house-price-prediction-model

February 16, 2024

1 House Price Prediction using Machine Learning in Python

1.1 1. Importing Libraries

[3]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

[4]:
```
data = pd.read_excel("drive/MyDrive/HousePricePrediction/HousePricePrediction.
↪xlsx")
```

[5]:
```
## First 5 rows
data.head()
```

[5]:

	Id	MSSubClass	MSZoning	LotArea	LotConfig	BldgType	OverallCond	\
0	0	60	RL	8450	Inside	1Fam	5	
1	1	20	RL	9600	FR2	1Fam	8	
2	2	60	RL	11250	Inside	1Fam	5	
3	3	70	RL	9550	Corner	1Fam	5	
4	4	60	RL	14260	FR2	1Fam	5	

	YearBuilt	YearRemodAdd	Exterior1st	BsmtFinSF2	TotalBsmtSF	SalePrice
0	2003	2003	VinylSd	0.0	856.0	208500.0
1	1976	1976	MetalSd	0.0	1262.0	181500.0
2	2001	2002	VinylSd	0.0	920.0	223500.0
3	1915	1970	Wd Sdng	0.0	756.0	140000.0
4	2000	2000	VinylSd	0.0	1145.0	250000.0

[6]:
```
# Shape of data
data.shape
```

[6]:
```
(2919, 13)
```

1.1.1 Data Preprocessing

I will categorize the features depending on their datatype(int, float, object) and then calsculate the number of them

[8]:
```
# Get the column names for each data type
object_cols = data.select_dtypes(include='object').columns
num_cols = data.select_dtypes(include='int').columns
fl_cols = data.select_dtypes(include='float').columns

# Print the number of each type of variable
print(f"Categorical variables: {len(object_cols)}")
print(f"Integer variables: {len(num_cols)}")
print(f"Float variables: {len(fl_cols)}")
```

```
Categorical variables: 4
Integer variables: 6
Float variables: 3
```

1.2 Exploratory Data Analysis

[10]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2919 entries, 0 to 2918
Data columns (total 13 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   Id            2919 non-null   int64
 1   MSSubClass    2919 non-null   int64
 2   MSZoning      2915 non-null   object
 3   LotArea       2919 non-null   int64
 4   LotConfig     2919 non-null   object
 5   BldgType      2919 non-null   object
 6   OverallCond   2919 non-null   int64
 7   YearBuilt     2919 non-null   int64
 8   YearRemodAdd  2919 non-null   int64
 9   Exterior1st   2918 non-null   object
 10  BsmtFinSF2    2918 non-null   float64
 11  TotalBsmtSF   2918 non-null   float64
 12  SalePrice     1460 non-null   float64
dtypes: float64(3), int64(6), object(4)
memory usage: 296.6+ KB
```

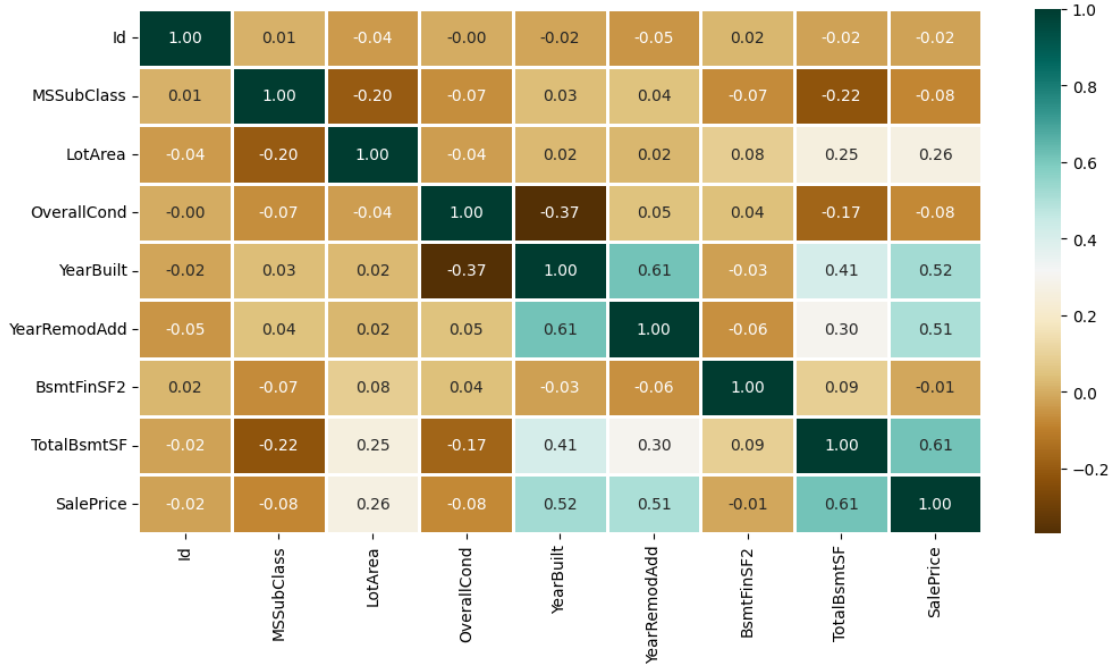
1.3 Heatmap

[11]:
```
plt.figure(figsize=(12,6))
sns.heatmap(data.corr(), cmap = 'BrBG',
            fmt = ".2f",
            linewidths = 2,
            annot = True)
```

```
<ipython-input-11-51b985f2144f>:2: FutureWarning: The default value of
```

```
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  sns.heatmap(data.corr(), cmap = 'BrBG',
```

[11]: <Axes: >

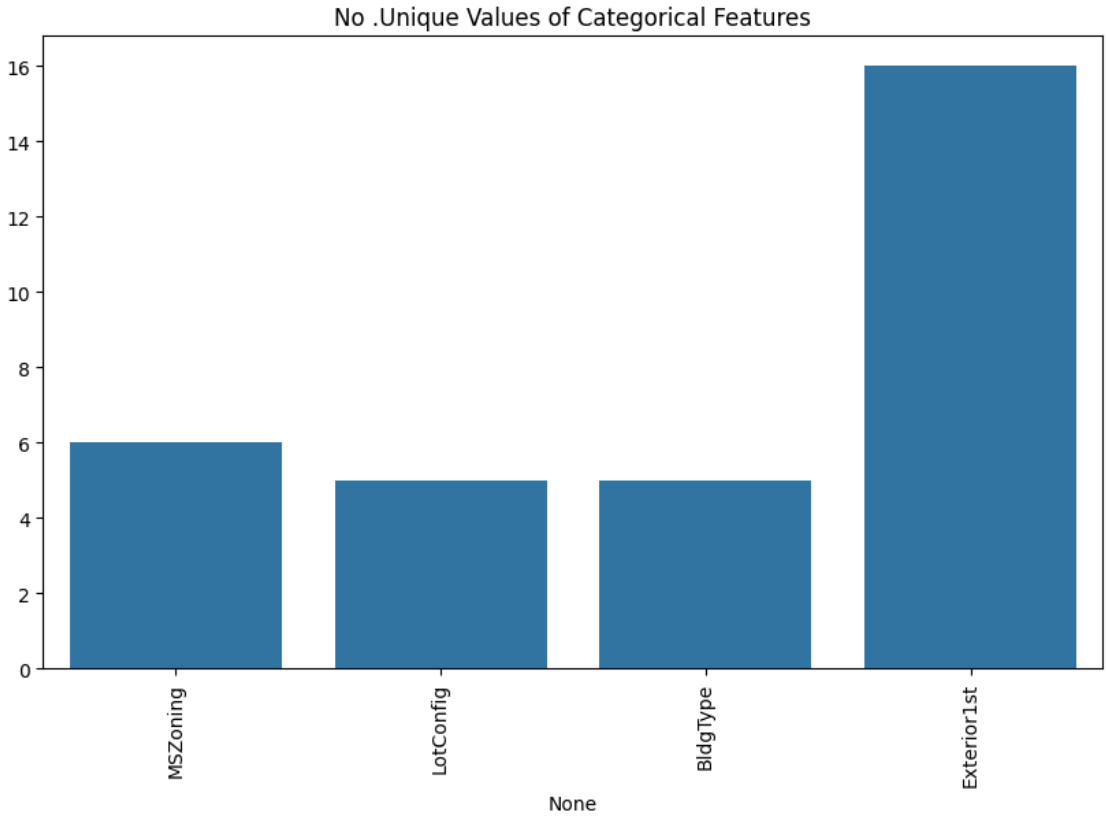


1.4 Barplot

[12]:
```
unique_values = []
for col in object_cols:
  unique_values.append(data[col].unique().size)

plt.figure(figsize=(10,6))
plt.title('No .Unique Values of Categorical Features')
plt.xticks(rotation = 90)
sns.barplot(x=object_cols,y=unique_values)
```

[12]: <Axes: title={'center': 'No .Unique Values of Categorical Features'},
xlabel='None'>



The plot shows that Exterior1st has around 16 unique categories and other features have around 6 unique categories. To findout the actual count of each category I can plot the bargraph of each four features separately.

[14]:
```
fig, axes = plt.subplots(len(object_cols), 1, figsize=(18, 36))
plt.suptitle('Categorical Features: Distribution')

for ax, col in zip(axes.flatten(), object_cols):
    y = data[col].value_counts()
    sns.barplot(x=list(y.index), y=y, ax=ax, palette='hsv')
    ax.set_xticklabels(ax.get_xticklabels(), rotation=90)

plt.tight_layout(rect=[0, 0, 1, 0.96])  # Adjust layout to make room for title
```

```
<ipython-input-14-9f4842450ac7>:6: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x=list(y.index), y=y, ax=ax, palette='hsv')
<ipython-input-14-9f4842450ac7>:7: UserWarning: FixedFormatter should only be
```

```
used together with FixedLocator
  ax.set_xticklabels(ax.get_xticklabels(), rotation=90)
<ipython-input-14-9f4842450ac7>:6: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x=list(y.index), y=y, ax=ax, palette='hsv')
<ipython-input-14-9f4842450ac7>:7: UserWarning: FixedFormatter should only be
used together with FixedLocator
  ax.set_xticklabels(ax.get_xticklabels(), rotation=90)
<ipython-input-14-9f4842450ac7>:6: FutureWarning:

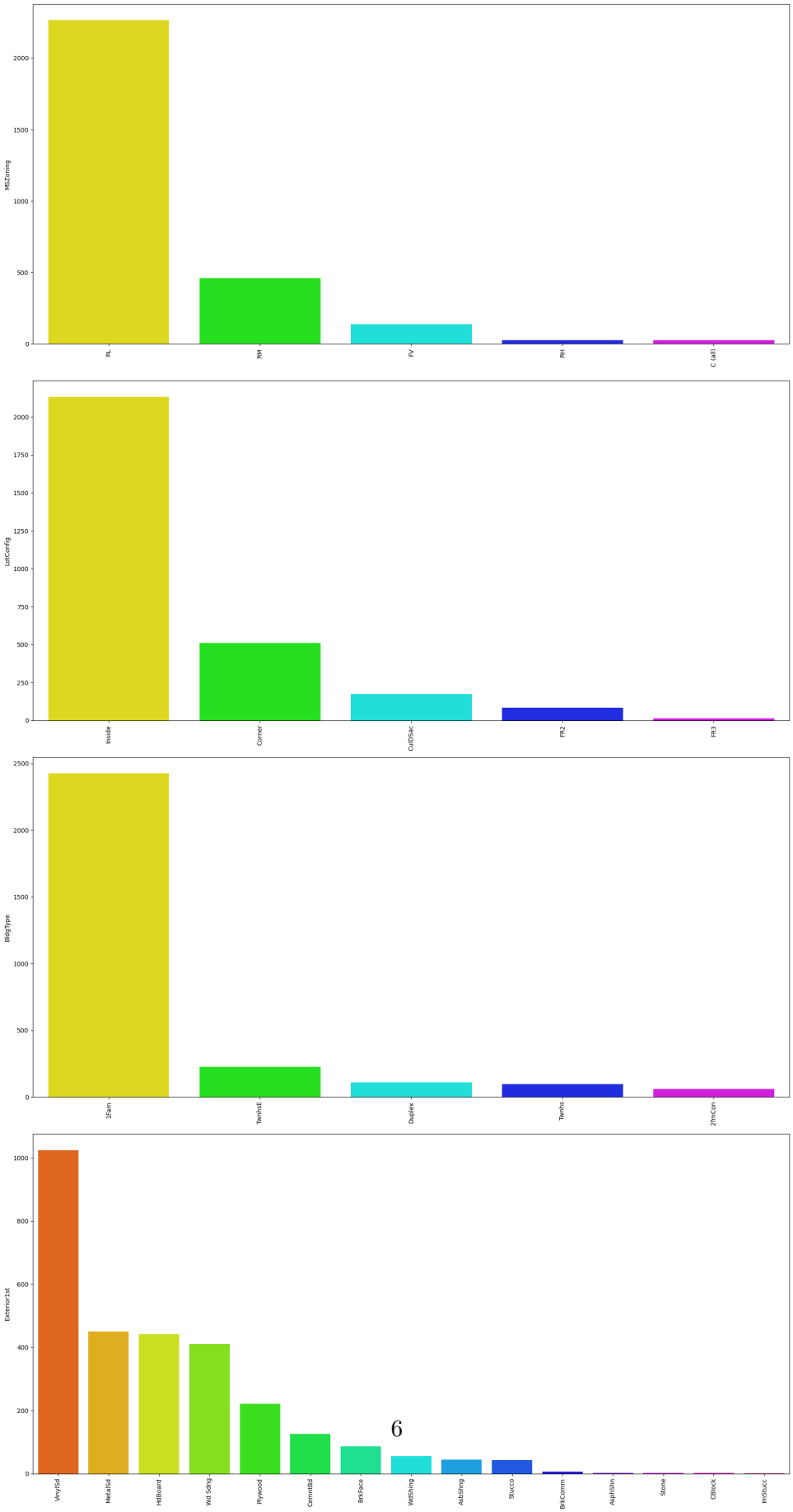
Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x=list(y.index), y=y, ax=ax, palette='hsv')
<ipython-input-14-9f4842450ac7>:7: UserWarning: FixedFormatter should only be
used together with FixedLocator
  ax.set_xticklabels(ax.get_xticklabels(), rotation=90)
<ipython-input-14-9f4842450ac7>:6: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.barplot(x=list(y.index), y=y, ax=ax, palette='hsv')
<ipython-input-14-9f4842450ac7>:7: UserWarning: FixedFormatter should only be
used together with FixedLocator
  ax.set_xticklabels(ax.get_xticklabels(), rotation=90)
```

Categorical Features: Distribution



1.5 Data Cleaning

In our dataset, there are some columns that are not important and irrelevant for the model training. So, I can drop that column before training.

As Id Column will not be participating in any prediction. So I can Drop it.

[15]:
```
data.drop(['Id'],axis = 1, inplace =True)
```

[18]:
```
data.isnull().sum()
```

[18]:
```
MSSubClass          0
MSZoning            4
LotArea             0
LotConfig           0
BldgType            0
OverallCond         0
YearBuilt           0
YearRemodAdd        0
Exterior1st         1
BsmtFinSF2          1
TotalBsmtSF         1
SalePrice        1459
dtype: int64
```

Replacing SalePrice Empty values with their mean values.

[19]:
```
data['SalePrice'] = data['SalePrice'].fillna(data['SalePrice'].mean())
```

[22]:
```
# Drop records with null values
new_data = data.dropna()
```

[54]:
```
new_data.isnull().sum()
```

[54]:
```
MSSubClass      0
MSZoning        0
LotArea         0
LotConfig       0
BldgType        0
OverallCond     0
YearBuilt       0
YearRemodAdd    0
Exterior1st     0
BsmtFinSF2      0
TotalBsmtSF     0
SalePrice       0
```

```
dtype: int64
```

1.6 OneHotEncoder – For Label categorical features

[24]:
```
from sklearn.preprocessing import OneHotEncoder

object_cols = new_data.select_dtypes(include='object').columns
print("Categorical variables:", object_cols)
print('No. of. categorical features:', len(object_cols))
```

```
Categorical variables: Index(['MSZoning', 'LotConfig', 'BldgType',
'Exterior1st'], dtype='object')
No. of. categorical features: 4
```

we can now perform a OneHotEncoding

[27]:
```
# Initialize the OneHotEncoder
OH_encoder = OneHotEncoder(sparse_output=False)
OH_cols = OH_encoder.fit_transform(new_data[object_cols])

# Convert the numpy array back into a dataframe with the correct column names␣
 ↪and index
OH_cols_df = pd.DataFrame(OH_cols, columns=OH_encoder.
 ↪get_feature_names_out(object_cols), index=new_data.index)
# Drop the original categorical columns from the original dataframe.
df_final = pd.concat([new_data.drop(object_cols, axis=1), OH_cols_df], axis=1)
```

1.7 Splitting Dataset into Traning and Testing

X and Y spliting (i.e Y is the SalePrice column and The rest of the Other Columns are X)

[30]:
```
from sklearn.metrics import mean_absolute_error
from sklearn.model_selection import train_test_split

X = df_final.drop(['SalePrice'], axis = 1)
Y =  df_final['SalePrice']

# Split the training and validation set
X_train, X_valid, Y_train, Y_valid = train_test_split(X,Y, train_size = 0.8,␣
 ↪test_size = 0.2,  random_state = 20)
```

1.8 Model and Accuracy

I will use 3 regression Models - SVM-Support Vector Machine - Random Forest Regressor - Linear Regressor - Cat Boost Regressor

To calculate Loss we will be using the Mean_absolute_Persentage_error module

1.8.1 SVM - Support Vector Nachine

[45]:
```
from sklearn import svm
from sklearn.svm import SVC
from sklearn.metrics import mean_absolute_percentage_error

model_SVR = svm.SVR().fit(X_train,Y_train)
Y_pred = model_SVR.predict(X_valid)

SVM_accuracy= mean_absolute_percentage_error(Y_valid, Y_pred)
print(SVM_accuracy)
```

```
0.17054583991574104
```

1.8.2 Random Forest Regression

[43]:
```
from  sklearn.ensemble import RandomForestRegressor as RR

model_RFR = RR(n_estimators = 10)
model_RFR.fit(X_train, Y_train)
Y_pred = model_RFR.predict(X_valid)


RR_accuracy = mean_absolute_percentage_error(Y_valid, Y_pred)
print(RR_accuracy)
```

```
0.18728535755164913
```

1.8.3 Linear Regression

[44]:
```
from sklearn.linear_model import LinearRegression

model_LR = LinearRegression()
model_LR.fit(X_train, Y_train)
Y_pred = model_LR.predict(X_valid)

lR_accuracy = mean_absolute_percentage_error(Y_valid, Y_pred)
print(lR_accuracy)
```

```
0.18697935434267113
```

1.8.4 Cat Boost Regressor

[42]:
```
from sklearn.metrics import r2_score
from catboost import CatBoostRegressor

cb_model = CatBoostRegressor()
cb_model.fit(X_train, Y_train)
```

```
preds = cb_model.predict(X_valid)

cb_r2_score = r2_score(Y_valid, preds)
print(cb_r2_score)
```

```
Learning rate set to 0.046797
0:      learn: 56643.8868898    total: 1.25ms   remaining: 1.24s
1:      learn: 55802.2770813    total: 2.46ms   remaining: 1.23s
2:      learn: 55087.2580417    total: 3.62ms   remaining: 1.2s
3:      learn: 54382.5902989    total: 4.87ms   remaining: 1.21s
4:      learn: 53735.4157889    total: 6.08ms   remaining: 1.21s
5:      learn: 53150.6150455    total: 7.28ms   remaining: 1.21s
6:      learn: 52526.6401427    total: 8.49ms   remaining: 1.2s
7:      learn: 52016.5666382    total: 9.83ms   remaining: 1.22s
8:      learn: 51479.2538858    total: 11.1ms   remaining: 1.23s
9:      learn: 51023.9678861    total: 12.4ms   remaining: 1.23s
10:     learn: 50610.0538726    total: 13.6ms   remaining: 1.22s
11:     learn: 50172.7715219    total: 14.9ms   remaining: 1.23s
12:     learn: 49821.5608046    total: 16.1ms   remaining: 1.22s
13:     learn: 49416.9200057    total: 17.3ms   remaining: 1.22s
14:     learn: 48927.3359132    total: 18.6ms   remaining: 1.22s
15:     learn: 48495.7726892    total: 19.8ms   remaining: 1.22s
16:     learn: 48166.8008007    total: 21.1ms   remaining: 1.22s
17:     learn: 47830.7059857    total: 22.3ms   remaining: 1.21s
18:     learn: 47624.6929613    total: 23.5ms   remaining: 1.21s
19:     learn: 47390.6382398    total: 24.7ms   remaining: 1.21s
20:     learn: 47034.1399111    total: 25.9ms   remaining: 1.21s
21:     learn: 46745.0360448    total: 27.1ms   remaining: 1.21s
22:     learn: 46404.5608088    total: 28.3ms   remaining: 1.2s
23:     learn: 46173.1883674    total: 29.6ms   remaining: 1.2s
24:     learn: 45905.0204097    total: 31.6ms   remaining: 1.23s
25:     learn: 45677.2238837    total: 33.3ms   remaining: 1.25s
26:     learn: 45409.5590387    total: 34.4ms   remaining: 1.24s
27:     learn: 45226.3324352    total: 35.7ms   remaining: 1.24s
28:     learn: 45048.7056669    total: 36.9ms   remaining: 1.24s
29:     learn: 44885.3057273    total: 38.2ms   remaining: 1.23s
30:     learn: 44743.4845526    total: 39.4ms   remaining: 1.23s
31:     learn: 44596.9270075    total: 40.6ms   remaining: 1.23s
32:     learn: 44417.1919223    total: 41.8ms   remaining: 1.23s
33:     learn: 44255.5805973    total: 43ms     remaining: 1.22s
34:     learn: 44114.9500897    total: 44.2ms   remaining: 1.22s
35:     learn: 43965.6382903    total: 45.4ms   remaining: 1.22s
36:     learn: 43815.5907287    total: 46.6ms   remaining: 1.21s
37:     learn: 43707.0902523    total: 47.9ms   remaining: 1.21s
38:     learn: 43520.2294129    total: 49.1ms   remaining: 1.21s
39:     learn: 43340.4032893    total: 50.2ms   remaining: 1.21s
40:     learn: 43235.9601204    total: 51.5ms   remaining: 1.2s
```

