Mercedes-Benz Greener Manufacturing

1.0 Business Problem

1.1 Description

Since the first automobile, the Benz Patent Motor Car in 1886, Mercedes-Benz has stood for important automotive innovations. These include, for example, passenger safety cell with crumple zone, airbags, intelligent assistance systems, 4 wheel drive, state of the art display systems, ABS, all wheel drive, electronic stability program and this list goes on.

Mercedes-Benz applies for nearly 2000 patents per year, making the brand the European leader among premium car makers. Daimler’s Mercedes-Benz cars are leaders in the premium car industry. With a huge selection of features and options, customers can choose the customized Mercedes-Benz of their dreams.

Credits: Kaggle

Problem Statement

- Tackle the curse of dimensionality. By doing this we can eliminate unimportant features that hold little or no value in predicting the output and this will indirectly truncate the testing time each car is subjected to therefore making the testing process more robust and efficient.
- Predict the time taken to pass the testing phase for each car in the test dataset. This is a regression problem which demands the use of regression models to predict the real valued outputs.

1.2 Sources/Useful Links

- Source : https://www.kaggle.com/c/mercedes-benz-greener-manufacturing (https://www.kaggle.com/c/mercedes-benz-greener-manufacturing)

Useful Links

- Discussions :
- https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/35871 (https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/35871)
- https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/35826 (https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/35826)
- https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/35445 (https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/35445)
- Kaggle Winning Solution and other approaches:
- https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/37700 (https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/37700)
- https://github.com/subhadipml/Mercedes-Benz-Greener-Manufacturing (https://github.com/subhadipml/Mercedes-Benz-Greener-Manufacturing)
- https://github.com/sanket1012/Mercedez-Benz-Greener-Manufacturing/blob/master/Mercedez%20Benz%20Project%20Final%20Report.pdf (https://github.com/sanket1012/Mercedez-Benz-Greener-Manufacturing/blob/master/Mercedez%20Benz%20Project%20Final%20Report.pdf)

1.3 Real world/Business Objectives and Constraints

1. No strict latency concerns.
2. No requirement in terms of Interpretability.

2.0 Machine Learning Probelm

2.1 Data

2.1.1 Data Overview

- This dataset contains an anonymized set of variables, each representing a custom feature in a Mercedes car. For example, a variable could be 4WD, added air suspension, or a head-up display.
- The ground truth is labeled ‘y’ and represents the time (in seconds) that the car took to pass testing for each variable.

2.1.2 Example Data point

ID y X0 X1 X2 X3 X4 X5 X6 X8 ... X375 X376 X377 X378 X379 X380 X382 X383 X384 X385 0 130.81 k v at a d u j o ... 0 0 1 0 0 0 0 0 0 0

2.2 Mapping the real world problem to an ML problem

2.2.1 Type of Machine Leaning Problem

- This is a regression problem to predict the time taken(in sec) to pass the testing phase for each car.

2.2.2 Performance Metric

- R2 (Coefficient of determination)

2.3 Train, CV and Test construction

- Train dataset provided by kaggle will be split randomly into train & CV in the ratio 80:20 .
- Test dataset provided by kaggle will be used for predictions.

3.0 Exploratory Data Analysis and featurizations

Importing all the modules

In [1]:

```
import warnings
warnings.filterwarnings("ignore")
from datetime import datetime
import sqlite3
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib notebook
%matplotlib inline
import seaborn as sns
from sklearn.feature_extraction.text import CountVectorizer
from sklearn import metrics
from sklearn.metrics import r2_score
import pickle
from tqdm import tqdm
import math
import os
from collections import Counter
```

3.1 Loading train & test data

In [2]:

```
train_df= pd.read_csv("train.csv")
train_df.head()
```

Out[2]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	...	X375	X376	X377	X378	X379	X380
0	0	130.81	k	v	at	a	d	u	j	o	...	0	0	1	0	0	0
1	6	88.53	k	t	av	e	d	y	l	o	...	1	0	0	0	0	0
2	7	76.26	az	w	n	c	d	x	j	x	...	0	0	0	0	0	0
3	9	80.62	az	t	n	f	d	x	l	e	...	0	0	0	0	0	0
4	13	78.02	az	v	n	f	d	h	d	n	...	0	0	0	0	0	0

5 rows × 378 columns

In [3]:

```
print(train_df.shape)
```

```
(4209, 378)
```

- There are 4209 datapoints or cars that have been subjected to testing
- There are 377 features or parts or subprocesses that were being tested

In [7]:

```
test_df= pd.read_csv("test.csv")
test_df.head()
```

Out[7]:

	ID	X0	X1	X2	X3	X4	X5	X6	X8	X10	...	X375	X376	X377	X378	X379	X380	X3
0	1	az	v	n	f	d	t	a	w	0	...	0	0	0	1	0	0	0
1	2	t	b	ai	a	d	b	g	y	0	...	0	0	1	0	0	0	0
2	3	az	v	as	f	d	a	j	j	0	...	0	0	0	1	0	0	0
3	4	az	l	n	f	d	z	l	n	0	...	0	0	0	1	0	0	0
4	5	w	s	as	c	d	y	i	m	0	...	1	0	0	0	0	0	0

5 rows × 377 columns

3.2 Checking for NaN values

In [14]:

```
# train data
nan_rows = train_df[train_df.isnull().any(axis=1)]
nan_rows
```

Out[14]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	...	X375	X376	X377	X378	X379	X380	X382

0 rows × 378 columns

In [21]:

```
# test data
nan_rows = test_df[test_df.isnull().any(axis=1)]
nan_rows
```

Out[21]:

	ID	X0	X1	X2	X3	X4	X5	X6	X8	X10	...	X375	X376	X377	X378	X379	X380	X38

0 rows × 377 columns

3.3 Finding datatypes of columns

In [27]:

```
#determine the datatype of features
train_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4209 entries, 0 to 4208
Columns: 378 entries, ID to X385
dtypes: float64(1), int64(369), object(8)
memory usage: 12.1+ MB
```

In [39]:

```
#ref: https://stackoverflow.com/questions/22470690/get-list-of-pandas-dataframe-columns
-based-on-data-type
#ref: https://www.geeksforgeeks.org/python-pandas-index-to_series/
d_types = train_df.columns.to_series().groupby(train_df.dtypes).groups
d_types
```

Out[39]:

```
{dtype('int64'): Index(['ID', 'X10', 'X11', 'X12', 'X13', 'X14', 'X15', 'X
16', 'X17', 'X18',
        ...
        'X375', 'X376', 'X377', 'X378', 'X379', 'X380', 'X382', 'X383', 'X
384',
        'X385'],
       dtype='object', length=369),
 dtype('float64'): Index(['y'], dtype='object'),
 dtype('O'): Index(['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8'], dtype
='object')}
```

- It can be observed that column y is of float type
- Columns from X0 to X6 & X8 are object type and hence they are categorical features
- Rest of the columns are of integer type

3.4 Univariate Analysis of the target variable(y)

In [233]:

```
# Basic stats:
train_df.y.describe()
```

Out[233]:

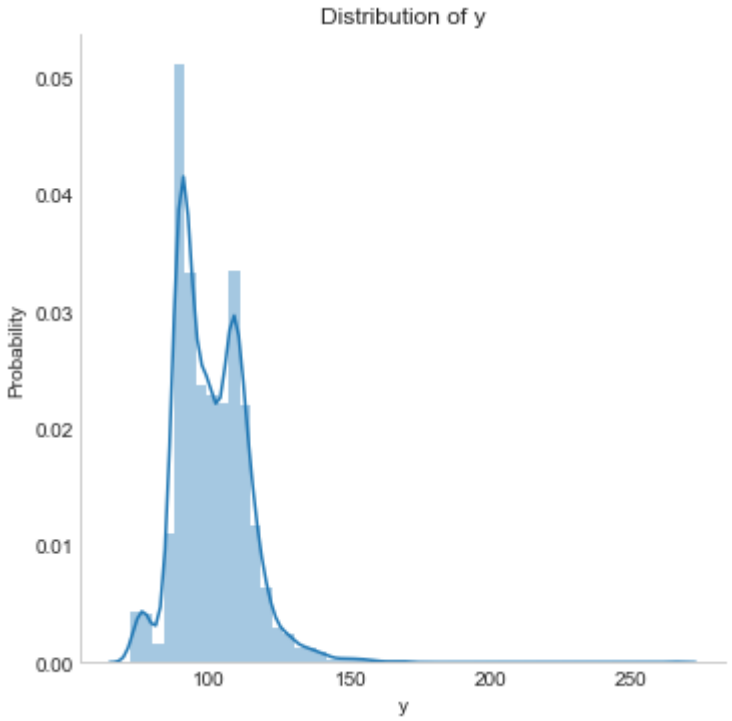
```
count    4209.000000
mean      100.669318
std        12.679381
min        72.110000
25%        90.820000
50%        99.150000
75%       109.010000
max       265.320000
Name: y, dtype: float64
```

Important points:

- Min value= 72.11
- Max value= 265.32
- Mean= 100.67
- IQR= 90.82-109.01

In [47]:

```
import warnings
warnings.filterwarnings("ignore")

sns.FacetGrid(train_df,size=5) \
   .map(sns.distplot,'y') \
   .add_legend()
plt.ylabel('Probability')
plt.title("Distribution of y")
plt.grid()
plt.show()
```



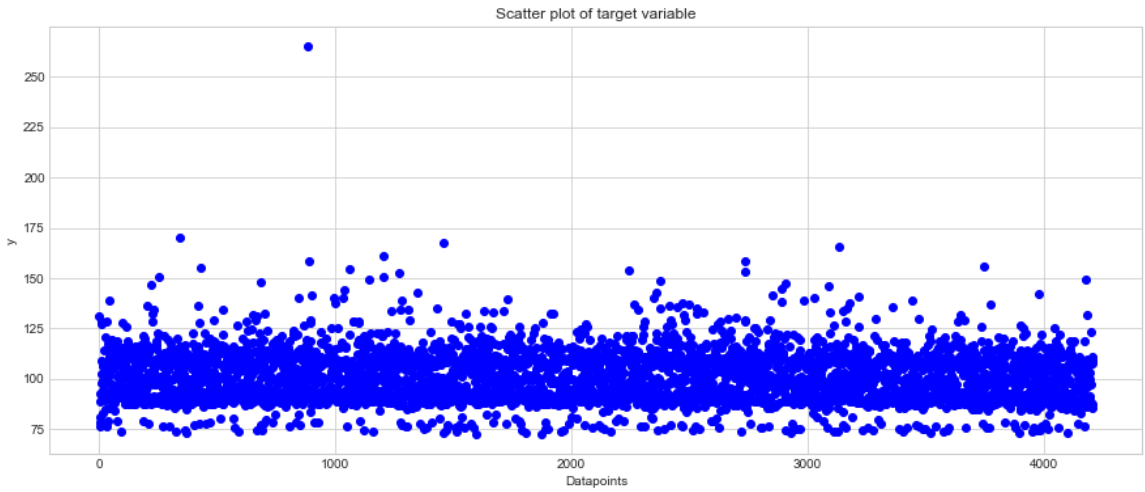
- As observed form the above plot, the pdf is skewed to its right (positive skewed).
- Most of the cars have a testing time of around 90.
- There are few outliers for y>150. Let's check with a scatter plot to get more clarity.

In [56]:

```
#scatter plot
x= range(train_df.shape[0])
y= train_df["y"].values
plt.figure(figsize=(15,6))
plt.plot(x, y, 'o', color='blue')
plt.title("Scatter plot of target variable")
plt.xlabel("Datapoints")
plt.ylabel("y")
```

Out[56]:

```
Text(0, 0.5, 'y')
```



- From the scatter plot above, it can be observed that there is one extreme outlier whose y value is 263 approx. This has to be removed.
- Also datapoints having y>150 can be considered as outliers and hence be removed.

In [57]:

```
train_new= train_df[train_df["y"]<150]
train_new.shape
```

Out[57]:

```
(4194, 378)
```

In [58]:

```
print("Number of outliers removed from the original dataset:",(train_df.shape[0]-train_new.shape[0]))
```

```
Number of outliers removed from the original dataset: 15
```

3.5 Univariate Analysis of ID

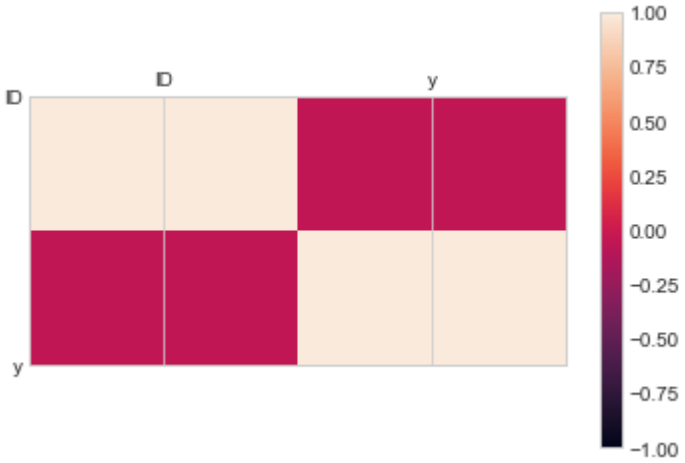
In [80]:

```
#calculating PCC between ID & y
#ref: https://machinelearningmastery.com/how-to-use-correlation-to-understand-the-relat
ionship-between-variables/
from scipy.stats import pearsonr
x= train_new.ID.values
y= train_new.y.values
corr, _ = pearsonr(x, y)
print('Pearsons correlation: %.3f' % corr)
```

```
Pearsons correlation: -0.049
```

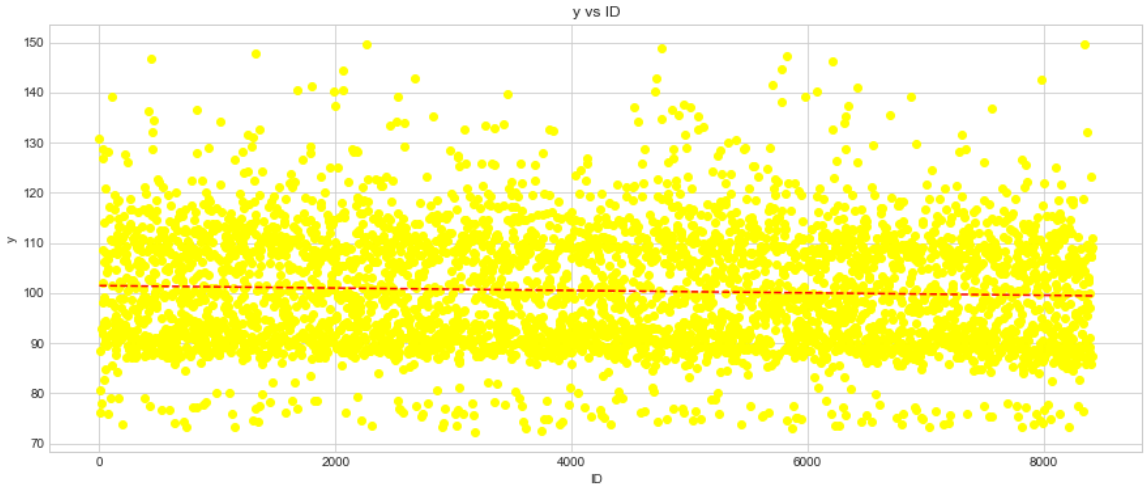
In [74]:

```
df_id= train_new[["ID","y"]]
correlations = df_id.corr()
# plot correlation matrix
fig = plt.figure()
ax = fig.add_subplot(111)
cax = ax.matshow(correlations, vmin=-1, vmax=1)
fig.colorbar(cax)
ticks = np.arange(0,2,1)
ax.set_xticks(ticks)
ax.set_yticks(ticks)
ax.set_xticklabels(df_id.columns)
ax.set_yticklabels(df_id.columns)
plt.show()
```



In [79]:

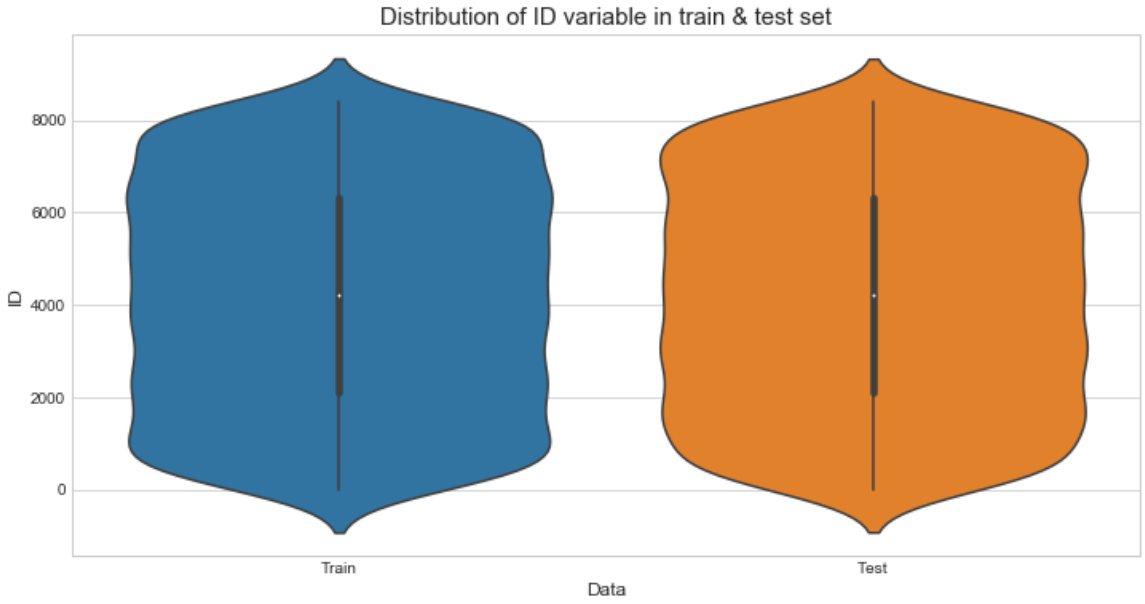
```
#scatter plot with trend line
#ref: https://stackoverflow.com/questions/41635448/how-can-i-draw-scatter-trend-line-on
-matplot-python-pandas/41635626
x= train_new.ID.values
y= train_new["y"].values
plt.figure(figsize=(15,6))
plt.plot(x, y, 'o', color='yellow')
z = np.polyfit(x, y, 1)
p = np.poly1d(z)
plt.plot(x,p(x),"r--")
plt.title("y vs ID")
plt.xlabel("ID")
plt.ylabel("y")
plt.show()
```



- With a PCC of -0.049 and a decreasing trend observed from the scatter plot, it can be concluded that y is negatively correlated to ID which also gives an intuition that the cars tested later took less time

In [232]:

```
#compare ID of train & test using violin plot
train_vio=train_new
test_vio=test_df
train_vio['type'] = "Train"
test_vio['type'] = "Test"
combined = pd.concat([train_vio[["ID",'type']], test_vio[["ID",'type']]], axis=0)

plt.figure(figsize=(12,6))
sns.violinplot(x='type', y='ID', data=combined)
plt.xlabel("Data", fontsize=12)
plt.ylabel('ID', fontsize=12)
plt.title("Distribution of ID variable in train & test set", fontsize=15)
plt.show()
```



- The ID values of both train & test data roughly have a similar distribution.

3.6 Univariate Analysis of categorical variables

In [5]:

```
#unique values in each of the 8 categorical columns:
columns=['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8']
for col in columns:
    unique= train[col].unique()
    print("Unique values in feature {} are:{}\n{}\n".format(col,len(unique),unique))
```

```
Unique values in feature X0 are:47
['k' 'az' 't' 'al' 'o' 'w' 'j' 'h' 's' 'n' 'ay' 'f' 'x' 'y' 'aj' 'ak' 'am'
 'z' 'q' 'at' 'ap' 'v' 'af' 'a' 'e' 'ai' 'd' 'aq' 'c' 'aa' 'ba' 'as' 'i'
 'r' 'b' 'ax' 'bc' 'u' 'ad' 'au' 'm' 'l' 'aw' 'ao' 'ac' 'g' 'ab']

Unique values in feature X1 are:27
['v' 't' 'w' 'b' 'r' 'l' 's' 'aa' 'c' 'a' 'e' 'h' 'z' 'j' 'o' 'u' 'p' 'n'
 'i' 'y' 'd' 'f' 'm' 'k' 'g' 'q' 'ab']

Unique values in feature X2 are:44
['at' 'av' 'n' 'e' 'as' 'aq' 'r' 'ai' 'ak' 'm' 'a' 'k' 'ae' 's' 'f' 'd'
 'ag' 'ay' 'ac' 'ap' 'g' 'i' 'aw' 'y' 'b' 'ao' 'al' 'h' 'x' 'au' 't' 'an'
 'z' 'ah' 'p' 'am' 'j' 'q' 'af' 'l' 'aa' 'c' 'o' 'ar']

Unique values in feature X3 are:7
['a' 'e' 'c' 'f' 'd' 'b' 'g']

Unique values in feature X4 are:4
['d' 'b' 'c' 'a']

Unique values in feature X5 are:29
['u' 'y' 'x' 'h' 'g' 'f' 'j' 'i' 'd' 'c' 'af' 'ag' 'ab' 'ac' 'ad' 'ae'
 'ah' 'l' 'k' 'n' 'm' 'p' 'q' 's' 'r' 'v' 'w' 'o' 'aa']

Unique values in feature X6 are:12
['j' 'l' 'd' 'h' 'i' 'a' 'g' 'c' 'k' 'e' 'f' 'b']

Unique values in feature X8 are:25
['o' 'x' 'e' 'n' 's' 'a' 'h' 'p' 'm' 'k' 'd' 'i' 'v' 'j' 'b' 'q' 'w' 'g'
 'y' 'l' 'f' 'u' 'r' 't' 'c']
```

In [6]:

```
#lets check the unique values of categorical features for test data
#unique values in each of the 8 categorical columns:
for col in columns:
    unique= test_df[col].unique()
    print("Unique values in feature {} are:{}\n{}\n".format(col,len(unique),unique))
```

```
Unique values in feature X0 are:49
['az' 't' 'w' 'y' 'x' 'f' 'ap' 'o' 'ay' 'al' 'h' 'z' 'aj' 'd' 'v' 'ak'
 'ba' 'n' 'j' 's' 'af' 'ax' 'at' 'aq' 'av' 'm' 'k' 'a' 'e' 'ai' 'i' 'ag'
 'b' 'am' 'aw' 'as' 'r' 'ao' 'u' 'l' 'c' 'ad' 'au' 'bc' 'g' 'an' 'ae' 'p'
 'bb']

Unique values in feature X1 are:27
['v' 'b' 'l' 's' 'aa' 'r' 'a' 'i' 'p' 'c' 'o' 'm' 'z' 'e' 'h' 'w' 'g' 'k'
 'y' 't' 'u' 'd' 'j' 'q' 'n' 'f' 'ab']

Unique values in feature X2 are:45
['n' 'ai' 'as' 'ae' 's' 'b' 'e' 'ak' 'm' 'a' 'aq' 'ag' 'r' 'k' 'aj' 'ay'
 'ao' 'an' 'ac' 'af' 'ax' 'h' 'i' 'f' 'ap' 'p' 'au' 't' 'z' 'y' 'aw' 'd'
 'at' 'g' 'am' 'j' 'x' 'ab' 'w' 'q' 'ah' 'ad' 'al' 'av' 'u']

Unique values in feature X3 are:7
['f' 'a' 'c' 'e' 'd' 'g' 'b']

Unique values in feature X4 are:4
['d' 'b' 'a' 'c']

Unique values in feature X5 are:32
['t' 'b' 'a' 'z' 'y' 'x' 'h' 'g' 'f' 'j' 'i' 'd' 'c' 'af' 'ag' 'ab' 'ac'
 'ad' 'ae' 'ah' 'l' 'k' 'n' 'm' 'p' 'q' 's' 'r' 'v' 'w' 'o' 'aa']

Unique values in feature X6 are:12
['a' 'g' 'j' 'l' 'i' 'd' 'f' 'h' 'c' 'k' 'e' 'b']

Unique values in feature X8 are:25
['w' 'y' 'j' 'n' 'm' 's' 'a' 'v' 'r' 'o' 't' 'h' 'c' 'k' 'p' 'u' 'd' 'g'
 'b' 'q' 'e' 'l' 'f' 'i' 'x']
```

Observations:

- Unique categories for X0,X2 & X5 are different in train & test and other columns are identical in count & values

In [18]:

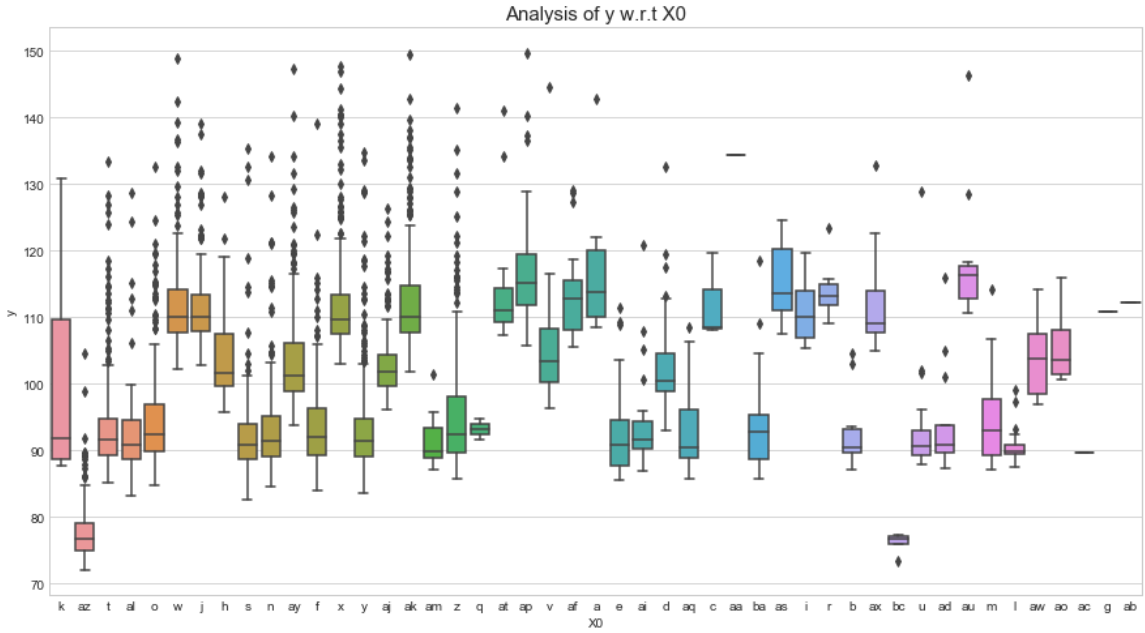
```
# Learning how different in terms of categories are columns 'X0','X2'&'X5' in train & t
est

diff= ['X0','X2','X5']

for col in diff:
    a= set(sorted(list(train[col].unique())))
    b= set(sorted(list(test_df[col].unique())))
    print("Categories of {} present in train but absent in test:{}".format(col,a-b))
    print("Categories of {} present in test but absent in train:{}\n".format(col,b-a))
```

