Top Coder - Breast Cancer Prediction

PROBLEM STATEMENT

The provided dataset includes participant characteristics previously shown to be associated with breast cancer risk estimation including age, race/ethnicity, age at first birth, breast density, mammogram result, use of hormone replacement therapy, menopausal status, surgical menopause, body mass index, breast procedure, and diagnosis of invasive breast cancer. These data can be used to describe the distribution of breast cancer risk in the general population or to explore relationships among breast cancer risk factors.

Objective

- **Predict Breast cancer result.**
- **The objective of the project is to leverage Topcoder member software development skills and Data Science skills in order to make progress in the field of Oncology.This progress can be in any sub-area, but it's mostly going to revolve around the sub-area of Cancer Prevention.**

Data Dictionary

1. **id:** Identifier of the row.
2. **menopaus:** 0 = premenopausal; 1 = postmenopausal or age>=55 ; 9 = unknown.
3. **agegrp:** 1 = 35-39; 2 = 40-44; 3 = 45-49; 4 = 50-54; 5 = 55-59; 6 = 60-64; 7 = 65-69; 8 = 70-74; 9 = 75-79; 10 = 80-84.
4. **density:** BI-RADS breast density codes 1 = Almost entirely fat; 2 = Scattered fibroglandular densities; 3 = Heterogeneously dense; 4 = Extremely dense; 9 = Unknown or different measurement system.
5. **race:** 1 = white; 2 = Asian/Pacific Islander; 3 = black; 4 = Native American; 5 = other/mixed; 9 = unknown.
6. **Hispanic:** 0 = no; 1 = yes; 9 = unknown.
7. **bmi:** Body mass index: 1 = 10-24.99; 2 = 25-29.99; 3 = 30-34.99; 4 = 35 or more; 9 = unknown.
8. **agefirst:** Age at first birth: 0 = Age < 30; 1 = Age 30 or greater; 2 = Nulliparous; 9 = unknown
9. **nrelbc:** Number of first degree relatives with breast cancer: 0 = zero; 1= one; 2 = 2 or more; 9 = unknown.
10. **brstproc:** Previous breast procedure: 0 = no; 1 = yes; 9 = unknown.
11. **lastmamm:** Result of last mammogram before the index mammogram: 0 = negative; 1 = false positive; 9 = unknown.
12. **surgmeno:** Marital status of customer.
13. **hrt:** Current hormone therapy: 0 = no; 1 = yes; 9 = unknown or not menopausal (menopaus=0 or menopaus=9).
14. **invasive:** Diagnosis of invasive breast cancer within one year of the index screening mammogram: 0 = no; 1 = yes.
15. **cancer:** Diagnosis of invasive or ductal carcinoma in situ breast cancer within one year of the index screening mammogram: 0 = no; 1 = yes.
16. **count:** Frequency count of this combination of covariates and outcomes (all variables 1 to 14).

In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

In [3]:

```
from platform import python_version
print(python_version())
```

```
3.9.12
```

In [ ]:

Read the data

In [4]:

```
df=pd.read_csv('data-training.csv')
df_test = pd.read_csv('data-provisional.csv')
```

In [5]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 196462 entries, 0 to 196461
Data columns (total 16 columns):
 #   Column     Non-Null Count   Dtype 
---  ------     --------------   ----- 
 0   id         196462 non-null  object
 1   menopaus   196462 non-null  int64 
 2   agegrp     196462 non-null  int64 
 3   density    196462 non-null  int64 
 4   race       196462 non-null  int64 
 5   Hispanic   196462 non-null  int64 
 6   bmi        196462 non-null  int64 
 7   agefirst   196462 non-null  int64 
 8   nrelbc     196462 non-null  int64 
 9   brstproc   196462 non-null  int64 
 10  lastmamm   196462 non-null  int64 
 11  surgmeno   196462 non-null  int64 
 12  hrt        196462 non-null  int64 
 13  invasive   196462 non-null  int64 
 14  cancer     196462 non-null  int64 
 15  count      196462 non-null  int64 
dtypes: int64(15), object(1)
memory usage: 24.0+ MB
```

In [6]:

```
df.head()
```

Out[6]:

	id	menopaus	agegrp	density	race	Hispanic	bmi	agefirst	nrelbc	brstproc	lastmamm	surgmeno	hrt	invasive
0	**RE-TRAIN-0000001**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**9**	**9**	**9**	**0**
1	**RE-TRAIN-0000002**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**9**	**9**	**9**	**0**
2	**RE-TRAIN-0000003**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**9**	**9**	**0**
3	**RE-TRAIN-0000004**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**1**	**0**	**9**	**9**	**9**	**0**
4	**RE-TRAIN-0000005**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**9**	**9**	**0**

In [7]:

```
df_test.head()
```

Out[7]:

	id	menopaus	agegrp	density	race	Hispanic	bmi	agefirst	nrelbc	brstproc	lastmamm	surgmeno	hrt	invasive
0	RE-PROV-0000001	0	1	1	1	0	1	0	0	0	0	9	9	0
1	RE-PROV-0000002	0	1	1	1	0	2	0	1	0	9	9	9	0
2	RE-PROV-0000003	0	1	1	1	0	2	9	0	0	0	9	9	0
3	RE-PROV-0000004	0	1	1	1	0	2	9	1	0	0	9	9	0
4	RE-PROV-0000005	0	1	1	1	0	3	2	0	0	9	9	9	0

In [8]:

```
test_file_ids = df_test['id'] ## necessary step
```

In [9]:

```
df = df.drop("id" , axis=1)
df_test = df_test.drop("id" , axis=1)
```

In [10]:

```
df.shape
```

Out[10]:

```
(196462, 15)
```

In [11]:

```
df_test.shape
```

Out[11]:

```
(28066, 14)
```

Target variable distribution

In [12]:

```
print(df.cancer.value_counts())
df.cancer.value_counts(normalize=True)
```

```
0    189942
1      6520
Name: cancer, dtype: int64
```

Out[12]:

```
0    0.966813
1    0.033187
Name: cancer, dtype: float64
```

Get the info

In [13]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 196462 entries, 0 to 196461
Data columns (total 15 columns):
```

```
Data columns (total 15 columns):
 #   Column     Non-Null Count   Dtype
---  ------     --------------   -----
 0   menopaus   196462 non-null  int64
 1   agegrp     196462 non-null  int64
 2   density    196462 non-null  int64
 3   race       196462 non-null  int64
 4   Hispanic   196462 non-null  int64
 5   bmi        196462 non-null  int64
 6   agefirst   196462 non-null  int64
 7   nrelbc     196462 non-null  int64
 8   brstproc   196462 non-null  int64
 9   lastmamm   196462 non-null  int64
 10  surgmeno   196462 non-null  int64
 11  hrt        196462 non-null  int64
 12  invasive   196462 non-null  int64
 13  cancer     196462 non-null  int64
 14  count      196462 non-null  int64
dtypes: int64(15)
memory usage: 22.5 MB
```

Get the Summary Statistics

In [14]:

```
df.describe(include='all').T
```

Out[14]:

	count	mean	std	min	25%	50%	75%	max
menopaus	196462.0	1.308752	1.908668	0.0	1.0	1.0	1.0	9.0
agegrp	196462.0	5.469674	2.387198	1.0	4.0	5.0	7.0	10.0
density	196462.0	4.093718	2.958682	1.0	2.0	3.0	9.0	9.0
race	196462.0	3.171438	3.145186	1.0	1.0	1.0	4.0	9.0
Hispanic	196462.0	2.887917	4.062008	0.0	0.0	0.0	9.0	9.0
bmi	196462.0	4.775483	3.469497	1.0	2.0	3.0	9.0	9.0
agefirst	196462.0	3.372927	3.973707	0.0	0.0	1.0	9.0	9.0
nrelbc	196462.0	1.571271	3.057983	0.0	0.0	0.0	1.0	9.0
brstproc	196462.0	1.450362	2.940595	0.0	0.0	0.0	1.0	9.0
lastmamm	196462.0	3.042176	4.198951	0.0	0.0	0.0	9.0	9.0
surgmeno	196462.0	4.118303	4.272907	0.0	0.0	1.0	9.0	9.0
hrt	196462.0	3.316484	4.050667	0.0	0.0	1.0	9.0	9.0
invasive	196462.0	0.025608	0.157963	0.0	0.0	0.0	0.0	1.0
cancer	196462.0	0.033187	0.179125	0.0	0.0	0.0	0.0	1.0
count	196462.0	8.474825	54.367564	1.0	1.0	1.0	4.0	7295.0

Check for Object Data Type

In [15]:

```
df.select_dtypes(include='object').head()
```

Out[15]:

0
1
2

~~3~~

4

Check for the different values under 'object' data type

In [16]:

```
df.menopaus.value_counts()
```

Out[16]:

```
1    157733
0     27686
9     11043
Name: menopaus, dtype: int64
```

In [17]:

```
df.agegrp.value_counts()
```

Out[17]:

```
4     32743
3     27677
5     26287
6     23083
7     21253
8     19599
9     16337
2     13339
10    10581
1      5563
Name: agegrp, dtype: int64
```

In [18]:

```
df.density.value_counts()
```

Out[18]:

```
2    56602
9    49730
3    49627
1    22469
4    18034
Name: density, dtype: int64
```

In [19]:

```
df.race.value_counts()
```

Out[19]:

```
1    108735
9     40451
2     16186
3     15065
5      8606
4      7419
Name: race, dtype: int64
```

In [20]:

```
df.Hispanic.value_counts()
```

Out[20]:

```
0    108288
9     59899
1     28275
Name: Hispanic, dtype: int64
```

In [21]:

```
df.bmi.value_counts()
```

Out[21]:

```
9    76505
1    44426
2    36838
3    23218
4    15475
Name: bmi, dtype: int64
```

In [22]:

```
df.agefirst.value_counts()
```

Out[22]:

```
0    77408
9    64061
2    31110
1    23883
Name: agefirst, dtype: int64
```

In [23]:

```
df.nrelbc.value_counts()
```

Out[23]:

```
0    116512
1     45707
9     27786
2      6457
Name: nrelbc, dtype: int64
```

In [24]:

```
df.brstproc.value_counts()
```

Out[24]:

```
0    114537
1     56548
9     25377
Name: brstproc, dtype: int64
```

In [25]:

```
df.lastmamm.value_counts()
```

Out[25]:

```
0    119278
9     65061
1     12123
Name: lastmamm, dtype: int64
```

In [26]:

```
df.surgmeno.value_counts()
```

Out[26]:

```
9    84860
0    66252
1    45350
Name: surgmeno, dtype: int64
```

In [27]:

```
df.hrt.value_counts()
```

Out[27]:

```
0    70771
9    65734
1    59957
Name: hrt, dtype: int64
```

In [28]:

```
df.invasive.value_counts()
```

Out[28]:

```
0    191431
1      5031
Name: invasive, dtype: int64
```

In [29]:

```
df.cancer.value_counts()
```

Out[29]:

```
0    189942
1      6520
Name: cancer, dtype: int64
```

In [30]:

```
#df.count.value_counts()
```

In [31]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 196462 entries, 0 to 196461
Data columns (total 15 columns):
 #   Column    Non-Null Count   Dtype
---  ------    --------------   -----
 0   menopaus  196462 non-null  int64
 1   agegrp    196462 non-null  int64
 2   density   196462 non-null  int64
 3   race      196462 non-null  int64
 4   Hispanic  196462 non-null  int64
 5   bmi       196462 non-null  int64
 6   agefirst  196462 non-null  int64
 7   nrelbc    196462 non-null  int64
 8   brstproc  196462 non-null  int64
 9   lastmamm  196462 non-null  int64
 10  surgmeno  196462 non-null  int64
 11  hrt       196462 non-null  int64
 12  invasive  196462 non-null  int64
 13  cancer    196462 non-null  int64
 14  count     196462 non-null  int64
dtypes: int64(15)
memory usage: 22.5 MB
```

Check for Null Values

In [32]:

```
df.isnull().sum()
```

Out[32]:

```
menopaus    0
agegrp      0
density     0
race        0
Hispanic    0
bmi         0
```

```
agefirst    0
nrelbc      0
brstproc    0
lastmamm    0
surgmeno    0
hrt         0
invasive    0
cancer      0
count       0
dtype: int64
```

In [33]:

```
df_test.isnull().sum()
```

Out[33]:

```
menopaus    0
agegrp      0
density     0
race        0
Hispanic    0
bmi         0
agefirst    0
nrelbc      0
brstproc    0
lastmamm    0
surgmeno    0
hrt         0
invasive    0
count       0
dtype: int64
```

In [ ]:

```

```

In [ ]:

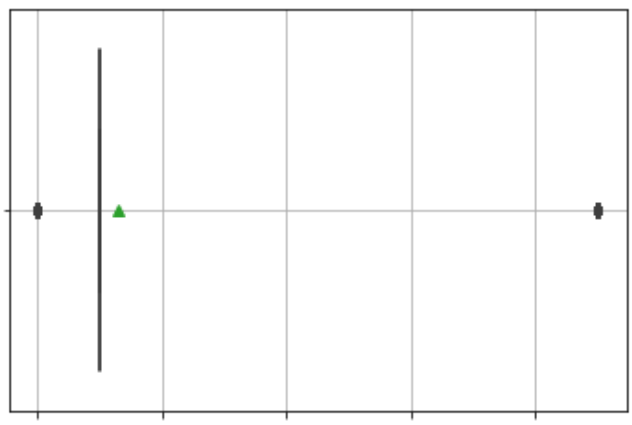
```

```

Check for Outliers

In [31]:

```
cols=['menopaus','agegrp','density','race','Hispanic','bmi','agefirst','nrelbc','brstproc
','lastmamm','surgmeno','hrt','invasive','count']
for i in cols:
    sns.boxplot(df[i],showmeans=True,whis=0.1)
    plt.grid()
    plt.show();
```

```
C:\Users\User\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid positional
argument will be `data`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```




```
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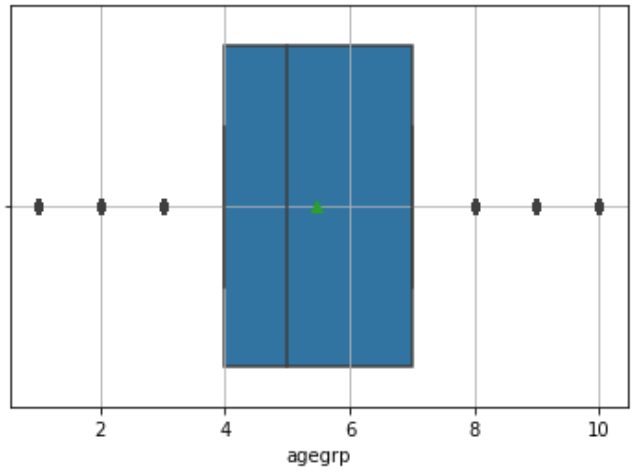


```
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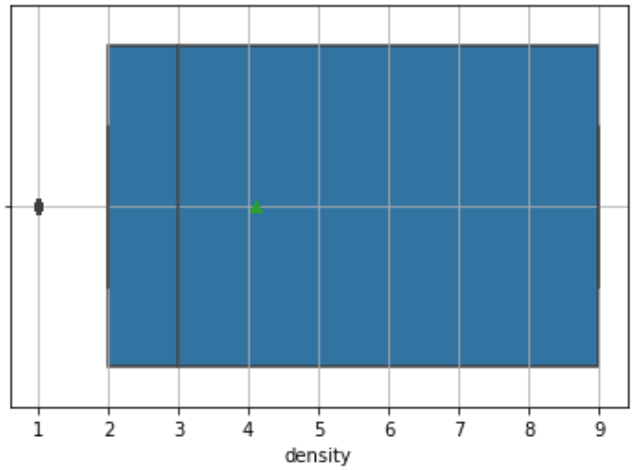


```
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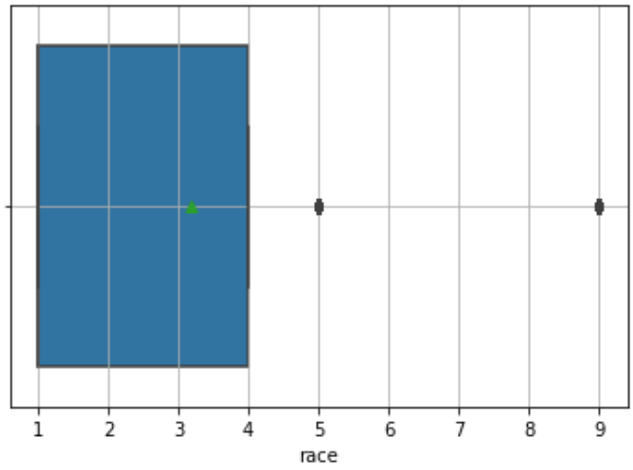


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```

```
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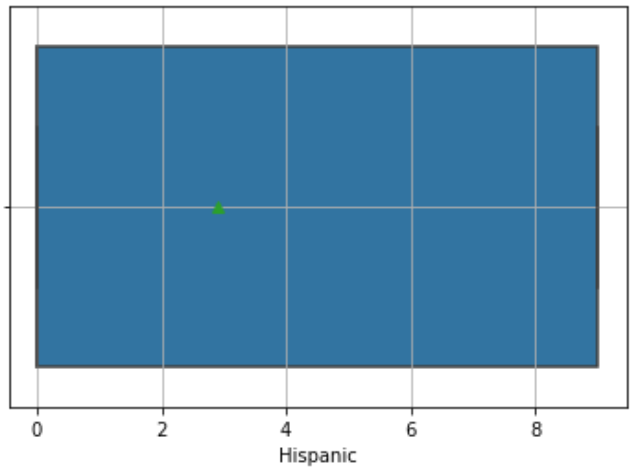


```
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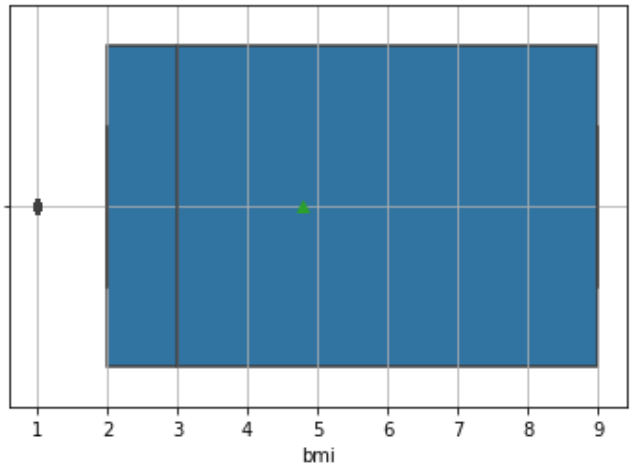


```
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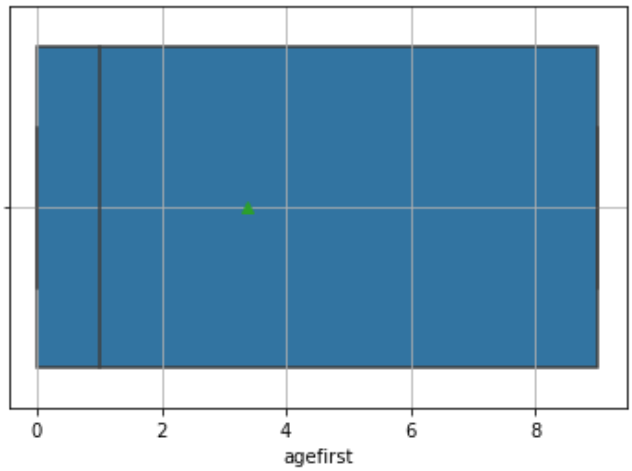


```
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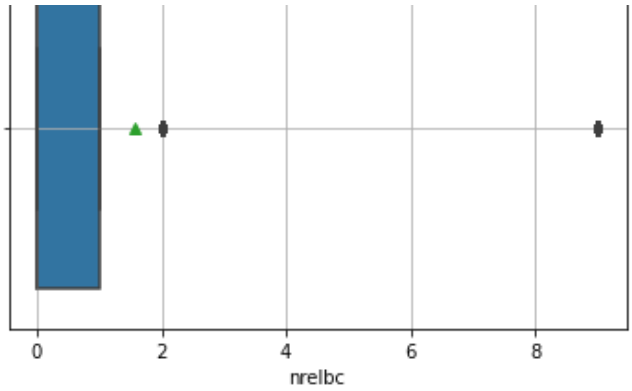


```
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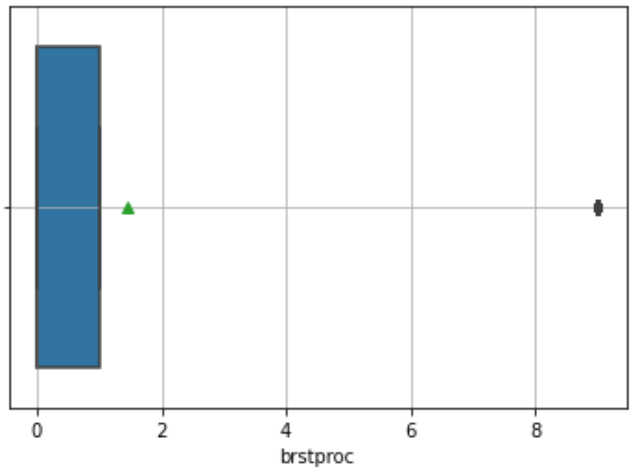


```
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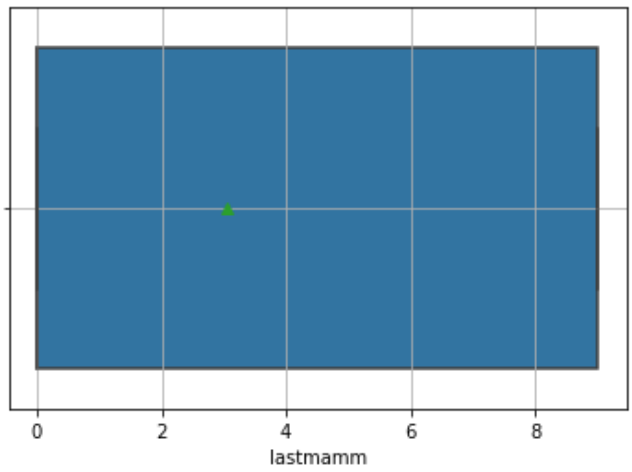


```
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  warnings.warn(
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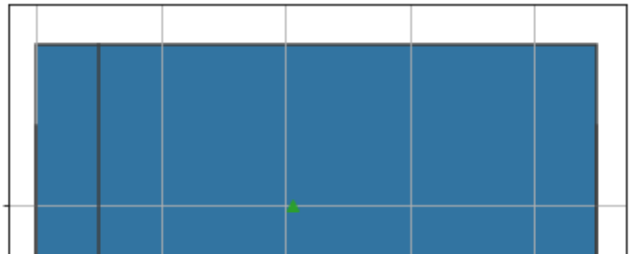

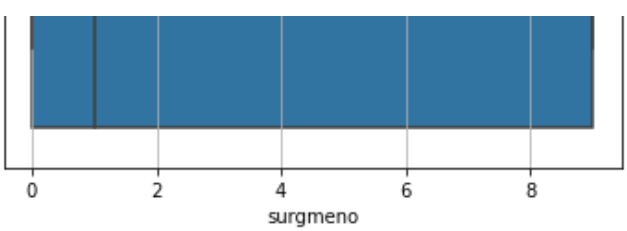


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  warnings.warn(
```
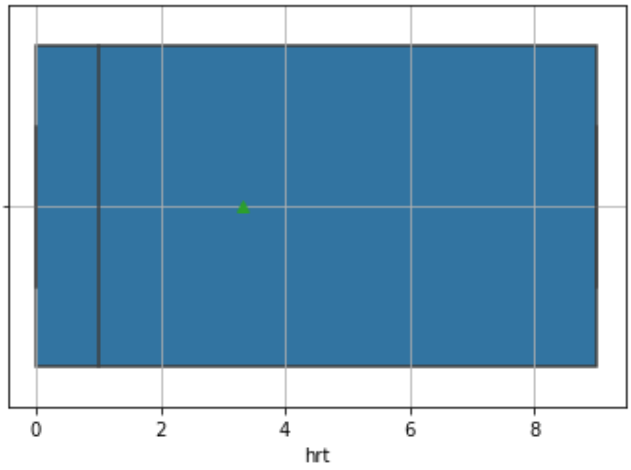
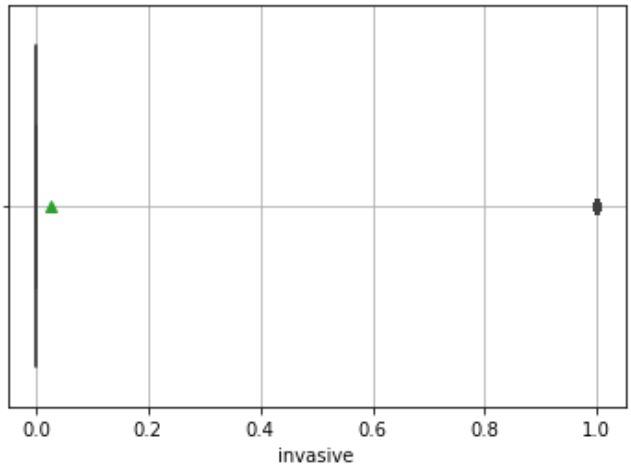
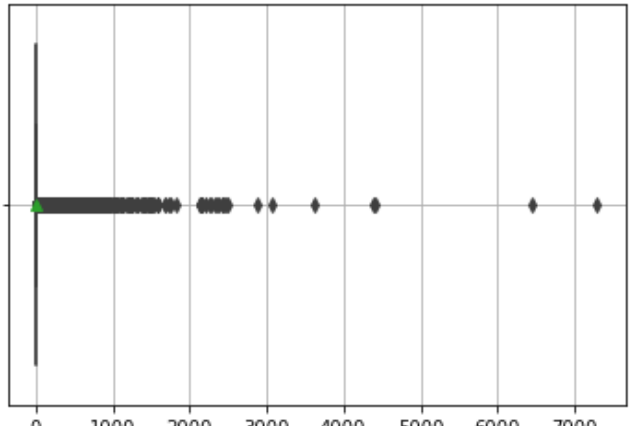




```
C:\Users\User\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid positional
argument will be `data`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```




```
C:\Users\User\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variable as a keyword arg: x. From version 0.12, the only valid positional
argument will be `data`, and passing other arguments without an explicit keyword will res
ult in an error or misinterpretation.
  warnings.warn(
```



0 1000 2000 3000 4000 5000 6000 7000
count

In [ ]:

```
```

Outlier Treatment

In [32]:

```
#def remove_outlier(col):
#    Q1,Q3=col.quantile([0.25,0.75])
#    IQR=Q3-Q1
#    lower_range= Q1-(1.5 * IQR)
#    upper_range= Q3+(1.5 * IQR)
#    return lower_range, upper_range
```

In [33]:

```
#for column in df[cols].columns:
#    lr,ur=remove_outlier(df[column])
#    df[column]=np.where(df[column]>ur,ur,df[column])
#    df[column]=np.where(df[column]<lr,lr,df[column])
```

In [34]:

```
#cols=['AgentBonus', 'Age', 'CustTenure', 'MonthlyIncome','ExistingPolicyTenure','SumAssured','LastMonthCalls']
#for i in cols:
#    sns.boxplot(df[i],whis=1.5)
#    plt.grid()
#    plt.show();
```

