SESSION 13: Decision Tree Based Models

Assignment 1

Table of Contents

1. Introduction

This assignment will help you understand the concepts learnt in the session.

2. Objective

This assignment will test your skills on the basics of decision tree.

3. Prerequisites

Not applicable.

4. Associated Data Files

Not applicable.

5. Problem Statement

1. Use the given link below:
https://archive.ics.uci.edu/ml/machine-learning-databases/00304/

Problem- prediction of the number of comments in the upcoming 24 hours on those blogs, the train data was generated from different base times that may temporally overlap. Therefore, if you simply split the train into disjoint partitions, the underlying time intervals may overlap. Therefore, the you should use the provided, temporally disjoint train and test splits to ensure that the evaluation is fair.

    a. Read the dataset and identify the right features.
    b. Clean dataset, impute missing values and perform exploratory data analysis.

c. Visualize the dataset and make inferences from that.
d. Perform any 3 hypothesis tests using columns of your choice, make conclusions.

```r
library(rstanarm)
library(class)
library(ggplot2)
library(png)
library(grid)

library(readr)
blogData_test <- read_csv("C:/Users/archana/Desktop/archana/GITS/blogData_test.csv")
View(blogData_test)
blog.full <- read.csv("C:/Users/archana/Desktop/archana/GITS/blogData_train.csv",header=FALSE)
blog.test <- read.csv("C:/Users/archana/Desktop/archana/GITS/blogData_train.csv",header=FALSE)
att_names <- c( paste(rep(c("_comm_","_links_"),each=5),
             c(".tot",".pre.1day",".pre.2day",
               ".post.1day",".pre.vsday"), sep=""))
names(blog.full) <- c( paste(c("avg","sd","min","max","med"),
               ".",rep(att_names,each=5),sep=""),
             att_names,
             "pubtime", "length",
             paste("bagwords_",1:200,sep=""),
             paste("basetime_",c("Mo","Tu","We","Th","Fr","Sa","Su"),sep=""),
             paste("pubtime_",c("Mo","Tu","We","Th","Fr","Sa","Su"),sep=""),
             "_parents",
             paste(c("min_","max_","avg_"),".comm.parents",sep=""),
             "comm.next24_" )
names(blog.test) <- names(blog.full)
View(blog.full)
```

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function   Addins   Project: (None)

Untitled16*   Untitled17*   blog.full   blogData_test

Source on Save   Run   Source

```
 9  View(blogData_test)
10  blog.full <- read.csv("C:/Users/archana/Desktop/archa
11  blog.test <- read.csv("C:/Users/archana/Desktop/archa
12  att_names <- c( paste(rep(c("_comm_","_links_"),each=
13                        c(".tot",".pre.1day",".pre.2day
14                        ".post.1day",".pre.vsday"), s
15  names(blog.full) <- c( paste(c("avg","sd","min","max"
16                        ".",rep(att_names,each=5
17                        att_names,
18                        "pubtime", "length",
19                        paste("bagwords_",1:200,sep=""
20                        paste("basetime_",c("Mo","Tu",
21
```

22:19   (Top Level)   R Script

Console ~/

```
,"Th","Fr","Sa","Su"),sep=""),
+                          paste("pubtime_",c("Mo","Tu","We",
"Th","Fr","Sa","Su"),sep=""),
+                          "_parents",
+                          paste(c("min_","max_","avg_"),".co
mm.parents",sep=""),
+                          "comm.next24_" )
> names(blog.test) <- names(blog.full)
> View(blog.full)
> 
```