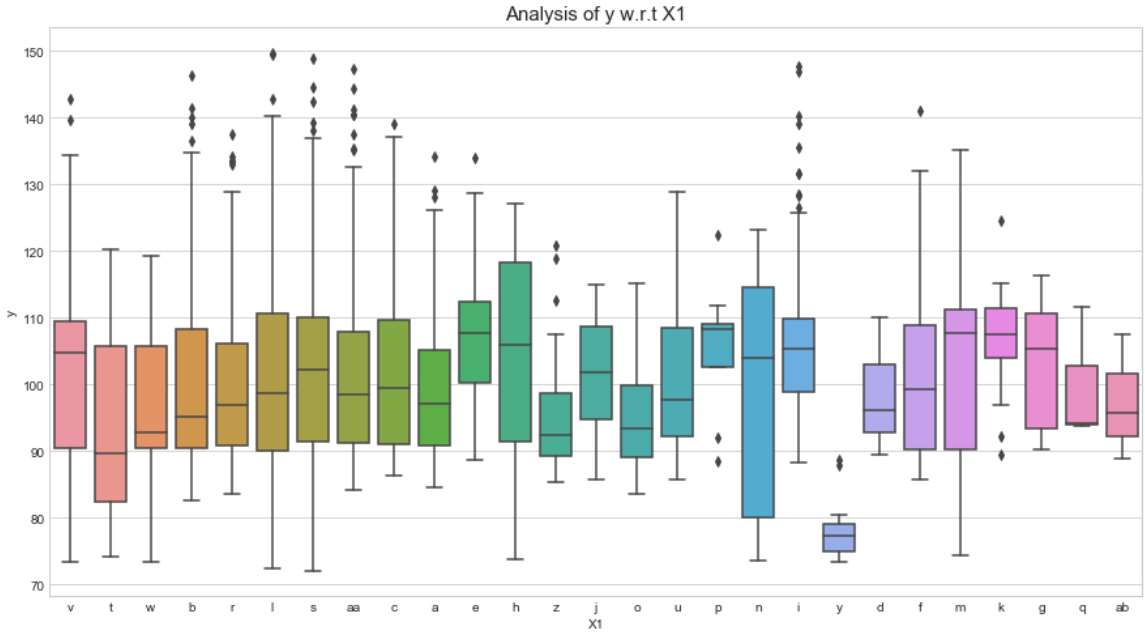
```
Categories of X0 present in train but absent in test:{'q', 'aa', 'ab', 'a
c'}
Categories of X0 present in test but absent in train:{'ae', 'ag', 'bb',
'p', 'an', 'av'}

Categories of X2 present in train but absent in test:{'c', 'o', 'aa', 'l',
'ar'}
Categories of X2 present in test but absent in train:{'aj', 'w', 'ab', 'a
x', 'u', 'ad'}

Categories of X5 present in train but absent in test:{'u'}
Categories of X5 present in test but absent in train:{'t', 'b', 'z', 'a'}
```

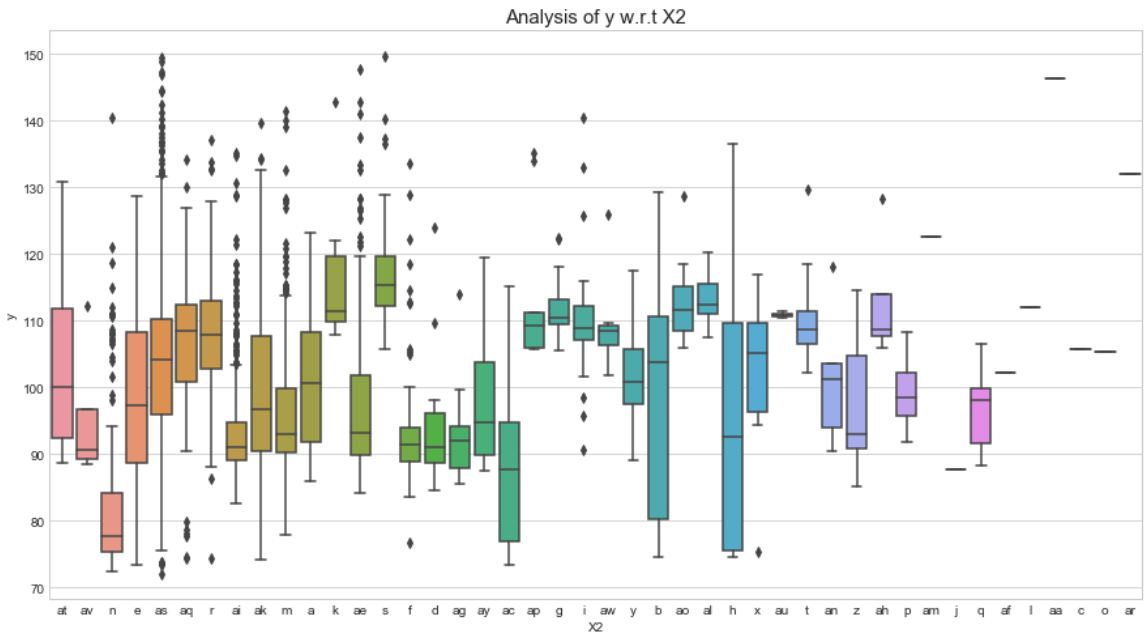
- Need to look after the categories present in test but not in train during target and label encoding

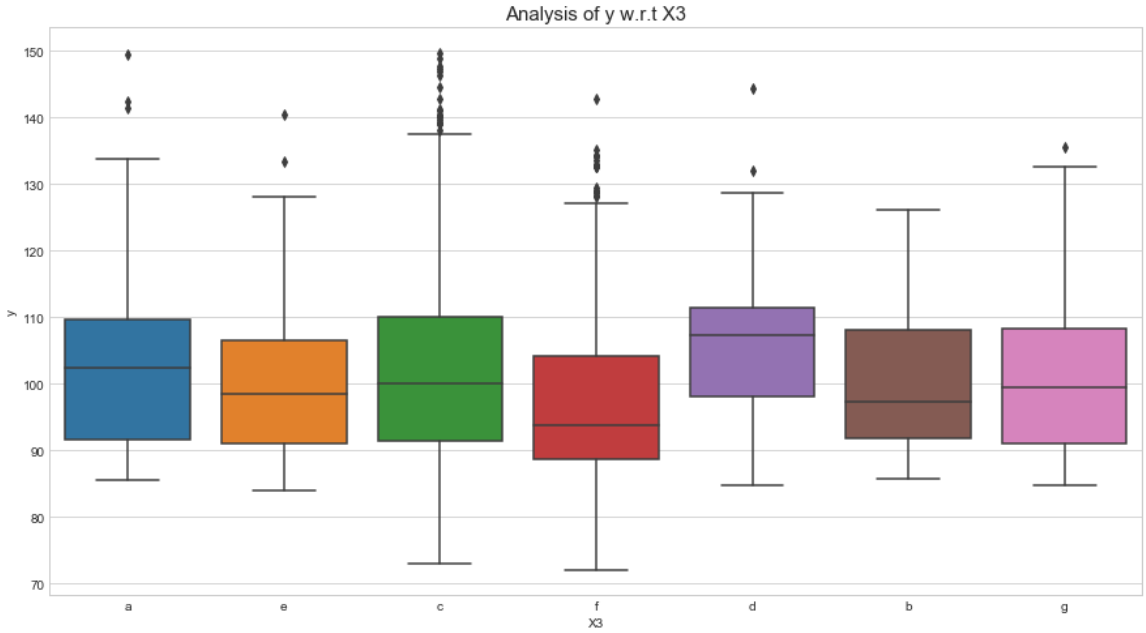
In [89]:

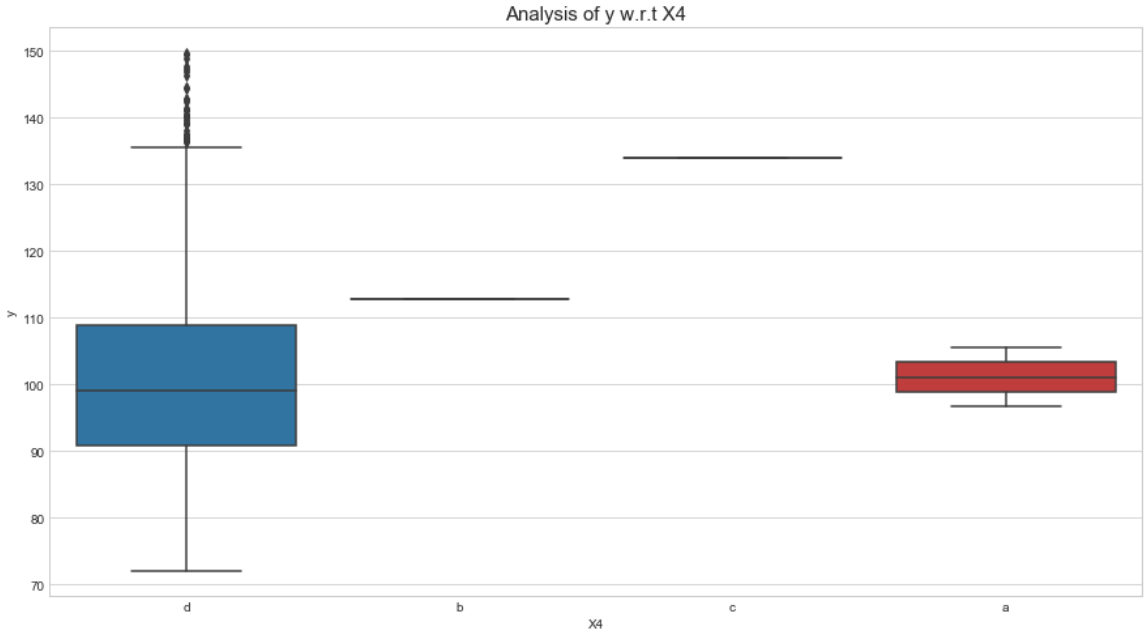
```
#box-plots
columns=['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8']
for col in columns:
    plt.figure(figsize=(15,8))
    sns.boxplot(x=col, y='y', data=train_new)
    plt.xlabel(col,fontsize=10)
    plt.ylabel("y",fontsize=10)
    plt.title('Analysis of y w.r.t '+col,fontsize=15)
    plt.show()
```

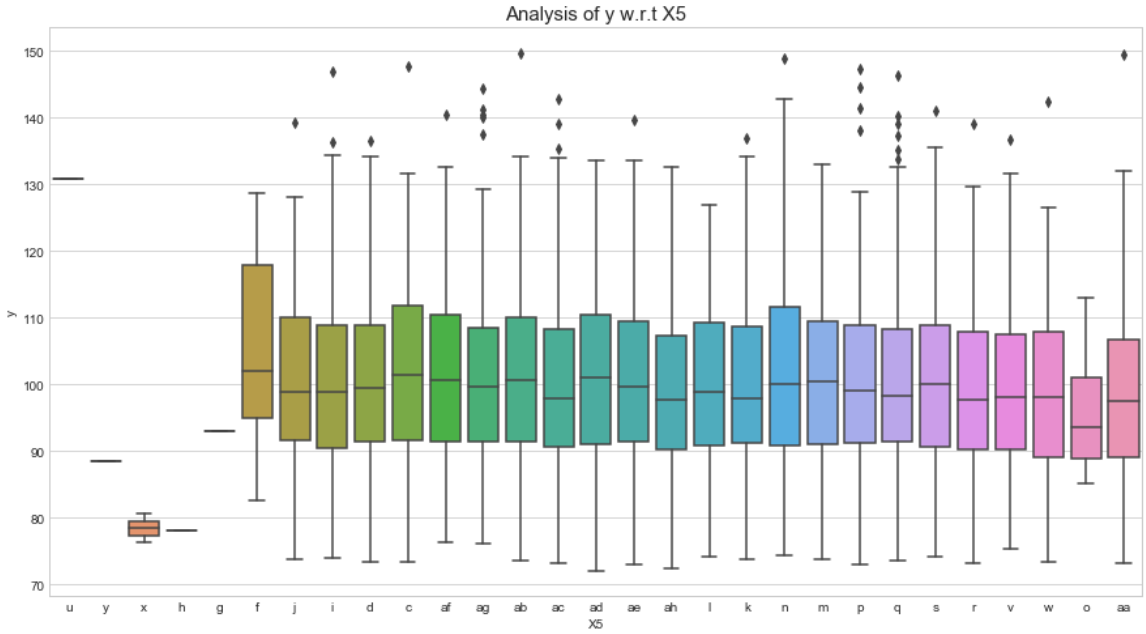

Analysis of y w.r.t X0
y
X0

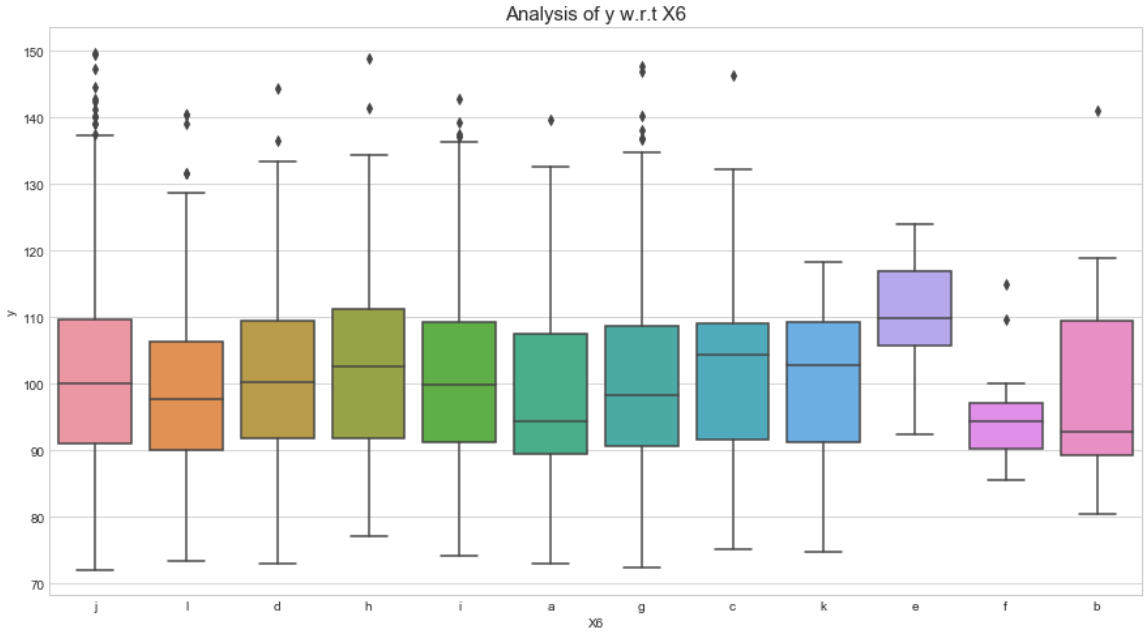

Analysis of y w.r.t X1
y
X1

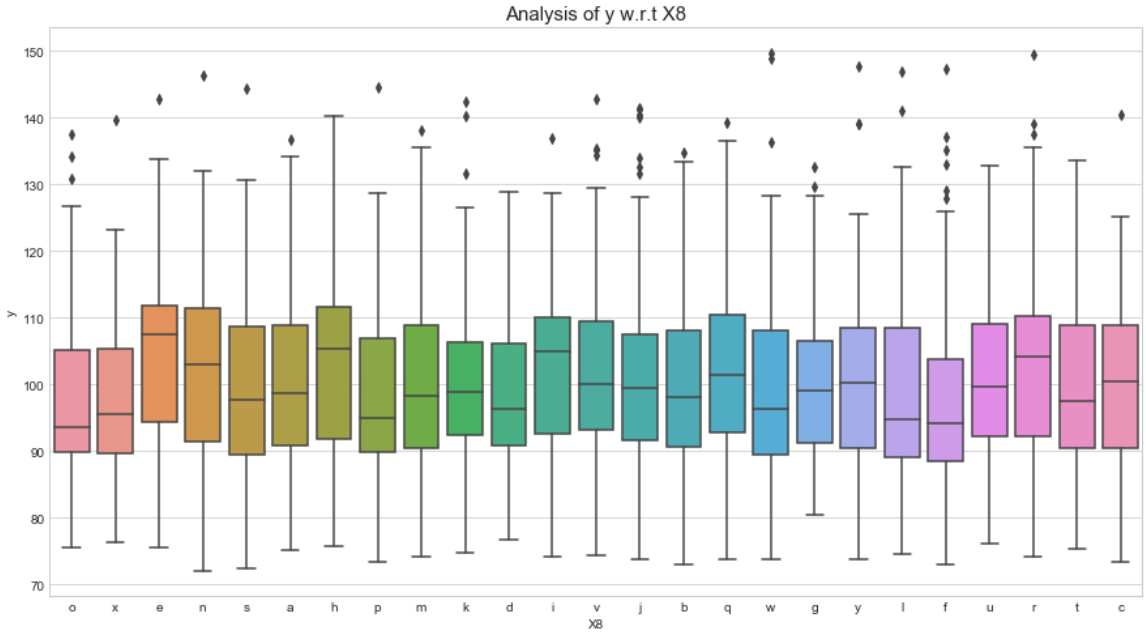

Analysis of y w.r.t X2
y
X2


Analysis of y w.r.t X3
y
X3
a
e
c
f
d
b
g


Analysis of y w.r.t X4
y
X4
d
b
c
a


Analysis of y w.r.t X5
y
X5
u
y
x
h
g
f
j
i
d
c
af
ag
ab
ac
ad
ae
ah
l
k
n
m
p
q
s
r
v
w
o
aa





Observations:

The plots are convoluted to observe but are self explanatory. However I will highlight few key aspects in each feature as briefly as possible:

- In X0, the least median time can be found for category az and the highest can be found for au. Intuitively, az is a sub-part/sub-assembly of the main assembly X0 which was tested quickly(on an average) compared to au. Note: This intuition applies to other features as well.
- In X1,the least median time can be found for category y and the highest can be found for p.
- In X2,the least median time can be found for category n and the highest can be found for s.
- In X3,the least median time can be found for category f and the highest can be found for d.
- In X4,the least median time can be found for category d and the highest can be found for c.
- In X5,the least median time can be found for category x and the highest can be found for f.
- In X6,the least median time can be found for category f and the highest can be found for e.
- In X8,the least median time can be found for category o and the highest can be found for e.

3.7 Univariate Analysis of integer/binary columns

3.7.1 Unique values in each of the columns

- From the looks of it all the integer columns are binary i.e contains 0 or 1. Anyways lets check it out!

In [108]:

```
non_int=['ID','y','X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8'] #non-integer columns
unique_val= dict() #dictionary to store unique values for all the columns

for col in train_new.columns:
    if col not in non_int:
        unique_val[col]=str(list(sorted(train_new[col].unique())))
```

- Let's check the unique values in the unique_val dictionary

In [124]:

```
u= set(unique_val.values())
u
```

Out[124]:

```
{'[0, 1]', '[0]'}
```

- For the sake of interpretability & readability I shall group columns/features according to their unique values

In [110]:

```
# Grouping dictionary keys by value
#ref: https://www.geeksforgeeks.org/python-grouping-dictionary-keys-by-value/

from collections import defaultdict
res = defaultdict(list)
for key, val in unique_val.items():
    res[val].append(key)
```

In [122]:

```
for key,val in res.items():
    print("Features with {} as unique values are:\n{}".format(key,val))
```

```
Features with [0, 1] as unique values are:
['X10', 'X12', 'X13', 'X14', 'X15', 'X16', 'X17', 'X18', 'X19', 'X20', 'X2
1', 'X22', 'X23', 'X24', 'X26', 'X27', 'X28', 'X29', 'X30', 'X31', 'X32',
'X33', 'X34', 'X35', 'X36', 'X37', 'X38', 'X39', 'X40', 'X41', 'X42', 'X4
3', 'X44', 'X45', 'X46', 'X47', 'X48', 'X49', 'X50', 'X51', 'X52', 'X53',
'X54', 'X55', 'X56', 'X57', 'X58', 'X59', 'X60', 'X61', 'X62', 'X63', 'X6
4', 'X65', 'X66', 'X67', 'X68', 'X69', 'X70', 'X71', 'X73', 'X74', 'X75',
'X76', 'X77', 'X78', 'X79', 'X80', 'X81', 'X82', 'X83', 'X84', 'X85', 'X8
6', 'X87', 'X88', 'X89', 'X90', 'X91', 'X92', 'X94', 'X95', 'X96', 'X97',
'X98', 'X99', 'X100', 'X101', 'X102', 'X103', 'X104', 'X105', 'X106', 'X10
8', 'X109', 'X110', 'X111', 'X112', 'X113', 'X114', 'X115', 'X116', 'X11
7', 'X118', 'X119', 'X120', 'X122', 'X123', 'X124', 'X125', 'X126', 'X12
7', 'X128', 'X129', 'X130', 'X131', 'X132', 'X133', 'X134', 'X135', 'X13
6', 'X137', 'X138', 'X139', 'X140', 'X141', 'X142', 'X143', 'X144', 'X14
5', 'X146', 'X147', 'X148', 'X150', 'X151', 'X152', 'X153', 'X154', 'X15
5', 'X156', 'X157', 'X158', 'X159', 'X160', 'X161', 'X162', 'X163', 'X16
4', 'X165', 'X166', 'X167', 'X168', 'X169', 'X170', 'X171', 'X172', 'X17
3', 'X174', 'X175', 'X176', 'X177', 'X178', 'X179', 'X180', 'X181', 'X18
2', 'X183', 'X184', 'X185', 'X186', 'X187', 'X189', 'X190', 'X191', 'X19
2', 'X194', 'X195', 'X196', 'X197', 'X198', 'X199', 'X200', 'X201', 'X20
2', 'X203', 'X204', 'X205', 'X206', 'X207', 'X208', 'X209', 'X210', 'X21
1', 'X212', 'X213', 'X214', 'X215', 'X216', 'X217', 'X218', 'X219', 'X22
0', 'X221', 'X222', 'X223', 'X224', 'X225', 'X226', 'X227', 'X228', 'X22
9', 'X230', 'X231', 'X232', 'X234', 'X236', 'X237', 'X238', 'X239', 'X24
0', 'X241', 'X242', 'X243', 'X244', 'X245', 'X246', 'X247', 'X248', 'X24
9', 'X250', 'X251', 'X252', 'X253', 'X254', 'X255', 'X256', 'X257', 'X25
8', 'X259', 'X260', 'X261', 'X262', 'X263', 'X264', 'X265', 'X266', 'X26
7', 'X269', 'X270', 'X271', 'X272', 'X273', 'X274', 'X275', 'X276', 'X27
7', 'X278', 'X279', 'X280', 'X281', 'X282', 'X283', 'X284', 'X285', 'X28
6', 'X287', 'X288', 'X291', 'X292', 'X294', 'X295', 'X296', 'X298', 'X29
9', 'X300', 'X301', 'X302', 'X304', 'X305', 'X306', 'X307', 'X308', 'X30
9', 'X310', 'X311', 'X312', 'X313', 'X314', 'X315', 'X316', 'X317', 'X31
8', 'X319', 'X320', 'X321', 'X322', 'X323', 'X324', 'X325', 'X326', 'X32
7', 'X328', 'X329', 'X331', 'X332', 'X333', 'X334', 'X335', 'X336', 'X33
7', 'X338', 'X340', 'X341', 'X342', 'X343', 'X344', 'X345', 'X346', 'X34
8', 'X349', 'X350', 'X351', 'X352', 'X353', 'X354', 'X355', 'X356', 'X35
7', 'X358', 'X359', 'X360', 'X361', 'X362', 'X363', 'X364', 'X365', 'X36
6', 'X367', 'X368', 'X369', 'X370', 'X371', 'X372', 'X373', 'X374', 'X37
5', 'X376', 'X377', 'X378', 'X379', 'X380', 'X382', 'X383', 'X384', 'X38
5']
Features with [0] as unique values are:
['X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X2
97', 'X330', 'X339', 'X347']
Features with 0 as unique values are:
[]
Features with 1 as unique values are:
[]
```

Observation

- ['X11', 'X93', 'X107', 'X233', 'X235', 'X268', 'X289', 'X290', 'X293', 'X297', 'X330', 'X339', 'X347'] are the features with 0 as unique values and the variance for these features would be 0 and hence keeping them would be useless for the model. Therefore it is better to eliminate it.
- Also in the following cells, I will be eliminating features whose variance is less than 0.01 which is an experimental threshold that I would be using.

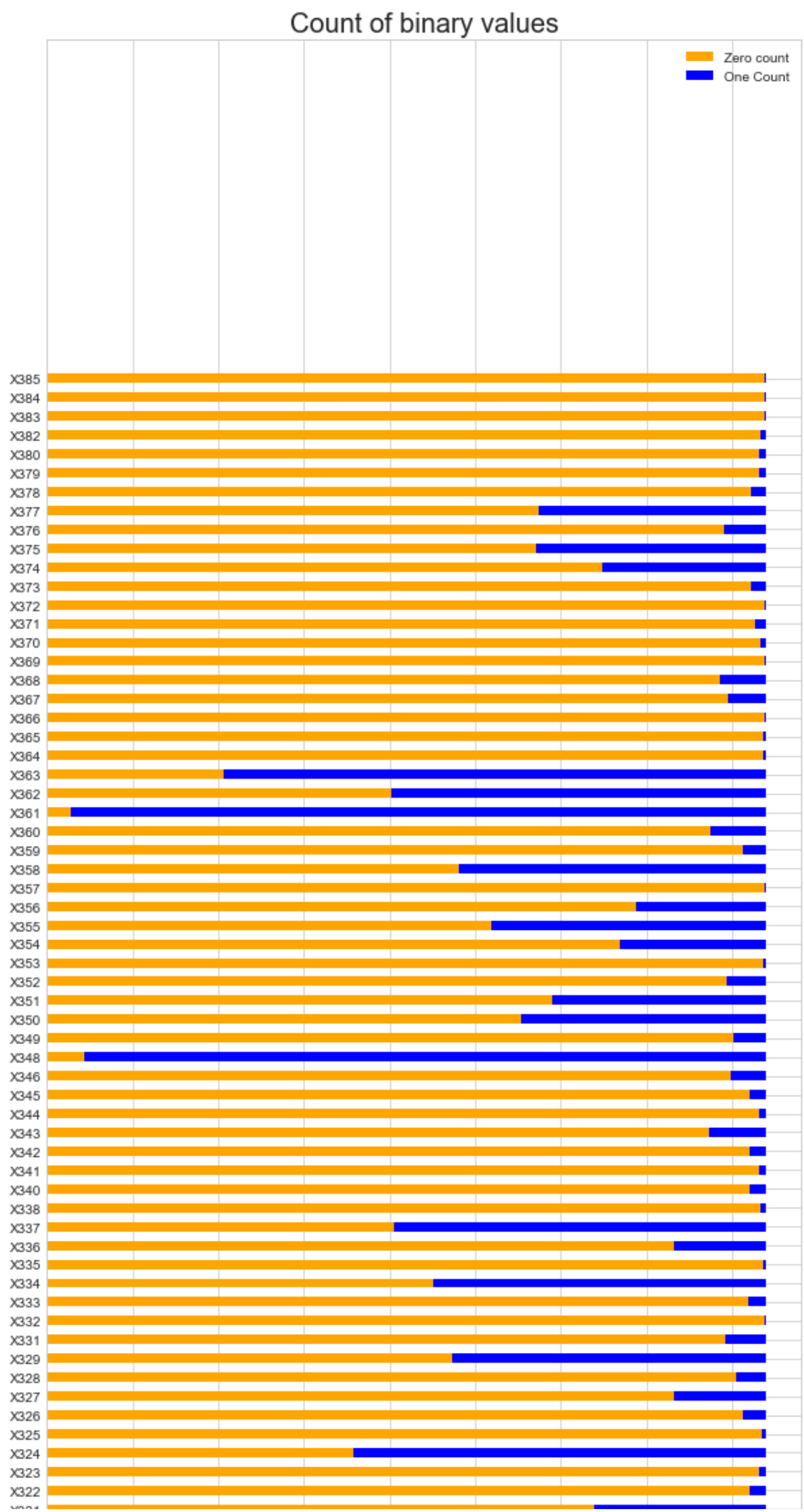
3.7.2 Count of 0's & 1's in columns having 0 & 1 as unique values

