

test1

August 29, 2021

```
[478]: # Warning Libraries :
import warnings
warnings.filterwarnings("ignore")

[479]: # Scientific and Data Manipulation Libraries :
import pandas as pd
import numpy as np
from numpy import percentile
import math
import os
from sklearn.model_selection import train_test_split

[480]: # Data Visualization Libraries :
%matplotlib inline
import seaborn as sns
import matplotlib.pyplot as plt

[481]: #Libraries to convert .las files to .csv and merge

import lasio
import glob ##For merging csv files

[482]: from sklearn.experimental import enable_iterative_imputer
from sklearn.impute import IterativeImputer
from sklearn.impute import KNNImputer
from sklearn.linear_model import LinearRegression

[483]: #Feature Selection Libraries
from sklearn.feature_selection import VarianceThreshold

[484]: #SCALING LIBRARIES
from sklearn.preprocessing import StandardScaler, MinMaxScaler, Normalizer,
↳RobustScaler, MaxAbsScaler

[485]: #MODEL TRAINING LIBRARIES
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Lasso
from catboost import CatBoostRegressor
```

```

from sklearn.ensemble import GradientBoostingRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.svm import SVR
from sklearn.ensemble import VotingRegressor
from sklearn.tree import DecisionTreeRegressor

```

```

[486]: #MODEL ACCURACY LIBRARIES
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error

```

```

[487]: path='/media/mr-robot/Local Disk/summer_training/Train'
os.chdir(path)

```

```

[488]: df = pd.read_csv('merged_data.csv')
df

```

```

[488]:
      DEPTH  ACOUSTICIMPEDANCE1      AI  AVG_PIGN  CALI  \
0    1295.9144      4834.3213  4834321.0      NaN  9.1419
1    1296.0668      4751.9272  4751927.0      NaN  9.2247
2    1296.2192      4777.4341  4777434.5      NaN  9.2680
3    1296.3716      4810.3301  4810330.0      NaN  9.2766
4    1296.5240      4827.2563  4827256.5      NaN  9.2866
...      ...      ...      ...      ...      ...
58494  1622.6028      6069.1309  6069130.5      NaN  8.5257
58495  1622.7552      6067.8120  6067812.0      NaN  8.5282
58496  1622.9076      6105.7729  6105773.0      NaN  8.5313
58497  1623.0600      6152.9897  6152977.5      NaN  8.5331
58498  1623.2124      6157.8291  6157829.5      NaN  8.5338

      CALI[DERIVED]1  DFL      DT  FACIES  FLD1  ...  CALI_1  NPHI_1  \
0           9.1419  1.0697  137.8066      NaN  NaN  ...      NaN      NaN
1           9.2247  1.2028  139.5873      0.0  NaN  ...      NaN      NaN
2           9.2680  1.2145  140.0185      0.0  NaN  ...      NaN      NaN
3           9.2766  1.0487  139.3474      0.0  NaN  ...      NaN      NaN
4           9.2866  0.9479  138.8638      0.0  NaN  ...      NaN      NaN
...      ...      ...      ...      ...      ...
58494           NaN      NaN  123.7404      NaN  NaN  ...      NaN  0.4993
58495           NaN      NaN  123.8728      NaN  NaN  ...      NaN  0.5313
58496           NaN      NaN  123.3722      NaN  NaN  ...      NaN  0.5448
58497           NaN      NaN  122.6038      NaN  NaN  ...      NaN  0.5364
58498           NaN      NaN  122.3045      NaN  NaN  ...      NaN  0.5331

      ZCOR  RHOB_1  RXO  SPDH      DTDS  M2R1  TH  U
0      NaN      NaN  NaN  NaN      NaN      NaN  NaN  NaN
1      NaN      NaN  NaN  NaN      NaN      NaN  NaN  NaN
2      NaN      NaN  NaN  NaN      NaN      NaN  NaN  NaN
3      NaN      NaN  NaN  NaN      NaN      NaN  NaN  NaN

```

```

4      NaN      NaN NaN      NaN      NaN      NaN NaN NaN
...
58494   NaN  2.4639 NaN      NaN  123.7404  1.5970 NaN NaN
58495   NaN  2.4660 NaN      NaN  123.8728  1.6128 NaN NaN
58496   NaN  2.4714 NaN      NaN  123.3722  1.7043 NaN NaN
58497   NaN  2.4750 NaN      NaN  122.6038  1.8375 NaN NaN
58498   NaN  2.4709 NaN      NaN  122.3045  1.9363 NaN NaN

```

[58499 rows x 66 columns]

[489]: df.info()

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 58499 entries, 0 to 58498
Data columns (total 66 columns):
#   Column                                Non-Null Count  Dtype
---  -
0   DEPTH                                58499 non-null  float64
1   ACOUSTICIMPEDANCE1                  58499 non-null  float64
2   AI                                  55259 non-null  float64
3   AVG_PIGN                             323 non-null    float64
4   CALI                                54981 non-null  float64
5   CALI[DERIVED]1                      44090 non-null  float64
6   DFL                                 23458 non-null  float64
7   DT                                  58499 non-null  float64
8   FACIES                              52641 non-null  float64
9   FLD1                                3963 non-null   float64
10  GR                                  58379 non-null  float64
11  HDRS                               26951 non-null  float64
12  HMRS                               26951 non-null  float64
13  DEPTH_1                             50885 non-null  float64
14  NPHI                               58172 non-null  float64
15  ONE-WAYTIME1                        15713 non-null  float64
16  PERF_INT                           1569 non-null   float64
17  PERMEABILITY                        28149 non-null  float64
18  PIGN                                46949 non-null  float64
19  PIGN_MODELLING                      51101 non-null  float64
20  PIMP                                55259 non-null  float64
21  RHOB                                58499 non-null  float64
22  RT_MODELLING                        53629 non-null  float64
23  RT_POWER                            51379 non-null  float64
24  SP                                  55992 non-null  float64
25  SUWI                                46947 non-null  float64
26  SUWI_MODELLING                      51099 non-null  float64
27  TDVSS                              58437 non-null  float64
28  VCL                                 46947 non-null  float64
29  WATER_VOL                          43735 non-null  float64
30  ZLT                                 44562 non-null  float64

```

| | | | |
|----|---------|----------------|---------|
| 31 | LLD | 44942 non-null | float64 |
| 32 | LLS | 27394 non-null | float64 |
| 33 | LL3 | 12373 non-null | float64 |
| 34 | BS | 6706 non-null | float64 |
| 35 | CALI1 | 2389 non-null | float64 |
| 36 | DEVI | 10283 non-null | float64 |
| 37 | DT1 | 6130 non-null | float64 |
| 38 | PHIT | 16532 non-null | float64 |
| 39 | PIGE | 5245 non-null | float64 |
| 40 | LLD_1 | 9518 non-null | float64 |
| 41 | SXWI | 27938 non-null | float64 |
| 42 | PEF | 19419 non-null | float64 |
| 43 | AZI1 | 2487 non-null | float64 |
| 44 | TEMP | 14514 non-null | float64 |
| 45 | DRES | 2765 non-null | float64 |
| 46 | DT2 | 2765 non-null | float64 |
| 47 | DT4P | 5854 non-null | float64 |
| 48 | GR_EDTC | 2765 non-null | float64 |
| 49 | M2R2 | 8568 non-null | float64 |
| 50 | LLS_1 | 238 non-null | float64 |
| 51 | MSFL | 2765 non-null | float64 |
| 52 | PR | 2757 non-null | float64 |
| 53 | TENS | 2765 non-null | float64 |
| 54 | VPVS | 2757 non-null | float64 |
| 55 | BIT | 5553 non-null | float64 |
| 56 | CALI_1 | 2999 non-null | float64 |
| 57 | NPHI_1 | 10811 non-null | float64 |
| 58 | ZCOR | 2998 non-null | float64 |
| 59 | RHOB_1 | 10899 non-null | float64 |
| 60 | RXO | 1552 non-null | float64 |
| 61 | SPDH | 3069 non-null | float64 |
| 62 | DTDS | 2546 non-null | float64 |
| 63 | M2R1 | 2546 non-null | float64 |
| 64 | TH | 2509 non-null | float64 |
| 65 | U | 2509 non-null | float64 |

dtypes: float64(66)

memory usage: 29.5 MB

```
[490]: #Selecting required feature
df=df[["GR","RHOB","NPHI","DT"]]
```

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

```
[491]: GR      120
      RHOB      0
      NPHI    327
      DT       0
```

dtype: int64

```
[492]: df= df.dropna(axis=0)
```

```
[493]: df
```

```
[493]:
```

| | GR | RHOB | NPHI | DT |
|-------|---------|--------|--------|----------|
| 0 | 61.3278 | 2.1857 | 0.5643 | 137.8066 |
| 1 | 61.9954 | 2.1762 | 0.5611 | 139.5873 |
| 2 | 63.5188 | 2.1946 | 0.5630 | 140.0185 |
| 3 | 64.9925 | 2.1992 | 0.5677 | 139.3474 |
| 4 | 65.6985 | 2.1992 | 0.5743 | 138.8638 |
| ... | ... | ... | ... | ... |
| 58461 | 82.2480 | 2.6072 | 0.5111 | 110.8313 |
| 58462 | 81.6189 | 2.5490 | 0.5079 | 110.6059 |
| 58463 | 82.5907 | 2.4944 | 0.4909 | 113.7010 |
| 58464 | 83.2526 | 2.4870 | 0.4823 | 116.2950 |
| 58465 | 82.9096 | 2.5198 | 0.4803 | 115.6295 |

[58097 rows x 4 columns]

```
[495]: x = df.drop("DT",1)
y = df["DT"]
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.2,
↳random_state=4)
```

```
[496]: X_train.shape
```

```
[496]: (46477, 3)
```

```
[497]: def outliers(dataConditioningStrategy,dataframe, y_dataframe,
↳dataconditioningcolumns):
    df=dataframe
    df["y"]=y_dataframe
    if dataConditioningStrategy == "3_Standard_Deviation":
        for column in dataconditioningcolumns:
            print("column",column )
            upperlimit = df[column].mean() + 3*df[column].std()
            lowerlimit = df[column].mean() - 3*df[column].std()

            print("3 standard deviation outliers -:")
            print(df[(df[column] > upperlimit) | (df[column] < lowerlimit)])
            print(df[(df[column] > upperlimit) | (df[column] < lowerlimit)].
↳shape)

            df= df[(df[column] < upperlimit) & (df[column] > lowerlimit)]
            print(df)
```

```

elif dataConditioningStrategy == "4_Standard_Deviation":
    for column in dataconditioningcolumns:
        print("column",column )
        upperlimit = df[column].mean() + 4*df[column].std()
        lowerlimit = df[column].mean() - 4*df[column].std()

        print("4 standard deviation outliers -:")
        print(df[(df[column] > upperlimit) | (df[column] < lowerlimit)])
        print(df[(df[column] > upperlimit) | (df[column] < lowerlimit)].
→shape)

        df= df[(df[column] < upperlimit) & (df[column] > lowerlimit)]
        print(df)

    elif dataConditioningStrategy == "InterquartileRange":
        for column in dataconditioningcolumns:
            print("column",column )
            q25, q75 = percentile(df[column], 25), percentile(df[column], 75)
            iqr = q75 - q25
            print('Percentiles: 25th=%.3f, 75th=%.3f, IQR=%.3f' % (q25, q75,
→iqr))

            cut_off = iqr * 1.5
            lowerlimit, upperlimit = q25 - cut_off, q75 + cut_off

            print("InterQuartile Range Outliers-:")
            print(df[(df[column] > upperlimit) | (df[column] < lowerlimit)])
            print(df[(df[column] > upperlimit) | (df[column] < lowerlimit)].
→shape)

            df= df[(df[column] < upperlimit) & (df[column] > lowerlimit)]
            print(df)