Environment   History   Connections

Import Dataset   List
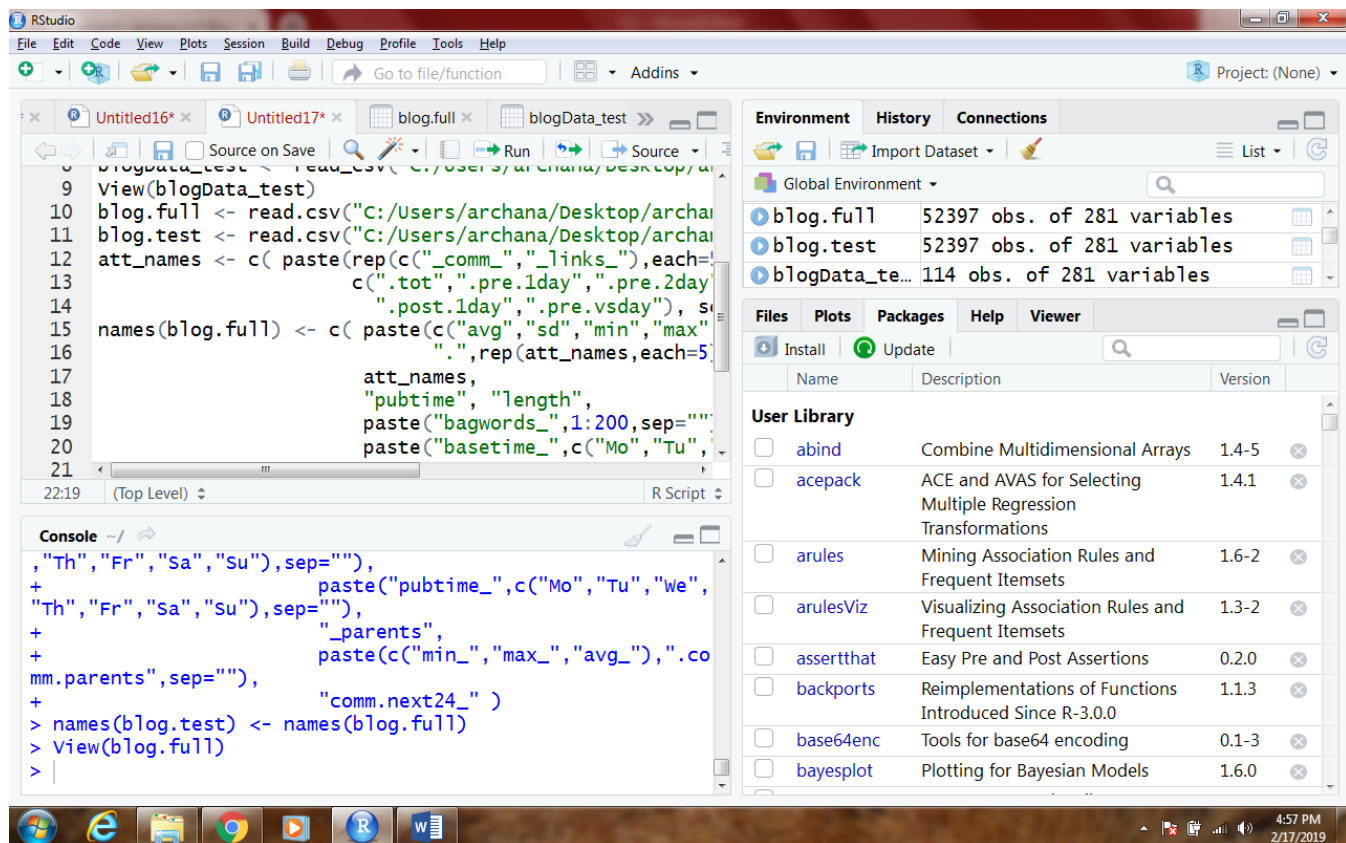
Global Environment

blog.full	52397 obs. of 281 variables	
blog.test	52397 obs. of 281 variables	
blogData_te...	114 obs. of 281 variables	

Files   Plots   Packages   Help   Viewer

Install   Update

Name	Description	Version	
User Library			
abind	Combine Multidimensional Arrays	1.4-5	
acepack	ACE and AVAS for Selecting Multiple Regression Transformations	1.4.1	
arules	Mining Association Rules and Frequent Itemsets	1.6-2	
arulesViz	Visualizing Association Rules and Frequent Itemsets	1.3-2	
assertthat	Easy Pre and Post Assertions	0.2.0	
backports	Reimplementations of Functions Introduced Since R-3.0.0	1.1.3	
base64enc	Tools for base64 encoding	0.1-3	
bayesplot	Plotting for Bayesian Models	1.6.0	

4:57 PM
2/17/2019

Data set with Headers.

Dataset Description:

Understanding the Data
This dataset contain data extracted from blog posts. One thing about this data set is that it is a labelled dataset, which means that we know the meaning of each column, which would dramatically help us in using this data correctly. According to the website, the meaning of each column is as follows:

This data originates from blog posts. The raw HTML-documents of the blog posts were crawled and processed. The prediction task associated with the data is the prediction of the number of comments in the upcoming 24 hours. In order to simulate this situation, we choose a basetime (in the past) and select the blog posts that were published at most 72 hours before the selected base date/time. Then, we calculate all the features of the selected blog posts from the information that was available at the basetime, therefore each instance corresponds to a blog post. The target is the number of comments that the blog post received in the next 24 hours relative to the basetime.

1...50:

Average, standard deviation, min, max and median of the Attributes 51...60 for the source of the current blog post. With source we mean the blog on which the post appeared. For example, myblog.blog.org would be the source of the post myblog.blog.org/post_2010_09_10

51: Total number of comments before basetime

52: Number of comments in the last 24 hours before the basetime

53: Let T1 denote the datetime 48 hours before basetime,

Let T2 denote the datetime 24 hours before basetime.

This attribute is the number of comments in the time period between T1 and T2

54: Number of comments in the first 24 hours after the publication of the blog post, but before basetime

55: The difference of Attribute 52 and Attribute 53

56...60:

The same features as the attributes 51...55, but features 56...60 refer to the number of links (trackbacks), while features 51...55 refer to the number of comments.

61: The length of time between the publication of the blog post and basetime

62: The length of the blog post

63...262:

The 200 bag of words features for 200 frequent words of the text of the blog post

263...269: binary indicator features (0 or 1) for the weekday (Monday...Sunday) of the basetime

270...276: binary indicator features (0 or 1) for the weekday (Monday...Sunday) of the date of publication of the blog post

277: Number of parent pages: we consider a blog post P as a parent of blog post B, if B is a reply (trackback) to blog post P.