```
41:     learn: 43108.9351787    total: 52.7ms   remaining: 1.2s
42:     learn: 42941.3107708    total: 53.9ms   remaining: 1.2s
43:     learn: 42863.3246756    total: 55.1ms   remaining: 1.2s
44:     learn: 42712.0647492    total: 56.2ms   remaining: 1.19s
45:     learn: 42578.5666083    total: 57.5ms   remaining: 1.19s
46:     learn: 42429.9822040    total: 58.6ms   remaining: 1.19s
47:     learn: 42314.8098554    total: 59.9ms   remaining: 1.19s
48:     learn: 42186.9019125    total: 61.1ms   remaining: 1.18s
49:     learn: 42079.3532500    total: 62.2ms   remaining: 1.18s
50:     learn: 41929.7572701    total: 63.4ms   remaining: 1.18s
51:     learn: 41843.8604645    total: 64.6ms   remaining: 1.18s
52:     learn: 41785.7203152    total: 65.8ms   remaining: 1.18s
53:     learn: 41681.2227529    total: 66.9ms   remaining: 1.17s
54:     learn: 41590.2723417    total: 68.1ms   remaining: 1.17s
55:     learn: 41442.3970639    total: 69.2ms   remaining: 1.17s
56:     learn: 41362.5429294    total: 70.5ms   remaining: 1.17s
57:     learn: 41254.4255516    total: 71.6ms   remaining: 1.16s
58:     learn: 41213.4451241    total: 72.8ms   remaining: 1.16s
59:     learn: 41102.6314130    total: 73.9ms   remaining: 1.16s
60:     learn: 40981.3698554    total: 75.2ms   remaining: 1.16s
61:     learn: 40921.2043075    total: 76.3ms   remaining: 1.15s
62:     learn: 40881.9059455    total: 77.5ms   remaining: 1.15s
63:     learn: 40813.2355963    total: 78.7ms   remaining: 1.15s
64:     learn: 40738.2566170    total: 79.9ms   remaining: 1.15s
65:     learn: 40662.1185394    total: 81.9ms   remaining: 1.16s
66:     learn: 40590.7192133    total: 83.1ms   remaining: 1.16s
67:     learn: 40526.4904454    total: 84.4ms   remaining: 1.16s
68:     learn: 40396.1404606    total: 85.6ms   remaining: 1.16s
69:     learn: 40287.0774081    total: 87ms     remaining: 1.16s
70:     learn: 40181.8717412    total: 88.2ms   remaining: 1.15s
71:     learn: 40125.9505464    total: 89.4ms   remaining: 1.15s
72:     learn: 40056.7429419    total: 90.7ms   remaining: 1.15s
73:     learn: 40008.4284965    total: 91.8ms   remaining: 1.15s
74:     learn: 39944.5043596    total: 93ms     remaining: 1.15s
75:     learn: 39893.8844725    total: 94.2ms   remaining: 1.14s
76:     learn: 39858.4365776    total: 95.4ms   remaining: 1.14s
77:     learn: 39801.7973420    total: 96.6ms   remaining: 1.14s
78:     learn: 39752.4207006    total: 97.8ms   remaining: 1.14s
79:     learn: 39727.3166313    total: 99.2ms   remaining: 1.14s
80:     learn: 39699.6601118    total: 101ms    remaining: 1.15s
81:     learn: 39616.0470032    total: 102ms    remaining: 1.15s
82:     learn: 39571.2472696    total: 104ms    remaining: 1.15s
83:     learn: 39528.8623666    total: 105ms    remaining: 1.15s
84:     learn: 39505.0150988    total: 106ms    remaining: 1.14s
85:     learn: 39465.0401593    total: 107ms    remaining: 1.14s
86:     learn: 39404.6548624    total: 109ms    remaining: 1.15s
87:     learn: 39381.8298261    total: 110ms    remaining: 1.14s
88:     learn: 39313.3126233    total: 112ms    remaining: 1.14s
```

```
89:     learn: 39286.4557533    total: 113ms    remaining: 1.14s
90:     learn: 39259.6638234    total: 114ms    remaining: 1.14s
91:     learn: 39231.9751944    total: 115ms    remaining: 1.14s
92:     learn: 39201.3780987    total: 117ms    remaining: 1.14s
93:     learn: 39154.5143158    total: 118ms    remaining: 1.14s
94:     learn: 39115.7073929    total: 119ms    remaining: 1.14s
95:     learn: 39072.2147461    total: 121ms    remaining: 1.13s
96:     learn: 39050.7577213    total: 122ms    remaining: 1.13s
97:     learn: 39009.4736936    total: 123ms    remaining: 1.13s
98:     learn: 38980.1521415    total: 124ms    remaining: 1.13s
99:     learn: 38914.7433373    total: 125ms    remaining: 1.13s
100:    learn: 38874.3420666    total: 126ms    remaining: 1.12s
101:    learn: 38845.2837628    total: 127ms    remaining: 1.12s
102:    learn: 38794.7569408    total: 129ms    remaining: 1.12s
103:    learn: 38762.1887200    total: 130ms    remaining: 1.12s
104:    learn: 38746.6778956    total: 131ms    remaining: 1.11s
105:    learn: 38693.5152067    total: 132ms    remaining: 1.11s
106:    learn: 38659.4801744    total: 133ms    remaining: 1.11s
107:    learn: 38641.9114520    total: 134ms    remaining: 1.11s
108:    learn: 38603.6656321    total: 136ms    remaining: 1.11s
109:    learn: 38520.9368279    total: 137ms    remaining: 1.11s
110:    learn: 38497.6535470    total: 138ms    remaining: 1.1s
111:    learn: 38475.5589642    total: 139ms    remaining: 1.1s
112:    learn: 38447.6340292    total: 140ms    remaining: 1.1s
113:    learn: 38404.5061232    total: 141ms    remaining: 1.1s
114:    learn: 38339.1561049    total: 143ms    remaining: 1.1s
115:    learn: 38289.3401798    total: 144ms    remaining: 1.1s
116:    learn: 38251.0539596    total: 145ms    remaining: 1.09s
117:    learn: 38202.3195500    total: 146ms    remaining: 1.09s
118:    learn: 38172.3100424    total: 147ms    remaining: 1.09s
119:    learn: 38139.3895765    total: 149ms    remaining: 1.09s
120:    learn: 38089.7157175    total: 150ms    remaining: 1.09s
121:    learn: 38058.9559478    total: 151ms    remaining: 1.09s
122:    learn: 38013.5673282    total: 152ms    remaining: 1.08s
123:    learn: 37979.6314242    total: 153ms    remaining: 1.08s
124:    learn: 37956.9610348    total: 154ms    remaining: 1.08s
125:    learn: 37927.6774794    total: 156ms    remaining: 1.08s
126:    learn: 37901.2247643    total: 158ms    remaining: 1.08s
127:    learn: 37875.8761759    total: 159ms    remaining: 1.08s
128:    learn: 37816.8106507    total: 160ms    remaining: 1.08s
129:    learn: 37741.9671896    total: 162ms    remaining: 1.08s
130:    learn: 37717.2631290    total: 163ms    remaining: 1.08s
131:    learn: 37675.4687425    total: 164ms    remaining: 1.08s
132:    learn: 37658.9479557    total: 165ms    remaining: 1.08s
133:    learn: 37645.3101314    total: 166ms    remaining: 1.08s
134:    learn: 37593.9821212    total: 168ms    remaining: 1.07s
135:    learn: 37541.6892578    total: 169ms    remaining: 1.07s
136:    learn: 37490.6666587    total: 170ms    remaining: 1.07s
```

```
137:    learn: 37457.9605664    total: 171ms    remaining: 1.07s
138:    learn: 37398.4253899    total: 172ms    remaining: 1.07s
139:    learn: 37370.9385522    total: 174ms    remaining: 1.07s
140:    learn: 37360.9237805    total: 175ms    remaining: 1.06s
141:    learn: 37336.3298187    total: 176ms    remaining: 1.06s
142:    learn: 37298.8884570    total: 177ms    remaining: 1.06s
143:    learn: 37231.2493190    total: 179ms    remaining: 1.06s
144:    learn: 37224.9638843    total: 180ms    remaining: 1.06s
145:    learn: 37175.6022971    total: 182ms    remaining: 1.06s
146:    learn: 37131.5091102    total: 183ms    remaining: 1.06s
147:    learn: 37108.0477770    total: 185ms    remaining: 1.06s
148:    learn: 37055.2487432    total: 187ms    remaining: 1.07s
149:    learn: 37044.8241888    total: 189ms    remaining: 1.07s
150:    learn: 37025.4446823    total: 190ms    remaining: 1.07s
151:    learn: 37010.4842384    total: 191ms    remaining: 1.07s
152:    learn: 36923.9498138    total: 193ms    remaining: 1.06s
153:    learn: 36888.0189777    total: 194ms    remaining: 1.06s
154:    learn: 36861.2778137    total: 195ms    remaining: 1.06s
155:    learn: 36832.1459594    total: 196ms    remaining: 1.06s
156:    learn: 36793.1646682    total: 197ms    remaining: 1.06s
157:    learn: 36777.2764701    total: 198ms    remaining: 1.06s
158:    learn: 36755.7058550    total: 200ms    remaining: 1.05s
159:    learn: 36731.4139160    total: 201ms    remaining: 1.05s
160:    learn: 36659.9486738    total: 202ms    remaining: 1.05s
161:    learn: 36649.6106743    total: 203ms    remaining: 1.05s
162:    learn: 36615.6307236    total: 204ms    remaining: 1.05s
163:    learn: 36575.3397889    total: 205ms    remaining: 1.05s
164:    learn: 36545.8648700    total: 207ms    remaining: 1.05s
165:    learn: 36519.7597309    total: 209ms    remaining: 1.05s
166:    learn: 36510.2600145    total: 210ms    remaining: 1.05s
167:    learn: 36491.3547273    total: 211ms    remaining: 1.05s
168:    learn: 36426.7809397    total: 212ms    remaining: 1.04s
169:    learn: 36405.6203830    total: 214ms    remaining: 1.04s
170:    learn: 36398.9725277    total: 215ms    remaining: 1.04s
171:    learn: 36342.0888930    total: 216ms    remaining: 1.04s
172:    learn: 36312.9813343    total: 217ms    remaining: 1.04s
173:    learn: 36304.3347158    total: 218ms    remaining: 1.04s
174:    learn: 36258.7012897    total: 219ms    remaining: 1.03s
175:    learn: 36255.4114767    total: 221ms    remaining: 1.03s
176:    learn: 36207.0223391    total: 222ms    remaining: 1.03s
177:    learn: 36199.0053791    total: 223ms    remaining: 1.03s
178:    learn: 36196.0136352    total: 224ms    remaining: 1.03s
179:    learn: 36190.3855653    total: 225ms    remaining: 1.02s
180:    learn: 36183.0204036    total: 226ms    remaining: 1.02s
181:    learn: 36175.7187218    total: 227ms    remaining: 1.02s
182:    learn: 36154.5663360    total: 229ms    remaining: 1.02s
183:    learn: 36106.5984508    total: 230ms    remaining: 1.02s
184:    learn: 36098.9049240    total: 232ms    remaining: 1.02s
```

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185:    learn: 36033.6361670    total: 233ms    remaining: 1.02s
186:    learn: 35979.8433234    total: 234ms    remaining: 1.02s
187:    learn: 35939.4935464    total: 235ms    remaining: 1.02s
188:    learn: 35915.7127240    total: 237ms    remaining: 1.01s
189:    learn: 35854.1533488    total: 238ms    remaining: 1.01s
190:    learn: 35835.8980059    total: 239ms    remaining: 1.01s
191:    learn: 35829.9513646    total: 240ms    remaining: 1.01s
192:    learn: 35825.1709237    total: 241ms    remaining: 1.01s
193:    learn: 35772.7656302    total: 242ms    remaining: 1.01s
194:    learn: 35717.7744966    total: 244ms    remaining: 1s
195:    learn: 35693.7161684    total: 245ms    remaining: 1s
196:    learn: 35691.6282740    total: 246ms    remaining: 1s
197:    learn: 35657.9973917    total: 247ms    remaining: 1s
198:    learn: 35647.1304969    total: 248ms    remaining: 999ms
199:    learn: 35644.0239386    total: 249ms    remaining: 997ms
200:    learn: 35640.3568667    total: 250ms    remaining: 995ms
201:    learn: 35632.1754983    total: 252ms    remaining: 994ms
202:    learn: 35629.9674500    total: 253ms    remaining: 992ms
203:    learn: 35607.0562583    total: 254ms    remaining: 990ms
204:    learn: 35589.9464030    total: 255ms    remaining: 989ms
205:    learn: 35553.4129451    total: 256ms    remaining: 988ms
206:    learn: 35542.6351455    total: 257ms    remaining: 986ms
207:    learn: 35540.5651672    total: 259ms    remaining: 984ms
208:    learn: 35534.9431567    total: 260ms    remaining: 983ms
209:    learn: 35487.0090478    total: 261ms    remaining: 981ms
210:    learn: 35484.0114121    total: 262ms    remaining: 979ms
211:    learn: 35476.1734085    total: 263ms    remaining: 978ms
212:    learn: 35422.6722680    total: 264ms    remaining: 976ms
213:    learn: 35361.2557602    total: 265ms    remaining: 974ms
214:    learn: 35358.9187653    total: 266ms    remaining: 973ms
215:    learn: 35324.1788883    total: 268ms    remaining: 971ms
216:    learn: 35322.0246727    total: 269ms    remaining: 969ms
217:    learn: 35282.0259259    total: 270ms    remaining: 968ms
218:    learn: 35280.3095885    total: 271ms    remaining: 966ms
219:    learn: 35278.4635226    total: 272ms    remaining: 964ms
220:    learn: 35253.5849703    total: 273ms    remaining: 963ms
221:    learn: 35251.8396781    total: 274ms    remaining: 961ms
222:    learn: 35229.4057007    total: 276ms    remaining: 960ms
223:    learn: 35178.6027257    total: 277ms    remaining: 958ms
224:    learn: 35122.4007272    total: 278ms    remaining: 957ms
225:    learn: 35101.3665828    total: 279ms    remaining: 957ms
226:    learn: 35098.6893496    total: 281ms    remaining: 955ms
227:    learn: 35096.2601963    total: 282ms    remaining: 954ms
228:    learn: 35049.5969847    total: 283ms    remaining: 953ms
229:    learn: 35030.7287922    total: 284ms    remaining: 951ms
230:    learn: 34995.1976157    total: 285ms    remaining: 949ms
231:    learn: 34975.9534247    total: 286ms    remaining: 948ms
232:    learn: 34928.3365639    total: 287ms    remaining: 946ms
```