        return df.drop("y",axis=1) , df["y"]

```

[498]: DATAConditioningStrategy =
→["3_Standard_Deviation","4_Standard_Deviation","InterquartileRange"]
DATAConditioningColumns = ["GR","RHOB","NPHI"]
optionoutlier = 0
X_train,y_train = outliers(DATAConditioningStrategy[optionoutlier] , X_train ,
→y_train, DATAConditioningColumns)

column GR

3 standard deviation outliers -:

| | GR | RHOB | NPHI | y |
|-------|----------|--------|--------|----------|
| 38872 | 177.2283 | 2.6526 | 0.5631 | 159.2438 |
| 37912 | 187.7777 | 2.4635 | 0.5864 | 128.4088 |
| 39003 | 185.1136 | 2.4443 | 0.6586 | 147.0338 |
| 37685 | 166.0200 | 2.3162 | 0.6634 | 131.6756 |

| | | | | |
|-------|----------|--------|--------|----------|
| 39289 | 167.0888 | 1.8879 | 0.8120 | 143.4888 |
| ... | ... | ... | ... | ... |
| 37868 | 171.6167 | 2.4143 | 0.5227 | 103.8630 |
| 39152 | 177.3839 | 1.9921 | 0.7775 | 145.7015 |
| 37412 | 169.6837 | 2.4180 | 0.6515 | 156.8676 |
| 39209 | 177.0399 | 2.0120 | 0.7306 | 132.1170 |
| 38963 | 193.1186 | 2.5238 | 0.6102 | 109.3014 |

[1149 rows x 4 columns]
(1149, 4)

| | GR | RHOB | NPHI | y |
|-------|----------|--------|--------|----------|
| 7174 | 54.9827 | 2.4818 | 0.5497 | 100.8784 |
| 34641 | 95.0442 | 2.5565 | 0.5258 | 101.1751 |
| 48215 | 69.2090 | 2.3328 | 0.5124 | 106.7575 |
| 18175 | 67.8533 | 2.4396 | 0.6228 | 119.8530 |
| 50056 | 88.0100 | 2.4424 | 0.4396 | 114.9634 |
| ... | ... | ... | ... | ... |
| 55488 | 103.1246 | 2.5150 | 0.4686 | 98.6188 |
| 50169 | 84.2108 | 2.3961 | 0.4774 | 108.7165 |
| 27063 | 58.8217 | 2.4845 | 0.5033 | 103.9533 |
| 8366 | 69.2729 | 2.0863 | 0.6274 | 147.9099 |
| 17530 | 68.4194 | 2.2210 | 0.3759 | 107.0126 |

[45328 rows x 4 columns]
column RHOB

3 standard deviation outliers -:

| | GR | RHOB | NPHI | y |
|-------|---------|--------|--------|----------|
| 30074 | 59.2786 | 1.0765 | 0.5302 | 41.9701 |
| 52295 | 21.2960 | 1.1319 | 0.6436 | 145.1185 |
| 45811 | 20.5741 | 1.1716 | 0.5891 | 151.3362 |
| 58023 | 29.6655 | 1.1436 | 0.6993 | 152.1691 |
| 24979 | 12.7422 | 1.1715 | 0.9076 | 152.7837 |
| ... | ... | ... | ... | ... |
| 48327 | 16.0175 | 1.1652 | 0.6124 | 148.6804 |
| 1078 | 20.4708 | 1.1724 | 0.9567 | 147.1638 |
| 30067 | 52.1434 | 0.9053 | 0.6049 | 45.4202 |
| 50900 | 19.0558 | 1.1364 | 0.7113 | 150.3924 |
| 30205 | 51.0205 | 1.0330 | 0.5134 | 39.0167 |

[676 rows x 4 columns]
(676, 4)

| | GR | RHOB | NPHI | y |
|-------|---------|--------|--------|----------|
| 7174 | 54.9827 | 2.4818 | 0.5497 | 100.8784 |
| 34641 | 95.0442 | 2.5565 | 0.5258 | 101.1751 |
| 48215 | 69.2090 | 2.3328 | 0.5124 | 106.7575 |
| 18175 | 67.8533 | 2.4396 | 0.6228 | 119.8530 |
| 50056 | 88.0100 | 2.4424 | 0.4396 | 114.9634 |
| ... | ... | ... | ... | ... |

| | | | | |
|-------|----------|--------|--------|----------|
| 55488 | 103.1246 | 2.5150 | 0.4686 | 98.6188 |
| 50169 | 84.2108 | 2.3961 | 0.4774 | 108.7165 |
| 27063 | 58.8217 | 2.4845 | 0.5033 | 103.9533 |
| 8366 | 69.2729 | 2.0863 | 0.6274 | 147.9099 |
| 17530 | 68.4194 | 2.2210 | 0.3759 | 107.0126 |

[44652 rows x 4 columns]

column NPHI

3 standard deviation outliers -:

| | GR | RHOB | NPHI | y |
|-------|----------|--------|---------|----------|
| 14548 | 10.9182 | 1.2070 | 1.0210 | 148.2126 |
| 52087 | 36.8205 | 2.2072 | 0.1976 | 95.5439 |
| 23781 | 31.1632 | 1.4102 | 0.8840 | 140.0048 |
| 24997 | 15.3672 | 1.2002 | 0.9074 | 153.3714 |
| 37306 | 138.7086 | 1.6408 | 0.9094 | 133.6813 |
| ... | ... | ... | ... | ... |
| 18917 | 22.7157 | 1.2346 | 0.9733 | 150.0270 |
| 19123 | 19.1466 | 1.2230 | 0.9875 | 148.9810 |
| 20220 | 0.0000 | 2.1634 | -0.0380 | 125.1803 |
| 1732 | 13.2997 | 1.1853 | 0.9820 | 152.9783 |
| 37290 | 118.3981 | 1.4250 | 1.0000 | 147.8758 |

[720 rows x 4 columns]

(720, 4)

| | GR | RHOB | NPHI | y |
|-------|----------|--------|--------|----------|
| 7174 | 54.9827 | 2.4818 | 0.5497 | 100.8784 |
| 34641 | 95.0442 | 2.5565 | 0.5258 | 101.1751 |
| 48215 | 69.2090 | 2.3328 | 0.5124 | 106.7575 |
| 18175 | 67.8533 | 2.4396 | 0.6228 | 119.8530 |
| 50056 | 88.0100 | 2.4424 | 0.4396 | 114.9634 |
| ... | ... | ... | ... | ... |
| 55488 | 103.1246 | 2.5150 | 0.4686 | 98.6188 |
| 50169 | 84.2108 | 2.3961 | 0.4774 | 108.7165 |
| 27063 | 58.8217 | 2.4845 | 0.5033 | 103.9533 |
| 8366 | 69.2729 | 2.0863 | 0.6274 | 147.9099 |
| 17530 | 68.4194 | 2.2210 | 0.3759 | 107.0126 |

[43932 rows x 4 columns]

[499]: X_train

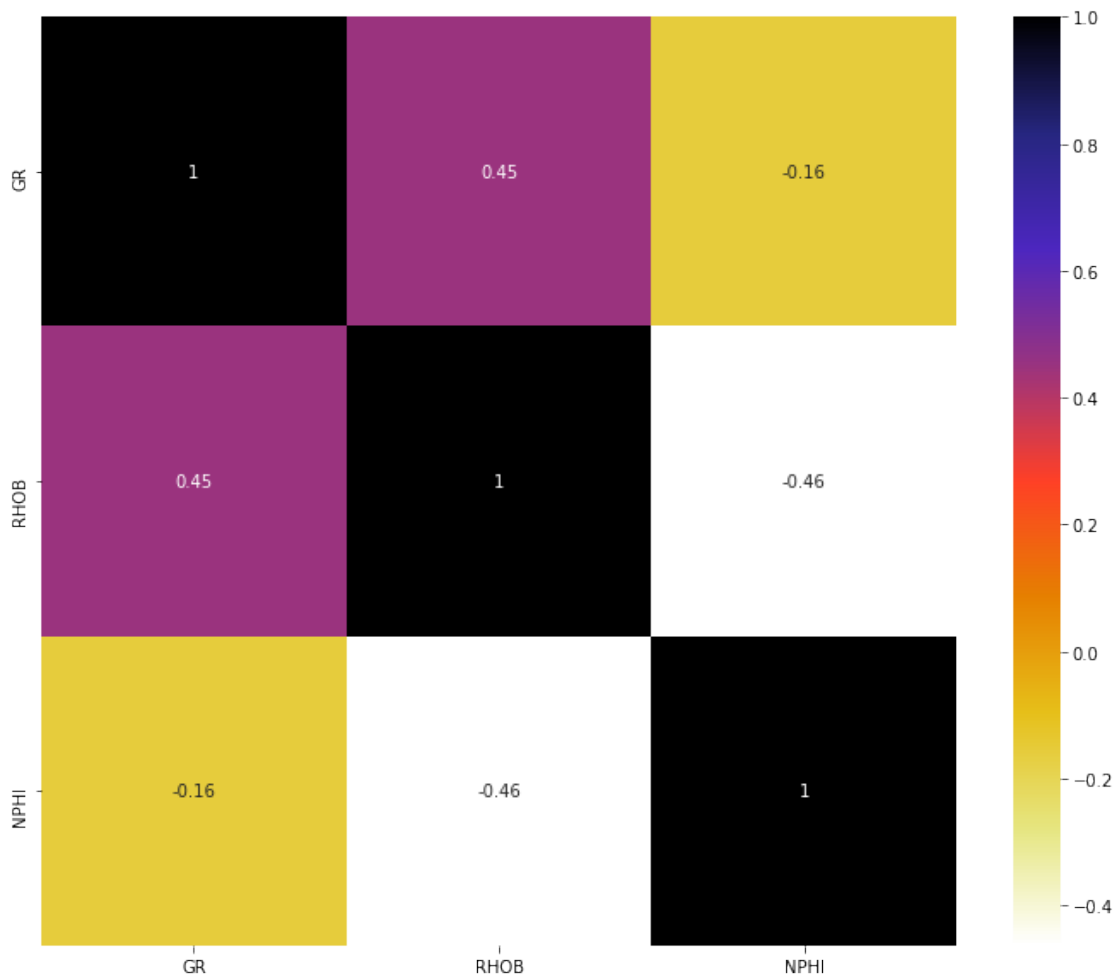
[499]:

| | GR | RHOB | NPHI |
|-------|---------|--------|--------|
| 7174 | 54.9827 | 2.4818 | 0.5497 |
| 34641 | 95.0442 | 2.5565 | 0.5258 |
| 48215 | 69.2090 | 2.3328 | 0.5124 |
| 18175 | 67.8533 | 2.4396 | 0.6228 |
| 50056 | 88.0100 | 2.4424 | 0.4396 |


```
...      ...      ...      ...
55488  103.1246  2.5150  0.4686
50169   84.2108  2.3961  0.4774
27063   58.8217  2.4845  0.5033
8366    69.2729  2.0863  0.6274
17530   68.4194  2.2210  0.3759
```

[43932 rows x 3 columns]

```
[500]: plt.figure(figsize=(12,10))
cor = X_train.corr()
sns.heatmap(cor , annot=True , cmap=plt.cm.CMRmap_r)
plt.show()
```



```
[501]: X_train.var()
```

```
[501]: GR      621.097210
      RHOB      0.093920
      NPHI      0.009019
      dtype: float64
```

```
[502]: X_train.corr()
```

```
[502]:          GR      RHOB      NPHI
GR      1.000000  0.447292 -0.157540
RHOB     0.447292  1.000000 -0.463009
NPHI    -0.157540 -0.463009  1.000000
```

```
[504]: X_train['NPHI2'] = 2 * X_train.NPHI
      X_train.drop('NPHI',1)
```

```
[504]:          GR      RHOB      NPHI2
7174      54.9827  2.4818  1.0994
34641     95.0442  2.5565  1.0516
48215     69.2090  2.3328  1.0248
18175     67.8533  2.4396  1.2456
50056     88.0100  2.4424  0.8792
...
55488    103.1246  2.5150  0.9372
50169     84.2108  2.3961  0.9548
27063     58.8217  2.4845  1.0066
8366      69.2729  2.0863  1.2548
17530     68.4194  2.2210  0.7518
```

[43932 rows x 3 columns]

```
[505]: X_train
```

```
[505]:          GR      RHOB      NPHI      NPHI2
7174      54.9827  2.4818  0.5497  1.0994
34641     95.0442  2.5565  0.5258  1.0516
48215     69.2090  2.3328  0.5124  1.0248
18175     67.8533  2.4396  0.6228  1.2456
50056     88.0100  2.4424  0.4396  0.8792
...
55488    103.1246  2.5150  0.4686  0.9372
50169     84.2108  2.3961  0.4774  0.9548
27063     58.8217  2.4845  0.5033  1.0066
8366      69.2729  2.0863  0.6274  1.2548
17530     68.4194  2.2210  0.3759  0.7518
```

[43932 rows x 4 columns]

```
def data_scaling( scaling_strategy , scaling_data , scaling_columns ):
```

```

if scaling_strategy == "RobustScaler" :
    scaling_data[scaling_columns] = RobustScaler().fit_transform(scaling_data[scaling_columns])

elif scaling_strategy == "MinMaxScaler" :
    scaling_data[scaling_columns] = MinMaxScaler().fit_transform(scaling_data[scaling_columns])

elif scaling_strategy == "StandardScaler" :
    scaling_data[scaling_columns] = StandardScaler().fit_transform(scaling_data[scaling_columns])

else : # If any other scaling send by mistake still perform Robust Scalar
    scaling_data[scaling_columns] = RobustScaler().fit_transform(scaling_data[scaling_columns])

return scaling_data

scaling_strategy = ["RobustScaler", "MinMaxScaler", "StandardScaler"] optionscaling = 0 X_train
= data_scaling( scaling_strategy[optionscaling] , X_train , X_train.columns )

```

[506]: X_train

```

[506]:
      GR      RHOB      NPHI      NPHI2
7174  54.9827  2.4818  0.5497  1.0994
34641  95.0442  2.5565  0.5258  1.0516
48215  69.2090  2.3328  0.5124  1.0248
18175  67.8533  2.4396  0.6228  1.2456
50056  88.0100  2.4424  0.4396  0.8792
...
55488 103.1246  2.5150  0.4686  0.9372
50169  84.2108  2.3961  0.4774  0.9548
27063  58.8217  2.4845  0.5033  1.0066
8366   69.2729  2.0863  0.6274  1.2548
17530  68.4194  2.2210  0.3759  0.7518

```

[43932 rows x 4 columns]

[507]: X_train.corr()

```

[507]:
      GR      RHOB      NPHI      NPHI2
GR      1.000000  0.447292 -0.157540 -0.157540
RHOB    0.447292  1.000000 -0.463009 -0.463009
NPHI   -0.157540 -0.463009  1.000000  1.000000
NPHI2  -0.157540 -0.463009  1.000000  1.000000

```

[508]: X_test,y_test= outliers(DATAConditioningStrategy[optionoutlier] , X_test ,
→ y_test, DATAConditioningColumns)

