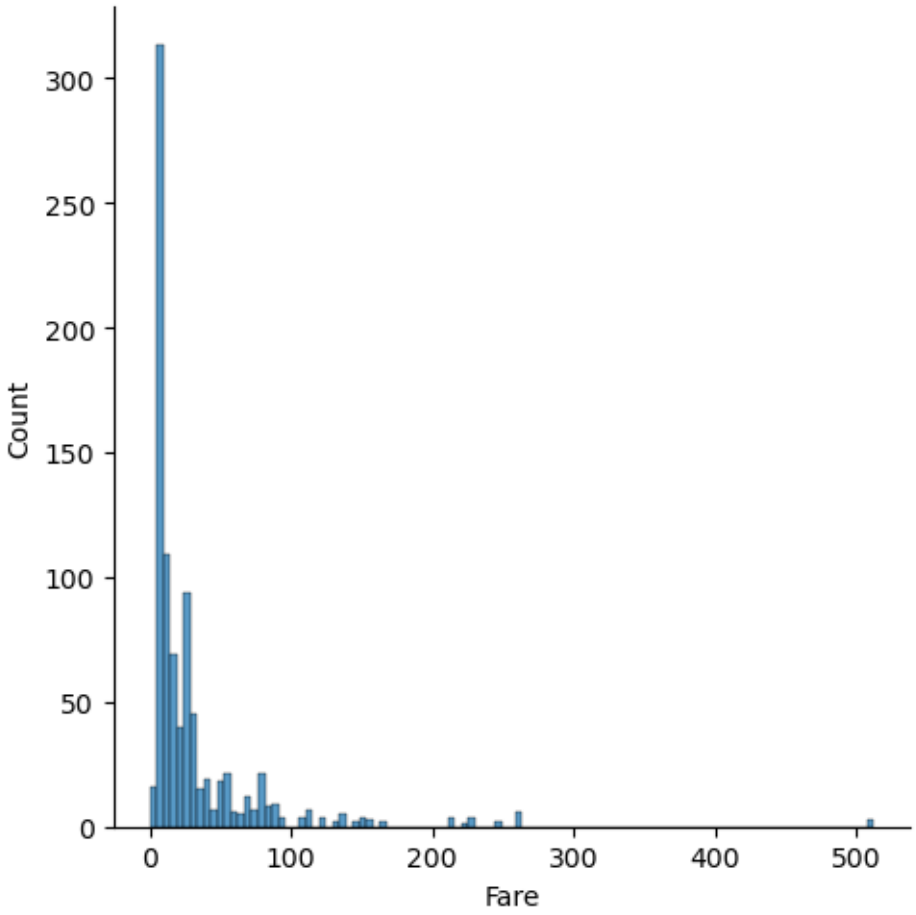
[166]:
```
sns.countplot(x='Embarked', data=train_df)
plt.ylabel('Count')
plt.show()
```



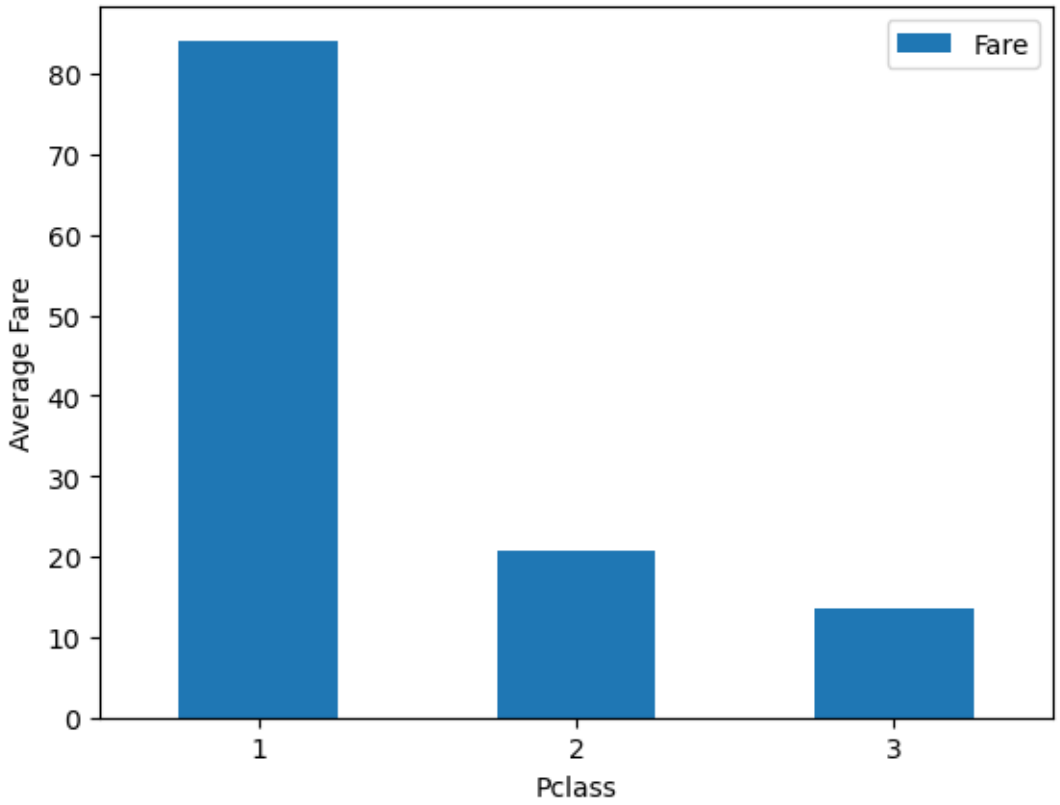
[167]:
```
#Numerical Attributes:

sns.histplot(x='Age', data=train_df)
plt.xlabel('Age')
plt.ylabel('Count')
plt.title('Distribution of Ages')
plt.show()
```



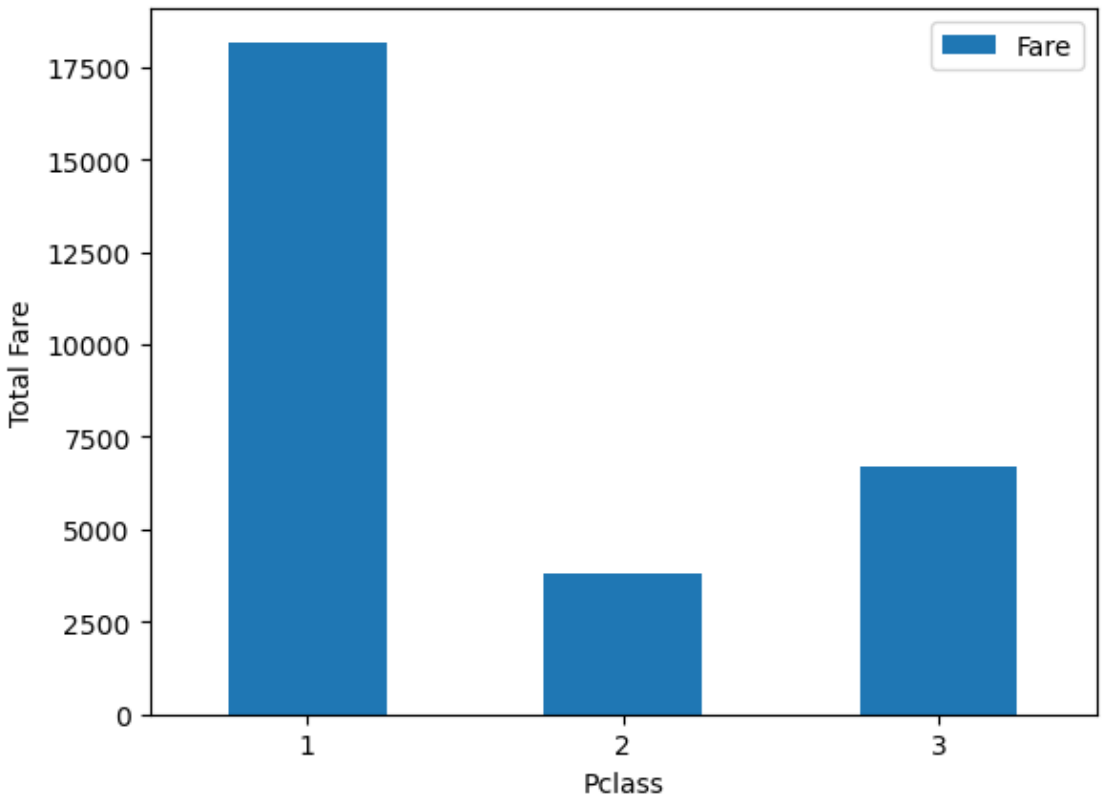
[168]:
```
sns.displot(x='Fare', data=train_df)
plt.ylabel('Count')
plt.show()
```



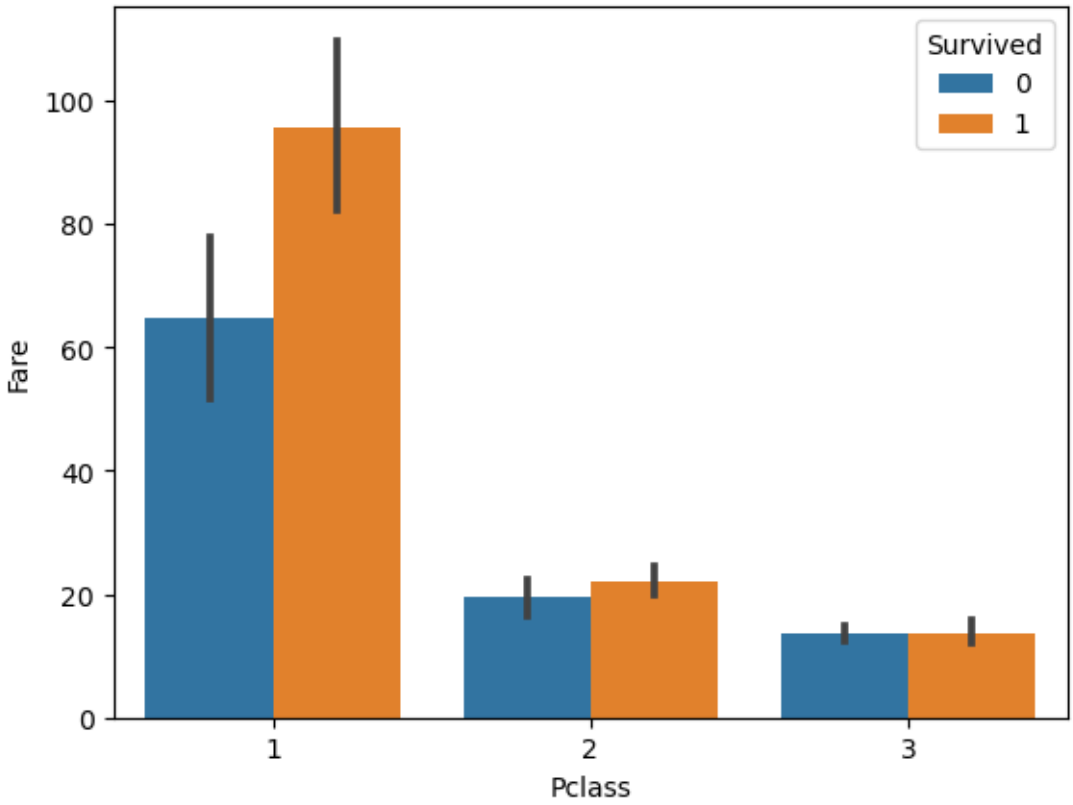
[169]:
```
class_fare = train_df.pivot_table(index='Pclass',values='Fare')
class_fare.plot(kind='bar')
plt.xlabel('Pclass')
plt.ylabel('Average Fare')
plt.xticks(rotation=0)
plt.show()
```



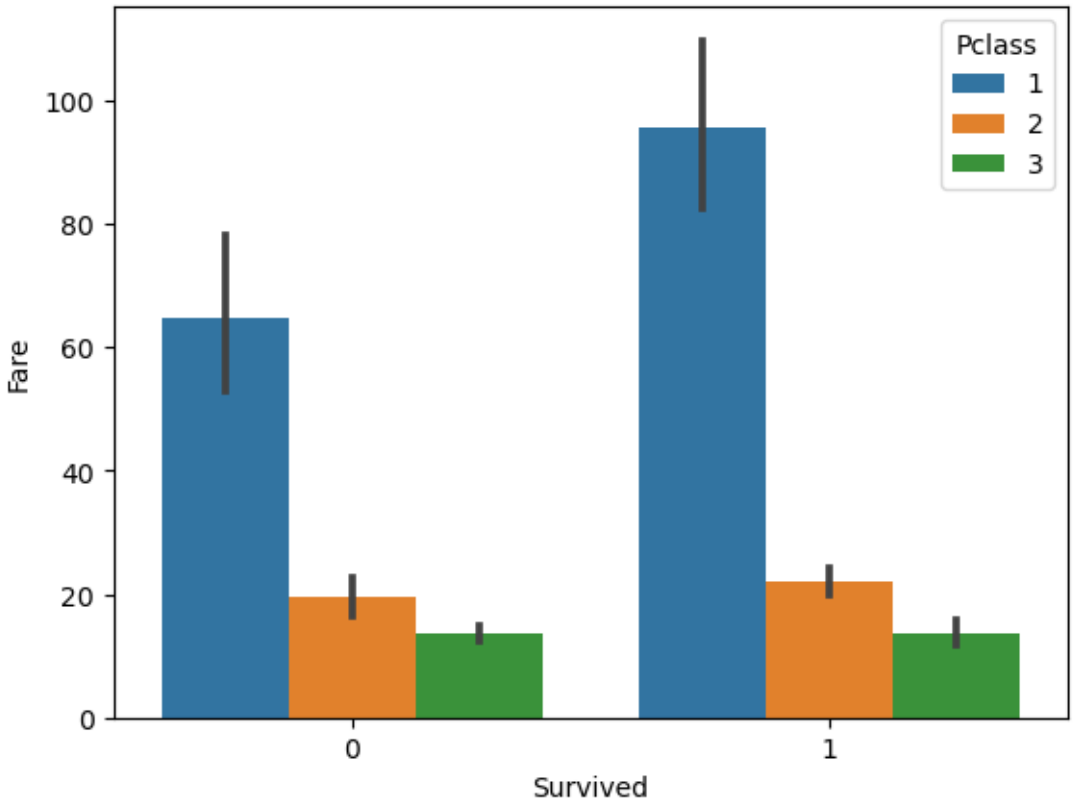
[170]:
```
class_fare = train_df.pivot_table(index='Pclass',values='Fare',aggfunc=np.sum)
class_fare.plot(kind='bar')
plt.xlabel('Pclass')
plt.ylabel('Total Fare')
plt.xticks(rotation=0)
plt.show()
```