278...280: Minimum, maximum, average number of comments that the parents received

281: The target: the number of comments in the next 24 hours (relative to basetime)

For any dataset, it is important to first understand what the data represents before diving deep into the actual data. Let's therefore study the description. From the description of the dataset above, we can see that each row of data was collected at a basetime (Note that the actual basetime is not recorded in the data). And data from all blogposts that was published at most 72 hours before the base time was recorded. These data include for example, number of comments, number of link backs, over 24, 48hr and 72hr time periods before the base time, words contained in the posts, length of posts, day at which the post was published, etc. The data was designed to be used to predict the number of comments a post would receive in the next 24 hours, and hence, being labelled data, we are actually given this number in the target column by assuming we are currently at the basetime.

ext, we use the read_csv() command to load the data into a dataframe. Because data files could be extremely large, we will be careful here and first only load in the first 100 rows to have a look at what the data is like, i.e. nrows = 100. The function returns a dataframe, which is the main datatype used in pandas. It is essentially a table with rows and columns, and have special functions allowing data manipulation within the table. We will be using different dataframe functions in the rest of the tutorials. For example, to view the dataframe, one could use the head function which display the first n number of rows in the table. By default n is 5. A similar function tail let you view the last n rows of the data:

It can be seen that the dataframe has 281 rows as expected. Another thing to notice is that the column names are all numbers. This tells us that in fact, the data file does not have any headers. We will be addressing it later. The next step would be to probe how many rows the file has, as this would determine whether we can process the table as a whole, or if we could view it with some other software such as excel to gain more insights into the data. Apart from judging from the file size, one thing that I find useful is to only read the first column of the whole file. This will minimise the memory used. You can specify the columns that you want to read as a list in the read_csv function using the usecols parameter, remembering that the first column is indexed as 0. We can then probe the number of rows by using len(df):

The number of rows in this file is only 52396. This is quite small by the data science standard. We can therefore safely load the whole data set into python in one go.

Before we do that, however, let's go back to the issue of headers. In Pandas, one of the most powerful thing is you could refer to a column by its header name. This is convenient as it makes the code more readable, and less likely to lose track of which column of data is being processed. In this case here, since the file doesn't actually have headers, it is useful to create headers, according to what the data is. read_csv() allows you to specify the name of the headers, again in a list, using the names parameter. You should also explicitly set the header parameter to None to tell the function that the data does not have any headers

b. Clean dataset, impute missing values and perform exploratory data analysis.

Now that the data is loaded into R, it is time to check the data and do some cleaning up. One of the things that you might want to do is to see if there are any missing data in the data set. This can be done using the

isnull() function:
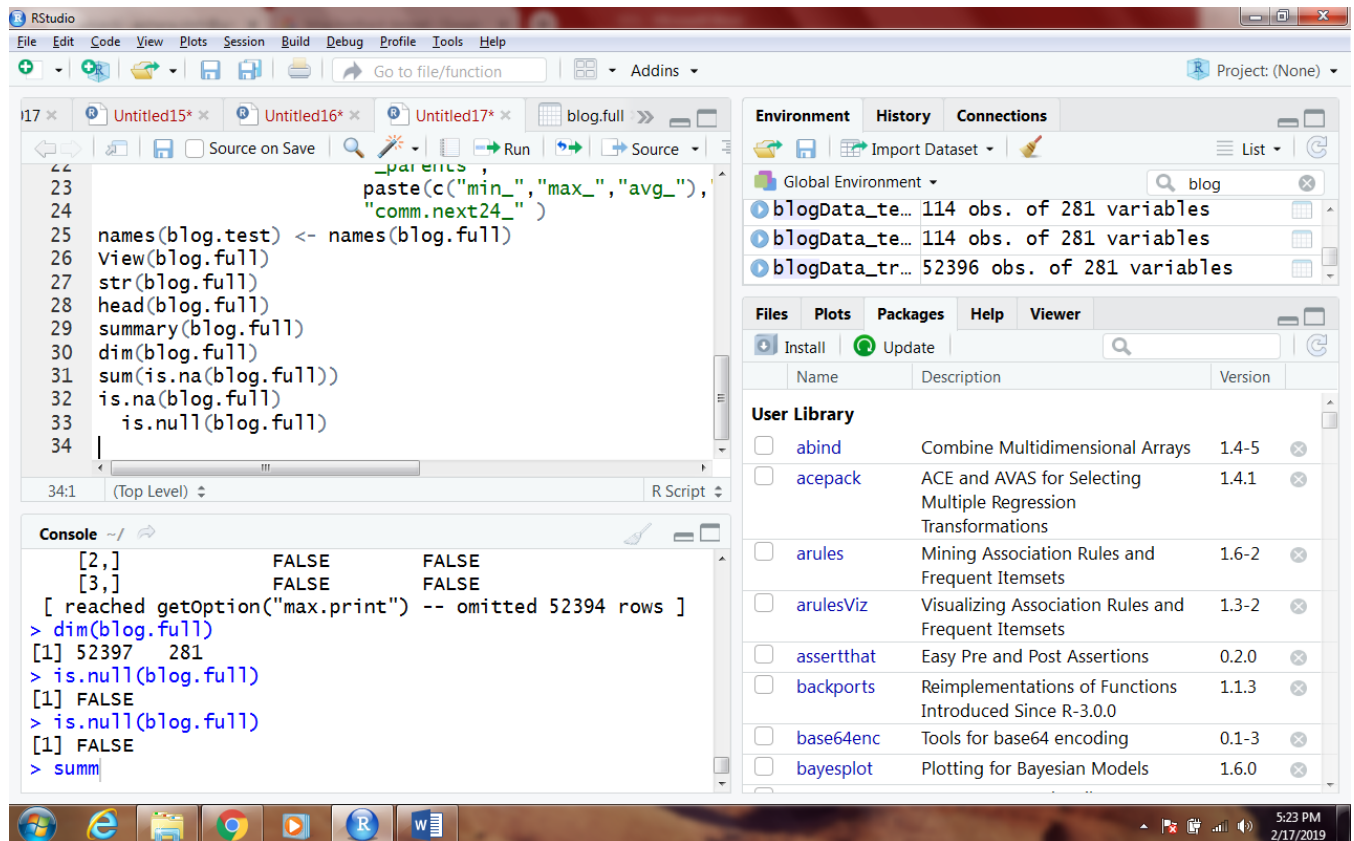
Which essentially sums up all the true and false values that is returned from the isnull() function. So the answer is greater than 0, then somewhere in the data set there is data is missing. In this case, there is no missing data. Alternatively, one can directly remove rows with missing data (if so wished) by directly calling the dropna() function:

sum(is.null(blog.full))

[1] 0
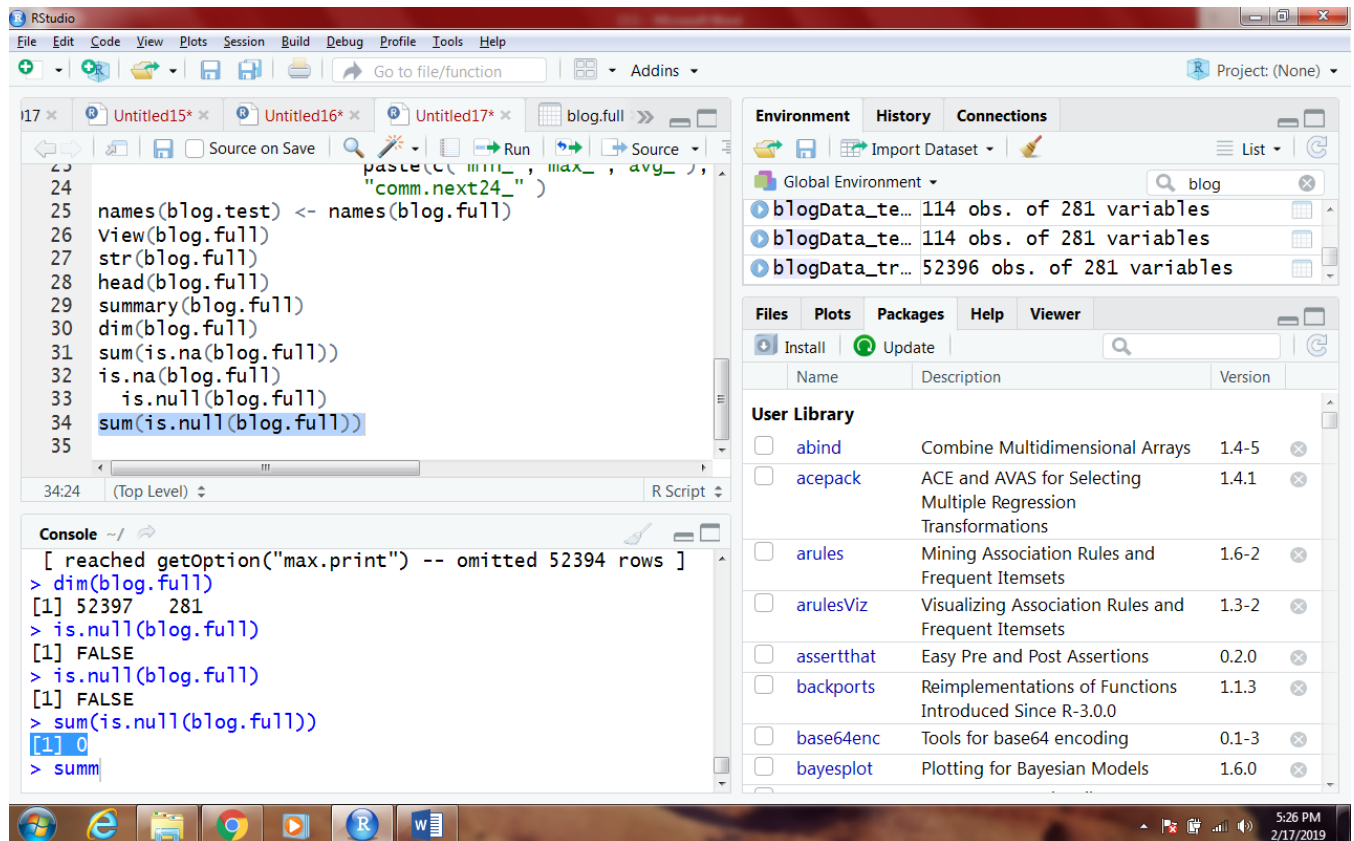
Problem- prediction of the number of comments in the upcoming 24 hours on those blogs, The train data was generated from different base times that may temporally overlap. Therefore, if you simply split the train into disjoint partitions, the underlying time intervals may overlap. Therefore, the you should use the provided, temporally disjoint train and test splits to ensure that the evaluation is fair.