```

column GR
3 standard deviation outliers -:
      GR      RHOB      NPHI      y
37849 175.6751  2.4016  0.5775 142.2255

```

| | | | | |
|-------|----------|--------|--------|----------|
| 37536 | 168.3488 | 2.2749 | 0.7082 | 132.1620 |
| 39217 | 184.6027 | 2.4462 | 0.5585 | 120.8720 |
| 38482 | 169.4325 | 2.3972 | 0.5975 | 122.9748 |
| 38892 | 210.6389 | 2.4015 | 0.6152 | 146.8278 |
| ... | ... | ... | ... | ... |
| 38529 | 174.2404 | 2.6524 | 0.5968 | 131.5116 |
| 38438 | 175.3356 | 2.5883 | 0.5503 | 123.4890 |
| 38209 | 167.6908 | 2.2047 | 0.5728 | 119.7681 |
| 38614 | 215.1731 | 2.4510 | 0.5954 | 130.6578 |
| 37673 | 169.2242 | 2.3503 | 0.6405 | 126.5171 |

[268 rows x 4 columns]
(268, 4)

| | GR | RHOB | NPHI | y |
|-------|----------|--------|--------|----------|
| 9485 | 81.7370 | 2.3038 | 0.6009 | 131.3419 |
| 17537 | 69.1520 | 2.2208 | 0.3879 | 111.5650 |
| 51851 | 96.9270 | 2.3463 | 0.3173 | 129.8816 |
| 51900 | 89.3109 | 2.4608 | 0.3544 | 109.1182 |
| 18016 | 59.3945 | 2.4996 | 0.5110 | 116.1016 |
| ... | ... | ... | ... | ... |
| 36698 | 146.2150 | 2.1922 | 0.7058 | 143.0331 |
| 23619 | 78.3988 | 2.4924 | 0.5179 | 124.7717 |
| 22116 | 69.6871 | 2.4871 | 0.4940 | 122.9038 |
| 53717 | 84.2177 | 2.2280 | 0.5453 | 127.1126 |
| 22310 | 74.2334 | 2.5713 | 0.4707 | 100.7292 |

[11352 rows x 4 columns]
column RHOB

3 standard deviation outliers -:

| | GR | RHOB | NPHI | y |
|-------|---------|--------|--------|----------|
| 55729 | 32.4591 | 1.0608 | 0.5852 | 147.9725 |
| 30169 | 52.0435 | 1.1398 | 0.5231 | 52.8476 |
| 58118 | 16.3385 | 1.1101 | 0.7049 | 153.0591 |
| 57970 | 15.8033 | 1.0989 | 0.6436 | 153.0778 |
| 30130 | 64.4212 | 1.0831 | 0.5529 | 36.3987 |
| ... | ... | ... | ... | ... |
| 58129 | 17.0859 | 1.0973 | 0.6187 | 152.5417 |
| 55731 | 31.0793 | 1.0589 | 0.6465 | 145.9229 |
| 30133 | 63.9850 | 1.1125 | 0.5336 | 34.8224 |
| 29946 | 61.2440 | 0.9751 | 0.5561 | 33.2426 |
| 30137 | 61.1217 | 1.1144 | 0.5031 | 34.2003 |

[100 rows x 4 columns]
(100, 4)

| | GR | RHOB | NPHI | y |
|-------|---------|--------|--------|----------|
| 9485 | 81.7370 | 2.3038 | 0.6009 | 131.3419 |
| 17537 | 69.1520 | 2.2208 | 0.3879 | 111.5650 |
| 51851 | 96.9270 | 2.3463 | 0.3173 | 129.8816 |

| | | | | |
|-------|----------|--------|--------|----------|
| 51900 | 89.3109 | 2.4608 | 0.3544 | 109.1182 |
| 18016 | 59.3945 | 2.4996 | 0.5110 | 116.1016 |
| ... | ... | ... | ... | ... |
| 36698 | 146.2150 | 2.1922 | 0.7058 | 143.0331 |
| 23619 | 78.3988 | 2.4924 | 0.5179 | 124.7717 |
| 22116 | 69.6871 | 2.4871 | 0.4940 | 122.9038 |
| 53717 | 84.2177 | 2.2280 | 0.5453 | 127.1126 |
| 22310 | 74.2334 | 2.5713 | 0.4707 | 100.7292 |

[11252 rows x 4 columns]

column NPHI

3 standard deviation outliers -:

| | GR | RHOB | NPHI | y |
|-------|----------|--------|---------|----------|
| 20206 | 0.0000 | 2.0817 | 1.0220 | 127.4388 |
| 14522 | 10.8924 | 1.2086 | 0.8916 | 148.2818 |
| 39056 | 136.9001 | 1.3953 | 0.9863 | 148.9868 |
| 38271 | 129.2833 | 1.6065 | 0.9657 | 177.8300 |
| 19495 | 14.4687 | 1.2134 | 0.9673 | 150.9600 |
| ... | ... | ... | ... | ... |
| 38806 | 152.2032 | 1.4683 | 1.1107 | 139.0581 |
| 37285 | 138.8664 | 1.7244 | 0.8842 | 148.5310 |
| 26861 | 19.5026 | 1.2367 | 0.9996 | 149.9351 |
| 20239 | 0.0000 | 2.3781 | -0.0242 | 123.8350 |
| 27506 | 18.4056 | 1.3308 | 1.0105 | 151.0704 |

[187 rows x 4 columns]

(187, 4)

| | GR | RHOB | NPHI | y |
|-------|----------|--------|--------|----------|
| 9485 | 81.7370 | 2.3038 | 0.6009 | 131.3419 |
| 17537 | 69.1520 | 2.2208 | 0.3879 | 111.5650 |
| 51851 | 96.9270 | 2.3463 | 0.3173 | 129.8816 |
| 51900 | 89.3109 | 2.4608 | 0.3544 | 109.1182 |
| 18016 | 59.3945 | 2.4996 | 0.5110 | 116.1016 |
| ... | ... | ... | ... | ... |
| 36698 | 146.2150 | 2.1922 | 0.7058 | 143.0331 |
| 23619 | 78.3988 | 2.4924 | 0.5179 | 124.7717 |
| 22116 | 69.6871 | 2.4871 | 0.4940 | 122.9038 |
| 53717 | 84.2177 | 2.2280 | 0.5453 | 127.1126 |
| 22310 | 74.2334 | 2.5713 | 0.4707 | 100.7292 |

[11065 rows x 4 columns]

X_test = data_scaling(scaling_strategy[optionscaling] , X_test , X_test.columns)

```
[510]: X_test['NPHI2'] = 2 * X_test.NPHI
X_test.drop('NPHI',1)
```

```
[510]:
```

| | GR | RHOB | NPHI2 |
|-------|----------|--------|--------|
| 9485 | 81.7370 | 2.3038 | 1.2018 |
| 17537 | 69.1520 | 2.2208 | 0.7758 |
| 51851 | 96.9270 | 2.3463 | 0.6346 |
| 51900 | 89.3109 | 2.4608 | 0.7088 |
| 18016 | 59.3945 | 2.4996 | 1.0220 |
| ... | ... | ... | ... |
| 36698 | 146.2150 | 2.1922 | 1.4116 |
| 23619 | 78.3988 | 2.4924 | 1.0358 |
| 22116 | 69.6871 | 2.4871 | 0.9880 |
| 53717 | 84.2177 | 2.2280 | 1.0906 |
| 22310 | 74.2334 | 2.5713 | 0.9414 |

[11065 rows x 3 columns]