[171]:
```
sns.barplot(data=train_df,x='Pclass',y='Fare',hue='Survived')
plt.show()
```



[172]:
```
sns.barplot(data=train_df,x='Survived',y='Fare',hue='Pclass')
plt.show()
```



0.12 Data PreProcessing

[173]:
```
train_len=len(train_df)
df=pd.concat([train_df,test_df],axis=0)
df=df.reset_index(drop=True)
df
```

[173]:

	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	
…	…	…	…	
1304	1305	NaN	3	
1305	1306	NaN	1	
1306	1307	NaN	3	
1307	1308	NaN	3	
1308	1309	NaN	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
…                                                      …     …   …    …
1304                                Spector, Mr. Woolf    male   NaN      0
1305                      Oliva y Ocana, Dona. Fermina  female  39.0      0
1306                      Saether, Mr. Simon Sivertsen    male  38.5      0
1307                               Ware, Mr. Frederick    male   NaN      0
1308                           Peter, Master. Michael J    male   NaN      1

      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
…     …                   …       …   …      …
1304      0           A.5. 3236    8.0500   NaN        S
1305      0            PC 17758  108.9000  C105        C
1306      0  SOTON/O.Q. 3101262    7.2500   NaN        S
1307      0              359309    8.0500   NaN        S
1308      1                2668   22.3583   NaN        C

[1309 rows x 12 columns]
```

0.12.1 Check for Null Values

[174]:
```
df.isnull().sum()
```

[174]:
```
PassengerId       0
Survived        418
Pclass            0
Name              0
Sex               0
Age             263
SibSp             0
Parch             0
Ticket            0
Fare              1
Cabin          1014
Embarked          2
dtype: int64
```

[175]:
```
df=df.drop(columns=['Cabin'],axis=1)
```

[176]:
```
df
```

[176]:
```
      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
…             …       …       …
1304         1305       NaN       3
1305         1306       NaN       1
1306         1307       NaN       3
1307         1308       NaN       3
1308         1309       NaN       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
…                                                 …     …   …    …
1304                               Spector, Mr. Woolf    male   NaN      0
1305                     Oliva y Ocana, Dona. Fermina  female  39.0      0
1306                     Saether, Mr. Simon Sivertsen    male  38.5      0
1307                              Ware, Mr. Frederick    male   NaN      0
1308                         Peter, Master. Michael J    male   NaN      1

      Parch              Ticket      Fare Embarked
0         0           A/5 21171    7.2500        S
1         0            PC 17599   71.2833        C
2         0    STON/O2. 3101282    7.9250        S
3         0              113803   53.1000        S
4         0              373450    8.0500        S
…     …                  …       …      …
1304      0           A.5. 3236    8.0500        S
1305      0            PC 17758  108.9000        C
1306      0  SOTON/O.Q. 3101262    7.2500        S
1307      0              359309    8.0500        S
1308      1                2668   22.3583        C

[1309 rows x 11 columns]
```

[177]:
```
df.columns
```

[177]:
```
Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Embarked'],
```

```
dtype='object')
```

0.13 Filling missing values

[178]:
```
df['Age'].mean
```

[178]:
```
<bound method NDFrame._add_numeric_operations.<locals>.mean of 0       22.0
1       38.0
2       26.0
3       35.0
4       35.0
        …
1304     NaN
1305    39.0
1306    38.5
1307     NaN
1308     NaN
Name: Age, Length: 1309, dtype: float64>
```

[179]:
```
df['Age'] = df['Age'].fillna(df['Age'].mean())
df['Fare'] = df['Fare'].fillna(df['Fare'].mean())
```

[180]:
```
df['Embarked'].mode()[0]
```

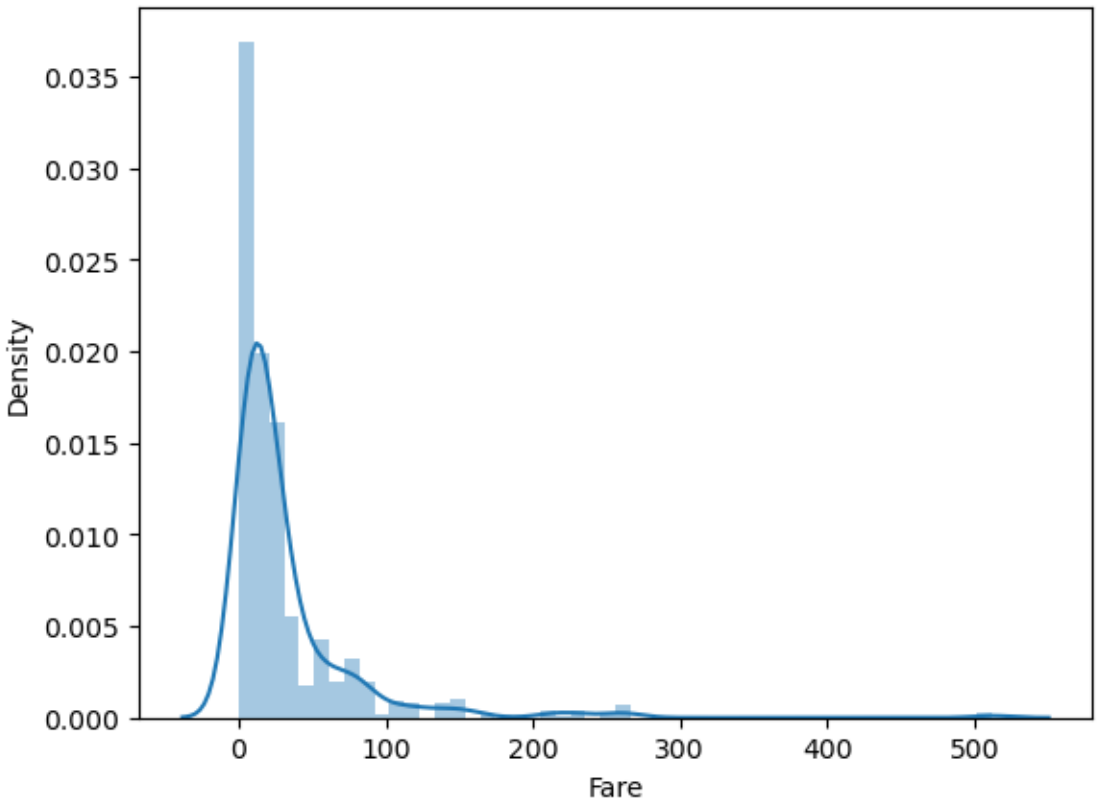
[180]:
```
'S'
```

[181]:
```
df['Embarked']=df['Embarked'].fillna(df['Embarked'].mode()[0])
```

0.14 Log transformation for uniform data distribution:

[182]:
```
sns.distplot(train_df['Fare'])
```

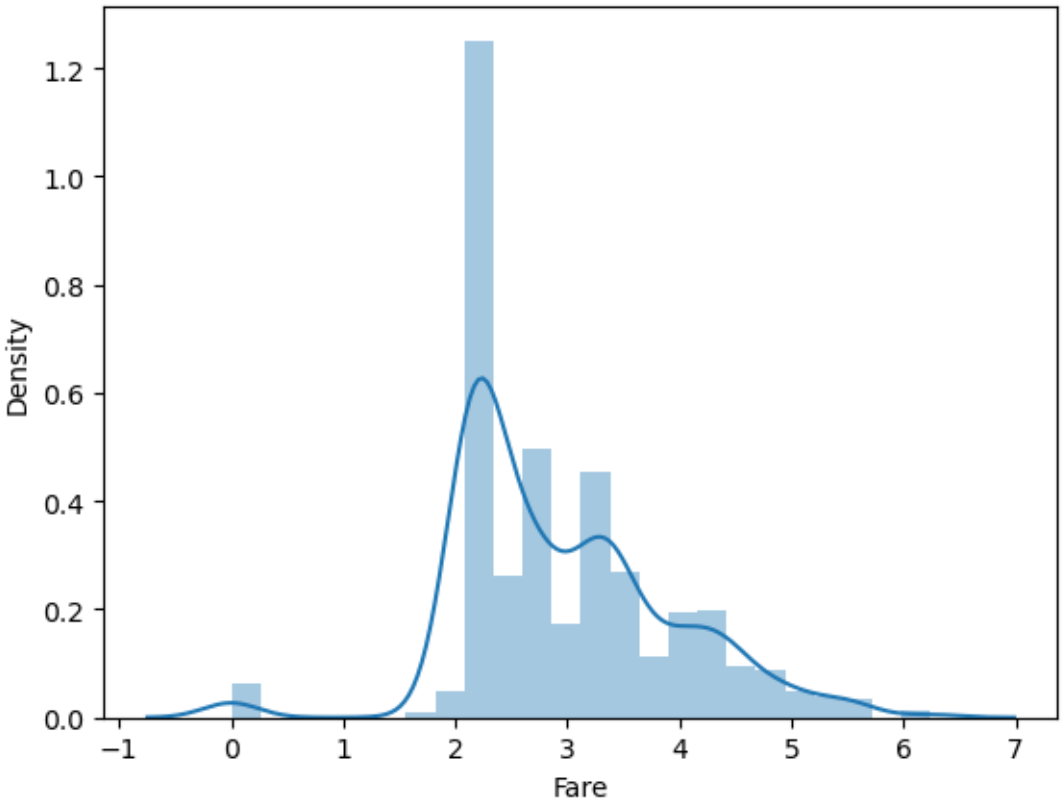
[182]:
```
<Axes: xlabel='Fare', ylabel='Density'>
```



[183]:
```
train_df['Fare'] = np.log(train_df['Fare']+1)
```

[184]:
```
sns.distplot(train_df['Fare'])
```

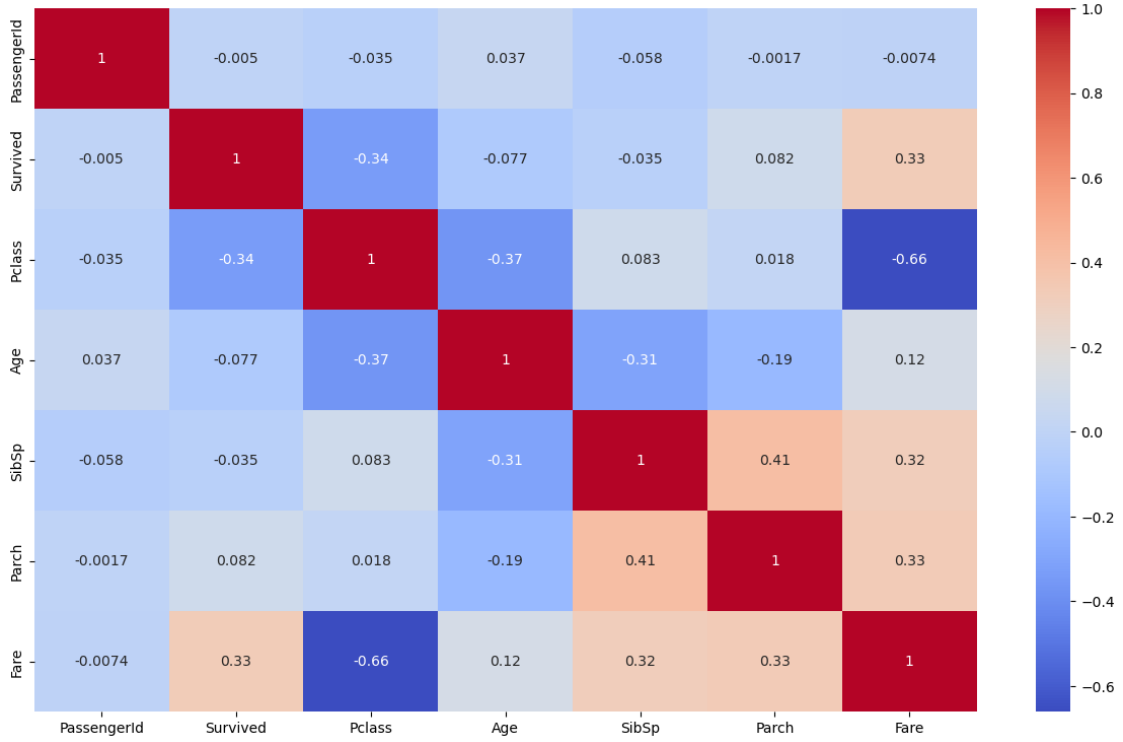
[184]: <Axes: xlabel='Fare', ylabel='Density'>



0.15 Correlation matrix

[185]:
```
# Assuming 'Name' is a column containing strings, and you want to exclude it
numeric_columns = train_df.select_dtypes(include=[np.number]).columns
subset_df = train_df[numeric_columns]

# Now compute the correlation matrix
corr_matrix = subset_df.corr()
plt.figure(figsize=(15,9))
sns.heatmap(corr_matrix,annot=True,cmap='coolwarm')
```

[185]: <Axes: >



[186]:
```
df.head()
```

[186]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Embarked
0	1	0.0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	S
1	2	1.0	1	Cumings, Mrs. John Bradley (Florence Briggs Th…	female	38.0	1	0	PC 17599	71.2833	C
2	3	1.0	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	S
3	4	1.0	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	S
4	5	0.0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	S

0.16 Drop Unnecessary Columns

[187]:
```
df=df.drop(['Name','Ticket'],axis=1)
```

[188]:
```
df
```

[188]:
```
      PassengerId  Survived  Pclass     Sex        Age  SibSp  Parch  \
0               1       0.0       3    male  22.000000      1      0
1               2       1.0       1  female  38.000000      1      0
2               3       1.0       3  female  26.000000      0      0
3               4       1.0       1  female  35.000000      1      0
4               5       0.0       3    male  35.000000      0      0
…             …       …     …      …         …    …      …
1304         1305       NaN       3    male  29.881138      0      0
1305         1306       NaN       1  female  39.000000      0      0
1306         1307       NaN       3    male  38.500000      0      0
1307         1308       NaN       3    male  29.881138      0      0
1308         1309       NaN       3    male  29.881138      1      1

          Fare Embarked
0       7.2500        S
1      71.2833        C
2       7.9250        S
3      53.1000        S
4       8.0500        S
…         …       …
1304    8.0500        S
1305  108.9000        C
1306    7.2500        S
1307    8.0500        S
1308   22.3583        C