In [ ]:

```
```

Univariate Analysis

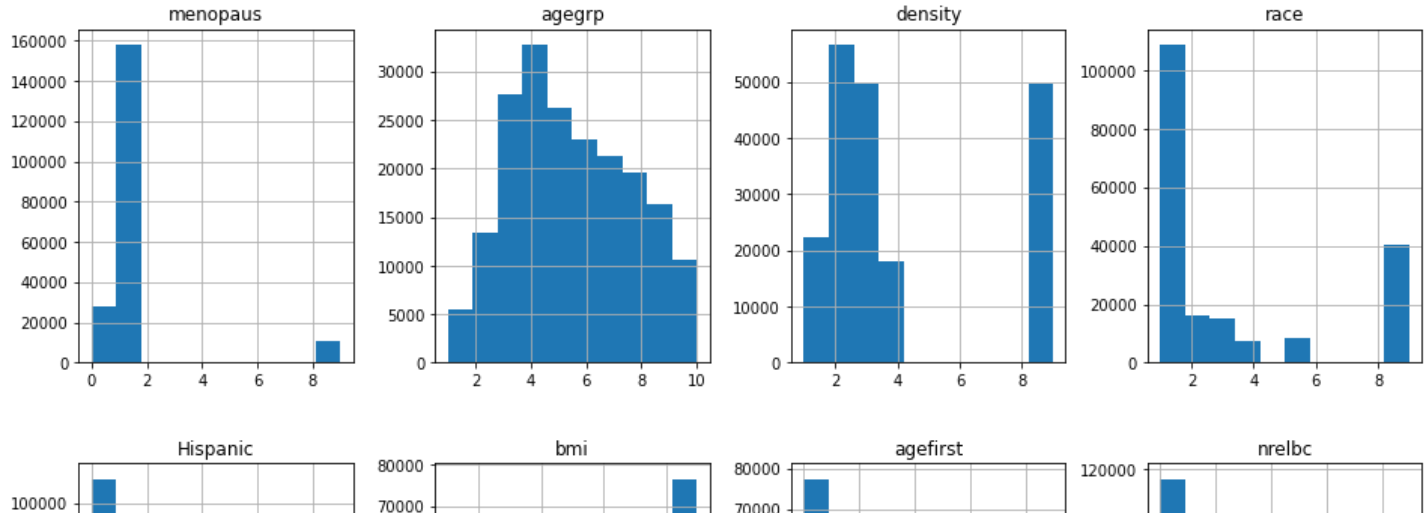
- **Distribution of variables**

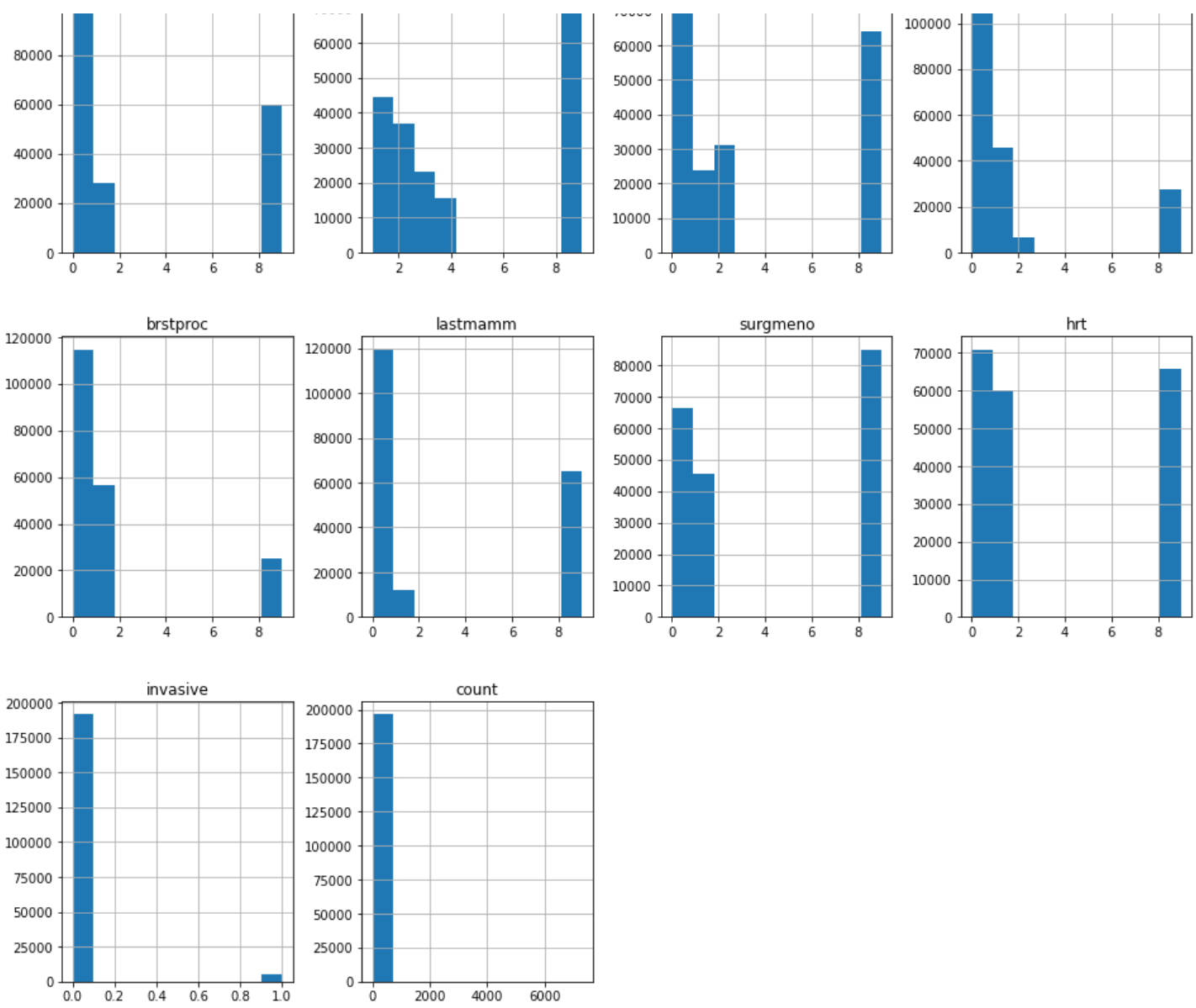
In [34]:

```
from pylab import rcParams
rcParams['figure.figsize'] = 16,20
```

In [36]:

```
df[['menopaus','agegrp','density','race','Hispanic','bmi','agefirst','nrelbc','brstproc',
'lastmamm','surgmeno','hrt','invasive','count']].hist();
```





BiVariate Analysis with Target Variable : 'cancer'

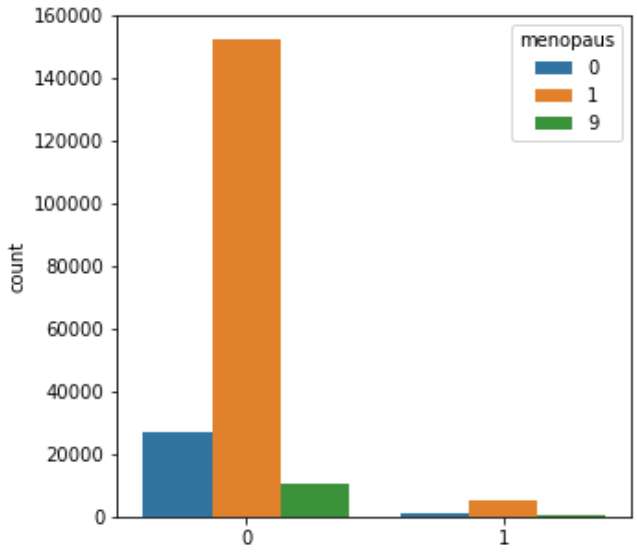
- **'menopaus' with 'cancer'**

In [37]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="menopaus",data=df)
```

Out[37]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



cancer

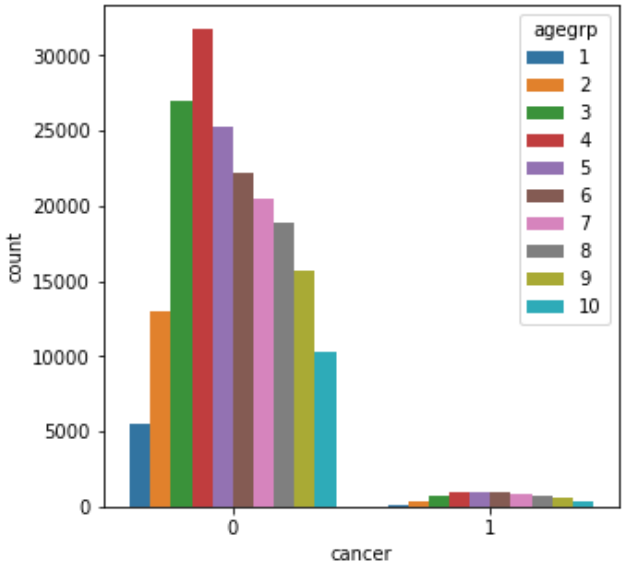
- **'agegrp' with 'cancer'**

In [38]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="agegrp",data=df)
```

Out[38]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



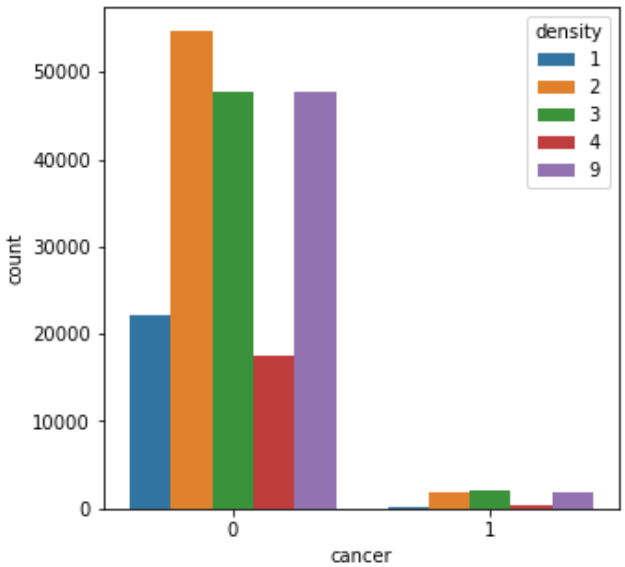
- **'density' with 'cancer'**

In [39]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="density",data=df)
```

Out[39]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



- **'race' with 'cancer'**

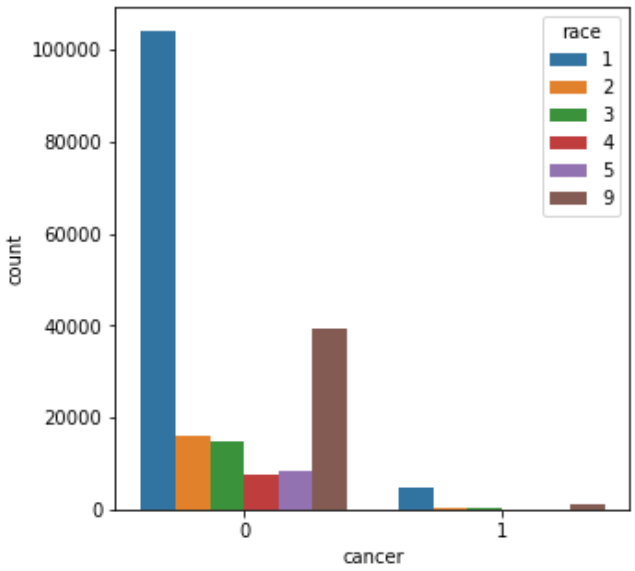
In [40]:

```
plt.figure(figsize=(5,5))
```

```
sns.countplot(x="cancer",hue="race",data=df)
```

Out[40]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



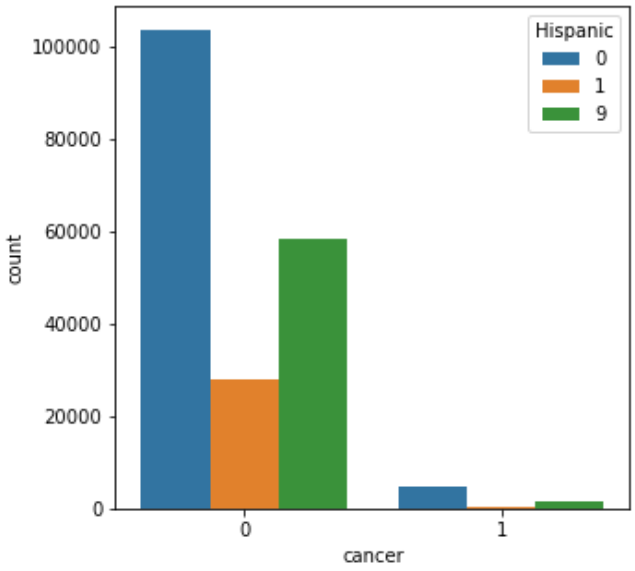
- **'Hispanic' with 'cancer'**

In [41]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="Hispanic",data=df)
```

Out[41]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



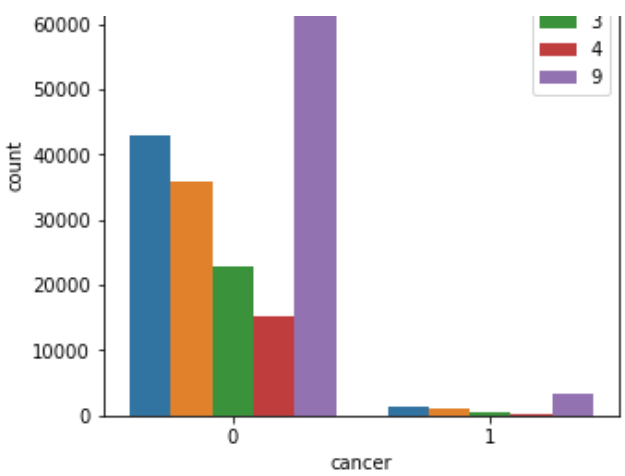
- **'bmi' with 'cancer'**

In [42]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="bmi",data=df)
```

Out[42]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



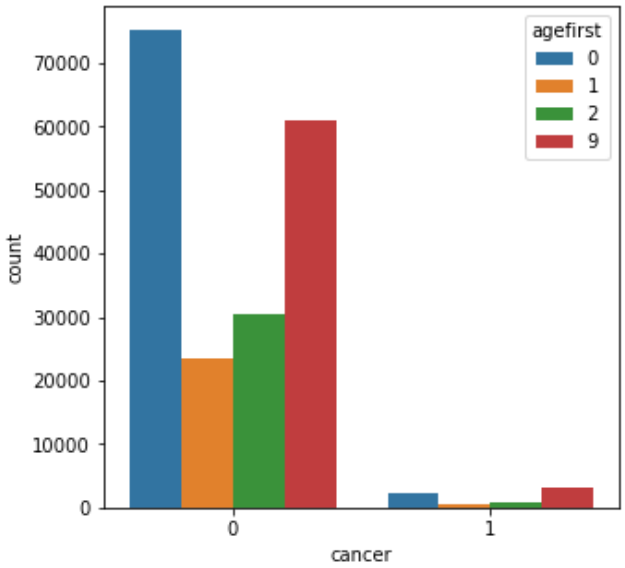
- **'agefirst' with 'cancer'**

In [43]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="agefirst",data=df)
```

Out[43]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



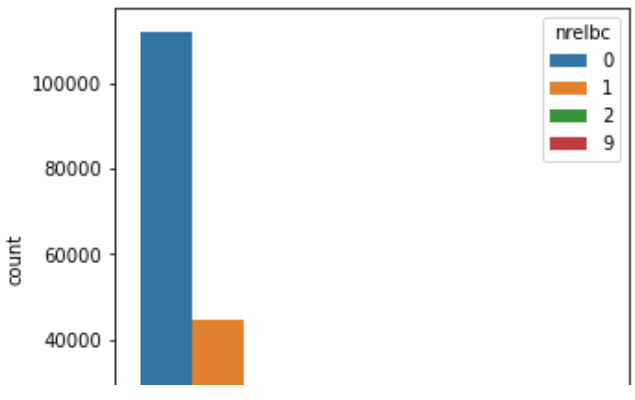
- **'nrelbc' with 'cancer'**

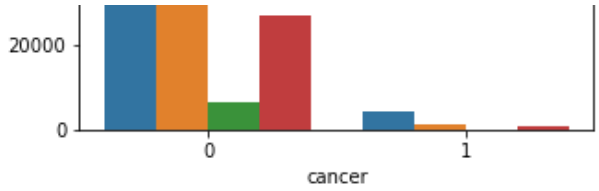
In [44]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="nrelbc",data=df)
```

Out[44]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```





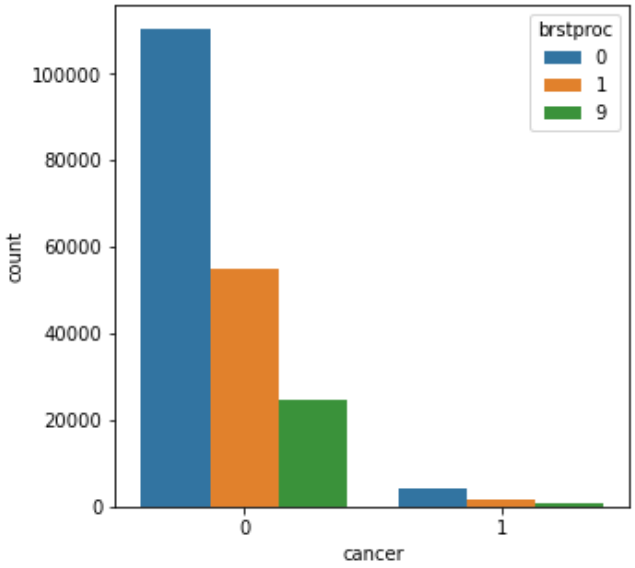
- **'brstproc' with 'cancer'**

In [45]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="brstproc",data=df)
```

Out[45]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



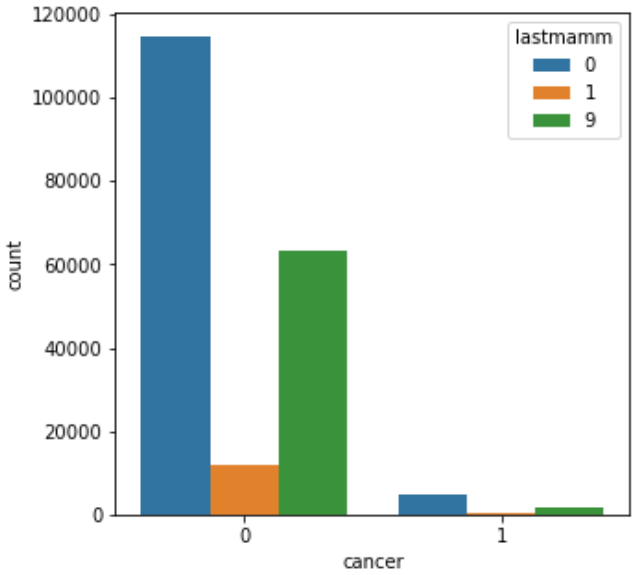
- **'lastmamm' with 'cancer'**

In [46]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="lastmamm",data=df)
```

Out[46]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



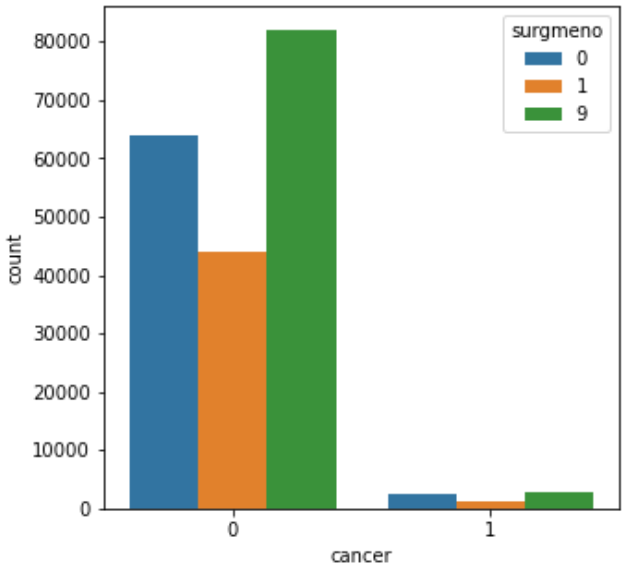
- **'surgmeno' with 'cancer'**

In [47]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="surgmeno",data=df)
```

Out[47]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



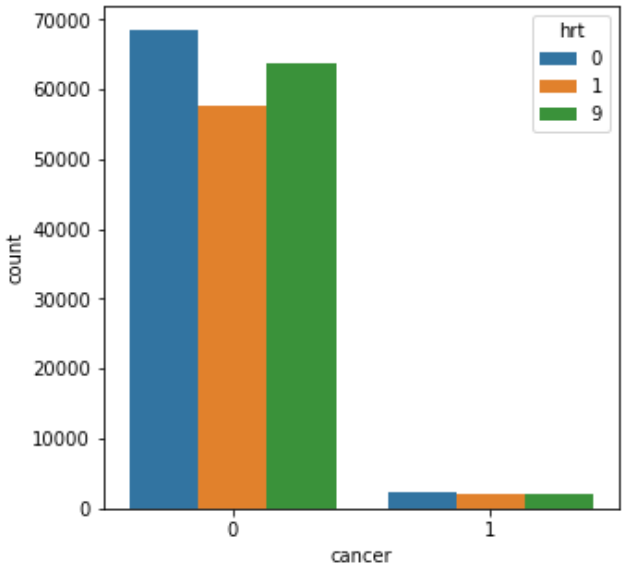
- **'hrt' with 'cancer'**

In [48]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="hrt",data=df)
```

Out[48]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```



- **'invasive' with 'cancer'**

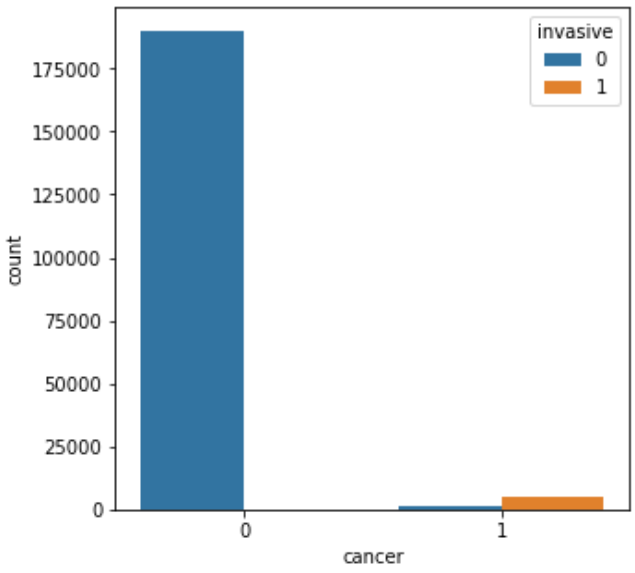
In [49]:

```
plt.figure(figsize=(5,5))
sns.countplot(x="cancer",hue="invasive",data=df)
```

Out[49]:

```
<AxesSubplot:xlabel='cancer', ylabel='count'>
```

<Axessubplot:xlabel='cancer', ylabel='count'>

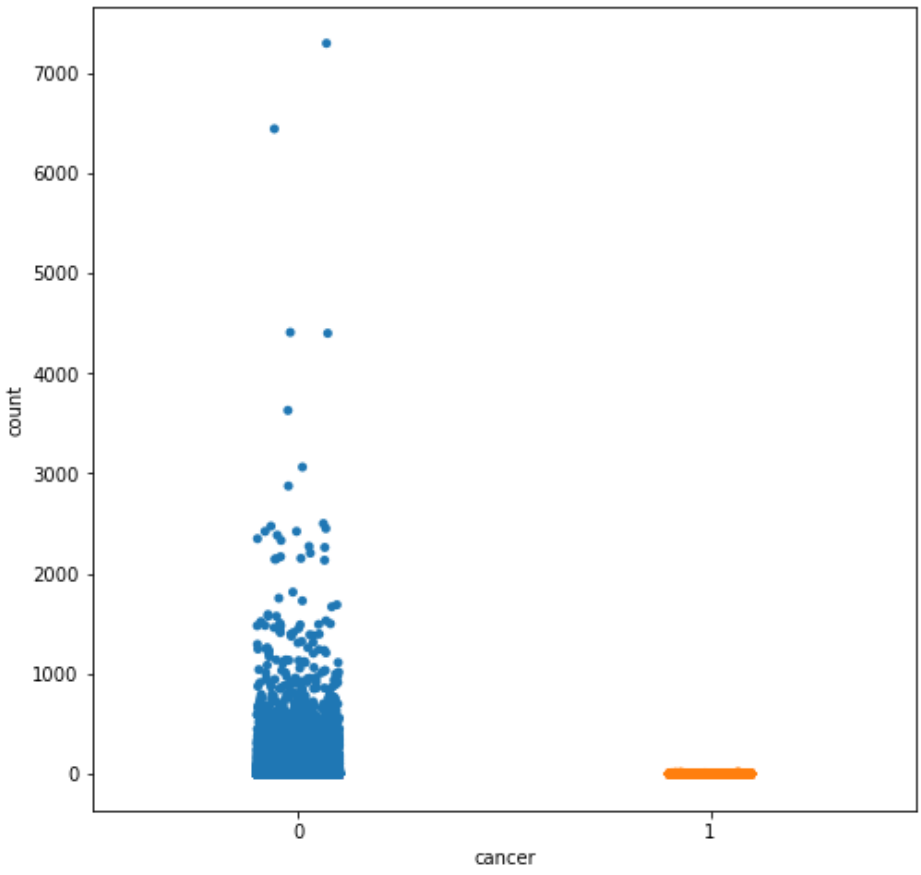


- **'count' with 'cancer'**

In [50]:

```
plt.figure(figsize=(8,8))
sns.stripplot(df["cancer"], df['count'], jitter=True)
plt.show()
```

```
C:\Users\User\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass
the following variables as keyword args: x, y. From version 0.12, the only valid position
al argument will be `data`, and passing other arguments without an explicit keyword will
result in an error or misinterpretation.
  warnings.warn(
```



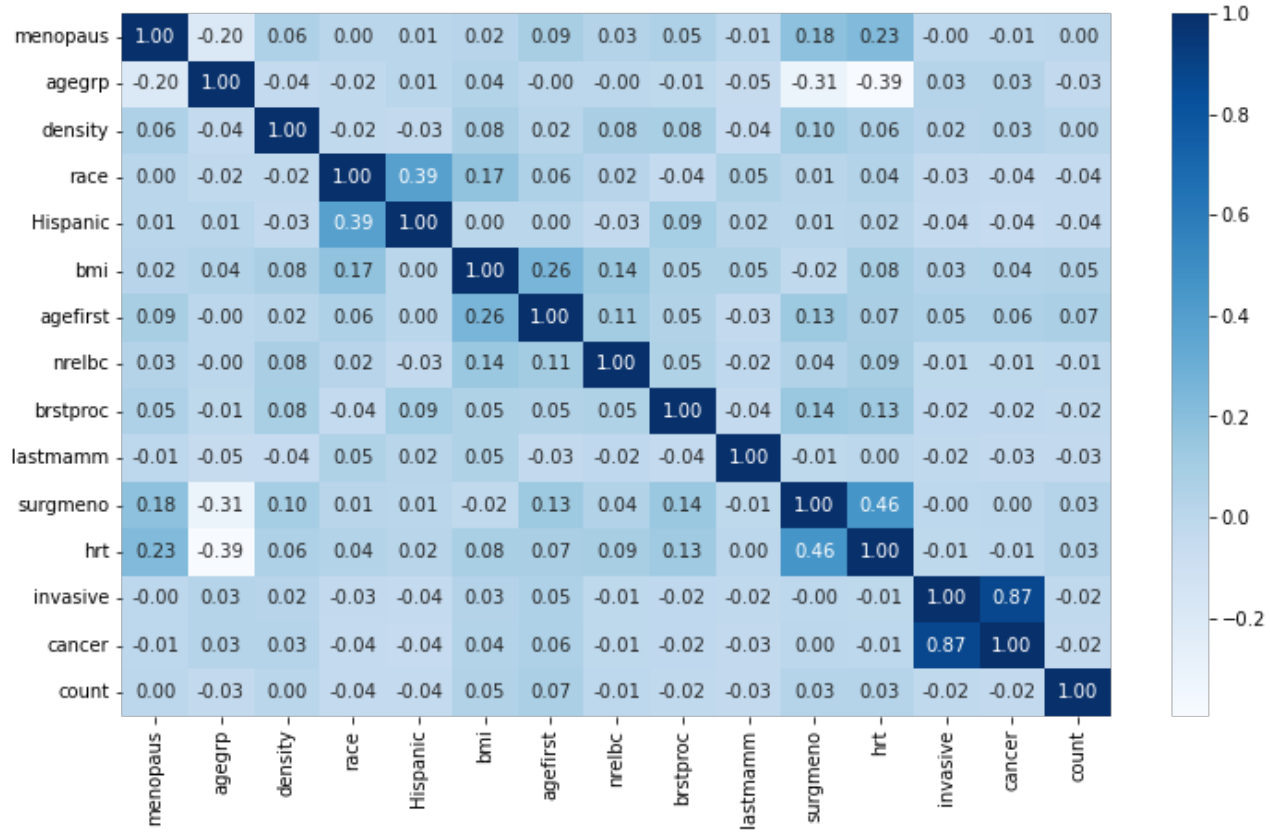
Multi variate Analysis

In [ ]:

```
#sns.pairplot(df,diag_kind='hist',hue='cancer');
```

In [35]:

```
plt.figure(figsize=(12,7))
sns.heatmap(df.corr(), annot=True, fmt='.2f', cmap='Blues')
plt.show()
```



Observation

- **The target field 'cancer'is highly influenced by 'invasive' field.**
- **There is no corelation among the predictor fields.**

In [ ]:

Insights from EDA

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

```
```

VIF

In [53]:

```
df.columns
```

Out[53]:

```
Index(['menopaus', 'agegrp', 'density', 'race', 'Hispanic', 'bmi', 'agefirst',
       'nrelbc', 'brstproc', 'lastmamm', 'surgmeno', 'hrt', 'invasive',
       'cancer', 'count'],
      dtype='object')
```

In [36]:

```
from scipy.stats import zscore
df_scaled=df.apply(zscore)
df_scaled.head()
```

Out[36]:

	menopaus	agegrp	density	race	Hispanic	bmi	agefirst	nrelbc	brstproc	lastmamm	surgmeno	hrt
0	-0.68569	-1.872356	-1.045643	-0.690402	-0.71096	-1.088196	-0.848813	-0.513827	-0.493222	1.418888	1.14248	1.40311
1	-0.68569	-1.872356	-1.045643	-0.690402	-0.71096	-1.088196	-0.848813	-0.513827	-0.493222	1.418888	1.14248	1.40311
2	-0.68569	-1.872356	-1.045643	-0.690402	-0.71096	-1.088196	-0.848813	-0.186813	-0.493222	-0.724511	1.14248	1.40311
3	-0.68569	-1.872356	-1.045643	-0.690402	-0.71096	-1.088196	-0.848813	-0.186813	-0.493222	1.418888	1.14248	1.40311
4	-0.68569	-1.872356	-1.045643	-0.690402	-0.71096	-1.088196	-0.597159	-0.513827	-0.493222	-0.724511	1.14248	1.40311

In [37]:

```
from statsmodels.stats.outliers_influence import variance_inflation_factor
Z = df_scaled
Z = df_scaled.drop(['cancer'],axis=1)
vif = pd.DataFrame()
vif["features"]=Z.columns
vif["VIF"] = [variance_inflation_factor(Z.values, i)
                          for i in range(len(Z.columns))]
print(vif.sort_values(by='VIF'))
```

```
    features       VIF
12  invasive  1.008640
13     count  1.013124
9   lastmamm  1.014482
2    density  1.030656
7     nrelbc  1.039857
8   brstproc  1.057166
0   menopaus  1.083250
6   agefirst  1.115200
5        bmi  1.154057
4   Hispanic  1.201960
3       race  1.235072
1     agegrp  1.248989
10  surgmeno  1.353580
11       hrt  1.442357
```

In [ ]:

In [ ]:

```
```

Train/Test Split

In [38]:

```
from sklearn.model_selection import train_test_split
```

In [39]:

```
# capture the target column ("cancer") into separate vectors for training set and test se
t

# Copy all the predictor variables into X dataframe
X = df.drop(['cancer'],axis=1)
# Copy target into the y dataframe.
y = df[['cancer']]
```

In [40]:

```
# splitting data into training and test set for independent attributes
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=0.30 , random_state=
1,stratify=df['cancer'])
```

In [41]:

```
x_train.shape, y_train.shape, x_test.shape, y_test.shape
```

Out[41]:

```
((137523, 14), (137523, 1), (58939, 14), (58939, 1))
```

In [42]:

```
y_test.value_counts(normalize=True)
```

Out[42]:

```
cancer
0         0.966813
1         0.033187
dtype: float64
```

In [43]:

```
y_train.value_counts(normalize=True)
```

Out[43]:

```
cancer
0         0.966813
1         0.033187
dtype: float64
```

In [ ]:

```
```

In [ ]:

```
```

Scaling

In [44]:

```
from sklearn.preprocessing import StandardScaler
```

In [45]:

```
ss=StandardScaler()
# we are scaling the data for ANN. Without scaling it will give very poor results. Comput
ations becomes easier
x_train_scaled=ss.fit_transform(x_train)
x_test_scaled=ss.transform(x_test)
```

In [ ]:

```

```

In [ ]:

```

```

In [ ]:

```

```

In [ ]:

```

```

Import necessary libraries for Model Building

In [46]:

```
from sklearn.ensemble import RandomForestClassifier
import catboost as catboost
from catboost import CatBoostClassifier
from xgboost import XGBClassifier
import xgboost as xgboost
```

In [47]:

```
from sklearn.model_selection import GridSearchCV
```

In [48]:

```
from sklearn import metrics
from sklearn.metrics import roc_auc_score,roc_curve,classification_report,confusion_matri
x,plot_confusion_matrix
```

In [ ]:

```

```

RandomForest, XGB, CatBoost

In [104]:

```
rf= RandomForestClassifier()
xgb = XGBClassifier()
cb = CatBoostClassifier()
```

In [105]:

```
models=[rf,xgb,cb]
scores_train=[]
scores_test=[]
```

In [106]:

```
for i in models:
        i.fit(x_train,y_train)
        scores_train.append(i.score(x_train, y_train))
        scores_test.append(i.score(x_test, y_test))
```

```
C:\Users\User\AppData\Local\Temp\ipykernel_4628\1020830230.py:2: DataConversionWarning: A
```

```
C:\Users\User\AppData\Local\Temp\ipykernel_1020\1020050290.py:2: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().
  i.fit(x_train,y_train)
```

```
Learning rate set to 0.084337
0: learn: 0.5097666 total: 371ms remaining: 6m 10s
1: learn: 0.3747878 total: 490ms remaining: 4m 4s
2: learn: 0.2811275 total: 601ms remaining: 3m 19s
3: learn: 0.2143181 total: 777ms remaining: 3m 13s
4: learn: 0.1682652 total: 909ms remaining: 3m
5: learn: 0.1355917 total: 1s remaining: 2m 46s
6: learn: 0.1125443 total: 1.1s remaining: 2m 35s
7: learn: 0.0957205 total: 1.2s remaining: 2m 28s
8: learn: 0.0830059 total: 1.29s remaining: 2m 22s
9: learn: 0.0737386 total: 1.39s remaining: 2m 17s
10: learn: 0.0645405 total: 1.47s remaining: 2m 12s
11: learn: 0.0594856 total: 1.56s remaining: 2m 8s
12: learn: 0.0555626 total: 1.65s remaining: 2m 5s
13: learn: 0.0527131 total: 1.76s remaining: 2m 4s
14: learn: 0.0485746 total: 1.88s remaining: 2m 3s
15: learn: 0.0470067 total: 2s remaining: 2m 3s
16: learn: 0.0456883 total: 2.12s remaining: 2m 2s
17: learn: 0.0435210 total: 2.23s remaining: 2m 1s
18: learn: 0.0418040 total: 2.33s remaining: 2m
19: learn: 0.0406963 total: 2.43s remaining: 1m 59s
20: learn: 0.0401695 total: 2.52s remaining: 1m 57s
21: learn: 0.0392835 total: 2.62s remaining: 1m 56s
22: learn: 0.0384482 total: 2.72s remaining: 1m 55s
23: learn: 0.0378369 total: 2.81s remaining: 1m 54s
24: learn: 0.0373257 total: 2.93s remaining: 1m 54s
25: learn: 0.0368406 total: 3.05s remaining: 1m 54s
26: learn: 0.0364735 total: 3.17s remaining: 1m 54s
27: learn: 0.0361382 total: 3.28s remaining: 1m 54s
28: learn: 0.0357750 total: 3.41s remaining: 1m 54s
29: learn: 0.0355434 total: 3.53s remaining: 1m 54s
30: learn: 0.0352085 total: 3.65s remaining: 1m 54s
31: learn: 0.0349560 total: 3.76s remaining: 1m 53s
32: learn: 0.0347878 total: 3.88s remaining: 1m 53s
33: learn: 0.0345894 total: 4s remaining: 1m 53s
34: learn: 0.0343579 total: 4.13s remaining: 1m 53s
35: learn: 0.0341936 total: 4.24s remaining: 1m 53s
36: learn: 0.0340158 total: 4.36s remaining: 1m 53s
37: learn: 0.0338362 total: 4.47s remaining: 1m 53s
38: learn: 0.0336668 total: 4.59s remaining: 1m 53s
39: learn: 0.0335100 total: 4.71s remaining: 1m 52s
40: learn: 0.0333984 total: 4.82s remaining: 1m 52s
41: learn: 0.0332773 total: 4.95s remaining: 1m 52s
42: learn: 0.0331302 total: 5.11s remaining: 1m 53s
43: learn: 0.0329886 total: 5.27s remaining: 1m 54s
44: learn: 0.0328474 total: 5.44s remaining: 1m 55s
45: learn: 0.0327311 total: 5.6s remaining: 1m 56s
46: learn: 0.0325225 total: 5.76s remaining: 1m 56s
47: learn: 0.0323966 total: 5.89s remaining: 1m 56s
48: learn: 0.0322749 total: 6.02s remaining: 1m 56s
49: learn: 0.0321210 total: 6.13s remaining: 1m 56s
50: learn: 0.0319365 total: 6.25s remaining: 1m 56s
51: learn: 0.0318124 total: 6.38s remaining: 1m 56s
52: learn: 0.0317042 total: 6.51s remaining: 1m 56s
53: learn: 0.0314545 total: 6.62s remaining: 1m 56s
54: learn: 0.0313181 total: 6.74s remaining: 1m 55s
55: learn: 0.0311860 total: 6.88s remaining: 1m 55s
56: learn: 0.0310811 total: 7.05s remaining: 1m 56s
57: learn: 0.0308858 total: 7.19s remaining: 1m 56s
58: learn: 0.0307495 total: 7.32s remaining: 1m 56s
59: learn: 0.0306808 total: 7.43s remaining: 1m 56s
60: learn: 0.0305461 total: 7.55s remaining: 1m 56s
61: learn: 0.0303960 total: 7.66s remaining: 1m 55s
62: learn: 0.0303222 total: 7.78s remaining: 1m 55s
63: learn: 0.0302451 total: 7.89s remaining: 1m 55s
64: learn: 0.0301710 total: 8.01s remaining: 1m 55s
65: learn: 0.0299982 total: 8.12s remaining: 1m 54s
66: learn: 0.0299052 total: 8.26s remaining: 1m 55s
```

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67: learn: 0.0298004 total: 8.38s remaining: 1m 54s
68: learn: 0.0297007 total: 8.54s remaining: 1m 55s
69: learn: 0.0295404 total: 8.72s remaining: 1m 55s
70: learn: 0.0294677 total: 8.9s remaining: 1m 56s
71: learn: 0.0293893 total: 9.1s remaining: 1m 57s
72: learn: 0.0292120 total: 9.34s remaining: 1m 58s
73: learn: 0.0291454 total: 9.72s remaining: 2m 1s
74: learn: 0.0289685 total: 9.89s remaining: 2m 1s
75: learn: 0.0288898 total: 10.5s remaining: 2m 7s
76: learn: 0.0287719 total: 11.1s remaining: 2m 12s
77: learn: 0.0286750 total: 11.6s remaining: 2m 17s
78: learn: 0.0285713 total: 12.2s remaining: 2m 22s
79: learn: 0.0284571 total: 12.6s remaining: 2m 24s
80: learn: 0.0283485 total: 13s remaining: 2m 27s
81: learn: 0.0282427 total: 13.3s remaining: 2m 29s
82: learn: 0.0280959 total: 13.8s remaining: 2m 32s
83: learn: 0.0280411 total: 14s remaining: 2m 32s
84: learn: 0.0279200 total: 14.2s remaining: 2m 32s
85: learn: 0.0278194 total: 14.6s remaining: 2m 35s
86: learn: 0.0277427 total: 15s remaining: 2m 37s
87: learn: 0.0276366 total: 15.6s remaining: 2m 41s
88: learn: 0.0275082 total: 16s remaining: 2m 43s
89: learn: 0.0274313 total: 16.1s remaining: 2m 43s
90: learn: 0.0273238 total: 16.6s remaining: 2m 46s
91: learn: 0.0272213 total: 16.8s remaining: 2m 45s
92: learn: 0.0270933 total: 17s remaining: 2m 46s
93: learn: 0.0270314 total: 17.2s remaining: 2m 46s
94: learn: 0.0269367 total: 17.3s remaining: 2m 45s
95: learn: 0.0268724 total: 17.6s remaining: 2m 45s
96: learn: 0.0267960 total: 17.8s remaining: 2m 46s
97: learn: 0.0267263 total: 18s remaining: 2m 45s
98: learn: 0.0266415 total: 18.3s remaining: 2m 46s
99: learn: 0.0265622 total: 18.4s remaining: 2m 45s
100: learn: 0.0264575 total: 18.5s remaining: 2m 44s
101: learn: 0.0263732 total: 18.6s remaining: 2m 43s
102: learn: 0.0262656 total: 18.9s remaining: 2m 44s
103: learn: 0.0261641 total: 19.1s remaining: 2m 44s
104: learn: 0.0260811 total: 19.3s remaining: 2m 44s
105: learn: 0.0260065 total: 19.5s remaining: 2m 44s
106: learn: 0.0259545 total: 19.8s remaining: 2m 44s
107: learn: 0.0258498 total: 20s remaining: 2m 45s
108: learn: 0.0257782 total: 20.2s remaining: 2m 45s
109: learn: 0.0257194 total: 20.5s remaining: 2m 45s
110: learn: 0.0256576 total: 20.7s remaining: 2m 45s
111: learn: 0.0256043 total: 21s remaining: 2m 46s
112: learn: 0.0255497 total: 21.2s remaining: 2m 46s
113: learn: 0.0254785 total: 21.3s remaining: 2m 45s
114: learn: 0.0253900 total: 21.4s remaining: 2m 44s
115: learn: 0.0253186 total: 21.6s remaining: 2m 44s
116: learn: 0.0252779 total: 21.7s remaining: 2m 43s
117: learn: 0.0252005 total: 21.9s remaining: 2m 43s
118: learn: 0.0251488 total: 22.1s remaining: 2m 43s
119: learn: 0.0251065 total: 22.3s remaining: 2m 43s
120: learn: 0.0250218 total: 22.4s remaining: 2m 42s
121: learn: 0.0248985 total: 22.5s remaining: 2m 42s
122: learn: 0.0248421 total: 22.7s remaining: 2m 41s
123: learn: 0.0247868 total: 22.8s remaining: 2m 40s
124: learn: 0.0247386 total: 22.9s remaining: 2m 40s
125: learn: 0.0246367 total: 23s remaining: 2m 39s
126: learn: 0.0245524 total: 23.2s remaining: 2m 39s
127: learn: 0.0244944 total: 23.3s remaining: 2m 38s
128: learn: 0.0244298 total: 23.4s remaining: 2m 38s
129: learn: 0.0243596 total: 23.6s remaining: 2m 37s
130: learn: 0.0243164 total: 23.7s remaining: 2m 37s
131: learn: 0.0242685 total: 23.9s remaining: 2m 36s
132: learn: 0.0242162 total: 24s remaining: 2m 36s
133: learn: 0.0241743 total: 24.2s remaining: 2m 36s
134: learn: 0.0241186 total: 24.3s remaining: 2m 35s
135: learn: 0.0240663 total: 24.4s remaining: 2m 35s
136: learn: 0.0239991 total: 24.6s remaining: 2m 34s
137: learn: 0.0239421 total: 24.7s remaining: 2m 34s
138: learn: 0.0238768 total: 24.9s remaining: 2m 34s
```

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139: learn: 0.0238204 total: 25.2s remaining: 2m 34s
140: learn: 0.0237755 total: 25.3s remaining: 2m 34s
141: learn: 0.0237089 total: 25.5s remaining: 2m 34s
142: learn: 0.0236534 total: 25.8s remaining: 2m 34s
143: learn: 0.0236181 total: 25.9s remaining: 2m 34s
144: learn: 0.0235720 total: 26.1s remaining: 2m 33s
145: learn: 0.0235140 total: 26.2s remaining: 2m 33s
146: learn: 0.0234666 total: 26.3s remaining: 2m 32s
147: learn: 0.0234222 total: 26.5s remaining: 2m 32s
148: learn: 0.0233631 total: 26.6s remaining: 2m 32s
149: learn: 0.0233281 total: 26.8s remaining: 2m 31s
150: learn: 0.0232772 total: 27s remaining: 2m 32s
151: learn: 0.0232183 total: 27.2s remaining: 2m 31s
152: learn: 0.0231189 total: 27.4s remaining: 2m 31s
153: learn: 0.0230662 total: 27.6s remaining: 2m 31s
154: learn: 0.0230303 total: 27.7s remaining: 2m 31s
155: learn: 0.0229800 total: 27.9s remaining: 2m 30s
156: learn: 0.0229319 total: 28s remaining: 2m 30s
157: learn: 0.0228963 total: 28.2s remaining: 2m 30s
158: learn: 0.0228545 total: 28.3s remaining: 2m 29s
159: learn: 0.0228141 total: 28.5s remaining: 2m 29s
160: learn: 0.0227792 total: 28.7s remaining: 2m 29s
161: learn: 0.0227271 total: 28.8s remaining: 2m 28s
162: learn: 0.0226870 total: 28.9s remaining: 2m 28s
163: learn: 0.0226504 total: 29.1s remaining: 2m 28s
164: learn: 0.0226159 total: 29.3s remaining: 2m 28s
165: learn: 0.0225760 total: 29.4s remaining: 2m 27s
166: learn: 0.0225284 total: 29.5s remaining: 2m 27s
167: learn: 0.0224787 total: 29.7s remaining: 2m 26s
168: learn: 0.0224174 total: 29.8s remaining: 2m 26s
169: learn: 0.0223526 total: 30s remaining: 2m 26s
170: learn: 0.0222981 total: 30.2s remaining: 2m 26s
171: learn: 0.0222673 total: 30.4s remaining: 2m 26s
172: learn: 0.0222291 total: 30.5s remaining: 2m 26s
173: learn: 0.0221876 total: 30.7s remaining: 2m 25s
174: learn: 0.0221256 total: 30.8s remaining: 2m 25s
175: learn: 0.0220822 total: 30.9s remaining: 2m 24s
176: learn: 0.0220450 total: 31s remaining: 2m 24s
177: learn: 0.0220211 total: 31.1s remaining: 2m 23s
178: learn: 0.0219648 total: 31.3s remaining: 2m 23s
179: learn: 0.0219290 total: 31.4s remaining: 2m 23s
180: learn: 0.0218970 total: 31.5s remaining: 2m 22s
181: learn: 0.0218508 total: 31.6s remaining: 2m 22s
182: learn: 0.0218138 total: 31.8s remaining: 2m 21s
183: learn: 0.0217760 total: 31.9s remaining: 2m 21s
184: learn: 0.0217405 total: 32.1s remaining: 2m 21s
185: learn: 0.0217064 total: 32.3s remaining: 2m 21s
186: learn: 0.0216497 total: 32.4s remaining: 2m 20s
187: learn: 0.0216163 total: 32.5s remaining: 2m 20s
188: learn: 0.0215872 total: 32.6s remaining: 2m 19s
189: learn: 0.0215378 total: 32.7s remaining: 2m 19s
190: learn: 0.0215097 total: 32.8s remaining: 2m 18s
191: learn: 0.0214814 total: 32.9s remaining: 2m 18s
192: learn: 0.0214402 total: 33s remaining: 2m 17s
193: learn: 0.0214063 total: 33.1s remaining: 2m 17s
194: learn: 0.0213760 total: 33.2s remaining: 2m 17s
195: learn: 0.0213464 total: 33.3s remaining: 2m 16s
196: learn: 0.0213193 total: 33.5s remaining: 2m 16s
197: learn: 0.0212950 total: 33.6s remaining: 2m 16s
198: learn: 0.0212690 total: 33.7s remaining: 2m 15s
199: learn: 0.0212351 total: 33.8s remaining: 2m 15s
200: learn: 0.0211919 total: 33.9s remaining: 2m 14s
201: learn: 0.0211704 total: 34s remaining: 2m 14s
202: learn: 0.0211428 total: 34.1s remaining: 2m 14s
203: learn: 0.0211129 total: 34.3s remaining: 2m 13s
204: learn: 0.0210916 total: 34.4s remaining: 2m 13s
205: learn: 0.0210462 total: 34.5s remaining: 2m 12s
206: learn: 0.0210173 total: 34.6s remaining: 2m 12s
207: learn: 0.0209675 total: 34.7s remaining: 2m 12s
208: learn: 0.0209390 total: 34.9s remaining: 2m 12s
209: learn: 0.0209111 total: 35.2s remaining: 2m 12s
210: learn: 0.0208885 total: 35.5s remaining: 2m 12s
```

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211: learn: 0.0208411 total: 35.7s remaining: 2m 12s
212: learn: 0.0207923 total: 36s remaining: 2m 13s
213: learn: 0.0207620 total: 36.2s remaining: 2m 12s
214: learn: 0.0207410 total: 36.3s remaining: 2m 12s
215: learn: 0.0207065 total: 36.5s remaining: 2m 12s
216: learn: 0.0206227 total: 36.7s remaining: 2m 12s
217: learn: 0.0205954 total: 36.9s remaining: 2m 12s
218: learn: 0.0205607 total: 37.1s remaining: 2m 12s
219: learn: 0.0205428 total: 37.4s remaining: 2m 12s
220: learn: 0.0204859 total: 37.6s remaining: 2m 12s
221: learn: 0.0204557 total: 37.8s remaining: 2m 12s
222: learn: 0.0204307 total: 37.9s remaining: 2m 12s
223: learn: 0.0204065 total: 38.1s remaining: 2m 11s
224: learn: 0.0203740 total: 38.3s remaining: 2m 11s
225: learn: 0.0203434 total: 38.4s remaining: 2m 11s
226: learn: 0.0203103 total: 38.6s remaining: 2m 11s
227: learn: 0.0202859 total: 38.8s remaining: 2m 11s
228: learn: 0.0202710 total: 38.9s remaining: 2m 11s
229: learn: 0.0202331 total: 39.1s remaining: 2m 10s
230: learn: 0.0201928 total: 39.3s remaining: 2m 10s
231: learn: 0.0201627 total: 39.4s remaining: 2m 10s
232: learn: 0.0201075 total: 39.6s remaining: 2m 10s
233: learn: 0.0200793 total: 39.8s remaining: 2m 10s
234: learn: 0.0200583 total: 40.1s remaining: 2m 10s
235: learn: 0.0200388 total: 40.4s remaining: 2m 10s
236: learn: 0.0200149 total: 40.7s remaining: 2m 10s
237: learn: 0.0199826 total: 40.9s remaining: 2m 10s
238: learn: 0.0199627 total: 41.1s remaining: 2m 10s
239: learn: 0.0199260 total: 41.2s remaining: 2m 10s
240: learn: 0.0199042 total: 41.4s remaining: 2m 10s
241: learn: 0.0198702 total: 41.5s remaining: 2m 9s
242: learn: 0.0198482 total: 41.6s remaining: 2m 9s
243: learn: 0.0197958 total: 41.8s remaining: 2m 9s
244: learn: 0.0197682 total: 42s remaining: 2m 9s
245: learn: 0.0197503 total: 42.2s remaining: 2m 9s
246: learn: 0.0197139 total: 42.4s remaining: 2m 9s
247: learn: 0.0196745 total: 42.6s remaining: 2m 9s
248: learn: 0.0196310 total: 42.8s remaining: 2m 8s
249: learn: 0.0196070 total: 42.9s remaining: 2m 8s
250: learn: 0.0195898 total: 43s remaining: 2m 8s
251: learn: 0.0195611 total: 43.2s remaining: 2m 8s
252: learn: 0.0195391 total: 43.3s remaining: 2m 7s
253: learn: 0.0195007 total: 43.5s remaining: 2m 7s
254: learn: 0.0194491 total: 43.7s remaining: 2m 7s
255: learn: 0.0194264 total: 43.8s remaining: 2m 7s
256: learn: 0.0193995 total: 44s remaining: 2m 7s
257: learn: 0.0193635 total: 44.2s remaining: 2m 7s
258: learn: 0.0193370 total: 44.4s remaining: 2m 7s
259: learn: 0.0193007 total: 44.5s remaining: 2m 6s
260: learn: 0.0192803 total: 44.8s remaining: 2m 6s
261: learn: 0.0192600 total: 44.9s remaining: 2m 6s
262: learn: 0.0192377 total: 45.1s remaining: 2m 6s
263: learn: 0.0192053 total: 45.4s remaining: 2m 6s
264: learn: 0.0191744 total: 45.5s remaining: 2m 6s
265: learn: 0.0191559 total: 45.7s remaining: 2m 6s
266: learn: 0.0191166 total: 45.8s remaining: 2m 5s
267: learn: 0.0190823 total: 46s remaining: 2m 5s
268: learn: 0.0190515 total: 46.1s remaining: 2m 5s
269: learn: 0.0190261 total: 46.2s remaining: 2m 5s
270: learn: 0.0189663 total: 46.4s remaining: 2m 4s
271: learn: 0.0189398 total: 46.5s remaining: 2m 4s
272: learn: 0.0189101 total: 46.5s remaining: 2m 3s
273: learn: 0.0188677 total: 46.7s remaining: 2m 3s
274: learn: 0.0188356 total: 46.9s remaining: 2m 3s
275: learn: 0.0187981 total: 47.1s remaining: 2m 3s
276: learn: 0.0187845 total: 47.2s remaining: 2m 3s
277: learn: 0.0187638 total: 47.4s remaining: 2m 3s
278: learn: 0.0187492 total: 47.6s remaining: 2m 2s
279: learn: 0.0187260 total: 47.7s remaining: 2m 2s
280: learn: 0.0187031 total: 47.8s remaining: 2m 2s
281: learn: 0.0186686 total: 48s remaining: 2m 2s
282: learn: 0.0186341 total: 48.1s remaining: 2m 1s
```