```
[511]: cat = CatBoostRegressor()
```

```
[512]: cat.fit(X_train,y_train)
```

Learning rate set to 0.076527

| | | | |
|-----|-------------------|---------------|------------------|
| 0: | learn: 25.2606402 | total: 2.99ms | remaining: 2.99s |
| 1: | learn: 24.5182811 | total: 5.73ms | remaining: 2.86s |
| 2: | learn: 23.8395858 | total: 8.19ms | remaining: 2.72s |
| 3: | learn: 23.2385256 | total: 10.6ms | remaining: 2.63s |
| 4: | learn: 22.7179691 | total: 13.4ms | remaining: 2.66s |
| 5: | learn: 22.2549527 | total: 16ms | remaining: 2.65s |
| 6: | learn: 21.8298942 | total: 18.6ms | remaining: 2.64s |
| 7: | learn: 21.4559203 | total: 21.3ms | remaining: 2.64s |
| 8: | learn: 21.1198636 | total: 24.7ms | remaining: 2.72s |
| 9: | learn: 20.8178518 | total: 27.1ms | remaining: 2.69s |
| 10: | learn: 20.5482451 | total: 29.7ms | remaining: 2.67s |
| 11: | learn: 20.3021294 | total: 32ms | remaining: 2.63s |
| 12: | learn: 20.0725712 | total: 34.3ms | remaining: 2.6s |
| 13: | learn: 19.8768744 | total: 36.8ms | remaining: 2.59s |
| 14: | learn: 19.7047498 | total: 39.1ms | remaining: 2.57s |
| 15: | learn: 19.5451385 | total: 41.7ms | remaining: 2.56s |
| 16: | learn: 19.4099704 | total: 44.1ms | remaining: 2.55s |
| 17: | learn: 19.2946994 | total: 46.6ms | remaining: 2.54s |
| 18: | learn: 19.1876368 | total: 49ms | remaining: 2.53s |
| 19: | learn: 19.0818952 | total: 51.4ms | remaining: 2.52s |
| 20: | learn: 18.9195356 | total: 53.7ms | remaining: 2.5s |
| 21: | learn: 18.8230745 | total: 56.1ms | remaining: 2.5s |
| 22: | learn: 18.7161046 | total: 58.8ms | remaining: 2.5s |
| 23: | learn: 18.6273215 | total: 61.3ms | remaining: 2.49s |
| 24: | learn: 18.5548344 | total: 63.4ms | remaining: 2.47s |
| 25: | learn: 18.4899022 | total: 65.7ms | remaining: 2.46s |
| 26: | learn: 18.4276311 | total: 68.6ms | remaining: 2.47s |
| 27: | learn: 18.3854681 | total: 70.9ms | remaining: 2.46s |

| | | | |
|-----|-------------------|---------------|------------------|
| 28: | learn: 18.3360091 | total: 73.3ms | remaining: 2.45s |
| 29: | learn: 18.2881324 | total: 76ms | remaining: 2.46s |
| 30: | learn: 18.2583024 | total: 78.6ms | remaining: 2.46s |
| 31: | learn: 18.2232255 | total: 83ms | remaining: 2.51s |
| 32: | learn: 18.1870360 | total: 85.5ms | remaining: 2.51s |
| 33: | learn: 18.1586554 | total: 88.8ms | remaining: 2.52s |
| 34: | learn: 18.1137372 | total: 91.9ms | remaining: 2.53s |
| 35: | learn: 18.0805202 | total: 94.5ms | remaining: 2.53s |
| 36: | learn: 18.0442266 | total: 96.8ms | remaining: 2.52s |
| 37: | learn: 18.0166694 | total: 102ms | remaining: 2.59s |
| 38: | learn: 17.9887767 | total: 106ms | remaining: 2.61s |
| 39: | learn: 17.9619899 | total: 108ms | remaining: 2.6s |
| 40: | learn: 17.9076870 | total: 111ms | remaining: 2.6s |
| 41: | learn: 17.8817437 | total: 114ms | remaining: 2.6s |
| 42: | learn: 17.8634129 | total: 118ms | remaining: 2.63s |
| 43: | learn: 17.8462470 | total: 121ms | remaining: 2.63s |
| 44: | learn: 17.8256632 | total: 123ms | remaining: 2.61s |
| 45: | learn: 17.8039588 | total: 126ms | remaining: 2.61s |
| 46: | learn: 17.7819908 | total: 128ms | remaining: 2.6s |
| 47: | learn: 17.7668377 | total: 130ms | remaining: 2.59s |
| 48: | learn: 17.6832596 | total: 133ms | remaining: 2.57s |
| 49: | learn: 17.6716885 | total: 135ms | remaining: 2.56s |
| 50: | learn: 17.6575425 | total: 138ms | remaining: 2.56s |
| 51: | learn: 17.6094196 | total: 140ms | remaining: 2.55s |
| 52: | learn: 17.5927654 | total: 142ms | remaining: 2.53s |
| 53: | learn: 17.5795691 | total: 144ms | remaining: 2.52s |
| 54: | learn: 17.5686491 | total: 146ms | remaining: 2.51s |
| 55: | learn: 17.5548442 | total: 148ms | remaining: 2.5s |
| 56: | learn: 17.4829641 | total: 151ms | remaining: 2.5s |
| 57: | learn: 17.4735096 | total: 153ms | remaining: 2.48s |
| 58: | learn: 17.4614874 | total: 155ms | remaining: 2.47s |
| 59: | learn: 17.4539101 | total: 157ms | remaining: 2.46s |
| 60: | learn: 17.4444876 | total: 159ms | remaining: 2.44s |
| 61: | learn: 17.4303535 | total: 161ms | remaining: 2.44s |
| 62: | learn: 17.4005011 | total: 163ms | remaining: 2.42s |
| 63: | learn: 17.3894233 | total: 165ms | remaining: 2.42s |
| 64: | learn: 17.3778731 | total: 169ms | remaining: 2.42s |
| 65: | learn: 17.3651935 | total: 171ms | remaining: 2.42s |
| 66: | learn: 17.3546840 | total: 173ms | remaining: 2.41s |
| 67: | learn: 17.3469494 | total: 176ms | remaining: 2.41s |
| 68: | learn: 17.3357333 | total: 178ms | remaining: 2.4s |
| 69: | learn: 17.3249768 | total: 184ms | remaining: 2.44s |
| 70: | learn: 17.3165088 | total: 187ms | remaining: 2.44s |
| 71: | learn: 17.3080791 | total: 189ms | remaining: 2.44s |
| 72: | learn: 17.3011171 | total: 191ms | remaining: 2.43s |
| 73: | learn: 17.2944967 | total: 194ms | remaining: 2.43s |
| 74: | learn: 17.2854690 | total: 197ms | remaining: 2.42s |
| 75: | learn: 17.2797159 | total: 199ms | remaining: 2.42s |

| | | | |
|------|-------------------|--------------|------------------|
| 76: | learn: 17.2715047 | total: 201ms | remaining: 2.41s |
| 77: | learn: 17.2612371 | total: 204ms | remaining: 2.41s |
| 78: | learn: 17.2568195 | total: 207ms | remaining: 2.41s |
| 79: | learn: 17.2522171 | total: 209ms | remaining: 2.4s |
| 80: | learn: 17.2210807 | total: 211ms | remaining: 2.4s |
| 81: | learn: 17.2160435 | total: 213ms | remaining: 2.39s |
| 82: | learn: 17.2088604 | total: 215ms | remaining: 2.38s |
| 83: | learn: 17.2001394 | total: 218ms | remaining: 2.38s |
| 84: | learn: 17.1944635 | total: 221ms | remaining: 2.38s |
| 85: | learn: 17.1745308 | total: 223ms | remaining: 2.37s |
| 86: | learn: 17.1696745 | total: 226ms | remaining: 2.37s |
| 87: | learn: 17.1621045 | total: 229ms | remaining: 2.37s |
| 88: | learn: 17.1553486 | total: 232ms | remaining: 2.37s |
| 89: | learn: 17.1519035 | total: 234ms | remaining: 2.37s |
| 90: | learn: 17.1432002 | total: 237ms | remaining: 2.37s |
| 91: | learn: 17.1393842 | total: 239ms | remaining: 2.36s |
| 92: | learn: 17.0618262 | total: 241ms | remaining: 2.35s |
| 93: | learn: 17.0166978 | total: 244ms | remaining: 2.35s |
| 94: | learn: 17.0120923 | total: 247ms | remaining: 2.35s |
| 95: | learn: 17.0067371 | total: 249ms | remaining: 2.35s |
| 96: | learn: 16.9987886 | total: 252ms | remaining: 2.34s |
| 97: | learn: 16.9937850 | total: 254ms | remaining: 2.34s |
| 98: | learn: 16.9904981 | total: 257ms | remaining: 2.34s |
| 99: | learn: 16.9878504 | total: 260ms | remaining: 2.34s |
| 100: | learn: 16.9849010 | total: 262ms | remaining: 2.33s |
| 101: | learn: 16.9778814 | total: 264ms | remaining: 2.33s |
| 102: | learn: 16.9715801 | total: 266ms | remaining: 2.32s |
| 103: | learn: 16.9635423 | total: 269ms | remaining: 2.32s |
| 104: | learn: 16.9599972 | total: 271ms | remaining: 2.31s |
| 105: | learn: 16.8923344 | total: 274ms | remaining: 2.31s |
| 106: | learn: 16.8874464 | total: 276ms | remaining: 2.3s |
| 107: | learn: 16.8266031 | total: 278ms | remaining: 2.3s |
| 108: | learn: 16.7715817 | total: 280ms | remaining: 2.29s |
| 109: | learn: 16.7650415 | total: 282ms | remaining: 2.28s |
| 110: | learn: 16.7571283 | total: 285ms | remaining: 2.28s |
| 111: | learn: 16.7547952 | total: 287ms | remaining: 2.28s |
| 112: | learn: 16.7042713 | total: 290ms | remaining: 2.27s |
| 113: | learn: 16.6968713 | total: 292ms | remaining: 2.27s |
| 114: | learn: 16.6912271 | total: 294ms | remaining: 2.27s |
| 115: | learn: 16.6679550 | total: 297ms | remaining: 2.26s |
| 116: | learn: 16.6649748 | total: 299ms | remaining: 2.26s |
| 117: | learn: 16.6603978 | total: 301ms | remaining: 2.25s |
| 118: | learn: 16.6567767 | total: 303ms | remaining: 2.25s |
| 119: | learn: 16.6521799 | total: 306ms | remaining: 2.24s |
| 120: | learn: 16.6487132 | total: 308ms | remaining: 2.23s |
| 121: | learn: 16.6436239 | total: 310ms | remaining: 2.23s |
| 122: | learn: 16.6025401 | total: 312ms | remaining: 2.23s |
| 123: | learn: 16.5982352 | total: 315ms | remaining: 2.22s |

| | | | |
|------|-------------------|--------------|------------------|
| 124: | learn: 16.5927153 | total: 317ms | remaining: 2.22s |
| 125: | learn: 16.5873108 | total: 319ms | remaining: 2.21s |
| 126: | learn: 16.5847020 | total: 322ms | remaining: 2.21s |
| 127: | learn: 16.5798871 | total: 324ms | remaining: 2.21s |
| 128: | learn: 16.5725404 | total: 326ms | remaining: 2.2s |
| 129: | learn: 16.5300666 | total: 328ms | remaining: 2.2s |
| 130: | learn: 16.5253827 | total: 331ms | remaining: 2.19s |
| 131: | learn: 16.5221422 | total: 333ms | remaining: 2.19s |
| 132: | learn: 16.5150683 | total: 335ms | remaining: 2.18s |
| 133: | learn: 16.5130089 | total: 337ms | remaining: 2.18s |
| 134: | learn: 16.4881421 | total: 339ms | remaining: 2.17s |
| 135: | learn: 16.4809585 | total: 341ms | remaining: 2.17s |
| 136: | learn: 16.4777168 | total: 344ms | remaining: 2.17s |
| 137: | learn: 16.4696833 | total: 346ms | remaining: 2.16s |
| 138: | learn: 16.4677249 | total: 348ms | remaining: 2.16s |
| 139: | learn: 16.4418538 | total: 350ms | remaining: 2.15s |
| 140: | learn: 16.4019855 | total: 352ms | remaining: 2.15s |
| 141: | learn: 16.3988937 | total: 355ms | remaining: 2.15s |
| 142: | learn: 16.3969460 | total: 357ms | remaining: 2.14s |
| 143: | learn: 16.3678646 | total: 360ms | remaining: 2.14s |
| 144: | learn: 16.3360175 | total: 362ms | remaining: 2.13s |
| 145: | learn: 16.3297248 | total: 365ms | remaining: 2.13s |
| 146: | learn: 16.3239245 | total: 367ms | remaining: 2.13s |
| 147: | learn: 16.3089935 | total: 370ms | remaining: 2.13s |
| 148: | learn: 16.2797013 | total: 373ms | remaining: 2.13s |
| 149: | learn: 16.2762265 | total: 375ms | remaining: 2.12s |
| 150: | learn: 16.2713135 | total: 377ms | remaining: 2.12s |
| 151: | learn: 16.2657558 | total: 380ms | remaining: 2.12s |
| 152: | learn: 16.2561764 | total: 383ms | remaining: 2.12s |
| 153: | learn: 16.2530079 | total: 385ms | remaining: 2.12s |
| 154: | learn: 16.2504130 | total: 388ms | remaining: 2.12s |
| 155: | learn: 16.2481253 | total: 390ms | remaining: 2.11s |
| 156: | learn: 16.2457755 | total: 393ms | remaining: 2.11s |
| 157: | learn: 16.2433113 | total: 395ms | remaining: 2.1s |
| 158: | learn: 16.2401635 | total: 397ms | remaining: 2.1s |
| 159: | learn: 16.2316308 | total: 399ms | remaining: 2.1s |
| 160: | learn: 16.2292484 | total: 401ms | remaining: 2.09s |
| 161: | learn: 16.2259961 | total: 406ms | remaining: 2.1s |
| 162: | learn: 16.2202651 | total: 408ms | remaining: 2.1s |
| 163: | learn: 16.2080800 | total: 411ms | remaining: 2.09s |
| 164: | learn: 16.2038412 | total: 413ms | remaining: 2.09s |
| 165: | learn: 16.1769125 | total: 415ms | remaining: 2.08s |
| 166: | learn: 16.1669900 | total: 417ms | remaining: 2.08s |
| 167: | learn: 16.1649132 | total: 419ms | remaining: 2.08s |
| 168: | learn: 16.1627418 | total: 421ms | remaining: 2.07s |
| 169: | learn: 16.1608933 | total: 423ms | remaining: 2.07s |
| 170: | learn: 16.1574464 | total: 425ms | remaining: 2.06s |
| 171: | learn: 16.1523677 | total: 427ms | remaining: 2.06s |

| | | | |
|------|-------------------|--------------|------------------|
| 172: | learn: 16.1478346 | total: 429ms | remaining: 2.05s |
| 173: | learn: 16.1451890 | total: 431ms | remaining: 2.05s |
| 174: | learn: 16.1374403 | total: 434ms | remaining: 2.05s |
| 175: | learn: 16.1320345 | total: 437ms | remaining: 2.04s |
| 176: | learn: 16.1277806 | total: 439ms | remaining: 2.04s |
| 177: | learn: 16.0984985 | total: 441ms | remaining: 2.04s |
| 178: | learn: 16.0930252 | total: 443ms | remaining: 2.03s |
| 179: | learn: 16.0908833 | total: 445ms | remaining: 2.03s |
| 180: | learn: 16.0866395 | total: 447ms | remaining: 2.02s |
| 181: | learn: 16.0841889 | total: 449ms | remaining: 2.02s |
| 182: | learn: 16.0825320 | total: 452ms | remaining: 2.02s |
| 183: | learn: 16.0782263 | total: 454ms | remaining: 2.01s |
| 184: | learn: 16.0734274 | total: 457ms | remaining: 2.01s |
| 185: | learn: 16.0694064 | total: 459ms | remaining: 2.01s |
| 186: | learn: 16.0667290 | total: 461ms | remaining: 2s |
| 187: | learn: 16.0646336 | total: 464ms | remaining: 2s |
| 188: | learn: 16.0628837 | total: 466ms | remaining: 2s |
| 189: | learn: 16.0605866 | total: 468ms | remaining: 2s |
| 190: | learn: 16.0535878 | total: 470ms | remaining: 1.99s |
| 191: | learn: 16.0316229 | total: 473ms | remaining: 1.99s |
| 192: | learn: 16.0304019 | total: 475ms | remaining: 1.98s |
| 193: | learn: 16.0271339 | total: 477ms | remaining: 1.98s |
| 194: | learn: 16.0225868 | total: 479ms | remaining: 1.98s |
| 195: | learn: 16.0201365 | total: 482ms | remaining: 1.98s |
| 196: | learn: 16.0181522 | total: 484ms | remaining: 1.97s |
| 197: | learn: 16.0158148 | total: 486ms | remaining: 1.97s |
| 198: | learn: 16.0141342 | total: 488ms | remaining: 1.96s |