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233:    learn: 34887.9882888    total: 289ms    remaining: 945ms
234:    learn: 34845.2836351    total: 290ms    remaining: 943ms
235:    learn: 34827.2439274    total: 291ms    remaining: 942ms
236:    learn: 34813.1559944    total: 292ms    remaining: 940ms
237:    learn: 34810.4131603    total: 293ms    remaining: 939ms
238:    learn: 34808.5968013    total: 294ms    remaining: 937ms
239:    learn: 34807.1733170    total: 295ms    remaining: 935ms
240:    learn: 34764.6405434    total: 297ms    remaining: 934ms
241:    learn: 34762.8160948    total: 298ms    remaining: 932ms
242:    learn: 34740.3102135    total: 299ms    remaining: 931ms
243:    learn: 34671.5711152    total: 300ms    remaining: 930ms
244:    learn: 34669.9252486    total: 301ms    remaining: 928ms
245:    learn: 34644.7499464    total: 302ms    remaining: 927ms
246:    learn: 34579.1609035    total: 304ms    remaining: 925ms
247:    learn: 34552.9143002    total: 305ms    remaining: 924ms
248:    learn: 34527.1898224    total: 306ms    remaining: 923ms
249:    learn: 34510.7446181    total: 307ms    remaining: 922ms
250:    learn: 34508.2875542    total: 309ms    remaining: 921ms
251:    learn: 34506.6069230    total: 310ms    remaining: 919ms
252:    learn: 34490.8278343    total: 311ms    remaining: 918ms
253:    learn: 34462.0222853    total: 312ms    remaining: 917ms
254:    learn: 34451.1704573    total: 313ms    remaining: 915ms
255:    learn: 34449.5345123    total: 314ms    remaining: 914ms
256:    learn: 34386.9561963    total: 316ms    remaining: 912ms
257:    learn: 34362.0120811    total: 317ms    remaining: 911ms
258:    learn: 34320.5107534    total: 318ms    remaining: 910ms
259:    learn: 34306.8426855    total: 319ms    remaining: 909ms
260:    learn: 34305.2481305    total: 320ms    remaining: 907ms
261:    learn: 34280.7286046    total: 321ms    remaining: 905ms
262:    learn: 34253.8191444    total: 323ms    remaining: 904ms
263:    learn: 34230.8074981    total: 324ms    remaining: 903ms
264:    learn: 34229.2471958    total: 325ms    remaining: 901ms
265:    learn: 34216.1393298    total: 326ms    remaining: 900ms
266:    learn: 34181.7311378    total: 327ms    remaining: 899ms
267:    learn: 34148.8742790    total: 328ms    remaining: 897ms
268:    learn: 34115.6599845    total: 330ms    remaining: 896ms
269:    learn: 34114.1391489    total: 331ms    remaining: 894ms
270:    learn: 34081.7726115    total: 332ms    remaining: 893ms
271:    learn: 34046.5507335    total: 333ms    remaining: 891ms
272:    learn: 34045.1086379    total: 334ms    remaining: 890ms
273:    learn: 34043.5379928    total: 335ms    remaining: 888ms
274:    learn: 34012.1675783    total: 336ms    remaining: 887ms
275:    learn: 33995.2939781    total: 337ms    remaining: 885ms
276:    learn: 33977.4006578    total: 339ms    remaining: 884ms
277:    learn: 33958.5008481    total: 340ms    remaining: 883ms
278:    learn: 33944.3804701    total: 342ms    remaining: 883ms
279:    learn: 33930.7403901    total: 344ms    remaining: 884ms
280:    learn: 33895.1493298    total: 345ms    remaining: 883ms
```

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281:    learn: 33873.4561997    total: 346ms    remaining: 881ms
282:    learn: 33872.1824623    total: 347ms    remaining: 880ms
283:    learn: 33849.7491817    total: 348ms    remaining: 879ms
284:    learn: 33826.9412768    total: 350ms    remaining: 877ms
285:    learn: 33784.8672447    total: 351ms    remaining: 876ms
286:    learn: 33755.2259045    total: 352ms    remaining: 874ms
287:    learn: 33721.0843649    total: 353ms    remaining: 873ms
288:    learn: 33680.2994545    total: 354ms    remaining: 872ms
289:    learn: 33655.1897907    total: 355ms    remaining: 870ms
290:    learn: 33635.9104026    total: 357ms    remaining: 869ms
291:    learn: 33612.7070498    total: 358ms    remaining: 867ms
292:    learn: 33596.9474666    total: 359ms    remaining: 866ms
293:    learn: 33565.7186947    total: 361ms    remaining: 866ms
294:    learn: 33552.7482943    total: 362ms    remaining: 866ms
295:    learn: 33505.9202467    total: 364ms    remaining: 865ms
296:    learn: 33483.3432904    total: 365ms    remaining: 863ms
297:    learn: 33477.8274340    total: 366ms    remaining: 862ms
298:    learn: 33443.0838827    total: 367ms    remaining: 861ms
299:    learn: 33402.2508755    total: 369ms    remaining: 860ms
300:    learn: 33371.4751180    total: 370ms    remaining: 859ms
301:    learn: 33356.5195950    total: 371ms    remaining: 857ms
302:    learn: 33346.6771240    total: 373ms    remaining: 859ms
303:    learn: 33323.3724781    total: 376ms    remaining: 861ms
304:    learn: 33305.9924949    total: 377ms    remaining: 860ms
305:    learn: 33284.9092636    total: 379ms    remaining: 859ms
306:    learn: 33252.4989079    total: 380ms    remaining: 857ms
307:    learn: 33227.4294608    total: 381ms    remaining: 856ms
308:    learn: 33211.0055543    total: 382ms    remaining: 855ms
309:    learn: 33209.7855050    total: 383ms    remaining: 853ms
310:    learn: 33182.9978135    total: 385ms    remaining: 852ms
311:    learn: 33161.7518938    total: 386ms    remaining: 851ms
312:    learn: 33133.5310998    total: 387ms    remaining: 849ms
313:    learn: 33097.1655626    total: 388ms    remaining: 848ms
314:    learn: 33058.5033624    total: 389ms    remaining: 847ms
315:    learn: 33023.4792331    total: 391ms    remaining: 845ms
316:    learn: 32973.9503556    total: 392ms    remaining: 844ms
317:    learn: 32961.3900989    total: 393ms    remaining: 843ms
318:    learn: 32938.6518975    total: 394ms    remaining: 841ms
319:    learn: 32912.2441771    total: 395ms    remaining: 840ms
320:    learn: 32889.5193269    total: 397ms    remaining: 839ms
321:    learn: 32863.2920620    total: 398ms    remaining: 838ms
322:    learn: 32839.8516393    total: 399ms    remaining: 836ms
323:    learn: 32803.2770218    total: 400ms    remaining: 835ms
324:    learn: 32775.3614655    total: 401ms    remaining: 833ms
325:    learn: 32766.3360153    total: 402ms    remaining: 832ms
326:    learn: 32747.3640127    total: 404ms    remaining: 831ms
327:    learn: 32725.4257424    total: 405ms    remaining: 829ms
328:    learn: 32720.5177725    total: 406ms    remaining: 828ms
```