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283: learn: 0.0186012 total: 48.2s remaining: 2m 1s
284: learn: 0.0185790 total: 48.3s remaining: 2m 1s
285: learn: 0.0185630 total: 48.4s remaining: 2m
286: learn: 0.0185337 total: 48.6s remaining: 2m
287: learn: 0.0185089 total: 48.7s remaining: 2m
288: learn: 0.0184757 total: 48.9s remaining: 2m
289: learn: 0.0184598 total: 49s remaining: 1m 59s
290: learn: 0.0184397 total: 49.1s remaining: 1m 59s
291: learn: 0.0184040 total: 49.3s remaining: 1m 59s
292: learn: 0.0183649 total: 49.4s remaining: 1m 59s
293: learn: 0.0183415 total: 49.5s remaining: 1m 58s
294: learn: 0.0183102 total: 49.8s remaining: 1m 58s
295: learn: 0.0182973 total: 49.9s remaining: 1m 58s
296: learn: 0.0182776 total: 50.1s remaining: 1m 58s
297: learn: 0.0182606 total: 50.2s remaining: 1m 58s
298: learn: 0.0182364 total: 50.4s remaining: 1m 58s
299: learn: 0.0181782 total: 50.5s remaining: 1m 57s
300: learn: 0.0181553 total: 50.6s remaining: 1m 57s
301: learn: 0.0181359 total: 50.8s remaining: 1m 57s
302: learn: 0.0181200 total: 50.9s remaining: 1m 57s
303: learn: 0.0180913 total: 51s remaining: 1m 56s
304: learn: 0.0180638 total: 51.1s remaining: 1m 56s
305: learn: 0.0180404 total: 51.2s remaining: 1m 56s
306: learn: 0.0180178 total: 51.4s remaining: 1m 56s
307: learn: 0.0179995 total: 51.7s remaining: 1m 56s
308: learn: 0.0179350 total: 51.9s remaining: 1m 56s
309: learn: 0.0178929 total: 52.1s remaining: 1m 55s
310: learn: 0.0178757 total: 52.2s remaining: 1m 55s
311: learn: 0.0178429 total: 52.4s remaining: 1m 55s
312: learn: 0.0178209 total: 52.6s remaining: 1m 55s
313: learn: 0.0178023 total: 52.8s remaining: 1m 55s
314: learn: 0.0177635 total: 52.9s remaining: 1m 55s
315: learn: 0.0177469 total: 53s remaining: 1m 54s
316: learn: 0.0177330 total: 53.2s remaining: 1m 54s
317: learn: 0.0177048 total: 53.3s remaining: 1m 54s
318: learn: 0.0176705 total: 53.4s remaining: 1m 54s
319: learn: 0.0176452 total: 53.7s remaining: 1m 54s
320: learn: 0.0176240 total: 53.8s remaining: 1m 53s
321: learn: 0.0176083 total: 54s remaining: 1m 53s
322: learn: 0.0175944 total: 54.1s remaining: 1m 53s
323: learn: 0.0175717 total: 54.3s remaining: 1m 53s
324: learn: 0.0175497 total: 54.5s remaining: 1m 53s
325: learn: 0.0175337 total: 54.7s remaining: 1m 53s
326: learn: 0.0175136 total: 55s remaining: 1m 53s
327: learn: 0.0174872 total: 55.3s remaining: 1m 53s
328: learn: 0.0174586 total: 55.6s remaining: 1m 53s
329: learn: 0.0174365 total: 55.9s remaining: 1m 53s
330: learn: 0.0174196 total: 56.1s remaining: 1m 53s
331: learn: 0.0173968 total: 56.3s remaining: 1m 53s
332: learn: 0.0173599 total: 56.4s remaining: 1m 53s
333: learn: 0.0173459 total: 56.6s remaining: 1m 52s
334: learn: 0.0173349 total: 56.8s remaining: 1m 52s
335: learn: 0.0173032 total: 57.1s remaining: 1m 52s
336: learn: 0.0172864 total: 57.3s remaining: 1m 52s
337: learn: 0.0172601 total: 57.7s remaining: 1m 53s
338: learn: 0.0172367 total: 58s remaining: 1m 53s
339: learn: 0.0171973 total: 58.2s remaining: 1m 52s
340: learn: 0.0171760 total: 58.4s remaining: 1m 52s
341: learn: 0.0171446 total: 58.6s remaining: 1m 52s
342: learn: 0.0171243 total: 58.7s remaining: 1m 52s
343: learn: 0.0171101 total: 58.9s remaining: 1m 52s
344: learn: 0.0170960 total: 59s remaining: 1m 52s
345: learn: 0.0170808 total: 59.2s remaining: 1m 51s
346: learn: 0.0170562 total: 59.3s remaining: 1m 51s
347: learn: 0.0170277 total: 59.6s remaining: 1m 51s
348: learn: 0.0170129 total: 59.8s remaining: 1m 51s
349: learn: 0.0169847 total: 1m remaining: 1m 51s
350: learn: 0.0169676 total: 1m remaining: 1m 51s
351: learn: 0.0169398 total: 1m remaining: 1m 51s
352: learn: 0.0169258 total: 1m remaining: 1m 51s
353: learn: 0.0169069 total: 1m remaining: 1m 51s
354: learn: 0.0168887 total: 1m remaining: 1m 50s
```

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355: learn: 0.0168748 total: 1m 1s remaining: 1m 50s
356: learn: 0.0168539 total: 1m 1s remaining: 1m 50s
357: learn: 0.0168208 total: 1m 1s remaining: 1m 50s
358: learn: 0.0168069 total: 1m 1s remaining: 1m 50s
359: learn: 0.0167864 total: 1m 1s remaining: 1m 50s
360: learn: 0.0167671 total: 1m 2s remaining: 1m 49s
361: learn: 0.0167439 total: 1m 2s remaining: 1m 49s
362: learn: 0.0167030 total: 1m 2s remaining: 1m 49s
363: learn: 0.0166830 total: 1m 2s remaining: 1m 49s
364: learn: 0.0166708 total: 1m 2s remaining: 1m 49s
365: learn: 0.0166578 total: 1m 2s remaining: 1m 48s
366: learn: 0.0166464 total: 1m 3s remaining: 1m 48s
367: learn: 0.0166274 total: 1m 3s remaining: 1m 48s
368: learn: 0.0166037 total: 1m 3s remaining: 1m 48s
369: learn: 0.0165796 total: 1m 3s remaining: 1m 48s
370: learn: 0.0165714 total: 1m 3s remaining: 1m 47s
371: learn: 0.0165575 total: 1m 3s remaining: 1m 47s
372: learn: 0.0165430 total: 1m 3s remaining: 1m 47s
373: learn: 0.0165225 total: 1m 3s remaining: 1m 47s
374: learn: 0.0165001 total: 1m 4s remaining: 1m 46s
375: learn: 0.0164875 total: 1m 4s remaining: 1m 46s
376: learn: 0.0164735 total: 1m 4s remaining: 1m 46s
377: learn: 0.0164461 total: 1m 4s remaining: 1m 46s
378: learn: 0.0164238 total: 1m 4s remaining: 1m 46s
379: learn: 0.0164100 total: 1m 4s remaining: 1m 45s
380: learn: 0.0163936 total: 1m 5s remaining: 1m 45s
381: learn: 0.0163713 total: 1m 5s remaining: 1m 45s
382: learn: 0.0163516 total: 1m 5s remaining: 1m 45s
383: learn: 0.0163330 total: 1m 5s remaining: 1m 45s
384: learn: 0.0163065 total: 1m 5s remaining: 1m 44s
385: learn: 0.0162810 total: 1m 5s remaining: 1m 44s
386: learn: 0.0162691 total: 1m 5s remaining: 1m 44s
387: learn: 0.0162479 total: 1m 6s remaining: 1m 44s
388: learn: 0.0162348 total: 1m 6s remaining: 1m 44s
389: learn: 0.0162047 total: 1m 6s remaining: 1m 43s
390: learn: 0.0161947 total: 1m 6s remaining: 1m 43s
391: learn: 0.0161745 total: 1m 6s remaining: 1m 43s
392: learn: 0.0161626 total: 1m 6s remaining: 1m 43s
393: learn: 0.0161436 total: 1m 6s remaining: 1m 43s
394: learn: 0.0161361 total: 1m 7s remaining: 1m 42s
395: learn: 0.0161237 total: 1m 7s remaining: 1m 42s
396: learn: 0.0161143 total: 1m 7s remaining: 1m 42s
397: learn: 0.0160996 total: 1m 7s remaining: 1m 42s
398: learn: 0.0160799 total: 1m 7s remaining: 1m 42s
399: learn: 0.0160620 total: 1m 7s remaining: 1m 41s
400: learn: 0.0160424 total: 1m 8s remaining: 1m 41s
401: learn: 0.0160323 total: 1m 8s remaining: 1m 41s
402: learn: 0.0160155 total: 1m 8s remaining: 1m 41s
403: learn: 0.0159951 total: 1m 8s remaining: 1m 41s
404: learn: 0.0159813 total: 1m 8s remaining: 1m 40s
405: learn: 0.0159695 total: 1m 8s remaining: 1m 40s
406: learn: 0.0159483 total: 1m 8s remaining: 1m 40s
407: learn: 0.0159289 total: 1m 9s remaining: 1m 40s
408: learn: 0.0159142 total: 1m 9s remaining: 1m 40s
409: learn: 0.0159048 total: 1m 9s remaining: 1m 40s
410: learn: 0.0158866 total: 1m 9s remaining: 1m 40s
411: learn: 0.0158728 total: 1m 10s remaining: 1m 40s
412: learn: 0.0158445 total: 1m 10s remaining: 1m 39s
413: learn: 0.0158251 total: 1m 10s remaining: 1m 39s
414: learn: 0.0158108 total: 1m 10s remaining: 1m 39s
415: learn: 0.0157925 total: 1m 10s remaining: 1m 39s
416: learn: 0.0157804 total: 1m 10s remaining: 1m 39s
417: learn: 0.0157475 total: 1m 11s remaining: 1m 39s
418: learn: 0.0157343 total: 1m 11s remaining: 1m 39s
419: learn: 0.0157155 total: 1m 11s remaining: 1m 38s
420: learn: 0.0156977 total: 1m 11s remaining: 1m 38s
421: learn: 0.0156832 total: 1m 11s remaining: 1m 38s
422: learn: 0.0156718 total: 1m 12s remaining: 1m 38s
423: learn: 0.0156470 total: 1m 12s remaining: 1m 38s
424: learn: 0.0156374 total: 1m 12s remaining: 1m 37s
425: learn: 0.0156023 total: 1m 12s remaining: 1m 37s
426: learn: 0.0155878 total: 1m 12s remaining: 1m 37s
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427: learn: 0.0155726 total: 1m 12s remaining: 1m 37s
428: learn: 0.0155573 total: 1m 12s remaining: 1m 36s
429: learn: 0.0155310 total: 1m 12s remaining: 1m 36s
430: learn: 0.0155020 total: 1m 13s remaining: 1m 36s
431: learn: 0.0154843 total: 1m 13s remaining: 1m 36s
432: learn: 0.0154713 total: 1m 13s remaining: 1m 36s
433: learn: 0.0154617 total: 1m 13s remaining: 1m 36s
434: learn: 0.0154440 total: 1m 14s remaining: 1m 36s
435: learn: 0.0154314 total: 1m 14s remaining: 1m 36s
436: learn: 0.0154085 total: 1m 14s remaining: 1m 36s
437: learn: 0.0153888 total: 1m 14s remaining: 1m 35s
438: learn: 0.0153780 total: 1m 14s remaining: 1m 35s
439: learn: 0.0153597 total: 1m 15s remaining: 1m 35s
440: learn: 0.0153462 total: 1m 15s remaining: 1m 35s
441: learn: 0.0153402 total: 1m 15s remaining: 1m 35s
442: learn: 0.0153341 total: 1m 15s remaining: 1m 35s
443: learn: 0.0153230 total: 1m 15s remaining: 1m 35s
444: learn: 0.0152888 total: 1m 16s remaining: 1m 34s
445: learn: 0.0152736 total: 1m 16s remaining: 1m 34s
446: learn: 0.0152584 total: 1m 16s remaining: 1m 34s
447: learn: 0.0152491 total: 1m 16s remaining: 1m 34s
448: learn: 0.0152289 total: 1m 16s remaining: 1m 34s
449: learn: 0.0152031 total: 1m 17s remaining: 1m 34s
450: learn: 0.0151936 total: 1m 17s remaining: 1m 33s
451: learn: 0.0151867 total: 1m 17s remaining: 1m 33s
452: learn: 0.0151668 total: 1m 17s remaining: 1m 33s
453: learn: 0.0151590 total: 1m 17s remaining: 1m 33s
454: learn: 0.0151482 total: 1m 17s remaining: 1m 33s
455: learn: 0.0151258 total: 1m 18s remaining: 1m 33s
456: learn: 0.0151081 total: 1m 18s remaining: 1m 33s
457: learn: 0.0150964 total: 1m 18s remaining: 1m 33s
458: learn: 0.0150771 total: 1m 19s remaining: 1m 33s
459: learn: 0.0150695 total: 1m 19s remaining: 1m 33s
460: learn: 0.0150592 total: 1m 19s remaining: 1m 33s
461: learn: 0.0150421 total: 1m 20s remaining: 1m 33s
462: learn: 0.0150312 total: 1m 20s remaining: 1m 33s
463: learn: 0.0150047 total: 1m 20s remaining: 1m 33s
464: learn: 0.0149843 total: 1m 21s remaining: 1m 33s
465: learn: 0.0149717 total: 1m 21s remaining: 1m 33s
466: learn: 0.0149521 total: 1m 21s remaining: 1m 33s
467: learn: 0.0149401 total: 1m 21s remaining: 1m 32s
468: learn: 0.0149154 total: 1m 21s remaining: 1m 32s
469: learn: 0.0148951 total: 1m 22s remaining: 1m 32s
470: learn: 0.0148857 total: 1m 22s remaining: 1m 32s
471: learn: 0.0148805 total: 1m 22s remaining: 1m 32s
472: learn: 0.0148703 total: 1m 23s remaining: 1m 32s
473: learn: 0.0148506 total: 1m 23s remaining: 1m 32s
474: learn: 0.0148405 total: 1m 23s remaining: 1m 32s
475: learn: 0.0148283 total: 1m 23s remaining: 1m 31s
476: learn: 0.0148171 total: 1m 23s remaining: 1m 31s
477: learn: 0.0147932 total: 1m 23s remaining: 1m 31s
478: learn: 0.0147797 total: 1m 23s remaining: 1m 31s
479: learn: 0.0147691 total: 1m 24s remaining: 1m 31s
480: learn: 0.0147512 total: 1m 24s remaining: 1m 31s
481: learn: 0.0147361 total: 1m 24s remaining: 1m 30s
482: learn: 0.0147200 total: 1m 25s remaining: 1m 30s
483: learn: 0.0147020 total: 1m 25s remaining: 1m 30s
484: learn: 0.0146820 total: 1m 25s remaining: 1m 30s
485: learn: 0.0146700 total: 1m 25s remaining: 1m 30s
486: learn: 0.0146614 total: 1m 26s remaining: 1m 30s
487: learn: 0.0146400 total: 1m 26s remaining: 1m 30s
488: learn: 0.0146224 total: 1m 26s remaining: 1m 30s
489: learn: 0.0146055 total: 1m 26s remaining: 1m 30s
490: learn: 0.0145811 total: 1m 27s remaining: 1m 30s
491: learn: 0.0145649 total: 1m 27s remaining: 1m 30s
492: learn: 0.0145529 total: 1m 27s remaining: 1m 30s
493: learn: 0.0145400 total: 1m 27s remaining: 1m 29s
494: learn: 0.0145237 total: 1m 28s remaining: 1m 29s
495: learn: 0.0145089 total: 1m 28s remaining: 1m 29s
496: learn: 0.0144878 total: 1m 28s remaining: 1m 29s
497: learn: 0.0144753 total: 1m 28s remaining: 1m 29s
498: learn: 0.0144587 total: 1m 29s remaining: 1m 29s
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499: learn: 0.0144430 total: 1m 29s remaining: 1m 29s
500: learn: 0.0144300 total: 1m 29s remaining: 1m 29s
501: learn: 0.0144142 total: 1m 30s remaining: 1m 29s
502: learn: 0.0143877 total: 1m 30s remaining: 1m 29s
503: learn: 0.0143786 total: 1m 31s remaining: 1m 30s
504: learn: 0.0143690 total: 1m 31s remaining: 1m 30s
505: learn: 0.0143590 total: 1m 32s remaining: 1m 29s
506: learn: 0.0143438 total: 1m 32s remaining: 1m 29s
507: learn: 0.0143328 total: 1m 32s remaining: 1m 29s
508: learn: 0.0143161 total: 1m 32s remaining: 1m 29s
509: learn: 0.0143015 total: 1m 33s remaining: 1m 29s
510: learn: 0.0142899 total: 1m 33s remaining: 1m 29s
511: learn: 0.0142726 total: 1m 33s remaining: 1m 29s
512: learn: 0.0142625 total: 1m 33s remaining: 1m 29s
513: learn: 0.0142518 total: 1m 34s remaining: 1m 29s
514: learn: 0.0142339 total: 1m 34s remaining: 1m 29s
515: learn: 0.0142156 total: 1m 34s remaining: 1m 29s
516: learn: 0.0141997 total: 1m 35s remaining: 1m 29s
517: learn: 0.0141919 total: 1m 35s remaining: 1m 29s
518: learn: 0.0141721 total: 1m 36s remaining: 1m 29s
519: learn: 0.0141610 total: 1m 36s remaining: 1m 29s
520: learn: 0.0141434 total: 1m 36s remaining: 1m 29s
521: learn: 0.0141268 total: 1m 37s remaining: 1m 28s
522: learn: 0.0141097 total: 1m 37s remaining: 1m 29s
523: learn: 0.0140914 total: 1m 37s remaining: 1m 28s
524: learn: 0.0140804 total: 1m 38s remaining: 1m 28s
525: learn: 0.0140608 total: 1m 38s remaining: 1m 28s
526: learn: 0.0140459 total: 1m 38s remaining: 1m 28s
527: learn: 0.0140341 total: 1m 38s remaining: 1m 28s
528: learn: 0.0140267 total: 1m 39s remaining: 1m 28s
529: learn: 0.0140210 total: 1m 39s remaining: 1m 28s
530: learn: 0.0140126 total: 1m 40s remaining: 1m 28s
531: learn: 0.0139983 total: 1m 40s remaining: 1m 28s
532: learn: 0.0139921 total: 1m 40s remaining: 1m 28s
533: learn: 0.0139776 total: 1m 41s remaining: 1m 28s
534: learn: 0.0139697 total: 1m 41s remaining: 1m 28s
535: learn: 0.0139605 total: 1m 42s remaining: 1m 28s
536: learn: 0.0139440 total: 1m 42s remaining: 1m 28s
537: learn: 0.0139355 total: 1m 42s remaining: 1m 28s
538: learn: 0.0139245 total: 1m 43s remaining: 1m 28s
539: learn: 0.0139088 total: 1m 43s remaining: 1m 28s
540: learn: 0.0138944 total: 1m 43s remaining: 1m 27s
541: learn: 0.0138861 total: 1m 43s remaining: 1m 27s
542: learn: 0.0138742 total: 1m 44s remaining: 1m 27s
543: learn: 0.0138635 total: 1m 44s remaining: 1m 27s
544: learn: 0.0138502 total: 1m 44s remaining: 1m 27s
545: learn: 0.0138340 total: 1m 45s remaining: 1m 27s
546: learn: 0.0138227 total: 1m 45s remaining: 1m 27s
547: learn: 0.0138089 total: 1m 45s remaining: 1m 27s
548: learn: 0.0137968 total: 1m 45s remaining: 1m 26s
549: learn: 0.0137840 total: 1m 46s remaining: 1m 26s
550: learn: 0.0137727 total: 1m 46s remaining: 1m 26s
551: learn: 0.0137620 total: 1m 46s remaining: 1m 26s
552: learn: 0.0137567 total: 1m 46s remaining: 1m 26s
553: learn: 0.0137379 total: 1m 47s remaining: 1m 26s
554: learn: 0.0137189 total: 1m 47s remaining: 1m 26s
555: learn: 0.0137079 total: 1m 47s remaining: 1m 25s
556: learn: 0.0136844 total: 1m 47s remaining: 1m 25s
557: learn: 0.0136768 total: 1m 48s remaining: 1m 25s
558: learn: 0.0136547 total: 1m 48s remaining: 1m 25s
559: learn: 0.0136334 total: 1m 48s remaining: 1m 25s
560: learn: 0.0136244 total: 1m 48s remaining: 1m 25s
561: learn: 0.0136099 total: 1m 48s remaining: 1m 24s
562: learn: 0.0135960 total: 1m 49s remaining: 1m 24s
563: learn: 0.0135858 total: 1m 49s remaining: 1m 24s
564: learn: 0.0135685 total: 1m 49s remaining: 1m 24s
565: learn: 0.0135537 total: 1m 49s remaining: 1m 24s
566: learn: 0.0135389 total: 1m 49s remaining: 1m 23s
567: learn: 0.0135294 total: 1m 49s remaining: 1m 23s
568: learn: 0.0135130 total: 1m 50s remaining: 1m 23s
569: learn: 0.0135082 total: 1m 50s remaining: 1m 23s
570: learn: 0.0134923 total: 1m 50s remaining: 1m 22s
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571: learn: 0.0134843 total: 1m 50s remaining: 1m 22s
572: learn: 0.0134697 total: 1m 50s remaining: 1m 22s
573: learn: 0.0134514 total: 1m 50s remaining: 1m 22s
574: learn: 0.0134432 total: 1m 50s remaining: 1m 21s
575: learn: 0.0134237 total: 1m 50s remaining: 1m 21s
576: learn: 0.0134096 total: 1m 51s remaining: 1m 21s
577: learn: 0.0133970 total: 1m 51s remaining: 1m 21s
578: learn: 0.0133902 total: 1m 51s remaining: 1m 20s
579: learn: 0.0133772 total: 1m 51s remaining: 1m 20s
580: learn: 0.0133690 total: 1m 51s remaining: 1m 20s
581: learn: 0.0133524 total: 1m 51s remaining: 1m 20s
582: learn: 0.0133339 total: 1m 51s remaining: 1m 19s
583: learn: 0.0133245 total: 1m 52s remaining: 1m 19s
584: learn: 0.0133068 total: 1m 52s remaining: 1m 19s
585: learn: 0.0133002 total: 1m 52s remaining: 1m 19s
586: learn: 0.0132886 total: 1m 52s remaining: 1m 19s
587: learn: 0.0132715 total: 1m 52s remaining: 1m 18s
588: learn: 0.0132584 total: 1m 52s remaining: 1m 18s
589: learn: 0.0132507 total: 1m 52s remaining: 1m 18s
590: learn: 0.0132424 total: 1m 53s remaining: 1m 18s
591: learn: 0.0132340 total: 1m 53s remaining: 1m 18s
592: learn: 0.0132214 total: 1m 53s remaining: 1m 17s
593: learn: 0.0132132 total: 1m 53s remaining: 1m 17s
594: learn: 0.0132056 total: 1m 53s remaining: 1m 17s
595: learn: 0.0131985 total: 1m 53s remaining: 1m 17s
596: learn: 0.0131899 total: 1m 53s remaining: 1m 16s
597: learn: 0.0131787 total: 1m 54s remaining: 1m 16s
598: learn: 0.0131678 total: 1m 54s remaining: 1m 16s
599: learn: 0.0131567 total: 1m 54s remaining: 1m 16s
600: learn: 0.0131488 total: 1m 55s remaining: 1m 16s
601: learn: 0.0131328 total: 1m 55s remaining: 1m 16s
602: learn: 0.0131218 total: 1m 56s remaining: 1m 16s
603: learn: 0.0131166 total: 1m 56s remaining: 1m 16s
604: learn: 0.0131122 total: 1m 57s remaining: 1m 16s
605: learn: 0.0131056 total: 1m 57s remaining: 1m 16s
606: learn: 0.0130944 total: 1m 57s remaining: 1m 16s
607: learn: 0.0130847 total: 1m 58s remaining: 1m 16s
608: learn: 0.0130712 total: 1m 58s remaining: 1m 15s
609: learn: 0.0130576 total: 1m 58s remaining: 1m 15s
610: learn: 0.0130503 total: 1m 58s remaining: 1m 15s
611: learn: 0.0130353 total: 1m 59s remaining: 1m 15s
612: learn: 0.0130278 total: 1m 59s remaining: 1m 15s
613: learn: 0.0130076 total: 1m 59s remaining: 1m 15s
614: learn: 0.0129956 total: 2m remaining: 1m 15s
615: learn: 0.0129799 total: 2m remaining: 1m 15s
616: learn: 0.0129695 total: 2m remaining: 1m 14s
617: learn: 0.0129591 total: 2m remaining: 1m 14s
618: learn: 0.0129469 total: 2m 1s remaining: 1m 14s
619: learn: 0.0129391 total: 2m 1s remaining: 1m 14s
620: learn: 0.0129297 total: 2m 1s remaining: 1m 14s
621: learn: 0.0129176 total: 2m 1s remaining: 1m 13s
622: learn: 0.0129086 total: 2m 2s remaining: 1m 13s
623: learn: 0.0129004 total: 2m 2s remaining: 1m 13s
624: learn: 0.0128937 total: 2m 2s remaining: 1m 13s
625: learn: 0.0128824 total: 2m 2s remaining: 1m 13s
626: learn: 0.0128751 total: 2m 3s remaining: 1m 13s
627: learn: 0.0128709 total: 2m 3s remaining: 1m 13s
628: learn: 0.0128533 total: 2m 3s remaining: 1m 12s
629: learn: 0.0128417 total: 2m 3s remaining: 1m 12s
630: learn: 0.0128254 total: 2m 4s remaining: 1m 12s
631: learn: 0.0128175 total: 2m 4s remaining: 1m 12s
632: learn: 0.0128067 total: 2m 5s remaining: 1m 12s
633: learn: 0.0127999 total: 2m 5s remaining: 1m 12s
634: learn: 0.0127844 total: 2m 5s remaining: 1m 12s
635: learn: 0.0127653 total: 2m 5s remaining: 1m 11s
636: learn: 0.0127559 total: 2m 5s remaining: 1m 11s
637: learn: 0.0127431 total: 2m 5s remaining: 1m 11s
638: learn: 0.0127282 total: 2m 5s remaining: 1m 11s
639: learn: 0.0127156 total: 2m 6s remaining: 1m 10s
640: learn: 0.0126968 total: 2m 6s remaining: 1m 10s
641: learn: 0.0126889 total: 2m 6s remaining: 1m 10s
642: learn: 0.0126781 total: 2m 6s remaining: 1m 10s
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643: learn: 0.0126674 total: 2m 6s remaining: 1m 10s
644: learn: 0.0126597 total: 2m 6s remaining: 1m 9s
645: learn: 0.0126459 total: 2m 6s remaining: 1m 9s
646: learn: 0.0126361 total: 2m 7s remaining: 1m 9s
647: learn: 0.0126288 total: 2m 7s remaining: 1m 9s
648: learn: 0.0126183 total: 2m 7s remaining: 1m 9s
649: learn: 0.0126079 total: 2m 7s remaining: 1m 8s
650: learn: 0.0125964 total: 2m 7s remaining: 1m 8s
651: learn: 0.0125909 total: 2m 8s remaining: 1m 8s
652: learn: 0.0125781 total: 2m 8s remaining: 1m 8s
653: learn: 0.0125725 total: 2m 8s remaining: 1m 7s
654: learn: 0.0125604 total: 2m 8s remaining: 1m 7s
655: learn: 0.0125528 total: 2m 8s remaining: 1m 7s
656: learn: 0.0125395 total: 2m 8s remaining: 1m 7s
657: learn: 0.0125249 total: 2m 9s remaining: 1m 7s
658: learn: 0.0125168 total: 2m 9s remaining: 1m 6s
659: learn: 0.0125060 total: 2m 9s remaining: 1m 6s
660: learn: 0.0124966 total: 2m 9s remaining: 1m 6s
661: learn: 0.0124888 total: 2m 9s remaining: 1m 6s
662: learn: 0.0124838 total: 2m 10s remaining: 1m 6s
663: learn: 0.0124777 total: 2m 10s remaining: 1m 5s
664: learn: 0.0124647 total: 2m 10s remaining: 1m 5s
665: learn: 0.0124558 total: 2m 10s remaining: 1m 5s
666: learn: 0.0124507 total: 2m 10s remaining: 1m 5s
667: learn: 0.0124422 total: 2m 10s remaining: 1m 5s
668: learn: 0.0124274 total: 2m 11s remaining: 1m 4s
669: learn: 0.0124124 total: 2m 11s remaining: 1m 4s
670: learn: 0.0124061 total: 2m 11s remaining: 1m 4s
671: learn: 0.0123967 total: 2m 11s remaining: 1m 4s
672: learn: 0.0123853 total: 2m 11s remaining: 1m 4s
673: learn: 0.0123759 total: 2m 11s remaining: 1m 3s
674: learn: 0.0123602 total: 2m 12s remaining: 1m 3s
675: learn: 0.0123545 total: 2m 12s remaining: 1m 3s
676: learn: 0.0123491 total: 2m 12s remaining: 1m 3s
677: learn: 0.0123435 total: 2m 12s remaining: 1m 2s
678: learn: 0.0123273 total: 2m 12s remaining: 1m 2s
679: learn: 0.0123130 total: 2m 12s remaining: 1m 2s
680: learn: 0.0123057 total: 2m 12s remaining: 1m 2s
681: learn: 0.0122965 total: 2m 12s remaining: 1m 2s
682: learn: 0.0122844 total: 2m 13s remaining: 1m 1s
683: learn: 0.0122708 total: 2m 13s remaining: 1m 1s
684: learn: 0.0122638 total: 2m 13s remaining: 1m 1s
685: learn: 0.0122509 total: 2m 13s remaining: 1m 1s
686: learn: 0.0122460 total: 2m 13s remaining: 1m
687: learn: 0.0122257 total: 2m 13s remaining: 1m
688: learn: 0.0122169 total: 2m 14s remaining: 1m
689: learn: 0.0122104 total: 2m 14s remaining: 1m
690: learn: 0.0122038 total: 2m 14s remaining: 1m
691: learn: 0.0121895 total: 2m 14s remaining: 59.9s
692: learn: 0.0121763 total: 2m 14s remaining: 59.7s
693: learn: 0.0121688 total: 2m 14s remaining: 59.4s
694: learn: 0.0121625 total: 2m 14s remaining: 59.2s
695: learn: 0.0121444 total: 2m 15s remaining: 59s
696: learn: 0.0121303 total: 2m 15s remaining: 58.8s
697: learn: 0.0121216 total: 2m 15s remaining: 58.5s
698: learn: 0.0121165 total: 2m 15s remaining: 58.3s
699: learn: 0.0121076 total: 2m 15s remaining: 58.1s
700: learn: 0.0120909 total: 2m 15s remaining: 57.9s
701: learn: 0.0120796 total: 2m 15s remaining: 57.7s
702: learn: 0.0120726 total: 2m 16s remaining: 57.5s
703: learn: 0.0120690 total: 2m 16s remaining: 57.3s
704: learn: 0.0120621 total: 2m 16s remaining: 57.1s
705: learn: 0.0120542 total: 2m 16s remaining: 56.9s
706: learn: 0.0120455 total: 2m 16s remaining: 56.7s
707: learn: 0.0120401 total: 2m 16s remaining: 56.5s
708: learn: 0.0120338 total: 2m 17s remaining: 56.3s
709: learn: 0.0120276 total: 2m 17s remaining: 56.1s
710: learn: 0.0120184 total: 2m 17s remaining: 55.8s
711: learn: 0.0120131 total: 2m 17s remaining: 55.6s
712: learn: 0.0120091 total: 2m 17s remaining: 55.4s
713: learn: 0.0120048 total: 2m 17s remaining: 55.2s
714: learn: 0.0119984 total: 2m 17s remaining: 55s

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715: learn: 0.0119933 total: 2m 17s remaining: 54.7s
716: learn: 0.0119789 total: 2m 18s remaining: 54.5s
717: learn: 0.0119699 total: 2m 18s remaining: 54.3s
718: learn: 0.0119532 total: 2m 18s remaining: 54.1s
719: learn: 0.0119387 total: 2m 18s remaining: 53.9s
720: learn: 0.0119228 total: 2m 18s remaining: 53.7s
721: learn: 0.0119156 total: 2m 18s remaining: 53.5s
722: learn: 0.0119108 total: 2m 19s remaining: 53.3s
723: learn: 0.0118944 total: 2m 19s remaining: 53.1s
724: learn: 0.0118886 total: 2m 19s remaining: 52.9s
725: learn: 0.0118813 total: 2m 19s remaining: 52.7s
726: learn: 0.0118668 total: 2m 19s remaining: 52.5s
727: learn: 0.0118566 total: 2m 19s remaining: 52.3s
728: learn: 0.0118439 total: 2m 20s remaining: 52.1s
729: learn: 0.0118222 total: 2m 20s remaining: 51.9s
730: learn: 0.0118104 total: 2m 20s remaining: 51.7s
731: learn: 0.0118012 total: 2m 20s remaining: 51.5s
732: learn: 0.0117982 total: 2m 20s remaining: 51.3s
733: learn: 0.0117857 total: 2m 21s remaining: 51.1s
734: learn: 0.0117750 total: 2m 21s remaining: 50.9s
735: learn: 0.0117590 total: 2m 21s remaining: 50.7s
736: learn: 0.0117495 total: 2m 21s remaining: 50.4s
737: learn: 0.0117369 total: 2m 21s remaining: 50.2s
738: learn: 0.0117302 total: 2m 21s remaining: 50s
739: learn: 0.0117247 total: 2m 21s remaining: 49.8s
740: learn: 0.0117148 total: 2m 21s remaining: 49.6s
741: learn: 0.0117056 total: 2m 21s remaining: 49.4s
742: learn: 0.0116928 total: 2m 22s remaining: 49.1s
743: learn: 0.0116892 total: 2m 22s remaining: 48.9s
744: learn: 0.0116735 total: 2m 22s remaining: 48.7s
745: learn: 0.0116694 total: 2m 22s remaining: 48.5s
746: learn: 0.0116639 total: 2m 22s remaining: 48.3s
747: learn: 0.0116565 total: 2m 22s remaining: 48s
748: learn: 0.0116529 total: 2m 22s remaining: 47.8s
749: learn: 0.0116364 total: 2m 22s remaining: 47.6s
750: learn: 0.0116311 total: 2m 22s remaining: 47.4s
751: learn: 0.0116200 total: 2m 23s remaining: 47.2s
752: learn: 0.0116057 total: 2m 23s remaining: 47s
753: learn: 0.0115826 total: 2m 23s remaining: 46.7s
754: learn: 0.0115756 total: 2m 23s remaining: 46.5s
755: learn: 0.0115705 total: 2m 23s remaining: 46.3s
756: learn: 0.0115601 total: 2m 23s remaining: 46.1s
757: learn: 0.0115529 total: 2m 23s remaining: 45.9s
758: learn: 0.0115464 total: 2m 23s remaining: 45.7s
759: learn: 0.0115384 total: 2m 24s remaining: 45.5s
760: learn: 0.0115325 total: 2m 24s remaining: 45.3s
761: learn: 0.0115197 total: 2m 24s remaining: 45.1s
762: learn: 0.0115094 total: 2m 24s remaining: 44.8s
763: learn: 0.0115047 total: 2m 24s remaining: 44.6s
764: learn: 0.0114970 total: 2m 24s remaining: 44.4s
765: learn: 0.0114809 total: 2m 24s remaining: 44.2s
766: learn: 0.0114712 total: 2m 24s remaining: 44s
767: learn: 0.0114613 total: 2m 25s remaining: 43.8s
768: learn: 0.0114463 total: 2m 25s remaining: 43.7s
769: learn: 0.0114331 total: 2m 25s remaining: 43.5s
770: learn: 0.0114197 total: 2m 25s remaining: 43.3s
771: learn: 0.0114130 total: 2m 25s remaining: 43.1s
772: learn: 0.0113979 total: 2m 26s remaining: 42.9s
773: learn: 0.0113890 total: 2m 26s remaining: 42.7s
774: learn: 0.0113791 total: 2m 26s remaining: 42.5s
775: learn: 0.0113732 total: 2m 26s remaining: 42.3s
776: learn: 0.0113697 total: 2m 26s remaining: 42.1s
777: learn: 0.0113598 total: 2m 26s remaining: 41.9s
778: learn: 0.0113527 total: 2m 27s remaining: 41.7s
779: learn: 0.0113436 total: 2m 27s remaining: 41.5s
780: learn: 0.0113384 total: 2m 27s remaining: 41.4s
781: learn: 0.0113260 total: 2m 27s remaining: 41.2s
782: learn: 0.0113110 total: 2m 27s remaining: 41s
783: learn: 0.0113061 total: 2m 27s remaining: 40.8s
784: learn: 0.0112992 total: 2m 28s remaining: 40.6s
785: learn: 0.0112888 total: 2m 28s remaining: 40.4s
786: learn: 0.0112778 total: 2m 28s remaining: 40.2s
```

```
787: learn: 0.0112724 total: 2m 28s remaining: 40s
788: learn: 0.0112651 total: 2m 28s remaining: 39.8s
789: learn: 0.0112522 total: 2m 29s remaining: 39.6s
790: learn: 0.0112461 total: 2m 29s remaining: 39.4s
791: learn: 0.0112411 total: 2m 29s remaining: 39.2s
792: learn: 0.0112328 total: 2m 29s remaining: 39s
793: learn: 0.0112212 total: 2m 29s remaining: 38.8s
794: learn: 0.0112188 total: 2m 29s remaining: 38.6s
795: learn: 0.0112107 total: 2m 29s remaining: 38.4s
796: learn: 0.0112052 total: 2m 29s remaining: 38.2s
797: learn: 0.0111923 total: 2m 30s remaining: 38s
798: learn: 0.0111767 total: 2m 30s remaining: 37.8s
799: learn: 0.0111726 total: 2m 30s remaining: 37.6s
800: learn: 0.0111683 total: 2m 30s remaining: 37.4s
801: learn: 0.0111638 total: 2m 30s remaining: 37.2s
802: learn: 0.0111589 total: 2m 30s remaining: 37s
803: learn: 0.0111538 total: 2m 31s remaining: 36.8s
804: learn: 0.0111461 total: 2m 31s remaining: 36.6s
805: learn: 0.0111423 total: 2m 31s remaining: 36.4s
806: learn: 0.0111358 total: 2m 31s remaining: 36.2s
807: learn: 0.0111315 total: 2m 31s remaining: 36.1s
808: learn: 0.0111244 total: 2m 31s remaining: 35.9s
809: learn: 0.0111074 total: 2m 32s remaining: 35.7s
810: learn: 0.0110979 total: 2m 32s remaining: 35.5s
811: learn: 0.0110942 total: 2m 32s remaining: 35.3s
812: learn: 0.0110789 total: 2m 32s remaining: 35.1s
813: learn: 0.0110745 total: 2m 32s remaining: 34.9s
814: learn: 0.0110695 total: 2m 32s remaining: 34.7s
815: learn: 0.0110597 total: 2m 32s remaining: 34.5s
816: learn: 0.0110471 total: 2m 33s remaining: 34.3s
817: learn: 0.0110398 total: 2m 33s remaining: 34.1s
818: learn: 0.0110358 total: 2m 33s remaining: 33.9s
819: learn: 0.0110310 total: 2m 33s remaining: 33.7s
820: learn: 0.0110257 total: 2m 34s remaining: 33.6s
821: learn: 0.0110078 total: 2m 34s remaining: 33.4s
822: learn: 0.0109951 total: 2m 34s remaining: 33.2s
823: learn: 0.0109905 total: 2m 34s remaining: 33s
824: learn: 0.0109880 total: 2m 34s remaining: 32.8s
825: learn: 0.0109758 total: 2m 34s remaining: 32.6s
826: learn: 0.0109715 total: 2m 34s remaining: 32.4s
827: learn: 0.0109609 total: 2m 35s remaining: 32.2s
828: learn: 0.0109548 total: 2m 35s remaining: 32s
829: learn: 0.0109407 total: 2m 35s remaining: 31.8s
830: learn: 0.0109279 total: 2m 35s remaining: 31.7s
831: learn: 0.0109164 total: 2m 35s remaining: 31.5s
832: learn: 0.0109087 total: 2m 35s remaining: 31.3s
833: learn: 0.0109008 total: 2m 36s remaining: 31.1s
834: learn: 0.0108975 total: 2m 36s remaining: 30.9s
835: learn: 0.0108907 total: 2m 36s remaining: 30.7s
836: learn: 0.0108820 total: 2m 36s remaining: 30.5s
837: learn: 0.0108631 total: 2m 36s remaining: 30.3s
838: learn: 0.0108492 total: 2m 36s remaining: 30.1s
839: learn: 0.0108445 total: 2m 36s remaining: 29.9s
840: learn: 0.0108355 total: 2m 37s remaining: 29.7s
841: learn: 0.0108314 total: 2m 37s remaining: 29.5s
842: learn: 0.0108271 total: 2m 37s remaining: 29.3s
843: learn: 0.0108242 total: 2m 37s remaining: 29.1s
844: learn: 0.0108197 total: 2m 37s remaining: 28.9s
845: learn: 0.0108167 total: 2m 37s remaining: 28.7s
846: learn: 0.0108118 total: 2m 37s remaining: 28.5s
847: learn: 0.0108038 total: 2m 38s remaining: 28.3s
848: learn: 0.0107993 total: 2m 38s remaining: 28.2s
849: learn: 0.0107895 total: 2m 38s remaining: 28s
850: learn: 0.0107861 total: 2m 38s remaining: 27.8s
851: learn: 0.0107781 total: 2m 38s remaining: 27.6s
852: learn: 0.0107709 total: 2m 38s remaining: 27.4s
853: learn: 0.0107620 total: 2m 38s remaining: 27.2s
854: learn: 0.0107571 total: 2m 39s remaining: 27s
855: learn: 0.0107522 total: 2m 39s remaining: 26.8s
856: learn: 0.0107490 total: 2m 39s remaining: 26.6s
857: learn: 0.0107459 total: 2m 39s remaining: 26.4s
858: learn: 0.0107393 total: 2m 39s remaining: 26.2s
```

```
859: learn: 0.0107325 total: 2m 39s remaining: 26s
860: learn: 0.0107234 total: 2m 39s remaining: 25.8s
861: learn: 0.0107164 total: 2m 39s remaining: 25.6s
862: learn: 0.0107117 total: 2m 40s remaining: 25.4s
863: learn: 0.0107020 total: 2m 40s remaining: 25.2s
864: learn: 0.0106945 total: 2m 40s remaining: 25s
865: learn: 0.0106808 total: 2m 40s remaining: 24.8s
866: learn: 0.0106762 total: 2m 40s remaining: 24.6s
867: learn: 0.0106655 total: 2m 40s remaining: 24.4s
868: learn: 0.0106632 total: 2m 40s remaining: 24.3s
869: learn: 0.0106588 total: 2m 41s remaining: 24.1s
870: learn: 0.0106457 total: 2m 41s remaining: 23.9s
871: learn: 0.0106337 total: 2m 41s remaining: 23.7s
872: learn: 0.0106262 total: 2m 41s remaining: 23.5s
873: learn: 0.0106242 total: 2m 41s remaining: 23.3s
874: learn: 0.0106177 total: 2m 41s remaining: 23.1s
875: learn: 0.0106109 total: 2m 41s remaining: 22.9s
876: learn: 0.0106056 total: 2m 41s remaining: 22.7s
877: learn: 0.0105969 total: 2m 42s remaining: 22.5s
878: learn: 0.0105871 total: 2m 42s remaining: 22.3s
879: learn: 0.0105836 total: 2m 42s remaining: 22.1s
880: learn: 0.0105790 total: 2m 42s remaining: 22s
881: learn: 0.0105729 total: 2m 42s remaining: 21.8s
882: learn: 0.0105677 total: 2m 42s remaining: 21.6s
883: learn: 0.0105538 total: 2m 43s remaining: 21.4s
884: learn: 0.0105432 total: 2m 43s remaining: 21.2s
885: learn: 0.0105366 total: 2m 43s remaining: 21s
886: learn: 0.0105266 total: 2m 43s remaining: 20.9s
887: learn: 0.0105196 total: 2m 43s remaining: 20.7s
888: learn: 0.0105159 total: 2m 44s remaining: 20.5s
889: learn: 0.0105104 total: 2m 44s remaining: 20.3s
890: learn: 0.0105034 total: 2m 44s remaining: 20.1s
891: learn: 0.0104953 total: 2m 44s remaining: 19.9s
892: learn: 0.0104894 total: 2m 44s remaining: 19.7s
893: learn: 0.0104861 total: 2m 44s remaining: 19.5s
894: learn: 0.0104836 total: 2m 44s remaining: 19.3s
895: learn: 0.0104794 total: 2m 45s remaining: 19.2s
896: learn: 0.0104766 total: 2m 45s remaining: 19s
897: learn: 0.0104676 total: 2m 45s remaining: 18.8s
898: learn: 0.0104641 total: 2m 45s remaining: 18.6s
899: learn: 0.0104601 total: 2m 45s remaining: 18.4s
900: learn: 0.0104533 total: 2m 45s remaining: 18.2s
901: learn: 0.0104497 total: 2m 45s remaining: 18s
902: learn: 0.0104463 total: 2m 46s remaining: 17.8s
903: learn: 0.0104431 total: 2m 46s remaining: 17.7s
904: learn: 0.0104337 total: 2m 46s remaining: 17.5s
905: learn: 0.0104248 total: 2m 46s remaining: 17.3s
906: learn: 0.0104127 total: 2m 46s remaining: 17.1s
907: learn: 0.0104086 total: 2m 47s remaining: 16.9s
908: learn: 0.0103979 total: 2m 47s remaining: 16.7s
909: learn: 0.0103903 total: 2m 47s remaining: 16.5s
910: learn: 0.0103846 total: 2m 47s remaining: 16.4s
911: learn: 0.0103808 total: 2m 47s remaining: 16.2s
912: learn: 0.0103684 total: 2m 47s remaining: 16s
913: learn: 0.0103535 total: 2m 47s remaining: 15.8s
914: learn: 0.0103420 total: 2m 48s remaining: 15.6s
915: learn: 0.0103324 total: 2m 48s remaining: 15.4s
916: learn: 0.0103234 total: 2m 48s remaining: 15.2s
917: learn: 0.0103157 total: 2m 48s remaining: 15.1s
918: learn: 0.0103090 total: 2m 48s remaining: 14.9s
919: learn: 0.0102995 total: 2m 49s remaining: 14.7s
920: learn: 0.0102968 total: 2m 49s remaining: 14.5s
921: learn: 0.0102873 total: 2m 49s remaining: 14.3s
922: learn: 0.0102749 total: 2m 49s remaining: 14.1s
923: learn: 0.0102707 total: 2m 49s remaining: 13.9s
924: learn: 0.0102675 total: 2m 49s remaining: 13.8s
925: learn: 0.0102653 total: 2m 49s remaining: 13.6s
926: learn: 0.0102544 total: 2m 50s remaining: 13.4s
927: learn: 0.0102505 total: 2m 50s remaining: 13.2s
928: learn: 0.0102422 total: 2m 50s remaining: 13s
929: learn: 0.0102338 total: 2m 50s remaining: 12.8s
930: learn: 0.0102241 total: 2m 50s remaining: 12.7s
```

```
931: learn: 0.0102154 total: 2m 50s remaining: 12.5s
932: learn: 0.0102126 total: 2m 50s remaining: 12.3s
933: learn: 0.0102004 total: 2m 51s remaining: 12.1s
934: learn: 0.0101935 total: 2m 51s remaining: 11.9s
935: learn: 0.0101882 total: 2m 51s remaining: 11.7s
936: learn: 0.0101859 total: 2m 51s remaining: 11.5s
937: learn: 0.0101762 total: 2m 51s remaining: 11.3s
938: learn: 0.0101744 total: 2m 51s remaining: 11.2s
939: learn: 0.0101642 total: 2m 51s remaining: 11s
940: learn: 0.0101572 total: 2m 52s remaining: 10.8s
941: learn: 0.0101432 total: 2m 52s remaining: 10.6s
942: learn: 0.0101348 total: 2m 52s remaining: 10.4s
943: learn: 0.0101312 total: 2m 52s remaining: 10.2s
944: learn: 0.0101201 total: 2m 52s remaining: 10.1s
945: learn: 0.0101166 total: 2m 52s remaining: 9.87s
946: learn: 0.0101109 total: 2m 52s remaining: 9.68s
947: learn: 0.0101064 total: 2m 53s remaining: 9.5s
948: learn: 0.0100984 total: 2m 53s remaining: 9.31s
949: learn: 0.0100925 total: 2m 53s remaining: 9.13s
950: learn: 0.0100851 total: 2m 53s remaining: 8.95s
951: learn: 0.0100822 total: 2m 53s remaining: 8.76s
952: learn: 0.0100776 total: 2m 53s remaining: 8.57s
953: learn: 0.0100670 total: 2m 53s remaining: 8.39s
954: learn: 0.0100610 total: 2m 54s remaining: 8.2s
955: learn: 0.0100535 total: 2m 54s remaining: 8.02s
956: learn: 0.0100398 total: 2m 54s remaining: 7.83s
957: learn: 0.0100333 total: 2m 54s remaining: 7.65s
958: learn: 0.0100183 total: 2m 54s remaining: 7.46s
959: learn: 0.0100124 total: 2m 54s remaining: 7.28s
960: learn: 0.0100023 total: 2m 54s remaining: 7.09s
961: learn: 0.0099899 total: 2m 54s remaining: 6.91s
962: learn: 0.0099853 total: 2m 55s remaining: 6.73s
963: learn: 0.0099818 total: 2m 55s remaining: 6.54s
964: learn: 0.0099761 total: 2m 55s remaining: 6.36s
965: learn: 0.0099626 total: 2m 55s remaining: 6.17s
966: learn: 0.0099520 total: 2m 55s remaining: 5.99s
967: learn: 0.0099406 total: 2m 55s remaining: 5.81s
968: learn: 0.0099344 total: 2m 55s remaining: 5.62s
969: learn: 0.0099323 total: 2m 55s remaining: 5.44s
970: learn: 0.0099294 total: 2m 56s remaining: 5.26s
971: learn: 0.0099234 total: 2m 56s remaining: 5.07s
972: learn: 0.0099150 total: 2m 56s remaining: 4.89s
973: learn: 0.0099085 total: 2m 56s remaining: 4.71s
974: learn: 0.0099003 total: 2m 56s remaining: 4.53s
975: learn: 0.0098967 total: 2m 56s remaining: 4.35s
976: learn: 0.0098920 total: 2m 56s remaining: 4.17s
977: learn: 0.0098896 total: 2m 57s remaining: 3.98s
978: learn: 0.0098872 total: 2m 57s remaining: 3.8s
979: learn: 0.0098835 total: 2m 57s remaining: 3.62s
980: learn: 0.0098755 total: 2m 57s remaining: 3.44s
981: learn: 0.0098722 total: 2m 57s remaining: 3.26s
982: learn: 0.0098541 total: 2m 57s remaining: 3.08s
983: learn: 0.0098405 total: 2m 58s remaining: 2.9s
984: learn: 0.0098312 total: 2m 58s remaining: 2.71s
985: learn: 0.0098268 total: 2m 58s remaining: 2.53s
986: learn: 0.0098220 total: 2m 58s remaining: 2.35s
987: learn: 0.0098191 total: 2m 59s remaining: 2.17s
988: learn: 0.0098148 total: 2m 59s remaining: 1.99s
989: learn: 0.0098109 total: 2m 59s remaining: 1.81s
990: learn: 0.0098066 total: 2m 59s remaining: 1.63s
991: learn: 0.0097963 total: 2m 59s remaining: 1.45s
992: learn: 0.0097933 total: 3m remaining: 1.27s
993: learn: 0.0097850 total: 3m remaining: 1.09s
994: learn: 0.0097830 total: 3m remaining: 908ms
995: learn: 0.0097776 total: 3m remaining: 726ms
996: learn: 0.0097720 total: 3m 1s remaining: 545ms
997: learn: 0.0097693 total: 3m 1s remaining: 364ms
998: learn: 0.0097657 total: 3m 1s remaining: 182ms
999: learn: 0.0097574 total: 3m 1s remaining: 0us
```