| 199: | learn: 16.0102469 | total: 490ms | remaining: 1.96s |
| 200: | learn: 16.0071620 | total: 492ms | remaining: 1.96s |
| 201: | learn: 16.0053426 | total: 494ms | remaining: 1.95s |
| 202: | learn: 15.9933941 | total: 496ms | remaining: 1.95s |
| 203: | learn: 15.9836858 | total: 499ms | remaining: 1.95s |
| 204: | learn: 15.9789229 | total: 501ms | remaining: 1.94s |
| 205: | learn: 15.9562330 | total: 503ms | remaining: 1.94s |
| 206: | learn: 15.9501166 | total: 505ms | remaining: 1.94s |
| 207: | learn: 15.9457552 | total: 507ms | remaining: 1.93s |
| 208: | learn: 15.9439505 | total: 510ms | remaining: 1.93s |
| 209: | learn: 15.9393766 | total: 512ms | remaining: 1.93s |
| 210: | learn: 15.9374576 | total: 514ms | remaining: 1.92s |
| 211: | learn: 15.9281252 | total: 516ms | remaining: 1.92s |
| 212: | learn: 15.9242739 | total: 518ms | remaining: 1.91s |
| 213: | learn: 15.9181533 | total: 520ms | remaining: 1.91s |
| 214: | learn: 15.9150469 | total: 523ms | remaining: 1.91s |
| 215: | learn: 15.9135435 | total: 525ms | remaining: 1.91s |
| 216: | learn: 15.9107817 | total: 528ms | remaining: 1.9s |
| 217: | learn: 15.9080733 | total: 530ms | remaining: 1.9s |
| 218: | learn: 15.9070579 | total: 532ms | remaining: 1.9s |
| 219: | learn: 15.9043632 | total: 534ms | remaining: 1.89s |

| | | | |
|------|-------------------|--------------|------------------|
| 220: | learn: 15.9004499 | total: 536ms | remaining: 1.89s |
| 221: | learn: 15.8988959 | total: 539ms | remaining: 1.89s |
| 222: | learn: 15.8968526 | total: 541ms | remaining: 1.88s |
| 223: | learn: 15.8950112 | total: 543ms | remaining: 1.88s |
| 224: | learn: 15.8931381 | total: 546ms | remaining: 1.88s |
| 225: | learn: 15.8880664 | total: 549ms | remaining: 1.88s |
| 226: | learn: 15.8865282 | total: 551ms | remaining: 1.88s |
| 227: | learn: 15.8843110 | total: 554ms | remaining: 1.88s |
| 228: | learn: 15.8665355 | total: 557ms | remaining: 1.87s |
| 229: | learn: 15.8541769 | total: 560ms | remaining: 1.88s |
| 230: | learn: 15.8513469 | total: 563ms | remaining: 1.87s |
| 231: | learn: 15.8454595 | total: 565ms | remaining: 1.87s |
| 232: | learn: 15.8376123 | total: 567ms | remaining: 1.87s |
| 233: | learn: 15.8334424 | total: 570ms | remaining: 1.86s |
| 234: | learn: 15.8303671 | total: 572ms | remaining: 1.86s |
| 235: | learn: 15.8271626 | total: 574ms | remaining: 1.86s |
| 236: | learn: 15.8248562 | total: 576ms | remaining: 1.85s |
| 237: | learn: 15.8190797 | total: 578ms | remaining: 1.85s |
| 238: | learn: 15.8154112 | total: 580ms | remaining: 1.85s |
| 239: | learn: 15.8112508 | total: 583ms | remaining: 1.84s |
| 240: | learn: 15.8063756 | total: 585ms | remaining: 1.84s |
| 241: | learn: 15.8049870 | total: 587ms | remaining: 1.84s |
| 242: | learn: 15.8009064 | total: 589ms | remaining: 1.83s |
| 243: | learn: 15.7979872 | total: 591ms | remaining: 1.83s |
| 244: | learn: 15.7964216 | total: 593ms | remaining: 1.83s |
| 245: | learn: 15.7810012 | total: 595ms | remaining: 1.82s |
| 246: | learn: 15.7798171 | total: 597ms | remaining: 1.82s |
| 247: | learn: 15.7756655 | total: 600ms | remaining: 1.82s |
| 248: | learn: 15.7738459 | total: 602ms | remaining: 1.81s |
| 249: | learn: 15.7725436 | total: 604ms | remaining: 1.81s |
| 250: | learn: 15.7581069 | total: 606ms | remaining: 1.81s |
| 251: | learn: 15.7534072 | total: 608ms | remaining: 1.8s |
| 252: | learn: 15.7497581 | total: 610ms | remaining: 1.8s |
| 253: | learn: 15.7479987 | total: 612ms | remaining: 1.8s |
| 254: | learn: 15.7459644 | total: 614ms | remaining: 1.79s |
| 255: | learn: 15.7428897 | total: 616ms | remaining: 1.79s |
| 256: | learn: 15.7404430 | total: 618ms | remaining: 1.79s |
| 257: | learn: 15.7390616 | total: 620ms | remaining: 1.78s |
| 258: | learn: 15.7375284 | total: 623ms | remaining: 1.78s |
| 259: | learn: 15.7358078 | total: 624ms | remaining: 1.78s |
| 260: | learn: 15.7324053 | total: 627ms | remaining: 1.77s |
| 261: | learn: 15.7309234 | total: 629ms | remaining: 1.77s |
| 262: | learn: 15.7287457 | total: 631ms | remaining: 1.77s |
| 263: | learn: 15.7273884 | total: 633ms | remaining: 1.76s |
| 264: | learn: 15.7236376 | total: 635ms | remaining: 1.76s |
| 265: | learn: 15.7190593 | total: 638ms | remaining: 1.76s |
| 266: | learn: 15.7049850 | total: 640ms | remaining: 1.76s |
| 267: | learn: 15.7031409 | total: 642ms | remaining: 1.75s |

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| 268: | learn: 15.6999561 | total: 644ms | remaining: 1.75s |
| 269: | learn: 15.6969964 | total: 646ms | remaining: 1.75s |
| 270: | learn: 15.6928440 | total: 648ms | remaining: 1.74s |
| 271: | learn: 15.6904301 | total: 651ms | remaining: 1.74s |
| 272: | learn: 15.6892017 | total: 653ms | remaining: 1.74s |
| 273: | learn: 15.6859798 | total: 655ms | remaining: 1.74s |
| 274: | learn: 15.6839666 | total: 657ms | remaining: 1.73s |
| 275: | learn: 15.6707183 | total: 660ms | remaining: 1.73s |
| 276: | learn: 15.6695920 | total: 662ms | remaining: 1.73s |
| 277: | learn: 15.6669277 | total: 664ms | remaining: 1.73s |
| 278: | learn: 15.6657919 | total: 666ms | remaining: 1.72s |
| 279: | learn: 15.6629732 | total: 668ms | remaining: 1.72s |
| 280: | learn: 15.6608092 | total: 670ms | remaining: 1.71s |
| 281: | learn: 15.6586343 | total: 672ms | remaining: 1.71s |
| 282: | learn: 15.6567404 | total: 675ms | remaining: 1.71s |
| 283: | learn: 15.6553587 | total: 677ms | remaining: 1.71s |
| 284: | learn: 15.6547750 | total: 679ms | remaining: 1.7s |
| 285: | learn: 15.6527499 | total: 681ms | remaining: 1.7s |
| 286: | learn: 15.6508793 | total: 683ms | remaining: 1.7s |
| 287: | learn: 15.6479506 | total: 685ms | remaining: 1.69s |
| 288: | learn: 15.6456011 | total: 687ms | remaining: 1.69s |
| 289: | learn: 15.6331843 | total: 689ms | remaining: 1.69s |
| 290: | learn: 15.6297226 | total: 691ms | remaining: 1.68s |
| 291: | learn: 15.6247608 | total: 693ms | remaining: 1.68s |
| 292: | learn: 15.6133502 | total: 695ms | remaining: 1.68s |
| 293: | learn: 15.6125541 | total: 697ms | remaining: 1.67s |
| 294: | learn: 15.6084354 | total: 699ms | remaining: 1.67s |
| 295: | learn: 15.6046649 | total: 701ms | remaining: 1.67s |
| 296: | learn: 15.6034999 | total: 703ms | remaining: 1.67s |
| 297: | learn: 15.6000436 | total: 706ms | remaining: 1.66s |
| 298: | learn: 15.5962962 | total: 708ms | remaining: 1.66s |
| 299: | learn: 15.5855635 | total: 710ms | remaining: 1.66s |
| 300: | learn: 15.5846568 | total: 712ms | remaining: 1.65s |
| 301: | learn: 15.5833296 | total: 714ms | remaining: 1.65s |
| 302: | learn: 15.5793480 | total: 716ms | remaining: 1.65s |
| 303: | learn: 15.5759951 | total: 719ms | remaining: 1.65s |
| 304: | learn: 15.5743770 | total: 721ms | remaining: 1.64s |
| 305: | learn: 15.5645996 | total: 724ms | remaining: 1.64s |
| 306: | learn: 15.5607201 | total: 727ms | remaining: 1.64s |
| 307: | learn: 15.5568251 | total: 729ms | remaining: 1.64s |
| 308: | learn: 15.5470155 | total: 731ms | remaining: 1.63s |
| 309: | learn: 15.5443892 | total: 733ms | remaining: 1.63s |
| 310: | learn: 15.5427245 | total: 735ms | remaining: 1.63s |
| 311: | learn: 15.5405961 | total: 738ms | remaining: 1.63s |
| 312: | learn: 15.5384197 | total: 741ms | remaining: 1.63s |
| 313: | learn: 15.5348009 | total: 743ms | remaining: 1.62s |
| 314: | learn: 15.5333303 | total: 745ms | remaining: 1.62s |
| 315: | learn: 15.5303859 | total: 748ms | remaining: 1.62s |

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| 316: | learn: 15.5213584 | total: 750ms | remaining: 1.61s |
| 317: | learn: 15.5191387 | total: 752ms | remaining: 1.61s |
| 318: | learn: 15.5179669 | total: 754ms | remaining: 1.61s |
| 319: | learn: 15.5170339 | total: 756ms | remaining: 1.61s |
| 320: | learn: 15.5085983 | total: 759ms | remaining: 1.6s |
| 321: | learn: 15.5074088 | total: 761ms | remaining: 1.6s |
| 322: | learn: 15.4994413 | total: 763ms | remaining: 1.6s |
| 323: | learn: 15.4969308 | total: 765ms | remaining: 1.59s |
| 324: | learn: 15.4961297 | total: 767ms | remaining: 1.59s |
| 325: | learn: 15.4948557 | total: 769ms | remaining: 1.59s |
| 326: | learn: 15.4915321 | total: 771ms | remaining: 1.59s |
| 327: | learn: 15.4896229 | total: 773ms | remaining: 1.58s |
| 328: | learn: 15.4873958 | total: 775ms | remaining: 1.58s |
| 329: | learn: 15.4858292 | total: 778ms | remaining: 1.58s |
| 330: | learn: 15.4846347 | total: 780ms | remaining: 1.58s |
| 331: | learn: 15.4834031 | total: 782ms | remaining: 1.57s |
| 332: | learn: 15.4819821 | total: 784ms | remaining: 1.57s |
| 333: | learn: 15.4744255 | total: 786ms | remaining: 1.57s |
| 334: | learn: 15.4678891 | total: 788ms | remaining: 1.56s |
| 335: | learn: 15.4654332 | total: 790ms | remaining: 1.56s |
| 336: | learn: 15.4636341 | total: 792ms | remaining: 1.56s |
| 337: | learn: 15.4609089 | total: 795ms | remaining: 1.56s |
| 338: | learn: 15.4588908 | total: 797ms | remaining: 1.55s |
| 339: | learn: 15.4572269 | total: 799ms | remaining: 1.55s |
| 340: | learn: 15.4558371 | total: 801ms | remaining: 1.55s |
| 341: | learn: 15.4548508 | total: 803ms | remaining: 1.54s |
| 342: | learn: 15.4530503 | total: 805ms | remaining: 1.54s |
| 343: | learn: 15.4508385 | total: 810ms | remaining: 1.54s |
| 344: | learn: 15.4475017 | total: 812ms | remaining: 1.54s |
| 345: | learn: 15.4446871 | total: 814ms | remaining: 1.54s |
| 346: | learn: 15.4428438 | total: 816ms | remaining: 1.54s |
| 347: | learn: 15.4413897 | total: 818ms | remaining: 1.53s |
| 348: | learn: 15.4399195 | total: 820ms | remaining: 1.53s |
| 349: | learn: 15.4346435 | total: 823ms | remaining: 1.53s |
| 350: | learn: 15.4317576 | total: 825ms | remaining: 1.52s |
| 351: | learn: 15.4272640 | total: 827ms | remaining: 1.52s |
| 352: | learn: 15.4262186 | total: 829ms | remaining: 1.52s |
| 353: | learn: 15.4241624 | total: 832ms | remaining: 1.52s |
| 354: | learn: 15.4223201 | total: 834ms | remaining: 1.51s |
| 355: | learn: 15.4186733 | total: 837ms | remaining: 1.51s |
| 356: | learn: 15.4172936 | total: 839ms | remaining: 1.51s |
| 357: | learn: 15.4143890 | total: 842ms | remaining: 1.51s |
| 358: | learn: 15.4122016 | total: 844ms | remaining: 1.51s |
| 359: | learn: 15.4104712 | total: 847ms | remaining: 1.5s |
| 360: | learn: 15.4093575 | total: 849ms | remaining: 1.5s |
| 361: | learn: 15.4078624 | total: 851ms | remaining: 1.5s |
| 362: | learn: 15.4053139 | total: 854ms | remaining: 1.5s |
| 363: | learn: 15.4032852 | total: 857ms | remaining: 1.5s |

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| 364: | learn: 15.4013175 | total: 859ms | remaining: 1.49s |
| 365: | learn: 15.3993214 | total: 861ms | remaining: 1.49s |
| 366: | learn: 15.3957123 | total: 864ms | remaining: 1.49s |
| 367: | learn: 15.3935595 | total: 866ms | remaining: 1.49s |
| 368: | learn: 15.3918369 | total: 869ms | remaining: 1.49s |
| 369: | learn: 15.3908871 | total: 871ms | remaining: 1.48s |
| 370: | learn: 15.3896281 | total: 873ms | remaining: 1.48s |
| 371: | learn: 15.3864933 | total: 876ms | remaining: 1.48s |
| 372: | learn: 15.3842823 | total: 878ms | remaining: 1.48s |
| 373: | learn: 15.3837103 | total: 881ms | remaining: 1.47s |
| 374: | learn: 15.3811544 | total: 883ms | remaining: 1.47s |
| 375: | learn: 15.3797407 | total: 886ms | remaining: 1.47s |
| 376: | learn: 15.3728499 | total: 888ms | remaining: 1.47s |
| 377: | learn: 15.3707924 | total: 891ms | remaining: 1.47s |
| 378: | learn: 15.3697478 | total: 893ms | remaining: 1.46s |
| 379: | learn: 15.3692715 | total: 896ms | remaining: 1.46s |
| 380: | learn: 15.3671265 | total: 898ms | remaining: 1.46s |
| 381: | learn: 15.3658906 | total: 901ms | remaining: 1.46s |
| 382: | learn: 15.3639540 | total: 905ms | remaining: 1.46s |
| 383: | learn: 15.3609327 | total: 907ms | remaining: 1.46s |
| 384: | learn: 15.3602371 | total: 910ms | remaining: 1.45s |
| 385: | learn: 15.3573793 | total: 912ms | remaining: 1.45s |
| 386: | learn: 15.3552454 | total: 915ms | remaining: 1.45s |
| 387: | learn: 15.3524483 | total: 918ms | remaining: 1.45s |
| 388: | learn: 15.3510377 | total: 921ms | remaining: 1.45s |
| 389: | learn: 15.3490877 | total: 923ms | remaining: 1.44s |
| 390: | learn: 15.3463404 | total: 926ms | remaining: 1.44s |
| 391: | learn: 15.3455373 | total: 928ms | remaining: 1.44s |
| 392: | learn: 15.3447927 | total: 931ms | remaining: 1.44s |
| 393: | learn: 15.3427377 | total: 933ms | remaining: 1.44s |
| 394: | learn: 15.3396640 | total: 936ms | remaining: 1.43s |
| 395: | learn: 15.3383938 | total: 939ms | remaining: 1.43s |
| 396: | learn: 15.3374824 | total: 941ms | remaining: 1.43s |
| 397: | learn: 15.3360682 | total: 944ms | remaining: 1.43s |
| 398: | learn: 15.3350372 | total: 946ms | remaining: 1.43s |