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329:    learn: 32689.9642089    total: 407ms    remaining: 827ms
330:    learn: 32657.3654551    total: 408ms    remaining: 825ms
331:    learn: 32631.2988391    total: 410ms    remaining: 824ms
332:    learn: 32603.2329276    total: 411ms    remaining: 823ms
333:    learn: 32584.0070477    total: 412ms    remaining: 821ms
334:    learn: 32566.3780931    total: 413ms    remaining: 820ms
335:    learn: 32543.9923190    total: 415ms    remaining: 820ms
336:    learn: 32524.6293237    total: 416ms    remaining: 818ms
337:    learn: 32503.1403896    total: 417ms    remaining: 817ms
338:    learn: 32488.5051825    total: 418ms    remaining: 816ms
339:    learn: 32477.9798423    total: 420ms    remaining: 814ms
340:    learn: 32466.3371527    total: 421ms    remaining: 813ms
341:    learn: 32450.2488838    total: 422ms    remaining: 812ms
342:    learn: 32427.8350572    total: 423ms    remaining: 810ms
343:    learn: 32426.3883601    total: 424ms    remaining: 809ms
344:    learn: 32416.0504342    total: 425ms    remaining: 808ms
345:    learn: 32389.6739192    total: 427ms    remaining: 806ms
346:    learn: 32377.6347279    total: 428ms    remaining: 805ms
347:    learn: 32371.8170025    total: 429ms    remaining: 804ms
348:    learn: 32366.6768271    total: 430ms    remaining: 802ms
349:    learn: 32348.8172756    total: 431ms    remaining: 801ms
350:    learn: 32312.6701334    total: 433ms    remaining: 800ms
351:    learn: 32292.0545478    total: 434ms    remaining: 799ms
352:    learn: 32267.3398450    total: 435ms    remaining: 798ms
353:    learn: 32241.5286603    total: 437ms    remaining: 797ms
354:    learn: 32208.3663106    total: 438ms    remaining: 796ms
355:    learn: 32197.5312905    total: 439ms    remaining: 794ms
356:    learn: 32183.0412525    total: 440ms    remaining: 793ms
357:    learn: 32146.2057879    total: 442ms    remaining: 792ms
358:    learn: 32120.0669356    total: 443ms    remaining: 790ms
359:    learn: 32106.2542068    total: 444ms    remaining: 789ms
360:    learn: 32075.3767349    total: 445ms    remaining: 788ms
361:    learn: 32037.5335145    total: 446ms    remaining: 787ms
362:    learn: 31992.2623241    total: 448ms    remaining: 786ms
363:    learn: 31979.2802723    total: 449ms    remaining: 785ms
364:    learn: 31977.9693100    total: 451ms    remaining: 784ms
365:    learn: 31960.2574960    total: 452ms    remaining: 783ms
366:    learn: 31939.9337702    total: 453ms    remaining: 782ms
367:    learn: 31933.0975881    total: 454ms    remaining: 781ms
368:    learn: 31909.6501083    total: 456ms    remaining: 779ms
369:    learn: 31890.3438591    total: 457ms    remaining: 778ms
370:    learn: 31857.6521806    total: 458ms    remaining: 777ms
371:    learn: 31848.7005142    total: 459ms    remaining: 775ms
372:    learn: 31814.9201637    total: 460ms    remaining: 774ms
373:    learn: 31789.3845467    total: 462ms    remaining: 773ms
374:    learn: 31780.6547593    total: 463ms    remaining: 771ms
375:    learn: 31762.0156434    total: 464ms    remaining: 770ms
376:    learn: 31735.8127257    total: 465ms    remaining: 769ms
```

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377:    learn: 31712.4607641    total: 466ms    remaining: 767ms
378:    learn: 31694.4051441    total: 468ms    remaining: 766ms
379:    learn: 31677.6933302    total: 469ms    remaining: 765ms
380:    learn: 31656.2127050    total: 470ms    remaining: 763ms
381:    learn: 31650.0543802    total: 471ms    remaining: 762ms
382:    learn: 31637.4055658    total: 472ms    remaining: 761ms
383:    learn: 31623.2623165    total: 474ms    remaining: 760ms
384:    learn: 31622.3956689    total: 475ms    remaining: 758ms
385:    learn: 31595.2538735    total: 476ms    remaining: 757ms
386:    learn: 31581.0591298    total: 477ms    remaining: 756ms
387:    learn: 31561.2654504    total: 478ms    remaining: 754ms
388:    learn: 31534.4407206    total: 479ms    remaining: 753ms
389:    learn: 31515.6733405    total: 481ms    remaining: 752ms
390:    learn: 31491.1164248    total: 482ms    remaining: 751ms
391:    learn: 31482.7327645    total: 483ms    remaining: 749ms
392:    learn: 31462.2212206    total: 484ms    remaining: 748ms
393:    learn: 31438.3679814    total: 485ms    remaining: 747ms
394:    learn: 31403.8759223    total: 487ms    remaining: 745ms
395:    learn: 31369.7266997    total: 488ms    remaining: 744ms
396:    learn: 31346.5510882    total: 489ms    remaining: 743ms
397:    learn: 31318.4571202    total: 490ms    remaining: 741ms
398:    learn: 31294.6988140    total: 491ms    remaining: 740ms
399:    learn: 31250.8968968    total: 493ms    remaining: 739ms
400:    learn: 31226.9259570    total: 494ms    remaining: 738ms
401:    learn: 31213.4186617    total: 495ms    remaining: 736ms
402:    learn: 31203.9556706    total: 496ms    remaining: 735ms
403:    learn: 31176.8869339    total: 497ms    remaining: 734ms
404:    learn: 31176.0909138    total: 498ms    remaining: 732ms
405:    learn: 31168.2566171    total: 500ms    remaining: 731ms
406:    learn: 31148.7381039    total: 501ms    remaining: 730ms
407:    learn: 31130.4939331    total: 502ms    remaining: 728ms
408:    learn: 31101.6481921    total: 503ms    remaining: 727ms
409:    learn: 31078.8358502    total: 504ms    remaining: 726ms
410:    learn: 31065.1775807    total: 505ms    remaining: 724ms
411:    learn: 31044.9104142    total: 507ms    remaining: 723ms
412:    learn: 31009.6213950    total: 508ms    remaining: 722ms
413:    learn: 30994.9990660    total: 509ms    remaining: 720ms
414:    learn: 30977.0555027    total: 510ms    remaining: 719ms
415:    learn: 30951.8742181    total: 511ms    remaining: 718ms
416:    learn: 30935.3751042    total: 513ms    remaining: 717ms
417:    learn: 30909.6016734    total: 514ms    remaining: 715ms
418:    learn: 30899.7904383    total: 515ms    remaining: 714ms
419:    learn: 30892.9188239    total: 516ms    remaining: 713ms
420:    learn: 30881.4996398    total: 517ms    remaining: 712ms
421:    learn: 30862.3623740    total: 519ms    remaining: 710ms
422:    learn: 30842.2393643    total: 520ms    remaining: 709ms
423:    learn: 30823.5626924    total: 521ms    remaining: 708ms
424:    learn: 30807.1196571    total: 522ms    remaining: 706ms
```

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425:    learn: 30780.4832763    total: 523ms    remaining: 705ms
426:    learn: 30779.7319872    total: 524ms    remaining: 704ms
427:    learn: 30751.7162199    total: 526ms    remaining: 702ms
428:    learn: 30735.9513834    total: 527ms    remaining: 701ms
429:    learn: 30716.1050819    total: 528ms    remaining: 700ms
430:    learn: 30693.3488345    total: 529ms    remaining: 699ms
431:    learn: 30672.8950773    total: 530ms    remaining: 697ms
432:    learn: 30667.4140615    total: 532ms    remaining: 696ms
433:    learn: 30666.7165165    total: 533ms    remaining: 695ms
434:    learn: 30645.1939958    total: 534ms    remaining: 694ms
435:    learn: 30630.4272651    total: 535ms    remaining: 693ms
436:    learn: 30619.0729107    total: 537ms    remaining: 691ms
437:    learn: 30599.1491397    total: 538ms    remaining: 690ms
438:    learn: 30596.6850095    total: 539ms    remaining: 689ms
439:    learn: 30568.6150504    total: 540ms    remaining: 687ms
440:    learn: 30544.5609694    total: 541ms    remaining: 686ms
441:    learn: 30515.6582614    total: 543ms    remaining: 685ms
442:    learn: 30514.8187608    total: 544ms    remaining: 684ms
443:    learn: 30493.8267504    total: 545ms    remaining: 682ms
444:    learn: 30493.1653079    total: 546ms    remaining: 681ms
445:    learn: 30475.0331227    total: 547ms    remaining: 680ms
446:    learn: 30460.8445362    total: 549ms    remaining: 679ms
447:    learn: 30451.5776082    total: 550ms    remaining: 677ms
448:    learn: 30442.3752464    total: 551ms    remaining: 676ms
449:    learn: 30426.9840341    total: 552ms    remaining: 675ms
450:    learn: 30410.4717325    total: 553ms    remaining: 674ms
451:    learn: 30396.2307195    total: 555ms    remaining: 672ms
452:    learn: 30382.4879556    total: 556ms    remaining: 671ms
453:    learn: 30360.1045595    total: 557ms    remaining: 670ms
454:    learn: 30345.2099284    total: 558ms    remaining: 669ms
455:    learn: 30342.7453478    total: 559ms    remaining: 667ms
456:    learn: 30322.4072199    total: 561ms    remaining: 666ms
457:    learn: 30304.8941565    total: 563ms    remaining: 666ms
458:    learn: 30289.0785555    total: 565ms    remaining: 666ms
459:    learn: 30288.3527017    total: 566ms    remaining: 665ms
460:    learn: 30277.1631314    total: 567ms    remaining: 663ms
461:    learn: 30264.4003823    total: 569ms    remaining: 662ms
462:    learn: 30250.3415913    total: 570ms    remaining: 661ms
463:    learn: 30233.4837396    total: 571ms    remaining: 660ms
464:    learn: 30207.9367320    total: 572ms    remaining: 658ms
465:    learn: 30179.0309499    total: 573ms    remaining: 657ms
466:    learn: 30150.6493868    total: 575ms    remaining: 656ms
467:    learn: 30138.7737204    total: 576ms    remaining: 655ms
468:    learn: 30120.6690040    total: 577ms    remaining: 653ms
469:    learn: 30113.0229938    total: 578ms    remaining: 652ms
470:    learn: 30099.0104678    total: 579ms    remaining: 651ms
471:    learn: 30090.9051144    total: 581ms    remaining: 649ms
472:    learn: 30077.9831937    total: 582ms    remaining: 648ms
```

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473:    learn: 30063.6588547    total: 583ms    remaining: 647ms
474:    learn: 30062.8031971    total: 584ms    remaining: 645ms
475:    learn: 30047.3508973    total: 585ms    remaining: 644ms
476:    learn: 30045.1731897    total: 586ms    remaining: 643ms
477:    learn: 30029.0722902    total: 588ms    remaining: 642ms
478:    learn: 30007.8109082    total: 589ms    remaining: 640ms
479:    learn: 30004.4064202    total: 590ms    remaining: 639ms
480:    learn: 29996.7129058    total: 591ms    remaining: 638ms
481:    learn: 29974.3309067    total: 592ms    remaining: 637ms
482:    learn: 29963.1469283    total: 594ms    remaining: 635ms
483:    learn: 29947.4438983    total: 595ms    remaining: 634ms
484:    learn: 29931.2983547    total: 596ms    remaining: 633ms
485:    learn: 29928.7993175    total: 597ms    remaining: 631ms
486:    learn: 29913.1251365    total: 598ms    remaining: 630ms
487:    learn: 29897.7908912    total: 599ms    remaining: 629ms
488:    learn: 29891.3722304    total: 601ms    remaining: 628ms
489:    learn: 29881.6296481    total: 602ms    remaining: 626ms
490:    learn: 29874.7272657    total: 603ms    remaining: 625ms
491:    learn: 29869.8526644    total: 604ms    remaining: 624ms
492:    learn: 29869.0853219    total: 605ms    remaining: 622ms
493:    learn: 29829.0721020    total: 606ms    remaining: 621ms
494:    learn: 29813.9726553    total: 608ms    remaining: 620ms
495:    learn: 29797.2134238    total: 609ms    remaining: 619ms
496:    learn: 29769.7807890    total: 610ms    remaining: 617ms
497:    learn: 29756.7084858    total: 611ms    remaining: 616ms
498:    learn: 29726.3113917    total: 613ms    remaining: 615ms
499:    learn: 29710.3415874    total: 614ms    remaining: 614ms
500:    learn: 29689.5241041    total: 615ms    remaining: 612ms
501:    learn: 29676.9536120    total: 616ms    remaining: 611ms
502:    learn: 29667.7505372    total: 617ms    remaining: 610ms
503:    learn: 29653.5170161    total: 618ms    remaining: 608ms
504:    learn: 29638.7902847    total: 619ms    remaining: 607ms
505:    learn: 29619.2361408    total: 621ms    remaining: 606ms
506:    learn: 29596.3305528    total: 622ms    remaining: 605ms
507:    learn: 29582.1276516    total: 623ms    remaining: 603ms
508:    learn: 29571.9459463    total: 624ms    remaining: 602ms
509:    learn: 29562.4198214    total: 625ms    remaining: 601ms
510:    learn: 29541.2832115    total: 627ms    remaining: 600ms
511:    learn: 29523.9199650    total: 628ms    remaining: 598ms
512:    learn: 29508.3010184    total: 629ms    remaining: 597ms
513:    learn: 29499.9232735    total: 630ms    remaining: 596ms
514:    learn: 29476.1989608    total: 632ms    remaining: 595ms
515:    learn: 29475.6610088    total: 633ms    remaining: 593ms
516:    learn: 29464.8629825    total: 634ms    remaining: 592ms
517:    learn: 29454.3951609    total: 635ms    remaining: 591ms
518:    learn: 29426.5804866    total: 636ms    remaining: 590ms
519:    learn: 29414.0693494    total: 637ms    remaining: 588ms
520:    learn: 29402.9446719    total: 638ms    remaining: 587ms
```