[1309 rows x 9 columns]
```

[189]:
```
df = pd.get_dummies(df, columns=['Sex', 'Embarked'], drop_first=True)
```

0.17 Spliting dataset

[190]:
```
train=df.iloc[:train_len:]
test=df.iloc[train_len:,:]
```

[191]:
```
train.head()
```

[191]:
```
   PassengerId  Survived  Pclass   Age  SibSp  Parch     Fare  Sex_male  \
0            1       0.0       3  22.0      1      0   7.2500      True
1            2       1.0       1  38.0      1      0  71.2833     False
2            3       1.0       3  26.0      0      0   7.9250     False
```

```
3            4       1.0       1  35.0      1      0  53.1000     False
4            5       0.0       3  35.0      0      0   8.0500      True

   Embarked_Q  Embarked_S
0       False        True
1       False       False
2       False        True
3       False        True
4       False        True
```

[192]:
```
test.head()
```

[192]:
```
     PassengerId  Survived  Pclass   Age  SibSp  Parch     Fare  Sex_male  \
891          892       NaN       3  34.5      0      0   7.8292      True
892          893       NaN       3  47.0      1      0   7.0000     False
893          894       NaN       2  62.0      0      0   9.6875      True
894          895       NaN       3  27.0      0      0   8.6625      True
895          896       NaN       3  22.0      1      1  12.2875     False

     Embarked_Q  Embarked_S
891        True       False
892       False        True
893        True       False
894       False        True
895       False        True
```

0.18 Train-Test Split

[193]:
```
x=df.drop(columns=['PassengerId','Survived'],axis=1)
y=train['Survived']
```

[194]:
```
x.head()
```

[194]:
```
   Pclass   Age  SibSp  Parch     Fare  Sex_male  Embarked_Q  Embarked_S
0       3  22.0      1      0   7.2500      True       False        True
1       1  38.0      1      0  71.2833     False       False       False
2       3  26.0      0      0   7.9250     False       False        True
3       1  35.0      1      0  53.1000     False       False        True
4       3  35.0      0      0   8.0500      True       False        True
```

[195]:
```
x.isnull().sum()
```

[195]:
```
Pclass      0
Age         0
SibSp       0
Parch       0
Fare        0
```

```
Sex_male      0
Embarked_Q    0
Embarked_S    0
dtype: int64
```

[196]:
```
df
```

[196]:
```
      PassengerId  Survived  Pclass        Age  SibSp  Parch      Fare  \
0               1       0.0       3  22.000000      1      0    7.2500
1               2       1.0       1  38.000000      1      0   71.2833
2               3       1.0       3  26.000000      0      0    7.9250
3               4       1.0       1  35.000000      1      0   53.1000
4               5       0.0       3  35.000000      0      0    8.0500
…             …       …     …         …    …      …       …
1304         1305       NaN       3  29.881138      0      0    8.0500
1305         1306       NaN       1  39.000000      0      0  108.9000
1306         1307       NaN       3  38.500000      0      0    7.2500
1307         1308       NaN       3  29.881138      0      0    8.0500
1308         1309       NaN       3  29.881138      1      1   22.3583

      Sex_male  Embarked_Q  Embarked_S
0         True       False        True
1        False       False       False
2        False       False        True
3        False       False        True
4         True       False        True
…        …          …          …
1304      True       False        True
1305     False       False       False
1306      True       False        True
1307      True       False        True
1308      True       False       False

[1309 rows x 10 columns]
```

[197]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(
    train.drop(['Survived', 'PassengerId'], axis=1),
    train['Survived'],
    test_size=0.2,
    random_state=42)
```

0.19 Checking for the shape of the training features(x) in the dataset:

[198]:
```
x_train.shape
```

[198]:
```
(712, 8)
```

0.20 Checking for the shape of the testing features(x) in the dataset:

[199]:
```
x_test.shape
```

[199]:
```
(179, 8)
```

0.21 Checking for the shape of the testing Target values(y) in the dataset:

[200]:
```
y_test.shape
```

[200]:
```
(179,)
```

0.22 Checking for the shape of the traning target values(y) in the dataset:

[201]:
```
y_train.shape
```

[201]:
```
(712,)
```

0.23 Model Evaluation:

0.24 1) Logistic Regression

[202]:
```
from sklearn.linear_model import LogisticRegression
model_lr = LogisticRegression()
```

[203]:
```
model_lr.fit(x_train,y_train)
y_pred = model_lr.predict(x_test)
```

0.25 Liogistic regression Model Evaluation:

[207]:
```
from sklearn.metrics import accuracy_score, classification_report,␣
 ↪confusion_matrix

accuracy = accuracy_score(y_test, y_pred)
```

[208]:
```
print(f"Accuracy: {accuracy}")
```

```
Accuracy: 0.7932960893854749
```

0.26 2) Decision Tree Classifier

[209]:
```
from sklearn.tree import DecisionTreeClassifier
model_dtc=DecisionTreeClassifier()
```

[210]:
```
model_lr.fit(x_train,y_train)
y_pred = model_lr.predict(x_test)
```

0.27 Decision tree model Evaluation:

[211]:
```
from sklearn.metrics import accuracy_score, classification_report,␣
↪confusion_matrix

accuracy = accuracy_score(y_test, y_pred)
```

[212]:
```
print(f"Accuracy: {accuracy}")
```

```
Accuracy: 0.7932960893854749
```

0.28 3) Random Forest Classifier

[213]:
```
from sklearn.ensemble import RandomForestClassifier
model_rfc=RandomForestClassifier()
```

[214]:
```
model_lr.fit(x_train,y_train)
y_pred = model_lr.predict(x_test)
```

0.29 Random Forest model evaluation:

[215]:
```
from sklearn.metrics import accuracy_score, classification_report,␣
↪confusion_matrix

accuracy = accuracy_score(y_test, y_pred)
```

[216]:
```
print(f"Accuracy: {accuracy}")
```

```
Accuracy: 0.7932960893854749
```

0.30 Support Vector Machines (SVM):

[217]:
```
from sklearn.svm import SVC
```

[218]:
```
svm_model = SVC(kernel='linear')
```

[219]:
```
svm_model.fit(x_train, y_train)
```

[219]:
```
SVC(kernel='linear')
```

[220]:
```
y_pred_svm = svm_model.predict(x_test)
```

0.31 SVM Evaluation:

[221]:
```
accuracy_svm = accuracy_score(y_test, y_pred_svm)
```

[222]:
```
print("SVM Accuracy:", accuracy_svm)
```

```
SVM Accuracy: 0.7821229050279329
```

0.32 K-Nearest Neighbors (KNN):

[223]:
```
from sklearn.neighbors import KNeighborsClassifier
```

[224]:
```
knn_model = KNeighborsClassifier(n_neighbors=5)
```

[225]:
```
knn_model.fit(x_train, y_train)
```

[225]:
```
KNeighborsClassifier()
```

[226]:
```
y_pred_knn = knn_model.predict(x_test)
```

0.33 KNN Evaluation

[227]:
```
accuracy_knn = accuracy_score(y_test, y_pred_knn)
```

[228]:
```
print("KNN Accuracy:", accuracy_knn)
```

```
KNN Accuracy: 0.6983240223463687
```

0.34 XGBoost:

[232]:
```
!pip install xgboost
```

```
Requirement already satisfied: xgboost in c:\users\lenovo\anaconda3\lib\site-
packages (2.0.2)
Requirement already satisfied: numpy in c:\users\lenovo\anaconda3\lib\site-
packages (from xgboost) (1.24.3)
Requirement already satisfied: scipy in c:\users\lenovo\anaconda3\lib\site-
packages (from xgboost) (1.11.1)
```

[233]:
```
from xgboost import XGBClassifier
```

[234]:
```
model_xgb = XGBClassifier()
```

[235]:
```
model_xgb.fit(x_train, y_train)
```

[235]:
```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
```

```
                    min_child_weight=None, missing=nan, monotone_constraints=None,
                    multi_strategy=None, n_estimators=None, n_jobs=None,
                    num_parallel_tree=None, random_state=None, …)
```

[236]:
```
y_pred = model_xgb.predict(x_test)
```

0.35 Evaluation:

[237]:
```
accuracy = accuracy_score(y_test, y_pred)
```

[238]:
```
print(f"Accuracy: {accuracy}")
```

```
Accuracy: 0.8156424581005587
```

0.36 Adaboost Classifier

[239]:
```
from sklearn.ensemble import AdaBoostClassifier
```

[240]:
```
model_adaboost = AdaBoostClassifier()
```

[241]:
```
model_adaboost.fit(x_train, y_train)
```

[241]:
```
AdaBoostClassifier()
```

[242]:
```
y_pred_adaboost = model_adaboost.predict(x_test)
```

0.37 Adaboost model evaluation

[243]:
```
accuracy_adaboost = accuracy_score(y_test, y_pred_adaboost)
```

[244]:
```
print(f"AdaBoost Accuracy: {accuracy_adaboost}")
```

```
AdaBoost Accuracy: 0.8044692737430168
```

0.38 Catboost Classifier

[246]:
```
pip install catboost
```

```
Collecting catboost
  Obtaining dependency information for catboost from https://files.pythonhosted.
org/packages/e2/63/379617e3d982e8a66c9d66ebf4621d3357c7c18ad356473c335bffd5aba6/
catboost-1.2.2-cp311-cp311-win_amd64.whl.metadata
  Downloading catboost-1.2.2-cp311-cp311-win_amd64.whl.metadata (1.2 kB)
Collecting graphviz (from catboost)
  Downloading graphviz-0.20.1-py3-none-any.whl (47 kB)
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     -------- ------------------------------- 10.2/47.0 kB ? eta -:--:--
```

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     --------------------------------- ---- 41.0/47.0 kB 393.8 kB/s eta 0:00:01
     ---------------------------------------- 47.0/47.0 kB 334.5 kB/s eta 0:00:00
Requirement already satisfied: matplotlib in c:\users\lenovo\anaconda3\lib\site-
packages (from catboost) (3.7.2)
Requirement already satisfied: numpy>=1.16.0 in
c:\users\lenovo\anaconda3\lib\site-packages (from catboost) (1.24.3)
Requirement already satisfied: pandas>=0.24 in
c:\users\lenovo\anaconda3\lib\site-packages (from catboost) (2.0.3)
Requirement already satisfied: scipy in c:\users\lenovo\anaconda3\lib\site-
packages (from catboost) (1.11.1)
Requirement already satisfied: plotly in c:\users\lenovo\anaconda3\lib\site-
packages (from catboost) (5.9.0)
Requirement already satisfied: six in c:\users\lenovo\anaconda3\lib\site-
packages (from catboost) (1.16.0)
Requirement already satisfied: python-dateutil>=2.8.2 in
c:\users\lenovo\anaconda3\lib\site-packages (from pandas>=0.24->catboost)
(2.8.2)
Requirement already satisfied: pytz>=2020.1 in
c:\users\lenovo\anaconda3\lib\site-packages (from pandas>=0.24->catboost)
(2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in
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(2023.3)
Requirement already satisfied: contourpy>=1.0.1 in
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Requirement already satisfied: cycler>=0.10 in
c:\users\lenovo\anaconda3\lib\site-packages (from matplotlib->catboost) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in
c:\users\lenovo\anaconda3\lib\site-packages (from matplotlib->catboost) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
c:\users\lenovo\anaconda3\lib\site-packages (from matplotlib->catboost) (1.4.4)
Requirement already satisfied: packaging>=20.0 in
c:\users\lenovo\anaconda3\lib\site-packages (from matplotlib->catboost) (23.1)
Requirement already satisfied: pillow>=6.2.0 in
c:\users\lenovo\anaconda3\lib\site-packages (from matplotlib->catboost) (9.4.0)
Requirement already satisfied: pyparsing<3.1,>=2.3.1 in
c:\users\lenovo\anaconda3\lib\site-packages (from matplotlib->catboost) (3.0.9)
Requirement already satisfied: tenacity>=6.2.0 in
c:\users\lenovo\anaconda3\lib\site-packages (from plotly->catboost) (8.2.2)
Downloading catboost-1.2.2-cp311-cp311-win_amd64.whl (101.0 MB)
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0:00:04Note: you may need to restart the kernel to use updated packages.

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Installing collected packages: graphviz, catboost
Successfully installed catboost-1.2.2 graphviz-0.20.1
```

[247]:
```
from catboost import CatBoostClassifier
```

[248]:
```
model_catboost = CatBoostClassifier()
```

[251]:
```
model_catboost.fit(x_train, y_train)
y_pred_catboost = model_catboost.predict(x_test)
```