In [107]:

```
print(pd.DataFrame({'Training Accuracy':scores_train,'Test Accuracy': scores_test},

                   index=['Random Forest','XGBoost','CatBoost']))
```

```
               Training Accuracy  Test Accuracy
Random Forest           0.999636       0.993247
XGBoost                 0.995993       0.995164
CatBoost                0.997128       0.995419
```

In [ ]:

```

```

Hyper Parameter Tuning

In [54]:

```
cb = CatBoostClassifier()
```

In [55]:

```
parameters = {'depth' : [ 4, 5, 6, 7, 8, 9, 10],
    'learning_rate': [0.04 , 0.05 , 0.06 , 0.07,0.08],
    'iterations': [100,200,300,400,500,600,700,800,900,1000,1100,1200]
}
```

In [56]:

```
Grid_CBC = GridSearchCV(estimator = cb, param_grid = parameters, cv = 2,n_jobs=-1)
```

In [ ]:

```
Grid_CBC.fit(x_train,y_train)
```

In [ ]:

```
print("\n The best estimator across all searched params:",Grid_CBC.best_estimator_)
```

In [ ]:

```
print("\n The best score across all searched params:",Grid_CBC.best_score_)
```

In [ ]:

```
print("\n The best parameter across all searched params:",Grid_CBC.best_params_)
```

In [ ]:

```
cb.score(x_train, y_train)
```

In [ ]:

```
cb.score(x_test, y_test)
```

In [ ]:

```

```

In [49]:

```
#Shinkansen
cb = CatBoostClassifier(iterations=1200, depth = 10,learning_rate=0.06)
#Train:94379/Test:35602
```

In [51]:

```
cb.fit(x_train,y_train)
scores_train.append(cb.score(x_train, y_train))
```

```
scores_test.append(cb.score(x_test, y_test))
```

```
0: learn: 0.5582000 total: 600ms remaining: 11m 59s
1: learn: 0.4478694 total: 734ms remaining: 7m 19s
2: learn: 0.3629266 total: 833ms remaining: 5m 32s
3: learn: 0.2974104 total: 922ms remaining: 4m 35s
4: learn: 0.2452435 total: 1.11s remaining: 4m 25s
5: learn: 0.2051404 total: 1.22s remaining: 4m 2s
6: learn: 0.1722599 total: 1.33s remaining: 3m 46s
7: learn: 0.1466927 total: 1.57s remaining: 3m 53s
8: learn: 0.1263717 total: 1.75s remaining: 3m 52s
9: learn: 0.1107794 total: 1.98s remaining: 3m 55s
10: learn: 0.0980550 total: 2.12s remaining: 3m 48s
11: learn: 0.0863539 total: 2.34s remaining: 3m 52s
12: learn: 0.0789372 total: 2.42s remaining: 3m 40s
13: learn: 0.0709044 total: 2.67s remaining: 3m 46s
14: learn: 0.0642029 total: 2.96s remaining: 3m 53s
15: learn: 0.0603276 total: 3.06s remaining: 3m 46s
16: learn: 0.0559775 total: 3.17s remaining: 3m 40s
17: learn: 0.0523183 total: 3.42s remaining: 3m 44s
18: learn: 0.0504179 total: 3.51s remaining: 3m 38s
19: learn: 0.0479098 total: 3.74s remaining: 3m 40s
20: learn: 0.0464263 total: 3.96s remaining: 3m 42s
21: learn: 0.0453094 total: 4.08s remaining: 3m 38s
22: learn: 0.0435388 total: 4.36s remaining: 3m 43s
23: learn: 0.0426115 total: 4.57s remaining: 3m 44s
24: learn: 0.0410465 total: 4.88s remaining: 3m 49s
25: learn: 0.0398906 total: 5.15s remaining: 3m 52s
26: learn: 0.0386854 total: 5.38s remaining: 3m 53s
27: learn: 0.0377255 total: 5.63s remaining: 3m 55s
28: learn: 0.0369224 total: 5.85s remaining: 3m 56s
29: learn: 0.0362301 total: 6.08s remaining: 3m 57s
30: learn: 0.0356390 total: 6.29s remaining: 3m 57s
31: learn: 0.0350720 total: 6.53s remaining: 3m 58s
32: learn: 0.0345443 total: 6.78s remaining: 3m 59s
33: learn: 0.0340092 total: 7.07s remaining: 4m 2s
34: learn: 0.0335654 total: 7.35s remaining: 4m 4s
35: learn: 0.0332325 total: 7.62s remaining: 4m 6s
36: learn: 0.0327932 total: 7.9s remaining: 4m 8s
37: learn: 0.0325184 total: 8.17s remaining: 4m 9s
38: learn: 0.0321369 total: 8.44s remaining: 4m 11s
39: learn: 0.0318037 total: 8.74s remaining: 4m 13s
40: learn: 0.0313998 total: 9s remaining: 4m 14s
41: learn: 0.0310366 total: 9.27s remaining: 4m 15s
42: learn: 0.0307800 total: 9.72s remaining: 4m 21s
43: learn: 0.0305195 total: 9.99s remaining: 4m 22s
44: learn: 0.0302015 total: 10.5s remaining: 4m 28s
45: learn: 0.0299424 total: 10.7s remaining: 4m 28s
46: learn: 0.0297180 total: 11s remaining: 4m 29s
47: learn: 0.0295040 total: 11.3s remaining: 4m 30s
48: learn: 0.0292464 total: 11.6s remaining: 4m 31s
49: learn: 0.0290713 total: 11.8s remaining: 4m 31s
50: learn: 0.0288983 total: 12.1s remaining: 4m 32s
51: learn: 0.0286925 total: 12.4s remaining: 4m 33s
52: learn: 0.0284957 total: 12.7s remaining: 4m 34s
53: learn: 0.0282962 total: 12.9s remaining: 4m 34s
54: learn: 0.0281143 total: 13.2s remaining: 4m 34s
55: learn: 0.0279552 total: 13.5s remaining: 4m 35s
56: learn: 0.0277522 total: 13.8s remaining: 4m 36s
57: learn: 0.0275588 total: 14s remaining: 4m 36s
58: learn: 0.0273665 total: 14.3s remaining: 4m 36s
59: learn: 0.0271936 total: 14.6s remaining: 4m 36s
60: learn: 0.0269965 total: 14.9s remaining: 4m 37s
61: learn: 0.0268779 total: 15.1s remaining: 4m 37s
62: learn: 0.0267621 total: 15.4s remaining: 4m 38s
63: learn: 0.0266496 total: 15.7s remaining: 4m 38s
64: learn: 0.0264871 total: 15.9s remaining: 4m 38s
65: learn: 0.0263739 total: 16.4s remaining: 4m 42s
66: learn: 0.0261840 total: 16.7s remaining: 4m 42s
67: learn: 0.0260491 total: 17s remaining: 4m 42s
68: learn: 0.0258701 total: 17.3s remaining: 4m 43s
69: learn: 0.0256921 total: 17.5s remaining: 4m 43s
```