| 399: | learn: 15.3328554 | total: 949ms | remaining: 1.42s |
| 400: | learn: 15.3314864 | total: 951ms | remaining: 1.42s |
| 401: | learn: 15.3302343 | total: 954ms | remaining: 1.42s |
| 402: | learn: 15.3288335 | total: 956ms | remaining: 1.42s |
| 403: | learn: 15.3247202 | total: 959ms | remaining: 1.42s |
| 404: | learn: 15.3239641 | total: 962ms | remaining: 1.41s |
| 405: | learn: 15.3224810 | total: 965ms | remaining: 1.41s |
| 406: | learn: 15.3160258 | total: 967ms | remaining: 1.41s |
| 407: | learn: 15.3151136 | total: 969ms | remaining: 1.41s |
| 408: | learn: 15.3140270 | total: 972ms | remaining: 1.4s |
| 409: | learn: 15.3118217 | total: 975ms | remaining: 1.4s |
| 410: | learn: 15.3104600 | total: 977ms | remaining: 1.4s |
| 411: | learn: 15.3089561 | total: 980ms | remaining: 1.4s |

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| 412: | learn: 15.3080945 | total: 982ms | remaining: 1.4s |
| 413: | learn: 15.3060446 | total: 985ms | remaining: 1.39s |
| 414: | learn: 15.3048939 | total: 987ms | remaining: 1.39s |
| 415: | learn: 15.3033023 | total: 989ms | remaining: 1.39s |
| 416: | learn: 15.3014968 | total: 993ms | remaining: 1.39s |
| 417: | learn: 15.3006729 | total: 995ms | remaining: 1.39s |
| 418: | learn: 15.2998174 | total: 998ms | remaining: 1.38s |
| 419: | learn: 15.2986051 | total: 1000ms | remaining: 1.38s |
| 420: | learn: 15.2974355 | total: 1s | remaining: 1.38s |
| 421: | learn: 15.2928285 | total: 1s | remaining: 1.38s |
| 422: | learn: 15.2910636 | total: 1.01s | remaining: 1.38s |
| 423: | learn: 15.2893189 | total: 1.01s | remaining: 1.37s |
| 424: | learn: 15.2878739 | total: 1.01s | remaining: 1.37s |
| 425: | learn: 15.2851378 | total: 1.01s | remaining: 1.37s |
| 426: | learn: 15.2838609 | total: 1.02s | remaining: 1.37s |
| 427: | learn: 15.2832484 | total: 1.02s | remaining: 1.36s |
| 428: | learn: 15.2818336 | total: 1.02s | remaining: 1.36s |
| 429: | learn: 15.2800875 | total: 1.03s | remaining: 1.36s |
| 430: | learn: 15.2789676 | total: 1.03s | remaining: 1.36s |
| 431: | learn: 15.2776599 | total: 1.03s | remaining: 1.35s |
| 432: | learn: 15.2753643 | total: 1.03s | remaining: 1.35s |
| 433: | learn: 15.2744823 | total: 1.03s | remaining: 1.35s |
| 434: | learn: 15.2725997 | total: 1.04s | remaining: 1.35s |
| 435: | learn: 15.2703665 | total: 1.04s | remaining: 1.34s |
| 436: | learn: 15.2678545 | total: 1.04s | remaining: 1.34s |
| 437: | learn: 15.2666464 | total: 1.04s | remaining: 1.34s |
| 438: | learn: 15.2658150 | total: 1.05s | remaining: 1.34s |
| 439: | learn: 15.2629666 | total: 1.05s | remaining: 1.34s |
| 440: | learn: 15.2604224 | total: 1.05s | remaining: 1.33s |
| 441: | learn: 15.2598785 | total: 1.05s | remaining: 1.33s |
| 442: | learn: 15.2588534 | total: 1.06s | remaining: 1.33s |
| 443: | learn: 15.2533048 | total: 1.06s | remaining: 1.33s |
| 444: | learn: 15.2480721 | total: 1.06s | remaining: 1.32s |
| 445: | learn: 15.2457345 | total: 1.06s | remaining: 1.32s |
| 446: | learn: 15.2416788 | total: 1.07s | remaining: 1.32s |
| 447: | learn: 15.2382763 | total: 1.07s | remaining: 1.32s |
| 448: | learn: 15.2369114 | total: 1.07s | remaining: 1.31s |
| 449: | learn: 15.2343746 | total: 1.07s | remaining: 1.31s |
| 450: | learn: 15.2326878 | total: 1.08s | remaining: 1.31s |
| 451: | learn: 15.2316598 | total: 1.08s | remaining: 1.31s |
| 452: | learn: 15.2280480 | total: 1.08s | remaining: 1.3s |
| 453: | learn: 15.2269187 | total: 1.08s | remaining: 1.31s |
| 454: | learn: 15.2244967 | total: 1.09s | remaining: 1.3s |
| 455: | learn: 15.2227627 | total: 1.09s | remaining: 1.3s |
| 456: | learn: 15.2213935 | total: 1.09s | remaining: 1.3s |
| 457: | learn: 15.2207103 | total: 1.1s | remaining: 1.3s |
| 458: | learn: 15.2181583 | total: 1.1s | remaining: 1.29s |
| 459: | learn: 15.2160766 | total: 1.1s | remaining: 1.29s |

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| 460: | learn: 15.2143693 | total: 1.1s | remaining: 1.29s |
| 461: | learn: 15.2109453 | total: 1.1s | remaining: 1.29s |
| 462: | learn: 15.2094301 | total: 1.11s | remaining: 1.28s |
| 463: | learn: 15.2059163 | total: 1.11s | remaining: 1.28s |
| 464: | learn: 15.2034548 | total: 1.11s | remaining: 1.28s |
| 465: | learn: 15.2008755 | total: 1.11s | remaining: 1.28s |
| 466: | learn: 15.1972562 | total: 1.12s | remaining: 1.27s |
| 467: | learn: 15.1952488 | total: 1.12s | remaining: 1.27s |
| 468: | learn: 15.1904293 | total: 1.12s | remaining: 1.27s |
| 469: | learn: 15.1888043 | total: 1.12s | remaining: 1.27s |
| 470: | learn: 15.1879982 | total: 1.13s | remaining: 1.26s |
| 471: | learn: 15.1868288 | total: 1.13s | remaining: 1.26s |
| 472: | learn: 15.1855254 | total: 1.13s | remaining: 1.26s |
| 473: | learn: 15.1841167 | total: 1.13s | remaining: 1.26s |
| 474: | learn: 15.1817987 | total: 1.13s | remaining: 1.25s |
| 475: | learn: 15.1809860 | total: 1.14s | remaining: 1.25s |
| 476: | learn: 15.1795507 | total: 1.14s | remaining: 1.25s |
| 477: | learn: 15.1761026 | total: 1.14s | remaining: 1.25s |
| 478: | learn: 15.1741487 | total: 1.14s | remaining: 1.24s |
| 479: | learn: 15.1732006 | total: 1.14s | remaining: 1.24s |
| 480: | learn: 15.1719810 | total: 1.15s | remaining: 1.24s |
| 481: | learn: 15.1701211 | total: 1.15s | remaining: 1.23s |
| 482: | learn: 15.1684935 | total: 1.15s | remaining: 1.23s |
| 483: | learn: 15.1672211 | total: 1.15s | remaining: 1.23s |
| 484: | learn: 15.1658508 | total: 1.16s | remaining: 1.23s |
| 485: | learn: 15.1634838 | total: 1.16s | remaining: 1.22s |
| 486: | learn: 15.1621367 | total: 1.16s | remaining: 1.22s |
| 487: | learn: 15.1600747 | total: 1.16s | remaining: 1.22s |
| 488: | learn: 15.1576999 | total: 1.16s | remaining: 1.22s |
| 489: | learn: 15.1567138 | total: 1.17s | remaining: 1.21s |
| 490: | learn: 15.1543251 | total: 1.17s | remaining: 1.21s |
| 491: | learn: 15.1532295 | total: 1.17s | remaining: 1.21s |
| 492: | learn: 15.1520420 | total: 1.17s | remaining: 1.21s |
| 493: | learn: 15.1460436 | total: 1.18s | remaining: 1.2s |
| 494: | learn: 15.1418365 | total: 1.18s | remaining: 1.2s |
| 495: | learn: 15.1401693 | total: 1.18s | remaining: 1.2s |
| 496: | learn: 15.1391684 | total: 1.18s | remaining: 1.2s |
| 497: | learn: 15.1388636 | total: 1.18s | remaining: 1.19s |
| 498: | learn: 15.1372734 | total: 1.19s | remaining: 1.19s |
| 499: | learn: 15.1355038 | total: 1.19s | remaining: 1.19s |
| 500: | learn: 15.1324849 | total: 1.19s | remaining: 1.19s |
| 501: | learn: 15.1307561 | total: 1.19s | remaining: 1.18s |
| 502: | learn: 15.1300196 | total: 1.19s | remaining: 1.18s |
| 503: | learn: 15.1290645 | total: 1.2s | remaining: 1.18s |
| 504: | learn: 15.1277080 | total: 1.2s | remaining: 1.18s |
| 505: | learn: 15.1269380 | total: 1.2s | remaining: 1.17s |
| 506: | learn: 15.1246325 | total: 1.2s | remaining: 1.17s |
| 507: | learn: 15.1226218 | total: 1.21s | remaining: 1.17s |

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| 508: | learn: 15.1210984 | total: 1.21s | remaining: 1.16s |
| 509: | learn: 15.1191180 | total: 1.21s | remaining: 1.16s |
| 510: | learn: 15.1178356 | total: 1.21s | remaining: 1.16s |
| 511: | learn: 15.1162976 | total: 1.21s | remaining: 1.16s |
| 512: | learn: 15.1155787 | total: 1.22s | remaining: 1.15s |
| 513: | learn: 15.1148611 | total: 1.22s | remaining: 1.15s |
| 514: | learn: 15.1138609 | total: 1.22s | remaining: 1.15s |
| 515: | learn: 15.1122977 | total: 1.22s | remaining: 1.15s |
| 516: | learn: 15.1105222 | total: 1.23s | remaining: 1.14s |
| 517: | learn: 15.1096253 | total: 1.23s | remaining: 1.14s |
| 518: | learn: 15.1083489 | total: 1.23s | remaining: 1.14s |
| 519: | learn: 15.1066507 | total: 1.23s | remaining: 1.14s |
| 520: | learn: 15.1047427 | total: 1.23s | remaining: 1.13s |
| 521: | learn: 15.1036397 | total: 1.24s | remaining: 1.13s |
| 522: | learn: 15.1025547 | total: 1.24s | remaining: 1.13s |
| 523: | learn: 15.1018685 | total: 1.24s | remaining: 1.13s |
| 524: | learn: 15.1013822 | total: 1.24s | remaining: 1.12s |
| 525: | learn: 15.0996379 | total: 1.24s | remaining: 1.12s |
| 526: | learn: 15.0989549 | total: 1.25s | remaining: 1.12s |
| 527: | learn: 15.0975637 | total: 1.25s | remaining: 1.12s |
| 528: | learn: 15.0967529 | total: 1.25s | remaining: 1.11s |
| 529: | learn: 15.0959262 | total: 1.25s | remaining: 1.11s |
| 530: | learn: 15.0934485 | total: 1.25s | remaining: 1.11s |
| 531: | learn: 15.0921081 | total: 1.26s | remaining: 1.1s |
| 532: | learn: 15.0910992 | total: 1.26s | remaining: 1.1s |
| 533: | learn: 15.0903048 | total: 1.26s | remaining: 1.1s |
| 534: | learn: 15.0876811 | total: 1.26s | remaining: 1.1s |
| 535: | learn: 15.0858875 | total: 1.27s | remaining: 1.1s |
| 536: | learn: 15.0807783 | total: 1.27s | remaining: 1.09s |
| 537: | learn: 15.0797760 | total: 1.27s | remaining: 1.09s |
| 538: | learn: 15.0770888 | total: 1.27s | remaining: 1.09s |
| 539: | learn: 15.0764443 | total: 1.28s | remaining: 1.09s |
| 540: | learn: 15.0755927 | total: 1.28s | remaining: 1.08s |
| 541: | learn: 15.0749730 | total: 1.28s | remaining: 1.08s |
| 542: | learn: 15.0702326 | total: 1.28s | remaining: 1.08s |
| 543: | learn: 15.0695110 | total: 1.28s | remaining: 1.08s |
| 544: | learn: 15.0676246 | total: 1.29s | remaining: 1.07s |
| 545: | learn: 15.0660507 | total: 1.29s | remaining: 1.07s |
| 546: | learn: 15.0652285 | total: 1.29s | remaining: 1.07s |
| 547: | learn: 15.0647296 | total: 1.29s | remaining: 1.07s |
| 548: | learn: 15.0632425 | total: 1.3s | remaining: 1.06s |
| 549: | learn: 15.0621956 | total: 1.3s | remaining: 1.06s |
| 550: | learn: 15.0607888 | total: 1.3s | remaining: 1.06s |
| 551: | learn: 15.0584543 | total: 1.3s | remaining: 1.06s |
| 552: | learn: 15.0559025 | total: 1.31s | remaining: 1.05s |
| 553: | learn: 15.0553496 | total: 1.31s | remaining: 1.05s |
| 554: | learn: 15.0535723 | total: 1.31s | remaining: 1.05s |
| 555: | learn: 15.0523897 | total: 1.31s | remaining: 1.05s |

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| 556: | learn: 15.0518469 | total: 1.31s | remaining: 1.04s |
| 557: | learn: 15.0510669 | total: 1.32s | remaining: 1.04s |
| 558: | learn: 15.0498329 | total: 1.32s | remaining: 1.04s |
| 559: | learn: 15.0479112 | total: 1.32s | remaining: 1.04s |
| 560: | learn: 15.0466818 | total: 1.32s | remaining: 1.03s |
| 561: | learn: 15.0438954 | total: 1.32s | remaining: 1.03s |
| 562: | learn: 15.0416683 | total: 1.33s | remaining: 1.03s |
| 563: | learn: 15.0401830 | total: 1.33s | remaining: 1.03s |
| 564: | learn: 15.0394151 | total: 1.33s | remaining: 1.02s |
| 565: | learn: 15.0385848 | total: 1.33s | remaining: 1.02s |
| 566: | learn: 15.0377889 | total: 1.34s | remaining: 1.02s |
| 567: | learn: 15.0363979 | total: 1.34s | remaining: 1.02s |
| 568: | learn: 15.0351738 | total: 1.34s | remaining: 1.01s |
| 569: | learn: 15.0341269 | total: 1.34s | remaining: 1.01s |
| 570: | learn: 15.0321261 | total: 1.34s | remaining: 1.01s |
| 571: | learn: 15.0312828 | total: 1.35s | remaining: 1.01s |
| 572: | learn: 15.0296085 | total: 1.35s | remaining: 1s |
| 573: | learn: 15.0284645 | total: 1.35s | remaining: 1s |
| 574: | learn: 15.0266787 | total: 1.35s | remaining: 1s |
| 575: | learn: 15.0255524 | total: 1.35s | remaining: 998ms |
| 576: | learn: 15.0234532 | total: 1.36s | remaining: 996ms |
| 577: | learn: 15.0214475 | total: 1.36s | remaining: 994ms |
| 578: | learn: 15.0203683 | total: 1.36s | remaining: 991ms |
| 579: | learn: 15.0199094 | total: 1.36s | remaining: 989ms |
| 580: | learn: 15.0193040 | total: 1.37s | remaining: 986ms |
| 581: | learn: 15.0183180 | total: 1.37s | remaining: 984ms |
| 582: | learn: 15.0162863 | total: 1.37s | remaining: 981ms |
| 583: | learn: 15.0150224 | total: 1.37s | remaining: 978ms |
| 584: | learn: 15.0135508 | total: 1.38s | remaining: 976ms |
| 585: | learn: 15.0108298 | total: 1.38s | remaining: 974ms |
| 586: | learn: 15.0098976 | total: 1.38s | remaining: 971ms |
| 587: | learn: 15.0089546 | total: 1.38s | remaining: 969ms |
| 588: | learn: 15.0061453 | total: 1.38s | remaining: 966ms |
| 589: | learn: 15.0028643 | total: 1.39s | remaining: 964ms |
| 590: | learn: 15.0009260 | total: 1.39s | remaining: 961ms |
| 591: | learn: 15.0002202 | total: 1.39s | remaining: 959ms |
| 592: | learn: 14.9992597 | total: 1.39s | remaining: 956ms |
| 593: | learn: 14.9985951 | total: 1.4s | remaining: 954ms |
| 594: | learn: 14.9978619 | total: 1.4s | remaining: 952ms |
| 595: | learn: 14.9955181 | total: 1.4s | remaining: 949ms |
| 596: | learn: 14.9939421 | total: 1.4s | remaining: 947ms |
| 597: | learn: 14.9930818 | total: 1.4s | remaining: 944ms |
| 598: | learn: 14.9917927 | total: 1.41s | remaining: 942ms |
| 599: | learn: 14.9901701 | total: 1.41s | remaining: 939ms |
| 600: | learn: 14.9891906 | total: 1.41s | remaining: 937ms |