```
Learning rate set to 0.008911
0:      learn: 0.6873382        total: 3.7ms    remaining: 3.69s
1:      learn: 0.6814495        total: 6.39ms   remaining: 3.19s
2:      learn: 0.6757707        total: 9.38ms   remaining: 3.12s
3:      learn: 0.6699594        total: 12.3ms   remaining: 3.07s
4:      learn: 0.6643071        total: 14.1ms   remaining: 2.81s
5:      learn: 0.6586778        total: 16.5ms   remaining: 2.73s
6:      learn: 0.6534965        total: 18.3ms   remaining: 2.59s
7:      learn: 0.6484308        total: 20.5ms   remaining: 2.54s
8:      learn: 0.6435631        total: 23.1ms   remaining: 2.55s
9:      learn: 0.6384417        total: 25.5ms   remaining: 2.53s
10:     learn: 0.6331897        total: 27.8ms   remaining: 2.5s
11:     learn: 0.6295968        total: 30.5ms   remaining: 2.51s
12:     learn: 0.6246575        total: 33.3ms   remaining: 2.53s
13:     learn: 0.6196201        total: 37.8ms   remaining: 2.66s
14:     learn: 0.6147832        total: 40.7ms   remaining: 2.67s
15:     learn: 0.6107804        total: 43.1ms   remaining: 2.65s
16:     learn: 0.6061339        total: 46.7ms   remaining: 2.7s
17:     learn: 0.6019731        total: 50ms     remaining: 2.73s
18:     learn: 0.5978610        total: 53.4ms   remaining: 2.76s
19:     learn: 0.5939687        total: 56.8ms   remaining: 2.78s
20:     learn: 0.5896404        total: 59.4ms   remaining: 2.77s
21:     learn: 0.5859911        total: 62.7ms   remaining: 2.79s
22:     learn: 0.5819175        total: 66.2ms   remaining: 2.81s
23:     learn: 0.5781531        total: 69.6ms   remaining: 2.83s
24:     learn: 0.5742221        total: 73ms     remaining: 2.85s
25:     learn: 0.5716425        total: 75.6ms   remaining: 2.83s
26:     learn: 0.5692565        total: 77.6ms   remaining: 2.8s
27:     learn: 0.5656028        total: 80.2ms   remaining: 2.78s
28:     learn: 0.5616221        total: 83.5ms   remaining: 2.8s
29:     learn: 0.5589024        total: 86.9ms   remaining: 2.81s
30:     learn: 0.5559787        total: 89.4ms   remaining: 2.79s
31:     learn: 0.5530263        total: 91.5ms   remaining: 2.77s
32:     learn: 0.5498130        total: 95ms     remaining: 2.78s
33:     learn: 0.5464717        total: 98.3ms   remaining: 2.79s
34:     learn: 0.5439340        total: 102ms    remaining: 2.8s
```

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35:     learn: 0.5416352        total: 105ms    remaining: 2.81s
36:     learn: 0.5383801        total: 108ms    remaining: 2.82s
37:     learn: 0.5357565        total: 112ms    remaining: 2.83s
38:     learn: 0.5334414        total: 113ms    remaining: 2.79s
39:     learn: 0.5307120        total: 117ms    remaining: 2.8s
40:     learn: 0.5283621        total: 120ms    remaining: 2.81s
41:     learn: 0.5260924        total: 122ms    remaining: 2.79s
42:     learn: 0.5236055        total: 126ms    remaining: 2.81s
43:     learn: 0.5213892        total: 129ms    remaining: 2.8s
44:     learn: 0.5187301        total: 132ms    remaining: 2.79s
45:     learn: 0.5158606        total: 135ms    remaining: 2.8s
46:     learn: 0.5138566        total: 138ms    remaining: 2.79s
47:     learn: 0.5118551        total: 141ms    remaining: 2.8s
48:     learn: 0.5096982        total: 144ms    remaining: 2.8s
49:     learn: 0.5076021        total: 148ms    remaining: 2.8s
50:     learn: 0.5051157        total: 151ms    remaining: 2.8s
51:     learn: 0.5026540        total: 154ms    remaining: 2.8s
52:     learn: 0.5014957        total: 155ms    remaining: 2.77s
53:     learn: 0.4996749        total: 158ms    remaining: 2.76s
54:     learn: 0.4973302        total: 160ms    remaining: 2.76s
55:     learn: 0.4948329        total: 164ms    remaining: 2.76s
56:     learn: 0.4930213        total: 167ms    remaining: 2.76s
57:     learn: 0.4908945        total: 170ms    remaining: 2.76s
58:     learn: 0.4885878        total: 173ms    remaining: 2.77s
59:     learn: 0.4867081        total: 176ms    remaining: 2.76s
60:     learn: 0.4845175        total: 180ms    remaining: 2.76s
61:     learn: 0.4830313        total: 182ms    remaining: 2.75s
62:     learn: 0.4809927        total: 189ms    remaining: 2.81s
63:     learn: 0.4787867        total: 193ms    remaining: 2.82s
64:     learn: 0.4768593        total: 196ms    remaining: 2.82s
65:     learn: 0.4753329        total: 206ms    remaining: 2.92s
66:     learn: 0.4737663        total: 210ms    remaining: 2.93s
67:     learn: 0.4720915        total: 214ms    remaining: 2.93s
68:     learn: 0.4703187        total: 218ms    remaining: 2.93s
69:     learn: 0.4687030        total: 221ms    remaining: 2.94s
70:     learn: 0.4668313        total: 225ms    remaining: 2.94s
71:     learn: 0.4652048        total: 228ms    remaining: 2.94s
72:     learn: 0.4635853        total: 231ms    remaining: 2.94s
73:     learn: 0.4621767        total: 235ms    remaining: 2.94s
74:     learn: 0.4604043        total: 238ms    remaining: 2.94s
75:     learn: 0.4586647        total: 242ms    remaining: 2.94s
76:     learn: 0.4574658        total: 245ms    remaining: 2.94s
77:     learn: 0.4566512        total: 248ms    remaining: 2.93s
78:     learn: 0.4553346        total: 251ms    remaining: 2.93s
79:     learn: 0.4543432        total: 255ms    remaining: 2.93s
80:     learn: 0.4529389        total: 258ms    remaining: 2.93s
81:     learn: 0.4514991        total: 261ms    remaining: 2.93s
82:     learn: 0.4502239        total: 265ms    remaining: 2.92s
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83:     learn: 0.4492037        total: 268ms    remaining: 2.92s
84:     learn: 0.4478834        total: 271ms    remaining: 2.92s
85:     learn: 0.4465419        total: 274ms    remaining: 2.91s
86:     learn: 0.4453395        total: 277ms    remaining: 2.91s
87:     learn: 0.4445328        total: 279ms    remaining: 2.89s
88:     learn: 0.4437493        total: 282ms    remaining: 2.89s
89:     learn: 0.4422742        total: 285ms    remaining: 2.88s
90:     learn: 0.4411252        total: 289ms    remaining: 2.88s
91:     learn: 0.4400183        total: 292ms    remaining: 2.88s
92:     learn: 0.4390395        total: 295ms    remaining: 2.87s
93:     learn: 0.4380999        total: 298ms    remaining: 2.87s
94:     learn: 0.4370863        total: 301ms    remaining: 2.87s
95:     learn: 0.4358992        total: 304ms    remaining: 2.86s
96:     learn: 0.4349475        total: 307ms    remaining: 2.86s
97:     learn: 0.4340189        total: 310ms    remaining: 2.85s
98:     learn: 0.4328332        total: 313ms    remaining: 2.85s
99:     learn: 0.4320286        total: 316ms    remaining: 2.85s
100:    learn: 0.4313060        total: 319ms    remaining: 2.84s
101:    learn: 0.4309450        total: 321ms    remaining: 2.83s
102:    learn: 0.4299453        total: 324ms    remaining: 2.82s
103:    learn: 0.4293672        total: 327ms    remaining: 2.82s
104:    learn: 0.4286292        total: 331ms    remaining: 2.82s
105:    learn: 0.4276768        total: 334ms    remaining: 2.81s
106:    learn: 0.4269259        total: 337ms    remaining: 2.81s
107:    learn: 0.4261791        total: 340ms    remaining: 2.81s
108:    learn: 0.4251842        total: 343ms    remaining: 2.81s
109:    learn: 0.4244097        total: 346ms    remaining: 2.8s
110:    learn: 0.4232563        total: 350ms    remaining: 2.8s
111:    learn: 0.4226457        total: 352ms    remaining: 2.79s
112:    learn: 0.4218529        total: 355ms    remaining: 2.78s
113:    learn: 0.4211370        total: 357ms    remaining: 2.78s
114:    learn: 0.4206720        total: 359ms    remaining: 2.76s
115:    learn: 0.4202390        total: 361ms    remaining: 2.75s
116:    learn: 0.4193944        total: 364ms    remaining: 2.75s
117:    learn: 0.4187656        total: 368ms    remaining: 2.75s
118:    learn: 0.4179986        total: 371ms    remaining: 2.75s
119:    learn: 0.4173514        total: 374ms    remaining: 2.75s
120:    learn: 0.4162610        total: 378ms    remaining: 2.75s
121:    learn: 0.4159933        total: 380ms    remaining: 2.73s
122:    learn: 0.4151391        total: 388ms    remaining: 2.76s
123:    learn: 0.4146966        total: 391ms    remaining: 2.76s
124:    learn: 0.4140672        total: 395ms    remaining: 2.76s
125:    learn: 0.4133396        total: 398ms    remaining: 2.76s
126:    learn: 0.4129969        total: 401ms    remaining: 2.76s
127:    learn: 0.4123252        total: 405ms    remaining: 2.76s
128:    learn: 0.4121657        total: 407ms    remaining: 2.75s
129:    learn: 0.4116847        total: 410ms    remaining: 2.74s
130:    learn: 0.4113766        total: 412ms    remaining: 2.73s
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131:    learn: 0.4107492        total: 416ms    remaining: 2.73s
132:    learn: 0.4101870        total: 419ms    remaining: 2.73s
133:    learn: 0.4095824        total: 422ms    remaining: 2.73s
134:    learn: 0.4088596        total: 426ms    remaining: 2.73s
135:    learn: 0.4081823        total: 429ms    remaining: 2.73s
136:    learn: 0.4077818        total: 433ms    remaining: 2.73s
137:    learn: 0.4073156        total: 437ms    remaining: 2.73s
138:    learn: 0.4067888        total: 440ms    remaining: 2.73s
139:    learn: 0.4063343        total: 443ms    remaining: 2.72s
140:    learn: 0.4056895        total: 447ms    remaining: 2.72s
141:    learn: 0.4050331        total: 450ms    remaining: 2.72s
142:    learn: 0.4046465        total: 452ms    remaining: 2.71s
143:    learn: 0.4042385        total: 455ms    remaining: 2.7s
144:    learn: 0.4037914        total: 458ms    remaining: 2.7s
145:    learn: 0.4034840        total: 460ms    remaining: 2.69s
146:    learn: 0.4027436        total: 464ms    remaining: 2.69s
147:    learn: 0.4021506        total: 467ms    remaining: 2.69s
148:    learn: 0.4017415        total: 470ms    remaining: 2.68s
149:    learn: 0.4013236        total: 473ms    remaining: 2.68s
150:    learn: 0.4009073        total: 476ms    remaining: 2.68s
151:    learn: 0.4004319        total: 480ms    remaining: 2.68s
152:    learn: 0.4000153        total: 483ms    remaining: 2.67s
153:    learn: 0.3996858        total: 486ms    remaining: 2.67s
154:    learn: 0.3991892        total: 489ms    remaining: 2.67s
155:    learn: 0.3986008        total: 492ms    remaining: 2.66s
156:    learn: 0.3980869        total: 496ms    remaining: 2.66s
157:    learn: 0.3974801        total: 499ms    remaining: 2.66s
158:    learn: 0.3971611        total: 502ms    remaining: 2.66s
159:    learn: 0.3967633        total: 506ms    remaining: 2.66s
160:    learn: 0.3964223        total: 509ms    remaining: 2.65s
161:    learn: 0.3959157        total: 513ms    remaining: 2.65s
162:    learn: 0.3957603        total: 515ms    remaining: 2.65s
163:    learn: 0.3953202        total: 519ms    remaining: 2.64s
164:    learn: 0.3948588        total: 522ms    remaining: 2.64s
165:    learn: 0.3945079        total: 525ms    remaining: 2.64s
166:    learn: 0.3939063        total: 529ms    remaining: 2.64s
167:    learn: 0.3934763        total: 532ms    remaining: 2.64s
168:    learn: 0.3930631        total: 536ms    remaining: 2.63s
169:    learn: 0.3929575        total: 537ms    remaining: 2.62s
170:    learn: 0.3924008        total: 541ms    remaining: 2.62s
171:    learn: 0.3921002        total: 544ms    remaining: 2.62s
172:    learn: 0.3916274        total: 548ms    remaining: 2.62s
173:    learn: 0.3915531        total: 549ms    remaining: 2.61s
174:    learn: 0.3911734        total: 553ms    remaining: 2.61s
175:    learn: 0.3905969        total: 556ms    remaining: 2.6s
176:    learn: 0.3902738        total: 560ms    remaining: 2.6s
177:    learn: 0.3899260        total: 563ms    remaining: 2.6s
178:    learn: 0.3897645        total: 566ms    remaining: 2.6s
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179:    learn: 0.3894258        total: 570ms    remaining: 2.59s
180:    learn: 0.3888948        total: 573ms    remaining: 2.59s
181:    learn: 0.3885675        total: 577ms    remaining: 2.59s
182:    learn: 0.3882781        total: 581ms    remaining: 2.59s
183:    learn: 0.3878560        total: 584ms    remaining: 2.59s
184:    learn: 0.3874949        total: 587ms    remaining: 2.59s
185:    learn: 0.3872174        total: 592ms    remaining: 2.59s
186:    learn: 0.3869178        total: 594ms    remaining: 2.58s
187:    learn: 0.3865117        total: 597ms    remaining: 2.58s
188:    learn: 0.3863086        total: 599ms    remaining: 2.57s
189:    learn: 0.3858566        total: 602ms    remaining: 2.56s
190:    learn: 0.3856523        total: 604ms    remaining: 2.56s
191:    learn: 0.3852587        total: 607ms    remaining: 2.55s
192:    learn: 0.3849731        total: 609ms    remaining: 2.54s
193:    learn: 0.3845737        total: 611ms    remaining: 2.54s
194:    learn: 0.3844028        total: 615ms    remaining: 2.54s
195:    learn: 0.3841026        total: 618ms    remaining: 2.54s
196:    learn: 0.3838036        total: 621ms    remaining: 2.53s
197:    learn: 0.3833346        total: 624ms    remaining: 2.53s
198:    learn: 0.3830231        total: 627ms    remaining: 2.52s
199:    learn: 0.3827714        total: 630ms    remaining: 2.52s
200:    learn: 0.3823982        total: 634ms    remaining: 2.52s
201:    learn: 0.3821057        total: 637ms    remaining: 2.52s
202:    learn: 0.3818536        total: 640ms    remaining: 2.51s
203:    learn: 0.3817831        total: 642ms    remaining: 2.5s
204:    learn: 0.3812656        total: 645ms    remaining: 2.5s
205:    learn: 0.3812252        total: 646ms    remaining: 2.49s
206:    learn: 0.3808662        total: 650ms    remaining: 2.49s
207:    learn: 0.3804931        total: 653ms    remaining: 2.48s
208:    learn: 0.3800493        total: 656ms    remaining: 2.48s
209:    learn: 0.3797887        total: 659ms    remaining: 2.48s
210:    learn: 0.3795260        total: 661ms    remaining: 2.47s
211:    learn: 0.3793141        total: 664ms    remaining: 2.47s
212:    learn: 0.3789575        total: 666ms    remaining: 2.46s
213:    learn: 0.3787689        total: 669ms    remaining: 2.46s
214:    learn: 0.3784875        total: 672ms    remaining: 2.45s
215:    learn: 0.3781213        total: 675ms    remaining: 2.45s
216:    learn: 0.3778110        total: 679ms    remaining: 2.45s
217:    learn: 0.3776621        total: 682ms    remaining: 2.45s
218:    learn: 0.3772633        total: 686ms    remaining: 2.44s
219:    learn: 0.3769747        total: 689ms    remaining: 2.44s
220:    learn: 0.3768150        total: 692ms    remaining: 2.44s
221:    learn: 0.3765344        total: 696ms    remaining: 2.44s
222:    learn: 0.3762683        total: 699ms    remaining: 2.44s
223:    learn: 0.3762166        total: 701ms    remaining: 2.43s
224:    learn: 0.3760024        total: 705ms    remaining: 2.43s
225:    learn: 0.3758325        total: 708ms    remaining: 2.42s
226:    learn: 0.3755053        total: 712ms    remaining: 2.42s
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227:    learn: 0.3752899        total: 715ms    remaining: 2.42s
228:    learn: 0.3750341        total: 717ms    remaining: 2.42s
229:    learn: 0.3747317        total: 721ms    remaining: 2.41s
230:    learn: 0.3744985        total: 724ms    remaining: 2.41s
231:    learn: 0.3743579        total: 728ms    remaining: 2.41s
232:    learn: 0.3740894        total: 731ms    remaining: 2.41s
233:    learn: 0.3737252        total: 735ms    remaining: 2.4s
234:    learn: 0.3736868        total: 737ms    remaining: 2.4s
235:    learn: 0.3732425        total: 740ms    remaining: 2.4s
236:    learn: 0.3730341        total: 744ms    remaining: 2.39s
237:    learn: 0.3727451        total: 748ms    remaining: 2.39s
238:    learn: 0.3726643        total: 751ms    remaining: 2.39s
239:    learn: 0.3725154        total: 754ms    remaining: 2.39s
240:    learn: 0.3721647        total: 757ms    remaining: 2.38s
241:    learn: 0.3718123        total: 761ms    remaining: 2.38s
242:    learn: 0.3717150        total: 764ms    remaining: 2.38s
243:    learn: 0.3715507        total: 767ms    remaining: 2.38s
244:    learn: 0.3713182        total: 770ms    remaining: 2.37s
245:    learn: 0.3710998        total: 773ms    remaining: 2.37s
246:    learn: 0.3709107        total: 776ms    remaining: 2.37s
247:    learn: 0.3708450        total: 779ms    remaining: 2.36s
248:    learn: 0.3704586        total: 782ms    remaining: 2.36s
249:    learn: 0.3702375        total: 785ms    remaining: 2.35s
250:    learn: 0.3700598        total: 788ms    remaining: 2.35s
251:    learn: 0.3696093        total: 792ms    remaining: 2.35s
252:    learn: 0.3694791        total: 794ms    remaining: 2.35s
253:    learn: 0.3693106        total: 796ms    remaining: 2.34s
254:    learn: 0.3690604        total: 798ms    remaining: 2.33s
255:    learn: 0.3688481        total: 801ms    remaining: 2.33s
256:    learn: 0.3686496        total: 804ms    remaining: 2.32s
257:    learn: 0.3685172        total: 807ms    remaining: 2.32s
258:    learn: 0.3682356        total: 809ms    remaining: 2.31s
259:    learn: 0.3680253        total: 812ms    remaining: 2.31s
260:    learn: 0.3678630        total: 816ms    remaining: 2.31s
261:    learn: 0.3676776        total: 819ms    remaining: 2.31s
262:    learn: 0.3675577        total: 822ms    remaining: 2.3s
263:    learn: 0.3674718        total: 824ms    remaining: 2.3s
264:    learn: 0.3672372        total: 827ms    remaining: 2.29s
265:    learn: 0.3670775        total: 831ms    remaining: 2.29s
266:    learn: 0.3668790        total: 833ms    remaining: 2.29s
267:    learn: 0.3667381        total: 836ms    remaining: 2.28s
268:    learn: 0.3665474        total: 839ms    remaining: 2.28s
269:    learn: 0.3665203        total: 841ms    remaining: 2.27s
270:    learn: 0.3663834        total: 843ms    remaining: 2.27s
271:    learn: 0.3662253        total: 846ms    remaining: 2.26s
272:    learn: 0.3659189        total: 848ms    remaining: 2.26s
273:    learn: 0.3657816        total: 851ms    remaining: 2.25s
274:    learn: 0.3656441        total: 854ms    remaining: 2.25s
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275:    learn: 0.3655200        total: 856ms    remaining: 2.25s
276:    learn: 0.3654143        total: 859ms    remaining: 2.24s
277:    learn: 0.3651294        total: 862ms    remaining: 2.24s
278:    learn: 0.3649642        total: 864ms    remaining: 2.23s
279:    learn: 0.3647313        total: 867ms    remaining: 2.23s
280:    learn: 0.3645594        total: 870ms    remaining: 2.22s
281:    learn: 0.3643355        total: 872ms    remaining: 2.22s
282:    learn: 0.3641975        total: 875ms    remaining: 2.21s
283:    learn: 0.3639722        total: 878ms    remaining: 2.21s
284:    learn: 0.3638443        total: 881ms    remaining: 2.21s
285:    learn: 0.3637799        total: 884ms    remaining: 2.21s
286:    learn: 0.3636857        total: 887ms    remaining: 2.2s
287:    learn: 0.3636751        total: 889ms    remaining: 2.2s
288:    learn: 0.3634139        total: 892ms    remaining: 2.19s
289:    learn: 0.3632249        total: 895ms    remaining: 2.19s
290:    learn: 0.3631516        total: 898ms    remaining: 2.19s
291:    learn: 0.3631359        total: 899ms    remaining: 2.18s
292:    learn: 0.3630044        total: 903ms    remaining: 2.18s
293:    learn: 0.3626706        total: 906ms    remaining: 2.17s
294:    learn: 0.3624326        total: 909ms    remaining: 2.17s
295:    learn: 0.3623538        total: 912ms    remaining: 2.17s
296:    learn: 0.3622263        total: 915ms    remaining: 2.17s
297:    learn: 0.3620627        total: 918ms    remaining: 2.16s
298:    learn: 0.3620488        total: 921ms    remaining: 2.16s
299:    learn: 0.3619864        total: 923ms    remaining: 2.15s
300:    learn: 0.3618287        total: 927ms    remaining: 2.15s
301:    learn: 0.3616512        total: 931ms    remaining: 2.15s
302:    learn: 0.3616117        total: 934ms    remaining: 2.15s
303:    learn: 0.3614754        total: 937ms    remaining: 2.15s
304:    learn: 0.3613744        total: 942ms    remaining: 2.15s
305:    learn: 0.3612703        total: 945ms    remaining: 2.14s
306:    learn: 0.3611587        total: 948ms    remaining: 2.14s
307:    learn: 0.3611071        total: 950ms    remaining: 2.13s
308:    learn: 0.3608803        total: 954ms    remaining: 2.13s
309:    learn: 0.3607773        total: 956ms    remaining: 2.13s
310:    learn: 0.3606957        total: 960ms    remaining: 2.13s
311:    learn: 0.3605497        total: 963ms    remaining: 2.12s
312:    learn: 0.3603944        total: 967ms    remaining: 2.12s
313:    learn: 0.3603446        total: 972ms    remaining: 2.12s
314:    learn: 0.3602047        total: 976ms    remaining: 2.12s
315:    learn: 0.3600473        total: 986ms    remaining: 2.13s
316:    learn: 0.3598737        total: 990ms    remaining: 2.13s
317:    learn: 0.3598200        total: 992ms    remaining: 2.13s
318:    learn: 0.3595464        total: 995ms    remaining: 2.12s
319:    learn: 0.3594214        total: 998ms    remaining: 2.12s
320:    learn: 0.3591621        total: 1s       remaining: 2.12s
321:    learn: 0.3589540        total: 1s       remaining: 2.12s
322:    learn: 0.3589056        total: 1.01s    remaining: 2.11s
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323:    learn: 0.3587961        total: 1.01s    remaining: 2.11s
324:    learn: 0.3586448        total: 1.01s    remaining: 2.11s
325:    learn: 0.3584721        total: 1.02s    remaining: 2.1s
326:    learn: 0.3583599        total: 1.02s    remaining: 2.1s
327:    learn: 0.3582531        total: 1.02s    remaining: 2.1s
328:    learn: 0.3581882        total: 1.03s    remaining: 2.1s
329:    learn: 0.3579756        total: 1.03s    remaining: 2.1s
330:    learn: 0.3576333        total: 1.03s    remaining: 2.09s
331:    learn: 0.3574297        total: 1.04s    remaining: 2.09s
332:    learn: 0.3572702        total: 1.04s    remaining: 2.09s
333:    learn: 0.3571026        total: 1.05s    remaining: 2.09s
334:    learn: 0.3569593        total: 1.05s    remaining: 2.08s
335:    learn: 0.3567804        total: 1.05s    remaining: 2.08s
336:    learn: 0.3566202        total: 1.06s    remaining: 2.08s
337:    learn: 0.3565122        total: 1.06s    remaining: 2.08s
338:    learn: 0.3564232        total: 1.06s    remaining: 2.08s
339:    learn: 0.3561297        total: 1.07s    remaining: 2.07s
340:    learn: 0.3559845        total: 1.07s    remaining: 2.07s
341:    learn: 0.3556856        total: 1.08s    remaining: 2.07s
342:    learn: 0.3553970        total: 1.08s    remaining: 2.07s
343:    learn: 0.3549894        total: 1.08s    remaining: 2.07s
344:    learn: 0.3547308        total: 1.09s    remaining: 2.06s
345:    learn: 0.3546207        total: 1.09s    remaining: 2.06s
346:    learn: 0.3544499        total: 1.09s    remaining: 2.06s
347:    learn: 0.3542093        total: 1.1s     remaining: 2.06s
348:    learn: 0.3541362        total: 1.1s     remaining: 2.05s
349:    learn: 0.3540479        total: 1.1s     remaining: 2.05s
350:    learn: 0.3539838        total: 1.11s    remaining: 2.05s
351:    learn: 0.3537166        total: 1.11s    remaining: 2.04s
352:    learn: 0.3536201        total: 1.11s    remaining: 2.04s
353:    learn: 0.3535335        total: 1.12s    remaining: 2.04s
354:    learn: 0.3534217        total: 1.12s    remaining: 2.04s
355:    learn: 0.3532936        total: 1.12s    remaining: 2.03s
356:    learn: 0.3532487        total: 1.13s    remaining: 2.03s
357:    learn: 0.3529228        total: 1.13s    remaining: 2.03s
358:    learn: 0.3526886        total: 1.14s    remaining: 2.03s
359:    learn: 0.3525187        total: 1.14s    remaining: 2.03s
360:    learn: 0.3523680        total: 1.14s    remaining: 2.02s
361:    learn: 0.3523305        total: 1.15s    remaining: 2.02s
362:    learn: 0.3521294        total: 1.15s    remaining: 2.02s
363:    learn: 0.3519612        total: 1.15s    remaining: 2.01s
364:    learn: 0.3518772        total: 1.15s    remaining: 2.01s
365:    learn: 0.3518350        total: 1.16s    remaining: 2s
366:    learn: 0.3516257        total: 1.16s    remaining: 2s
367:    learn: 0.3515015        total: 1.16s    remaining: 2s
368:    learn: 0.3514396        total: 1.17s    remaining: 2s
369:    learn: 0.3513694        total: 1.17s    remaining: 1.99s
370:    learn: 0.3513501        total: 1.17s    remaining: 1.99s
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371:    learn: 0.3512034        total: 1.18s    remaining: 1.99s
372:    learn: 0.3510075        total: 1.19s    remaining: 1.99s
373:    learn: 0.3509169        total: 1.19s    remaining: 1.99s
374:    learn: 0.3507138        total: 1.19s    remaining: 1.99s
375:    learn: 0.3506456        total: 1.2s     remaining: 1.98s
376:    learn: 0.3505994        total: 1.2s     remaining: 1.98s
377:    learn: 0.3504550        total: 1.2s     remaining: 1.98s
378:    learn: 0.3503949        total: 1.21s    remaining: 1.98s
379:    learn: 0.3502479        total: 1.21s    remaining: 1.97s
380:    learn: 0.3501809        total: 1.21s    remaining: 1.97s
381:    learn: 0.3500567        total: 1.22s    remaining: 1.97s
382:    learn: 0.3499410        total: 1.22s    remaining: 1.97s
383:    learn: 0.3497386        total: 1.22s    remaining: 1.96s
384:    learn: 0.3496669        total: 1.23s    remaining: 1.96s
385:    learn: 0.3496080        total: 1.23s    remaining: 1.96s
386:    learn: 0.3494620        total: 1.23s    remaining: 1.96s
387:    learn: 0.3493818        total: 1.24s    remaining: 1.95s
388:    learn: 0.3491923        total: 1.24s    remaining: 1.95s
389:    learn: 0.3490555        total: 1.25s    remaining: 1.95s
390:    learn: 0.3487414        total: 1.25s    remaining: 1.95s
391:    learn: 0.3485541        total: 1.25s    remaining: 1.94s
392:    learn: 0.3484630        total: 1.26s    remaining: 1.94s
393:    learn: 0.3483991        total: 1.26s    remaining: 1.94s
394:    learn: 0.3483549        total: 1.26s    remaining: 1.93s
395:    learn: 0.3482663        total: 1.26s    remaining: 1.93s
396:    learn: 0.3481375        total: 1.27s    remaining: 1.93s
397:    learn: 0.3480288        total: 1.27s    remaining: 1.92s
398:    learn: 0.3478206        total: 1.27s    remaining: 1.92s
399:    learn: 0.3477222        total: 1.28s    remaining: 1.92s
400:    learn: 0.3476589        total: 1.28s    remaining: 1.92s
401:    learn: 0.3475296        total: 1.28s    remaining: 1.91s
402:    learn: 0.3471696        total: 1.29s    remaining: 1.91s
403:    learn: 0.3470769        total: 1.29s    remaining: 1.91s
404:    learn: 0.3467578        total: 1.29s    remaining: 1.9s
405:    learn: 0.3466452        total: 1.3s     remaining: 1.9s
406:    learn: 0.3464496        total: 1.3s     remaining: 1.9s
407:    learn: 0.3463568        total: 1.3s     remaining: 1.89s
408:    learn: 0.3461299        total: 1.31s    remaining: 1.89s
409:    learn: 0.3459631        total: 1.31s    remaining: 1.89s
410:    learn: 0.3458402        total: 1.31s    remaining: 1.89s
411:    learn: 0.3455856        total: 1.32s    remaining: 1.88s
412:    learn: 0.3454456        total: 1.32s    remaining: 1.88s
413:    learn: 0.3452758        total: 1.32s    remaining: 1.88s
414:    learn: 0.3451988        total: 1.33s    remaining: 1.87s
415:    learn: 0.3451310        total: 1.33s    remaining: 1.87s
416:    learn: 0.3450205        total: 1.33s    remaining: 1.87s
417:    learn: 0.3447640        total: 1.34s    remaining: 1.86s
418:    learn: 0.3445384        total: 1.34s    remaining: 1.86s
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419:    learn: 0.3443237        total: 1.35s    remaining: 1.86s
420:    learn: 0.3442674        total: 1.35s    remaining: 1.86s
421:    learn: 0.3440609        total: 1.35s    remaining: 1.85s
422:    learn: 0.3438997        total: 1.36s    remaining: 1.85s
423:    learn: 0.3437988        total: 1.36s    remaining: 1.85s
424:    learn: 0.3435673        total: 1.36s    remaining: 1.84s
425:    learn: 0.3434309        total: 1.37s    remaining: 1.84s
426:    learn: 0.3433536        total: 1.37s    remaining: 1.84s
427:    learn: 0.3432635        total: 1.37s    remaining: 1.83s
428:    learn: 0.3432099        total: 1.38s    remaining: 1.83s
429:    learn: 0.3431853        total: 1.38s    remaining: 1.83s
430:    learn: 0.3430897        total: 1.39s    remaining: 1.83s
431:    learn: 0.3428719        total: 1.39s    remaining: 1.83s
432:    learn: 0.3428345        total: 1.39s    remaining: 1.82s
433:    learn: 0.3427350        total: 1.39s    remaining: 1.82s
434:    learn: 0.3426850        total: 1.4s     remaining: 1.81s
435:    learn: 0.3425685        total: 1.4s     remaining: 1.81s
436:    learn: 0.3425622        total: 1.4s     remaining: 1.81s
437:    learn: 0.3424590        total: 1.4s     remaining: 1.8s
438:    learn: 0.3420261        total: 1.41s    remaining: 1.8s
439:    learn: 0.3419427        total: 1.41s    remaining: 1.79s
440:    learn: 0.3419014        total: 1.41s    remaining: 1.79s
441:    learn: 0.3418112        total: 1.42s    remaining: 1.79s
442:    learn: 0.3416953        total: 1.42s    remaining: 1.78s
443:    learn: 0.3414722        total: 1.42s    remaining: 1.78s
444:    learn: 0.3413436        total: 1.42s    remaining: 1.78s
445:    learn: 0.3413032        total: 1.43s    remaining: 1.77s
446:    learn: 0.3409846        total: 1.43s    remaining: 1.77s
447:    learn: 0.3408993        total: 1.43s    remaining: 1.77s
448:    learn: 0.3408426        total: 1.44s    remaining: 1.76s
449:    learn: 0.3407779        total: 1.44s    remaining: 1.76s
450:    learn: 0.3407412        total: 1.44s    remaining: 1.76s
451:    learn: 0.3406706        total: 1.45s    remaining: 1.75s
452:    learn: 0.3405466        total: 1.45s    remaining: 1.75s
453:    learn: 0.3404366        total: 1.45s    remaining: 1.75s
454:    learn: 0.3402343        total: 1.46s    remaining: 1.74s
455:    learn: 0.3401728        total: 1.46s    remaining: 1.74s
456:    learn: 0.3400261        total: 1.46s    remaining: 1.74s
457:    learn: 0.3399237        total: 1.47s    remaining: 1.73s
458:    learn: 0.3398142        total: 1.47s    remaining: 1.73s
459:    learn: 0.3397267        total: 1.47s    remaining: 1.73s
460:    learn: 0.3395417        total: 1.48s    remaining: 1.73s
461:    learn: 0.3395075        total: 1.48s    remaining: 1.72s
462:    learn: 0.3394488        total: 1.48s    remaining: 1.72s
463:    learn: 0.3394226        total: 1.48s    remaining: 1.72s
464:    learn: 0.3392128        total: 1.49s    remaining: 1.71s
465:    learn: 0.3390040        total: 1.49s    remaining: 1.71s
466:    learn: 0.3389094        total: 1.49s    remaining: 1.71s
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467:    learn: 0.3387967        total: 1.5s     remaining: 1.7s
468:    learn: 0.3386382        total: 1.5s     remaining: 1.7s
469:    learn: 0.3386074        total: 1.5s     remaining: 1.7s
470:    learn: 0.3385275        total: 1.51s    remaining: 1.69s
471:    learn: 0.3383822        total: 1.51s    remaining: 1.69s
472:    learn: 0.3381710        total: 1.51s    remaining: 1.69s
473:    learn: 0.3380164        total: 1.52s    remaining: 1.69s
474:    learn: 0.3379515        total: 1.52s    remaining: 1.68s
475:    learn: 0.3377986        total: 1.52s    remaining: 1.68s
476:    learn: 0.3376119        total: 1.53s    remaining: 1.68s
477:    learn: 0.3376009        total: 1.53s    remaining: 1.67s
478:    learn: 0.3375476        total: 1.53s    remaining: 1.67s
479:    learn: 0.3375376        total: 1.54s    remaining: 1.66s
480:    learn: 0.3375056        total: 1.54s    remaining: 1.66s
481:    learn: 0.3373180        total: 1.54s    remaining: 1.66s
482:    learn: 0.3372707        total: 1.54s    remaining: 1.65s
483:    learn: 0.3371810        total: 1.55s    remaining: 1.65s
484:    learn: 0.3371520        total: 1.55s    remaining: 1.65s
485:    learn: 0.3370701        total: 1.55s    remaining: 1.65s
486:    learn: 0.3369718        total: 1.56s    remaining: 1.64s
487:    learn: 0.3368130        total: 1.56s    remaining: 1.64s
488:    learn: 0.3367091        total: 1.56s    remaining: 1.64s
489:    learn: 0.3365652        total: 1.57s    remaining: 1.63s
490:    learn: 0.3365299        total: 1.57s    remaining: 1.63s
491:    learn: 0.3363863        total: 1.57s    remaining: 1.63s
492:    learn: 0.3362917        total: 1.58s    remaining: 1.62s
493:    learn: 0.3362571        total: 1.58s    remaining: 1.62s
494:    learn: 0.3362469        total: 1.58s    remaining: 1.61s
495:    learn: 0.3361371        total: 1.59s    remaining: 1.61s
496:    learn: 0.3360659        total: 1.59s    remaining: 1.61s
497:    learn: 0.3359965        total: 1.59s    remaining: 1.6s
498:    learn: 0.3358331        total: 1.59s    remaining: 1.6s
499:    learn: 0.3356936        total: 1.6s     remaining: 1.6s
500:    learn: 0.3356029        total: 1.6s     remaining: 1.59s
501:    learn: 0.3353790        total: 1.6s     remaining: 1.59s
502:    learn: 0.3352960        total: 1.61s    remaining: 1.59s
503:    learn: 0.3351102        total: 1.61s    remaining: 1.58s
504:    learn: 0.3350278        total: 1.61s    remaining: 1.58s
505:    learn: 0.3349226        total: 1.61s    remaining: 1.58s
506:    learn: 0.3348609        total: 1.62s    remaining: 1.57s
507:    learn: 0.3347810        total: 1.62s    remaining: 1.57s
508:    learn: 0.3347386        total: 1.63s    remaining: 1.57s
509:    learn: 0.3345712        total: 1.63s    remaining: 1.56s
510:    learn: 0.3344393        total: 1.63s    remaining: 1.56s
511:    learn: 0.3343600        total: 1.64s    remaining: 1.56s
512:    learn: 0.3342955        total: 1.64s    remaining: 1.56s
513:    learn: 0.3342604        total: 1.64s    remaining: 1.55s
514:    learn: 0.3341575        total: 1.65s    remaining: 1.55s
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515:    learn: 0.3340810        total: 1.65s    remaining: 1.55s
516:    learn: 0.3339420        total: 1.65s    remaining: 1.54s
517:    learn: 0.3338534        total: 1.66s    remaining: 1.54s
518:    learn: 0.3337624        total: 1.66s    remaining: 1.54s
519:    learn: 0.3336640        total: 1.66s    remaining: 1.53s
520:    learn: 0.3334899        total: 1.67s    remaining: 1.53s
521:    learn: 0.3334318        total: 1.67s    remaining: 1.53s
522:    learn: 0.3333955        total: 1.67s    remaining: 1.53s
523:    learn: 0.3333302        total: 1.68s    remaining: 1.52s
524:    learn: 0.3331762        total: 1.68s    remaining: 1.52s
525:    learn: 0.3330613        total: 1.68s    remaining: 1.52s
526:    learn: 0.3329327        total: 1.69s    remaining: 1.51s
527:    learn: 0.3327866        total: 1.69s    remaining: 1.51s
528:    learn: 0.3326733        total: 1.69s    remaining: 1.51s
529:    learn: 0.3325197        total: 1.7s     remaining: 1.51s
530:    learn: 0.3323716        total: 1.7s     remaining: 1.5s
531:    learn: 0.3323039        total: 1.71s    remaining: 1.5s
532:    learn: 0.3322373        total: 1.71s    remaining: 1.5s
533:    learn: 0.3321185        total: 1.71s    remaining: 1.5s
534:    learn: 0.3319187        total: 1.72s    remaining: 1.49s
535:    learn: 0.3318226        total: 1.72s    remaining: 1.49s
536:    learn: 0.3316507        total: 1.72s    remaining: 1.49s
537:    learn: 0.3315872        total: 1.73s    remaining: 1.48s
538:    learn: 0.3313350        total: 1.73s    remaining: 1.48s
539:    learn: 0.3312482        total: 1.73s    remaining: 1.48s
540:    learn: 0.3309644        total: 1.74s    remaining: 1.47s
541:    learn: 0.3307170        total: 1.74s    remaining: 1.47s
542:    learn: 0.3305402        total: 1.74s    remaining: 1.47s
543:    learn: 0.3304458        total: 1.75s    remaining: 1.46s
544:    learn: 0.3303560        total: 1.75s    remaining: 1.46s
545:    learn: 0.3303539        total: 1.75s    remaining: 1.46s
546:    learn: 0.3303175        total: 1.75s    remaining: 1.45s
547:    learn: 0.3301970        total: 1.76s    remaining: 1.45s
548:    learn: 0.3301877        total: 1.76s    remaining: 1.44s
549:    learn: 0.3300884        total: 1.76s    remaining: 1.44s
550:    learn: 0.3298450        total: 1.76s    remaining: 1.44s
551:    learn: 0.3296908        total: 1.77s    remaining: 1.43s
552:    learn: 0.3296650        total: 1.77s    remaining: 1.43s
553:    learn: 0.3295646        total: 1.77s    remaining: 1.43s
554:    learn: 0.3295388        total: 1.78s    remaining: 1.42s
555:    learn: 0.3294846        total: 1.78s    remaining: 1.42s
556:    learn: 0.3293262        total: 1.79s    remaining: 1.42s
557:    learn: 0.3292157        total: 1.79s    remaining: 1.42s
558:    learn: 0.3290473        total: 1.79s    remaining: 1.41s
559:    learn: 0.3290308        total: 1.8s     remaining: 1.41s
560:    learn: 0.3288724        total: 1.8s     remaining: 1.41s
561:    learn: 0.3287484        total: 1.8s     remaining: 1.41s
562:    learn: 0.3286357        total: 1.81s    remaining: 1.4s
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563:    learn: 0.3284583        total: 1.81s    remaining: 1.4s
564:    learn: 0.3284314        total: 1.81s    remaining: 1.4s
565:    learn: 0.3283930        total: 1.82s    remaining: 1.4s
566:    learn: 0.3283192        total: 1.82s    remaining: 1.39s
567:    learn: 0.3282208        total: 1.83s    remaining: 1.39s
568:    learn: 0.3280504        total: 1.83s    remaining: 1.39s
569:    learn: 0.3280216        total: 1.83s    remaining: 1.38s
570:    learn: 0.3278425        total: 1.84s    remaining: 1.38s
571:    learn: 0.3277497        total: 1.84s    remaining: 1.38s
572:    learn: 0.3276305        total: 1.84s    remaining: 1.37s
573:    learn: 0.3274584        total: 1.85s    remaining: 1.37s
574:    learn: 0.3274057        total: 1.85s    remaining: 1.37s
575:    learn: 0.3273867        total: 1.85s    remaining: 1.36s
576:    learn: 0.3272328        total: 1.85s    remaining: 1.36s
577:    learn: 0.3271041        total: 1.86s    remaining: 1.36s
578:    learn: 0.3269708        total: 1.86s    remaining: 1.35s
579:    learn: 0.3268349        total: 1.86s    remaining: 1.35s
580:    learn: 0.3267103        total: 1.87s    remaining: 1.35s
581:    learn: 0.3266494        total: 1.87s    remaining: 1.34s
582:    learn: 0.3264064        total: 1.88s    remaining: 1.34s
583:    learn: 0.3263134        total: 1.88s    remaining: 1.34s
584:    learn: 0.3261921        total: 1.88s    remaining: 1.33s
585:    learn: 0.3261408        total: 1.89s    remaining: 1.33s
586:    learn: 0.3260458        total: 1.89s    remaining: 1.33s
587:    learn: 0.3259425        total: 1.89s    remaining: 1.32s
588:    learn: 0.3259003        total: 1.9s     remaining: 1.32s
589:    learn: 0.3258112        total: 1.9s     remaining: 1.32s
590:    learn: 0.3257256        total: 1.9s     remaining: 1.31s
591:    learn: 0.3256686        total: 1.9s     remaining: 1.31s
592:    learn: 0.3256188        total: 1.91s    remaining: 1.31s
593:    learn: 0.3255294        total: 1.91s    remaining: 1.3s
594:    learn: 0.3254401        total: 1.91s    remaining: 1.3s
595:    learn: 0.3252772        total: 1.92s    remaining: 1.3s
596:    learn: 0.3250674        total: 1.92s    remaining: 1.29s
597:    learn: 0.3250093        total: 1.92s    remaining: 1.29s
598:    learn: 0.3249212        total: 1.93s    remaining: 1.29s
599:    learn: 0.3247222        total: 1.93s    remaining: 1.28s
600:    learn: 0.3246934        total: 1.93s    remaining: 1.28s
601:    learn: 0.3245874        total: 1.94s    remaining: 1.28s
602:    learn: 0.3243587        total: 1.94s    remaining: 1.28s
603:    learn: 0.3242675        total: 1.94s    remaining: 1.27s
604:    learn: 0.3242356        total: 1.94s    remaining: 1.27s
605:    learn: 0.3241863        total: 1.95s    remaining: 1.27s
606:    learn: 0.3241449        total: 1.95s    remaining: 1.26s
607:    learn: 0.3240383        total: 1.96s    remaining: 1.26s
608:    learn: 0.3240146        total: 1.96s    remaining: 1.26s
609:    learn: 0.3239182        total: 1.96s    remaining: 1.25s
610:    learn: 0.3235824        total: 1.96s    remaining: 1.25s
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611:    learn: 0.3234301        total: 1.97s    remaining: 1.25s
612:    learn: 0.3233607        total: 1.97s    remaining: 1.24s
613:    learn: 0.3232309        total: 1.98s    remaining: 1.24s
614:    learn: 0.3230537        total: 1.98s    remaining: 1.24s
615:    learn: 0.3230056        total: 1.99s    remaining: 1.24s
616:    learn: 0.3228124        total: 1.99s    remaining: 1.23s
617:    learn: 0.3227567        total: 1.99s    remaining: 1.23s
618:    learn: 0.3227301        total: 2s       remaining: 1.23s
619:    learn: 0.3226491        total: 2s       remaining: 1.23s
620:    learn: 0.3225651        total: 2s       remaining: 1.22s
621:    learn: 0.3223884        total: 2s       remaining: 1.22s
622:    learn: 0.3223472        total: 2.01s    remaining: 1.22s
623:    learn: 0.3221503        total: 2.01s    remaining: 1.21s
624:    learn: 0.3220536        total: 2.02s    remaining: 1.21s
625:    learn: 0.3219580        total: 2.02s    remaining: 1.21s
626:    learn: 0.3218109        total: 2.02s    remaining: 1.2s
627:    learn: 0.3216916        total: 2.02s    remaining: 1.2s
628:    learn: 0.3216459        total: 2.03s    remaining: 1.2s
629:    learn: 0.3215854        total: 2.03s    remaining: 1.19s
630:    learn: 0.3215001        total: 2.03s    remaining: 1.19s
631:    learn: 0.3213352        total: 2.04s    remaining: 1.19s
632:    learn: 0.3212666        total: 2.04s    remaining: 1.18s
633:    learn: 0.3211177        total: 2.04s    remaining: 1.18s
634:    learn: 0.3209899        total: 2.05s    remaining: 1.18s
635:    learn: 0.3209774        total: 2.05s    remaining: 1.17s
636:    learn: 0.3209189        total: 2.06s    remaining: 1.17s
637:    learn: 0.3206917        total: 2.06s    remaining: 1.17s
638:    learn: 0.3205797        total: 2.06s    remaining: 1.16s
639:    learn: 0.3204509        total: 2.06s    remaining: 1.16s
640:    learn: 0.3201483        total: 2.07s    remaining: 1.16s
641:    learn: 0.3200852        total: 2.07s    remaining: 1.16s
642:    learn: 0.3198622        total: 2.08s    remaining: 1.15s
643:    learn: 0.3197864        total: 2.08s    remaining: 1.15s
644:    learn: 0.3196922        total: 2.08s    remaining: 1.15s
645:    learn: 0.3194858        total: 2.08s    remaining: 1.14s
646:    learn: 0.3194097        total: 2.09s    remaining: 1.14s
647:    learn: 0.3192122        total: 2.09s    remaining: 1.14s
648:    learn: 0.3190550        total: 2.1s     remaining: 1.13s
649:    learn: 0.3190415        total: 2.1s     remaining: 1.13s
650:    learn: 0.3190335        total: 2.1s     remaining: 1.13s
651:    learn: 0.3189693        total: 2.1s     remaining: 1.12s
652:    learn: 0.3189368        total: 2.1s     remaining: 1.12s
653:    learn: 0.3187507        total: 2.11s    remaining: 1.11s
654:    learn: 0.3187256        total: 2.11s    remaining: 1.11s
655:    learn: 0.3186848        total: 2.12s    remaining: 1.11s
656:    learn: 0.3186104        total: 2.12s    remaining: 1.11s
657:    learn: 0.3184287        total: 2.12s    remaining: 1.1s
658:    learn: 0.3183470        total: 2.13s    remaining: 1.1s
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659:    learn: 0.3181682        total: 2.13s    remaining: 1.1s
660:    learn: 0.3181269        total: 2.13s    remaining: 1.09s
661:    learn: 0.3180291        total: 2.14s    remaining: 1.09s
662:    learn: 0.3179391        total: 2.14s    remaining: 1.09s
663:    learn: 0.3177954        total: 2.14s    remaining: 1.08s
664:    learn: 0.3177028        total: 2.15s    remaining: 1.08s
665:    learn: 0.3176745        total: 2.15s    remaining: 1.08s
666:    learn: 0.3174799        total: 2.15s    remaining: 1.07s
667:    learn: 0.3173740        total: 2.15s    remaining: 1.07s
668:    learn: 0.3172210        total: 2.16s    remaining: 1.07s
669:    learn: 0.3171815        total: 2.16s    remaining: 1.06s
670:    learn: 0.3171690        total: 2.16s    remaining: 1.06s
671:    learn: 0.3171146        total: 2.17s    remaining: 1.06s
672:    learn: 0.3170431        total: 2.17s    remaining: 1.05s
673:    learn: 0.3169521        total: 2.17s    remaining: 1.05s
674:    learn: 0.3168876        total: 2.18s    remaining: 1.05s
675:    learn: 0.3167723        total: 2.18s    remaining: 1.04s
676:    learn: 0.3165434        total: 2.18s    remaining: 1.04s
677:    learn: 0.3164651        total: 2.18s    remaining: 1.04s
678:    learn: 0.3162072        total: 2.19s    remaining: 1.03s
679:    learn: 0.3160995        total: 2.19s    remaining: 1.03s
680:    learn: 0.3160121        total: 2.19s    remaining: 1.03s
681:    learn: 0.3158504        total: 2.19s    remaining: 1.02s
682:    learn: 0.3155742        total: 2.2s     remaining: 1.02s
683:    learn: 0.3153484        total: 2.2s     remaining: 1.02s
684:    learn: 0.3152781        total: 2.2s     remaining: 1.01s
685:    learn: 0.3152471        total: 2.21s    remaining: 1.01s
686:    learn: 0.3151567        total: 2.21s    remaining: 1.01s
687:    learn: 0.3150760        total: 2.21s    remaining: 1s
688:    learn: 0.3149385        total: 2.22s    remaining: 1s
689:    learn: 0.3148466        total: 2.22s    remaining: 997ms
690:    learn: 0.3147809        total: 2.22s    remaining: 994ms
691:    learn: 0.3146032        total: 2.23s    remaining: 991ms
692:    learn: 0.3144197        total: 2.23s    remaining: 988ms
693:    learn: 0.3143789        total: 2.23s    remaining: 985ms
694:    learn: 0.3142572        total: 2.24s    remaining: 982ms
695:    learn: 0.3140689        total: 2.24s    remaining: 979ms
696:    learn: 0.3140161        total: 2.24s    remaining: 975ms
697:    learn: 0.3138208        total: 2.25s    remaining: 972ms
698:    learn: 0.3136955        total: 2.25s    remaining: 969ms
699:    learn: 0.3136150        total: 2.25s    remaining: 966ms
700:    learn: 0.3135775        total: 2.25s    remaining: 962ms
701:    learn: 0.3135064        total: 2.26s    remaining: 959ms
702:    learn: 0.3135003        total: 2.26s    remaining: 955ms
703:    learn: 0.3134965        total: 2.26s    remaining: 951ms
704:    learn: 0.3133540        total: 2.27s    remaining: 948ms
705:    learn: 0.3132436        total: 2.27s    remaining: 945ms
706:    learn: 0.3131473        total: 2.27s    remaining: 942ms
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707:    learn: 0.3130748        total: 2.27s    remaining: 939ms
708:    learn: 0.3128492        total: 2.28s    remaining: 935ms
709:    learn: 0.3127921        total: 2.28s    remaining: 932ms
710:    learn: 0.3126609        total: 2.29s    remaining: 929ms
711:    learn: 0.3125155        total: 2.29s    remaining: 927ms
712:    learn: 0.3125055        total: 2.29s    remaining: 923ms
713:    learn: 0.3123957        total: 2.3s     remaining: 920ms
714:    learn: 0.3123685        total: 2.3s     remaining: 917ms
715:    learn: 0.3122984        total: 2.3s     remaining: 914ms
716:    learn: 0.3121576        total: 2.31s    remaining: 911ms
717:    learn: 0.3121510        total: 2.31s    remaining: 907ms
718:    learn: 0.3120436        total: 2.31s    remaining: 904ms
719:    learn: 0.3119240        total: 2.32s    remaining: 901ms
720:    learn: 0.3117322        total: 2.32s    remaining: 898ms
721:    learn: 0.3116116        total: 2.33s    remaining: 895ms
722:    learn: 0.3115562        total: 2.33s    remaining: 892ms
723:    learn: 0.3114457        total: 2.33s    remaining: 889ms
724:    learn: 0.3113777        total: 2.33s    remaining: 885ms
725:    learn: 0.3112565        total: 2.34s    remaining: 882ms
726:    learn: 0.3111369        total: 2.34s    remaining: 878ms
727:    learn: 0.3110540        total: 2.34s    remaining: 875ms
728:    learn: 0.3110290        total: 2.35s    remaining: 872ms
729:    learn: 0.3109916        total: 2.35s    remaining: 869ms
730:    learn: 0.3109269        total: 2.35s    remaining: 866ms
731:    learn: 0.3108181        total: 2.36s    remaining: 863ms
732:    learn: 0.3108009        total: 2.36s    remaining: 859ms
733:    learn: 0.3107177        total: 2.36s    remaining: 856ms
734:    learn: 0.3104959        total: 2.37s    remaining: 854ms
735:    learn: 0.3103897        total: 2.37s    remaining: 851ms
736:    learn: 0.3103166        total: 2.38s    remaining: 848ms
737:    learn: 0.3102668        total: 2.38s    remaining: 845ms
738:    learn: 0.3102079        total: 2.38s    remaining: 842ms
739:    learn: 0.3101395        total: 2.39s    remaining: 839ms
740:    learn: 0.3100633        total: 2.39s    remaining: 835ms
741:    learn: 0.3099218        total: 2.39s    remaining: 832ms
742:    learn: 0.3097766        total: 2.4s     remaining: 829ms
743:    learn: 0.3096445        total: 2.4s     remaining: 826ms
744:    learn: 0.3096067        total: 2.4s     remaining: 823ms
745:    learn: 0.3094245        total: 2.41s    remaining: 820ms
746:    learn: 0.3093898        total: 2.41s    remaining: 817ms
747:    learn: 0.3093128        total: 2.41s    remaining: 813ms
748:    learn: 0.3092529        total: 2.42s    remaining: 810ms
749:    learn: 0.3091681        total: 2.42s    remaining: 807ms
750:    learn: 0.3091137        total: 2.42s    remaining: 804ms
751:    learn: 0.3090101        total: 2.43s    remaining: 801ms
752:    learn: 0.3088392        total: 2.43s    remaining: 798ms
753:    learn: 0.3087738        total: 2.44s    remaining: 794ms
754:    learn: 0.3087089        total: 2.44s    remaining: 791ms
```