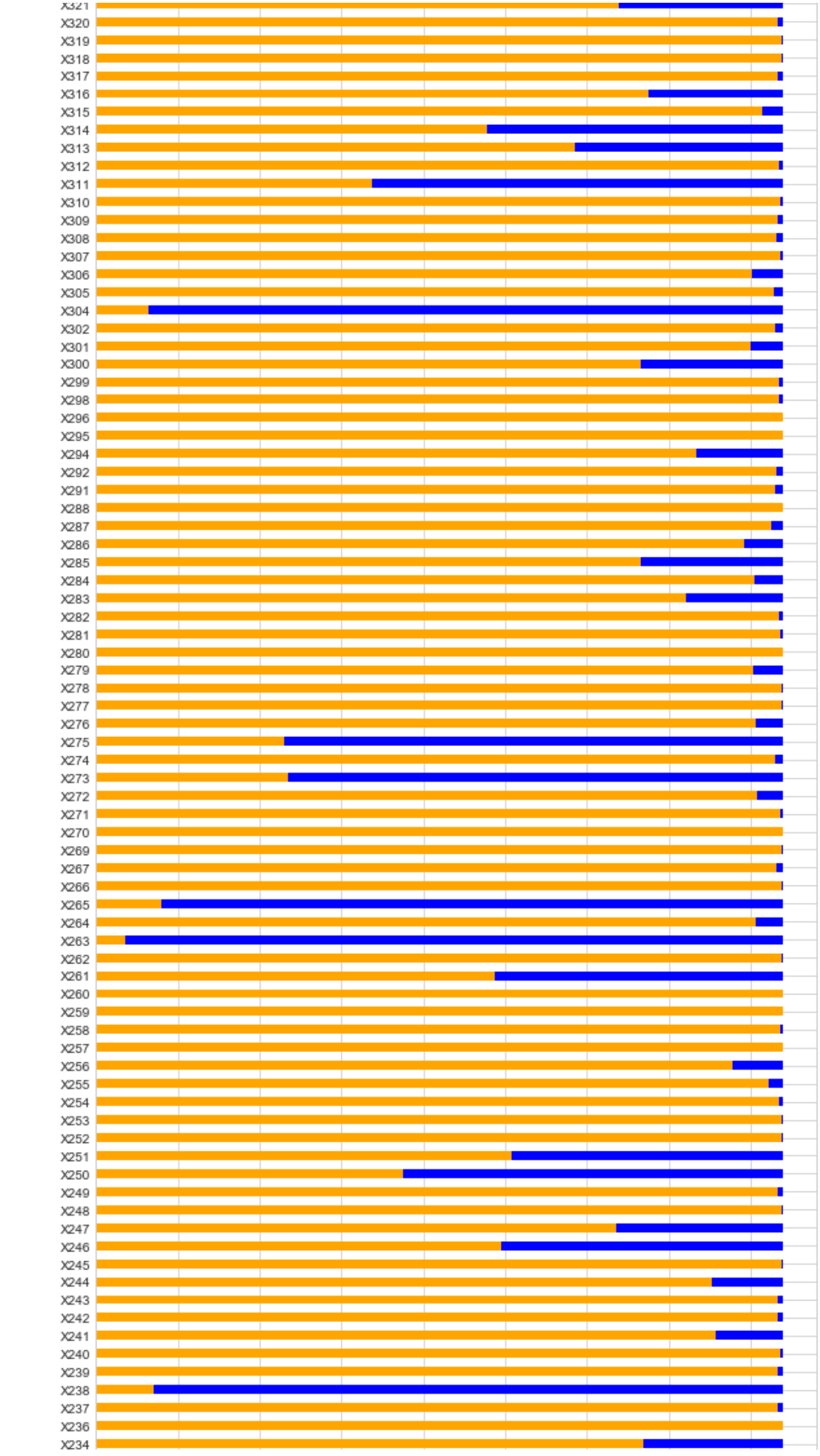
In [132]:

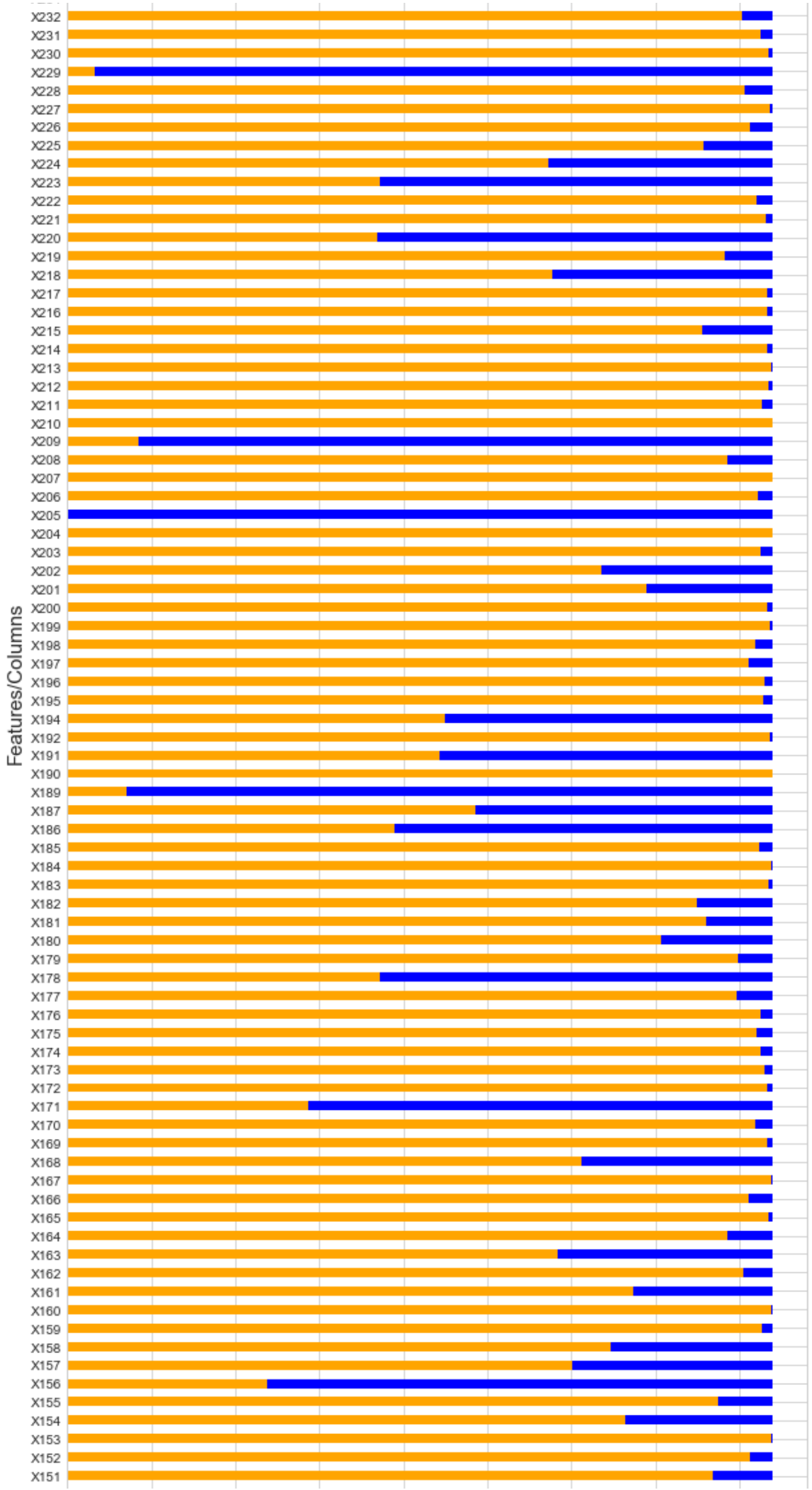
```
#creating lists with 0's count and 1's count
zero_count= []
one_count= []
columns= res['[0, 1]']
for col in columns:
    zero_count.append((train_new[col]==0).sum())
    one_count.append((train_new[col]==1).sum())
```

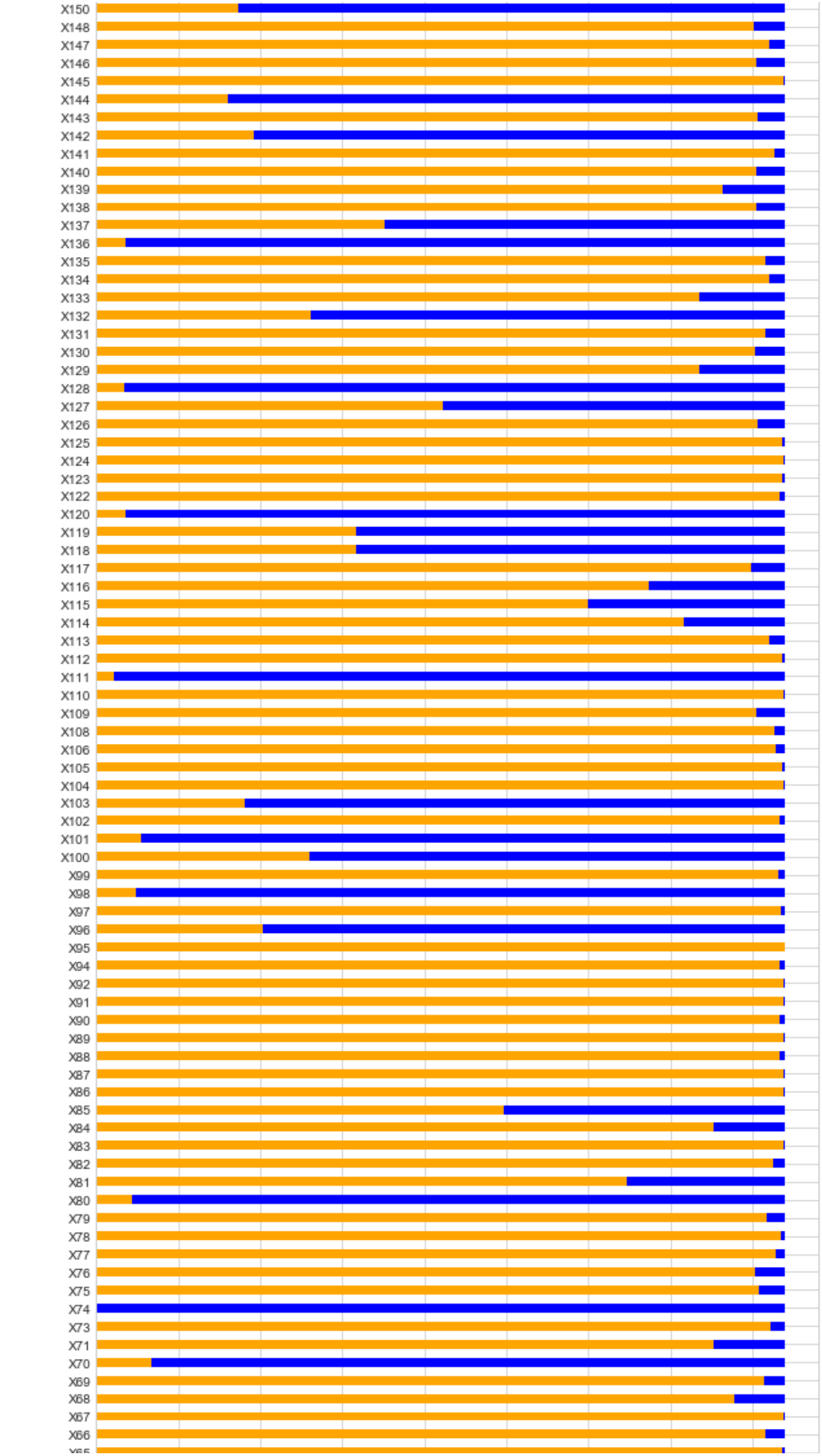
In [151]:

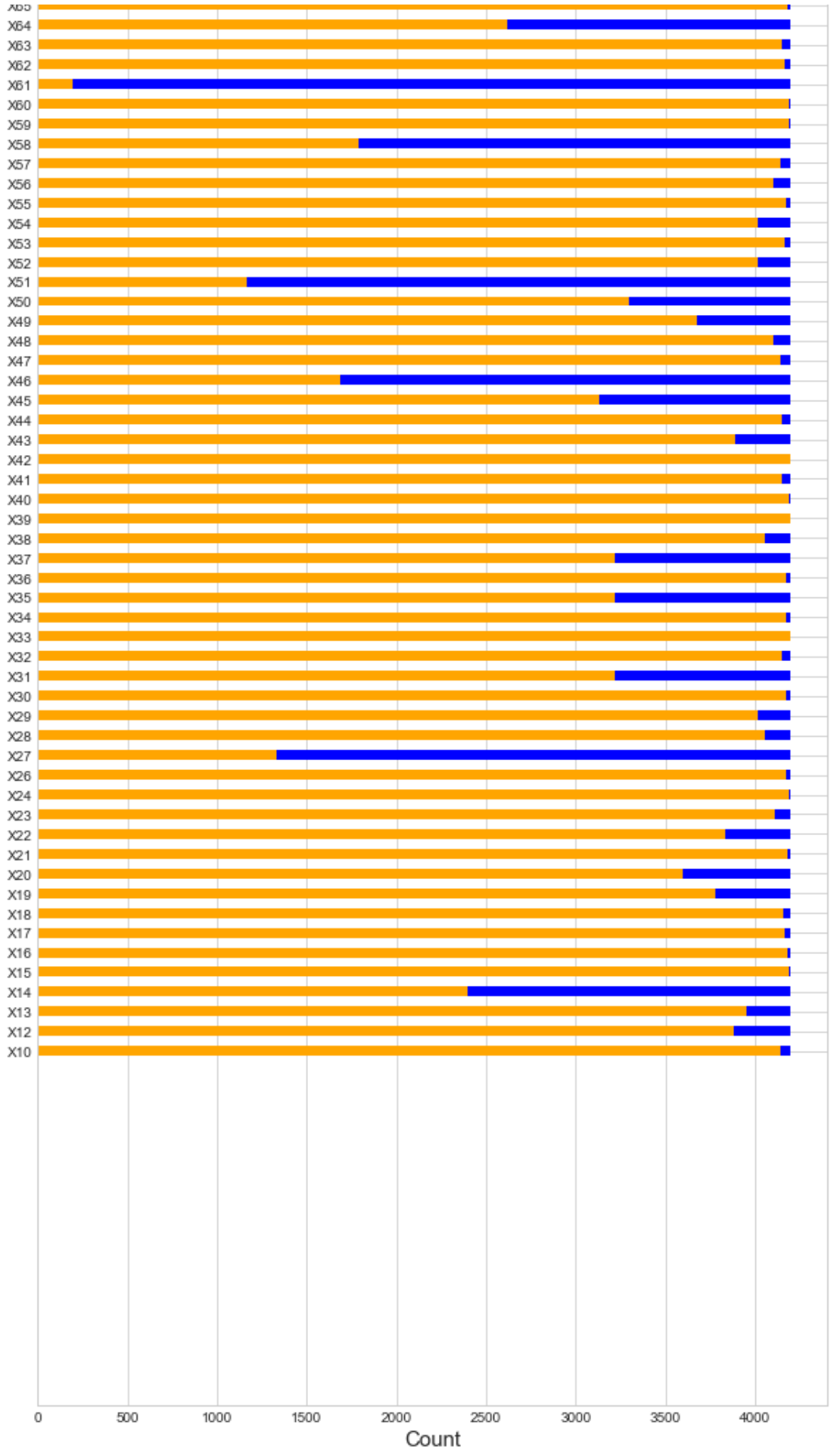
```
# Plotting stacked bar graph: Ref-https://stackoverflow.com/questions/16653815/horizont
al-stacked-bar-chart-in-matplotlib

N = len(columns) #number of columns
ind = np.arange(N)  #indices required while plotting along y axis
width = 0.50

plt.figure(figsize=(10,100))
p1 = plt.barh(ind, zero_count, width, color='orange')
p2 = plt.barh(ind, one_count, width, left=zero_count, color="blue")
plt.yticks(ind, columns)
plt.legend(('Zero count', 'One Count'))
plt.xlabel("Count",fontsize=15)
plt.ylabel("Features/Columns",fontsize=15)
plt.title('Count of binary values',fontsize=20)
plt.show()
```


Count of binary values
Zero count
One Count
X385
X384
X383
X382
X380
X379
X378
X377
X376
X375
X374
X373
X372
X371
X370
X369
X368
X367
X366
X365
X364
X363
X362
X361
X360
X359
X358
X357
X356
X355
X354
X353
X352
X351
X350
X349
X348
X346
X345
X344
X343
X342
X341
X340
X338
X337
X336
X335
X334
X333
X332
X331
X329
X328
X327
X326
X325
X324
X323
X322


X321
X320
X319
X318
X317
X316
X315
X314
X313
X312
X311
X310
X309
X308
X307
X306
X305
X304
X302
X301
X300
X299
X298
X296
X295
X294
X292
X291
X288
X287
X286
X285
X284
X283
X282
X281
X280
X279
X278
X277
X276
X275
X274
X273
X272
X271
X270
X269
X267
X266
X265
X264
X263
X262
X261
X260
X259
X258
X257
X256
X255
X254
X253
X252
X251
X250
X249
X248
X247
X246
X245
X244
X243
X242
X241
X240
X239
X238
X237
X236
X234


Features/Columns
X232
X231
X230
X229
X228
X227
X226
X225
X224
X223
X222
X221
X220
X219
X218
X217
X216
X215
X214
X213
X212
X211
X210
X209
X208
X207
X206
X205
X204
X203
X202
X201
X200
X199
X198
X197
X196
X195
X194
X192
X191
X190
X189
X187
X186
X185
X184
X183
X182
X181
X180
X179
X178
X177
X176
X175
X174
X173
X172
X171
X170
X169
X168
X167
X166
X165
X164
X163
X162
X161
X160
X159
X158
X157
X156
X155
X154
X153
X152
X151


X150
X148
X147
X146
X145
X144
X143
X142
X141
X140
X139
X138
X137
X136
X135
X134
X133
X132
X131
X130
X129
X128
X127
X126
X125
X124
X123
X122
X120
X119
X118
X117
X116
X115
X114
X113
X112
X111
X110
X109
X108
X106
X105
X104
X103
X102
X101
X100
X99
X98
X97
X96
X95
X94
X92
X91
X90
X89
X88
X87
X86
X85
X84
X83
X82
X81
X80
X79
X78
X77
X76
X75
X74
X73
X71
X70
X69
X68
X67
X66


X64
X63
X62
X61
X60
X59
X58
X57
X56
X55
X54
X53
X52
X51
X50
X49
X48
X47
X46
X45
X44
X43
X42
X41
X40
X39
X38
X37
X36
X35
X34
X33
X32
X31
X30
X29
X28
X27
X26
X24
X23
X22
X21
X20
X19
X18
X17
X16
X15
X14
X13
X12
X10
0
500
1000
1500
2000
2500
3000
3500
4000
Count

Observations:

- It can be observed from the above plot that most of the integer features/columns have zeroes which occur more prominently than ones which means that a particular feature represented by 0 is tested consistently.

4.0 Data cleaning

In [4]:

```
train.head()
```

Out[4]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	...	X375	X376	X377	X378	X379	X380
0	0	130.81	k	v	at	a	d	u	j	o	...	0	0	1	0	0	0
1	6	88.53	k	t	av	e	d	y	l	o	...	1	0	0	0	0	0
2	7	76.26	az	w	n	c	d	x	j	x	...	0	0	0	0	0	0
3	9	80.62	az	t	n	f	d	x	l	e	...	0	0	0	0	0	0
4	13	78.02	az	v	n	f	d	h	d	n	...	0	0	0	0	0	0

5 rows × 378 columns

4.1 Removing features having unique values as only 0

In [6]:

```
train_bin= train.copy()
#As discussed in 3.7.1 observation
train_bin= train_bin.drop(['y','X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8','X11', 'X
93', 'X107', 'X233', 'X235', 'X268',
                       'X289', 'X290','X293', 'X297', 'X330', 'X339', 'X347'], axis=1)
train_bin.head()
```

Out[6]:

	ID	X10	X12	X13	X14	X15	X16	X17	X18	X19	...	X375	X376	X377	X378	X379
0	0	0	0	1	0	0	0	0	1	0	...	0	0	1	0	0
1	6	0	0	0	0	0	0	0	1	0	...	1	0	0	0	0
2	7	0	0	0	0	0	0	1	0	0	...	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	13	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0

5 rows × 356 columns

In [52]:

```
test_bin= test_df.copy()
test_bin= test_bin.drop(['X0', 'X1', 'X2', 'X3', 'X4', 'X5', 'X6', 'X8','X11', 'X93',
'X107', 'X233', 'X235', 'X268',
                       'X289', 'X290','X293', 'X297', 'X330', 'X339', 'X347'], axis=1)
test_bin.head()
```

Out[52]:

	ID	X10	X12	X13	X14	X15	X16	X17	X18	X19	...	X375	X376	X377	X378	X379
0	1	0	0	0	0	0	0	0	0	0	...	0	0	0	1	0
1	2	0	0	0	0	0	0	0	0	1	...	0	0	1	0	0
2	3	0	0	0	1	0	0	0	0	0	...	0	0	0	1	0
3	4	0	0	0	0	0	0	0	0	0	...	0	0	0	1	0
4	5	0	0	0	1	0	0	0	0	0	...	1	0	0	0	0

5 rows × 356 columns

4.2 Removing features whose variance is <0.01 (Threshold)

In [9]:

```
low_var_cols=[]
for i in test_bin.columns:
    if test_bin[i].var()<0.01: #Threshold value is experimental
        low_var_cols.append(i)

print("Number of columns having very less variance are:\n",len(low_var_cols))
print("Columns are:\n",low_var_cols)
```

```
Number of columns having very less variance are:
 133
Columns are:
 ['X15', 'X16', 'X17', 'X21', 'X24', 'X26', 'X30', 'X33', 'X34', 'X36', 'X
39', 'X40', 'X42', 'X44', 'X53', 'X55', 'X59', 'X60', 'X62', 'X65', 'X67',
'X74', 'X78', 'X83', 'X86', 'X87', 'X88', 'X89', 'X90', 'X91', 'X92', 'X9
4', 'X95', 'X97', 'X99', 'X102', 'X104', 'X105', 'X110', 'X112', 'X122',
'X123', 'X124', 'X125', 'X145', 'X153', 'X160', 'X165', 'X167', 'X169', 'X
172', 'X183', 'X184', 'X190', 'X192', 'X199', 'X200', 'X204', 'X205', 'X20
7', 'X210', 'X212', 'X213', 'X214', 'X216', 'X217', 'X221', 'X227', 'X23
0', 'X236', 'X237', 'X239', 'X240', 'X242', 'X243', 'X245', 'X248', 'X24
9', 'X252', 'X253', 'X254', 'X257', 'X258', 'X259', 'X260', 'X262', 'X26
6', 'X267', 'X269', 'X270', 'X271', 'X277', 'X278', 'X280', 'X281', 'X28
2', 'X288', 'X292', 'X295', 'X296', 'X298', 'X299', 'X302', 'X305', 'X30
7', 'X308', 'X309', 'X310', 'X312', 'X317', 'X318', 'X319', 'X320', 'X32
3', 'X325', 'X332', 'X335', 'X338', 'X341', 'X344', 'X353', 'X357', 'X36
4', 'X365', 'X366', 'X369', 'X370', 'X372', 'X380', 'X382', 'X383', 'X38
4', 'X385']
```

In [10]:

```
#dropping the above columns

train_bin = train_bin.drop(low_var_cols,axis=1)
test_bin = test_bin.drop(low_var_cols,axis=1)
print(train_bin.shape)
print(test_bin.shape)
```

```
(4194, 223)
(4209, 223)
```

In [11]:

```
train_bin.head()
```

Out[11]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X367	X368	X371	X373	X374
0	0	0	0	1	0	1	0	0	0	0	...	0	0	0	0	0
1	6	0	0	0	0	1	0	0	0	0	...	0	0	0	0	0
2	7	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	13	0	0	0	0	0	0	0	0	0	...	0	0	1	0	0

5 rows × 223 columns

In [23]:

```
#checking for very highly correlated features i.e. around 1
temp= train_bin.copy()
temp= temp.drop('ID',axis=1)
ext_corr=[]
cols = list(temp.columns.values)
for i in range(len(cols)):
    for j in range(i+1,len(cols)):
        val=temp[cols[i]].corr(temp[cols[j]])
        if val>=0.99:
            ext_corr.append((cols[i],cols[j]))
print(len(ext_corr))
#print(ext_corr[:-1])
```

```
42
```

In [24]:

```
print(ext_corr[-5:])
```

```
[('X155', 'X360'), ('X202', 'X247'), ('X208', 'X368'), ('X226', 'X326'),
('X232', 'X279')]
```

These highly correlated features can be somewhat considered as duplicates.

4.3 Checking for duplicate columns

In [29]:

```
#ref: https://thispointer.com/how-to-find-drop-duplicate-columns-in-a-dataframe-python-pandas/

def getDuplicateColumns(df):
    '''
    Get a list of duplicate columns.
    It will iterate over all the columns in dataframe and find the columns whose contents are duplicate.
    :param df: Dataframe object
    :return: List of columns whose contents are duplicates.
    '''
    duplicateColumnNames = set()
    # Iterate over all the columns in dataframe
    pairs=[]
    for x in range(df.shape[1]):
        # Select column at xth index.
        col = df.iloc[:, x]
        # Iterate over all the columns in DataFrame from (x+1)th index till end
        for y in range(x + 1, df.shape[1]):
            # Select column at yth index.
            otherCol = df.iloc[:, y]
            # Check if two columns at x 7 y index are equal
            if col.equals(otherCol):
                duplicateColumnNames.add(df.columns.values[y])
                #pairs.append((df.columns.values[x],df.columns.values[y]))

    return list(duplicateColumnNames)
```

In [30]:

```
train_duplicates= getDuplicateColumns(train_bin)
print("Number of duplicates in train data =",len(train_duplicates))
print("Duplicate columns are:")
print(train_duplicates)
```

```
Number of duplicates in train data = 18
Duplicate columns are:
['X134', 'X76', 'X84', 'X247', 'X232', 'X113', 'X324', 'X222', 'X244', 'X3
5', 'X360', 'X147', 'X146', 'X326', 'X226', 'X279', 'X119', 'X37']
```

4.4 Checking for high correlations among duplicate columns

Let us check correlations among a set of duplicate features and prepare those pairs which are highly correlated.

In [36]:

```
#checking for very highly correlated features i.e. around 1
temp= train_bin.copy()
temp= temp.drop('ID',axis=1)
corr_values=[]
high_corr=[]
cols = train_duplicates
for i in range(len(cols)):
    for j in range(i+1,len(cols)):
        val=temp[cols[i]].corr(temp[cols[j]])
        if val>=0.90:
            corr_values.append(val)
            high_corr.append((cols[i],cols[j]))
print("Number of correlated pairs:",len(high_corr))
print("\n")
print("Correlation values:\n",corr_values)
print("\n")
print("Feature pairs:\n",high_corr)
```

```
Number of correlated pairs: 12


Correlation values:
 [1.0, 1.0, 1.0, 0.9971247031088808, 0.9971247031088808, 0.999999999999999
8, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0]


Feature pairs:
 [('X134', 'X113'), ('X134', 'X222'), ('X134', 'X147'), ('X76', 'X232'),
('X76', 'X279'), ('X84', 'X244'), ('X232', 'X279'), ('X113', 'X222'), ('X1
13', 'X147'), ('X222', 'X147'), ('X35', 'X37'), ('X326', 'X226')]
```

In [37]:

```
# Comparing pairs and removing distinct features manually

to_drop=['X279','X76','X37','X134','X147','X222','X244','X326']
train_bin= train_bin.drop(to_drop,axis=1)
test_bin= test_bin.drop(to_drop,axis=1)
print(train_bin.shape)
print(test_bin.shape)
```

```
(4194, 215)
(4209, 215)
```

5.0 Feature Engineering & data preparation

5.1 Feature Engineering

Feature engineering in the form of 2 way and 3 way interactions of the variables/features could result in better model performance. I will be trying out the following 2 way & 3 way interations: (X314, X315), (X118, X119), (X47, X48),(X10, X54) and (X10, X29) as 2 way interactions & (X118, X314, X315) as 3 way interaction. Reference: https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/37700 (https://www.kaggle.com/c/mercedes-benz-greener-manufacturing/discussion/37700)

- Before adding the above features let us check correlation between them & the target variable

In [38]:

```
#calculating PCC between ID & y
#ref: https://machinelearningmastery.com/how-to-use-correlation-to-understand-the-relat
ionship-between-variables/
from scipy.stats import pearsonr
x= train.y.values
y1= train_bin["X314"]+train_bin["X315"].values
y2= train_bin["X118"]+train_bin["X119"].values
y3= train_bin["X47"]+train_bin["X48"].values
y4= train_bin["X118"]+train_bin["X314"]+train_bin["X315"].values
y5= train_bin["X10"]+train_bin["X54"].values
y6= train_bin["X10"]+train_bin["X29"].values
corr1, _ = pearsonr(x, y1)
corr2, _ = pearsonr(x, y2)
corr3, _ = pearsonr(x, y3)
corr4, _ = pearsonr(x, y4)
corr5, _ = pearsonr(x, y5)
corr6, _ = pearsonr(x, y6)
print('Pearsons correlation for (X314, X315) with y: %.3f' % corr1)
print('Pearsons correlation for (X118, X119) with y: %.3f' % corr2)
print('Pearsons correlation for (X47, X48) with y: %.3f' % corr3)
print('Pearsons correlation for (X118, X314, X315) with y: %.3f' % corr4)
print('Pearsons correlation for (X10, X54) with y: %.3f' % corr5)
print('Pearsons correlation for (X10, X29) with y: %.3f' % corr6)
```

```
Pearsons correlation for (X314, X315) with y: 0.699
Pearsons correlation for (X118, X119) with y: 0.291
Pearsons correlation for (X47, X48) with y: 0.243
Pearsons correlation for (X118, X314, X315) with y: 0.684
Pearsons correlation for (X10, X54) with y: -0.360
Pearsons correlation for (X10, X29) with y: -0.363
```

- (X314, X315) & (X118, X314, X315) seems to be very important. Anyways lets confirm this by training a XGBoost model.
- Also among 2 way interaction features, I will be considering (X10, X54) & (X10, X29) because their magnitudes are greater than correlation scores for feature combinations (X118, X119) & (X47, X48).