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70: learn: 0.0255546 total: 17.8s remaining: 4m 43s
71: learn: 0.0254392 total: 18.1s remaining: 4m 43s
72: learn: 0.0252946 total: 18.3s remaining: 4m 43s
73: learn: 0.0250792 total: 18.6s remaining: 4m 42s
74: learn: 0.0249524 total: 18.8s remaining: 4m 42s
75: learn: 0.0249119 total: 18.9s remaining: 4m 40s
76: learn: 0.0247778 total: 19.2s remaining: 4m 39s
77: learn: 0.0245936 total: 19.4s remaining: 4m 38s
78: learn: 0.0243955 total: 19.6s remaining: 4m 38s
79: learn: 0.0242375 total: 19.9s remaining: 4m 38s
80: learn: 0.0240670 total: 20.1s remaining: 4m 38s
81: learn: 0.0239272 total: 20.4s remaining: 4m 37s
82: learn: 0.0237726 total: 20.8s remaining: 4m 39s
83: learn: 0.0236572 total: 21.1s remaining: 4m 39s
84: learn: 0.0234781 total: 21.3s remaining: 4m 39s
85: learn: 0.0233802 total: 21.5s remaining: 4m 38s
86: learn: 0.0232333 total: 21.8s remaining: 4m 38s
87: learn: 0.0231253 total: 22s remaining: 4m 38s
88: learn: 0.0230377 total: 22.2s remaining: 4m 37s
89: learn: 0.0229296 total: 22.4s remaining: 4m 36s
90: learn: 0.0228099 total: 22.7s remaining: 4m 36s
91: learn: 0.0226936 total: 22.9s remaining: 4m 36s
92: learn: 0.0225892 total: 23.2s remaining: 4m 35s
93: learn: 0.0224698 total: 23.4s remaining: 4m 35s
94: learn: 0.0223614 total: 23.7s remaining: 4m 35s
95: learn: 0.0222159 total: 24s remaining: 4m 35s
96: learn: 0.0220908 total: 24.3s remaining: 4m 36s
97: learn: 0.0220100 total: 24.7s remaining: 4m 37s
98: learn: 0.0218933 total: 25s remaining: 4m 38s
99: learn: 0.0218498 total: 25.2s remaining: 4m 36s
100: learn: 0.0217178 total: 25.4s remaining: 4m 36s
101: learn: 0.0215981 total: 25.7s remaining: 4m 36s
102: learn: 0.0214634 total: 26s remaining: 4m 36s
103: learn: 0.0213583 total: 26.3s remaining: 4m 36s
104: learn: 0.0212457 total: 26.6s remaining: 4m 36s
105: learn: 0.0211651 total: 26.8s remaining: 4m 36s
106: learn: 0.0210695 total: 27.1s remaining: 4m 36s
107: learn: 0.0209774 total: 27.4s remaining: 4m 37s
108: learn: 0.0208596 total: 27.7s remaining: 4m 37s
109: learn: 0.0207690 total: 28.1s remaining: 4m 38s
110: learn: 0.0206953 total: 28.5s remaining: 4m 39s
111: learn: 0.0206227 total: 28.8s remaining: 4m 39s
112: learn: 0.0205014 total: 29.5s remaining: 4m 43s
113: learn: 0.0204145 total: 30.1s remaining: 4m 46s
114: learn: 0.0203366 total: 30.6s remaining: 4m 48s
115: learn: 0.0202360 total: 31s remaining: 4m 49s
116: learn: 0.0201664 total: 31.3s remaining: 4m 49s
117: learn: 0.0200379 total: 31.6s remaining: 4m 50s
118: learn: 0.0199594 total: 32.1s remaining: 4m 51s
119: learn: 0.0198527 total: 32.6s remaining: 4m 53s
120: learn: 0.0197673 total: 33s remaining: 4m 54s
121: learn: 0.0196201 total: 33.4s remaining: 4m 55s
122: learn: 0.0195341 total: 33.8s remaining: 4m 55s
123: learn: 0.0194177 total: 34.3s remaining: 4m 57s
124: learn: 0.0193491 total: 34.5s remaining: 4m 56s
125: learn: 0.0192756 total: 34.9s remaining: 4m 57s
126: learn: 0.0192029 total: 35.2s remaining: 4m 57s
127: learn: 0.0191186 total: 35.6s remaining: 4m 58s
128: learn: 0.0190983 total: 35.7s remaining: 4m 56s
129: learn: 0.0189959 total: 36.1s remaining: 4m 57s
130: learn: 0.0189336 total: 36.4s remaining: 4m 57s
131: learn: 0.0188486 total: 36.8s remaining: 4m 57s
132: learn: 0.0187633 total: 37.2s remaining: 4m 58s
133: learn: 0.0186490 total: 37.6s remaining: 4m 58s
134: learn: 0.0185316 total: 37.9s remaining: 4m 59s
135: learn: 0.0184620 total: 38.2s remaining: 4m 59s
136: learn: 0.0183886 total: 38.5s remaining: 4m 58s
137: learn: 0.0182975 total: 38.8s remaining: 4m 58s
138: learn: 0.0181938 total: 39.1s remaining: 4m 58s
139: learn: 0.0181868 total: 39.2s remaining: 4m 57s
140: learn: 0.0180966 total: 39.6s remaining: 4m 57s
141: learn: 0.0180292 total: 39.9s remaining: 4m 57s
```

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142: learn: 0.0179741 total: 40.3s remaining: 4m 57s
143: learn: 0.0179655 total: 40.4s remaining: 4m 56s
144: learn: 0.0178552 total: 40.7s remaining: 4m 56s
145: learn: 0.0177967 total: 41.1s remaining: 4m 56s
146: learn: 0.0177245 total: 41.5s remaining: 4m 57s
147: learn: 0.0176376 total: 41.9s remaining: 4m 57s
148: learn: 0.0175729 total: 42.2s remaining: 4m 57s
149: learn: 0.0175479 total: 42.4s remaining: 4m 56s
150: learn: 0.0174820 total: 42.7s remaining: 4m 56s
151: learn: 0.0173895 total: 43.1s remaining: 4m 57s
152: learn: 0.0172973 total: 43.5s remaining: 4m 57s
153: learn: 0.0172516 total: 43.8s remaining: 4m 57s
154: learn: 0.0171924 total: 44.1s remaining: 4m 57s
155: learn: 0.0171809 total: 44.2s remaining: 4m 55s
156: learn: 0.0171045 total: 44.4s remaining: 4m 55s
157: learn: 0.0170171 total: 44.7s remaining: 4m 54s
158: learn: 0.0169547 total: 45s remaining: 4m 54s
159: learn: 0.0168707 total: 45.3s remaining: 4m 54s
160: learn: 0.0167994 total: 45.6s remaining: 4m 54s
161: learn: 0.0167529 total: 45.8s remaining: 4m 53s
162: learn: 0.0167042 total: 46.1s remaining: 4m 53s
163: learn: 0.0166288 total: 46.4s remaining: 4m 53s
164: learn: 0.0165494 total: 46.7s remaining: 4m 52s
165: learn: 0.0164875 total: 46.9s remaining: 4m 52s
166: learn: 0.0164370 total: 47.2s remaining: 4m 51s
167: learn: 0.0163909 total: 47.4s remaining: 4m 51s
168: learn: 0.0163147 total: 47.7s remaining: 4m 50s
169: learn: 0.0162724 total: 48s remaining: 4m 50s
170: learn: 0.0162096 total: 48.2s remaining: 4m 50s
171: learn: 0.0161537 total: 48.5s remaining: 4m 49s
172: learn: 0.0160840 total: 48.8s remaining: 4m 49s
173: learn: 0.0160657 total: 48.9s remaining: 4m 48s
174: learn: 0.0160012 total: 49.2s remaining: 4m 47s
175: learn: 0.0159373 total: 49.4s remaining: 4m 47s
176: learn: 0.0158748 total: 49.7s remaining: 4m 47s
177: learn: 0.0158344 total: 49.9s remaining: 4m 46s
178: learn: 0.0157647 total: 50.2s remaining: 4m 46s
179: learn: 0.0157151 total: 50.5s remaining: 4m 46s
180: learn: 0.0156664 total: 50.8s remaining: 4m 45s
181: learn: 0.0156185 total: 51s remaining: 4m 45s
182: learn: 0.0155373 total: 51.3s remaining: 4m 44s
183: learn: 0.0155023 total: 51.5s remaining: 4m 44s
184: learn: 0.0154488 total: 51.7s remaining: 4m 43s
185: learn: 0.0153855 total: 52s remaining: 4m 43s
186: learn: 0.0153574 total: 52.2s remaining: 4m 42s
187: learn: 0.0153147 total: 52.4s remaining: 4m 42s
188: learn: 0.0152485 total: 52.6s remaining: 4m 41s
189: learn: 0.0151973 total: 52.9s remaining: 4m 41s
190: learn: 0.0151462 total: 53.1s remaining: 4m 40s
191: learn: 0.0150780 total: 53.3s remaining: 4m 39s
192: learn: 0.0150191 total: 53.6s remaining: 4m 39s
193: learn: 0.0149782 total: 53.8s remaining: 4m 38s
194: learn: 0.0149465 total: 54s remaining: 4m 38s
195: learn: 0.0149299 total: 54.1s remaining: 4m 37s
196: learn: 0.0148776 total: 54.4s remaining: 4m 36s
197: learn: 0.0147838 total: 54.6s remaining: 4m 36s
198: learn: 0.0147154 total: 54.8s remaining: 4m 35s
199: learn: 0.0146728 total: 55.1s remaining: 4m 35s
200: learn: 0.0146301 total: 55.3s remaining: 4m 34s
201: learn: 0.0145628 total: 55.6s remaining: 4m 34s
202: learn: 0.0145138 total: 55.9s remaining: 4m 34s
203: learn: 0.0144680 total: 56.2s remaining: 4m 34s
204: learn: 0.0144242 total: 56.4s remaining: 4m 33s
205: learn: 0.0143469 total: 56.7s remaining: 4m 33s
206: learn: 0.0143016 total: 57s remaining: 4m 33s
207: learn: 0.0142624 total: 57.2s remaining: 4m 32s
208: learn: 0.0141893 total: 57.5s remaining: 4m 32s
209: learn: 0.0141458 total: 57.8s remaining: 4m 32s
210: learn: 0.0140771 total: 58s remaining: 4m 31s
211: learn: 0.0140522 total: 58.3s remaining: 4m 31s
212: learn: 0.0139898 total: 58.6s remaining: 4m 31s
213: learn: 0.0139535 total: 58.8s remaining: 4m 30s
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214: learn: 0.0139117 total: 59s remaining: 4m 30s
215: learn: 0.0138799 total: 59.3s remaining: 4m 30s
216: learn: 0.0138247 total: 59.6s remaining: 4m 29s
217: learn: 0.0137873 total: 59.9s remaining: 4m 29s
218: learn: 0.0137625 total: 1m remaining: 4m 29s
219: learn: 0.0137271 total: 1m remaining: 4m 28s
220: learn: 0.0136686 total: 1m remaining: 4m 28s
221: learn: 0.0136085 total: 1m remaining: 4m 28s
222: learn: 0.0135858 total: 1m 1s remaining: 4m 27s
223: learn: 0.0135386 total: 1m 1s remaining: 4m 27s
224: learn: 0.0134701 total: 1m 1s remaining: 4m 27s
225: learn: 0.0134429 total: 1m 1s remaining: 4m 27s
226: learn: 0.0133970 total: 1m 2s remaining: 4m 26s
227: learn: 0.0133742 total: 1m 2s remaining: 4m 26s
228: learn: 0.0133430 total: 1m 2s remaining: 4m 25s
229: learn: 0.0132886 total: 1m 3s remaining: 4m 25s
230: learn: 0.0132422 total: 1m 3s remaining: 4m 25s
231: learn: 0.0132095 total: 1m 3s remaining: 4m 25s
232: learn: 0.0131886 total: 1m 3s remaining: 4m 25s
233: learn: 0.0131326 total: 1m 4s remaining: 4m 24s
234: learn: 0.0130945 total: 1m 4s remaining: 4m 24s
235: learn: 0.0130716 total: 1m 4s remaining: 4m 24s
236: learn: 0.0130296 total: 1m 4s remaining: 4m 23s
237: learn: 0.0129932 total: 1m 5s remaining: 4m 23s
238: learn: 0.0129594 total: 1m 5s remaining: 4m 23s
239: learn: 0.0129264 total: 1m 5s remaining: 4m 22s
240: learn: 0.0128999 total: 1m 5s remaining: 4m 22s
241: learn: 0.0128662 total: 1m 6s remaining: 4m 22s
242: learn: 0.0128478 total: 1m 6s remaining: 4m 21s
243: learn: 0.0128188 total: 1m 6s remaining: 4m 21s
244: learn: 0.0127888 total: 1m 6s remaining: 4m 20s
245: learn: 0.0127715 total: 1m 7s remaining: 4m 20s
246: learn: 0.0127497 total: 1m 7s remaining: 4m 19s
247: learn: 0.0127092 total: 1m 7s remaining: 4m 19s
248: learn: 0.0126915 total: 1m 7s remaining: 4m 19s
249: learn: 0.0126565 total: 1m 8s remaining: 4m 18s
250: learn: 0.0126228 total: 1m 8s remaining: 4m 18s
251: learn: 0.0125890 total: 1m 8s remaining: 4m 17s
252: learn: 0.0125411 total: 1m 8s remaining: 4m 17s
253: learn: 0.0124986 total: 1m 9s remaining: 4m 17s
254: learn: 0.0124703 total: 1m 9s remaining: 4m 16s
255: learn: 0.0124312 total: 1m 9s remaining: 4m 16s
256: learn: 0.0123987 total: 1m 9s remaining: 4m 15s
257: learn: 0.0123725 total: 1m 9s remaining: 4m 15s
258: learn: 0.0123298 total: 1m 10s remaining: 4m 14s
259: learn: 0.0123112 total: 1m 10s remaining: 4m 14s
260: learn: 0.0122827 total: 1m 10s remaining: 4m 14s
261: learn: 0.0122575 total: 1m 10s remaining: 4m 13s
262: learn: 0.0122334 total: 1m 11s remaining: 4m 13s
263: learn: 0.0122083 total: 1m 11s remaining: 4m 13s
264: learn: 0.0121947 total: 1m 11s remaining: 4m 13s
265: learn: 0.0121636 total: 1m 12s remaining: 4m 12s
266: learn: 0.0121186 total: 1m 12s remaining: 4m 12s
267: learn: 0.0120917 total: 1m 12s remaining: 4m 12s
268: learn: 0.0120668 total: 1m 12s remaining: 4m 12s
269: learn: 0.0120535 total: 1m 13s remaining: 4m 11s
270: learn: 0.0120369 total: 1m 13s remaining: 4m 11s
271: learn: 0.0119827 total: 1m 13s remaining: 4m 11s
272: learn: 0.0119572 total: 1m 13s remaining: 4m 11s
273: learn: 0.0119226 total: 1m 14s remaining: 4m 11s
274: learn: 0.0119055 total: 1m 14s remaining: 4m 10s
275: learn: 0.0118768 total: 1m 14s remaining: 4m 10s
276: learn: 0.0118240 total: 1m 15s remaining: 4m 10s
277: learn: 0.0117944 total: 1m 15s remaining: 4m 10s
278: learn: 0.0117597 total: 1m 15s remaining: 4m 10s
279: learn: 0.0117437 total: 1m 16s remaining: 4m 9s
280: learn: 0.0117162 total: 1m 16s remaining: 4m 9s
281: learn: 0.0116953 total: 1m 16s remaining: 4m 9s
282: learn: 0.0116686 total: 1m 16s remaining: 4m 9s
283: learn: 0.0116331 total: 1m 17s remaining: 4m 8s
284: learn: 0.0116125 total: 1m 17s remaining: 4m 8s
285: learn: 0.0115902 total: 1m 17s remaining: 4m 8s
```