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755:    learn: 0.3086440        total: 2.44s    remaining: 788ms
756:    learn: 0.3084267        total: 2.44s    remaining: 785ms
757:    learn: 0.3082744        total: 2.45s    remaining: 781ms
758:    learn: 0.3081365        total: 2.45s    remaining: 779ms
759:    learn: 0.3080627        total: 2.45s    remaining: 775ms
760:    learn: 0.3079084        total: 2.46s    remaining: 772ms
761:    learn: 0.3076324        total: 2.46s    remaining: 769ms
762:    learn: 0.3075555        total: 2.46s    remaining: 765ms
763:    learn: 0.3075034        total: 2.47s    remaining: 762ms
764:    learn: 0.3072678        total: 2.47s    remaining: 759ms
765:    learn: 0.3071357        total: 2.47s    remaining: 756ms
766:    learn: 0.3070487        total: 2.48s    remaining: 753ms
767:    learn: 0.3067977        total: 2.48s    remaining: 749ms
768:    learn: 0.3067065        total: 2.48s    remaining: 746ms
769:    learn: 0.3066438        total: 2.49s    remaining: 743ms
770:    learn: 0.3066152        total: 2.49s    remaining: 739ms
771:    learn: 0.3065233        total: 2.49s    remaining: 736ms
772:    learn: 0.3064127        total: 2.5s     remaining: 733ms
773:    learn: 0.3063163        total: 2.5s     remaining: 730ms
774:    learn: 0.3062027        total: 2.5s     remaining: 727ms
775:    learn: 0.3061113        total: 2.51s    remaining: 724ms
776:    learn: 0.3060482        total: 2.51s    remaining: 721ms
777:    learn: 0.3060131        total: 2.51s    remaining: 717ms
778:    learn: 0.3059190        total: 2.52s    remaining: 714ms
779:    learn: 0.3058346        total: 2.52s    remaining: 711ms
780:    learn: 0.3058229        total: 2.52s    remaining: 708ms
781:    learn: 0.3056590        total: 2.53s    remaining: 704ms
782:    learn: 0.3054500        total: 2.53s    remaining: 701ms
783:    learn: 0.3054022        total: 2.53s    remaining: 698ms
784:    learn: 0.3052474        total: 2.54s    remaining: 695ms
785:    learn: 0.3050557        total: 2.54s    remaining: 692ms
786:    learn: 0.3049786        total: 2.54s    remaining: 688ms
787:    learn: 0.3047801        total: 2.55s    remaining: 685ms
788:    learn: 0.3045316        total: 2.55s    remaining: 682ms
789:    learn: 0.3044810        total: 2.55s    remaining: 679ms
790:    learn: 0.3042974        total: 2.56s    remaining: 676ms
791:    learn: 0.3041986        total: 2.56s    remaining: 672ms
792:    learn: 0.3040069        total: 2.57s    remaining: 671ms
793:    learn: 0.3038674        total: 2.57s    remaining: 667ms
794:    learn: 0.3037817        total: 2.58s    remaining: 664ms
795:    learn: 0.3035959        total: 2.58s    remaining: 661ms
796:    learn: 0.3034450        total: 2.58s    remaining: 658ms
797:    learn: 0.3033485        total: 2.59s    remaining: 655ms
798:    learn: 0.3032248        total: 2.59s    remaining: 652ms
799:    learn: 0.3031341        total: 2.59s    remaining: 648ms
800:    learn: 0.3030365        total: 2.6s     remaining: 645ms
801:    learn: 0.3028304        total: 2.6s     remaining: 642ms
802:    learn: 0.3026661        total: 2.6s     remaining: 639ms
```