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521:    learn: 29374.4928091    total: 640ms    remaining: 586ms
522:    learn: 29361.6163268    total: 641ms    remaining: 584ms
523:    learn: 29349.6487950    total: 642ms    remaining: 583ms
524:    learn: 29332.5025854    total: 643ms    remaining: 582ms
525:    learn: 29326.7230798    total: 644ms    remaining: 581ms
526:    learn: 29291.7653193    total: 646ms    remaining: 580ms
527:    learn: 29281.2156790    total: 647ms    remaining: 578ms
528:    learn: 29279.8147314    total: 648ms    remaining: 577ms
529:    learn: 29268.8156557    total: 649ms    remaining: 576ms
530:    learn: 29245.7195638    total: 650ms    remaining: 574ms
531:    learn: 29234.4242791    total: 652ms    remaining: 573ms
532:    learn: 29220.0682308    total: 653ms    remaining: 572ms
533:    learn: 29216.6984729    total: 654ms    remaining: 571ms
534:    learn: 29194.8856890    total: 655ms    remaining: 569ms
535:    learn: 29174.1347471    total: 656ms    remaining: 568ms
536:    learn: 29167.3589020    total: 658ms    remaining: 567ms
537:    learn: 29160.7839717    total: 659ms    remaining: 566ms
538:    learn: 29135.4316370    total: 660ms    remaining: 564ms
539:    learn: 29114.8727708    total: 661ms    remaining: 563ms
540:    learn: 29114.3346345    total: 662ms    remaining: 562ms
541:    learn: 29093.8199618    total: 663ms    remaining: 561ms
542:    learn: 29076.3419994    total: 665ms    remaining: 560ms
543:    learn: 29066.0039457    total: 666ms    remaining: 559ms
544:    learn: 29054.2950981    total: 667ms    remaining: 557ms
545:    learn: 29043.3145918    total: 669ms    remaining: 556ms
546:    learn: 29016.6047771    total: 670ms    remaining: 555ms
547:    learn: 29010.0917183    total: 671ms    remaining: 553ms
548:    learn: 28993.8576604    total: 672ms    remaining: 552ms
549:    learn: 28982.7255092    total: 673ms    remaining: 551ms
550:    learn: 28965.3856675    total: 675ms    remaining: 550ms
551:    learn: 28950.8572764    total: 676ms    remaining: 548ms
552:    learn: 28941.8258860    total: 677ms    remaining: 547ms
553:    learn: 28918.1797208    total: 678ms    remaining: 546ms
554:    learn: 28910.6069664    total: 679ms    remaining: 545ms
555:    learn: 28897.5809138    total: 680ms    remaining: 543ms
556:    learn: 28896.1172648    total: 682ms    remaining: 542ms
557:    learn: 28878.6195640    total: 683ms    remaining: 541ms
558:    learn: 28871.9050996    total: 684ms    remaining: 540ms
559:    learn: 28862.9249208    total: 685ms    remaining: 538ms
560:    learn: 28842.7681388    total: 686ms    remaining: 537ms
561:    learn: 28823.6043969    total: 688ms    remaining: 536ms
562:    learn: 28797.9277400    total: 689ms    remaining: 535ms
563:    learn: 28782.8134059    total: 690ms    remaining: 533ms
564:    learn: 28766.4378257    total: 691ms    remaining: 532ms
565:    learn: 28757.4270793    total: 692ms    remaining: 531ms
566:    learn: 28747.8103279    total: 693ms    remaining: 530ms
567:    learn: 28729.3358649    total: 695ms    remaining: 528ms
568:    learn: 28718.1170518    total: 696ms    remaining: 527ms
```

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569:    learn: 28696.1981100    total: 697ms    remaining: 526ms
570:    learn: 28685.2604306    total: 698ms    remaining: 525ms
571:    learn: 28684.7285009    total: 699ms    remaining: 523ms
572:    learn: 28684.2514820    total: 700ms    remaining: 522ms
573:    learn: 28666.5871421    total: 702ms    remaining: 521ms
574:    learn: 28648.7869288    total: 703ms    remaining: 519ms
575:    learn: 28638.0115353    total: 704ms    remaining: 518ms
576:    learn: 28620.1242597    total: 705ms    remaining: 517ms
577:    learn: 28602.3418922    total: 706ms    remaining: 516ms
578:    learn: 28584.1662222    total: 707ms    remaining: 514ms
579:    learn: 28553.9610833    total: 709ms    remaining: 513ms
580:    learn: 28553.3275983    total: 710ms    remaining: 512ms
581:    learn: 28533.6554547    total: 711ms    remaining: 511ms
582:    learn: 28525.6125273    total: 712ms    remaining: 509ms
583:    learn: 28517.2958906    total: 713ms    remaining: 508ms
584:    learn: 28514.3112818    total: 715ms    remaining: 507ms
585:    learn: 28504.7112435    total: 716ms    remaining: 506ms
586:    learn: 28482.3786741    total: 717ms    remaining: 504ms
587:    learn: 28473.0804706    total: 718ms    remaining: 503ms
588:    learn: 28470.2942566    total: 719ms    remaining: 502ms
589:    learn: 28459.2720794    total: 720ms    remaining: 501ms
590:    learn: 28457.8508968    total: 722ms    remaining: 499ms
591:    learn: 28450.9073231    total: 723ms    remaining: 498ms
592:    learn: 28434.1963335    total: 724ms    remaining: 497ms
593:    learn: 28409.1748084    total: 725ms    remaining: 496ms
594:    learn: 28399.5407762    total: 727ms    remaining: 495ms
595:    learn: 28391.3822315    total: 729ms    remaining: 494ms
596:    learn: 28377.7165200    total: 730ms    remaining: 493ms
597:    learn: 28377.2387385    total: 732ms    remaining: 492ms
598:    learn: 28373.4695868    total: 733ms    remaining: 490ms
599:    learn: 28358.3176154    total: 734ms    remaining: 489ms
600:    learn: 28344.8723770    total: 735ms    remaining: 488ms
601:    learn: 28327.7408598    total: 736ms    remaining: 487ms
602:    learn: 28327.1731642    total: 737ms    remaining: 486ms
603:    learn: 28311.9737210    total: 739ms    remaining: 484ms
604:    learn: 28302.5268160    total: 740ms    remaining: 483ms
605:    learn: 28285.8562939    total: 741ms    remaining: 482ms
606:    learn: 28274.4028054    total: 742ms    remaining: 481ms
607:    learn: 28260.4729846    total: 743ms    remaining: 479ms
608:    learn: 28254.5154947    total: 745ms    remaining: 478ms
609:    learn: 28239.8822585    total: 746ms    remaining: 477ms
610:    learn: 28228.9406756    total: 747ms    remaining: 476ms
611:    learn: 28214.5428049    total: 748ms    remaining: 474ms
612:    learn: 28203.0238462    total: 751ms    remaining: 474ms
613:    learn: 28202.5690869    total: 752ms    remaining: 473ms
614:    learn: 28178.4689207    total: 756ms    remaining: 473ms
615:    learn: 28170.9185413    total: 757ms    remaining: 472ms
616:    learn: 28163.1927044    total: 758ms    remaining: 471ms
```

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617:    learn: 28149.0358361    total: 759ms    remaining: 469ms
618:    learn: 28142.8008496    total: 760ms    remaining: 468ms
619:    learn: 28134.0523651    total: 762ms    remaining: 467ms
620:    learn: 28116.0814003    total: 763ms    remaining: 466ms
621:    learn: 28093.8514616    total: 764ms    remaining: 464ms
622:    learn: 28084.9756192    total: 765ms    remaining: 463ms
623:    learn: 28078.4851745    total: 766ms    remaining: 462ms
624:    learn: 28076.5434781    total: 768ms    remaining: 461ms
625:    learn: 28063.6476508    total: 769ms    remaining: 459ms
626:    learn: 28047.6452759    total: 770ms    remaining: 458ms
627:    learn: 28021.9193836    total: 771ms    remaining: 457ms
628:    learn: 28009.2780082    total: 772ms    remaining: 455ms
629:    learn: 28001.3416722    total: 773ms    remaining: 454ms
630:    learn: 27996.0432164    total: 775ms    remaining: 453ms
631:    learn: 27988.7557984    total: 776ms    remaining: 452ms
632:    learn: 27973.6761445    total: 777ms    remaining: 450ms
633:    learn: 27962.9813810    total: 778ms    remaining: 449ms
634:    learn: 27953.6205897    total: 779ms    remaining: 448ms
635:    learn: 27935.1167699    total: 781ms    remaining: 447ms
636:    learn: 27932.5309187    total: 782ms    remaining: 445ms
637:    learn: 27926.8821448    total: 783ms    remaining: 444ms
638:    learn: 27919.4359826    total: 784ms    remaining: 443ms
639:    learn: 27909.1557918    total: 785ms    remaining: 442ms
640:    learn: 27895.1348392    total: 787ms    remaining: 441ms
641:    learn: 27877.3391965    total: 788ms    remaining: 439ms
642:    learn: 27871.8008143    total: 789ms    remaining: 438ms
643:    learn: 27854.0993745    total: 790ms    remaining: 437ms
644:    learn: 27837.2935958    total: 791ms    remaining: 436ms
645:    learn: 27826.0609047    total: 792ms    remaining: 434ms
646:    learn: 27811.7214397    total: 794ms    remaining: 433ms
647:    learn: 27793.6864776    total: 796ms    remaining: 432ms
648:    learn: 27777.6762494    total: 797ms    remaining: 431ms
649:    learn: 27759.5363758    total: 798ms    remaining: 430ms
650:    learn: 27758.8608585    total: 799ms    remaining: 428ms
651:    learn: 27751.8480422    total: 801ms    remaining: 427ms
652:    learn: 27751.3699515    total: 802ms    remaining: 426ms
653:    learn: 27734.3651661    total: 803ms    remaining: 425ms
654:    learn: 27724.1623851    total: 805ms    remaining: 424ms
655:    learn: 27707.5238389    total: 806ms    remaining: 423ms
656:    learn: 27681.6984654    total: 807ms    remaining: 421ms
657:    learn: 27665.3465168    total: 808ms    remaining: 420ms
658:    learn: 27654.9355075    total: 809ms    remaining: 419ms
659:    learn: 27638.8008063    total: 813ms    remaining: 419ms
660:    learn: 27608.0862865    total: 815ms    remaining: 418ms
661:    learn: 27599.6388754    total: 818ms    remaining: 418ms
662:    learn: 27588.6943571    total: 822ms    remaining: 418ms
663:    learn: 27587.5606898    total: 825ms    remaining: 418ms
664:    learn: 27581.2442336    total: 826ms    remaining: 416ms
```

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665:    learn: 27579.6534676    total: 827ms    remaining: 415ms
666:    learn: 27572.9187940    total: 829ms    remaining: 414ms
667:    learn: 27570.7098808    total: 830ms    remaining: 412ms
668:    learn: 27555.7692189    total: 831ms    remaining: 411ms
669:    learn: 27543.3347143    total: 832ms    remaining: 410ms
670:    learn: 27533.5029640    total: 833ms    remaining: 409ms
671:    learn: 27506.4646480    total: 834ms    remaining: 407ms
672:    learn: 27496.3910975    total: 835ms    remaining: 406ms
673:    learn: 27485.6291441    total: 837ms    remaining: 405ms
674:    learn: 27476.8888391    total: 838ms    remaining: 403ms
675:    learn: 27470.4493856    total: 839ms    remaining: 402ms
676:    learn: 27452.2802467    total: 841ms    remaining: 401ms
677:    learn: 27442.7450147    total: 842ms    remaining: 400ms
678:    learn: 27433.2154844    total: 843ms    remaining: 399ms
679:    learn: 27422.7162480    total: 845ms    remaining: 397ms
680:    learn: 27407.9664848    total: 846ms    remaining: 396ms
681:    learn: 27402.0419379    total: 847ms    remaining: 395ms
682:    learn: 27386.5501965    total: 849ms    remaining: 394ms
683:    learn: 27376.2083918    total: 850ms    remaining: 393ms
684:    learn: 27364.0386013    total: 852ms    remaining: 392ms
685:    learn: 27349.1999315    total: 853ms    remaining: 390ms
686:    learn: 27348.6118992    total: 854ms    remaining: 389ms
687:    learn: 27340.4576097    total: 855ms    remaining: 388ms
688:    learn: 27319.4837387    total: 857ms    remaining: 387ms
689:    learn: 27300.8898192    total: 858ms    remaining: 385ms
690:    learn: 27289.4611254    total: 859ms    remaining: 384ms
691:    learn: 27275.0785215    total: 860ms    remaining: 383ms
692:    learn: 27274.2120719    total: 861ms    remaining: 382ms
693:    learn: 27252.1157156    total: 863ms    remaining: 380ms
694:    learn: 27238.7706128    total: 864ms    remaining: 379ms
695:    learn: 27220.9957375    total: 865ms    remaining: 378ms
696:    learn: 27214.5963311    total: 866ms    remaining: 377ms
697:    learn: 27200.3336213    total: 868ms    remaining: 375ms
698:    learn: 27192.7199335    total: 869ms    remaining: 374ms
699:    learn: 27182.4969539    total: 871ms    remaining: 373ms
700:    learn: 27169.2131315    total: 872ms    remaining: 372ms
701:    learn: 27157.8935992    total: 874ms    remaining: 371ms
702:    learn: 27134.0825545    total: 875ms    remaining: 370ms
703:    learn: 27118.7605420    total: 877ms    remaining: 369ms
704:    learn: 27112.3806844    total: 878ms    remaining: 368ms
705:    learn: 27091.0571589    total: 880ms    remaining: 366ms
706:    learn: 27077.7202366    total: 881ms    remaining: 365ms
707:    learn: 27071.8697992    total: 882ms    remaining: 364ms
708:    learn: 27050.7724357    total: 883ms    remaining: 363ms
709:    learn: 27041.9723231    total: 885ms    remaining: 361ms
710:    learn: 27034.7441721    total: 886ms    remaining: 360ms
711:    learn: 27029.2460580    total: 887ms    remaining: 359ms
712:    learn: 27021.4125230    total: 888ms    remaining: 358ms
```