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286: learn: 0.0115718 total: 1m 18s remaining: 4m 8s
287: learn: 0.0115592 total: 1m 18s remaining: 4m 7s
288: learn: 0.0115462 total: 1m 18s remaining: 4m 7s
289: learn: 0.0115323 total: 1m 18s remaining: 4m 7s
290: learn: 0.0114949 total: 1m 19s remaining: 4m 6s
291: learn: 0.0114833 total: 1m 19s remaining: 4m 6s
292: learn: 0.0114474 total: 1m 19s remaining: 4m 6s
293: learn: 0.0114317 total: 1m 19s remaining: 4m 6s
294: learn: 0.0114067 total: 1m 20s remaining: 4m 5s
295: learn: 0.0113915 total: 1m 20s remaining: 4m 5s
296: learn: 0.0113702 total: 1m 20s remaining: 4m 5s
297: learn: 0.0113087 total: 1m 21s remaining: 4m 5s
298: learn: 0.0112478 total: 1m 21s remaining: 4m 5s
299: learn: 0.0112192 total: 1m 21s remaining: 4m 4s
300: learn: 0.0112008 total: 1m 21s remaining: 4m 4s
301: learn: 0.0111612 total: 1m 22s remaining: 4m 3s
302: learn: 0.0111369 total: 1m 22s remaining: 4m 3s
303: learn: 0.0110788 total: 1m 22s remaining: 4m 3s
304: learn: 0.0110546 total: 1m 22s remaining: 4m 2s
305: learn: 0.0110284 total: 1m 22s remaining: 4m 2s
306: learn: 0.0109725 total: 1m 23s remaining: 4m 2s
307: learn: 0.0109607 total: 1m 23s remaining: 4m 1s
308: learn: 0.0109025 total: 1m 23s remaining: 4m 1s
309: learn: 0.0108798 total: 1m 23s remaining: 4m
310: learn: 0.0108562 total: 1m 24s remaining: 4m
311: learn: 0.0108404 total: 1m 24s remaining: 4m
312: learn: 0.0108263 total: 1m 24s remaining: 3m 59s
313: learn: 0.0107970 total: 1m 24s remaining: 3m 59s
314: learn: 0.0107508 total: 1m 25s remaining: 3m 59s
315: learn: 0.0107293 total: 1m 25s remaining: 3m 58s
316: learn: 0.0107151 total: 1m 25s remaining: 3m 58s
317: learn: 0.0106945 total: 1m 25s remaining: 3m 58s
318: learn: 0.0106835 total: 1m 26s remaining: 3m 57s
319: learn: 0.0106335 total: 1m 26s remaining: 3m 57s
320: learn: 0.0105968 total: 1m 26s remaining: 3m 56s
321: learn: 0.0105726 total: 1m 26s remaining: 3m 56s
322: learn: 0.0105506 total: 1m 27s remaining: 3m 56s
323: learn: 0.0105221 total: 1m 27s remaining: 3m 56s
324: learn: 0.0104573 total: 1m 27s remaining: 3m 55s
325: learn: 0.0104264 total: 1m 27s remaining: 3m 55s
326: learn: 0.0104101 total: 1m 28s remaining: 3m 55s
327: learn: 0.0103835 total: 1m 28s remaining: 3m 55s
328: learn: 0.0103602 total: 1m 28s remaining: 3m 54s
329: learn: 0.0103448 total: 1m 28s remaining: 3m 54s
330: learn: 0.0103237 total: 1m 29s remaining: 3m 54s
331: learn: 0.0103075 total: 1m 29s remaining: 3m 54s
332: learn: 0.0102816 total: 1m 29s remaining: 3m 53s
333: learn: 0.0102508 total: 1m 30s remaining: 3m 53s
334: learn: 0.0102302 total: 1m 30s remaining: 3m 53s
335: learn: 0.0102047 total: 1m 30s remaining: 3m 52s
336: learn: 0.0101867 total: 1m 30s remaining: 3m 52s
337: learn: 0.0101579 total: 1m 31s remaining: 3m 52s
338: learn: 0.0101355 total: 1m 31s remaining: 3m 52s
339: learn: 0.0101130 total: 1m 31s remaining: 3m 51s
340: learn: 0.0100985 total: 1m 31s remaining: 3m 51s
341: learn: 0.0100361 total: 1m 32s remaining: 3m 51s
342: learn: 0.0099769 total: 1m 32s remaining: 3m 51s
343: learn: 0.0099561 total: 1m 32s remaining: 3m 50s
344: learn: 0.0099350 total: 1m 33s remaining: 3m 50s
345: learn: 0.0099082 total: 1m 33s remaining: 3m 50s
346: learn: 0.0098901 total: 1m 33s remaining: 3m 49s
347: learn: 0.0098655 total: 1m 33s remaining: 3m 49s
348: learn: 0.0098517 total: 1m 34s remaining: 3m 49s
349: learn: 0.0098280 total: 1m 34s remaining: 3m 49s
350: learn: 0.0098022 total: 1m 34s remaining: 3m 48s
351: learn: 0.0097807 total: 1m 34s remaining: 3m 48s
352: learn: 0.0097677 total: 1m 35s remaining: 3m 48s
353: learn: 0.0097477 total: 1m 35s remaining: 3m 48s
354: learn: 0.0097331 total: 1m 35s remaining: 3m 47s
355: learn: 0.0097173 total: 1m 35s remaining: 3m 47s
356: learn: 0.0096987 total: 1m 36s remaining: 3m 47s
357: learn: 0.0096663 total: 1m 36s remaining: 3m 46s
```

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358: learn: 0.0096449 total: 1m 36s remaining: 3m 46s
359: learn: 0.0096244 total: 1m 36s remaining: 3m 46s
360: learn: 0.0096095 total: 1m 37s remaining: 3m 45s
361: learn: 0.0095706 total: 1m 37s remaining: 3m 45s
362: learn: 0.0095548 total: 1m 37s remaining: 3m 45s
363: learn: 0.0095277 total: 1m 37s remaining: 3m 44s
364: learn: 0.0094813 total: 1m 38s remaining: 3m 44s
365: learn: 0.0094595 total: 1m 38s remaining: 3m 44s
366: learn: 0.0094512 total: 1m 38s remaining: 3m 43s
367: learn: 0.0094121 total: 1m 38s remaining: 3m 43s
368: learn: 0.0093998 total: 1m 39s remaining: 3m 42s
369: learn: 0.0093874 total: 1m 39s remaining: 3m 42s
370: learn: 0.0093752 total: 1m 39s remaining: 3m 42s
371: learn: 0.0093467 total: 1m 39s remaining: 3m 41s
372: learn: 0.0093302 total: 1m 39s remaining: 3m 41s
373: learn: 0.0093041 total: 1m 40s remaining: 3m 41s
374: learn: 0.0092698 total: 1m 40s remaining: 3m 40s
375: learn: 0.0092552 total: 1m 40s remaining: 3m 40s
376: learn: 0.0092194 total: 1m 40s remaining: 3m 40s
377: learn: 0.0092064 total: 1m 41s remaining: 3m 39s
378: learn: 0.0091711 total: 1m 41s remaining: 3m 39s
379: learn: 0.0091629 total: 1m 41s remaining: 3m 38s
380: learn: 0.0091222 total: 1m 41s remaining: 3m 38s
381: learn: 0.0090864 total: 1m 41s remaining: 3m 38s
382: learn: 0.0090757 total: 1m 42s remaining: 3m 37s
383: learn: 0.0090547 total: 1m 42s remaining: 3m 37s
384: learn: 0.0090073 total: 1m 42s remaining: 3m 37s
385: learn: 0.0089946 total: 1m 42s remaining: 3m 36s
386: learn: 0.0089711 total: 1m 43s remaining: 3m 36s
387: learn: 0.0089350 total: 1m 43s remaining: 3m 36s
388: learn: 0.0089232 total: 1m 43s remaining: 3m 36s
389: learn: 0.0089053 total: 1m 43s remaining: 3m 35s
390: learn: 0.0088888 total: 1m 44s remaining: 3m 35s
391: learn: 0.0088764 total: 1m 44s remaining: 3m 35s
392: learn: 0.0088659 total: 1m 44s remaining: 3m 34s
393: learn: 0.0088465 total: 1m 44s remaining: 3m 34s
394: learn: 0.0088307 total: 1m 45s remaining: 3m 34s
395: learn: 0.0088060 total: 1m 45s remaining: 3m 34s
396: learn: 0.0087940 total: 1m 45s remaining: 3m 33s
397: learn: 0.0087824 total: 1m 45s remaining: 3m 33s
398: learn: 0.0087703 total: 1m 46s remaining: 3m 33s
399: learn: 0.0087328 total: 1m 46s remaining: 3m 33s
400: learn: 0.0087190 total: 1m 46s remaining: 3m 32s
401: learn: 0.0086588 total: 1m 47s remaining: 3m 32s
402: learn: 0.0086121 total: 1m 47s remaining: 3m 32s
403: learn: 0.0085766 total: 1m 47s remaining: 3m 32s
404: learn: 0.0085652 total: 1m 47s remaining: 3m 31s
405: learn: 0.0085461 total: 1m 48s remaining: 3m 31s
406: learn: 0.0085256 total: 1m 48s remaining: 3m 31s
407: learn: 0.0085131 total: 1m 48s remaining: 3m 30s
408: learn: 0.0085010 total: 1m 48s remaining: 3m 30s
409: learn: 0.0084702 total: 1m 49s remaining: 3m 30s
410: learn: 0.0084563 total: 1m 49s remaining: 3m 30s
411: learn: 0.0084323 total: 1m 49s remaining: 3m 29s
412: learn: 0.0084124 total: 1m 49s remaining: 3m 29s
413: learn: 0.0083987 total: 1m 50s remaining: 3m 29s
414: learn: 0.0083860 total: 1m 50s remaining: 3m 28s
415: learn: 0.0083720 total: 1m 50s remaining: 3m 28s
416: learn: 0.0083602 total: 1m 51s remaining: 3m 28s
417: learn: 0.0083404 total: 1m 51s remaining: 3m 28s
418: learn: 0.0083271 total: 1m 51s remaining: 3m 27s
419: learn: 0.0083140 total: 1m 51s remaining: 3m 27s
420: learn: 0.0083058 total: 1m 52s remaining: 3m 27s
421: learn: 0.0082925 total: 1m 52s remaining: 3m 27s
422: learn: 0.0082838 total: 1m 52s remaining: 3m 26s
423: learn: 0.0082643 total: 1m 52s remaining: 3m 26s
424: learn: 0.0082483 total: 1m 53s remaining: 3m 26s
425: learn: 0.0082389 total: 1m 53s remaining: 3m 25s
426: learn: 0.0082053 total: 1m 53s remaining: 3m 25s
427: learn: 0.0081852 total: 1m 53s remaining: 3m 25s
428: learn: 0.0081740 total: 1m 54s remaining: 3m 24s
429: learn: 0.0081625 total: 1m 54s remaining: 3m 24s
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430: learn: 0.0081528 total: 1m 54s remaining: 3m 24s
431: learn: 0.0081177 total: 1m 54s remaining: 3m 23s
432: learn: 0.0080996 total: 1m 54s remaining: 3m 23s
433: learn: 0.0080885 total: 1m 55s remaining: 3m 23s
434: learn: 0.0080688 total: 1m 55s remaining: 3m 22s
435: learn: 0.0080516 total: 1m 55s remaining: 3m 22s
436: learn: 0.0080211 total: 1m 55s remaining: 3m 22s
437: learn: 0.0080079 total: 1m 56s remaining: 3m 22s
438: learn: 0.0079785 total: 1m 56s remaining: 3m 21s
439: learn: 0.0079677 total: 1m 56s remaining: 3m 21s
440: learn: 0.0079526 total: 1m 56s remaining: 3m 21s
441: learn: 0.0079220 total: 1m 57s remaining: 3m 20s
442: learn: 0.0079092 total: 1m 57s remaining: 3m 20s
443: learn: 0.0078884 total: 1m 57s remaining: 3m 20s
444: learn: 0.0078492 total: 1m 57s remaining: 3m 19s
445: learn: 0.0078326 total: 1m 57s remaining: 3m 19s
446: learn: 0.0078082 total: 1m 58s remaining: 3m 19s
447: learn: 0.0077838 total: 1m 58s remaining: 3m 18s
448: learn: 0.0077762 total: 1m 58s remaining: 3m 18s
449: learn: 0.0077498 total: 1m 58s remaining: 3m 18s
450: learn: 0.0077346 total: 1m 59s remaining: 3m 17s
451: learn: 0.0077256 total: 1m 59s remaining: 3m 17s
452: learn: 0.0077174 total: 1m 59s remaining: 3m 17s
453: learn: 0.0077072 total: 2m remaining: 3m 17s
454: learn: 0.0076932 total: 2m remaining: 3m 16s
455: learn: 0.0076846 total: 2m remaining: 3m 16s
456: learn: 0.0076771 total: 2m remaining: 3m 16s
457: learn: 0.0076603 total: 2m 1s remaining: 3m 16s
458: learn: 0.0076473 total: 2m 1s remaining: 3m 15s
459: learn: 0.0076340 total: 2m 1s remaining: 3m 15s
460: learn: 0.0076168 total: 2m 1s remaining: 3m 15s
461: learn: 0.0075845 total: 2m 2s remaining: 3m 15s
462: learn: 0.0075343 total: 2m 2s remaining: 3m 14s
463: learn: 0.0075077 total: 2m 2s remaining: 3m 14s
464: learn: 0.0074824 total: 2m 2s remaining: 3m 14s
465: learn: 0.0074713 total: 2m 3s remaining: 3m 14s
466: learn: 0.0074530 total: 2m 3s remaining: 3m 13s
467: learn: 0.0074143 total: 2m 3s remaining: 3m 13s
468: learn: 0.0073860 total: 2m 4s remaining: 3m 13s
469: learn: 0.0073744 total: 2m 4s remaining: 3m 13s
470: learn: 0.0073653 total: 2m 4s remaining: 3m 12s
471: learn: 0.0073472 total: 2m 4s remaining: 3m 12s
472: learn: 0.0073373 total: 2m 5s remaining: 3m 12s
473: learn: 0.0073126 total: 2m 5s remaining: 3m 12s
474: learn: 0.0073037 total: 2m 5s remaining: 3m 11s
475: learn: 0.0072790 total: 2m 5s remaining: 3m 11s
476: learn: 0.0072689 total: 2m 6s remaining: 3m 11s
477: learn: 0.0072562 total: 2m 6s remaining: 3m 11s
478: learn: 0.0072375 total: 2m 6s remaining: 3m 10s
479: learn: 0.0072276 total: 2m 7s remaining: 3m 10s
480: learn: 0.0072166 total: 2m 7s remaining: 3m 10s
481: learn: 0.0071976 total: 2m 7s remaining: 3m 9s
482: learn: 0.0071834 total: 2m 7s remaining: 3m 9s
483: learn: 0.0071715 total: 2m 8s remaining: 3m 9s
484: learn: 0.0071555 total: 2m 8s remaining: 3m 9s
485: learn: 0.0071485 total: 2m 8s remaining: 3m 8s
486: learn: 0.0071395 total: 2m 8s remaining: 3m 8s
487: learn: 0.0071305 total: 2m 9s remaining: 3m 8s
488: learn: 0.0071195 total: 2m 9s remaining: 3m 8s
489: learn: 0.0071061 total: 2m 9s remaining: 3m 7s
490: learn: 0.0070970 total: 2m 9s remaining: 3m 7s
491: learn: 0.0070911 total: 2m 10s remaining: 3m 7s
492: learn: 0.0070694 total: 2m 10s remaining: 3m 6s
493: learn: 0.0070589 total: 2m 10s remaining: 3m 6s
494: learn: 0.0070347 total: 2m 10s remaining: 3m 6s
495: learn: 0.0070256 total: 2m 10s remaining: 3m 5s
496: learn: 0.0070202 total: 2m 11s remaining: 3m 5s
497: learn: 0.0069968 total: 2m 11s remaining: 3m 5s
498: learn: 0.0069830 total: 2m 11s remaining: 3m 4s
499: learn: 0.0069684 total: 2m 11s remaining: 3m 4s
500: learn: 0.0069493 total: 2m 12s remaining: 3m 4s
501: learn: 0.0069398 total: 2m 12s remaining: 3m 3s
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502: learn: 0.0069238 total: 2m 12s remaining: 3m 3s
503: learn: 0.0069017 total: 2m 12s remaining: 3m 3s
504: learn: 0.0068960 total: 2m 12s remaining: 3m 3s
505: learn: 0.0068716 total: 2m 13s remaining: 3m 2s
506: learn: 0.0068630 total: 2m 13s remaining: 3m 2s
507: learn: 0.0068506 total: 2m 13s remaining: 3m 2s
508: learn: 0.0068289 total: 2m 13s remaining: 3m 1s
509: learn: 0.0068036 total: 2m 14s remaining: 3m 1s
510: learn: 0.0067911 total: 2m 14s remaining: 3m 1s
511: learn: 0.0067803 total: 2m 14s remaining: 3m 1s
512: learn: 0.0067606 total: 2m 14s remaining: 3m
513: learn: 0.0067492 total: 2m 15s remaining: 3m
514: learn: 0.0067445 total: 2m 15s remaining: 3m
515: learn: 0.0067339 total: 2m 15s remaining: 2m 59s
516: learn: 0.0067258 total: 2m 16s remaining: 2m 59s
517: learn: 0.0067202 total: 2m 16s remaining: 2m 59s
518: learn: 0.0066995 total: 2m 16s remaining: 2m 59s
519: learn: 0.0066914 total: 2m 16s remaining: 2m 58s
520: learn: 0.0066677 total: 2m 17s remaining: 2m 58s
521: learn: 0.0066464 total: 2m 17s remaining: 2m 58s
522: learn: 0.0066374 total: 2m 17s remaining: 2m 58s
523: learn: 0.0066259 total: 2m 17s remaining: 2m 57s
524: learn: 0.0066043 total: 2m 18s remaining: 2m 57s
525: learn: 0.0065987 total: 2m 18s remaining: 2m 57s
526: learn: 0.0065911 total: 2m 18s remaining: 2m 57s
527: learn: 0.0065818 total: 2m 18s remaining: 2m 56s
528: learn: 0.0065753 total: 2m 19s remaining: 2m 56s
529: learn: 0.0065583 total: 2m 19s remaining: 2m 56s
530: learn: 0.0065508 total: 2m 19s remaining: 2m 56s
531: learn: 0.0065222 total: 2m 20s remaining: 2m 55s
532: learn: 0.0065027 total: 2m 20s remaining: 2m 55s
533: learn: 0.0064859 total: 2m 20s remaining: 2m 55s
534: learn: 0.0064664 total: 2m 20s remaining: 2m 55s
535: learn: 0.0064590 total: 2m 21s remaining: 2m 54s
536: learn: 0.0064377 total: 2m 21s remaining: 2m 54s
537: learn: 0.0064293 total: 2m 21s remaining: 2m 54s
538: learn: 0.0064236 total: 2m 21s remaining: 2m 53s
539: learn: 0.0064098 total: 2m 22s remaining: 2m 53s
540: learn: 0.0063966 total: 2m 22s remaining: 2m 53s
541: learn: 0.0063809 total: 2m 22s remaining: 2m 53s
542: learn: 0.0063720 total: 2m 22s remaining: 2m 52s
543: learn: 0.0063644 total: 2m 23s remaining: 2m 52s
544: learn: 0.0063503 total: 2m 23s remaining: 2m 52s
545: learn: 0.0063298 total: 2m 23s remaining: 2m 52s
546: learn: 0.0063142 total: 2m 23s remaining: 2m 51s
547: learn: 0.0062976 total: 2m 24s remaining: 2m 51s
548: learn: 0.0062897 total: 2m 24s remaining: 2m 51s
549: learn: 0.0062844 total: 2m 24s remaining: 2m 51s
550: learn: 0.0062773 total: 2m 25s remaining: 2m 50s
551: learn: 0.0062671 total: 2m 25s remaining: 2m 50s
552: learn: 0.0062562 total: 2m 25s remaining: 2m 50s
553: learn: 0.0062527 total: 2m 25s remaining: 2m 49s
554: learn: 0.0062445 total: 2m 25s remaining: 2m 49s
555: learn: 0.0062352 total: 2m 26s remaining: 2m 49s
556: learn: 0.0062029 total: 2m 26s remaining: 2m 48s
557: learn: 0.0061937 total: 2m 26s remaining: 2m 48s
558: learn: 0.0061884 total: 2m 26s remaining: 2m 48s
559: learn: 0.0061712 total: 2m 27s remaining: 2m 48s
560: learn: 0.0061541 total: 2m 27s remaining: 2m 47s
561: learn: 0.0061472 total: 2m 27s remaining: 2m 47s
562: learn: 0.0061309 total: 2m 27s remaining: 2m 47s
563: learn: 0.0061195 total: 2m 27s remaining: 2m 46s
564: learn: 0.0061134 total: 2m 28s remaining: 2m 46s
565: learn: 0.0061070 total: 2m 28s remaining: 2m 46s
566: learn: 0.0060992 total: 2m 28s remaining: 2m 45s
567: learn: 0.0060889 total: 2m 28s remaining: 2m 45s
568: learn: 0.0060843 total: 2m 29s remaining: 2m 45s
569: learn: 0.0060680 total: 2m 29s remaining: 2m 45s
570: learn: 0.0060625 total: 2m 29s remaining: 2m 44s
571: learn: 0.0060534 total: 2m 29s remaining: 2m 44s
572: learn: 0.0060465 total: 2m 30s remaining: 2m 44s
573: learn: 0.0060406 total: 2m 30s remaining: 2m 43s
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574: learn: 0.0060324 total: 2m 30s remaining: 2m 43s
575: learn: 0.0060287 total: 2m 30s remaining: 2m 43s
576: learn: 0.0060050 total: 2m 31s remaining: 2m 43s
577: learn: 0.0059920 total: 2m 31s remaining: 2m 42s
578: learn: 0.0059808 total: 2m 31s remaining: 2m 42s
579: learn: 0.0059718 total: 2m 31s remaining: 2m 42s
580: learn: 0.0059546 total: 2m 32s remaining: 2m 42s
581: learn: 0.0059480 total: 2m 32s remaining: 2m 41s
582: learn: 0.0059407 total: 2m 32s remaining: 2m 41s
583: learn: 0.0059357 total: 2m 33s remaining: 2m 41s
584: learn: 0.0059305 total: 2m 33s remaining: 2m 41s
585: learn: 0.0059080 total: 2m 33s remaining: 2m 40s
586: learn: 0.0059000 total: 2m 33s remaining: 2m 40s
587: learn: 0.0058753 total: 2m 34s remaining: 2m 40s
588: learn: 0.0058596 total: 2m 34s remaining: 2m 40s
589: learn: 0.0058478 total: 2m 34s remaining: 2m 39s
590: learn: 0.0058397 total: 2m 34s remaining: 2m 39s
591: learn: 0.0058197 total: 2m 35s remaining: 2m 39s
592: learn: 0.0058134 total: 2m 35s remaining: 2m 39s
593: learn: 0.0058028 total: 2m 35s remaining: 2m 38s
594: learn: 0.0057963 total: 2m 35s remaining: 2m 38s
595: learn: 0.0057931 total: 2m 36s remaining: 2m 38s
596: learn: 0.0057555 total: 2m 36s remaining: 2m 38s
597: learn: 0.0057493 total: 2m 36s remaining: 2m 37s
598: learn: 0.0057327 total: 2m 37s remaining: 2m 37s
599: learn: 0.0057190 total: 2m 37s remaining: 2m 37s
600: learn: 0.0056996 total: 2m 37s remaining: 2m 37s
601: learn: 0.0056864 total: 2m 37s remaining: 2m 36s
602: learn: 0.0056712 total: 2m 38s remaining: 2m 36s
603: learn: 0.0056639 total: 2m 38s remaining: 2m 36s
604: learn: 0.0056503 total: 2m 38s remaining: 2m 36s
605: learn: 0.0056437 total: 2m 38s remaining: 2m 35s
606: learn: 0.0056301 total: 2m 39s remaining: 2m 35s
607: learn: 0.0056231 total: 2m 39s remaining: 2m 35s
608: learn: 0.0056064 total: 2m 39s remaining: 2m 35s
609: learn: 0.0055923 total: 2m 40s remaining: 2m 34s
610: learn: 0.0055859 total: 2m 40s remaining: 2m 34s
611: learn: 0.0055807 total: 2m 40s remaining: 2m 34s
612: learn: 0.0055614 total: 2m 40s remaining: 2m 34s
613: learn: 0.0055501 total: 2m 41s remaining: 2m 33s
614: learn: 0.0055396 total: 2m 41s remaining: 2m 33s
615: learn: 0.0055331 total: 2m 41s remaining: 2m 33s
616: learn: 0.0055281 total: 2m 41s remaining: 2m 32s
617: learn: 0.0055180 total: 2m 42s remaining: 2m 32s
618: learn: 0.0055142 total: 2m 42s remaining: 2m 32s
619: learn: 0.0054979 total: 2m 42s remaining: 2m 32s
620: learn: 0.0054862 total: 2m 42s remaining: 2m 31s
621: learn: 0.0054779 total: 2m 42s remaining: 2m 31s
622: learn: 0.0054723 total: 2m 43s remaining: 2m 31s
623: learn: 0.0054648 total: 2m 43s remaining: 2m 30s
624: learn: 0.0054601 total: 2m 43s remaining: 2m 30s
625: learn: 0.0054547 total: 2m 43s remaining: 2m 30s
626: learn: 0.0054492 total: 2m 44s remaining: 2m 29s
627: learn: 0.0054365 total: 2m 44s remaining: 2m 29s
628: learn: 0.0054314 total: 2m 44s remaining: 2m 29s
629: learn: 0.0054091 total: 2m 44s remaining: 2m 28s
630: learn: 0.0054047 total: 2m 44s remaining: 2m 28s
631: learn: 0.0053993 total: 2m 45s remaining: 2m 28s
632: learn: 0.0053923 total: 2m 45s remaining: 2m 28s
633: learn: 0.0053875 total: 2m 45s remaining: 2m 27s
634: learn: 0.0053768 total: 2m 45s remaining: 2m 27s
635: learn: 0.0053637 total: 2m 46s remaining: 2m 27s
636: learn: 0.0053591 total: 2m 46s remaining: 2m 26s
637: learn: 0.0053517 total: 2m 46s remaining: 2m 26s
638: learn: 0.0053411 total: 2m 46s remaining: 2m 26s
639: learn: 0.0053353 total: 2m 47s remaining: 2m 26s
640: learn: 0.0053234 total: 2m 47s remaining: 2m 25s
641: learn: 0.0053160 total: 2m 47s remaining: 2m 25s
642: learn: 0.0053090 total: 2m 47s remaining: 2m 25s
643: learn: 0.0053001 total: 2m 48s remaining: 2m 25s
644: learn: 0.0052934 total: 2m 48s remaining: 2m 24s
645: learn: 0.0052901 total: 2m 48s remaining: 2m 24s
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646: learn: 0.0052727 total: 2m 48s remaining: 2m 24s
647: learn: 0.0052600 total: 2m 49s remaining: 2m 24s
648: learn: 0.0052535 total: 2m 49s remaining: 2m 23s
649: learn: 0.0052492 total: 2m 49s remaining: 2m 23s
650: learn: 0.0052449 total: 2m 49s remaining: 2m 23s
651: learn: 0.0052383 total: 2m 50s remaining: 2m 23s
652: learn: 0.0052290 total: 2m 50s remaining: 2m 22s
653: learn: 0.0052231 total: 2m 50s remaining: 2m 22s
654: learn: 0.0052106 total: 2m 51s remaining: 2m 22s
655: learn: 0.0051791 total: 2m 51s remaining: 2m 22s
656: learn: 0.0051725 total: 2m 51s remaining: 2m 21s
657: learn: 0.0051600 total: 2m 51s remaining: 2m 21s
658: learn: 0.0051485 total: 2m 52s remaining: 2m 21s
659: learn: 0.0051430 total: 2m 52s remaining: 2m 21s
660: learn: 0.0051300 total: 2m 52s remaining: 2m 20s
661: learn: 0.0051245 total: 2m 52s remaining: 2m 20s
662: learn: 0.0051193 total: 2m 53s remaining: 2m 20s
663: learn: 0.0051153 total: 2m 53s remaining: 2m 19s
664: learn: 0.0051094 total: 2m 53s remaining: 2m 19s
665: learn: 0.0051040 total: 2m 53s remaining: 2m 19s
666: learn: 0.0050929 total: 2m 54s remaining: 2m 19s
667: learn: 0.0050843 total: 2m 54s remaining: 2m 18s
668: learn: 0.0050693 total: 2m 54s remaining: 2m 18s
669: learn: 0.0050605 total: 2m 55s remaining: 2m 18s
670: learn: 0.0050468 total: 2m 55s remaining: 2m 18s
671: learn: 0.0050421 total: 2m 55s remaining: 2m 17s
672: learn: 0.0050321 total: 2m 55s remaining: 2m 17s
673: learn: 0.0050210 total: 2m 56s remaining: 2m 17s
674: learn: 0.0050077 total: 2m 56s remaining: 2m 17s
675: learn: 0.0050031 total: 2m 56s remaining: 2m 16s
676: learn: 0.0049899 total: 2m 56s remaining: 2m 16s
677: learn: 0.0049854 total: 2m 57s remaining: 2m 16s
678: learn: 0.0049726 total: 2m 57s remaining: 2m 16s
679: learn: 0.0049684 total: 2m 57s remaining: 2m 15s
680: learn: 0.0049524 total: 2m 57s remaining: 2m 15s
681: learn: 0.0049465 total: 2m 58s remaining: 2m 15s
682: learn: 0.0049391 total: 2m 58s remaining: 2m 14s
683: learn: 0.0049361 total: 2m 58s remaining: 2m 14s
684: learn: 0.0049328 total: 2m 58s remaining: 2m 14s
685: learn: 0.0049286 total: 2m 58s remaining: 2m 14s
686: learn: 0.0049235 total: 2m 59s remaining: 2m 13s
687: learn: 0.0049198 total: 2m 59s remaining: 2m 13s
688: learn: 0.0049153 total: 2m 59s remaining: 2m 13s
689: learn: 0.0049126 total: 2m 59s remaining: 2m 12s
690: learn: 0.0048874 total: 3m remaining: 2m 12s
691: learn: 0.0048841 total: 3m remaining: 2m 12s
692: learn: 0.0048803 total: 3m remaining: 2m 12s
693: learn: 0.0048772 total: 3m remaining: 2m 11s
694: learn: 0.0048712 total: 3m 1s remaining: 2m 11s
695: learn: 0.0048630 total: 3m 1s remaining: 2m 11s
696: learn: 0.0048600 total: 3m 1s remaining: 2m 10s
697: learn: 0.0048506 total: 3m 1s remaining: 2m 10s
698: learn: 0.0048446 total: 3m 1s remaining: 2m 10s
699: learn: 0.0048385 total: 3m 2s remaining: 2m 10s
700: learn: 0.0048309 total: 3m 2s remaining: 2m 9s
701: learn: 0.0048250 total: 3m 2s remaining: 2m 9s
702: learn: 0.0048170 total: 3m 2s remaining: 2m 9s
703: learn: 0.0048141 total: 3m 3s remaining: 2m 9s
704: learn: 0.0048087 total: 3m 3s remaining: 2m 8s
705: learn: 0.0048026 total: 3m 3s remaining: 2m 8s
706: learn: 0.0047961 total: 3m 4s remaining: 2m 8s
707: learn: 0.0047903 total: 3m 4s remaining: 2m 8s
708: learn: 0.0047796 total: 3m 4s remaining: 2m 7s
709: learn: 0.0047700 total: 3m 4s remaining: 2m 7s
710: learn: 0.0047589 total: 3m 5s remaining: 2m 7s
711: learn: 0.0047545 total: 3m 5s remaining: 2m 7s
712: learn: 0.0047477 total: 3m 5s remaining: 2m 6s
713: learn: 0.0047332 total: 3m 5s remaining: 2m 6s
714: learn: 0.0047259 total: 3m 6s remaining: 2m 6s
715: learn: 0.0047195 total: 3m 6s remaining: 2m 6s
716: learn: 0.0047128 total: 3m 6s remaining: 2m 5s
717: learn: 0.0047084 total: 3m 6s remaining: 2m 5s
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718: learn: 0.0046924 total: 3m 7s remaining: 2m 5s
719: learn: 0.0046882 total: 3m 7s remaining: 2m 4s
720: learn: 0.0046761 total: 3m 7s remaining: 2m 4s
721: learn: 0.0046640 total: 3m 8s remaining: 2m 4s
722: learn: 0.0046543 total: 3m 8s remaining: 2m 4s
723: learn: 0.0046413 total: 3m 8s remaining: 2m 3s
724: learn: 0.0046326 total: 3m 8s remaining: 2m 3s
725: learn: 0.0046266 total: 3m 9s remaining: 2m 3s
726: learn: 0.0046224 total: 3m 9s remaining: 2m 3s
727: learn: 0.0046179 total: 3m 9s remaining: 2m 2s
728: learn: 0.0046054 total: 3m 9s remaining: 2m 2s
729: learn: 0.0045932 total: 3m 10s remaining: 2m 2s
730: learn: 0.0045872 total: 3m 10s remaining: 2m 2s
731: learn: 0.0045807 total: 3m 10s remaining: 2m 1s
732: learn: 0.0045769 total: 3m 10s remaining: 2m 1s
733: learn: 0.0045747 total: 3m 11s remaining: 2m 1s
734: learn: 0.0045699 total: 3m 11s remaining: 2m 1s
735: learn: 0.0045670 total: 3m 11s remaining: 2m
736: learn: 0.0045645 total: 3m 12s remaining: 2m
737: learn: 0.0045543 total: 3m 12s remaining: 2m
738: learn: 0.0045481 total: 3m 12s remaining: 2m
739: learn: 0.0045454 total: 3m 12s remaining: 1m 59s
740: learn: 0.0045355 total: 3m 13s remaining: 1m 59s
741: learn: 0.0045283 total: 3m 13s remaining: 1m 59s
742: learn: 0.0045258 total: 3m 13s remaining: 1m 59s
743: learn: 0.0045158 total: 3m 13s remaining: 1m 58s
744: learn: 0.0045032 total: 3m 14s remaining: 1m 58s
745: learn: 0.0044938 total: 3m 14s remaining: 1m 58s
746: learn: 0.0044876 total: 3m 14s remaining: 1m 57s
747: learn: 0.0044777 total: 3m 14s remaining: 1m 57s
748: learn: 0.0044739 total: 3m 15s remaining: 1m 57s
749: learn: 0.0044675 total: 3m 15s remaining: 1m 57s
750: learn: 0.0044573 total: 3m 15s remaining: 1m 56s
751: learn: 0.0044483 total: 3m 15s remaining: 1m 56s
752: learn: 0.0044418 total: 3m 16s remaining: 1m 56s
753: learn: 0.0044324 total: 3m 16s remaining: 1m 56s
754: learn: 0.0044288 total: 3m 16s remaining: 1m 55s
755: learn: 0.0044211 total: 3m 16s remaining: 1m 55s
756: learn: 0.0044083 total: 3m 16s remaining: 1m 55s
757: learn: 0.0044046 total: 3m 17s remaining: 1m 54s
758: learn: 0.0044006 total: 3m 17s remaining: 1m 54s
759: learn: 0.0043957 total: 3m 17s remaining: 1m 54s
760: learn: 0.0043856 total: 3m 18s remaining: 1m 54s
761: learn: 0.0043822 total: 3m 18s remaining: 1m 53s
762: learn: 0.0043791 total: 3m 18s remaining: 1m 53s
763: learn: 0.0043719 total: 3m 18s remaining: 1m 53s
764: learn: 0.0043656 total: 3m 18s remaining: 1m 53s
765: learn: 0.0043622 total: 3m 19s remaining: 1m 52s
766: learn: 0.0043585 total: 3m 19s remaining: 1m 52s
767: learn: 0.0043537 total: 3m 19s remaining: 1m 52s
768: learn: 0.0043483 total: 3m 20s remaining: 1m 52s
769: learn: 0.0043454 total: 3m 20s remaining: 1m 51s
770: learn: 0.0043432 total: 3m 20s remaining: 1m 51s
771: learn: 0.0043388 total: 3m 20s remaining: 1m 51s
772: learn: 0.0043361 total: 3m 21s remaining: 1m 51s
773: learn: 0.0043340 total: 3m 21s remaining: 1m 50s
774: learn: 0.0043306 total: 3m 21s remaining: 1m 50s
775: learn: 0.0043265 total: 3m 21s remaining: 1m 50s
776: learn: 0.0043228 total: 3m 22s remaining: 1m 50s
777: learn: 0.0043151 total: 3m 22s remaining: 1m 49s
778: learn: 0.0043114 total: 3m 22s remaining: 1m 49s
779: learn: 0.0043035 total: 3m 23s remaining: 1m 49s
780: learn: 0.0042966 total: 3m 23s remaining: 1m 49s
781: learn: 0.0042906 total: 3m 23s remaining: 1m 48s
782: learn: 0.0042843 total: 3m 23s remaining: 1m 48s
783: learn: 0.0042822 total: 3m 24s remaining: 1m 48s
784: learn: 0.0042791 total: 3m 24s remaining: 1m 47s
785: learn: 0.0042682 total: 3m 24s remaining: 1m 47s
786: learn: 0.0042620 total: 3m 24s remaining: 1m 47s
787: learn: 0.0042554 total: 3m 25s remaining: 1m 47s
788: learn: 0.0042450 total: 3m 25s remaining: 1m 47s
789: learn: 0.0042357 total: 3m 25s remaining: 1m 46s
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790: learn: 0.0042290 total: 3m 25s remaining: 1m 46s
791: learn: 0.0042253 total: 3m 26s remaining: 1m 46s
792: learn: 0.0042200 total: 3m 26s remaining: 1m 45s
793: learn: 0.0042160 total: 3m 26s remaining: 1m 45s
794: learn: 0.0042090 total: 3m 27s remaining: 1m 45s
795: learn: 0.0041995 total: 3m 27s remaining: 1m 45s
796: learn: 0.0041910 total: 3m 27s remaining: 1m 44s
797: learn: 0.0041811 total: 3m 27s remaining: 1m 44s
798: learn: 0.0041750 total: 3m 28s remaining: 1m 44s
799: learn: 0.0041675 total: 3m 28s remaining: 1m 44s
800: learn: 0.0041633 total: 3m 28s remaining: 1m 43s
801: learn: 0.0041516 total: 3m 28s remaining: 1m 43s
802: learn: 0.0041387 total: 3m 29s remaining: 1m 43s
803: learn: 0.0041339 total: 3m 29s remaining: 1m 43s
804: learn: 0.0041288 total: 3m 29s remaining: 1m 42s
805: learn: 0.0041233 total: 3m 29s remaining: 1m 42s
806: learn: 0.0041204 total: 3m 29s remaining: 1m 42s
807: learn: 0.0041135 total: 3m 30s remaining: 1m 41s
808: learn: 0.0041066 total: 3m 30s remaining: 1m 41s
809: learn: 0.0041025 total: 3m 30s remaining: 1m 41s
810: learn: 0.0040965 total: 3m 30s remaining: 1m 41s
811: learn: 0.0040893 total: 3m 30s remaining: 1m 40s
812: learn: 0.0040865 total: 3m 31s remaining: 1m 40s
813: learn: 0.0040820 total: 3m 31s remaining: 1m 40s
814: learn: 0.0040719 total: 3m 31s remaining: 1m 39s
815: learn: 0.0040668 total: 3m 31s remaining: 1m 39s
816: learn: 0.0040465 total: 3m 32s remaining: 1m 39s
817: learn: 0.0040438 total: 3m 32s remaining: 1m 39s
818: learn: 0.0040383 total: 3m 32s remaining: 1m 38s
819: learn: 0.0040330 total: 3m 32s remaining: 1m 38s
820: learn: 0.0040284 total: 3m 32s remaining: 1m 38s
821: learn: 0.0040213 total: 3m 33s remaining: 1m 38s
822: learn: 0.0040173 total: 3m 33s remaining: 1m 37s
823: learn: 0.0040093 total: 3m 33s remaining: 1m 37s
824: learn: 0.0040020 total: 3m 33s remaining: 1m 37s
825: learn: 0.0039995 total: 3m 34s remaining: 1m 36s
826: learn: 0.0039896 total: 3m 34s remaining: 1m 36s
827: learn: 0.0039837 total: 3m 34s remaining: 1m 36s
828: learn: 0.0039748 total: 3m 34s remaining: 1m 36s
829: learn: 0.0039697 total: 3m 35s remaining: 1m 35s
830: learn: 0.0039640 total: 3m 35s remaining: 1m 35s
831: learn: 0.0039611 total: 3m 35s remaining: 1m 35s
832: learn: 0.0039562 total: 3m 35s remaining: 1m 35s
833: learn: 0.0039536 total: 3m 36s remaining: 1m 34s
834: learn: 0.0039513 total: 3m 36s remaining: 1m 34s
835: learn: 0.0039471 total: 3m 36s remaining: 1m 34s
836: learn: 0.0039437 total: 3m 36s remaining: 1m 34s
837: learn: 0.0039408 total: 3m 37s remaining: 1m 33s
838: learn: 0.0039331 total: 3m 37s remaining: 1m 33s
839: learn: 0.0039257 total: 3m 37s remaining: 1m 33s
840: learn: 0.0039205 total: 3m 37s remaining: 1m 33s
841: learn: 0.0039167 total: 3m 38s remaining: 1m 32s
842: learn: 0.0039078 total: 3m 38s remaining: 1m 32s
843: learn: 0.0039044 total: 3m 38s remaining: 1m 32s
844: learn: 0.0038956 total: 3m 39s remaining: 1m 32s
845: learn: 0.0038940 total: 3m 39s remaining: 1m 31s
846: learn: 0.0038881 total: 3m 39s remaining: 1m 31s
847: learn: 0.0038843 total: 3m 39s remaining: 1m 31s
848: learn: 0.0038829 total: 3m 40s remaining: 1m 30s
849: learn: 0.0038806 total: 3m 40s remaining: 1m 30s
850: learn: 0.0038783 total: 3m 40s remaining: 1m 30s
851: learn: 0.0038730 total: 3m 40s remaining: 1m 30s
852: learn: 0.0038700 total: 3m 41s remaining: 1m 29s
853: learn: 0.0038611 total: 3m 41s remaining: 1m 29s
854: learn: 0.0038501 total: 3m 41s remaining: 1m 29s
855: learn: 0.0038363 total: 3m 41s remaining: 1m 29s
856: learn: 0.0038212 total: 3m 42s remaining: 1m 28s
857: learn: 0.0038165 total: 3m 42s remaining: 1m 28s
858: learn: 0.0038102 total: 3m 42s remaining: 1m 28s
859: learn: 0.0038078 total: 3m 42s remaining: 1m 28s
860: learn: 0.0038026 total: 3m 43s remaining: 1m 27s
861: learn: 0.0037980 total: 3m 43s remaining: 1m 27s
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862: learn: 0.0037953 total: 3m 43s remaining: 1m 27s
863: learn: 0.0037919 total: 3m 43s remaining: 1m 27s
864: learn: 0.0037862 total: 3m 44s remaining: 1m 26s
865: learn: 0.0037786 total: 3m 44s remaining: 1m 26s
866: learn: 0.0037766 total: 3m 44s remaining: 1m 26s
867: learn: 0.0037737 total: 3m 44s remaining: 1m 26s
868: learn: 0.0037675 total: 3m 45s remaining: 1m 25s
869: learn: 0.0037649 total: 3m 45s remaining: 1m 25s
870: learn: 0.0037584 total: 3m 45s remaining: 1m 25s
871: learn: 0.0037537 total: 3m 45s remaining: 1m 24s
872: learn: 0.0037496 total: 3m 46s remaining: 1m 24s
873: learn: 0.0037445 total: 3m 46s remaining: 1m 24s
874: learn: 0.0037404 total: 3m 46s remaining: 1m 24s
875: learn: 0.0037341 total: 3m 46s remaining: 1m 23s
876: learn: 0.0037293 total: 3m 46s remaining: 1m 23s
877: learn: 0.0037256 total: 3m 47s remaining: 1m 23s
878: learn: 0.0037181 total: 3m 47s remaining: 1m 23s
879: learn: 0.0037074 total: 3m 47s remaining: 1m 22s
880: learn: 0.0036991 total: 3m 47s remaining: 1m 22s
881: learn: 0.0036884 total: 3m 48s remaining: 1m 22s
882: learn: 0.0036828 total: 3m 48s remaining: 1m 21s
883: learn: 0.0036790 total: 3m 48s remaining: 1m 21s
884: learn: 0.0036751 total: 3m 48s remaining: 1m 21s
885: learn: 0.0036730 total: 3m 48s remaining: 1m 21s
886: learn: 0.0036709 total: 3m 49s remaining: 1m 20s
887: learn: 0.0036688 total: 3m 49s remaining: 1m 20s
888: learn: 0.0036663 total: 3m 49s remaining: 1m 20s
889: learn: 0.0036636 total: 3m 49s remaining: 1m 20s
890: learn: 0.0036529 total: 3m 49s remaining: 1m 19s
891: learn: 0.0036452 total: 3m 50s remaining: 1m 19s
892: learn: 0.0036410 total: 3m 50s remaining: 1m 19s
893: learn: 0.0036346 total: 3m 50s remaining: 1m 18s
894: learn: 0.0036287 total: 3m 51s remaining: 1m 18s
895: learn: 0.0036253 total: 3m 51s remaining: 1m 18s
896: learn: 0.0036179 total: 3m 51s remaining: 1m 18s
897: learn: 0.0036130 total: 3m 51s remaining: 1m 17s
898: learn: 0.0036099 total: 3m 52s remaining: 1m 17s
899: learn: 0.0035994 total: 3m 52s remaining: 1m 17s
900: learn: 0.0035904 total: 3m 52s remaining: 1m 17s
901: learn: 0.0035866 total: 3m 52s remaining: 1m 16s
902: learn: 0.0035838 total: 3m 53s remaining: 1m 16s
903: learn: 0.0035780 total: 3m 53s remaining: 1m 16s
904: learn: 0.0035752 total: 3m 53s remaining: 1m 16s
905: learn: 0.0035701 total: 3m 54s remaining: 1m 15s
906: learn: 0.0035632 total: 3m 54s remaining: 1m 15s
907: learn: 0.0035587 total: 3m 54s remaining: 1m 15s
908: learn: 0.0035547 total: 3m 54s remaining: 1m 15s
909: learn: 0.0035527 total: 3m 55s remaining: 1m 14s
910: learn: 0.0035490 total: 3m 55s remaining: 1m 14s
911: learn: 0.0035436 total: 3m 55s remaining: 1m 14s
912: learn: 0.0035421 total: 3m 55s remaining: 1m 14s
913: learn: 0.0035403 total: 3m 56s remaining: 1m 13s
914: learn: 0.0035382 total: 3m 56s remaining: 1m 13s
915: learn: 0.0035353 total: 3m 56s remaining: 1m 13s
916: learn: 0.0035331 total: 3m 57s remaining: 1m 13s
917: learn: 0.0035278 total: 3m 57s remaining: 1m 12s
918: learn: 0.0035238 total: 3m 57s remaining: 1m 12s
919: learn: 0.0035215 total: 3m 57s remaining: 1m 12s
920: learn: 0.0035167 total: 3m 58s remaining: 1m 12s
921: learn: 0.0035114 total: 3m 58s remaining: 1m 11s
922: learn: 0.0035068 total: 3m 58s remaining: 1m 11s
923: learn: 0.0035007 total: 3m 58s remaining: 1m 11s
924: learn: 0.0034987 total: 3m 59s remaining: 1m 11s
925: learn: 0.0034918 total: 3m 59s remaining: 1m 10s
926: learn: 0.0034877 total: 3m 59s remaining: 1m 10s
927: learn: 0.0034825 total: 3m 59s remaining: 1m 10s
928: learn: 0.0034803 total: 4m remaining: 1m 10s
929: learn: 0.0034760 total: 4m remaining: 1m 9s
930: learn: 0.0034659 total: 4m remaining: 1m 9s
931: learn: 0.0034591 total: 4m remaining: 1m 9s
932: learn: 0.0034554 total: 4m 1s remaining: 1m 9s
933: learn: 0.0034537 total: 4m 1s remaining: 1m 8s
```