In [39]:

```
#adding newly engineered features to the train dataframe

train_bin["X314_X315"]= train_bin["X314"]+train_bin["X315"]
train_bin["X10_X54"]= train_bin["X10"]+train_bin["X54"]
train_bin["X10_X29"]= train_bin["X10"]+train_bin["X29"]
train_bin["X118_X314_X315"]= train_bin["X118"]+train_bin["X314"]+train_bin["X315"]
```

In [41]:

```
train_bin.shape
```

Out[41]:

```
(4194, 219)
```

In [42]:

```
train_bin.head()
```

Out[42]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X374	X375	X376	X377	X378
0	0	0	0	1	0	1	0	0	0	0	...	0	0	0	1	0
1	6	0	0	0	0	1	0	0	0	0	...	0	1	0	0	0
2	7	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	13	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0

5 rows × 219 columns

5.2 Removing highly correlated(+ve & -ve) features

In [43]:

```
X_corr= train_bin.copy()
X_corr= train_bin.drop(['X314_X315','X10_X54','X10_X29','X118_X314_X315'], axis=1)
X_corr.head()
```

Out[43]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X367	X368	X371	X373	X374
0	0	0	0	1	0	1	0	0	0	0	...	0	0	0	0	0
1	6	0	0	0	0	1	0	0	0	0	...	0	0	0	0	0
2	7	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	13	0	0	0	0	0	0	0	0	0	...	0	0	1	0	0

5 rows × 215 columns

In [44]:

```
corr_values=[] #list to store the correlated values of feature pairs
features=[] #list of correlated feature pairs

for i in range(0,len(X_corr.columns)-1):
    for j in range(i+1,len(X_corr.columns)):
        temp_corr=X_corr[X_corr.columns[i]].corr(X_corr[X_corr.columns[j]])
        if temp_corr>=0.95 or temp_corr<=-0.95: # 95% is the threshold value
            features.append((X_corr.columns[i],X_corr.columns[j]))
            corr_values.append(temp_corr)
print("Number of pairs of extremely correlated features:\n",len(corr_values))
print("Correlation values are:\n{}\n".format(corr_values))
print("Pairs of features are:",features)
```

```
Number of pairs of extremely correlated features:
 63
Correlation values are:
[0.9946771070439342, 0.9971247031088808, -0.9971247031088808, 0.9648413386
410916, 1.0, -1.0, 0.9648408939580227, 1.0, 1.0, 0.9840544130049858, 0.997
7888851113587, -0.9557434679384933, -1.0, -1.0, 0.9679831714512914, 0.9971
247031088808, -0.9971247031088808, 0.9620666899352026, 0.9859289752165855,
1.0, 0.9557434679384932, -0.963330132336009, 0.9999999999999998, 0.9928835
33669104, 0.9884237028691648, 0.983500761957513, 0.9840544130049858, 0.999
9999999999999, 0.9511039203196862, 0.9511039203196862, 0.993710978386211,
-1.0, -0.9679831714512914, -0.9971247031088808, 0.9971247031088808, -0.962
0666899352026, 0.9859289752165855, 0.9939219558941387, 1.0, 0.993921955894
1387, -1.0, 1.0, 1.0, -1.0, 0.9648413386410916, -0.9648413386410916, 0.957
1020171597314, 0.9841141702127958, 0.9519877302458076, -0.999999999999999
9, 0.9689188050447414, -0.9689188050447414, 0.9999999999999999, 0.99394921
90401003, -0.9875330640747707, -1.0, 0.9648408939580227, 0.964856796672390
7, 0.9754219815269457, -0.9648408939580224, 0.9818398347145244, 0.95876217
32762152, -0.959242354766056]

Pairs of features are: [('X19', 'X215'), ('X29', 'X54'), ('X29', 'X136'),
('X29', 'X162'), ('X29', 'X232'), ('X29', 'X263'), ('X29', 'X328'), ('X3
1', 'X35'), ('X48', 'X113'), ('X48', 'X198'), ('X49', 'X129'), ('X52', 'X6
1'), ('X52', 'X120'), ('X54', 'X136'), ('X54', 'X162'), ('X54', 'X232'),
('X54', 'X263'), ('X54', 'X328'), ('X58', 'X137'), ('X58', 'X324'), ('X6
1', 'X120'), ('X66', 'X111'), ('X71', 'X84'), ('X80', 'X348'), ('X96', 'X3
63'), ('X108', 'X371'), ('X113', 'X198'), ('X118', 'X119'), ('X118', 'X31
1'), ('X119', 'X311'), ('X126', 'X264'), ('X128', 'X130'), ('X136', 'X16
2'), ('X136', 'X232'), ('X136', 'X263'), ('X136', 'X328'), ('X137', 'X32
4'), ('X138', 'X140'), ('X138', 'X146'), ('X140', 'X146'), ('X142', 'X15
8'), ('X152', 'X226'), ('X155', 'X360'), ('X156', 'X157'), ('X162', 'X23
2'), ('X162', 'X263'), ('X162', 'X328'), ('X178', 'X250'), ('X185', 'X37
8'), ('X186', 'X194'), ('X186', 'X362'), ('X194', 'X362'), ('X202', 'X24
7'), ('X208', 'X368'), ('X228', 'X229'), ('X232', 'X263'), ('X232', 'X32
8'), ('X246', 'X358'), ('X261', 'X314'), ('X263', 'X328'), ('X331', 'X35
2'), ('X331', 'X367'), ('X334', 'X337')]
```

- In the pairs of features above lot of features are repeated and hence it is kinda tricky to remove these manually
- In order to simplify this operation I created an array booler having only 0's & 1's and it helps in keeping a track of the features that needs to be dropped

In [45]:

```
booler = np.ones(400) #array to keep a track of the features that needs to be dropped
corr_cols=[] #list storing the features to be dropped
for i in features:
    if booler[int(i[1][1:])]==1: #this expression will check for the 2nd term in the tu
ple
        booler[int(i[1][1:])]=0
        corr_cols.append(i[1])
    elif booler[int(i[0][1:])]==1: #this expression will check for the 1st term in the
 tuple in case the value in booler is already zero
        booler[int(i[0][1:])]=0
        corr_cols.append(i[0])
```

In [46]:

```
print("Finally, number of columns to be removed:",len(corr_cols))
print("Columns are:\n",corr_cols)
```

```
Finally, number of columns to be removed: 42
Columns are:
 ['X215', 'X54', 'X136', 'X162', 'X232', 'X263', 'X328', 'X35', 'X113', 'X
198', 'X129', 'X61', 'X120', 'X137', 'X324', 'X111', 'X84', 'X348', 'X36
3', 'X371', 'X119', 'X311', 'X264', 'X130', 'X140', 'X146', 'X158', 'X22
6', 'X360', 'X157', 'X250', 'X378', 'X194', 'X362', 'X247', 'X368', 'X22
9', 'X358', 'X314', 'X352', 'X367', 'X337']
```

In [47]:

```
#dropping the correlated columns from train
train_bin = train_bin.drop(corr_cols,axis=1)
print(train_bin.shape)
```

```
(4194, 177)
```

In [48]:

```
train_bin.head()
```

Out[48]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X373	X374	X375	X376	X377
0	0	0	0	1	0	1	0	0	0	0	...	0	0	0	0	1
1	6	0	0	0	0	1	0	0	0	0	...	0	0	1	0	0
2	7	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
3	9	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	13	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0

5 rows × 177 columns

5.2.1 Updating the test dataframe

In [55]:

```
test_bin["X314_X315"]= test_bin["X314"]+test_bin["X315"]
test_bin["X10_X54"]= test_bin["X10"]+test_bin["X54"]
test_bin["X10_X29"]= test_bin["X10"]+test_bin["X29"]
test_bin["X118_X314_X315"]= test_bin["X118"]+test_bin["X314"]+test_bin["X315"]
```

In [56]:

```
#dropping the correlated columns from test
test_bin = test_bin.drop(corr_cols,axis=1)
print(test_bin.shape)
```

```
(4209, 177)
```

In [57]:

```
test_bin.head()
```

Out[57]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X373	X374	X375	X376	X377
0	1	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
1	2	0	0	0	0	0	1	0	0	0	...	0	0	0	0	1
2	3	0	0	0	1	0	0	0	0	0	...	0	0	0	0	0
3	4	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	5	0	0	0	1	0	0	0	0	0	...	0	0	1	0	0

5 rows × 177 columns

So finally after all these variance & correlation checks, I managed to reduce the number of features(integer/binary) from 368 to 176 (engineered features & ID excluded) which is about 47.8% reduction.

In [58]:

```
train.head()
```

Out[58]:

	ID	y	X0	X1	X2	X3	X4	X5	X6	X8	...	X375	X376	X377	X378	X379	X380
0	0	130.81	k	v	at	a	d	u	j	o	...	0	0	1	0	0	0
1	6	88.53	k	t	av	e	d	y	l	o	...	1	0	0	0	0	0
2	7	76.26	az	w	n	c	d	x	j	x	...	0	0	0	0	0	0
3	9	80.62	az	t	n	f	d	x	l	e	...	0	0	0	0	0	0
4	13	78.02	az	v	n	f	d	h	d	n	...	0	0	0	0	0	0

5 rows × 378 columns

5.3 Preparing final data

In [59]:

```
#preparing final data matrix by adding categorical features to the above dataframe

X1= train_bin.copy() #final train data with target variable
cat=['X0', 'X1', 'X2', 'X3','X4','X5', 'X6', 'X8','y']
for i in cat:
    X1[i]= train[i].values
print(X1.shape)
X1.head()
```

```
(4194, 186)
```

Out[59]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X118_X314_X315	X0	X1	X2	X
0	0	0	0	1	0	1	0	0	0	0	...	1	k	v	at	a
1	6	0	0	0	0	1	0	0	0	0	...	1	k	t	av	e
2	7	0	0	0	0	0	0	0	0	0	...	0	az	w	n	c
3	9	0	0	0	0	0	0	0	0	0	...	0	az	t	n	f
4	13	0	0	0	0	0	0	0	0	0	...	0	az	v	n	f

5 rows × 186 columns

In [63]:

```
X2= test_bin.copy()
cat=['X0', 'X1', 'X2', 'X3','X4','X5', 'X6', 'X8']
for i in cat:
    X2[i]= test_df[i].values
print(X2.shape)
X2.head()
```

```
(4209, 185)
```

Out[63]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0
0	1	0	0	0	0	0	0	0	0	0	...	1	0	az
1	2	0	0	0	0	0	1	0	0	0	...	0	1	t
2	3	0	0	0	1	0	0	0	0	0	...	1	0	az
3	4	0	0	0	0	0	0	0	0	0	...	1	0	az
4	5	0	0	0	1	0	0	0	0	0	...	0	2	w

5 rows × 185 columns

In [64]:

```
#saving final train & test data
X1.to_csv("final_train_data.csv")
X2.to_csv("final_test_data.csv")
```

6.0 Splitting the train data into train & CV

In [2]:

```
train= pd.read_csv("final_train_data.csv", index_col=0)
test= pd.read_csv("final_test_data.csv", index_col=0)
```

In [3]:

```
train.head()
```

Out[3]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X118_X314_X315	X0	X1	X2	X
0	0	0	0	1	0	1	0	0	0	0	...	1	k	v	at	a
1	6	0	0	0	0	1	0	0	0	0	...	1	k	t	av	e
2	7	0	0	0	0	0	0	0	0	0	...	0	az	w	n	c
3	9	0	0	0	0	0	0	0	0	0	...	0	az	t	n	f
4	13	0	0	0	0	0	0	0	0	0	...	0	az	v	n	f

5 rows × 186 columns

In [4]:

```
test.head()
```

Out[4]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0
0	1	0	0	0	0	0	0	0	0	0	...	1	0	az
1	2	0	0	0	0	0	1	0	0	0	...	0	1	t
2	3	0	0	0	1	0	0	0	0	0	...	1	0	az
3	4	0	0	0	0	0	0	0	0	0	...	1	0	az
4	5	0	0	0	1	0	0	0	0	0	...	0	2	w

5 rows × 185 columns

In [5]:

```
#preparing data to split
y = train['y']
X = train.drop(['y'], axis=1)
print(X.shape)
print(test.shape)
```

```
(4194, 185)
(4209, 185)
```

In [6]:

```
from sklearn.model_selection import train_test_split
X_train, X_cv, y_train, y_cv = train_test_split(X, y, test_size=0.2)
print("Shape of train data:",X_train.shape)
print("Shape of cv data:",X_cv.shape)
```

```
Shape of train data: (3355, 185)
Shape of cv data: (839, 185)
```

7.0 Check for feature importance(only integer columns)

7.1 XGBoost model

In [70]:

```
#check if the newly added features are important or not
check_y= y_train
check_x= X_train.drop(['X0', 'X1', 'X2', 'X3','X4','X5', 'X6', 'X8'], axis=1) #dropping
all categorical features
```

In [71]:

```
#XGBoost
import warnings
warnings.filterwarnings("ignore")
from xgboost import XGBRegressor
from sklearn.metrics import r2_score
from sklearn.model_selection import RandomizedSearchCV

model1 = XGBRegressor(n_jobs = -1)
parameters = {'learning_rate': [0.01,0.02,0.03,0.05,0.1,0.2],'subsample':[0.7, 0.8, 0.9
],'colsample_bytree':[0.3, 0.5, 0.8, 0.9],
          'max_depth': [2, 3, 4, 5, 6],'n_estimators': [100, 200, 300, 500, 800, 1000,
1200]}
rs1 = RandomizedSearchCV(model1, parameters, scoring = 'r2',n_jobs = -1)
rs1.fit(check_x, check_y)
```

```
[15:54:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[71]:

```
RandomizedSearchCV(cv='warn', error_score='raise-deprecating',
                   estimator=XGBRegressor(base_score=0.5, booster='gbtre
e',
                                          colsample_bylevel=1,
                                          colsample_bynode=1,
                                          colsample_bytree=1, gamma=0,
                                          importance_type='gain',
                                          learning_rate=0.1, max_delta_ste
p=0,
                                          max_depth=3, min_child_weight=1,
                                          missing=None, n_estimators=100,
                                          n_jobs=-1, nthread=None,
                                          objective='reg:linear',
                                          ran...
                                          seed=None, silent=None, subsampl
e=1,
                                          verbosity=1),
                   iid='warn', n_iter=10, n_jobs=-1,
                   param_distributions={'colsample_bytree': [0.3, 0.5, 0.
8,
                                                             0.9],
                                        'learning_rate': [0.01, 0.02, 0.0
3,
                                                          0.05, 0.1, 0.2],
                                        'max_depth': [2, 3, 4, 5, 6],
                                        'n_estimators': [100, 200, 300, 50
0,
                                                         800, 1000, 1200],
                                        'subsample': [0.7, 0.8, 0.9]},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring='r2', verbose=0)
```

In [72]:

```
rs1.best_estimator_
```

Out[72]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.5, gamma=0,
             importance_type='gain', learning_rate=0.01, max_delta_step=0,
             max_depth=4, min_child_weight=1, missing=None, n_estimators=8
00,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.7, verbosity=1)
```

In [73]:

```
# Training a hyper-parameter tuned Xg-Boost regressor on our train data
import xgboost as xgb
model2 = xgb.XGBRegressor(
 learning_rate =0.01,
 subsample=0.7,
 colsample_bytree=0.5,
 gamma=0,
 max_depth=4,
 n_estimators=800,n_jobs = -1)
model2.fit(check_x, check_y)
```

```
[15:55:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

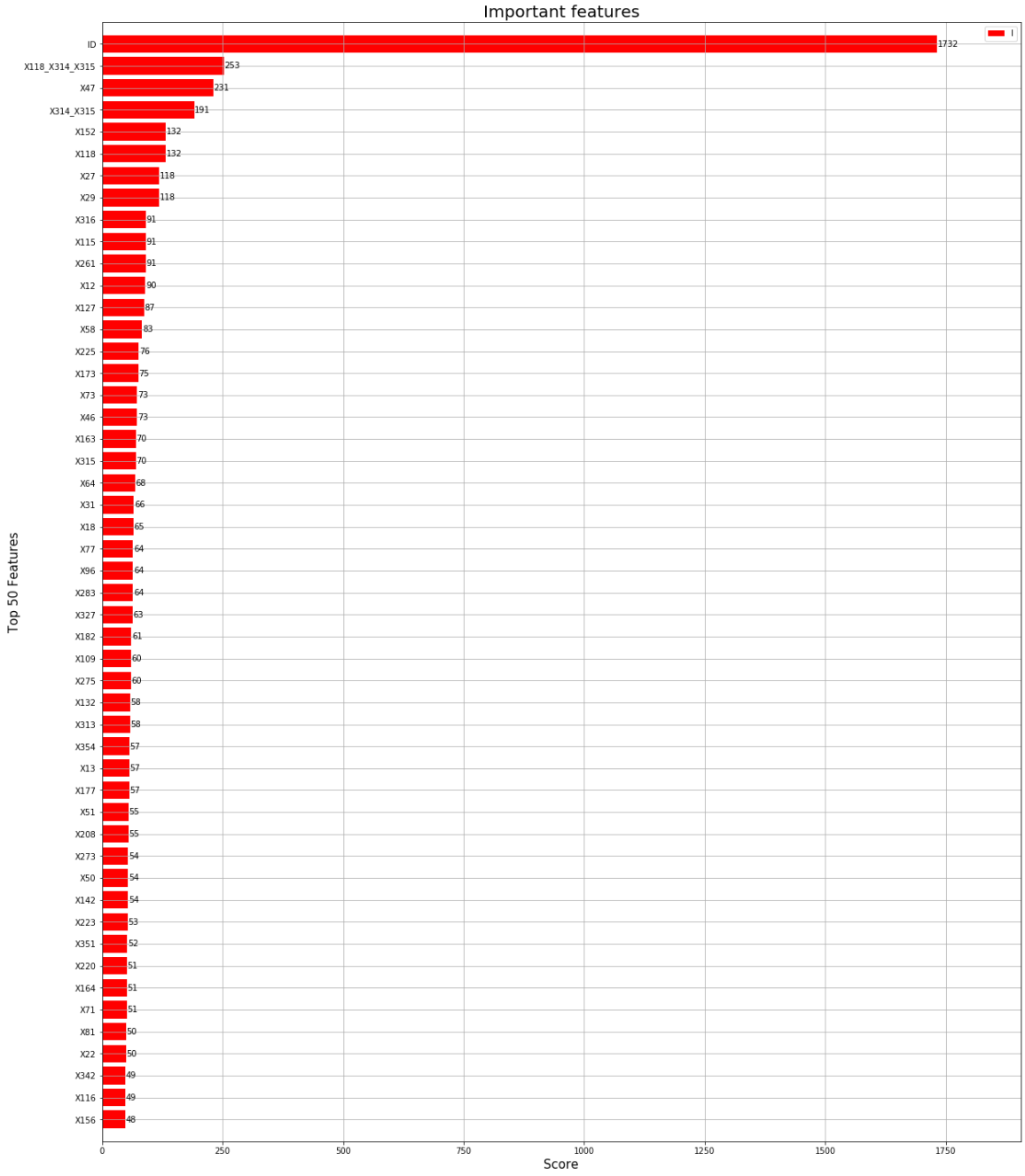
Out[73]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.5, gamma=0,
             importance_type='gain', learning_rate=0.01, max_delta_step=0,
             max_depth=4, min_child_weight=1, missing=None, n_estimators=8
00,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.7, verbosity=1)
```

7.2 Important features

In [74]:

```
fig, ax = plt.subplots(figsize=(20,25))
xgb.plot_importance(model2, max_num_features=50, height=0.8, ax=ax, color = 'red')
plt.legend(('Importance score'))
plt.xlabel("Score",fontsize=15)
plt.ylabel("Top 50 Features",fontsize=15)
plt.title('Important features',fontsize=20)
plt.show()
```



In [75]:

```
#feature importances
import operator

# dictionary of feature importance from the XGboost regressor with key as features & va
lues as importance value
imp_dict=model2.get_booster().get_score(importance_type='weight')

#sorting the dictionary in descending order of values
#ref:https://www.w3resource.com/python-exercises/dictionary/python-data-type-dictionary
-exercise-1.php
sorted_dict = dict( sorted(imp_dict.items(), key=operator.itemgetter(1),reverse=True))

import itertools
# Get first N items in dictionary
#https://www.geeksforgeeks.org/python-get-first-n-keyvalue-pairs-in-given-dictionary/

top_100 = dict(itertools.islice(sorted_dict.items(), 100))
print(top_100)
```

```
{'ID': 1732, 'X118_X314_X315': 253, 'X47': 231, 'X314_X315': 191, 'X118':
132, 'X152': 132, 'X29': 118, 'X27': 118, 'X261': 91, 'X115': 91, 'X316':
91, 'X12': 90, 'X127': 87, 'X58': 83, 'X225': 76, 'X173': 75, 'X46': 73,
'X73': 73, 'X315': 70, 'X163': 70, 'X64': 68, 'X31': 66, 'X18': 65, 'X28
3': 64, 'X96': 64, 'X77': 64, 'X327': 63, 'X182': 61, 'X275': 60, 'X109':
60, 'X313': 58, 'X132': 58, 'X177': 57, 'X13': 57, 'X354': 57, 'X208': 55,
'X51': 55, 'X142': 54, 'X50': 54, 'X273': 54, 'X223': 53, 'X351': 52, 'X7
1': 51, 'X164': 51, 'X220': 51, 'X22': 50, 'X81': 50, 'X116': 49, 'X342':
49, 'X156': 48, 'X189': 47, 'X218': 47, 'X203': 47, 'X100': 46, 'X151': 4
5, 'X20': 45, 'X117': 44, 'X14': 44, 'X19': 44, 'X355': 44, 'X224': 44, 'X
340': 43, 'X350': 43, 'X174': 42, 'X70': 42, 'X377': 42, 'X359': 41, 'X32
1': 41, 'X49': 40, 'X131': 40, 'X196': 40, 'X181': 40, 'X329': 39, 'X45':
39, 'X176': 38, 'X375': 37, 'X98': 36, 'X28': 35, 'X38': 34, 'X286': 34,
'X168': 34, 'X68': 34, 'X336': 33, 'X150': 33, 'X180': 32, 'X306': 32, 'X1
78': 32, 'X246': 32, 'X241': 32, 'X154': 31, 'X43': 30, 'X334': 30, 'X13
3': 30, 'X294': 30, 'X138': 30, 'X75': 29, 'X139': 29, 'X144': 28, 'X161':
28, 'X345': 28}
```

In [76]:

```
len(imp_dict)
```

Out[76]:

177

Observations:

- 'X118_X314_X315'& 'X314_X315' being in the top 50 important features turned out to be very useful. BAM! Feature engg was a success.
- 'X10_X29' & 'X10_X54' were not in the top 50, but still I would retain it for modeling.

8.0 Utility functions[These will be used throughout]

In [7]:

```
def one_hot_encoding(column,train,cv,test):
    ''' Function to encode categorical features'''

    vectorizer = CountVectorizer(token_pattern = r"(?u)\b\w+\b") #https://datascience.stackexchange.com/questions/29352/sklearn-countvectorizer-token-pattern-skip-token-if-pattern-match
    vectorizer.fit(train[column].values) # fit has to happen only on train data
    train_ohe = vectorizer.transform(train[column].values)
    cv_ohe = vectorizer.transform(cv[column].values)
    test_ohe = vectorizer.transform(test[column].values)
    return train_ohe,cv_ohe,test_ohe,print("Shape of matrix for column {} afer vectorization:".format(column)),print(train_ohe.shape,cv_ohe.shape,test_ohe.shape)
```

In [8]:

```
def score(y_true, y_pred):
    ''' Function to calculate R2 score'''

    return r2_score(y_true, y_pred)
```

My approaches towards modelling will be based on the encoding method of categorical features & dimensionality reduction technique with integer columns retained as is.

Approach-1

In this approach I will be encoding categorical features using one hot encoding and I will be trying out different models on the sparse data.

1.0 One hot encoding of categorical features

X_train, X_cv & test are already generated during splitting of data.

In [9]:

```
tr_X0_ohe, cv_X0_ohe, ts_X0_ohe,a,b= one_hot_encoding("X0",X_train,X_cv,test)
tr_X1_ohe, cv_X1_ohe, ts_X1_ohe,a,b= one_hot_encoding("X1",X_train,X_cv,test)
tr_X2_ohe, cv_X2_ohe, ts_X2_ohe,a,b= one_hot_encoding("X2",X_train,X_cv,test)
tr_X3_ohe, cv_X3_ohe, ts_X3_ohe,a,b= one_hot_encoding("X3",X_train,X_cv,test)
tr_X4_ohe, cv_X4_ohe, ts_X4_ohe,a,b= one_hot_encoding("X4",X_train,X_cv,test)
tr_X5_ohe, cv_X5_ohe, ts_X5_ohe,a,b= one_hot_encoding("X5",X_train,X_cv,test)
tr_X6_ohe, cv_X6_ohe, ts_X6_ohe,a,b= one_hot_encoding("X6",X_train,X_cv,test)
tr_X8_ohe, cv_X8_ohe, ts_X8_ohe,a,b= one_hot_encoding("X8",X_train,X_cv,test)
```

```
Shape of matrix for column X0 afer vectorization:
(3355, 45) (839, 45) (4209, 45)
Shape of matrix for column X1 afer vectorization:
(3355, 27) (839, 27) (4209, 27)
Shape of matrix for column X2 afer vectorization:
(3355, 40) (839, 40) (4209, 40)
Shape of matrix for column X3 afer vectorization:
(3355, 7) (839, 7) (4209, 7)
Shape of matrix for column X4 afer vectorization:
(3355, 3) (839, 3) (4209, 3)
Shape of matrix for column X5 afer vectorization:
(3355, 29) (839, 29) (4209, 29)
Shape of matrix for column X6 afer vectorization:
(3355, 12) (839, 12) (4209, 12)
Shape of matrix for column X8 afer vectorization:
(3355, 25) (839, 25) (4209, 25)
```

In [10]:

```
#Considering the remaining 175 features
tr_rem= X_train.drop(['X0', 'X1', 'X2', 'X3','X4','X5', 'X6', 'X8'],axis=1).values
cv_rem= X_cv.drop(['X0', 'X1', 'X2', 'X3','X4', 'X5', 'X6', 'X8'],axis=1).values
ts_rem= test.drop(['X0', 'X1', 'X2', 'X3','X4','X5', 'X6', 'X8'],axis=1).values
print(tr_rem.shape,cv_rem.shape,ts_rem.shape)
```

```
(3355, 177) (839, 177) (4209, 177)
```

1.1 Combining categorical & integer features

In [11]:

```
# merge two sparse matrices: https://stackoverflow.com/a/19710648/4084039
from scipy.sparse import hstack

X_tr_ohe = hstack((tr_X0_ohe,tr_X1_ohe,tr_X2_ohe,tr_X3_ohe,tr_X4_ohe,tr_X5_ohe,tr_X6_oh
e,tr_X8_ohe,tr_rem)).tocsr()

X_cv_ohe = hstack((cv_X0_ohe,cv_X1_ohe,cv_X2_ohe,cv_X3_ohe,cv_X4_ohe,cv_X5_ohe,cv_X6_oh
e,cv_X8_ohe,cv_rem)).tocsr()

X_test_ohe = hstack((ts_X0_ohe,ts_X1_ohe,ts_X2_ohe,ts_X3_ohe,ts_X4_ohe,ts_X5_ohe,ts_X6_
ohe,ts_X8_ohe,ts_rem)).tocsr()

print("Final Data Matrix")
print(X_tr_ohe.shape, y_train.shape)
print(X_cv_ohe.shape, y_cv.shape)
print(X_test_ohe.shape)
```

```
Final Data Matrix
(3355, 365) (3355,)
(839, 365) (839,)
(4209, 365)
```

2.0 Models

Normalizing data for linear and SVR models

In [13]:

```
from sklearn.preprocessing import MaxAbsScaler
scaler = MaxAbsScaler() #MinMaxScaler does not operate on sparse matrices
X_tr_norm = scaler.fit_transform(X_tr_ohe)
X_cv_norm = scaler.transform(X_cv_ohe)
X_test_norm = scaler.transform(X_test_ohe)
print(X_tr_norm.shape)
print(X_cv_norm.shape)
print(X_test_norm.shape)
```

```
(3355, 365)
(839, 365)
(4209, 365)
```

2.1 Linear regression with hyperparameter tuning

In [16]:

```
#Linear regression
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import GridSearchCV

lr= LinearRegression(n_jobs=-1)
parameters = {'fit_intercept':[True,False], 'normalize':[True,False]}
grid = GridSearchCV(lr, parameters, scoring='r2', n_jobs=-1)
grid.fit(X_tr_norm, y_train.values)
```

Out[16]:

```
GridSearchCV(cv='warn', error_score='raise-deprecating',
             estimator=LinearRegression(copy_X=True, fit_intercept=True,
                                        n_jobs=-1, normalize=False),
             iid='warn', n_jobs=-1,
             param_grid={'fit_intercept': [True, False],
                         'normalize': [True, False]},
             pre_dispatch='2*n_jobs', refit=True, return_train_score=Fals
e,
             scoring='r2', verbose=0)
```

In [17]:

```
grid.best_estimator_
```

Out[17]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=-1, normalize=Tru
e)
```

In [18]:

```
lr_reg = LinearRegression(fit_intercept= True, normalize= True, n_jobs = -1)
lr_reg.fit(X_tr_norm, y_train.values)

y_pred_cv_lr = lr_reg.predict(X_cv_norm)

y_pred_train_lr = lr_reg.predict(X_tr_norm)

train_score_lr=score(y_train.values, y_pred_train_lr)
cv_score_lr=score(y_cv.values, y_pred_cv_lr)
print("Train score:",round(train_score_lr,4))
print("Cross validation score:",round(cv_score_lr,4))
```

```
Train score: 0.6659
Cross validation score: 0.6281
```

In [19]:

```
y_pred_test_lr = lr_reg.predict(X_test_norm)
y_pred_test_lr
```

Out[19]:

```
array([ 67.27865238,  95.91336739,  73.76040087, ...,  92.6255186 ,
       109.48671927,  91.00451061])
```

In [20]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test_lr
submission.to_csv('Predictions_LR_OHE.csv', index=False)
```

In [21]:

```
submission.head(10)
```

Out[21]:

	ID	y
0	1	67.278652
1	2	95.913367
2	3	73.760401
3	4	69.108009
4	5	106.129797
5	8	101.086508
6	10	120.069767
7	11	87.549346
8	12	110.704260
9	14	89.455761

With this submission I got a Private R2 score of 0.51398 & public R2 score of 0.52360.