a. Read the dataset and identify the right features
b. Clean dataset, impute missing values and perform exploratory data analysis.
c. Visualize the dataset and make inferences from that
d. Perform any 3 hypothesis tests using columns of your choice, make conclusions
e. Create a linear regression model to predict the number of comments in the next 24 hours (relative to basetime)
f. Fine tune the model and represent important features
g. Interpret the summary of the linear model
h. Report the test accuracy vs. the training accuracy
i. Interpret the final model coefficients
j. Plot the model result and compare it with assumptions of the model

Data Preprocessing
library(data.table) library(foreach)
library(readr)

[1] "C:/Users/Downloads/New folder (2)" setwd("C:/Users/archana/Desktop/BlogFeedback")

# [1] "C:/Users/seshan/Downloads/New folder (2)"
blogData_train <- read_csv("C:/Users/archana/Desktop/BlogFeedback/blogData_tra in.csv")

Warning: Duplicated column names deduplicated: '0.0' => '0.0_1' [8],
'0.0' => '0.0_2' [13], '377.0' => '377.0_1' [14], '0.0' => '0.0_3' [18],
'377.0' => '377.0_2' [24], '0.0' => '0.0_4' [25], '0.0' => '0.0_5' [28],
'0.0' => '0.0_6' [30], '0.0' => '0.0_7' [33], '0.0' => '0.0_8' [35], '0.0'
=> '0.0_9' [38], '9.0' => '9.0_1' [39], '0.0' => '0.0_10' [40], '0.0'
=> '0.0_11' [43], '0.0' => '0.0_12' [45], '9.0' => '9.0_2' [49], '0.0'
=> '0.0_13' [50], '2.0' => '2.0_1' [51], '2.0' => '2.0_2' [52], '0.0'
=> '0.0_14' [53], '2.0' => '2.0_3' [54], '2.0' => '2.0_4' [55], '0.0' =>
'0.0_15' [56], '0.0' => '0.0_16' [57], '0.0' => '0.0_17' [58], '0.0' =>
'0.0_18' [59], '0.0' => '0.0_19' [60], '10.0' => '10.0_1' [61], '0.0' => ## '0.0_20' [62], '0.0' => '0.0_21' [63],
'0.0' => '0.0_22' [64], '0.0' =>
'0.0_23' [65], '0.0' => '0.0_24' [66], '0.0' => '0.0_25' [67], '0.0' =>
'0.0_26' [68], '0.0' => '0.0_27' [69], '0.0' => '0.0_28' [70], '0.0' =>
'0.0_29' [71], '0.0' => '0.0_30' [72], '0.0' => '0.0_31' [73], '0.0' =>
'0.0_32' [74], '0.0' => '0.0_33' [75], '0.0' => '0.0_34' [76], '0.0' =>
'0.0_35' [77], '0.0' => '0.0_36' [78], '0.0' => '0.0_37' [79], '0.0' =>
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'0.0_41' [83], '0.0' => '0.0_42' [84], '0.0' => '0.0_43' [85], '0.0' =>
'0.0_44' [86], '0.0' => '0.0_45' [87], '0.0' => '0.0_46' [88], '0.0' =>
'0.0_47' [89], '0.0' => '0.0_48' [90], '0.0' => '0.0_49' [91], '0.0' =>
'0.0_50' [92], '0.0' => '0.0_51' [93], '0.0' => '0.0_52' [94], '0.0' =>
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'0.0_56' [98], '0.0' => '0.0_57' [99], '0.0' => '0.0_58' [100], '0.0' =>
'0.0_59' [101], '0.0' => '0.0_60' [102], '0.0' => '0.0_61' [103], '0.0' =>
'0.0_62' [104], '0.0' => '0.0_63' [105], '0.0' => '0.0_64' [106], '0.0' =>
'0.0_65' [107], '0.0' => '0.0_66' [108], '0.0' => '0.0_67' [109], '0.0' =>
'0.0_68' [110], '0.0' => '0.0_69' [111], '0.0' => '0.0_70' [112], '0.0' =>
'0.0_71' [113], '0.0' => '0.0_72' [114], '0.0' => '0.0_73' [115], '0.0' =>
'0.0_74' [116], '0.0' => '0.0_75' [117], '0.0' => '0.0_76' [118], '0.0' =>
'0.0_77' [119], '0.0' => '0.0_78' [120], '0.0' => '0.0_79' [121], '0.0' =>
'0.0_80' [122], '0.0' => '0.0_81' [123], '0.0' => '0.0_82' [124], '0.0' =>
'0.0_83' [125], '0.0' => '0.0_84' [126], '0.0' => '0.0_85' [127], '0.0' =>
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'0.0_89' [131], '0.0' => '0.0_90' [132], '0.0' => '0.0_91' [133], '0.0' =>

```
## '0.0_92' [134], '0.0' => '0.0_93' [135], '0.0' => '0.0_94' [136], '0.0' =>
## '0.0_95' [137], '0.0' => '0.0_96' [138], '0.0' => '0.0_97' [139], '0.0' =>
## '0.0_98' [140], '0.0 ' => '0.0_99' [141], '0.0' => '0.0_100' [142], '0.0'  =
>