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934: learn: 0.0034488 total: 4m 1s remaining: 1m 8s
935: learn: 0.0034460 total: 4m 1s remaining: 1m 8s
936: learn: 0.0034363 total: 4m 2s remaining: 1m 7s
937: learn: 0.0034327 total: 4m 2s remaining: 1m 7s
938: learn: 0.0034296 total: 4m 2s remaining: 1m 7s
939: learn: 0.0034254 total: 4m 2s remaining: 1m 7s
940: learn: 0.0034218 total: 4m 2s remaining: 1m 6s
941: learn: 0.0034156 total: 4m 3s remaining: 1m 6s
942: learn: 0.0034138 total: 4m 3s remaining: 1m 6s
943: learn: 0.0034063 total: 4m 3s remaining: 1m 6s
944: learn: 0.0034003 total: 4m 3s remaining: 1m 5s
945: learn: 0.0033926 total: 4m 4s remaining: 1m 5s
946: learn: 0.0033863 total: 4m 4s remaining: 1m 5s
947: learn: 0.0033824 total: 4m 4s remaining: 1m 4s
948: learn: 0.0033796 total: 4m 4s remaining: 1m 4s
949: learn: 0.0033752 total: 4m 4s remaining: 1m 4s
950: learn: 0.0033723 total: 4m 5s remaining: 1m 4s
951: learn: 0.0033695 total: 4m 5s remaining: 1m 3s
952: learn: 0.0033622 total: 4m 5s remaining: 1m 3s
953: learn: 0.0033591 total: 4m 5s remaining: 1m 3s
954: learn: 0.0033562 total: 4m 6s remaining: 1m 3s
955: learn: 0.0033527 total: 4m 6s remaining: 1m 2s
956: learn: 0.0033471 total: 4m 6s remaining: 1m 2s
957: learn: 0.0033456 total: 4m 6s remaining: 1m 2s
958: learn: 0.0033443 total: 4m 7s remaining: 1m 2s
959: learn: 0.0033419 total: 4m 7s remaining: 1m 1s
960: learn: 0.0033397 total: 4m 7s remaining: 1m 1s
961: learn: 0.0033324 total: 4m 7s remaining: 1m 1s
962: learn: 0.0033286 total: 4m 8s remaining: 1m 1s
963: learn: 0.0033221 total: 4m 8s remaining: 1m
964: learn: 0.0033176 total: 4m 8s remaining: 1m
965: learn: 0.0033091 total: 4m 9s remaining: 1m
966: learn: 0.0033064 total: 4m 9s remaining: 1m
967: learn: 0.0033010 total: 4m 9s remaining: 59.8s
968: learn: 0.0032951 total: 4m 9s remaining: 59.6s
969: learn: 0.0032923 total: 4m 10s remaining: 59.3s
970: learn: 0.0032906 total: 4m 10s remaining: 59s
971: learn: 0.0032860 total: 4m 10s remaining: 58.8s
972: learn: 0.0032826 total: 4m 10s remaining: 58.5s
973: learn: 0.0032787 total: 4m 11s remaining: 58.3s
974: learn: 0.0032752 total: 4m 11s remaining: 58s
975: learn: 0.0032707 total: 4m 11s remaining: 57.8s
976: learn: 0.0032682 total: 4m 11s remaining: 57.5s
977: learn: 0.0032666 total: 4m 12s remaining: 57.3s
978: learn: 0.0032640 total: 4m 12s remaining: 57s
979: learn: 0.0032602 total: 4m 12s remaining: 56.7s
980: learn: 0.0032563 total: 4m 13s remaining: 56.5s
981: learn: 0.0032543 total: 4m 13s remaining: 56.2s
982: learn: 0.0032524 total: 4m 13s remaining: 56s
983: learn: 0.0032506 total: 4m 13s remaining: 55.7s
984: learn: 0.0032440 total: 4m 14s remaining: 55.5s
985: learn: 0.0032399 total: 4m 14s remaining: 55.2s
986: learn: 0.0032380 total: 4m 14s remaining: 55s
987: learn: 0.0032310 total: 4m 14s remaining: 54.7s
988: learn: 0.0032254 total: 4m 15s remaining: 54.4s
989: learn: 0.0032233 total: 4m 15s remaining: 54.2s
990: learn: 0.0032191 total: 4m 15s remaining: 53.9s
991: learn: 0.0032159 total: 4m 15s remaining: 53.7s
992: learn: 0.0032102 total: 4m 16s remaining: 53.4s
993: learn: 0.0032080 total: 4m 16s remaining: 53.2s
994: learn: 0.0032046 total: 4m 16s remaining: 52.9s
995: learn: 0.0031999 total: 4m 16s remaining: 52.6s
996: learn: 0.0031937 total: 4m 17s remaining: 52.4s
997: learn: 0.0031893 total: 4m 17s remaining: 52.1s
998: learn: 0.0031867 total: 4m 17s remaining: 51.8s
999: learn: 0.0031855 total: 4m 17s remaining: 51.6s
1000: learn: 0.0031842 total: 4m 18s remaining: 51.3s
1001: learn: 0.0031780 total: 4m 18s remaining: 51s
1002: learn: 0.0031749 total: 4m 18s remaining: 50.8s
1003: learn: 0.0031708 total: 4m 18s remaining: 50.5s
1004: learn: 0.0031692 total: 4m 18s remaining: 50.2s
1005: learn: 0.0031667 total: 4m 19s remaining: 50s
```

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1006: learn: 0.0031618 total: 4m 19s remaining: 49.7s
1007: learn: 0.0031581 total: 4m 19s remaining: 49.5s
1008: learn: 0.0031561 total: 4m 19s remaining: 49.2s
1009: learn: 0.0031546 total: 4m 20s remaining: 48.9s
1010: learn: 0.0031521 total: 4m 20s remaining: 48.7s
1011: learn: 0.0031476 total: 4m 20s remaining: 48.4s
1012: learn: 0.0031461 total: 4m 20s remaining: 48.2s
1013: learn: 0.0031441 total: 4m 21s remaining: 47.9s
1014: learn: 0.0031374 total: 4m 21s remaining: 47.6s
1015: learn: 0.0031327 total: 4m 21s remaining: 47.4s
1016: learn: 0.0031296 total: 4m 21s remaining: 47.1s
1017: learn: 0.0031250 total: 4m 21s remaining: 46.8s
1018: learn: 0.0031220 total: 4m 22s remaining: 46.6s
1019: learn: 0.0031198 total: 4m 22s remaining: 46.3s
1020: learn: 0.0031161 total: 4m 22s remaining: 46.1s
1021: learn: 0.0031142 total: 4m 23s remaining: 45.8s
1022: learn: 0.0031112 total: 4m 23s remaining: 45.6s
1023: learn: 0.0031042 total: 4m 23s remaining: 45.3s
1024: learn: 0.0031007 total: 4m 23s remaining: 45.1s
1025: learn: 0.0030976 total: 4m 24s remaining: 44.8s
1026: learn: 0.0030935 total: 4m 24s remaining: 44.5s
1027: learn: 0.0030917 total: 4m 24s remaining: 44.3s
1028: learn: 0.0030884 total: 4m 24s remaining: 44s
1029: learn: 0.0030865 total: 4m 25s remaining: 43.8s
1030: learn: 0.0030854 total: 4m 25s remaining: 43.5s
1031: learn: 0.0030828 total: 4m 25s remaining: 43.3s
1032: learn: 0.0030805 total: 4m 25s remaining: 43s
1033: learn: 0.0030779 total: 4m 26s remaining: 42.7s
1034: learn: 0.0030758 total: 4m 26s remaining: 42.5s
1035: learn: 0.0030740 total: 4m 26s remaining: 42.2s
1036: learn: 0.0030713 total: 4m 27s remaining: 42s
1037: learn: 0.0030677 total: 4m 27s remaining: 41.7s
1038: learn: 0.0030632 total: 4m 27s remaining: 41.5s
1039: learn: 0.0030616 total: 4m 27s remaining: 41.2s
1040: learn: 0.0030568 total: 4m 28s remaining: 40.9s
1041: learn: 0.0030446 total: 4m 28s remaining: 40.7s
1042: learn: 0.0030388 total: 4m 28s remaining: 40.4s
1043: learn: 0.0030352 total: 4m 28s remaining: 40.2s
1044: learn: 0.0030330 total: 4m 29s remaining: 39.9s
1045: learn: 0.0030267 total: 4m 29s remaining: 39.7s
1046: learn: 0.0030237 total: 4m 29s remaining: 39.4s
1047: learn: 0.0030203 total: 4m 30s remaining: 39.2s
1048: learn: 0.0030191 total: 4m 30s remaining: 38.9s
1049: learn: 0.0030173 total: 4m 30s remaining: 38.6s
1050: learn: 0.0030131 total: 4m 30s remaining: 38.4s
1051: learn: 0.0030080 total: 4m 31s remaining: 38.1s
1052: learn: 0.0030061 total: 4m 31s remaining: 37.9s
1053: learn: 0.0030036 total: 4m 31s remaining: 37.6s
1054: learn: 0.0029990 total: 4m 31s remaining: 37.4s
1055: learn: 0.0029963 total: 4m 32s remaining: 37.1s
1056: learn: 0.0029918 total: 4m 32s remaining: 36.9s
1057: learn: 0.0029877 total: 4m 32s remaining: 36.6s
1058: learn: 0.0029861 total: 4m 32s remaining: 36.3s
1059: learn: 0.0029826 total: 4m 33s remaining: 36.1s
1060: learn: 0.0029803 total: 4m 33s remaining: 35.8s
1061: learn: 0.0029769 total: 4m 33s remaining: 35.5s
1062: learn: 0.0029747 total: 4m 33s remaining: 35.3s
1063: learn: 0.0029709 total: 4m 34s remaining: 35s
1064: learn: 0.0029665 total: 4m 34s remaining: 34.8s
1065: learn: 0.0029629 total: 4m 34s remaining: 34.5s
1066: learn: 0.0029616 total: 4m 34s remaining: 34.3s
1067: learn: 0.0029605 total: 4m 35s remaining: 34s
1068: learn: 0.0029580 total: 4m 35s remaining: 33.7s
1069: learn: 0.0029557 total: 4m 35s remaining: 33.5s
1070: learn: 0.0029530 total: 4m 35s remaining: 33.2s
1071: learn: 0.0029520 total: 4m 35s remaining: 32.9s
1072: learn: 0.0029485 total: 4m 36s remaining: 32.7s
1073: learn: 0.0029458 total: 4m 36s remaining: 32.4s
1074: learn: 0.0029413 total: 4m 36s remaining: 32.2s
1075: learn: 0.0029396 total: 4m 36s remaining: 31.9s
1076: learn: 0.0029339 total: 4m 37s remaining: 31.6s
1077: learn: 0.0029303 total: 4m 37s remaining: 31.4s
```

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1078: learn: 0.0029267 total: 4m 37s remaining: 31.1s
1079: learn: 0.0029257 total: 4m 37s remaining: 30.9s
1080: learn: 0.0029226 total: 4m 38s remaining: 30.6s
1081: learn: 0.0029210 total: 4m 38s remaining: 30.4s
1082: learn: 0.0029192 total: 4m 38s remaining: 30.1s
1083: learn: 0.0029180 total: 4m 38s remaining: 29.8s
1084: learn: 0.0029166 total: 4m 39s remaining: 29.6s
1085: learn: 0.0029144 total: 4m 39s remaining: 29.3s
1086: learn: 0.0029109 total: 4m 39s remaining: 29.1s
1087: learn: 0.0029048 total: 4m 39s remaining: 28.8s
1088: learn: 0.0029029 total: 4m 40s remaining: 28.6s
1089: learn: 0.0028987 total: 4m 40s remaining: 28.3s
1090: learn: 0.0028931 total: 4m 40s remaining: 28s
1091: learn: 0.0028911 total: 4m 40s remaining: 27.8s
1092: learn: 0.0028877 total: 4m 41s remaining: 27.5s
1093: learn: 0.0028862 total: 4m 41s remaining: 27.3s
1094: learn: 0.0028844 total: 4m 41s remaining: 27s
1095: learn: 0.0028820 total: 4m 42s remaining: 26.8s
1096: learn: 0.0028794 total: 4m 42s remaining: 26.5s
1097: learn: 0.0028773 total: 4m 42s remaining: 26.2s
1098: learn: 0.0028757 total: 4m 42s remaining: 26s
1099: learn: 0.0028734 total: 4m 43s remaining: 25.7s
1100: learn: 0.0028676 total: 4m 43s remaining: 25.5s
1101: learn: 0.0028628 total: 4m 43s remaining: 25.2s
1102: learn: 0.0028573 total: 4m 44s remaining: 25s
1103: learn: 0.0028542 total: 4m 44s remaining: 24.7s
1104: learn: 0.0028530 total: 4m 44s remaining: 24.5s
1105: learn: 0.0028503 total: 4m 44s remaining: 24.2s
1106: learn: 0.0028465 total: 4m 45s remaining: 24s
1107: learn: 0.0028425 total: 4m 45s remaining: 23.7s
1108: learn: 0.0028405 total: 4m 45s remaining: 23.5s
1109: learn: 0.0028377 total: 4m 46s remaining: 23.2s
1110: learn: 0.0028356 total: 4m 46s remaining: 22.9s
1111: learn: 0.0028309 total: 4m 46s remaining: 22.7s
1112: learn: 0.0028274 total: 4m 47s remaining: 22.4s
1113: learn: 0.0028208 total: 4m 47s remaining: 22.2s
1114: learn: 0.0028196 total: 4m 47s remaining: 21.9s
1115: learn: 0.0028178 total: 4m 48s remaining: 21.7s
1116: learn: 0.0028160 total: 4m 48s remaining: 21.4s
1117: learn: 0.0028147 total: 4m 48s remaining: 21.2s
1118: learn: 0.0028130 total: 4m 48s remaining: 20.9s
1119: learn: 0.0028067 total: 4m 49s remaining: 20.6s
1120: learn: 0.0028049 total: 4m 49s remaining: 20.4s
1121: learn: 0.0028020 total: 4m 49s remaining: 20.1s
1122: learn: 0.0027963 total: 4m 49s remaining: 19.9s
1123: learn: 0.0027911 total: 4m 50s remaining: 19.6s
1124: learn: 0.0027856 total: 4m 50s remaining: 19.4s
1125: learn: 0.0027822 total: 4m 50s remaining: 19.1s
1126: learn: 0.0027796 total: 4m 50s remaining: 18.8s
1127: learn: 0.0027770 total: 4m 50s remaining: 18.6s
1128: learn: 0.0027751 total: 4m 51s remaining: 18.3s
1129: learn: 0.0027737 total: 4m 51s remaining: 18.1s
1130: learn: 0.0027703 total: 4m 51s remaining: 17.8s
1131: learn: 0.0027690 total: 4m 51s remaining: 17.5s
1132: learn: 0.0027632 total: 4m 52s remaining: 17.3s
1133: learn: 0.0027603 total: 4m 52s remaining: 17s
1134: learn: 0.0027580 total: 4m 52s remaining: 16.8s
1135: learn: 0.0027560 total: 4m 52s remaining: 16.5s
1136: learn: 0.0027534 total: 4m 52s remaining: 16.2s
1137: learn: 0.0027469 total: 4m 53s remaining: 16s
1138: learn: 0.0027435 total: 4m 53s remaining: 15.7s
1139: learn: 0.0027402 total: 4m 53s remaining: 15.5s
1140: learn: 0.0027365 total: 4m 53s remaining: 15.2s
1141: learn: 0.0027356 total: 4m 54s remaining: 14.9s
1142: learn: 0.0027326 total: 4m 54s remaining: 14.7s
1143: learn: 0.0027308 total: 4m 54s remaining: 14.4s
1144: learn: 0.0027273 total: 4m 54s remaining: 14.2s
1145: learn: 0.0027257 total: 4m 55s remaining: 13.9s
1146: learn: 0.0027249 total: 4m 55s remaining: 13.7s
1147: learn: 0.0027224 total: 4m 55s remaining: 13.4s
1148: learn: 0.0027207 total: 4m 56s remaining: 13.1s
1149: learn: 0.0027196 total: 4m 56s remaining: 12.9s
```

```
1150: learn: 0.0027185 total: 4m 56s remaining: 12.6s
1151: learn: 0.0027169 total: 4m 56s remaining: 12.4s
1152: learn: 0.0027143 total: 4m 57s remaining: 12.1s
1153: learn: 0.0027067 total: 4m 57s remaining: 11.9s
1154: learn: 0.0026992 total: 4m 57s remaining: 11.6s
1155: learn: 0.0026966 total: 4m 57s remaining: 11.3s
1156: learn: 0.0026953 total: 4m 58s remaining: 11.1s
1157: learn: 0.0026932 total: 4m 58s remaining: 10.8s
1158: learn: 0.0026898 total: 4m 58s remaining: 10.6s
1159: learn: 0.0026886 total: 4m 58s remaining: 10.3s
1160: learn: 0.0026875 total: 4m 59s remaining: 10.1s
1161: learn: 0.0026858 total: 4m 59s remaining: 9.79s
1162: learn: 0.0026825 total: 4m 59s remaining: 9.54s
1163: learn: 0.0026796 total: 5m remaining: 9.28s
1164: learn: 0.0026781 total: 5m remaining: 9.02s
1165: learn: 0.0026761 total: 5m remaining: 8.76s
1166: learn: 0.0026744 total: 5m remaining: 8.51s
1167: learn: 0.0026724 total: 5m 1s remaining: 8.25s
1168: learn: 0.0026710 total: 5m 1s remaining: 7.99s
1169: learn: 0.0026688 total: 5m 1s remaining: 7.73s
1170: learn: 0.0026674 total: 5m 1s remaining: 7.47s
1171: learn: 0.0026620 total: 5m 2s remaining: 7.22s
1172: learn: 0.0026573 total: 5m 2s remaining: 6.96s
1173: learn: 0.0026553 total: 5m 2s remaining: 6.7s
1174: learn: 0.0026526 total: 5m 2s remaining: 6.45s
1175: learn: 0.0026485 total: 5m 3s remaining: 6.19s
1176: learn: 0.0026465 total: 5m 3s remaining: 5.93s
1177: learn: 0.0026447 total: 5m 3s remaining: 5.67s
1178: learn: 0.0026396 total: 5m 4s remaining: 5.42s
1179: learn: 0.0026367 total: 5m 4s remaining: 5.16s
1180: learn: 0.0026342 total: 5m 4s remaining: 4.9s
1181: learn: 0.0026299 total: 5m 4s remaining: 4.64s
1182: learn: 0.0026252 total: 5m 5s remaining: 4.38s
1183: learn: 0.0026227 total: 5m 5s remaining: 4.13s
1184: learn: 0.0026208 total: 5m 5s remaining: 3.87s
1185: learn: 0.0026193 total: 5m 5s remaining: 3.61s
1186: learn: 0.0026151 total: 5m 6s remaining: 3.35s
1187: learn: 0.0026135 total: 5m 6s remaining: 3.09s
1188: learn: 0.0026116 total: 5m 6s remaining: 2.83s
1189: learn: 0.0026090 total: 5m 6s remaining: 2.58s
1190: learn: 0.0026042 total: 5m 7s remaining: 2.32s
1191: learn: 0.0026026 total: 5m 7s remaining: 2.06s
1192: learn: 0.0025984 total: 5m 7s remaining: 1.81s
1193: learn: 0.0025971 total: 5m 8s remaining: 1.55s
1194: learn: 0.0025955 total: 5m 8s remaining: 1.29s
1195: learn: 0.0025924 total: 5m 8s remaining: 1.03s
1196: learn: 0.0025903 total: 5m 9s remaining: 775ms
1197: learn: 0.0025883 total: 5m 9s remaining: 517ms
1198: learn: 0.0025869 total: 5m 10s remaining: 259ms
1199: learn: 0.0025845 total: 5m 10s remaining: 0us

---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Input In [51], in <cell line: 2>()
      1 cb.fit(x_train,y_train)
----> 2 scores_train.append(cb.score(x_train, y_train))
      3 scores_test.append(cb.score(x_test, y_test))

NameError: name 'scores_train' is not defined
```

In [52]:

```
cb.score(x_train, y_train)
```

Out[52]:

```
0.9995418948103226
```

In [53]:

```
cb.score(x_test, y_test)
```

Out[53]:

```
0.9948251582144251
```

In [ ]:

```
```

Model Evaluation

In [108]:

```
model=cb
```

In [109]:

```
#predict Train/Test
ytrain_predict = model.predict(x_train)
ytest_predict = model.predict(x_test)
```

In [110]:

```
#Predict Probobality
ytest_predict_prob = model.predict_proba(x_test)
```

In [111]:

```
ytest_predict_prob
```

Out[111]:

```
array([[9.99078217e-01, 9.21782605e-04],
       [9.99999109e-01, 8.90782238e-07],
       [9.99992439e-01, 7.56113820e-06],
       ...,
       [9.95052204e-01, 4.94779613e-03],
       [9.99982276e-01, 1.77237889e-05],
       [9.99662252e-01, 3.37747511e-04]])
```

In [ ]:

```
```

In [ ]:

```
```

In [ ]:

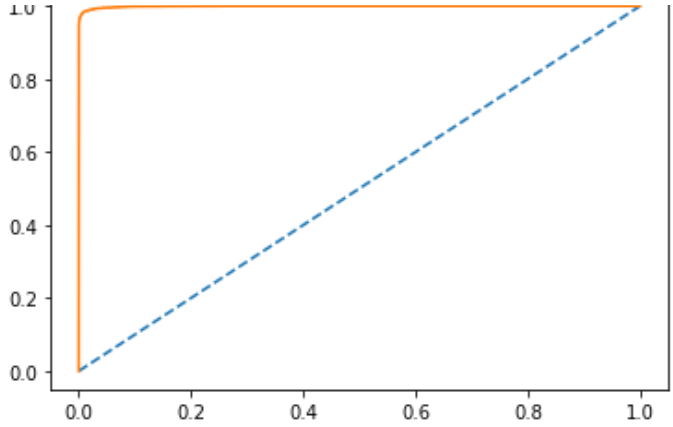
```
```

AUC/ROC,Classification Report for Training data

In [112]:

```
# predict probabilities
probs = model.predict_proba(x_train)
# keep probabilities for the positive outcome only
probs = probs[:, 1]
# calculate AUC
auc = roc_auc_score(y_train, probs)
print('AUC: %.3f' % auc)
# calculate roc curve
train_fpr, train_tpr, train_thresholds = roc_curve(y_train, probs)
plt.plot([0, 1], [0, 1], linestyle='--')
# plot the roc curve for the model
plt.plot(train_fpr, train_tpr);
```

```
AUC: 0.999
```



In [113]:

```
# Accuracy - Train Data
model.score(x_train, y_train)
```

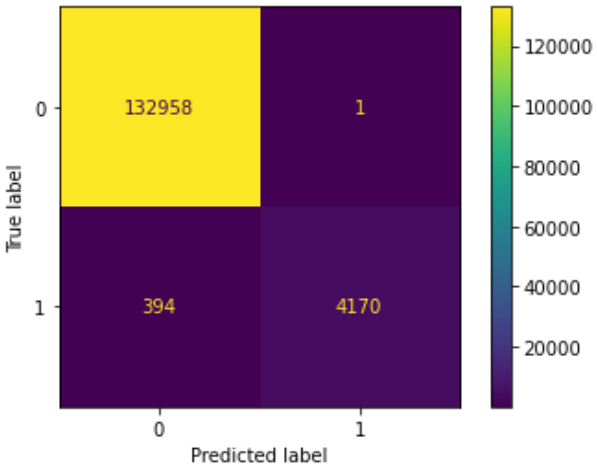
Out[113]:

```
0.9971277531758324
```

In [114]:

```
confusion_matrix(y_train, ytrain_predict)
plot_confusion_matrix(model,x_train,y_train);
```

```
C:\Users\User\anaconda3\lib\site-packages\sklearn\utils\deprecation.py:87: FutureWarning:
Function plot_confusion_matrix is deprecated; Function `plot_confusion_matrix` is depreca
ted in 1.0 and will be removed in 1.2. Use one of the class methods: ConfusionMatrixDispl
ay.from_predictions or ConfusionMatrixDisplay.from_estimator.
  warnings.warn(msg, category=FutureWarning)
```



In [115]:

```
print(classification_report(y_train, ytrain_predict))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00    132959
           1       1.00      0.91      0.95      4564

    accuracy                           1.00    137523
   macro avg       1.00      0.96      0.98    137523
weighted avg       1.00      1.00      1.00    137523
```

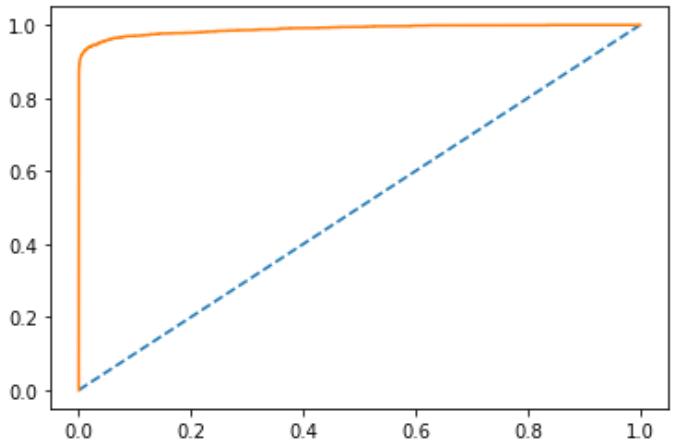
AUC/ROC,Classification Report for Test data

In [116]:

```
# predict probabilities
probs = model.predict_proba(x_test)
```

```
# keep probabilities for the positive outcome only
probs = probs[:, 1]
# calculate AUC
test_auc = roc_auc_score(y_test, probs)
print('AUC: %.3f' % auc)
# calculate roc curve
test_fpr, test_tpr, test_thresholds = roc_curve(y_test, probs)
plt.plot([0, 1], [0, 1], linestyle='--')
# plot the roc curve for the model
plt.plot(test_fpr, test_tpr);
```

```
AUC: 0.999
```



In [117]:

```
# Accuracy - Test Data
model.score(x_test, y_test)
```

Out[117]:

```
0.9954189925176877
```

In [118]:

```
confusion_matrix(y_test, ytest_predict)
```

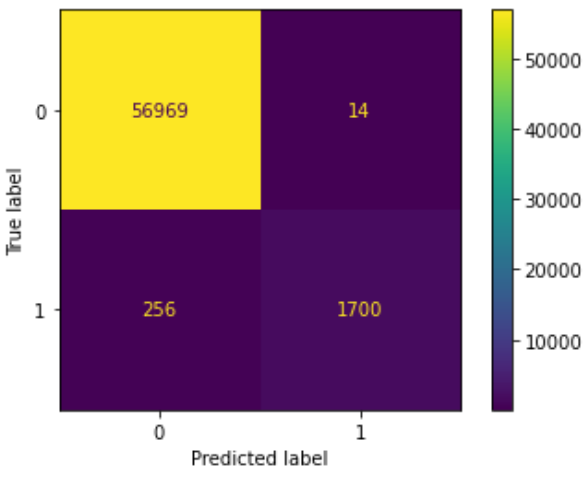
Out[118]:

```
array([[56969,    14],
       [  256,  1700]], dtype=int64)
```

In [119]:

```
plot_confusion_matrix(model,x_test,y_test);
```

```
C:\Users\User\anaconda3\lib\site-packages\sklearn\utils\deprecation.py:87: FutureWarning:
Function plot_confusion_matrix is deprecated; Function `plot_confusion_matrix` is depreca
ted in 1.0 and will be removed in 1.2. Use one of the class methods: ConfusionMatrixDispl
ay.from_predictions or ConfusionMatrixDisplay.from_estimator.
  warnings.warn(msg, category=FutureWarning)
```



In [120]:

```
print(classification_report(y_test, ytest_predict))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00     56983
           1       0.99      0.87      0.93      1956

    accuracy                           1.00     58939
   macro avg       0.99      0.93      0.96     58939
weighted avg       1.00      1.00      1.00     58939
```

In [ ]:

```

```

Selected Model and Submission

In [157]:

```
#final_model=CatBoostClassifier()
#final_model=XGBClassifier()
final_model=RandomForestClassifier()
```

In [158]:

```
final_model.fit(X,y)
```

```
C:\Users\User\AppData\Local\Temp\ipykernel_4628\3155372493.py:1: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().
  final_model.fit(X,y)
```

Out[158]:

```
RandomForestClassifier()
```

In [159]:

```
df_test.shape
```

Out[159]:

```
(28066, 14)
```

In [160]:

```
final_predictions = final_model.predict(df_test)
final_predictions
```

Out[160]:

```
array([0, 0, 0, ..., 0, 0, 1], dtype=int64)
```

In [145]:

```
submission=pd.DataFrame([test_file_ids,final_predictions]).T
submission
```

Out[145]:

	id	Unnamed 0
0	RE-PROV-0000001	0
1	RE-PROV-0000002	0
2	RE-PROV-0000003	0
3	RE-PROV-0000004	0
4	RE-PROV-0000005	0

	id	Unnamed 0
...	...	...
28061	**RE-PROV-0028062**	**0**
28062	**RE-PROV-0028063**	**0**
28063	**RE-PROV-0028064**	**0**
28064	**RE-PROV-0028065**	**0**
28065	**RE-PROV-0028066**	**1**

28066 rows × 2 columns

In [146]:

```
submission.rename(columns={"Unnamed 0": "prediction"},inplace=True)
```

In [147]:

```
submission.prediction.value_counts(normalize=True)
```

Out[147]:

```
0    0.970427
1    0.029573
Name: prediction, dtype: float64
```

In [148]:

```
submission['prediction'] = submission['prediction'].astype('float64')
```

In [149]:

```
submission.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 28066 entries, 0 to 28065
Data columns (total 2 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   id          28066 non-null  object 
 1   prediction  28066 non-null  float64
dtypes: float64(1), object(1)
memory usage: 438.7+ KB
```

In [150]:

```
submission.to_csv('solution.csv',index = False)
```

In [ ]:

```

```

Submission for Probobality of Prediction

In [161]:

```
final_predictions_prob = final_model.predict_proba(df_test)
final_predictions_prob
```

Out[161]:

```
array([[1.  , 0.  ],
       [1.  , 0.  ],
       [0.99, 0.01],
       ...,
       [1.  , 0.  ],
       [0.96, 0.04],
       [0.14, 0.86]])
```

In [162]:

In [162]:

```
df_predict_prob = pd.DataFrame(final_predictions_prob, columns =['Prob-0','prediction'])
df_predict_prob
```

Out[162]:

	Prob-0	prediction
0	1.00	0.00
1	1.00	0.00
2	0.99	0.01
3	1.00	0.00
4	1.00	0.00
...	...	...
28061	0.92	0.08
28062	0.97	0.03
28063	1.00	0.00
28064	0.96	0.04
28065	0.14	0.86

28066 rows × 2 columns

In [163]:

```
#submit_prob=pd.DataFrame([test_file_ids,round(df_predict_prob['prediction'],2)]).T
submit_prob=pd.DataFrame([test_file_ids,df_predict_prob['prediction']]).T
submit_prob
```

Out[163]:

	id	prediction
0	RE-PROV-0000001	0.0
1	RE-PROV-0000002	0.0
2	RE-PROV-0000003	0.01
3	RE-PROV-0000004	0.0
4	RE-PROV-0000005	0.0
...	...	...
28061	RE-PROV-0028062	0.08
28062	RE-PROV-0028063	0.03
28063	RE-PROV-0028064	0.0
28064	RE-PROV-0028065	0.04
28065	RE-PROV-0028066	0.86

28066 rows × 2 columns

In [164]:

```
submit_prob['prediction'] = submit_prob['prediction'].astype('float64')
```

In [165]:

```
submit_prob.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 28066 entries, 0 to 28065
Data columns (total 2 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
```

```
 0   id          28066 non-null  object
 1   prediction  28066 non-null  float64
dtypes: float64(1), object(1)
memory usage: 438.7+ KB
```

In [166]:

```
submit_prob.to_csv('solution.csv',index = False)
```

In [ ]:

```

```