```
803:    learn: 0.3024430        total: 2.61s    remaining: 636ms
804:    learn: 0.3023839        total: 2.61s    remaining: 633ms
805:    learn: 0.3023140        total: 2.61s    remaining: 629ms
806:    learn: 0.3022500        total: 2.62s    remaining: 626ms
807:    learn: 0.3020725        total: 2.62s    remaining: 623ms
808:    learn: 0.3020116        total: 2.63s    remaining: 620ms
809:    learn: 0.3019352        total: 2.63s    remaining: 617ms
810:    learn: 0.3019218        total: 2.63s    remaining: 613ms
811:    learn: 0.3018591        total: 2.63s    remaining: 610ms
812:    learn: 0.3017869        total: 2.64s    remaining: 607ms
813:    learn: 0.3017141        total: 2.64s    remaining: 603ms
814:    learn: 0.3016398        total: 2.64s    remaining: 600ms
815:    learn: 0.3015462        total: 2.65s    remaining: 597ms
816:    learn: 0.3014923        total: 2.65s    remaining: 594ms
817:    learn: 0.3014434        total: 2.65s    remaining: 590ms
818:    learn: 0.3013189        total: 2.66s    remaining: 587ms
819:    learn: 0.3011642        total: 2.66s    remaining: 584ms
820:    learn: 0.3011302        total: 2.66s    remaining: 580ms
821:    learn: 0.3008943        total: 2.66s    remaining: 577ms
822:    learn: 0.3008030        total: 2.67s    remaining: 574ms
823:    learn: 0.3007523        total: 2.67s    remaining: 570ms
824:    learn: 0.3006498        total: 2.67s    remaining: 567ms
825:    learn: 0.3004048        total: 2.67s    remaining: 563ms
826:    learn: 0.3002673        total: 2.68s    remaining: 560ms
827:    learn: 0.3002140        total: 2.68s    remaining: 557ms
828:    learn: 0.3000426        total: 2.68s    remaining: 554ms
829:    learn: 0.2999516        total: 2.69s    remaining: 550ms
830:    learn: 0.2999221        total: 2.69s    remaining: 547ms
831:    learn: 0.2998256        total: 2.69s    remaining: 544ms
832:    learn: 0.2997357        total: 2.7s     remaining: 541ms
833:    learn: 0.2996188        total: 2.7s     remaining: 538ms
834:    learn: 0.2995667        total: 2.71s    remaining: 535ms
835:    learn: 0.2992732        total: 2.71s    remaining: 531ms
836:    learn: 0.2991536        total: 2.71s    remaining: 528ms
837:    learn: 0.2990596        total: 2.71s    remaining: 525ms
838:    learn: 0.2989938        total: 2.72s    remaining: 522ms
839:    learn: 0.2988841        total: 2.72s    remaining: 519ms
840:    learn: 0.2987609        total: 2.73s    remaining: 515ms
841:    learn: 0.2985550        total: 2.73s    remaining: 512ms
842:    learn: 0.2983171        total: 2.73s    remaining: 509ms
843:    learn: 0.2982269        total: 2.74s    remaining: 506ms
844:    learn: 0.2981691        total: 2.74s    remaining: 502ms
845:    learn: 0.2981385        total: 2.74s    remaining: 499ms
846:    learn: 0.2979684        total: 2.75s    remaining: 496ms
847:    learn: 0.2978663        total: 2.75s    remaining: 493ms
848:    learn: 0.2977538        total: 2.75s    remaining: 489ms
849:    learn: 0.2976705        total: 2.75s    remaining: 486ms
850:    learn: 0.2976123        total: 2.76s    remaining: 483ms
```