2.2 KNN regressor with hyperparameter tuning

In [22]:

```
from sklearn.neighbors import KNeighborsRegressor
from sklearn.model_selection import GridSearchCV

nn= KNeighborsRegressor(n_jobs=-1)
parameters = {'n_neighbors':[3, 15, 25, 50, 100], 'metric':['minkowski','euclidean','ma
nhattan']}
grid1 = GridSearchCV(nn, parameters, scoring='r2', n_jobs=-1)
grid1.fit(X_tr_norm, y_train.values)
```

Out[22]:

```
GridSearchCV(cv='warn', error_score='raise-deprecating',
             estimator=KNeighborsRegressor(algorithm='auto', leaf_size=30,
                                           metric='minkowski',
                                           metric_params=None, n_jobs=-1,
                                           n_neighbors=5, p=2,
                                           weights='uniform'),
             iid='warn', n_jobs=-1,
             param_grid={'metric': ['minkowski', 'euclidean', 'manhatta
n'],
                         'n_neighbors': [3, 15, 25, 50, 100]},
             pre_dispatch='2*n_jobs', refit=True, return_train_score=Fals
e,
             scoring='r2', verbose=0)
```

In [23]:

```
grid1.best_estimator_
```

Out[23]:

```
KNeighborsRegressor(algorithm='auto', leaf_size=30, metric='manhattan',
                    metric_params=None, n_jobs=-1, n_neighbors=15, p=2,
                    weights='uniform')
```

In [24]:

```
knn= KNeighborsRegressor(n_neighbors=15,metric='manhattan',n_jobs=-1)
knn.fit(X_tr_norm, y_train.values)
```

Out[24]:

```
KNeighborsRegressor(algorithm='auto', leaf_size=30, metric='manhattan',
                    metric_params=None, n_jobs=-1, n_neighbors=15, p=2,
                    weights='uniform')
```

In [25]:

```
y_pred_cv_knn = knn.predict(X_cv_norm)

y_pred_train_knn = knn.predict(X_tr_norm)

train_score_knn=score(y_train.values, y_pred_train_knn)
cv_score_knn=score(y_cv.values, y_pred_cv_knn)
print("Train score:",round(train_score_knn,4))
print("Cross validation score:",round(cv_score_knn,4))
```

```
Train score: 0.5952
Cross validation score: 0.5839
```

In [26]:

```
y_pred_test_knn = knn.predict(X_test_norm)
y_pred_test_knn
```

Out[26]:

```
array([ 78.06133333,  92.486     ,  78.01466667, ...,  96.56933333,
       111.98266667,  91.60733333])
```

In [27]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test_knn
submission.to_csv('Predictions_KNN_OHE.csv', index=False)
```

In [28]:

```
submission.head(10)
```

Out[28]:

	ID	y
0	1	78.061333
1	2	92.486000
2	3	78.014667
3	4	78.334667
4	5	112.676000
5	8	92.560667
6	10	104.105333
7	11	99.016000
8	12	117.516000
9	14	93.364667

With this submission I got a Private R2 score of 0.47784 & public R2 score of 0.49714.

2.3 SVR with hyperparameter tuning

In [29]:

```
#https://scikit-learn.org/stable/modules/generated/sklearn.svm.SVR.html
from sklearn.svm import SVR
from sklearn.model_selection import GridSearchCV

clf= SVR()
parameters = {'C':[1, 10, 100, 1000]} # rbf is the default kernel here
grid2 = GridSearchCV(clf, parameters, scoring='r2', n_jobs=-1)
grid2.fit(X_tr_norm, y_train.values)
```

Out[29]:

```
GridSearchCV(cv='warn', error_score='raise-deprecating',
             estimator=SVR(C=1.0, cache_size=200, coef0=0.0, degree=3,
                           epsilon=0.1, gamma='auto_deprecated', kernel='r
bf',
                           max_iter=-1, shrinking=True, tol=0.001,
                           verbose=False),
             iid='warn', n_jobs=-1, param_grid={'C': [1, 10, 100, 1000]},
             pre_dispatch='2*n_jobs', refit=True, return_train_score=Fals
e,
             scoring='r2', verbose=0)
```

In [30]:

```
grid2.best_estimator_
```

Out[30]:

```
SVR(C=100, cache_size=200, coef0=0.0, degree=3, epsilon=0.1,
    gamma='auto_deprecated', kernel='rbf', max_iter=-1, shrinking=True,
    tol=0.001, verbose=False)
```

In [31]:

```
sv= SVR(C=100)
sv.fit(X_tr_norm, y_train)

y_pred_cv_svr = sv.predict(X_cv_norm)

y_pred_train_svr = sv.predict(X_tr_norm)

train_score_svr=score(y_train, y_pred_train_svr)
cv_score_svr=score(y_cv, y_pred_cv_svr)
print("Train score:",round(train_score_svr,4))
print("Cross validation score:",round(cv_score_svr,4))
```

```
Train score: 0.6248
Cross validation score: 0.6308
```

- The CV score looks interesting and the overfitting issue is also less compared to linear regression & KNN regressor. So let me check how this model performs with test data.

In [32]:

```
y_pred_test_svr = sv.predict(X_test_norm)
y_pred_test_svr
```

Out[32]:

```
array([ 79.36785035,  91.78564557,  78.32998707, ...,  90.90155118,
       108.14147815,  88.73258898])
```

In [33]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test_svr
submission.to_csv('Predictions_svr_OHE_exp6.csv', index=False)
```

In [34]:

```
submission.head(10)
```

Out[34]:

	ID	y
0	1	79.367850
1	2	91.785646
2	3	78.329987
3	4	80.674599
4	5	112.029205
5	8	91.876450
6	10	107.996430
7	11	93.204263
8	12	117.204774
9	14	93.504324

In [35]:

```
submission.shape
```

Out[35]:

```
(4209, 2)
```

With this submission I got a Private R2 score of 0.50506 & public R2 score of 0.51859.

2.4 Random forest with hyperparameter tuning

In [36]:

```
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import RandomizedSearchCV

rf = RandomForestRegressor(n_jobs=-1)
parameters = {'max_features':['sqrt', 'log2'],'min_samples_leaf':[1, 10, 100],'min_samp
les_split' : [3,5,7,8],
              'max_depth' : [2, 3, 4, 5, 6], 'n_estimators':[80, 100, 200, 300, 500, 10
00, 1200]}
rs = RandomizedSearchCV(rf, parameters, scoring='r2',n_jobs=-1)
rs.fit(X_tr_ohe, y_train.values)
```

Out[36]:

```
RandomizedSearchCV(cv='warn', error_score='raise-deprecating',
                   estimator=RandomForestRegressor(bootstrap=True,
                                                   criterion='mse',
                                                   max_depth=None,
                                                   max_features='auto',
                                                   max_leaf_nodes=None,
                                                   min_impurity_decrease=
0.0,
                                                   min_impurity_split=Non
e,
                                                   min_samples_leaf=1,
                                                   min_samples_split=2,
                                                   min_weight_fraction_lea
f=0.0,
                                                   n_estimators='warn',
                                                   n_jobs=-1, oob_score=Fa
lse,
                                                   random_...e=None, verbo
se=0,
                                                   warm_start=False),
                   iid='warn', n_iter=10, n_jobs=-1,
                   param_distributions={'max_depth': [2, 3, 4, 5, 6],
                                        'max_features': ['sqrt', 'log2'],
                                        'min_samples_leaf': [1, 10, 100],
                                        'min_samples_split': [3, 5, 7, 8],
                                        'n_estimators': [80, 100, 200, 30
0, 500,
                                                         1000, 1200]},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring='r2', verbose=0)
```

In [37]:

```
rs.best_estimator_
```

Out[37]:

```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=6,
                      max_features='sqrt', max_leaf_nodes=None,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=8,
                      min_weight_fraction_leaf=0.0, n_estimators=100, n_jo
bs=-1,
                      oob_score=False, random_state=None, verbose=0,
                      warm_start=False)
```

In [38]:

```
rfb = RandomForestRegressor(max_features='sqrt',min_samples_leaf=1,min_samples_split=8,
n_estimators=100, max_depth=6,
                            n_jobs=-1)
rfb.fit(X_tr_ohe, y_train.values)
```

Out[38]:

```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=6,
                      max_features='sqrt', max_leaf_nodes=None,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=8,
                      min_weight_fraction_leaf=0.0, n_estimators=100, n_jo
bs=-1,
                      oob_score=False, random_state=None, verbose=0,
                      warm_start=False)
```

In [39]:

```
y_pred_cv_rf = rfb.predict(X_cv_ohe)

y_pred_train_rf = rfb.predict(X_tr_ohe)

train_score_rf=score(y_train.values, y_pred_train_rf)
cv_score_rf=score(y_cv.values, y_pred_cv_rf)
print("Train score:",round(train_score_rf,4))
print("Cross validation score:",round(cv_score_rf,4))
```

```
Train score: 0.6053
Cross validation score: 0.6261
```

In [40]:

```
y_pred_test_rf = rfb.predict(X_test_ohe)
y_pred_test_rf
```

Out[40]:

```
array([ 79.68949481,  95.28237829,  80.30021152, ...,  95.41625976,
       110.43764224,  94.49660038])
```

In [41]:

```
y_pred_test_rf
```

Out[41]:

```
array([ 79.68949481,  95.28237829,  80.30021152, ...,  95.41625976,
       110.43764224,  94.49660038])
```

In [42]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test_rf
submission.to_csv('Predictions_RF_OHE_exp6.csv', index=False)
```

In [43]:

```
submission.head(10)
```

Out[43]:

	ID	y
0	1	79.689495
1	2	95.282378
2	3	80.300212
3	4	79.713469
4	5	109.796058
5	8	95.211581
6	10	109.242372
7	11	96.715800
8	12	116.638620
9	14	96.628367

With this submission I got a Private R2 score of 0.52089 & public R2 score of 0.52742.

2.5 XGBoost regressor with hyperparameter tuning

In [89]:

```
#XGBoost
import warnings
warnings.filterwarnings("ignore")
from xgboost import XGBRegressor
from sklearn.metrics import r2_score
from sklearn.model_selection import RandomizedSearchCV

model3 = XGBRegressor(n_jobs = -1)
parameters = {'learning_rate': [0.4, 0.3, 0.2, 0.1, 0.05, 0.01, 0.005],'subsample':[0.7
, 0.8, 0.9],'colsample_bytree':[0.3, 0.5, 0.6, 0.8, 0.9],'gamma':[0,1,5,10,15,20,25,30
],
          'max_depth': [2, 3, 4, 5, 6],'n_estimators': [80,90,100,150,200,250,300, 500,
800, 1000]}
rs3 = RandomizedSearchCV(model3, parameters, scoring = 'r2',n_jobs=-1)
rs3.fit(X_tr_ohe, y_train.values)
```

```
[16:08:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[89]:

```
RandomizedSearchCV(cv='warn', error_score='raise-deprecating',
                   estimator=XGBRegressor(base_score=0.5, booster='gbtre
e',
                                          colsample_bylevel=1,
                                          colsample_bynode=1,
                                          colsample_bytree=1, gamma=0,
                                          importance_type='gain',
                                          learning_rate=0.1, max_delta_ste
p=0,
                                          max_depth=3, min_child_weight=1,
                                          missing=None, n_estimators=100,
                                          n_jobs=-1, nthread=None,
                                          objective='reg:linear',
                                          ran...
                   param_distributions={'colsample_bytree': [0.3, 0.5, 0.
6, 0.8,
                                                             0.9],
                                        'gamma': [0, 1, 5, 10, 15, 20, 25,
30],
                                        'learning_rate': [0.4, 0.3, 0.2,
0.1,
                                                          0.05, 0.01, 0.00
5],
                                        'max_depth': [2, 3, 4, 5, 6],
                                        'n_estimators': [80, 90, 100, 150,
200,
                                                         250, 300, 500, 80
0,
                                                         1000],
                                        'subsample': [0.7, 0.8, 0.9]},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring='r2', verbose=0)
```

In [90]:

```
rs3.best_estimator_
```

Out[90]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.3, gamma=15,
             importance_type='gain', learning_rate=0.01, max_delta_step=0,
             max_depth=4, min_child_weight=1, missing=None, n_estimators=8
00,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.9, verbosity=1)
```

In [115]:

```
# Training a hyper-parameter tuned Xg-Boost regressor on our train data
import xgboost as xgb
model4 = xgb.XGBRegressor(
 learning_rate =0.01,
 subsample=0.9,
 colsample_bytree=0.3,
 gamma=15,
 max_depth=2,
 n_estimators=800,n_jobs = -1)
model4.fit(X_tr_ohe, y_train.values)
```

```
[16:21:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[115]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.3, gamma=15,
             importance_type='gain', learning_rate=0.01, max_delta_step=0,
             max_depth=2, min_child_weight=1, missing=None, n_estimators=8
00,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.9, verbosity=1)
```

In [116]:

```
y_pred_cv = model4.predict(X_cv_ohe)
y_pred_train = model4.predict(X_tr_ohe)
y_pred_test = model4.predict(X_test_ohe)
```

In [117]:

```
train_score=score(y_train.values, y_pred_train)
cv_score=score(y_cv.values, y_pred_cv)
print("Train score:",round(train_score,4))
print("Cross validation score:",round(cv_score,4))
```

```
Train score: 0.6473
Cross validation score: 0.6343
```

In [118]:

```
y_pred_test
```

Out[118]:

```
array([ 81.4259 ,  97.74504,  81.9031 , ...,  92.47554, 110.95321,
        92.40911], dtype=float32)
```

In [119]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test
submission.to_csv('Predictions_xgb_OHE_2_2.csv', index=False)
```

In [120]:

```
submission.head(10)
```

Out[120]:

	ID	y
0	1	81.425903
1	2	97.745041
2	3	81.903099
3	4	81.398148
4	5	113.972298
5	8	96.529991
6	10	115.068176
7	11	97.221664
8	12	119.613876
9	14	97.916573

- **I got a Private R2 score of 0.54910 & public R2 score of 0.55551.**

Approach-2

Applying SVD for dimensionality reduction and check if R2 improves or not.

Using SVD over PCA as PCA does not work on sparse matrices and our resultant matrix is sparse because of one hot encoding.

In [14]:

```
X_tr_svd= X_tr_ohe
X_cv_svd= X_cv_ohe
X_test_svd= X_test_ohe
```

1.0 SVD on data

In [15]:

```
#standardize the data in order to apply svd
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler(with_mean=False) #https://stackoverflow.com/questions/52008548/
python-running-into-x-test-y-test-fit-errors
# Fit on training set only.
scaler.fit(X_tr_svd)
# Apply transform to both the training set and the test set.
X_tr_svd = scaler.transform(X_tr_svd)
X_cv_svd = scaler.transform(X_cv_svd)
X_test_svd = scaler.transform(X_test_svd)
```

In [16]:

```
X_tr_svd.shape
```

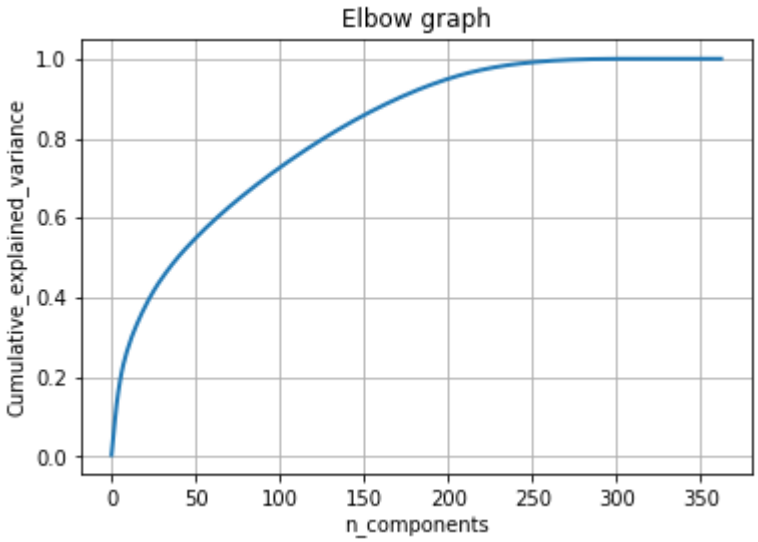
Out[16]:

```
(3355, 365)
```

1.1 Determining n_components using elbow method

In [48]:

```
#elbow method

# initializing the SVD
from sklearn.decomposition import TruncatedSVD
svd = TruncatedSVD(n_components=364)
svd.fit(X_tr_svd)

percentage_var_explained = svd.explained_variance_/ np.sum(svd.explained_variance_);

cum_var_explained = np.cumsum(percentage_var_explained)

# Plot the SVD spectrum
plt.figure(1, figsize=(6, 4))

plt.clf()
plt.plot(cum_var_explained, linewidth=2)
plt.axis('tight')
plt.grid()
plt.xlabel('n_components')
plt.ylabel('Cumulative_explained_variance')
plt.title("Elbow graph")
plt.show()
```



From the above graph it can be observed that 95% of the variance can be explained with n_components=225

In [49]:

```
svd_225 = TruncatedSVD(n_components= 225)
svd_225.fit(X_tr_svd)
X_tr_svd = svd_225.transform(X_tr_svd)
X_cv_svd = svd_225.transform(X_cv_svd)
X_test_svd = svd_225.transform(X_test_svd)
```

In [50]:

```
print("Updated shapes of train, cv & test data:")
print(X_tr_svd.shape)
print(X_cv_svd.shape)
print(X_test_svd.shape)
```

```
Updated shapes of train, cv & test data:
(3355, 225)
(839, 225)
(4209, 225)
```

Since XGB regressor was the best model in the previous approach, I will be training XGB regressor here & henceforth.

2.0 XGBoost regressor with hyperparameter tuning

In [51]:

```
#XGBoost
import warnings
warnings.filterwarnings("ignore")
from xgboost import XGBRegressor
from sklearn.metrics import r2_score
from sklearn.model_selection import RandomizedSearchCV

model4 = XGBRegressor(n_jobs = -1)
parameters = {'learning_rate': [0.01,0.02,0.05,0.1,0.5,1],'subsample':[0.7, 0.8, 0.9],
'colsample_bytree':[0.3, 0.5, 0.6, 0.8, 0.9],'gamma':[0,1,5,10,15,20,25,30],
          'max_depth': [2, 3, 4, 5, 6],'n_estimators': [80, 90, 100, 150, 200, 250,300,
500, 800, 1000]}
rs4 = RandomizedSearchCV(model4, parameters, scoring = 'r2',n_jobs=-1)
rs4.fit(X_tr_svd, y_train.values)
```

```
[17:09:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[51]:

```
RandomizedSearchCV(cv='warn', error_score='raise-deprecating',
                   estimator=XGBRegressor(base_score=0.5, booster='gbtre
e',
                                          colsample_bylevel=1,
                                          colsample_bynode=1,
                                          colsample_bytree=1, gamma=0,
                                          importance_type='gain',
                                          learning_rate=0.1, max_delta_ste
p=0,
                                          max_depth=3, min_child_weight=1,
                                          missing=None, n_estimators=100,
                                          n_jobs=-1, nthread=None,
                                          objective='reg:linear',
                                          ran...
                   iid='warn', n_iter=10, n_jobs=-1,
                   param_distributions={'colsample_bytree': [0.3, 0.5, 0.
6, 0.8,
                                                             0.9],
                                        'gamma': [0, 1, 5, 10, 15, 20, 25,
30],
                                        'learning_rate': [0.01, 0.02, 0.0
5, 0.1,
                                                          0.5, 1],
                                        'max_depth': [2, 3, 4, 5, 6],
                                        'n_estimators': [80, 90, 100, 150,
200,
                                                         250, 300, 500, 80
0,
                                                         1000],
                                        'subsample': [0.7, 0.8, 0.9]},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring='r2', verbose=0)
```

In [52]:

```
rs4.best_estimator_
```

Out[52]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.8, gamma=20,
             importance_type='gain', learning_rate=0.02, max_delta_step=0,
             max_depth=3, min_child_weight=1, missing=None, n_estimators=5
00,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.7, verbosity=1)
```

In [56]:

```
# Training a hyper-parameter tuned Xg-Boost regressor on our train data
import xgboost as xgb
model5 = xgb.XGBRegressor(
 learning_rate =0.02,
 subsample=0.7,
 colsample_bytree=0.8,
 gamma=20,
 max_depth=2,
 n_estimators=500,n_jobs = -1)
model5.fit(X_tr_svd, y_train.values)
```

```
[17:10:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[56]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.8, gamma=20,
             importance_type='gain', learning_rate=0.02, max_delta_step=0,
             max_depth=2, min_child_weight=1, missing=None, n_estimators=5
00,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.7, verbosity=1)
```

In [57]:

```
y_pred_cv = model5.predict(X_cv_svd)
y_pred_train = model5.predict(X_tr_svd)
y_pred_test = model5.predict(X_test_svd)
```

In [58]:

```
train_score=score(y_train.values, y_pred_train)
cv_score=score(y_cv.values, y_pred_cv)
print("Train score:",round(train_score,4))
print("Cross validation score:",round(cv_score,4))
```

```
Train score: 0.6311
Cross validation score: 0.6003
```

In [59]:

```
y_pred_test
```

Out[59]:

```
array([ 80.61638,  93.09882,  79.25799, ...,  94.49089, 110.37918,
        93.65836], dtype=float32)
```

In [60]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test
submission.to_csv('Predictions_xgb_svd_exp6.csv', index=False)
```

In [61]:

```
submission.head(10)
```

Out[61]:

	ID	y
0	1	80.616379
1	2	93.098824
2	3	79.257988
3	4	79.144333
4	5	108.024719
5	8	93.306557
6	10	104.848259
7	11	95.779129
8	12	116.990997
9	14	98.194511

- **Best estimator hyperparameters were overfitting. Therefore experimented for depth =2 & n_est = 500, I got a Private R2 score of 0.49440 & public R2 score of 0.50422.**
- **Results are are not good.**

Approach-3

In this approach I will be trying SelectKBest technique of dimensionality reduction on one hot encoded categorical features & integer features and check if the R2 score improves or not.

In [21]:

```
print("Data Matrix")
print(X_tr_ohe.shape, y_train.shape)
print(X_cv_ohe.shape, y_cv.shape)
print(X_test_ohe.shape)
```

```
Data Matrix
(3355, 365) (3355,)
(839, 365) (839,)
(4209, 365)
```

In [27]:

```
# Ref: https://scikit-learn.org/stable/modules/generated/sklearn.feature_selection.SelectKBest.html
from sklearn.feature_selection import SelectKBest,f_regression
# feature extraction
fe = SelectKBest(score_func=f_regression, k=182) #considering 50% feature reduction
X_tr_ohe_best = fe.fit_transform(X_tr_ohe, y_train)
X_cv_ohe_best = fe.transform(X_cv_ohe)
X_test_ohe_best = fe.transform(X_test_ohe)

print("Final reduced Data Matrix")
print(X_tr_ohe_best.shape, y_train.shape)
print(X_cv_ohe_best.shape, y_cv.shape)
print(X_test_ohe_best.shape)
```

```
Final reduced Data Matrix
(3355, 182) (3355,)
(839, 182) (839,)
(4209, 182)
```

Hyperparameter tuning of XGBoost regressor

In [32]:

```
# applying XGBoost
import warnings
warnings.filterwarnings("ignore")
from xgboost import XGBRegressor
from sklearn.metrics import r2_score
from sklearn.model_selection import RandomizedSearchCV

model_k = XGBRegressor(n_jobs = -1)
parameters = {'learning_rate': [0.005, 0.01, 0.02, 0.05, 0.1,0.5],'subsample':[0.7, 0.8
, 0.9],'colsample_bytree':[0.3, 0.5, 0.6, 0.8, 0.9],'gamma':[0,1,5,10,15,20,25,30],
          'max_depth': [2, 3, 4, 5, 6],'n_estimators': [80, 90, 100, 150, 200, 250,300,
500, 800, 1000]}
rs = RandomizedSearchCV(model_k, parameters, scoring = 'r2',n_jobs=-1)
rs.fit(X_tr_ohe_best, y_train.values)
```

```
[12:29:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[32]:

```
RandomizedSearchCV(cv='warn', error_score='raise-deprecating',
                   estimator=XGBRegressor(base_score=0.5, booster='gbtre
e',
                                          colsample_bylevel=1,
                                          colsample_bynode=1,
                                          colsample_bytree=1, gamma=0,
                                          importance_type='gain',
                                          learning_rate=0.1, max_delta_ste
p=0,
                                          max_depth=3, min_child_weight=1,
                                          missing=None, n_estimators=100,
                                          n_jobs=-1, nthread=None,
                                          objective='reg:linear',
                                          ran...
                   iid='warn', n_iter=10, n_jobs=-1,
                   param_distributions={'colsample_bytree': [0.3, 0.5, 0.
6, 0.8,
                                                             0.9],
                                        'gamma': [0, 1, 5, 10, 15, 20, 25,
30],
                                        'learning_rate': [0.005, 0.01, 0.0
2,
                                                          0.05, 0.1, 0.5],
                                        'max_depth': [2, 3, 4, 5, 6],
                                        'n_estimators': [80, 90, 100, 150,
200,
                                                         250, 300, 500, 80
0,
                                                         1000],
                                        'subsample': [0.7, 0.8, 0.9]},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring='r2', verbose=0)
```

In [33]:

```
rs.best_estimator_
```

Out[33]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.5, gamma=15,
             importance_type='gain', learning_rate=0.05, max_delta_step=0,
             max_depth=2, min_child_weight=1, missing=None, n_estimators=1
50,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.8, verbosity=1)
```

In [34]:

```
# Training a hyper-parameter tuned Xg-Boost regressor on our train data
import xgboost as xgb
model_k = xgb.XGBRegressor(
 learning_rate =0.05,
 subsample=0.8,
 colsample_bytree=0.5,
 gamma=15,
 max_depth=2,
 n_estimators=150,n_jobs = -1)
model_k.fit(X_tr_ohe_best, y_train.values)
```

```
[12:31:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

Out[34]:

```
XGBRegressor(base_score=0.5, booster='gbtree', colsample_bylevel=1,
             colsample_bynode=1, colsample_bytree=0.5, gamma=15,
             importance_type='gain', learning_rate=0.05, max_delta_step=0,
             max_depth=2, min_child_weight=1, missing=None, n_estimators=1
50,
             n_jobs=-1, nthread=None, objective='reg:linear', random_state
=0,
             reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
             silent=None, subsample=0.8, verbosity=1)
```

In [35]:

```
y_pred_cv = model_k.predict(X_cv_ohe_best)
y_pred_train = model_k.predict(X_tr_ohe_best)
y_pred_test = model_k.predict(X_test_ohe_best)
```

In [36]:

```
train_score=score(y_train.values, y_pred_train)
cv_score=score(y_cv.values, y_pred_cv)
print("Train score:",round(train_score,4))
print("Cross validation score:",round(cv_score,4))
```

```
Train score: 0.6429
Cross validation score: 0.6432
```

In [37]:

```
y_pred_test
```

Out[37]:

```
array([ 80.54896 ,  94.18076 ,  79.802925, ...,  94.64967 , 111.79481 ,
       102.35253 ], dtype=float32)
```

In [38]:

```
submission = pd.DataFrame()
submission['ID'] = test.ID.values
submission['y'] = y_pred_test
submission.to_csv('Predictions_xgb_sk_ohe.csv', index=False)
```

In [39]:

```
submission.head(10)
```

Out[39]:

	ID	y
0	1	80.548958
1	2	94.180763
2	3	79.802925
3	4	80.394875
4	5	112.191460
5	8	93.843826
6	10	112.497711
7	11	94.681602
8	12	115.927361
9	14	94.815086

- **I got a Private R2 score of 0.54938 & public R2 score of 0.55583.**
- **Impressive! So, SelectKbest outperformed SVD and in fact it gave me the best score with one hot encoding approach.**

Approach-4

- **This approach will be similar to Approach-1 but the only difference is in encoding of categorical features where I will be implementing target encoding instead of one hot encoding.**
- **Here, I will not be splitting the train data into train & cv. I will be considering the entire train data for modelling.**
- **Also, I will be implementing the native XGBoost API instead of scikit learn version of XGBoost regressor.**

1.0 Target encoding of categorical features

In [40]:

```
train.head()
```

Out[40]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X118_X314_X315	X0	X1	X2	X
0	0	0	0	1	0	1	0	0	0	0	...	1	k	v	at	a
1	6	0	0	0	0	1	0	0	0	0	...	1	k	t	av	e
2	7	0	0	0	0	0	0	0	0	0	...	0	az	w	n	c
3	9	0	0	0	0	0	0	0	0	0	...	0	az	t	n	f
4	13	0	0	0	0	0	0	0	0	0	...	0	az	v	n	f

5 rows × 186 columns

In [41]:

```
train_y= train.y
X_train_te= train.copy()
X_train_te= X_train_te.drop('y',axis=1)
X_test_te= test.copy()
print("Shape of train data:",X_train_te.shape)
print("Shape of test data:",X_test_te.shape)
```

```
Shape of train data: (4194, 185)
Shape of test data: (4209, 185)
```

In [42]:

```
cat= ['X0', 'X1', 'X2', 'X3','X4', 'X5', 'X6', 'X8']
```

In [43]:

```
#https://contrib.scikit-learn.org/categorical-encoding/targetencoder.html
#https://pypi.org/project/category-encoders/
from category_encoders import *
# use target encoding to encode 8 categorical features
enc = TargetEncoder(cols=cat).fit(X_train_te, train_y)

# transform the datasets
X_train_te = enc.transform(X_train_te, train_y)
X_test_te = enc.transform(X_test_te)
```

In [44]:

```
X_train_te.head()
```

Out[44]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	
0	0	0	0	1	0	1	0	0	0	0	...	0	1	99.
1	6	0	0	0	0	1	0	0	0	0	...	0	1	99.
2	7	0	0	0	0	0	0	0	0	0	...	1	0	78.
3	9	0	0	0	0	0	0	0	0	0	...	1	0	78.
4	13	0	0	0	0	0	0	0	0	0	...	1	0	78.