| 601: | learn: 14.9878021 | total: 1.41s | remaining: 934ms |
| 602: | learn: 14.9865344 | total: 1.42s | remaining: 932ms |
| 603: | learn: 14.9851848 | total: 1.42s | remaining: 929ms |

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| 604: | learn: 14.9844123 | total: 1.42s | remaining: 927ms |
| 605: | learn: 14.9836927 | total: 1.42s | remaining: 925ms |
| 606: | learn: 14.9818385 | total: 1.42s | remaining: 922ms |
| 607: | learn: 14.9803661 | total: 1.43s | remaining: 920ms |
| 608: | learn: 14.9797407 | total: 1.43s | remaining: 917ms |
| 609: | learn: 14.9784899 | total: 1.43s | remaining: 915ms |
| 610: | learn: 14.9772916 | total: 1.43s | remaining: 912ms |
| 611: | learn: 14.9765905 | total: 1.44s | remaining: 910ms |
| 612: | learn: 14.9757792 | total: 1.44s | remaining: 907ms |
| 613: | learn: 14.9747846 | total: 1.44s | remaining: 905ms |
| 614: | learn: 14.9733619 | total: 1.44s | remaining: 903ms |
| 615: | learn: 14.9726267 | total: 1.44s | remaining: 900ms |
| 616: | learn: 14.9704152 | total: 1.45s | remaining: 898ms |
| 617: | learn: 14.9691493 | total: 1.45s | remaining: 896ms |
| 618: | learn: 14.9681035 | total: 1.45s | remaining: 894ms |
| 619: | learn: 14.9665812 | total: 1.45s | remaining: 891ms |
| 620: | learn: 14.9656111 | total: 1.46s | remaining: 889ms |
| 621: | learn: 14.9648926 | total: 1.46s | remaining: 886ms |
| 622: | learn: 14.9634280 | total: 1.46s | remaining: 884ms |
| 623: | learn: 14.9622286 | total: 1.46s | remaining: 881ms |
| 624: | learn: 14.9611159 | total: 1.47s | remaining: 879ms |
| 625: | learn: 14.9595529 | total: 1.47s | remaining: 877ms |
| 626: | learn: 14.9589446 | total: 1.47s | remaining: 875ms |
| 627: | learn: 14.9582551 | total: 1.47s | remaining: 872ms |
| 628: | learn: 14.9564915 | total: 1.48s | remaining: 870ms |
| 629: | learn: 14.9557806 | total: 1.48s | remaining: 868ms |
| 630: | learn: 14.9552221 | total: 1.48s | remaining: 866ms |
| 631: | learn: 14.9544877 | total: 1.48s | remaining: 863ms |
| 632: | learn: 14.9525014 | total: 1.48s | remaining: 861ms |
| 633: | learn: 14.9496706 | total: 1.49s | remaining: 859ms |
| 634: | learn: 14.9487512 | total: 1.49s | remaining: 856ms |
| 635: | learn: 14.9467716 | total: 1.49s | remaining: 854ms |
| 636: | learn: 14.9461464 | total: 1.49s | remaining: 851ms |
| 637: | learn: 14.9450982 | total: 1.5s | remaining: 849ms |
| 638: | learn: 14.9445294 | total: 1.5s | remaining: 846ms |
| 639: | learn: 14.9423657 | total: 1.5s | remaining: 844ms |
| 640: | learn: 14.9415855 | total: 1.5s | remaining: 841ms |
| 641: | learn: 14.9405311 | total: 1.5s | remaining: 839ms |
| 642: | learn: 14.9391196 | total: 1.51s | remaining: 836ms |
| 643: | learn: 14.9374649 | total: 1.51s | remaining: 834ms |
| 644: | learn: 14.9361147 | total: 1.51s | remaining: 832ms |
| 645: | learn: 14.9349273 | total: 1.51s | remaining: 829ms |
| 646: | learn: 14.9317550 | total: 1.51s | remaining: 827ms |
| 647: | learn: 14.9305336 | total: 1.52s | remaining: 824ms |
| 648: | learn: 14.9288166 | total: 1.52s | remaining: 822ms |
| 649: | learn: 14.9281181 | total: 1.52s | remaining: 819ms |
| 650: | learn: 14.9267227 | total: 1.52s | remaining: 817ms |
| 651: | learn: 14.9255491 | total: 1.52s | remaining: 814ms |

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| 652: | learn: 14.9240265 | total: 1.53s | remaining: 812ms |
| 653: | learn: 14.9231284 | total: 1.53s | remaining: 810ms |
| 654: | learn: 14.9220756 | total: 1.53s | remaining: 807ms |
| 655: | learn: 14.9215667 | total: 1.53s | remaining: 805ms |
| 656: | learn: 14.9209220 | total: 1.54s | remaining: 802ms |
| 657: | learn: 14.9203081 | total: 1.54s | remaining: 800ms |
| 658: | learn: 14.9185209 | total: 1.54s | remaining: 798ms |
| 659: | learn: 14.9170937 | total: 1.54s | remaining: 795ms |
| 660: | learn: 14.9152262 | total: 1.54s | remaining: 793ms |
| 661: | learn: 14.9140871 | total: 1.55s | remaining: 790ms |
| 662: | learn: 14.9136432 | total: 1.55s | remaining: 788ms |
| 663: | learn: 14.9126025 | total: 1.55s | remaining: 785ms |
| 664: | learn: 14.9111878 | total: 1.55s | remaining: 783ms |
| 665: | learn: 14.9100451 | total: 1.56s | remaining: 781ms |
| 666: | learn: 14.9090588 | total: 1.56s | remaining: 778ms |
| 667: | learn: 14.9080250 | total: 1.56s | remaining: 776ms |
| 668: | learn: 14.9076467 | total: 1.56s | remaining: 774ms |
| 669: | learn: 14.9067332 | total: 1.56s | remaining: 771ms |
| 670: | learn: 14.9061536 | total: 1.57s | remaining: 769ms |
| 671: | learn: 14.9044780 | total: 1.57s | remaining: 766ms |
| 672: | learn: 14.9038519 | total: 1.57s | remaining: 764ms |
| 673: | learn: 14.9034477 | total: 1.57s | remaining: 761ms |
| 674: | learn: 14.9027315 | total: 1.58s | remaining: 759ms |
| 675: | learn: 14.9016691 | total: 1.58s | remaining: 757ms |
| 676: | learn: 14.9009456 | total: 1.58s | remaining: 754ms |
| 677: | learn: 14.9001551 | total: 1.58s | remaining: 752ms |
| 678: | learn: 14.8988856 | total: 1.58s | remaining: 749ms |
| 679: | learn: 14.8975023 | total: 1.59s | remaining: 747ms |
| 680: | learn: 14.8971245 | total: 1.59s | remaining: 745ms |
| 681: | learn: 14.8952165 | total: 1.59s | remaining: 742ms |
| 682: | learn: 14.8946825 | total: 1.59s | remaining: 740ms |
| 683: | learn: 14.8933979 | total: 1.6s | remaining: 737ms |
| 684: | learn: 14.8922430 | total: 1.6s | remaining: 735ms |
| 685: | learn: 14.8912279 | total: 1.6s | remaining: 733ms |
| 686: | learn: 14.8908531 | total: 1.6s | remaining: 730ms |
| 687: | learn: 14.8898107 | total: 1.6s | remaining: 728ms |
| 688: | learn: 14.8878206 | total: 1.61s | remaining: 725ms |
| 689: | learn: 14.8870153 | total: 1.61s | remaining: 723ms |
| 690: | learn: 14.8864399 | total: 1.61s | remaining: 720ms |
| 691: | learn: 14.8856708 | total: 1.61s | remaining: 718ms |
| 692: | learn: 14.8850155 | total: 1.61s | remaining: 716ms |
| 693: | learn: 14.8843226 | total: 1.62s | remaining: 713ms |
| 694: | learn: 14.8830491 | total: 1.62s | remaining: 711ms |
| 695: | learn: 14.8825069 | total: 1.62s | remaining: 708ms |
| 696: | learn: 14.8789147 | total: 1.62s | remaining: 706ms |
| 697: | learn: 14.8774714 | total: 1.63s | remaining: 704ms |
| 698: | learn: 14.8771473 | total: 1.63s | remaining: 701ms |
| 699: | learn: 14.8766443 | total: 1.63s | remaining: 699ms |

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| 700: | learn: 14.8749156 | total: 1.63s | remaining: 697ms |
| 701: | learn: 14.8724721 | total: 1.64s | remaining: 695ms |
| 702: | learn: 14.8709646 | total: 1.64s | remaining: 692ms |
| 703: | learn: 14.8701378 | total: 1.64s | remaining: 690ms |
| 704: | learn: 14.8695820 | total: 1.64s | remaining: 687ms |
| 705: | learn: 14.8674792 | total: 1.65s | remaining: 685ms |
| 706: | learn: 14.8665184 | total: 1.65s | remaining: 683ms |
| 707: | learn: 14.8649694 | total: 1.65s | remaining: 680ms |
| 708: | learn: 14.8634970 | total: 1.65s | remaining: 678ms |
| 709: | learn: 14.8619770 | total: 1.65s | remaining: 676ms |
| 710: | learn: 14.8614858 | total: 1.66s | remaining: 673ms |
| 711: | learn: 14.8609027 | total: 1.66s | remaining: 671ms |
| 712: | learn: 14.8596019 | total: 1.66s | remaining: 669ms |
| 713: | learn: 14.8575269 | total: 1.66s | remaining: 666ms |
| 714: | learn: 14.8562396 | total: 1.67s | remaining: 664ms |
| 715: | learn: 14.8543102 | total: 1.67s | remaining: 662ms |
| 716: | learn: 14.8515822 | total: 1.67s | remaining: 659ms |
| 717: | learn: 14.8504261 | total: 1.67s | remaining: 657ms |
| 718: | learn: 14.8478886 | total: 1.67s | remaining: 655ms |
| 719: | learn: 14.8466909 | total: 1.68s | remaining: 652ms |
| 720: | learn: 14.8462889 | total: 1.68s | remaining: 650ms |
| 721: | learn: 14.8456247 | total: 1.68s | remaining: 647ms |
| 722: | learn: 14.8446974 | total: 1.68s | remaining: 645ms |
| 723: | learn: 14.8427580 | total: 1.69s | remaining: 643ms |
| 724: | learn: 14.8423413 | total: 1.69s | remaining: 640ms |
| 725: | learn: 14.8409597 | total: 1.69s | remaining: 638ms |
| 726: | learn: 14.8395122 | total: 1.69s | remaining: 636ms |
| 727: | learn: 14.8389156 | total: 1.69s | remaining: 633ms |
| 728: | learn: 14.8376755 | total: 1.7s | remaining: 631ms |
| 729: | learn: 14.8354334 | total: 1.7s | remaining: 628ms |
| 730: | learn: 14.8347857 | total: 1.7s | remaining: 626ms |
| 731: | learn: 14.8342572 | total: 1.7s | remaining: 623ms |
| 732: | learn: 14.8332490 | total: 1.7s | remaining: 621ms |
| 733: | learn: 14.8325174 | total: 1.71s | remaining: 619ms |
| 734: | learn: 14.8320727 | total: 1.71s | remaining: 616ms |
| 735: | learn: 14.8313796 | total: 1.71s | remaining: 614ms |
| 736: | learn: 14.8298750 | total: 1.71s | remaining: 612ms |
| 737: | learn: 14.8284947 | total: 1.72s | remaining: 609ms |
| 738: | learn: 14.8261165 | total: 1.72s | remaining: 607ms |
| 739: | learn: 14.8251391 | total: 1.72s | remaining: 604ms |
| 740: | learn: 14.8240193 | total: 1.72s | remaining: 602ms |
| 741: | learn: 14.8232748 | total: 1.72s | remaining: 600ms |
| 742: | learn: 14.8216319 | total: 1.73s | remaining: 597ms |
| 743: | learn: 14.8206339 | total: 1.73s | remaining: 595ms |
| 744: | learn: 14.8199576 | total: 1.73s | remaining: 593ms |
| 745: | learn: 14.8183165 | total: 1.74s | remaining: 591ms |
| 746: | learn: 14.8173552 | total: 1.74s | remaining: 589ms |
| 747: | learn: 14.8163486 | total: 1.74s | remaining: 587ms |

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| 748: | learn: 14.8153654 | total: 1.74s | remaining: 584ms |
| 749: | learn: 14.8140592 | total: 1.75s | remaining: 582ms |
| 750: | learn: 14.8123755 | total: 1.75s | remaining: 580ms |
| 751: | learn: 14.8109506 | total: 1.75s | remaining: 577ms |
| 752: | learn: 14.8098539 | total: 1.75s | remaining: 575ms |
| 753: | learn: 14.8078847 | total: 1.76s | remaining: 573ms |
| 754: | learn: 14.8070277 | total: 1.76s | remaining: 571ms |
| 755: | learn: 14.8058850 | total: 1.76s | remaining: 568ms |
| 756: | learn: 14.8046358 | total: 1.76s | remaining: 566ms |
| 757: | learn: 14.8029839 | total: 1.76s | remaining: 564ms |
| 758: | learn: 14.8016673 | total: 1.77s | remaining: 561ms |
| 759: | learn: 14.8000743 | total: 1.77s | remaining: 559ms |
| 760: | learn: 14.7959698 | total: 1.77s | remaining: 557ms |
| 761: | learn: 14.7948205 | total: 1.77s | remaining: 554ms |
| 762: | learn: 14.7935814 | total: 1.78s | remaining: 552ms |
| 763: | learn: 14.7926144 | total: 1.78s | remaining: 550ms |
| 764: | learn: 14.7918315 | total: 1.78s | remaining: 548ms |
| 765: | learn: 14.7895492 | total: 1.78s | remaining: 545ms |
| 766: | learn: 14.7885261 | total: 1.79s | remaining: 543ms |
| 767: | learn: 14.7870842 | total: 1.79s | remaining: 541ms |
| 768: | learn: 14.7849535 | total: 1.79s | remaining: 538ms |
| 769: | learn: 14.7831933 | total: 1.79s | remaining: 536ms |
| 770: | learn: 14.7827823 | total: 1.8s | remaining: 534ms |
| 771: | learn: 14.7817514 | total: 1.8s | remaining: 532ms |
| 772: | learn: 14.7809802 | total: 1.8s | remaining: 529ms |
| 773: | learn: 14.7795776 | total: 1.8s | remaining: 527ms |
| 774: | learn: 14.7784704 | total: 1.81s | remaining: 525ms |
| 775: | learn: 14.7751698 | total: 1.81s | remaining: 522ms |
| 776: | learn: 14.7726004 | total: 1.81s | remaining: 520ms |
| 777: | learn: 14.7696472 | total: 1.81s | remaining: 518ms |
| 778: | learn: 14.7680050 | total: 1.82s | remaining: 516ms |
| 779: | learn: 14.7671807 | total: 1.82s | remaining: 513ms |
| 780: | learn: 14.7660740 | total: 1.82s | remaining: 511ms |
| 781: | learn: 14.7647941 | total: 1.82s | remaining: 509ms |
| 782: | learn: 14.7621620 | total: 1.83s | remaining: 506ms |
| 783: | learn: 14.7596533 | total: 1.83s | remaining: 504ms |
| 784: | learn: 14.7592655 | total: 1.83s | remaining: 502ms |
| 785: | learn: 14.7587539 | total: 1.83s | remaining: 500ms |
| 786: | learn: 14.7571103 | total: 1.84s | remaining: 497ms |
| 787: | learn: 14.7564983 | total: 1.84s | remaining: 495ms |
| 788: | learn: 14.7550914 | total: 1.84s | remaining: 493ms |
| 789: | learn: 14.7532974 | total: 1.84s | remaining: 491ms |
| 790: | learn: 14.7519232 | total: 1.85s | remaining: 488ms |
| 791: | learn: 14.7513816 | total: 1.85s | remaining: 486ms |
| 792: | learn: 14.7508119 | total: 1.85s | remaining: 484ms |
| 793: | learn: 14.7500853 | total: 1.86s | remaining: 482ms |
| 794: | learn: 14.7489801 | total: 1.86s | remaining: 479ms |
| 795: | learn: 14.7486342 | total: 1.86s | remaining: 477ms |

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| 796: | learn: 14.7473334 | total: 1.86s | remaining: 475ms |
| 797: | learn: 14.7468687 | total: 1.87s | remaining: 472ms |
| 798: | learn: 14.7464396 | total: 1.87s | remaining: 470ms |
| 799: | learn: 14.7461224 | total: 1.87s | remaining: 468ms |
| 800: | learn: 14.7450447 | total: 1.87s | remaining: 465ms |