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713:    learn: 27004.2056811    total: 890ms    remaining: 356ms
714:    learn: 26996.0559465    total: 891ms    remaining: 355ms
715:    learn: 26974.5564134    total: 892ms    remaining: 354ms
716:    learn: 26964.5899807    total: 893ms    remaining: 353ms
717:    learn: 26955.4958231    total: 894ms    remaining: 351ms
718:    learn: 26937.0361375    total: 895ms    remaining: 350ms
719:    learn: 26920.4049484    total: 897ms    remaining: 349ms
720:    learn: 26913.6978976    total: 898ms    remaining: 347ms
721:    learn: 26908.7556832    total: 899ms    remaining: 346ms
722:    learn: 26908.0779837    total: 900ms    remaining: 345ms
723:    learn: 26907.7833448    total: 901ms    remaining: 344ms
724:    learn: 26903.0406465    total: 903ms    remaining: 342ms
725:    learn: 26892.6349770    total: 904ms    remaining: 341ms
726:    learn: 26886.2410553    total: 905ms    remaining: 340ms
727:    learn: 26870.4548272    total: 906ms    remaining: 339ms
728:    learn: 26851.1797050    total: 907ms    remaining: 337ms
729:    learn: 26844.3111454    total: 908ms    remaining: 336ms
730:    learn: 26835.8691943    total: 910ms    remaining: 335ms
731:    learn: 26815.6231698    total: 911ms    remaining: 333ms
732:    learn: 26806.6520598    total: 912ms    remaining: 332ms
733:    learn: 26785.5136744    total: 913ms    remaining: 331ms
734:    learn: 26771.1293716    total: 914ms    remaining: 330ms
735:    learn: 26755.8572415    total: 916ms    remaining: 328ms
736:    learn: 26748.2007676    total: 917ms    remaining: 327ms
737:    learn: 26736.9935758    total: 918ms    remaining: 326ms
738:    learn: 26720.0600307    total: 919ms    remaining: 325ms
739:    learn: 26713.5677530    total: 920ms    remaining: 323ms
740:    learn: 26704.6570480    total: 922ms    remaining: 322ms
741:    learn: 26703.5534032    total: 923ms    remaining: 321ms
742:    learn: 26686.2885055    total: 924ms    remaining: 320ms
743:    learn: 26683.0757997    total: 926ms    remaining: 319ms
744:    learn: 26668.1123449    total: 927ms    remaining: 317ms
745:    learn: 26658.3233586    total: 928ms    remaining: 316ms
746:    learn: 26649.2878068    total: 929ms    remaining: 315ms
747:    learn: 26632.8830150    total: 931ms    remaining: 314ms
748:    learn: 26618.4438560    total: 932ms    remaining: 312ms
749:    learn: 26609.3396795    total: 934ms    remaining: 311ms
750:    learn: 26597.7683138    total: 935ms    remaining: 310ms
751:    learn: 26590.6387288    total: 937ms    remaining: 309ms
752:    learn: 26568.7700520    total: 938ms    remaining: 308ms
753:    learn: 26565.7107572    total: 939ms    remaining: 306ms
754:    learn: 26556.3640465    total: 942ms    remaining: 306ms
755:    learn: 26542.9969783    total: 943ms    remaining: 305ms
756:    learn: 26533.0750043    total: 946ms    remaining: 304ms
757:    learn: 26518.5927341    total: 947ms    remaining: 302ms
758:    learn: 26511.1593236    total: 948ms    remaining: 301ms
759:    learn: 26506.6423774    total: 949ms    remaining: 300ms
760:    learn: 26498.7053809    total: 950ms    remaining: 299ms
```

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761:    learn: 26497.3692181    total: 952ms    remaining: 297ms
762:    learn: 26482.0012179    total: 953ms    remaining: 296ms
763:    learn: 26475.6071240    total: 954ms    remaining: 295ms
764:    learn: 26465.2778362    total: 955ms    remaining: 293ms
765:    learn: 26457.7749670    total: 956ms    remaining: 292ms
766:    learn: 26448.6602831    total: 957ms    remaining: 291ms
767:    learn: 26444.2827318    total: 959ms    remaining: 290ms
768:    learn: 26427.4407385    total: 960ms    remaining: 288ms
769:    learn: 26417.8985981    total: 961ms    remaining: 287ms
770:    learn: 26405.3722117    total: 962ms    remaining: 286ms
771:    learn: 26395.9217471    total: 963ms    remaining: 285ms
772:    learn: 26389.4665732    total: 964ms    remaining: 283ms
773:    learn: 26384.4898463    total: 966ms    remaining: 282ms
774:    learn: 26379.4789732    total: 967ms    remaining: 281ms
775:    learn: 26359.0061733    total: 968ms    remaining: 279ms
776:    learn: 26342.3714587    total: 969ms    remaining: 278ms
777:    learn: 26327.5007719    total: 970ms    remaining: 277ms
778:    learn: 26323.2287852    total: 972ms    remaining: 276ms
779:    learn: 26319.1847975    total: 973ms    remaining: 275ms
780:    learn: 26303.8147033    total: 975ms    remaining: 273ms
781:    learn: 26297.8672478    total: 976ms    remaining: 272ms
782:    learn: 26293.9028757    total: 977ms    remaining: 271ms
783:    learn: 26287.4514112    total: 979ms    remaining: 270ms
784:    learn: 26268.9384187    total: 980ms    remaining: 268ms
785:    learn: 26245.3524538    total: 981ms    remaining: 267ms
786:    learn: 26236.6042557    total: 982ms    remaining: 266ms
787:    learn: 26235.9710197    total: 983ms    remaining: 265ms
788:    learn: 26223.7091805    total: 985ms    remaining: 263ms
789:    learn: 26218.2004486    total: 986ms    remaining: 262ms
790:    learn: 26208.6980541    total: 987ms    remaining: 261ms
791:    learn: 26203.7666936    total: 988ms    remaining: 259ms
792:    learn: 26187.2948916    total: 989ms    remaining: 258ms
793:    learn: 26167.6116385    total: 990ms    remaining: 257ms
794:    learn: 26157.1900970    total: 992ms    remaining: 256ms
795:    learn: 26146.2236443    total: 993ms    remaining: 254ms
796:    learn: 26138.2934449    total: 994ms    remaining: 253ms
797:    learn: 26124.9434384    total: 995ms    remaining: 252ms
798:    learn: 26116.9820698    total: 996ms    remaining: 251ms
799:    learn: 26105.5381570    total: 998ms    remaining: 249ms
800:    learn: 26104.2514457    total: 999ms    remaining: 248ms
801:    learn: 26088.0433333    total: 1000ms   remaining: 247ms
802:    learn: 26073.1664448    total: 1s       remaining: 246ms
803:    learn: 26056.4134996    total: 1s       remaining: 244ms
804:    learn: 26042.9092347    total: 1s       remaining: 243ms
805:    learn: 26030.4411183    total: 1s       remaining: 242ms
806:    learn: 26011.6605306    total: 1s       remaining: 241ms
807:    learn: 26003.0742398    total: 1.01s    remaining: 239ms
808:    learn: 25992.6859916    total: 1.01s    remaining: 238ms
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809:    learn: 25988.8577548    total: 1.01s    remaining: 237ms
810:    learn: 25982.3620987    total: 1.01s    remaining: 235ms
811:    learn: 25974.1878992    total: 1.01s    remaining: 234ms
812:    learn: 25965.7478676    total: 1.01s    remaining: 233ms
813:    learn: 25950.9595598    total: 1.01s    remaining: 232ms
814:    learn: 25939.3111253    total: 1.01s    remaining: 230ms
815:    learn: 25927.0007244    total: 1.02s    remaining: 229ms
816:    learn: 25915.8465247    total: 1.02s    remaining: 228ms
817:    learn: 25905.7483136    total: 1.02s    remaining: 227ms
818:    learn: 25884.0395925    total: 1.02s    remaining: 225ms
819:    learn: 25877.2975241    total: 1.02s    remaining: 224ms
820:    learn: 25872.8512372    total: 1.02s    remaining: 223ms
821:    learn: 25861.2228218    total: 1.02s    remaining: 222ms
822:    learn: 25858.5265201    total: 1.02s    remaining: 220ms
823:    learn: 25850.9412056    total: 1.02s    remaining: 219ms
824:    learn: 25839.8864282    total: 1.03s    remaining: 218ms
825:    learn: 25822.1760903    total: 1.03s    remaining: 217ms
826:    learn: 25821.6663739    total: 1.03s    remaining: 215ms
827:    learn: 25808.4271567    total: 1.03s    remaining: 214ms
828:    learn: 25799.0760048    total: 1.03s    remaining: 213ms
829:    learn: 25786.4844581    total: 1.03s    remaining: 212ms
830:    learn: 25778.6004846    total: 1.03s    remaining: 210ms
831:    learn: 25753.9359037    total: 1.03s    remaining: 209ms
832:    learn: 25737.2601529    total: 1.04s    remaining: 208ms
833:    learn: 25735.9200444    total: 1.04s    remaining: 206ms
834:    learn: 25726.5039953    total: 1.04s    remaining: 205ms
835:    learn: 25719.5144650    total: 1.04s    remaining: 204ms
836:    learn: 25703.7720300    total: 1.04s    remaining: 203ms
837:    learn: 25697.4140097    total: 1.04s    remaining: 201ms
838:    learn: 25690.5541002    total: 1.04s    remaining: 200ms
839:    learn: 25682.9105462    total: 1.04s    remaining: 199ms
840:    learn: 25673.1943874    total: 1.04s    remaining: 198ms
841:    learn: 25667.6899596    total: 1.05s    remaining: 196ms
842:    learn: 25648.3236071    total: 1.05s    remaining: 195ms
843:    learn: 25637.8887044    total: 1.05s    remaining: 194ms
844:    learn: 25636.4798495    total: 1.05s    remaining: 193ms
845:    learn: 25617.8877305    total: 1.05s    remaining: 191ms
846:    learn: 25604.0068814    total: 1.05s    remaining: 190ms
847:    learn: 25595.2361196    total: 1.05s    remaining: 189ms
848:    learn: 25584.1498709    total: 1.05s    remaining: 188ms
849:    learn: 25582.4275741    total: 1.06s    remaining: 186ms
850:    learn: 25571.1727009    total: 1.06s    remaining: 185ms
851:    learn: 25554.6367004    total: 1.06s    remaining: 184ms
852:    learn: 25548.1564550    total: 1.06s    remaining: 183ms
853:    learn: 25542.4932039    total: 1.06s    remaining: 181ms
854:    learn: 25541.6784388    total: 1.06s    remaining: 180ms
855:    learn: 25541.4421670    total: 1.06s    remaining: 179ms
856:    learn: 25533.0970251    total: 1.06s    remaining: 178ms
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857:    learn: 25532.2751132    total: 1.06s    remaining: 176ms
858:    learn: 25522.6673810    total: 1.07s    remaining: 175ms