5 rows × 185 columns

In [45]:

```
X_test_te.head()
```

Out[45]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	
0	1	0	0	0	0	0	0	0	0	0	...	1	0	78.(
1	2	0	0	0	0	0	1	0	0	0	...	0	1	93.5
2	3	0	0	0	1	0	0	0	0	0	...	1	0	78.(
3	4	0	0	0	0	0	0	0	0	0	...	1	0	78.(
4	5	0	0	0	1	0	0	0	0	0	...	0	2	112

5 rows × 185 columns

1.1 Checking for NaN values if any

In [46]:

```
# test data
nan_rows = X_test_te[X_test_te.isnull().any(axis=1)]
nan_rows
```

Out[46]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0

0 rows × 185 columns

In [47]:

```
# train data
nan_rows = X_train_te[X_train_te.isnull().any(axis=1)]
nan_rows
```

Out[47]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0

0 rows × 185 columns

- **Target encoder provides an option of handle_missing='value'& handle_unknown='value' where value is mean of the target variable, we do not have to worry about NaN's**

2.0 XGBoost model with hyperparameter tuning

2.1 Hyperparameter tuning

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [13]:

```
import xgboost as xgb

#preparing train & test matrices
dtrain = xgb.DMatrix(X_train_te, label=train_y)
dtest = xgb.DMatrix(X_test_te)
num_boost_round = 1000


params = {
    # Parameters that we are going to tune. Below are the default values of the paramet
ers
    'max_depth':6,
    'min_child_weight': 1,
    'eta':.3,
    'subsample': 1,
    'colsample_bytree': 1,
    'objective':'reg:linear',
    'eval_metric':'rmse'
}
```

In [15]:

```
#Let’s see what cross-validation score we get with our current parameters:
cv_results = xgb.cv(
    params,
    dtrain,
    num_boost_round=num_boost_round,
    seed=42,
    nfold=5,
    metrics={'rmse'},
    early_stopping_rounds=50
)

print(cv_results['test-rmse-mean'].min())
```

```
[13:27:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:27:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:27:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:27:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:27:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
7.476154800000001
```

In [16]:

```
cv_results
```

Out[16]:

	train-rmse-mean	train-rmse-std	test-rmse-mean	test-rmse-std
0	70.691104	0.062909	70.688881	0.329249
1	49.788036	0.045937	49.786632	0.320848
2	35.265200	0.034915	35.264314	0.319898
3	25.248762	0.028411	25.256982	0.330428
4	18.431080	0.024849	18.456827	0.340102
5	13.884497	0.026920	13.973699	0.347921
6	10.940489	0.027392	11.135726	0.324649
7	9.093285	0.034705	9.413359	0.309213
8	7.995387	0.037834	8.446029	0.278169
9	7.336958	0.046580	7.942328	0.241516
10	6.957165	0.038848	7.676222	0.211436
11	6.720268	0.044037	7.549454	0.192632
12	6.573738	0.052153	7.488233	0.186903
13	6.456602	0.069400	7.476155	0.173697

Tuning Parameters max_depth and min_child_weight

In [17]:

```
gridsearch_params = [(max_depth, min_child_weight)
    for max_depth in range(2,7)
    for min_child_weight in range(4,8)]
print(gridsearch_params)
```

```
[(2, 4), (2, 5), (2, 6), (2, 7), (3, 4), (3, 5), (3, 6), (3, 7), (4, 4),
(4, 5), (4, 6), (4, 7), (5, 4), (5, 5), (5, 6), (5, 7), (6, 4), (6, 5),
(6, 6), (6, 7)]
```

In [18]:

```
# Define initial best params and RMSE
min_rmse = float("Inf")
best_params = None
for max_depth, min_child_weight in gridsearch_params:
    print("CV with max_depth={}, min_child_weight={}".format(
                             max_depth,
                             min_child_weight))
    # Update our parameters
    params['max_depth'] = max_depth
    params['min_child_weight'] = min_child_weight
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=1000,
        seed=42,
        nfold=5,
        metrics={'rmse'},
        early_stopping_rounds=50
    )
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (max_depth,min_child_weight)
print("Best params: {}, {}, RMSE: {}".format(best_params[0], best_params[1], min_rmse))
```

```
CV with max_depth=2, min_child_weight=4
[13:35:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3127104 for 17 rounds
CV with max_depth=2, min_child_weight=5
[13:35:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.310635 for 16 rounds
CV with max_depth=2, min_child_weight=6
[13:35:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.309747 for 19 rounds
CV with max_depth=2, min_child_weight=7
[13:35:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:35:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:35:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3099924000000005 for 19 rounds
CV with max_depth=3, min_child_weight=4
[13:36:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3350318 for 15 rounds
CV with max_depth=3, min_child_weight=5
[13:36:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.334905999999999 for 17 rounds
CV with max_depth=3, min_child_weight=6
[13:36:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.325737200000001 for 15 rounds
CV with max_depth=3, min_child_weight=7
[13:36:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:36:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3248976 for 16 rounds
CV with max_depth=4, min_child_weight=4
[13:36:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3738280000000005 for 14 rounds
CV with max_depth=4, min_child_weight=5
[13:36:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3670902 for 14 rounds
CV with max_depth=4, min_child_weight=6
[13:36:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:36:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.362244200000001 for 14 rounds
CV with max_depth=4, min_child_weight=7
[13:36:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3671634 for 14 rounds
CV with max_depth=5, min_child_weight=4
[13:36:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4199666 for 15 rounds
CV with max_depth=5, min_child_weight=5
[13:36:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:36:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4129606 for 16 rounds
CV with max_depth=5, min_child_weight=6
[13:37:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:37:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4318452 for 14 rounds
CV with max_depth=5, min_child_weight=7
[13:37:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.397397600000001 for 14 rounds
CV with max_depth=6, min_child_weight=4
[13:37:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4796728 for 14 rounds
CV with max_depth=6, min_child_weight=5
[13:37:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
        RMSE 7.4648004 for 14 rounds
CV with max_depth=6, min_child_weight=6
[13:37:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.443504 for 14 rounds
CV with max_depth=6, min_child_weight=7
[13:37:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:37:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4432378 for 14 rounds
Best params: 2, 6, RMSE: 7.309747
```

In [19]:

```
print("Best params: max_depth:{}, min_child_weight:{}, RMSE: {}".format(best_params[0],
best_params[1], min_rmse))
```

```
Best params: max_depth:2, min_child_weight:6, RMSE: 7.309747
```

In [20]:

```
#updating the parameter dictionary
params['max_depth'] = 2
params['min_child_weight'] = 6
```

Tuning Parameters subsample and colsample

In [21]:

```
gridsearch_params = [(subsample, colsample)
    for subsample in [i/10. for i in range(6,11)]
    for colsample in [i/10. for i in range(5,11)]]
print(gridsearch_params)
```

```
[(0.6, 0.5), (0.6, 0.6), (0.6, 0.7), (0.6, 0.8), (0.6, 0.9), (0.6, 1.0),
(0.7, 0.5), (0.7, 0.6), (0.7, 0.7), (0.7, 0.8), (0.7, 0.9), (0.7, 1.0),
(0.8, 0.5), (0.8, 0.6), (0.8, 0.7), (0.8, 0.8), (0.8, 0.9), (0.8, 1.0),
(0.9, 0.5), (0.9, 0.6), (0.9, 0.7), (0.9, 0.8), (0.9, 0.9), (0.9, 1.0),
(1.0, 0.5), (1.0, 0.6), (1.0, 0.7), (1.0, 0.8), (1.0, 0.9), (1.0, 1.0)]
```

In [22]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for subsample, colsample in reversed(gridsearch_params):
    print("CV with subsample={}, colsample={}".format(subsample,colsample))
    # We update our parameters
    params['subsample'] = subsample
    params['colsample_bytree'] = colsample
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=1000,
        seed=42,
        nfold=5,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (subsample,colsample)
```

```
CV with subsample=1.0, colsample=1.0
[13:43:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.309747 for 19 rounds
CV with subsample=1.0, colsample=0.9
[13:43:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.295356600000001 for 21 rounds
CV with subsample=1.0, colsample=0.8
[13:43:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:43:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.304603 for 20 rounds
CV with subsample=1.0, colsample=0.7
[13:44:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:44:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2829278 for 20 rounds
CV with subsample=1.0, colsample=0.6
[13:44:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2873176 for 20 rounds
CV with subsample=1.0, colsample=0.5
[13:44:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.285973799999999 for 17 rounds
CV with subsample=0.9, colsample=1.0
[13:44:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2915592 for 18 rounds
CV with subsample=0.9, colsample=0.9
[13:44:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:44:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.293028799999999 for 18 rounds
CV with subsample=0.9, colsample=0.8
[13:44:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.290108399999999 for 16 rounds
CV with subsample=0.9, colsample=0.7
[13:44:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2923203999999995 for 16 rounds
CV with subsample=0.9, colsample=0.6
[13:44:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:44:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2895134 for 17 rounds
CV with subsample=0.9, colsample=0.5
[13:44:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2917316 for 22 rounds
CV with subsample=0.8, colsample=1.0
[13:44:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.296972600000001 for 18 rounds
CV with subsample=0.8, colsample=0.9
[13:44:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.298672599999999 for 16 rounds
CV with subsample=0.8, colsample=0.8
[13:44:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:44:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:44:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.299668800000001 for 15 rounds
CV with subsample=0.8, colsample=0.7
[13:45:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3063868 for 17 rounds
CV with subsample=0.8, colsample=0.6
[13:45:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2942266 for 21 rounds
CV with subsample=0.8, colsample=0.5
[13:45:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
        RMSE 7.2971346 for 21 rounds
CV with subsample=0.7, colsample=1.0
[13:45:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.302944200000001 for 15 rounds
CV with subsample=0.7, colsample=0.9
[13:45:21] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:21] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:21] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:21] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:21] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.296552800000001 for 18 rounds
CV with subsample=0.7, colsample=0.8
[13:45:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.312700000000001 for 16 rounds
CV with subsample=0.7, colsample=0.7
[13:45:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:45:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2996452000000005 for 15 rounds
CV with subsample=0.7, colsample=0.6
[13:45:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.324920400000001 for 15 rounds
CV with subsample=0.7, colsample=0.5
[13:45:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.313404 for 19 rounds
CV with subsample=0.6, colsample=1.0
[13:45:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.312129199999999 for 18 rounds
CV with subsample=0.6, colsample=0.9
[13:45:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3160023999999995 for 17 rounds
CV with subsample=0.6, colsample=0.8
[13:45:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3219458 for 18 rounds
CV with subsample=0.6, colsample=0.7
[13:45:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:45:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.321 for 15 rounds
CV with subsample=0.6, colsample=0.6
[13:46:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:46:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.311514000000001 for 15 rounds
CV with subsample=0.6, colsample=0.5
[13:46:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:46:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3195296 for 19 rounds
```

In [23]:

```
print("Best params: subsample:{}, colsample:{}, RMSE: {}".format(best_params[0], best_p
arams[1], min_rmse))
```

```
Best params: subsample:1.0, colsample:0.7, RMSE: 7.2829278
```

In [24]:

```
#updating the parameter dictionary
params['subsample'] = 1.0
params['colsample_bytree'] = 0.7
```

In [25]:

```
params
```

Out[25]:

```
{'max_depth': 2,
 'min_child_weight': 6,
 'eta': 0.3,
 'subsample': 1.0,
 'colsample_bytree': 0.7,
 'objective': 'reg:linear',
 'eval_metric': 'rmse'}
```

Tuning learning rate: eta

In [26]:

```
%time
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for eta in [0.4, 0.3, 0.2, 0.1, 0.05, 0.01, 0.005, 0.0025]:
    print("CV with eta={}".format(eta))
    # We update our parameters
    params['eta'] = eta

    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=1000,
        seed=42,
        nfold=5,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = eta
```

```
Wall time: 0 ns
CV with eta=0.4
[13:48:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:48:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:48:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:48:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:48:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.305766800000001 for 12 rounds
CV with eta=0.3
[13:49:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2829278 for 20 rounds
CV with eta=0.2
[13:49:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.291076199999999 for 31 rounds
CV with eta=0.1
[13:49:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:49:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.297343 for 58 rounds
CV with eta=0.05
[13:49:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2920717999999995 for 123 rounds
CV with eta=0.01
[13:49:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:49:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2907376 for 653 rounds
CV with eta=0.005
[13:50:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:50:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:50:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:50:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:50:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.321251200000001 for 999 rounds
CV with eta=0.0025
[13:51:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:51:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:51:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:51:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:51:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 11.049065600000002 for 999 rounds
```

In [27]:

```
print("Best params: eta:{}, RMSE: {}".format(best_params, min_rmse))
```

```
Best params: eta:0.3, RMSE: 7.2829278
```

In [28]:

```
#updating the parameter dictionary
params['eta'] = 0.3
```

In [29]:

```
print("Final parameter dictionary:")
params
```

```
Final parameter dictionary:
```

Out[29]:

```
{'max_depth': 2,
 'min_child_weight': 6,
 'eta': 0.3,
 'subsample': 1.0,
 'colsample_bytree': 0.7,
 'objective': 'reg:linear',
 'eval_metric': 'rmse'}
```

2.2 XGBoost regressor

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [131]:

```
num_boost_round = model.best_iteration + 1
best_model = xgb.train(
    params,
    dtrain,
    num_boost_round=20,
    evals=[(dtrain, "Train")]
)
```

```
[15:29:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[0]     Train-rmse:70.6847
[1]     Train-rmse:49.779
[2]     Train-rmse:35.2563
[3]     Train-rmse:25.2465
[4]     Train-rmse:18.4461
[5]     Train-rmse:13.944
[6]     Train-rmse:11.0675
[7]     Train-rmse:9.33207
[8]     Train-rmse:8.33459
[9]     Train-rmse:7.79411
[10]    Train-rmse:7.50825
[11]    Train-rmse:7.35637
[12]    Train-rmse:7.27756
[13]    Train-rmse:7.227
[14]    Train-rmse:7.19932
[15]    Train-rmse:7.17977
[16]    Train-rmse:7.16348
[17]    Train-rmse:7.15276
[18]    Train-rmse:7.14156
[19]    Train-rmse:7.1358
```

In [137]:

```
#predicting train & test target values
y_pred_train = best_model.predict(dtrain)
y_pred_test = best_model.predict(dtest)
```

In [138]:

```
train_score=score(train_y.values, y_pred_train)
print("Train score:",round(train_score,4))
```

```
Train score: 0.6443
```

In [139]:

```
y_pred_test
```

Out[139]:

```
array([ 82.496895,  95.62018 ,  81.34072 , ...,  91.94877 , 110.25    ,
        92.08288 ], dtype=float32)
```

In [140]:

```
submission = pd.DataFrame()
submission['ID'] = X_test_te.ID.values
submission['y'] = y_pred_test
submission.to_csv('sub.csv', index=False)
```

In [87]:

```
#saving model
best_model.save_model("TE_0.55078.model")
```

In [136]:

```
#loading model
best_model = xgb.Booster()
best_model.load_model("TE_0.55078.model")
```

```
[15:33:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

- **After experimenting with a lot of rounds, I finally got a Private R2 score of 0.55078 & public R2 score of 0.55595. This is the highest R2 score I've got by far.**
- **With this score I'm in the top 24% at 922nd position.**

Approach-5

In this approach I will be trying SelectKBest technique of dimensionality reduction on target encoded features & integer features and check if the R2 score improves or not.

In [52]:

```
from sklearn.feature_selection import SelectKBest,f_regression
# feature extraction
fe = SelectKBest(score_func=f_regression, k=100) #considering 55% feature reduction
X_train_te_best = fe.fit_transform(X_train_te, train_y)
X_test_te_best = fe.transform(X_test_te)

print("Final reduced Data Matrix")
print(X_train_te_best.shape, train_y.shape)
print(X_test_te_best.shape)
```

```
Final reduced Data Matrix
(4194, 100) (4194,)
(4209, 100)
```

1.0 XGBoost model with hyperparameter tuning

1.1 Hyperparameter tuning

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [53]:

```
import xgboost as xgb

#preparing train & test matrices
dtrain = xgb.DMatrix(X_train_te_best, label=train_y)
dtest = xgb.DMatrix(X_test_te_best)
num_boost_round = 1000


params = {
    # Parameters that we are going to tune. Below are the default values of the paramet
ers
    'max_depth':6,
    'min_child_weight': 1,
    'eta':.3,
    'subsample': 1,
    'colsample_bytree': 1,
    'objective':'reg:linear',
    'eval_metric':'rmse'
}
```

In [54]:

```
#Let's see what cross-validation score we get with our current parameters:
cv_results = xgb.cv(
    params,
    dtrain,
    num_boost_round=num_boost_round,
    seed=42,
    nfold=5,
    metrics={'rmse'},
    early_stopping_rounds=50
)

print(cv_results['test-rmse-mean'].min())
```

```
[13:06:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:06:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:06:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:06:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:06:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
7.415836400000001
```

Tuning Parameters max_depth and min_child_weight

In [55]:

```
gridsearch_params = [(max_depth, min_child_weight)
    for max_depth in range(2,7)
    for min_child_weight in range(4,8)]
print(gridsearch_params)
```

```
[(2, 4), (2, 5), (2, 6), (2, 7), (3, 4), (3, 5), (3, 6), (3, 7), (4, 4),
(4, 5), (4, 6), (4, 7), (5, 4), (5, 5), (5, 6), (5, 7), (6, 4), (6, 5),
(6, 6), (6, 7)]
```

In [56]:

```
# Define initial best params and RMSE
min_rmse = float("Inf")
best_params = None
for max_depth, min_child_weight in gridsearch_params:
    print("CV with max_depth={}, min_child_weight={}".format(
                             max_depth,
                             min_child_weight))
    # Update our parameters
    params['max_depth'] = max_depth
    params['min_child_weight'] = min_child_weight
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=1000,
        seed=42,
        nfold=5,
        metrics={'rmse'},
        early_stopping_rounds=50
    )
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (max_depth,min_child_weight)
print("Best params: {}, {}, RMSE: {}".format(best_params[0], best_params[1], min_rmse))
```

```
CV with max_depth=2, min_child_weight=4
[13:07:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2904501999999995 for 19 rounds
CV with max_depth=2, min_child_weight=5
[13:07:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.290152600000001 for 19 rounds
CV with max_depth=2, min_child_weight=6
[13:07:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2877982 for 19 rounds
CV with max_depth=2, min_child_weight=7
[13:07:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:07:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2875388 for 18 rounds
CV with max_depth=3, min_child_weight=4
[13:07:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3041602 for 17 rounds
CV with max_depth=3, min_child_weight=5
[13:07:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.306205 for 16 rounds
CV with max_depth=3, min_child_weight=6
[13:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3015086 for 15 rounds
CV with max_depth=3, min_child_weight=7
[13:07:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:07:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2978634 for 16 rounds
CV with max_depth=4, min_child_weight=4
[13:07:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3565917999999995 for 14 rounds
CV with max_depth=4, min_child_weight=5
[13:07:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3480996 for 15 rounds
CV with max_depth=4, min_child_weight=6
[13:07:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:07:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.327556200000001 for 16 rounds
CV with max_depth=4, min_child_weight=7
[13:07:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3432956 for 15 rounds
CV with max_depth=5, min_child_weight=4
[13:07:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.383887799999999 for 14 rounds
CV with max_depth=5, min_child_weight=5
[13:07:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.396016 for 15 rounds
CV with max_depth=5, min_child_weight=6
[13:07:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:07:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3734552 for 14 rounds
CV with max_depth=5, min_child_weight=7
[13:07:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:07:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3530532 for 16 rounds
CV with max_depth=6, min_child_weight=4
[13:08:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.474065400000001 for 13 rounds
CV with max_depth=6, min_child_weight=5
[13:08:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
        RMSE 7.4446883999999995 for 13 rounds
CV with max_depth=6, min_child_weight=6
[13:08:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.416135399999999 for 14 rounds
CV with max_depth=6, min_child_weight=7
[13:08:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:08:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4200268000000005 for 15 rounds
Best params: 2, 7, RMSE: 7.2875388
```

In [57]:

```
print("Best params: max_depth:{}, min_child_weight:{}, RMSE: {}".format(best_params[0],
best_params[1], min_rmse))
```

```
Best params: max_depth:2, min_child_weight:7, RMSE: 7.2875388
```

In [58]:

```
#updating the parameter dictionary
params['max_depth'] = 2
params['min_child_weight'] = 7
```

Tuning Parameters subsample and colsample

In [59]:

```
gridsearch_params = [(subsample, colsample)
    for subsample in [i/10. for i in range(6,11)]
    for colsample in [i/10. for i in range(5,11)]]
print(gridsearch_params)
```

```
[(0.6, 0.5), (0.6, 0.6), (0.6, 0.7), (0.6, 0.8), (0.6, 0.9), (0.6, 1.0),
(0.7, 0.5), (0.7, 0.6), (0.7, 0.7), (0.7, 0.8), (0.7, 0.9), (0.7, 1.0),
(0.8, 0.5), (0.8, 0.6), (0.8, 0.7), (0.8, 0.8), (0.8, 0.9), (0.8, 1.0),
(0.9, 0.5), (0.9, 0.6), (0.9, 0.7), (0.9, 0.8), (0.9, 0.9), (0.9, 1.0),
(1.0, 0.5), (1.0, 0.6), (1.0, 0.7), (1.0, 0.8), (1.0, 0.9), (1.0, 1.0)]
```

In [60]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for subsample, colsample in reversed(gridsearch_params):
    print("CV with subsample={}, colsample={}".format(subsample,colsample))
    # We update our parameters
    params['subsample'] = subsample
    params['colsample_bytree'] = colsample
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=1000,
        seed=42,
        nfold=5,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (subsample,colsample)
```

```
CV with subsample=1.0, colsample=1.0
[13:09:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2875388 for 18 rounds
CV with subsample=1.0, colsample=0.9
[13:09:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2768552 for 21 rounds
CV with subsample=1.0, colsample=0.8
[13:09:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2877488 for 22 rounds
CV with subsample=1.0, colsample=0.7
[13:09:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:09:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.287289599999999 for 18 rounds
CV with subsample=1.0, colsample=0.6
[13:09:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2948607999999995 for 18 rounds
CV with subsample=1.0, colsample=0.5
[13:09:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.290384400000001 for 23 rounds
CV with subsample=0.9, colsample=1.0
[13:09:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.286198399999999 for 19 rounds
CV with subsample=0.9, colsample=0.9
[13:09:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:09:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.294122799999999 for 18 rounds
CV with subsample=0.9, colsample=0.8
[13:09:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.277038999999999 for 16 rounds
CV with subsample=0.9, colsample=0.7
[13:09:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.285482400000001 for 16 rounds
CV with subsample=0.9, colsample=0.6
[13:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.286451199999999 for 17 rounds
CV with subsample=0.9, colsample=0.5
[13:10:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.292948 for 21 rounds
CV with subsample=0.8, colsample=1.0
[13:10:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2840468000000005 for 18 rounds
CV with subsample=0.8, colsample=0.9
[13:10:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.28737 for 19 rounds
CV with subsample=0.8, colsample=0.8
[13:10:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:10:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:09] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2855716 for 20 rounds
CV with subsample=0.8, colsample=0.7
[13:10:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2864926 for 20 rounds
CV with subsample=0.8, colsample=0.6
[13:10:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:14] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2942208 for 18 rounds
CV with subsample=0.8, colsample=0.5
[13:10:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
        RMSE 7.2925004 for 19 rounds
CV with subsample=0.7, colsample=1.0
[13:10:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.297500600000001 for 15 rounds
CV with subsample=0.7, colsample=0.9
[13:10:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.293027599999999 for 18 rounds
CV with subsample=0.7, colsample=0.8
[13:10:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.289135999999999 for 19 rounds
CV with subsample=0.7, colsample=0.7
[13:10:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:10:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.297246799999999 for 17 rounds
CV with subsample=0.7, colsample=0.6
[13:10:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2939542 for 16 rounds
CV with subsample=0.7, colsample=0.5
[13:10:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2850342 for 19 rounds
CV with subsample=0.6, colsample=1.0
[13:10:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.308340199999999 for 19 rounds
CV with subsample=0.6, colsample=0.9
[13:10:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2858812 for 16 rounds
CV with subsample=0.6, colsample=0.8
[13:10:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:40] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.295765399999999 for 18 rounds
CV with subsample=0.6, colsample=0.7
[13:10:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.293681599999999 for 16 rounds
CV with subsample=0.6, colsample=0.6
[13:10:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:10:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2887972 for 16 rounds
CV with subsample=0.6, colsample=0.5
[13:10:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:10:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.308444400000001 for 19 rounds
```

In [61]:

```
print("Best params: subsample:{}, colsample:{}, RMSE: {}".format(best_params[0], best_p
arams[1], min_rmse))
```

```
Best params: subsample:1.0, colsample:0.9, RMSE: 7.2768552
```

In [62]:

```
#updating the parameter dictionary
params['subsample'] = 1.0
params['colsample_bytree'] = 0.9
```

In [63]:

```
params
```

Out[63]:

```
{'max_depth': 2,
 'min_child_weight': 7,
 'eta': 0.3,
 'subsample': 1.0,
 'colsample_bytree': 0.9,
 'objective': 'reg:linear',
 'eval_metric': 'rmse'}
```

Tuning learning rate: eta

In [64]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for eta in [0.4, 0.3, 0.2, 0.1, 0.05, 0.01, 0.005, 0.0025]:
    print("CV with eta={}".format(eta))
    # We update our parameters
    params['eta'] = eta

    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=1000,
        seed=42,
        nfold=5,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = eta
```

```
CV with eta=0.4
[13:13:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.294961600000001 for 11 rounds
CV with eta=0.3
[13:13:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2768552 for 21 rounds
CV with eta=0.2
[13:13:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2819278 for 33 rounds
CV with eta=0.1
[13:13:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[13:13:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2827703999999995 for 71 rounds
CV with eta=0.05
[13:13:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:13:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.282876999999999 for 135 rounds
CV with eta=0.01
[13:14:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2859294000000006 for 697 rounds
CV with eta=0.005
[13:14:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:14:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3198186000000005 for 999 rounds
CV with eta=0.0025
[13:15:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
```

```
g:squarederror.
[13:15:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:15:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:15:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[13:15:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 11.0439828 for 999 rounds
```

In [65]:

```
print("Best params: eta:{}, RMSE: {}".format(best_params, min_rmse))
```

```
Best params: eta:0.3, RMSE: 7.2768552
```

In [66]:

```
#updating the parameter dictionary
params['eta'] = 0.3
```

In [67]:

```
print("Final parameter dictionary:")
params
```

```
Final parameter dictionary:
```

Out[67]:

```
{'max_depth': 2,
 'min_child_weight': 7,
 'eta': 0.3,
 'subsample': 1.0,
 'colsample_bytree': 0.9,
 'objective': 'reg:linear',
 'eval_metric': 'rmse'}
```

1.2 XGBoost regressor

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [93]:

```
model = xgb.train(
    params,
    dtrain,
    num_boost_round=20,
    evals=[(dtrain, "Train")],
    early_stopping_rounds=50
)
print("Best RMSE: {:.4f} in {} rounds".format(model.best_score, model.best_iteration+1
))
```

```
[13:32:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[0]     Train-rmse:70.6847
Will train until Train-rmse hasn't improved in 50 rounds.
[1]     Train-rmse:49.779
[2]     Train-rmse:35.2563
[3]     Train-rmse:25.2465
[4]     Train-rmse:18.4461
[5]     Train-rmse:13.9373
[6]     Train-rmse:11.0627
[7]     Train-rmse:9.32582
[8]     Train-rmse:8.33201
[9]     Train-rmse:7.78715
[10]    Train-rmse:7.50197
[11]    Train-rmse:7.35076
[12]    Train-rmse:7.26452
[13]    Train-rmse:7.21854
[14]    Train-rmse:7.19184
[15]    Train-rmse:7.17404
[16]    Train-rmse:7.16348
[17]    Train-rmse:7.15465
[18]    Train-rmse:7.1485
[19]    Train-rmse:7.14149
Best RMSE: 7.1415 in 20 rounds
```

In [94]:

```
num_boost_round = model.best_iteration + 1
best_model = xgb.train(
    params,
    dtrain,
    num_boost_round=num_boost_round,
    evals=[(dtrain, "Train")]
)
```

```
[13:33:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[0]     Train-rmse:70.6847
[1]     Train-rmse:49.779
[2]     Train-rmse:35.2563
[3]     Train-rmse:25.2465
[4]     Train-rmse:18.4461
[5]     Train-rmse:13.9373
[6]     Train-rmse:11.0627
[7]     Train-rmse:9.32582
[8]     Train-rmse:8.33201
[9]     Train-rmse:7.78715
[10]    Train-rmse:7.50197
[11]    Train-rmse:7.35076
[12]    Train-rmse:7.26452
[13]    Train-rmse:7.21854
[14]    Train-rmse:7.19184
[15]    Train-rmse:7.17404
[16]    Train-rmse:7.16348
[17]    Train-rmse:7.15465
[18]    Train-rmse:7.1485
[19]    Train-rmse:7.14149
```

In [95]:

```
#predicting train & test target values
y_pred_train = best_model.predict(dtrain)
y_pred_test = best_model.predict(dtest)
```

In [96]:

```
train_score=score(train_y.values, y_pred_train)
print("Train score:",round(train_score,4))
```

```
Train score: 0.6454
```

In [97]:

```
y_pred_test
```

Out[97]:

```
array([ 78.58798 ,  93.48651 ,  79.83068 , ...,  92.18607 , 111.022675,
        92.27672 ], dtype=float32)
```

In [98]:

```
submission = pd.DataFrame()
submission['ID'] = X_test_te.ID.values
submission['y'] = y_pred_test
submission.to_csv('XGB_pred_te_kbest_3.csv', index=False)
```

- **In this case I got a Private R2 score of 0.54828 & public R2 score of 0.55386.**
- **Since the R2 score did not improve from 0.55078, SelectKbest approach did not work well here.**

Approach-6

- **This approach will be similar to Approach-4 but the only difference is in encoding of categorical features where I will be implementing label encoding instead of target encoding.**
- **Similarly to approach-4, I will not be splitting the train data into train & cv. I will be considering the entire train data for modelling and I will be implementing the native XGBoost API instead of scikit learn version of XGBoost regressor.**

In [99]:

```
train_y= train.y
X_train_le= train.copy()
X_train_le= X_train_le.drop('y',axis=1)
X_test_le= test.copy()
print("Shape of train data:",X_train_le.shape)
print("Shape of test data:",X_test_le.shape)
```

```
Shape of train data: (4194, 185)
Shape of test data: (4209, 185)
```

In [100]:

```
X_train_le.head()
```

Out[100]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0
0	0	0	0	1	0	1	0	0	0	0	...	0	1	k
1	6	0	0	0	0	1	0	0	0	0	...	0	1	k
2	7	0	0	0	0	0	0	0	0	0	...	1	0	az
3	9	0	0	0	0	0	0	0	0	0	...	1	0	az
4	13	0	0	0	0	0	0	0	0	0	...	1	0	az

5 rows × 185 columns

In [101]:

```
X_test_le.head()
```

Out[101]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0
0	1	0	0	0	0	0	0	0	0	0	...	1	0	az
1	2	0	0	0	0	0	1	0	0	0	...	0	1	t
2	3	0	0	0	1	0	0	0	0	0	...	1	0	az
3	4	0	0	0	0	0	0	0	0	0	...	1	0	az
4	5	0	0	0	1	0	0	0	0	0	...	0	2	w

5 rows × 185 columns

1.0 Label encoding

In [102]:

```
#Label encoding
from sklearn import preprocessing
cat=['X0', 'X1', 'X2', 'X3','X4','X5', 'X6', 'X8']
for i in cat:
    le = preprocessing.LabelEncoder()
    if (i =='X0') or (i=='X2') or (i=='X5'): # doing this because there are lots of dif
ferent categories in test that are not in train.Please refer to section 3.6 in the EDA
 part above.
        diff= list(set(X_test_le[i].unique())-set(X_train_le[i].unique())) #did this in
order to avoid data leakage by fitting values of test directly into fit function
        le.fit(list(X_train_le[i].values)+diff) # fitting only on train data and the di
fference in categories between train & test as explained above
        X_train_le[i]= le.transform(list(X_train_le[i].values))
        X_test_le[i]= le.transform(list(X_test_le[i].values))
    else:
        le.fit(list(X_train_le[i].values))
        X_train_le[i]= le.transform(list(X_train_le[i].values))
        X_test_le[i]= le.transform(list(X_test_le[i].values))
```

In [103]:

```
X_train_le.head()
```

Out[103]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0
0	0	0	0	1	0	1	0	0	0	0	...	0	1	37
1	6	0	0	0	0	1	0	0	0	0	...	0	1	37
2	7	0	0	0	0	0	0	0	0	0	...	1	0	24
3	9	0	0	0	0	0	0	0	0	0	...	1	0	24
4	13	0	0	0	0	0	0	0	0	0	...	1	0	24

5 rows × 185 columns

In [104]:

```
X_test_le.head()
```

Out[104]:

	ID	X10	X12	X13	X14	X18	X19	X20	X22	X23	...	X10_X29	X118_X314_X315	X0
0	1	0	0	0	0	0	0	0	0	0	...	1	0	24
1	2	0	0	0	0	0	1	0	0	0	...	0	1	46
2	3	0	0	0	1	0	0	0	0	0	...	1	0	24
3	4	0	0	0	0	0	0	0	0	0	...	1	0	24
4	5	0	0	0	1	0	0	0	0	0	...	0	2	49

5 rows × 185 columns

2.0 XGBoost Model

2.1 Hyperparameter tuning

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [150]:

```
import xgboost as xgb

dtrain = xgb.DMatrix(X_train_le, label=train_y)
dtest = xgb.DMatrix(X_test_le)
num_boost_round = 500


params = {
    # Parameters that we are going to tune. Below are the default values of the paramet
ers
    'max_depth':6,
    'min_child_weight': 1,
    'eta':.3,
    'subsample': 1,
    'colsample_bytree': 1,
    'objective':'reg:linear',
    'eval_metric':'rmse',
    'base_score':np.mean(train_y),
}
```

In [151]:

```
#Let’s see what cross-validation score we get with our current parameters:
cv_results = xgb.cv(
    params,
    dtrain,
    num_boost_round=num_boost_round,
    seed=42,
    nfold=10,
    metrics={'rmse'},
    early_stopping_rounds=50
)

print(cv_results['test-rmse-mean'].min())
```

```
[16:41:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:41:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
7.4762062
```

In [152]:

```
cv_results
```

Out[152]:

	train-rmse-mean	train-rmse-std	test-rmse-mean	test-rmse-std
0	9.817281	0.032377	9.912818	0.318243
1	8.520287	0.031284	8.720672	0.298735
2	7.771003	0.036153	8.085065	0.289589
3	7.334397	0.035617	7.745025	0.302524
4	7.064456	0.034163	7.583892	0.311970
5	6.893895	0.041714	7.521552	0.310812
6	6.768483	0.045799	7.490600	0.319996
7	6.664052	0.044890	7.476206	0.327909

Tuning Parameters max_depth and min_child_weight

In [153]:

```
gridsearch_params = [(max_depth, min_child_weight)
    for max_depth in range(2,7)
    for min_child_weight in range(3,8)]
print(gridsearch_params)
```

```
[(2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (3, 3), (3, 4), (3, 5), (3, 6),
(3, 7), (4, 3), (4, 4), (4, 5), (4, 6), (4, 7), (5, 3), (5, 4), (5, 5),
(5, 6), (5, 7), (6, 3), (6, 4), (6, 5), (6, 6), (6, 7)]
```

In [154]:

```
# Define initial best params and RMSE
min_rmse = float("Inf")
best_params = None
for max_depth, min_child_weight in gridsearch_params:
    print("CV with max_depth={}, min_child_weight={}".format(
                             max_depth,
                             min_child_weight))
    # Update our parameters
    params['max_depth'] = max_depth
    params['min_child_weight'] = min_child_weight
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=500,
        seed=42,
        nfold=10,
        metrics={'rmse'},
        early_stopping_rounds=50
    )
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (max_depth,min_child_weight)
print("Best params: {}, {}, RMSE: {}".format(best_params[0], best_params[1], min_rmse))
```

```
CV with max_depth=2, min_child_weight=3
[16:44:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:44:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2891356 for 14 rounds
CV with max_depth=2, min_child_weight=4
[16:45:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.289613900000001 for 14 rounds
CV with max_depth=2, min_child_weight=5
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.288937799999999 for 34 rounds
CV with max_depth=2, min_child_weight=6
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.285889299999999 for 21 rounds
CV with max_depth=2, min_child_weight=7
[16:45:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2876304 for 30 rounds
CV with max_depth=3, min_child_weight=3
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:45:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3095327 for 17 rounds
CV with max_depth=3, min_child_weight=4
[16:46:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:03] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3048172000000005 for 15 rounds
CV with max_depth=3, min_child_weight=5
[16:46:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.310055299999999 for 12 rounds
CV with max_depth=3, min_child_weight=6
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.314732699999999 for 10 rounds
CV with max_depth=3, min_child_weight=7
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:41] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.31594 for 15 rounds
CV with max_depth=4, min_child_weight=3
[16:46:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:46:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.347109999999999 for 9 rounds
CV with max_depth=4, min_child_weight=4
[16:47:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3335324 for 9 rounds
CV with max_depth=4, min_child_weight=5
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.349178599999999 for 12 rounds
CV with max_depth=4, min_child_weight=6
[16:47:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3470921 for 10 rounds
CV with max_depth=4, min_child_weight=7
[16:47:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:47:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.342068500000001 for 10 rounds
CV with max_depth=5, min_child_weight=3
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.367671800000001 for 7 rounds
CV with max_depth=5, min_child_weight=4
[16:48:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.377089600000001 for 9 rounds
CV with max_depth=5, min_child_weight=5
[16:48:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3839416 for 8 rounds
CV with max_depth=5, min_child_weight=6
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:48:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3714191 for 7 rounds
CV with max_depth=5, min_child_weight=7
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.367761399999999 for 9 rounds
CV with max_depth=6, min_child_weight=3
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
        RMSE 7.429634200000001 for 7 rounds
CV with max_depth=6, min_child_weight=4
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.430439300000001 for 8 rounds
CV with max_depth=6, min_child_weight=5
[16:49:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:49:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.421115300000001 for 8 rounds
CV with max_depth=6, min_child_weight=6
[16:50:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:11] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:11] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:11] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:11] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.422968900000001 for 7 rounds
CV with max_depth=6, min_child_weight=7
[16:50:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:50:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.411387700000001 for 8 rounds
Best params: 2, 6, RMSE: 7.285889299999999
```

In [155]:

```
print("Best params: max_depth:{}, min_child_weight:{}, RMSE: {}".format(best_params[0],
best_params[1], min_rmse))
```

```
Best params: max_depth:2, min_child_weight:6, RMSE: 7.285889299999999
```

In [156]:

```
#updating the parameter dictionary
params['max_depth'] = 2
params['min_child_weight'] = 6
```

Tuning Parameters subsample and colsample

In [157]:

```
gridsearch_params = [(subsample, colsample)
    for subsample in [i/10. for i in range(6,11)]
    for colsample in [i/10. for i in range(5,11)]]
print(gridsearch_params)
```

```
[(0.6, 0.5), (0.6, 0.6), (0.6, 0.7), (0.6, 0.8), (0.6, 0.9), (0.6, 1.0),
(0.7, 0.5), (0.7, 0.6), (0.7, 0.7), (0.7, 0.8), (0.7, 0.9), (0.7, 1.0),
(0.8, 0.5), (0.8, 0.6), (0.8, 0.7), (0.8, 0.8), (0.8, 0.9), (0.8, 1.0),
(0.9, 0.5), (0.9, 0.6), (0.9, 0.7), (0.9, 0.8), (0.9, 0.9), (0.9, 1.0),
(1.0, 0.5), (1.0, 0.6), (1.0, 0.7), (1.0, 0.8), (1.0, 0.9), (1.0, 1.0)]
```

In [158]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for subsample, colsample in reversed(gridsearch_params):
    print("CV with subsample={}, colsample={}".format(subsample,colsample))
    # We update our parameters
    params['subsample'] = subsample
    params['colsample_bytree'] = colsample
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=500,
        seed=42,
        nfold=10,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (subsample,colsample)
```

```
CV with subsample=1.0, colsample=1.0
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.285889299999999 for 21 rounds
CV with subsample=1.0, colsample=0.9
[16:53:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.286402700000001 for 29 rounds
CV with subsample=1.0, colsample=0.8
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2922910000000005 for 20 rounds
CV with subsample=1.0, colsample=0.7
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.295783500000001 for 34 rounds
CV with subsample=1.0, colsample=0.6
[16:53:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:53:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3199623 for 15 rounds
CV with subsample=1.0, colsample=0.5
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.305408300000001 for 19 rounds
CV with subsample=0.9, colsample=1.0
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2829730999999995 for 26 rounds
CV with subsample=0.9, colsample=0.9
[16:54:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:24] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.291735299999999 for 19 rounds
CV with subsample=0.9, colsample=0.8
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.292665000000001 for 25 rounds
CV with subsample=0.9, colsample=0.7
[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:54:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2875915 for 25 rounds
CV with subsample=0.9, colsample=0.6
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
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[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:54:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.302292399999999 for 22 rounds
CV with subsample=0.9, colsample=0.5
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.295042 for 22 rounds
CV with subsample=0.8, colsample=1.0
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2951581 for 23 rounds
CV with subsample=0.8, colsample=0.9
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.294326799999999 for 21 rounds
CV with subsample=0.8, colsample=0.8
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2894893 for 22 rounds
CV with subsample=0.8, colsample=0.7
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.297550899999999 for 21 rounds
CV with subsample=0.8, colsample=0.6
[16:55:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:57] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:55:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.313061700000001 for 17 rounds
CV with subsample=0.8, colsample=0.5
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3007053 for 27 rounds
CV with subsample=0.7, colsample=1.0
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2990294 for 19 rounds
CV with subsample=0.7, colsample=0.9
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:26] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.293305999999999 for 19 rounds
CV with subsample=0.7, colsample=0.8
[16:56:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:35] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:36] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
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        RMSE 7.2950829 for 14 rounds
CV with subsample=0.7, colsample=0.7
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.308279399999999 for 18 rounds
CV with subsample=0.7, colsample=0.6
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:56:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
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[16:56:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3195278 for 21 rounds
CV with subsample=0.7, colsample=0.5
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:02] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.314419200000001 for 18 rounds
CV with subsample=0.6, colsample=1.0
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2970171 for 13 rounds
CV with subsample=0.6, colsample=0.9
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2821383 for 20 rounds
CV with subsample=0.6, colsample=0.8
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:29] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2941778 for 21 rounds
CV with subsample=0.6, colsample=0.7
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2965003 for 21 rounds
CV with subsample=0.6, colsample=0.6
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:57:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.319107900000001 for 19 rounds
CV with subsample=0.6, colsample=0.5
[16:57:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:57:56] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.290026099999999 for 21 rounds
```

In [159]:

```
print("Best params: subsample:{}, colsample:{}, RMSE: {}".format(best_params[0], best_p
arams[1], min_rmse))
```

```
Best params: subsample:0.6, colsample:0.9, RMSE: 7.2821383
```

In [160]:

```
#updating the parameter dictionary
params['subsample'] = 0.6
params['colsample_bytree'] = 0.9
```

In [161]:

```
params
```

Out[161]:

```
{'max_depth': 2,
 'min_child_weight': 6,
 'eta': 0.3,
 'subsample': 0.6,
 'colsample_bytree': 0.9,
 'objective': 'reg:linear',
 'eval_metric': 'rmse',
 'base_score': 100.43993800667607}
```

Tuning learning rate: eta

In [162]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for eta in [0.1, 0.05, 0.01, 0.005, 0.0025]:
    print("CV with eta={}".format(eta))
    # We update our parameters
    params['eta'] = eta

    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=500,
        seed=42,
        nfold=10,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = eta
```

```
CV with eta=0.1
[17:07:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:05] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2928679 for 77 rounds
CV with eta=0.05
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.289007099999999 for 128 rounds
CV with eta=0.01
[17:07:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:07:46] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.2968657 for 499 rounds
CV with eta=0.005
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:08:53] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4029405000000015 for 499 rounds
CV with eta=0.0025
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[17:09:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.895495100000001 for 499 rounds
```

In [163]:

```
print("Best params: eta:{}, RMSE: {}".format(best_params, min_rmse))
```

```
Best params: eta:0.05, RMSE: 7.289007099999999
```

In [210]:

```
#updating the parameter dictionary
params['eta'] = 0.05
```

In [109]:

```
print("Final parameter dictionary:")
params
```

```
Final parameter dictionary:
```

Out[109]:

```
{'max_depth': 2,
 'min_child_weight': 6,
 'eta': 0.05,
 'subsample': 0.6,
 'colsample_bytree': 0.9,
 'objective': 'reg:linear',
 'eval_metric': 'rmse',
 'base_score': 100.43993800667607}
```

2.2 Model

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [205]:

```
best_model = xgb.train(
    params,
    dtrain,
    num_boost_round=20,
    evals=[(dtrain, "Train")]
)
```

```
[17:32:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[0]     Train-rmse:9.92395
[1]     Train-rmse:8.88357
[2]     Train-rmse:8.16485
[3]     Train-rmse:7.77836
[4]     Train-rmse:7.58752
[5]     Train-rmse:7.47142
[6]     Train-rmse:7.40304
[7]     Train-rmse:7.35519
[8]     Train-rmse:7.32161
[9]     Train-rmse:7.2938
[10]    Train-rmse:7.27428
[11]    Train-rmse:7.26191
[12]    Train-rmse:7.24257
[13]    Train-rmse:7.23144
[14]    Train-rmse:7.22073
[15]    Train-rmse:7.21309
[16]    Train-rmse:7.2044
[17]    Train-rmse:7.19423
[18]    Train-rmse:7.1877
[19]    Train-rmse:7.18172
```

- **With these parameters my R2 score was around 0.55119.**
- **In order to increase the score I tweaked and played around with 'max_depth','eta' or learning rate and subsample and it worked wonders as I got a private score of 0.55342 & public score of 0.55653.**
- Took few hints from this reference: https://www.kaggle.com/deadskull7/78th-place-solution-private-lb-0-55282-top-2 (https://www.kaggle.com/deadskull7/78th-place-solution-private-lb-0-55282-top-2)

In [244]:

```
#updating new parameters
params['max_depth']=3
params['eta']=0.005
params['subsample']=0.95
params['silent']=1
```

In [253]:

```
print("Updated parameters:")
params
```

```
Updated parameters:
```

Out[253]:

```
{'max_depth': 3,
 'min_child_weight': 6,
 'eta': 0.005,
 'subsample': 0.95,
 'colsample_bytree': 0.9,
 'objective': 'reg:linear',
 'eval_metric': 'rmse',
 'base_score': 100.43993800667607,
 'n_trees': 500,
 'silent': 1}
```

Defining the R2 custom metric function

In [212]:

```
#https://xgboost.readthedocs.io/en/latest/parameter.html#parameters-for-tree-booster
def xgb_r2_score(preds, dtrain):
    ''' This is a customized metric function created to calculate R2 score'''

    labels = dtrain.get_label()
    return 'r2', r2_score(labels, preds)
```

Applying XGboost regressor

In [246]:

```
best_model = xgb.train(params, dtrain, 1050 , evals=[(dtrain, "Train")], early_stopping
_rounds=50,
                       feval=xgb_r2_score, maximize=True, verbose_eval=20)
```

```
[0]     Train-rmse:11.9559      Train-r2:0.006237
Multiple eval metrics have been passed: 'Train-r2' will be used for early
stopping.

Will train until Train-r2 hasn't improved in 50 rounds.
[20]    Train-rmse:11.2604      Train-r2:0.11848
[40]    Train-rmse:10.6545      Train-r2:0.210793
[60]    Train-rmse:10.13        Train-r2:0.28659
[80]    Train-rmse:9.68016      Train-r2:0.348542
[100]   Train-rmse:9.29472      Train-r2:0.399389
[120]   Train-rmse:8.96622      Train-r2:0.441093
[140]   Train-rmse:8.68691      Train-r2:0.475372
[160]   Train-rmse:8.45125      Train-r2:0.50345
[180]   Train-rmse:8.2522       Train-r2:0.526565
[200]   Train-rmse:8.08434      Train-r2:0.545629
[220]   Train-rmse:7.94346      Train-r2:0.561328
[240]   Train-rmse:7.82545      Train-r2:0.574265
[260]   Train-rmse:7.72658      Train-r2:0.584955
[280]   Train-rmse:7.64445      Train-r2:0.593732
[300]   Train-rmse:7.57525      Train-r2:0.601053
[320]   Train-rmse:7.51731      Train-r2:0.607133
[340]   Train-rmse:7.46893      Train-r2:0.612173
[360]   Train-rmse:7.42862      Train-r2:0.616349
[380]   Train-rmse:7.39407      Train-r2:0.619909
[400]   Train-rmse:7.36461      Train-r2:0.622931
[420]   Train-rmse:7.33928      Train-r2:0.625521
[440]   Train-rmse:7.31769      Train-r2:0.627721
[460]   Train-rmse:7.2984       Train-r2:0.629681
[480]   Train-rmse:7.28132      Train-r2:0.631412
[500]   Train-rmse:7.26641      Train-r2:0.632919
[520]   Train-rmse:7.25327      Train-r2:0.634246
[540]   Train-rmse:7.24102      Train-r2:0.635481
[560]   Train-rmse:7.23039      Train-r2:0.63655
[580]   Train-rmse:7.22043      Train-r2:0.63755
[600]   Train-rmse:7.21141      Train-r2:0.638456
[620]   Train-rmse:7.20324      Train-r2:0.639275
[640]   Train-rmse:7.19519      Train-r2:0.64008
[660]   Train-rmse:7.18799      Train-r2:0.6408
[680]   Train-rmse:7.18101      Train-r2:0.641498
[700]   Train-rmse:7.17427      Train-r2:0.64217
[720]   Train-rmse:7.16733      Train-r2:0.642862
[740]   Train-rmse:7.16089      Train-r2:0.643504
[760]   Train-rmse:7.1545       Train-r2:0.64414
[780]   Train-rmse:7.14809      Train-r2:0.644777
[800]   Train-rmse:7.1406       Train-r2:0.645522
[820]   Train-rmse:7.13474      Train-r2:0.646103
[840]   Train-rmse:7.1289       Train-r2:0.646682
[860]   Train-rmse:7.12261      Train-r2:0.647306
[880]   Train-rmse:7.11692      Train-r2:0.647869
[900]   Train-rmse:7.11119      Train-r2:0.648435
[920]   Train-rmse:7.1059       Train-r2:0.648958
[940]   Train-rmse:7.10058      Train-r2:0.649483
[960]   Train-rmse:7.0948       Train-r2:0.650054
[980]   Train-rmse:7.08931      Train-r2:0.650595
[1000]  Train-rmse:7.08374      Train-r2:0.651144
[1020]  Train-rmse:7.07836      Train-r2:0.651674
[1040]  Train-rmse:7.07238      Train-r2:0.652262
[1049]  Train-rmse:7.06955      Train-r2:0.65254
```

In [247]:

```
#train & test predictions
y_pred_train = best_model.predict(dtrain)
y_pred_test = best_model.predict(dtest)
```

In [248]:

```
#R2 score
train_score=score(train_y.values, y_pred_train)
print("Train score:",round(train_score,4))
```

```
Train score: 0.6525
```

In [249]:

```
y_pred_test
```

Out[249]:

```
array([ 82.20061,  98.34518,  82.59914, ...,  92.21068, 110.25938,
        91.86498], dtype=float32)
```

In [250]:

```
submission = pd.DataFrame()
submission['ID'] = X_test_le.ID.values
submission['y'] = y_pred_test
submission.to_csv('6.csv', index=False)
```

In [251]:

```
best_model.save_model("LE_0.55342.model")
```

With a score of 0.55342 I'm in the top 0.88% at 34th position and in the silver group!

Approach-7

In this approach I will be trying SelectKBest technique of dimensionality reduction on label encoded categorical features & integer features and check if the R2 score improves or not.