| 801: | learn: 14.7439450 | total: 1.88s | remaining: 463ms |
| 802: | learn: 14.7425909 | total: 1.88s | remaining: 461ms |
| 803: | learn: 14.7420496 | total: 1.88s | remaining: 458ms |
| 804: | learn: 14.7415579 | total: 1.88s | remaining: 456ms |
| 805: | learn: 14.7408191 | total: 1.88s | remaining: 454ms |
| 806: | learn: 14.7399044 | total: 1.89s | remaining: 451ms |
| 807: | learn: 14.7380279 | total: 1.89s | remaining: 449ms |
| 808: | learn: 14.7375577 | total: 1.89s | remaining: 447ms |
| 809: | learn: 14.7359670 | total: 1.89s | remaining: 444ms |
| 810: | learn: 14.7350562 | total: 1.9s | remaining: 442ms |
| 811: | learn: 14.7335364 | total: 1.9s | remaining: 440ms |
| 812: | learn: 14.7309831 | total: 1.9s | remaining: 437ms |
| 813: | learn: 14.7303890 | total: 1.9s | remaining: 435ms |
| 814: | learn: 14.7287789 | total: 1.91s | remaining: 433ms |
| 815: | learn: 14.7278943 | total: 1.91s | remaining: 430ms |
| 816: | learn: 14.7270040 | total: 1.91s | remaining: 428ms |
| 817: | learn: 14.7258422 | total: 1.91s | remaining: 426ms |
| 818: | learn: 14.7247877 | total: 1.91s | remaining: 423ms |
| 819: | learn: 14.7234704 | total: 1.92s | remaining: 421ms |
| 820: | learn: 14.7230372 | total: 1.92s | remaining: 419ms |
| 821: | learn: 14.7201814 | total: 1.92s | remaining: 416ms |
| 822: | learn: 14.7197552 | total: 1.92s | remaining: 414ms |
| 823: | learn: 14.7188169 | total: 1.93s | remaining: 411ms |
| 824: | learn: 14.7175402 | total: 1.93s | remaining: 409ms |
| 825: | learn: 14.7165987 | total: 1.93s | remaining: 407ms |
| 826: | learn: 14.7135628 | total: 1.93s | remaining: 404ms |
| 827: | learn: 14.7123169 | total: 1.94s | remaining: 402ms |
| 828: | learn: 14.7110874 | total: 1.94s | remaining: 400ms |
| 829: | learn: 14.7086632 | total: 1.94s | remaining: 397ms |
| 830: | learn: 14.7068305 | total: 1.94s | remaining: 395ms |
| 831: | learn: 14.7060668 | total: 1.94s | remaining: 393ms |
| 832: | learn: 14.7050270 | total: 1.95s | remaining: 390ms |
| 833: | learn: 14.7045179 | total: 1.95s | remaining: 388ms |
| 834: | learn: 14.7042555 | total: 1.95s | remaining: 386ms |
| 835: | learn: 14.7028453 | total: 1.95s | remaining: 383ms |
| 836: | learn: 14.7022822 | total: 1.96s | remaining: 381ms |
| 837: | learn: 14.7008047 | total: 1.96s | remaining: 379ms |
| 838: | learn: 14.6987393 | total: 1.96s | remaining: 376ms |
| 839: | learn: 14.6975146 | total: 1.96s | remaining: 374ms |
| 840: | learn: 14.6966228 | total: 1.97s | remaining: 372ms |
| 841: | learn: 14.6951151 | total: 1.97s | remaining: 369ms |
| 842: | learn: 14.6942992 | total: 1.97s | remaining: 367ms |
| 843: | learn: 14.6920410 | total: 1.97s | remaining: 365ms |

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| 844: | learn: 14.6902892 | total: 1.98s | remaining: 362ms |
| 845: | learn: 14.6896986 | total: 1.98s | remaining: 360ms |
| 846: | learn: 14.6864192 | total: 1.98s | remaining: 358ms |
| 847: | learn: 14.6857059 | total: 1.98s | remaining: 355ms |
| 848: | learn: 14.6845881 | total: 1.99s | remaining: 353ms |
| 849: | learn: 14.6841189 | total: 1.99s | remaining: 351ms |
| 850: | learn: 14.6832915 | total: 1.99s | remaining: 348ms |
| 851: | learn: 14.6817921 | total: 1.99s | remaining: 346ms |
| 852: | learn: 14.6815386 | total: 1.99s | remaining: 344ms |
| 853: | learn: 14.6804758 | total: 2s | remaining: 341ms |
| 854: | learn: 14.6777876 | total: 2s | remaining: 339ms |
| 855: | learn: 14.6768349 | total: 2s | remaining: 337ms |
| 856: | learn: 14.6754825 | total: 2s | remaining: 334ms |
| 857: | learn: 14.6748434 | total: 2.01s | remaining: 332ms |
| 858: | learn: 14.6735565 | total: 2.01s | remaining: 330ms |
| 859: | learn: 14.6731588 | total: 2.01s | remaining: 328ms |
| 860: | learn: 14.6728022 | total: 2.01s | remaining: 325ms |
| 861: | learn: 14.6721216 | total: 2.02s | remaining: 323ms |
| 862: | learn: 14.6710248 | total: 2.02s | remaining: 321ms |
| 863: | learn: 14.6703064 | total: 2.02s | remaining: 318ms |
| 864: | learn: 14.6692400 | total: 2.02s | remaining: 316ms |
| 865: | learn: 14.6687281 | total: 2.03s | remaining: 314ms |
| 866: | learn: 14.6679619 | total: 2.03s | remaining: 311ms |
| 867: | learn: 14.6670659 | total: 2.03s | remaining: 309ms |
| 868: | learn: 14.6659406 | total: 2.03s | remaining: 307ms |
| 869: | learn: 14.6645360 | total: 2.04s | remaining: 304ms |
| 870: | learn: 14.6638862 | total: 2.04s | remaining: 302ms |
| 871: | learn: 14.6632837 | total: 2.04s | remaining: 300ms |
| 872: | learn: 14.6624280 | total: 2.04s | remaining: 297ms |
| 873: | learn: 14.6617797 | total: 2.04s | remaining: 295ms |
| 874: | learn: 14.6598600 | total: 2.05s | remaining: 293ms |
| 875: | learn: 14.6594141 | total: 2.05s | remaining: 290ms |
| 876: | learn: 14.6590915 | total: 2.05s | remaining: 288ms |
| 877: | learn: 14.6578272 | total: 2.05s | remaining: 285ms |
| 878: | learn: 14.6571559 | total: 2.06s | remaining: 283ms |
| 879: | learn: 14.6564718 | total: 2.06s | remaining: 281ms |
| 880: | learn: 14.6551543 | total: 2.06s | remaining: 278ms |
| 881: | learn: 14.6543842 | total: 2.06s | remaining: 276ms |
| 882: | learn: 14.6534719 | total: 2.06s | remaining: 274ms |
| 883: | learn: 14.6526150 | total: 2.07s | remaining: 271ms |
| 884: | learn: 14.6517714 | total: 2.07s | remaining: 269ms |
| 885: | learn: 14.6509345 | total: 2.07s | remaining: 267ms |
| 886: | learn: 14.6504250 | total: 2.07s | remaining: 264ms |
| 887: | learn: 14.6493599 | total: 2.08s | remaining: 262ms |
| 888: | learn: 14.6483627 | total: 2.08s | remaining: 259ms |
| 889: | learn: 14.6476750 | total: 2.08s | remaining: 257ms |
| 890: | learn: 14.6471619 | total: 2.08s | remaining: 255ms |
| 891: | learn: 14.6445758 | total: 2.08s | remaining: 252ms |

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| 892: | learn: 14.6437726 | total: 2.09s | remaining: 250ms |
| 893: | learn: 14.6424300 | total: 2.09s | remaining: 248ms |
| 894: | learn: 14.6418275 | total: 2.09s | remaining: 245ms |
| 895: | learn: 14.6405725 | total: 2.09s | remaining: 243ms |
| 896: | learn: 14.6394340 | total: 2.1s | remaining: 241ms |
| 897: | learn: 14.6387674 | total: 2.1s | remaining: 238ms |
| 898: | learn: 14.6385063 | total: 2.1s | remaining: 236ms |
| 899: | learn: 14.6370262 | total: 2.1s | remaining: 234ms |
| 900: | learn: 14.6358554 | total: 2.1s | remaining: 231ms |
| 901: | learn: 14.6353595 | total: 2.11s | remaining: 229ms |
| 902: | learn: 14.6344216 | total: 2.11s | remaining: 226ms |
| 903: | learn: 14.6336498 | total: 2.11s | remaining: 224ms |
| 904: | learn: 14.6317921 | total: 2.11s | remaining: 222ms |
| 905: | learn: 14.6307644 | total: 2.12s | remaining: 220ms |
| 906: | learn: 14.6303591 | total: 2.12s | remaining: 217ms |
| 907: | learn: 14.6291073 | total: 2.12s | remaining: 215ms |
| 908: | learn: 14.6270326 | total: 2.12s | remaining: 212ms |
| 909: | learn: 14.6249193 | total: 2.12s | remaining: 210ms |
| 910: | learn: 14.6241651 | total: 2.13s | remaining: 208ms |
| 911: | learn: 14.6216744 | total: 2.13s | remaining: 205ms |
| 912: | learn: 14.6207141 | total: 2.13s | remaining: 203ms |
| 913: | learn: 14.6195127 | total: 2.13s | remaining: 201ms |
| 914: | learn: 14.6185617 | total: 2.13s | remaining: 198ms |
| 915: | learn: 14.6182840 | total: 2.14s | remaining: 196ms |
| 916: | learn: 14.6177921 | total: 2.14s | remaining: 194ms |
| 917: | learn: 14.6171316 | total: 2.14s | remaining: 191ms |
| 918: | learn: 14.6160628 | total: 2.14s | remaining: 189ms |
| 919: | learn: 14.6152014 | total: 2.15s | remaining: 187ms |
| 920: | learn: 14.6144267 | total: 2.15s | remaining: 184ms |
| 921: | learn: 14.6137942 | total: 2.15s | remaining: 182ms |
| 922: | learn: 14.6133754 | total: 2.15s | remaining: 180ms |
| 923: | learn: 14.6118318 | total: 2.15s | remaining: 177ms |
| 924: | learn: 14.6109530 | total: 2.16s | remaining: 175ms |
| 925: | learn: 14.6102961 | total: 2.16s | remaining: 173ms |
| 926: | learn: 14.6096668 | total: 2.16s | remaining: 170ms |
| 927: | learn: 14.6091896 | total: 2.16s | remaining: 168ms |
| 928: | learn: 14.6079971 | total: 2.17s | remaining: 166ms |
| 929: | learn: 14.6076253 | total: 2.17s | remaining: 163ms |
| 930: | learn: 14.6071161 | total: 2.17s | remaining: 161ms |
| 931: | learn: 14.6066492 | total: 2.17s | remaining: 158ms |
| 932: | learn: 14.6052905 | total: 2.17s | remaining: 156ms |
| 933: | learn: 14.6048251 | total: 2.17s | remaining: 154ms |
| 934: | learn: 14.6026715 | total: 2.18s | remaining: 151ms |
| 935: | learn: 14.6008184 | total: 2.18s | remaining: 149ms |
| 936: | learn: 14.5998290 | total: 2.18s | remaining: 147ms |
| 937: | learn: 14.5981658 | total: 2.18s | remaining: 144ms |
| 938: | learn: 14.5966537 | total: 2.19s | remaining: 142ms |
| 939: | learn: 14.5960039 | total: 2.19s | remaining: 140ms |

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| 940: | learn: 14.5954557 | total: 2.19s | remaining: 138ms |
| 941: | learn: 14.5945100 | total: 2.2s | remaining: 135ms |
| 942: | learn: 14.5940479 | total: 2.2s | remaining: 133ms |
| 943: | learn: 14.5929390 | total: 2.2s | remaining: 131ms |
| 944: | learn: 14.5906254 | total: 2.2s | remaining: 128ms |
| 945: | learn: 14.5901270 | total: 2.21s | remaining: 126ms |
| 946: | learn: 14.5894845 | total: 2.21s | remaining: 124ms |
| 947: | learn: 14.5882350 | total: 2.21s | remaining: 121ms |
| 948: | learn: 14.5877469 | total: 2.21s | remaining: 119ms |
| 949: | learn: 14.5871150 | total: 2.22s | remaining: 117ms |
| 950: | learn: 14.5865285 | total: 2.22s | remaining: 114ms |
| 951: | learn: 14.5851221 | total: 2.22s | remaining: 112ms |
| 952: | learn: 14.5846441 | total: 2.22s | remaining: 110ms |
| 953: | learn: 14.5835441 | total: 2.22s | remaining: 107ms |
| 954: | learn: 14.5827889 | total: 2.23s | remaining: 105ms |
| 955: | learn: 14.5812019 | total: 2.23s | remaining: 103ms |
| 956: | learn: 14.5808497 | total: 2.23s | remaining: 100ms |
| 957: | learn: 14.5793306 | total: 2.23s | remaining: 97.9ms |
| 958: | learn: 14.5783411 | total: 2.24s | remaining: 95.6ms |
| 959: | learn: 14.5772626 | total: 2.24s | remaining: 93.3ms |
| 960: | learn: 14.5768417 | total: 2.24s | remaining: 90.9ms |
| 961: | learn: 14.5761988 | total: 2.24s | remaining: 88.6ms |
| 962: | learn: 14.5740613 | total: 2.25s | remaining: 86.3ms |
| 963: | learn: 14.5736615 | total: 2.25s | remaining: 83.9ms |
| 964: | learn: 14.5717724 | total: 2.25s | remaining: 81.6ms |
| 965: | learn: 14.5702888 | total: 2.25s | remaining: 79.3ms |
| 966: | learn: 14.5698176 | total: 2.25s | remaining: 77ms |
| 967: | learn: 14.5692479 | total: 2.26s | remaining: 74.6ms |
| 968: | learn: 14.5687541 | total: 2.26s | remaining: 72.3ms |
| 969: | learn: 14.5663420 | total: 2.26s | remaining: 69.9ms |
| 970: | learn: 14.5653954 | total: 2.26s | remaining: 67.6ms |
| 971: | learn: 14.5632831 | total: 2.27s | remaining: 65.3ms |
| 972: | learn: 14.5630107 | total: 2.27s | remaining: 63ms |
| 973: | learn: 14.5623048 | total: 2.27s | remaining: 60.6ms |
| 974: | learn: 14.5616854 | total: 2.27s | remaining: 58.3ms |
| 975: | learn: 14.5610471 | total: 2.27s | remaining: 56ms |
| 976: | learn: 14.5606084 | total: 2.28s | remaining: 53.6ms |
| 977: | learn: 14.5603259 | total: 2.28s | remaining: 51.3ms |
| 978: | learn: 14.5588884 | total: 2.28s | remaining: 49ms |
| 979: | learn: 14.5569902 | total: 2.28s | remaining: 46.6ms |
| 980: | learn: 14.5555874 | total: 2.29s | remaining: 44.3ms |
| 981: | learn: 14.5543602 | total: 2.29s | remaining: 42ms |
| 982: | learn: 14.5532205 | total: 2.29s | remaining: 39.6ms |
| 983: | learn: 14.5525891 | total: 2.29s | remaining: 37.3ms |
| 984: | learn: 14.5520281 | total: 2.29s | remaining: 35ms |
| 985: | learn: 14.5516212 | total: 2.3s | remaining: 32.6ms |
| 986: | learn: 14.5507031 | total: 2.3s | remaining: 30.3ms |
| 987: | learn: 14.5493152 | total: 2.3s | remaining: 28ms |

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| 988: | learn: 14.5487315 | total: 2.3s | remaining: 25.6ms |
| 989: | learn: 14.5478657 | total: 2.31s | remaining: 23.3ms |
| 990: | learn: 14.5472582 | total: 2.31s | remaining: 21ms |
| 991: | learn: 14.5468474 | total: 2.31s | remaining: 18.6ms |
| 992: | learn: 14.5464146 | total: 2.31s | remaining: 16.3ms |
| 993: | learn: 14.5455159 | total: 2.32s | remaining: 14ms |
| 994: | learn: 14.5451597 | total: 2.32s | remaining: 11.7ms |
| 995: | learn: 14.5447414 | total: 2.32s | remaining: 9.32ms |
| 996: | learn: 14.5441536 | total: 2.32s | remaining: 6.99ms |
| 997: | learn: 14.5432415 | total: 2.33s | remaining: 4.66ms |
| 998: | learn: 14.5421538 | total: 2.33s | remaining: 2.33ms |
| 999: | learn: 14.5416389 | total: 2.33s | remaining: 0us |

[512]: <catboost.core.CatBoostRegressor at 0x7fa94e9defd0>

[513]: `y_pred = cat.predict(X_test)`

[514]: `r2_score(y_test,y_pred)`

[514]: 0.6215964899517009