```
851:    learn: 0.2975143        total: 2.76s    remaining: 480ms
852:    learn: 0.2974453        total: 2.76s    remaining: 476ms
853:    learn: 0.2971868        total: 2.77s    remaining: 473ms
854:    learn: 0.2970347        total: 2.77s    remaining: 470ms
855:    learn: 0.2968558        total: 2.77s    remaining: 467ms
856:    learn: 0.2967249        total: 2.78s    remaining: 463ms
857:    learn: 0.2966361        total: 2.78s    remaining: 460ms
858:    learn: 0.2963429        total: 2.78s    remaining: 457ms
859:    learn: 0.2961318        total: 2.78s    remaining: 453ms
860:    learn: 0.2960097        total: 2.79s    remaining: 450ms
861:    learn: 0.2958712        total: 2.79s    remaining: 447ms
862:    learn: 0.2957667        total: 2.79s    remaining: 443ms
863:    learn: 0.2957185        total: 2.8s     remaining: 440ms
864:    learn: 0.2956703        total: 2.8s     remaining: 437ms
865:    learn: 0.2953735        total: 2.8s     remaining: 434ms
866:    learn: 0.2952228        total: 2.81s    remaining: 430ms
867:    learn: 0.2951805        total: 2.81s    remaining: 427ms
868:    learn: 0.2951576        total: 2.81s    remaining: 424ms
869:    learn: 0.2950821        total: 2.81s    remaining: 421ms
870:    learn: 0.2950100        total: 2.82s    remaining: 417ms
871:    learn: 0.2948382        total: 2.82s    remaining: 414ms
872:    learn: 0.2947352        total: 2.82s    remaining: 411ms
873:    learn: 0.2946830        total: 2.83s    remaining: 407ms
874:    learn: 0.2945826        total: 2.83s    remaining: 404ms
875:    learn: 0.2943605        total: 2.83s    remaining: 401ms
876:    learn: 0.2941908        total: 2.83s    remaining: 398ms
877:    learn: 0.2941344        total: 2.84s    remaining: 395ms
878:    learn: 0.2940526        total: 2.84s    remaining: 391ms
879:    learn: 0.2939417        total: 2.85s    remaining: 388ms
880:    learn: 0.2938786        total: 2.85s    remaining: 385ms
881:    learn: 0.2937547        total: 2.85s    remaining: 382ms
882:    learn: 0.2936713        total: 2.86s    remaining: 378ms
883:    learn: 0.2936206        total: 2.86s    remaining: 375ms
884:    learn: 0.2935542        total: 2.86s    remaining: 372ms
885:    learn: 0.2934881        total: 2.87s    remaining: 369ms
886:    learn: 0.2933250        total: 2.87s    remaining: 366ms
887:    learn: 0.2932239        total: 2.87s    remaining: 362ms
888:    learn: 0.2931291        total: 2.88s    remaining: 359ms
889:    learn: 0.2930418        total: 2.88s    remaining: 356ms
890:    learn: 0.2928105        total: 2.88s    remaining: 353ms
891:    learn: 0.2927644        total: 2.89s    remaining: 349ms
892:    learn: 0.2925732        total: 2.89s    remaining: 346ms
893:    learn: 0.2923884        total: 2.89s    remaining: 343ms
894:    learn: 0.2923859        total: 2.89s    remaining: 340ms
895:    learn: 0.2923157        total: 2.9s     remaining: 336ms
896:    learn: 0.2922880        total: 2.9s     remaining: 333ms
897:    learn: 0.2920981        total: 2.9s     remaining: 330ms
898:    learn: 0.2920712        total: 2.91s    remaining: 327ms
```