## '0.0_101' [143], '0.0' => '0.0_102' [144], '0.0' => '0.0_103' [145], '0.0'
## => '0.0_104' [146], '0.0' => '0.0_105' [147], '0.0' => '0.0_106' [148],
## '0.0' => '0.0_107' [149], '0.0' => '0.0_108' [150], '0.0' =>
## '0.0_109' [151], '0.0' => '0.0_110' [152], '0.0' => '0.0_111' [153], '0.0'
## => '0.0_112' [154], '0.0' => '0.0_113' [155], '0.0' => '0.0_114' [156],
## '0.0' => '0.0_115' [157], '0.0' => '0.0_116' [158], '0.0' =>
## '0.0_117' [159], '0.0' => '0.0_118' [160], '0.0' => '0.0_119' [161], '0.0'
## => '0.0_120' [162], '0.0' => '0.0_121' [163], '0.0' => '0.0_122' [164],
## '0.0' => '0.0_123' [165], '0.0' => '0.0_124' [166], '0.0' =>
## '0.0_125' [167], '0.0' => '0.0_126' [168], '0.0' => '0.0_127' [169], '0.0'
## => '0.0_128' [170], '0.0' => '0.0_129' [171], '0.0' => '0.0_130' [172],
## '0.0' => '0.0_131' [173], '0.0' => '0.0_132' [174], '0.0' =>
## '0.0_133' [175], '0.0' => '0.0_134' [176], '0.0' => '0.0_135' [177], '0.0'
## => '0.0_136' [178], '0.0' => '0.0_137' [179], '0.0' => '0.0_138' [180], ## '0.0' => '0.0_139' [181], '0.0'
=> '0.0_140' [182], '0.0' =>
## '0.0_141' [183], '0.0' => '0.0_142' [184], '0.0' => '0.0_143' [185], '0.0'
## => '0.0_144' [186], '0.0' => '0.0_145' [187], '0.0' => '0.0_146' [188], ## '0.0' => '0.0_147' [189], '0.0'
=> '0.0_148' [190], '0.0' =>
## '0.0_149' [191], '0.0' => '0.0_150' [192], '0.0' => '0.0_151' [193], '0.0'
## => '0.0_152' [194], '0.0' => '0.0_153' [195], '0.0' => '0.0_154' [196],
## '0.0' => '0.0_155' [197], '0.0' => '0.0_156' [198], '0.0' =>
## '0.0_157' [199], '0.0' => '0.0_158' [200], '0.0' => '0.0_159' [201], '0.0'
## => '0.0_160' [202], '0.0' => '0.0_161' [203], '0.0' => '0.0_162' [204],
## '0.0' => '0.0_163' [205], '0.0' => '0.0_164' [206], '0.0' =>
## '0.0_165' [207], '0.0' => '0.0_166' [208], '0.0' => '0.0_167' [209], '0.0'
## => '0.0_168' [210], '0.0' => '0.0_169' [211], '0.0' => '0.0_170' [212],
## '0.0' => '0.0_171' [213], '0.0' => '0.0_172' [214], '0.0' =>
```

```
## '0.0_173' [215], '0.0' => '0.0_174' [216], '0.0' => '0.0_175' [217], '0.0'
## => '0.0_176' [218], '0.0' => '0.0_177' [219], '0.0' => '0.0_178' [220],
## '0.0' => '0.0_179' [221], '0.0' => '0.0_180' [222], '0.0' =>
## '0.0_181' [223], '0.0' => '0.0_182' [224], '0.0' => '0.0_183' [225], '0.0'
## => '0.0_184' [226], '0.0' => '0.0_185' [227], '0.0' => '0.0_186' [228],
## '0.0' => '0.0_187' [229], '0.0' => '0.0_188' [230], '0.0' =>
## '0.0_189' [231], '0.0' => '0.0_190' [232], '0.0' => '0.0_191' [233], '0.0'
## => '0.0_192' [234], '0.0' => '0.0_193' [235], '0.0' => '0.0_194' [236], ## '0.0' => '0.0_195' [237], '0.0'
=> '0.0_196' [238], '0.0' =>
## '0.0_197' [239], '0.0' => '0.0_198' [240], '0.0' => '0.0_199' [241], '0.0'
## => '0.0_200' [242], '0.0' => '0.0_201' [243], '0.0' => '0.0_202' [244],
## '0.0' => '0.0_203' [245], '0.0' => '0.0_204' [246], '0.0' =>
## '0.0_205' [247], '0.0' => '0.0_206' [248], '0.0' => '0.0_207' [249], '0.0'
## => '0.0_208' [250], '0.0' => '0.0_209' [251], '0.0' => '0.0_210' [252],
## '0.0' => '0.0_211' [253], '0.0' => '0.0_212' [254], '0.0' =>
## '0.0_213' [255], '0.0' => '0.0_214' [256], '0.0' => '0.0_215' [257], '0.0'
## => '0.0_216' [258], '0.0' => '0.0_217' [259], '0.0' => '0.0_218' [260],
## '0.0' => '0.0_219' [261], '0.0' => '0.0_220' [262], '0.0' =>
## '0.0_221' [263], '0.0' => '0.0_222' [264], '0.0' => '0.0_223' [265], '0.0'
## => '0.0_224' [266], '0.0' => '0.0_225' [268], '0.0' => '0.0_226' [269],
## '0.0' => '0.0_227' [270], '0.0' => '0.0_228' [271], '0.0' =>
## '0.0_229' [272], '1.0' => '1.0_1' [273], '0.0' => '0.0 _230' [274], '0.0'  =
>
## '0.0_231' [275], '0.0' => '0.0_232' [276], '0.0' => '0.0_233' [277], '0.0'
## => '0.0_234' [278], '0.0' => '0.0_235' [279], '0.0' => '0.0_236' [280], ## '1.0' => '1.0_2' [281]

## Parsed with column specification:
## cols(
##   .default = col_double() ## )

## See spec(...) for full column specifications.
```