In [105]:

```
from sklearn.feature_selection import SelectKBest,f_regression
# feature extraction
fe = SelectKBest(score_func=f_regression, k=100) #considering 55% feature reduction
X_train_le_best = fe.fit_transform(X_train_le, train_y)
X_test_le_best = fe.transform(X_test_le)

print("Final reduced Data Matrix")
print(X_train_le_best.shape, train_y.shape)
print(X_test_le_best.shape)
```

```
Final reduced Data Matrix
(4194, 100) (4194,)
(4209, 100)
```

1.0 XGBoost model with hyperparameter tuning

1.1 Hyperparameter tuning

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [115]:

```
import xgboost as xgb

dtrain = xgb.DMatrix(X_train_le_best, label=train_y)
dtest = xgb.DMatrix(X_test_le_best)
num_boost_round = 500


params = {
    # Parameters that we are going to tune. Below are the default values of the paramet
ers
    'max_depth':6,
    'min_child_weight': 1,
    'eta':.3,
    'subsample': 1,
    'colsample_bytree': 1,
    'objective':'reg:linear',
    'eval_metric':'rmse',
    'base_score':np.mean(train_y),
}
```

In [116]:

```
#Let’s see what cross-validation score we get with our current parameters:
cv_results = xgb.cv(
    params,
    dtrain,
    num_boost_round=num_boost_round,
    seed=42,
    nfold=10,
    metrics={'rmse'},
    early_stopping_rounds=50
)

print(cv_results['test-rmse-mean'].min())
```

```
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:10:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
7.4090601000000005
```

Tuning Parameters max_depth and min_child_weight

In [117]:

```
gridsearch_params = [(max_depth, min_child_weight)
    for max_depth in range(2,7)
    for min_child_weight in range(3,8)]
print(gridsearch_params)
```

```
[(2, 3), (2, 4), (2, 5), (2, 6), (2, 7), (3, 3), (3, 4), (3, 5), (3, 6),
(3, 7), (4, 3), (4, 4), (4, 5), (4, 6), (4, 7), (5, 3), (5, 4), (5, 5),
(5, 6), (5, 7), (6, 3), (6, 4), (6, 5), (6, 6), (6, 7)]
```

In [118]:

```
# Define initial best params and RMSE
min_rmse = float("Inf")
best_params = None
for max_depth, min_child_weight in gridsearch_params:
    print("CV with max_depth={}, min_child_weight={}".format(
                             max_depth,
                             min_child_weight))
    # Update our parameters
    params['max_depth'] = max_depth
    params['min_child_weight'] = min_child_weight
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=500,
        seed=42,
        nfold=10,
        metrics={'rmse'},
        early_stopping_rounds=50
    )
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (max_depth,min_child_weight)
print("Best params: {}, {}, RMSE: {}".format(best_params[0], best_params[1], min_rmse))
```

```
CV with max_depth=2, min_child_weight=3
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3224982 for 15 rounds
CV with max_depth=2, min_child_weight=4
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:50] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3200671999999996 for 19 rounds
CV with max_depth=2, min_child_weight=5
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:11:55] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3224238 for 15 rounds
CV with max_depth=2, min_child_weight=6
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:01] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3225144 for 15 rounds
CV with max_depth=2, min_child_weight=7
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:07] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.323402300000001 for 15 rounds
CV with max_depth=3, min_child_weight=3
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.337723500000001 for 10 rounds
CV with max_depth=3, min_child_weight=4
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3382841 for 10 rounds
CV with max_depth=3, min_child_weight=5
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:25] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3389188 for 10 rounds
CV with max_depth=3, min_child_weight=6
[16:12:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:31] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.337919599999999 for 11 rounds
CV with max_depth=3, min_child_weight=7
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3346542999999995 for 11 rounds
CV with max_depth=4, min_child_weight=3
[16:12:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.346069100000001 for 10 rounds
CV with max_depth=4, min_child_weight=4
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:12:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.347242199999999 for 9 rounds
CV with max_depth=4, min_child_weight=5
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.350101799999999 for 9 rounds
CV with max_depth=4, min_child_weight=6
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.342596700000001 for 9 rounds
CV with max_depth=4, min_child_weight=7
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.345409000000001 for 9 rounds
CV with max_depth=5, min_child_weight=3
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.366412700000001 for 9 rounds
CV with max_depth=5, min_child_weight=4
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3810063999999995 for 8 rounds
CV with max_depth=5, min_child_weight=5
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.379529 for 8 rounds
CV with max_depth=5, min_child_weight=6
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:51] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.354640600000001 for 9 rounds
CV with max_depth=5, min_child_weight=7
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:13:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3655953 for 9 rounds
CV with max_depth=6, min_child_weight=3
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:08] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
        RMSE 7.4055032 for 8 rounds
CV with max_depth=6, min_child_weight=4
[16:14:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:17] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3877675 for 8 rounds
CV with max_depth=6, min_child_weight=5
[16:14:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:14:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3888024 for 7 rounds
CV with max_depth=6, min_child_weight=6
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:37] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.391587200000001 for 8 rounds
CV with max_depth=6, min_child_weight=7
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:14:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.374922700000001 for 8 rounds
Best params: 2, 4, RMSE: 7.3200671999999996
```

In [119]:

```
print("Best params: max_depth:{}, min_child_weight:{}, RMSE: {}".format(best_params[0],
best_params[1], min_rmse))
```

```
Best params: max_depth:2, min_child_weight:4, RMSE: 7.3200671999999996
```

In [120]:

```
#updating the parameter dictionary
params['max_depth'] = 2
params['min_child_weight'] = 4
```

Tuning Parameters subsample and colsample

In [121]:

```
gridsearch_params = [(subsample, colsample)
    for subsample in [i/10. for i in range(6,11)]
    for colsample in [i/10. for i in range(5,11)]]
print(gridsearch_params)
```

```
[(0.6, 0.5), (0.6, 0.6), (0.6, 0.7), (0.6, 0.8), (0.6, 0.9), (0.6, 1.0),
(0.7, 0.5), (0.7, 0.6), (0.7, 0.7), (0.7, 0.8), (0.7, 0.9), (0.7, 1.0),
(0.8, 0.5), (0.8, 0.6), (0.8, 0.7), (0.8, 0.8), (0.8, 0.9), (0.8, 1.0),
(0.9, 0.5), (0.9, 0.6), (0.9, 0.7), (0.9, 0.8), (0.9, 0.9), (0.9, 1.0),
(1.0, 0.5), (1.0, 0.6), (1.0, 0.7), (1.0, 0.8), (1.0, 0.9), (1.0, 1.0)]
```

In [122]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for subsample, colsample in reversed(gridsearch_params):
    print("CV with subsample={}, colsample={}".format(subsample,colsample))
    # We update our parameters
    params['subsample'] = subsample
    params['colsample_bytree'] = colsample
    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=500,
        seed=42,
        nfold=10,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = (subsample,colsample)
```

```
CV with subsample=1.0, colsample=1.0
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:20] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3200671999999996 for 19 rounds
CV with subsample=1.0, colsample=0.9
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.335181999999999 for 15 rounds
CV with subsample=1.0, colsample=0.8
[16:15:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:32] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3303119 for 15 rounds
CV with subsample=1.0, colsample=0.7
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3281341 for 15 rounds
CV with subsample=1.0, colsample=0.6
[16:15:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:42] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3335925 for 21 rounds
CV with subsample=1.0, colsample=0.5
[16:15:47] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:48] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.319890999999998 for 17 rounds
CV with subsample=0.9, colsample=1.0
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:52] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3230154 for 21 rounds
CV with subsample=0.9, colsample=0.9
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:58] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:15:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3341629 for 11 rounds
CV with subsample=0.9, colsample=0.8
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:04] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.331708999999999 for 23 rounds
CV with subsample=0.9, colsample=0.7
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:10] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3353007 for 14 rounds
CV with subsample=0.9, colsample=0.6
[16:16:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:15] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:16] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3353792 for 26 rounds
CV with subsample=0.9, colsample=0.5
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:22] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.344842699999999 for 18 rounds
CV with subsample=0.8, colsample=1.0
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:27] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3238129 for 18 rounds
CV with subsample=0.8, colsample=0.9
[16:16:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:16:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:16:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:34] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3347891 for 12 rounds
CV with subsample=0.8, colsample=0.8
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:39] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.341064299999999 for 13 rounds
CV with subsample=0.8, colsample=0.7
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3432306999999994 for 13 rounds
CV with subsample=0.8, colsample=0.6
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3374477 for 18 rounds
CV with subsample=0.8, colsample=0.5
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.345305400000001 for 19 rounds
CV with subsample=0.7, colsample=1.0
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:16:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.338578200000001 for 11 rounds
CV with subsample=0.7, colsample=0.9
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:06] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3366737 for 14 rounds
CV with subsample=0.7, colsample=0.8
[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
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[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:13] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
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        RMSE 7.3305431 for 11 rounds
CV with subsample=0.7, colsample=0.7
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
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[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:18] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.332203099999999 for 15 rounds
CV with subsample=0.7, colsample=0.6
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
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[16:17:23] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3375619 for 14 rounds
CV with subsample=0.7, colsample=0.5
[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
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g:squarederror.
[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:28] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.341827200000002 for 13 rounds
CV with subsample=0.6, colsample=1.0
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
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[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:33] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3395964 for 11 rounds
CV with subsample=0.6, colsample=0.9
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:38] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.335621399999999 for 11 rounds
CV with subsample=0.6, colsample=0.8
[16:17:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:43] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:44] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3342567 for 13 rounds
CV with subsample=0.6, colsample=0.7
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:49] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3371499 for 13 rounds
CV with subsample=0.6, colsample=0.6
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
```

```
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:54] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3321357 for 13 rounds
CV with subsample=0.6, colsample=0.5
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:17:59] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.342592600000001 for 18 rounds
```

In [123]:

```
print("Best params: subsample:{}, colsample:{}, RMSE: {}".format(best_params[0], best_p
arams[1], min_rmse))
```

```
Best params: subsample:1.0, colsample:0.5, RMSE: 7.319890999999998
```

In [124]:

```
#updating the parameter dictionary
params['subsample'] = 1.0
params['colsample_bytree'] = 0.5
```

In [125]:

```
params
```

Out[125]:

```
{'max_depth': 2,
 'min_child_weight': 4,
 'eta': 0.3,
 'subsample': 1.0,
 'colsample_bytree': 0.5,
 'objective': 'reg:linear',
 'eval_metric': 'rmse',
 'base_score': 100.43993800667607}
```

Tuning learning rate: eta

In [126]:

```
min_rmse = float("Inf")
best_params = None

# We start by the largest values and go down to the smallest
for eta in [0.1, 0.05, 0.01, 0.005, 0.0025]:
    print("CV with eta={}".format(eta))
    # We update our parameters
    params['eta'] = eta

    # Run CV
    cv_results = xgb.cv(
        params,
        dtrain,
        num_boost_round=500,
        seed=42,
        nfold=10,
        metrics={'rmse'},
        early_stopping_rounds=50)
    # Update best RMSE
    mean_rmse = cv_results['test-rmse-mean'].min()
    boost_rounds = cv_results['test-rmse-mean'].argmin()
    print("\tRMSE {} for {} rounds".format(mean_rmse, boost_rounds))
    if mean_rmse < min_rmse:
        min_rmse = mean_rmse
        best_params = eta
```

```
CV with eta=0.1
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:12] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.316051200000001 for 55 rounds
CV with eta=0.05
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:19] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3162006 for 119 rounds
CV with eta=0.01
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:19:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.3245225000000005 for 499 rounds
CV with eta=0.005
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
```

```
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:00] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 7.4340256 for 499 rounds
CV with eta=0.0025
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[16:20:30] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
        RMSE 8.0015607 for 499 rounds
```

In [127]:

```
print("Best params: eta:{}, RMSE: {}".format(best_params, min_rmse))
```

```
Best params: eta:0.1, RMSE: 7.316051200000001
```

In [145]:

```
#updating the parameter dictionary
params['eta'] = 0.05
```

In [137]:

```
print("Final parameter dictionary:")
params
```

```
Final parameter dictionary:
```

Out[137]:

```
{'max_depth': 2,
 'min_child_weight': 4,
 'eta': 0.05,
 'subsample': 1.0,
 'colsample_bytree': 0.5,
 'objective': 'reg:linear',
 'eval_metric': 'rmse',
 'base_score': 100.43993800667607}
```

2.2 Model

Ref: https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f (https://blog.cambridgespark.com/hyperparameter-tuning-in-xgboost-4ff9100a3b2f)

In [139]:

```
best_model = xgb.train(
    params,
    dtrain,
    num_boost_round=119,
    evals=[(dtrain, "Train")]
)
```

```
[16:31:45] WARNING: C:/Jenkins/workspace/xgboost-win64_release_0.90/src/ob
jective/regression_obj.cu:152: reg:linear is now deprecated in favor of re
g:squarederror.
[0]     Train-rmse:11.6684
[1]     Train-rmse:11.3686
[2]     Train-rmse:11.0821
[3]     Train-rmse:10.8193
[4]     Train-rmse:10.5741
[5]     Train-rmse:10.3073
[6]     Train-rmse:10.0604
[7]     Train-rmse:9.8727
[8]     Train-rmse:9.65903
[9]     Train-rmse:9.46201
[10]    Train-rmse:9.28057
[11]    Train-rmse:9.15162
[12]    Train-rmse:9.00524
[13]    Train-rmse:8.86124
[14]    Train-rmse:8.74218
[15]    Train-rmse:8.63316
[16]    Train-rmse:8.52004
[17]    Train-rmse:8.43196
[18]    Train-rmse:8.34464
[19]    Train-rmse:8.25732
[20]    Train-rmse:8.17654
[21]    Train-rmse:8.1161
[22]    Train-rmse:8.04843
[23]    Train-rmse:7.99082
[24]    Train-rmse:7.93328
[25]    Train-rmse:7.88098
[26]    Train-rmse:7.83345
[27]    Train-rmse:7.7903
[28]    Train-rmse:7.75218
[29]    Train-rmse:7.71652
[30]    Train-rmse:7.68421
[31]    Train-rmse:7.65681
[32]    Train-rmse:7.62997
[33]    Train-rmse:7.60989
[34]    Train-rmse:7.58667
[35]    Train-rmse:7.56613
[36]    Train-rmse:7.54657
[37]    Train-rmse:7.52874
[38]    Train-rmse:7.51231
[39]    Train-rmse:7.49725
[40]    Train-rmse:7.48342
[41]    Train-rmse:7.47154
[42]    Train-rmse:7.45987
[43]    Train-rmse:7.45311
[44]    Train-rmse:7.44187
[45]    Train-rmse:7.43179
[46]    Train-rmse:7.42468
[47]    Train-rmse:7.41628
[48]    Train-rmse:7.40822
[49]    Train-rmse:7.40087
[50]    Train-rmse:7.3953
[51]    Train-rmse:7.38991
[52]    Train-rmse:7.38364
[53]    Train-rmse:7.37743
[54]    Train-rmse:7.37189
[55]    Train-rmse:7.36653
[56]    Train-rmse:7.36166
[57]    Train-rmse:7.35721
```

```
[58]    Train-rmse:7.35248
[59]    Train-rmse:7.34928
[60]    Train-rmse:7.34518
[61]    Train-rmse:7.34196
[62]    Train-rmse:7.33827
[63]    Train-rmse:7.33475
[64]    Train-rmse:7.33213
[65]    Train-rmse:7.32881
[66]    Train-rmse:7.3258
[67]    Train-rmse:7.32373
[68]    Train-rmse:7.32167
[69]    Train-rmse:7.31928
[70]    Train-rmse:7.31713
[71]    Train-rmse:7.31468
[72]    Train-rmse:7.31165
[73]    Train-rmse:7.3096
[74]    Train-rmse:7.30744
[75]    Train-rmse:7.3048
[76]    Train-rmse:7.30289
[77]    Train-rmse:7.30138
[78]    Train-rmse:7.2996
[79]    Train-rmse:7.29786
[80]    Train-rmse:7.29615
[81]    Train-rmse:7.29433
[82]    Train-rmse:7.29297
[83]    Train-rmse:7.29166
[84]    Train-rmse:7.29036
[85]    Train-rmse:7.28901
[86]    Train-rmse:7.28787
[87]    Train-rmse:7.2867
[88]    Train-rmse:7.28508
[89]    Train-rmse:7.28385
[90]    Train-rmse:7.28274
[91]    Train-rmse:7.28156
[92]    Train-rmse:7.28055
[93]    Train-rmse:7.27935
[94]    Train-rmse:7.27813
[95]    Train-rmse:7.27689
[96]    Train-rmse:7.27603
[97]    Train-rmse:7.27513
[98]    Train-rmse:7.27436
[99]    Train-rmse:7.27334
[100]   Train-rmse:7.27254
[101]   Train-rmse:7.27117
[102]   Train-rmse:7.26996
[103]   Train-rmse:7.26916
[104]   Train-rmse:7.26821
[105]   Train-rmse:7.26751
[106]   Train-rmse:7.26689
[107]   Train-rmse:7.26622
[108]   Train-rmse:7.26528
[109]   Train-rmse:7.26448
[110]   Train-rmse:7.26382
[111]   Train-rmse:7.26301
[112]   Train-rmse:7.26204
[113]   Train-rmse:7.2613
[114]   Train-rmse:7.26055
[115]   Train-rmse:7.25984
[116]   Train-rmse:7.25918
[117]   Train-rmse:7.25859
[118]   Train-rmse:7.25814
```

In [140]:

```
#predicting train & test target values
y_pred_train = best_model.predict(dtrain)
y_pred_test = best_model.predict(dtest)
```

In [141]:

```
train_score=score(train_y.values, y_pred_train)
print("Train score:",round(train_score,4))
```

```
Train score: 0.6338
```

In [142]:

```
y_pred_test
```

Out[142]:

```
array([ 78.56423 ,  93.736465,  78.53227 , ...,  93.839294, 111.89283 ,
        93.6191  ], dtype=float32)
```

In [143]:

```
submission = pd.DataFrame()
submission['ID'] = X_test_te.ID.values
submission['y'] = y_pred_test
submission.to_csv('submission.csv', index=False)
```

- **With these parameters my R2 score was around 0.54726.**
- **In order to increase the score I tweaked and played around with 'max_depth','eta' or learning rate and subsample I got a private score of 0.54796 & public score of 0.55017.**
- Took few hints from this reference: https://www.kaggle.com/deadskull7/78th-place-solution-private-lb-0-55282-top-2 (https://www.kaggle.com/deadskull7/78th-place-solution-private-lb-0-55282-top-2)

In [146]:

```
#updating new parameters
params['max_depth']=3
params['eta']=0.005
params['subsample']=0.95
params['silent']=1
```

In [147]:

```
print("Updated parameters:")
params
```

Updated parameters:

Out[147]:

```
{'max_depth': 3,
 'min_child_weight': 4,
 'eta': 0.005,
 'subsample': 0.95,
 'colsample_bytree': 0.5,
 'objective': 'reg:linear',
 'eval_metric': 'rmse',
 'base_score': 100.43993800667607,
 'silent': 1}
```

Defining the R2 custom metric function

In [148]:

```
#https://xgboost.readthedocs.io/en/latest/parameter.html#parameters-for-tree-booster
def xgb_r2_score(preds, dtrain):
    ''' This is a customized metric function created to calculate R2 score'''

    labels = dtrain.get_label()
    return 'r2', r2_score(labels, preds)
```

Applying XGboost regressor

In [149]:

```
best_model = xgb.train(params, dtrain, 1050 , evals=[(dtrain, "Train")], early_stopping
_rounds=50,
                       feval=xgb_r2_score, maximize=True, verbose_eval=20)
```

```
[0]     Train-rmse:11.9563      Train-r2:0.006166
Multiple eval metrics have been passed: 'Train-r2' will be used for early
stopping.

Will train until Train-r2 hasn't improved in 50 rounds.
[20]    Train-rmse:11.3083      Train-r2:0.110978
[40]    Train-rmse:10.7099      Train-r2:0.202577
[60]    Train-rmse:10.1899      Train-r2:0.278125
[80]    Train-rmse:9.7557       Train-r2:0.338335
[100]   Train-rmse:9.3753       Train-r2:0.388929
[120]   Train-rmse:9.06215      Train-r2:0.429069
[140]   Train-rmse:8.78189      Train-r2:0.463837
[160]   Train-rmse:8.54225      Train-r2:0.492699
[180]   Train-rmse:8.34178      Train-r2:0.516231
[200]   Train-rmse:8.17197      Train-r2:0.535726
[220]   Train-rmse:8.02743      Train-r2:0.552004
[240]   Train-rmse:7.90582      Train-r2:0.565475
[260]   Train-rmse:7.80124      Train-r2:0.576895
[280]   Train-rmse:7.71411      Train-r2:0.586293
[300]   Train-rmse:7.64228      Train-r2:0.593962
[320]   Train-rmse:7.58276      Train-r2:0.600262
[340]   Train-rmse:7.53012      Train-r2:0.605793
[360]   Train-rmse:7.48738      Train-r2:0.610255
[380]   Train-rmse:7.45203      Train-r2:0.613926
[400]   Train-rmse:7.41999      Train-r2:0.617239
[420]   Train-rmse:7.39239      Train-r2:0.620081
[440]   Train-rmse:7.36931      Train-r2:0.62245
[460]   Train-rmse:7.34963      Train-r2:0.624464
[480]   Train-rmse:7.33296      Train-r2:0.626165
[500]   Train-rmse:7.31865      Train-r2:0.627623
[520]   Train-rmse:7.30625      Train-r2:0.628884
[540]   Train-rmse:7.29561      Train-r2:0.629963
[560]   Train-rmse:7.28625      Train-r2:0.630913
[580]   Train-rmse:7.27733      Train-r2:0.631816
[600]   Train-rmse:7.26967      Train-r2:0.63259
[620]   Train-rmse:7.26272      Train-r2:0.633293
[640]   Train-rmse:7.25675      Train-r2:0.633895
[660]   Train-rmse:7.25097      Train-r2:0.634478
[680]   Train-rmse:7.24579      Train-r2:0.635
[700]   Train-rmse:7.24094      Train-r2:0.635489
[720]   Train-rmse:7.23671      Train-r2:0.635914
[740]   Train-rmse:7.23249      Train-r2:0.636339
[760]   Train-rmse:7.22844      Train-r2:0.636746
[780]   Train-rmse:7.22481      Train-r2:0.637111
[800]   Train-rmse:7.22133      Train-r2:0.63746
[820]   Train-rmse:7.21809      Train-r2:0.637786
[840]   Train-rmse:7.21436      Train-r2:0.638159
[860]   Train-rmse:7.21117      Train-r2:0.63848
[880]   Train-rmse:7.20814      Train-r2:0.638784
[900]   Train-rmse:7.20544      Train-r2:0.639054
[920]   Train-rmse:7.20268      Train-r2:0.639331
[940]   Train-rmse:7.19982      Train-r2:0.639618
[960]   Train-rmse:7.19729      Train-r2:0.63987
[980]   Train-rmse:7.19459      Train-r2:0.64014
[1000]  Train-rmse:7.19148      Train-r2:0.640452
[1020]  Train-rmse:7.18912      Train-r2:0.640688
[1040]  Train-rmse:7.18648      Train-r2:0.640952
[1049]  Train-rmse:7.18534      Train-r2:0.641065
```

In [150]:

```
#train & test predictions
y_pred_train = best_model.predict(dtrain)
y_pred_test = best_model.predict(dtest)
```

In [151]:

```
#R2 score
train_score=score(train_y.values, y_pred_train)
print("Train score:",round(train_score,4))
```

```
Train score: 0.6411
```

In [152]:

```
y_pred_test
```

Out[152]:

```
array([ 78.309166,  93.31956 ,  78.23791 , ...,  93.98702 , 111.91316 ,
        93.31597 ], dtype=float32)
```

In [153]:

```
submission = pd.DataFrame()
submission['ID'] = X_test_le.ID.values
submission['y'] = y_pred_test
submission.to_csv('3.csv', index=False)
```

- **In this approach there was no improvement in the previous R2 score of 0.55342. Therefore, SelectKbest did not perform well on label encoded features & integer features.**

Score Summary

In [154]:

```
#Ref: http://zetcode.com/python/prettytable/
from prettytable import PrettyTable


x = PrettyTable()
x.field_names = ["Model","Encoder","Test R2-Private","Test R2-Public"]
x.add_row(["Linear regression","OHE", 0.51398,0.52360])
x.add_row(["KNN Regressor","OHE", 0.47784,0.49714])
x.add_row(["Support vector regressor","OHE", 0.50506,0.51859])
x.add_row(["Random forest","OHE",0.52089,0.52742])
x.add_row(["XGBoost regressor","OHE", 0.54910,0.55551])
x.add_row(["XGB on SVD data","OHE", 0.49440,0.50422])
x.add_row(["XGB on SelectKbest data","OHE", 0.54938,0.55583])
x.add_row(["XGB regressor","Target encoding", 0.55078, 0.55595])
x.add_row(["XGB on SelectKbest data","Target encoding", 0.54828, 0.55386])
x.add_row(["XGB regressor","Lablel encoding", 0.55342, 0.55653])
x.add_row(["XGB on SelectKbest data","Lablel encoding", 0.54796, 0.55017])
print(x)

#OHE=One hot encoding
```

```
+--------------------------+-----------------+-----------------+----------
------+
|          Model           |     Encoder     | Test R2-Private | Test R2-P
ublic |
+--------------------------+-----------------+-----------------+----------
------+
|    Linear regression     |       OHE       |     0.51398     |     0.523
6     |
|      KNN Regressor       |       OHE       |     0.47784     |    0.4971
4     |
| Support vector regressor |       OHE       |     0.50506     |    0.5185
9     |
|      Random forest       |       OHE       |     0.52089     |    0.5274
2     |
|    XGBoost regressor     |       OHE       |      0.5491     |    0.5555
1     |
|     XGB on SVD data      |       OHE       |      0.4944     |    0.5042
2     |
| XGB on SelectKbest data  |       OHE       |     0.54938     |    0.5558
3     |
|      XGB regressor       | Target encoding |     0.55078     |    0.5559
5     |
| XGB on SelectKbest data  | Target encoding |     0.54828     |    0.5538
6     |
|      XGB regressor       | Lablel encoding |     0.55342     |    0.5565
3     |
| XGB on SelectKbest data  | Lablel encoding |     0.54796     |    0.5501
7     |
+--------------------------+-----------------+-----------------+----------
------+
```

Conclusion

- Highest score of 0.55342 on private leaderboard & 0.55653 on public leaderboard was obtained when a tuned native XGBoost model was trained on one label encoded features and integer features.
- With these scores I managed to bag the 34th position out of 3822 (top 0.88%) on private leaderboard.
- SelectKBest technique performed well on sparse data and hence outperformed SVD by a considerable margin in R2 score.
- SelectKBest technique did not perform well on target encoded & label encoded categorical features (Approaches 5 & 7) and hence applying XGB regressor on the complete data rather than reduced data gave very good results.

Steps followed to solve this case study:

1. The first basic step was to carry out EDA on the train & test data. This included finding datatypes of all features followed by Univariate Analysis of the target variable(y) & the ID feature where the outliers were removed from the data .
2. Next was the univariate analysis of categorical variables in both train & test data where important conclusions were drawn regarding the difference between train & test data. This was followed by Univariate Analysis of integer/binary columns where unique values and counts of the values was observed. This marks the end of EDA.
3. The next important stage was data cleaning where features were eliminated considering variance in the respective columns, & the duplicate columns. These sequence of operations resulted in the elimination of 163 weak columns.
4. Data cleaning was followed by feature engineering where 3 two-way and 1 three-way interactions were added and mmore columns were eliminated which showed extreme positive & negative correlation using the thresholds -0.95 & +0.95 respectively. Therefore, the final data had 185 important features.
5. Next, feature importance was determined using a XGBoost regressor and it was learnt that the feature interactions had a lot of influence on the target variable.
6. Once the final, clean & processed data was ready the next obvious stage was modelling where I followed 7 approaches based on encoding technique of categorical features & dimensionality reduction technique.
7. The encoding of categorical features in approach 1,2 & 3 was one hot encoding. In approach 1, 5 various hyperparameter tuned regressor algorithms were applied on the data. These were Linear regression, KNN Regressor, Support vector regressor & XGBoost regressor. Among them XGBoost regressor performed best with highest R2 score.
8. In approach 2 & 3, SVD & SelectKBest dimensionality reduction techniques were applied on the high dimensional(due to one hot encoding) data and XGBoost regressor which was the best performing algorithm was applied on the feature reduced datasets.
9. The encoding of categorical features in approach 4 & 5 was target encoding. Approach 4 involved applying XGBoost regressor on all features and Approach 5 involved applying XGBoost regressor on selected important features obatined from SelectKBest.
10. The encoding of categorical features in approach 6 & 7 was label encoding. Approach 6 involved applying XGBoost regressor on all features and Approach 7 involved applying XGBoost regressor on selected important features obatined from SelectKBest.
11. Test predictions were made using the best model and the prediction csv file was uploaded on kaggle to get the final R2 score.