859:    learn: 25522.3980540    total: 1.07s    remaining: 174ms
860:    learn: 25507.8470382    total: 1.07s    remaining: 173ms
861:    learn: 25500.4956355    total: 1.07s    remaining: 171ms
862:    learn: 25491.0422037    total: 1.07s    remaining: 170ms
863:    learn: 25480.2337897    total: 1.07s    remaining: 169ms
864:    learn: 25465.5133047    total: 1.07s    remaining: 168ms
865:    learn: 25464.5641134    total: 1.08s    remaining: 167ms
866:    learn: 25448.2535265    total: 1.08s    remaining: 165ms
867:    learn: 25440.0479508    total: 1.08s    remaining: 164ms
868:    learn: 25432.3595575    total: 1.08s    remaining: 163ms
869:    learn: 25419.6783602    total: 1.08s    remaining: 162ms
870:    learn: 25408.7822294    total: 1.08s    remaining: 160ms
871:    learn: 25398.7958861    total: 1.08s    remaining: 159ms
872:    learn: 25391.9497955    total: 1.08s    remaining: 158ms
873:    learn: 25381.5755095    total: 1.08s    remaining: 157ms
874:    learn: 25369.5221504    total: 1.09s    remaining: 155ms
875:    learn: 25360.7247030    total: 1.09s    remaining: 154ms
876:    learn: 25352.4125837    total: 1.09s    remaining: 153ms
877:    learn: 25346.4013478    total: 1.09s    remaining: 152ms
878:    learn: 25333.9645952    total: 1.09s    remaining: 150ms
879:    learn: 25311.0803879    total: 1.09s    remaining: 149ms
880:    learn: 25292.9824552    total: 1.09s    remaining: 148ms
881:    learn: 25287.5994624    total: 1.09s    remaining: 147ms
882:    learn: 25279.5498693    total: 1.1s     remaining: 145ms
883:    learn: 25270.1774601    total: 1.1s     remaining: 144ms
884:    learn: 25259.3094776    total: 1.1s     remaining: 143ms
885:    learn: 25244.8827342    total: 1.1s     remaining: 142ms
886:    learn: 25238.5900152    total: 1.1s     remaining: 140ms
887:    learn: 25227.8182804    total: 1.1s     remaining: 139ms
888:    learn: 25218.1474261    total: 1.1s     remaining: 138ms
889:    learn: 25208.5684126    total: 1.1s     remaining: 137ms
890:    learn: 25203.8079612    total: 1.11s    remaining: 135ms
891:    learn: 25198.9462765    total: 1.11s    remaining: 134ms
892:    learn: 25179.8432937    total: 1.11s    remaining: 133ms
893:    learn: 25169.3067315    total: 1.11s    remaining: 132ms
894:    learn: 25166.6437352    total: 1.11s    remaining: 130ms
895:    learn: 25154.9976123    total: 1.11s    remaining: 129ms
896:    learn: 25143.2231730    total: 1.11s    remaining: 128ms
897:    learn: 25133.1196700    total: 1.11s    remaining: 127ms
898:    learn: 25116.8225296    total: 1.12s    remaining: 125ms
899:    learn: 25116.4575325    total: 1.12s    remaining: 124ms
900:    learn: 25100.5886565    total: 1.12s    remaining: 123ms
901:    learn: 25092.0180927    total: 1.12s    remaining: 122ms
902:    learn: 25089.2295112    total: 1.12s    remaining: 120ms
903:    learn: 25089.0215414    total: 1.12s    remaining: 119ms
904:    learn: 25082.4189416    total: 1.12s    remaining: 118ms
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905:    learn: 25075.2325085    total: 1.12s    remaining: 117ms
906:    learn: 25068.8877757    total: 1.13s    remaining: 115ms
907:    learn: 25064.2064282    total: 1.13s    remaining: 114ms
908:    learn: 25052.1300184    total: 1.13s    remaining: 113ms
909:    learn: 25050.2545281    total: 1.13s    remaining: 112ms
910:    learn: 25041.8372295    total: 1.13s    remaining: 111ms
911:    learn: 25026.9399239    total: 1.13s    remaining: 109ms
912:    learn: 25011.7737771    total: 1.14s    remaining: 108ms
913:    learn: 25003.8412882    total: 1.14s    remaining: 107ms
914:    learn: 24998.4477245    total: 1.14s    remaining: 106ms
915:    learn: 24985.9663170    total: 1.14s    remaining: 104ms
916:    learn: 24985.4278138    total: 1.14s    remaining: 103ms
917:    learn: 24977.8665967    total: 1.14s    remaining: 102ms
918:    learn: 24975.2115538    total: 1.14s    remaining: 101ms
919:    learn: 24973.9123548    total: 1.14s    remaining: 99.5ms
920:    learn: 24970.8615034    total: 1.15s    remaining: 98.2ms
921:    learn: 24966.0589898    total: 1.15s    remaining: 97.1ms
922:    learn: 24965.7641216    total: 1.15s    remaining: 95.9ms
923:    learn: 24958.6186760    total: 1.15s    remaining: 94.7ms
924:    learn: 24953.6362713    total: 1.15s    remaining: 93.6ms
925:    learn: 24953.4415525    total: 1.16s    remaining: 92.3ms
926:    learn: 24950.0363394    total: 1.16s    remaining: 91.1ms
927:    learn: 24947.0849123    total: 1.16s    remaining: 89.8ms
928:    learn: 24943.6032771    total: 1.16s    remaining: 88.6ms
929:    learn: 24939.2245017    total: 1.16s    remaining: 87.3ms
930:    learn: 24932.4194666    total: 1.16s    remaining: 86.1ms
931:    learn: 24932.1278733    total: 1.16s    remaining: 84.8ms
932:    learn: 24917.4623924    total: 1.16s    remaining: 83.6ms
933:    learn: 24904.0340721    total: 1.16s    remaining: 82.3ms
934:    learn: 24898.7770101    total: 1.17s    remaining: 81.1ms
935:    learn: 24897.8014837    total: 1.17s    remaining: 79.8ms
936:    learn: 24880.3782076    total: 1.17s    remaining: 78.5ms
937:    learn: 24869.7999666    total: 1.17s    remaining: 77.3ms
938:    learn: 24861.1287689    total: 1.17s    remaining: 76ms
939:    learn: 24849.2931255    total: 1.17s    remaining: 74.8ms
940:    learn: 24849.1157616    total: 1.17s    remaining: 73.5ms
941:    learn: 24836.1323261    total: 1.17s    remaining: 72.3ms
942:    learn: 24831.8014453    total: 1.18s    remaining: 71ms
943:    learn: 24831.6561237    total: 1.18s    remaining: 69.8ms
944:    learn: 24825.8623582    total: 1.18s    remaining: 68.5ms
945:    learn: 24823.7049485    total: 1.18s    remaining: 67.3ms
946:    learn: 24823.4045031    total: 1.18s    remaining: 66ms
947:    learn: 24818.2995863    total: 1.18s    remaining: 64.8ms
948:    learn: 24803.1001879    total: 1.18s    remaining: 63.5ms
949:    learn: 24784.4284476    total: 1.18s    remaining: 62.3ms
950:    learn: 24778.0113185    total: 1.18s    remaining: 61ms
951:    learn: 24774.8365681    total: 1.19s    remaining: 59.8ms
952:    learn: 24762.3353660    total: 1.19s    remaining: 58.5ms
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953:    learn: 24758.6797826    total: 1.19s    remaining: 57.3ms
954:    learn: 24756.6678626    total: 1.19s    remaining: 56ms
955:    learn: 24750.0736353    total: 1.19s    remaining: 54.8ms
956:    learn: 24736.2992943    total: 1.19s    remaining: 53.5ms
957:    learn: 24723.1584631    total: 1.19s    remaining: 52.3ms
958:    learn: 24715.4496876    total: 1.19s    remaining: 51ms
959:    learn: 24707.7566648    total: 1.19s    remaining: 49.8ms
960:    learn: 24696.9778781    total: 1.2s     remaining: 48.5ms
961:    learn: 24692.5360297    total: 1.2s     remaining: 47.3ms
962:    learn: 24686.6947355    total: 1.2s     remaining: 46ms
963:    learn: 24680.4136434    total: 1.2s     remaining: 44.8ms
964:    learn: 24679.4776539    total: 1.2s     remaining: 43.6ms
965:    learn: 24664.9344278    total: 1.2s     remaining: 42.3ms
966:    learn: 24658.4145301    total: 1.2s     remaining: 41.1ms
967:    learn: 24658.2413155    total: 1.2s     remaining: 39.8ms
968:    learn: 24648.1266043    total: 1.21s    remaining: 38.6ms
969:    learn: 24640.9990226    total: 1.21s    remaining: 37.3ms
970:    learn: 24630.1887102    total: 1.21s    remaining: 36.1ms
971:    learn: 24621.9103664    total: 1.21s    remaining: 34.8ms
972:    learn: 24621.7332142    total: 1.21s    remaining: 33.6ms
973:    learn: 24618.2969598    total: 1.21s    remaining: 32.3ms
974:    learn: 24610.9643995    total: 1.21s    remaining: 31.1ms
975:    learn: 24599.2044857    total: 1.21s    remaining: 29.8ms
976:    learn: 24578.5806390    total: 1.21s    remaining: 28.6ms
977:    learn: 24573.3840841    total: 1.22s    remaining: 27.4ms
978:    learn: 24553.9259879    total: 1.22s    remaining: 26.1ms
979:    learn: 24541.0259957    total: 1.22s    remaining: 24.9ms
980:    learn: 24530.2836293    total: 1.22s    remaining: 23.6ms
981:    learn: 24528.0187650    total: 1.22s    remaining: 22.4ms
982:    learn: 24517.6920340    total: 1.22s    remaining: 21.1ms
983:    learn: 24505.6886255    total: 1.22s    remaining: 19.9ms
984:    learn: 24491.1903816    total: 1.22s    remaining: 18.6ms
985:    learn: 24490.9507854    total: 1.23s    remaining: 17.4ms
986:    learn: 24480.1796087    total: 1.23s    remaining: 16.2ms
987:    learn: 24471.3280194    total: 1.23s    remaining: 14.9ms
988:    learn: 24460.9909177    total: 1.23s    remaining: 13.7ms
989:    learn: 24454.0877876    total: 1.23s    remaining: 12.4ms
990:    learn: 24446.3123777    total: 1.23s    remaining: 11.2ms
991:    learn: 24443.9925032    total: 1.23s    remaining: 9.94ms
992:    learn: 24438.7334178    total: 1.23s    remaining: 8.7ms
993:    learn: 24434.6701630    total: 1.24s    remaining: 7.46ms
994:    learn: 24430.4093669    total: 1.24s    remaining: 6.21ms
995:    learn: 24418.6432101    total: 1.24s    remaining: 4.97ms
996:    learn: 24415.0917182    total: 1.24s    remaining: 3.73ms
997:    learn: 24405.4002724    total: 1.24s    remaining: 2.48ms
998:    learn: 24401.7322361    total: 1.24s    remaining: 1.24ms
999:    learn: 24397.7807038    total: 1.24s    remaining: 0us
0.28575303564875276
```

[53]:
```
best_model = {'SVM Regresion':SVM_accuracy, 'Random Forest Regression':␣
 ↪RR_accuracy, 'Linear Regression':lR_accuracy, 'Cat Boost Regressor':
 ↪cb_r2_score}

best_model_name = min(best_model, key=best_model.get)
best_model_value = best_model[best_model_name]

print(best_model_name,':', best_model_value)
```

```
SVM Regresion : 0.17054583991574104
```