View(blogData_train)

```r
  # retrieve filenames of test sets
  test_filenames = list.files(pattern = "blogData_test")

  # load and combine dataset     train =
fread("blogData_train.csv")
  test = foreach(i = 1:length(test_filenames), .combine = rbind) %do% {     temp =
fread(test_filenames[i], header = F)    }

  # log-transform     train[, V281 := log(1 +
V281)]    test[, V281 := log(1 + V281)]
```

```r
# drop continous variables without variation
drop = c(8, 13, 28, 33, 38, 40,
43, 50, 278)
```

```r
  train[,
(drop)        :=
NULL]    test[,
(drop)        :=
NULL]
```

row.names = F) row.names = F)

```r
  #      write      to     files
write.csv(train,  "BlogFeedback-
Train.csv",        write.csv(test,
"BlogFeedback-Test.csv", train
```

04423

```
##          V1     V2 V3  V4 V5
V6      V7 V9 V10     V11
##    1: 40.30467 53.84566  0
401 15 15.52416 32.44188 377
3 14.04423
##    2: 40.30467 53.84566  0
401 15 15.52416 32.44188 377
3 14.
```

0000

```
##    3: 40.30467 53.84566  0
401 15 15.52416 32.44188 377
3 14.04423
```

56757 48.47518   0 378 12 1.479934 46.18691

```
##    4: 40.30467 53.84566  0
401 15 15.52416 32.44188 377
3 14.04423
```

9934 46.18691

```
##    5: 40.30467 53.84566  0 401
15  15.52416 32.44188  377     3
14.04423 ##   ---
## 52393: 33.00000  0.00000 33
33 33 11.00000 15.55635  33   0
11.00000
```

33 33 33 0.000000 26.94439

```
## 52394: 33.00000  0.00000 33
33 33 11.00000 15.55635  33   0
11.00000  ##  52395:    0.00000
0.00000 0  0 0 0.00000 0.00000
0  0 0.0
```

0   0 0.000000 0.00000

```
## 52396:  0.00000  0.00000  0
0 0 0.00000 0.00000  0 0
0.00000
```

0
0
0
0
0

```
## 52397:  0.00000  0.00000  0
0 0 0.00000 0.00000  0 0
0.00000
```

0

0 0.6666667 0.9428091   2   0

```
##         V12 V14 V15     V16
V17 V18 V19 V20     V21     V22
##    1: 32.61542 377   2 34.
```