```
899:    learn: 0.2920097        total: 2.91s    remaining: 324ms
900:    learn: 0.2918373        total: 2.92s    remaining: 320ms
901:    learn: 0.2917861        total: 2.92s    remaining: 317ms
902:    learn: 0.2915292        total: 2.92s    remaining: 314ms
903:    learn: 0.2913930        total: 2.92s    remaining: 311ms
904:    learn: 0.2913368        total: 2.93s    remaining: 307ms
905:    learn: 0.2912667        total: 2.93s    remaining: 304ms
906:    learn: 0.2912001        total: 2.93s    remaining: 301ms
907:    learn: 0.2909684        total: 2.94s    remaining: 298ms
908:    learn: 0.2907005        total: 2.94s    remaining: 294ms
909:    learn: 0.2904687        total: 2.94s    remaining: 291ms
910:    learn: 0.2903576        total: 2.95s    remaining: 288ms
911:    learn: 0.2902714        total: 2.95s    remaining: 285ms
912:    learn: 0.2901788        total: 2.95s    remaining: 281ms
913:    learn: 0.2899811        total: 2.96s    remaining: 278ms
914:    learn: 0.2899402        total: 2.96s    remaining: 275ms
915:    learn: 0.2898050        total: 2.96s    remaining: 272ms
916:    learn: 0.2896659        total: 2.96s    remaining: 268ms
917:    learn: 0.2895508        total: 2.97s    remaining: 265ms
918:    learn: 0.2894778        total: 2.97s    remaining: 262ms
919:    learn: 0.2892365        total: 2.97s    remaining: 259ms
920:    learn: 0.2890533        total: 2.98s    remaining: 255ms
921:    learn: 0.2889904        total: 2.98s    remaining: 252ms
922:    learn: 0.2888683        total: 2.98s    remaining: 249ms
923:    learn: 0.2887893        total: 2.99s    remaining: 246ms
924:    learn: 0.2887443        total: 2.99s    remaining: 242ms
925:    learn: 0.2886874        total: 2.99s    remaining: 239ms
926:    learn: 0.2885088        total: 3s       remaining: 236ms
927:    learn: 0.2884517        total: 3s       remaining: 233ms
928:    learn: 0.2883776        total: 3s       remaining: 229ms
929:    learn: 0.2883056        total: 3s       remaining: 226ms
930:    learn: 0.2882425        total: 3.01s    remaining: 223ms
931:    learn: 0.2881686        total: 3.01s    remaining: 220ms
932:    learn: 0.2879281        total: 3.02s    remaining: 217ms
933:    learn: 0.2876573        total: 3.02s    remaining: 213ms
934:    learn: 0.2874392        total: 3.02s    remaining: 210ms
935:    learn: 0.2872290        total: 3.02s    remaining: 207ms
936:    learn: 0.2871137        total: 3.03s    remaining: 204ms
937:    learn: 0.2869363        total: 3.03s    remaining: 200ms
938:    learn: 0.2867952        total: 3.04s    remaining: 197ms
939:    learn: 0.2867676        total: 3.04s    remaining: 194ms
940:    learn: 0.2865582        total: 3.04s    remaining: 191ms
941:    learn: 0.2865127        total: 3.04s    remaining: 188ms
942:    learn: 0.2864095        total: 3.05s    remaining: 184ms
943:    learn: 0.2863557        total: 3.05s    remaining: 181ms
944:    learn: 0.2862755        total: 3.06s    remaining: 178ms
945:    learn: 0.2862000        total: 3.06s    remaining: 175ms
946:    learn: 0.2861278        total: 3.06s    remaining: 171ms
```

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947:    learn: 0.2858606        total: 3.07s    remaining: 168ms
948:    learn: 0.2857963        total: 3.07s    remaining: 165ms
949:    learn: 0.2857342        total: 3.07s    remaining: 162ms
950:    learn: 0.2856176        total: 3.08s    remaining: 158ms
951:    learn: 0.2855274        total: 3.08s    remaining: 155ms
952:    learn: 0.2854799        total: 3.08s    remaining: 152ms
953:    learn: 0.2853082        total: 3.09s    remaining: 149ms
954:    learn: 0.2851187        total: 3.09s    remaining: 146ms
955:    learn: 0.2850452        total: 3.09s    remaining: 142ms
956:    learn: 0.2849737        total: 3.1s     remaining: 139ms
957:    learn: 0.2848725        total: 3.1s     remaining: 136ms
958:    learn: 0.2847710        total: 3.1s     remaining: 133ms
959:    learn: 0.2846850        total: 3.11s    remaining: 129ms
960:    learn: 0.2845882        total: 3.11s    remaining: 126ms
961:    learn: 0.2844767        total: 3.11s    remaining: 123ms
962:    learn: 0.2842544        total: 3.12s    remaining: 120ms
963:    learn: 0.2841982        total: 3.12s    remaining: 116ms
964:    learn: 0.2840058        total: 3.12s    remaining: 113ms
965:    learn: 0.2839316        total: 3.13s    remaining: 110ms
966:    learn: 0.2838886        total: 3.13s    remaining: 107ms
967:    learn: 0.2837995        total: 3.13s    remaining: 104ms
968:    learn: 0.2837035        total: 3.14s    remaining: 100ms
969:    learn: 0.2836071        total: 3.14s    remaining: 97.1ms
970:    learn: 0.2834836        total: 3.14s    remaining: 93.9ms
971:    learn: 0.2834458        total: 3.15s    remaining: 90.6ms
972:    learn: 0.2833002        total: 3.15s    remaining: 87.4ms
973:    learn: 0.2832471        total: 3.15s    remaining: 84.2ms
974:    learn: 0.2830316        total: 3.16s    remaining: 80.9ms
975:    learn: 0.2829435        total: 3.16s    remaining: 77.7ms
976:    learn: 0.2828010        total: 3.16s    remaining: 74.5ms
977:    learn: 0.2827018        total: 3.17s    remaining: 71.3ms
978:    learn: 0.2826880        total: 3.17s    remaining: 68.1ms
979:    learn: 0.2826763        total: 3.18s    remaining: 64.8ms
980:    learn: 0.2825139        total: 3.18s    remaining: 61.6ms
981:    learn: 0.2824229        total: 3.18s    remaining: 58.4ms
982:    learn: 0.2821586        total: 3.19s    remaining: 55.1ms
983:    learn: 0.2819487        total: 3.19s    remaining: 51.9ms
984:    learn: 0.2818348        total: 3.19s    remaining: 48.7ms
985:    learn: 0.2817564        total: 3.2s     remaining: 45.4ms
986:    learn: 0.2817152        total: 3.2s     remaining: 42.2ms
987:    learn: 0.2816849        total: 3.2s     remaining: 38.9ms
988:    learn: 0.2816165        total: 3.21s    remaining: 35.7ms
989:    learn: 0.2814036        total: 3.21s    remaining: 32.5ms
990:    learn: 0.2813824        total: 3.21s    remaining: 29.2ms
991:    learn: 0.2811821        total: 3.22s    remaining: 26ms
992:    learn: 0.2811032        total: 3.22s    remaining: 22.7ms
993:    learn: 0.2810324        total: 3.23s    remaining: 19.5ms
994:    learn: 0.2808465        total: 3.23s    remaining: 16.2ms
```

```
995:    learn: 0.2806064        total: 3.23s    remaining: 13ms
996:    learn: 0.2805156        total: 3.23s    remaining: 9.74ms
997:    learn: 0.2803922        total: 3.24s    remaining: 6.49ms
998:    learn: 0.2801342        total: 3.24s    remaining: 3.25ms
999:    learn: 0.2800990        total: 3.25s    remaining: 0us
```

0.39 Evaluation

[252]:
```
accuracy_catboost = accuracy_score(y_test, y_pred_catboost)
print(f"CatBoost Accuracy: {accuracy_catboost}")
```

```
CatBoost Accuracy: 0.8268156424581006
```

[ ]:
```

```