0 0.02293202

```
##    2: 32.61542 377  2
34.56757 48.47518  0 378 12
1.479934 46.18691
##    3: 32.61542 377  2
34.56757 48.47518  0 378 12
1.479934 46.18691
##    4: 32.61542 377  2
34.56757 48.47518  0 378 12
1.47
##   5: 32.61542 377  2 34.56757
48.47518   0 378  12 1.479934
46.18691    ##              --
## 52393: 15.55635    33     0
33.00000  0.00000  33  33  33
0.000000 26.94439
## 52394: 15.55635 33  0
33.00000 0.00000
## 52395: 0.00000  0  0
0.00000 0.00000  0  0  0
0.000000 0.00000
## 52396: 0.00000  0  0
0.00000 0.00000  0  0  0
0.000000 0.00000
## 52397: 0.00000  0  0 0.00000
0.00000  0
##      V23 V24 V25    V26
V27 V29 V30    V31    V32 V34
V35
##    1: -356 377   0 1.076167
1.795416 11  0 0.4004914
1.0780969  9
##    2: -356 377   0 1.076167
1.795416 11  0 0.4004914
1.0780969  9
##    3: -356 377   0 1.076167
1.795416 11  0 0.4004914
1.0780969  9
##     4: -356 377    0 1.076167
1.795416   11     0  0.4004914
1.0780969  9  ##    5: -356 377
0  1.076167  1.795416   11    0
0.4004914 1.0780969  9  ##  --
-
## 52393: -33  33   0 0.000000
0.000000  0  0 0.0000000
0.0000000  0
```

```
## 52394: -33  33  0 0.000000
0.000000  0  0 0.0000000
0.0000000  0
## 52395:   0   0   0 2.000000
0.000000  2  2
## 52396:   0  0  0 2.000000
0.000000  2  2 0.6666667
0.9428091  2  0
## 52397:   0  0  0 2.000000
0.000000  2  2 0.6666667
0.9428091  2  0
##         V36     V37 V39
V41    V42 V44 V45     V46
##   1: 0.3775594 1.0742100  9
0.972973 1.704671  10
##   2: 0.3775594 1.0742100  9
0.972973 1.704671  10   0
0.02293202
##   3: 0.3775594 1.0742100  9
0.972973 1.704671  10   0
0.02293202
```

```
##   4: 0.3775594 1.0742100   9 0.972973 1.704671  10   0 0.02293202
```

```
##     5: 0.3775594 1.0742100   9 0.972973 1.704671  10   0 0.02293202
##     ---
## 52393: 0.0000000 0.0000000   0 0.000000 0.000000   0   0 0.00000000
## 52394: 0.0000000 0.0000000   0 0.000000 0.000000   0   0 0.00000000
## 52395: 0.6666667 0.9428091   2 2.000000 0.000000   2   2 0.00000000
## 52396: 0.6666667 0.9428091   2 2.000000 0.000000   2   2 0.00000000
## 52397: 0.6666667 0.9428091   2 2.000000 0.000000   2   2 0.00000000
##          V47 V48 V49 V51 V52 V53 V54 V55 V56 V57 V58 V59 V60 V61  V62
##     1: 1.521174  -8   9   2   2   0   2   2   0   0   0   0   0 10   0
##     2: 1.521174  -8   9   6   2   4   5  -2   0   0   0   0   0 35   0
##     3: 1.521174  -8   9   6   2   4   5  -2   0   0   0   0   0 35   0
##     4: 1.521174  -8   9   2   2   0   2   2   0   0   0   0   0 10   0
##     5: 1.521174  -8   9   3   1   2   2  -1   0   0   0   0   0 34   0
##     ---
## 52393: 0.000000   0   0  33   0  33  33 -33   0   0   0   0   0 38 3137
## 52394: 0.000000   0   0  33   0   0  33   0   0   0   0   0   0 62 3137
## 52395: 1.632993  -2   2   0   0   0   0   0   2   2   0   2   2 13   0
## 52396: 1.632993  -2   2   0   0   0   0   0   2   0   2   2  -2 37   0
## 52397: 1.632993  -2   2   0   0   0   0   0   2   0   0   2   0 61   0
##     V63 V64 V65 V66 V67 V68 V69 V70 V71 V72 V73 V74 V75 V76 V77 V78 V79
##     1: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     2: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     3: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     4: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     5: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     ---
## 52393:  0   1   0   0   0   0   1   0   0   0   0   0   0   0   0   0   0
## 52394:  0   1   0   0   0   0   1   0   0   0   0   0   0   0   0   0   0
## 52395:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     V80 V81 V82 V83 V84 V85 V86 V87 V88 V89 V90 V91 V92 V93 V94 V95 V96
##     1: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     2: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     3: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     4: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     5: 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##     ---
## 52393:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52394:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52395:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
```

```
## 52397:  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##      V97 V98 V99 V100 V101 V102 V103 V104 V105 V106 V107 V108 V109 V110
##   1:  0  0  0   0   0   0   0   0   0   0   0   0   0   0
##   2:  0  0  0   0   0   0   0   0   0   0   0   0   0   0
##   3:  0  0  0   0   0   0   0   0   0   0   0   0   0   0
##   4:  0  0  0   0   0   0   0   0   0   0   0   0   0   0
##   5:  0  0  0   0   0   0   0   0   0   0   0   0   0   0
```

```
##    ---
## 52393: 0  0  0  0  1  0  0  0  0  0  0  0  0  0
## 52394: 0  0  0  0  1  0  0  0  0  0  0  0  0  0
## 52395: 0  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52396: 0  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52397: 0  0  0  0  0  0  0  0  0  0  0  0  0  0
##     V111 V112 V113 V114 V115 V116 V117 V118 V119 V120 V121 V122 V123
## 1:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 3:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 4:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 5:   0    0    0    0    0    0    0    0    0    0    0    0    0
##    ---
## 52393: 0  0  0  0  0  0  0  0  0  0  0  1  0
## 52394: 0  0  0  0  0  0  0  0  0  0  0  1  0
## 52395: 0  0  0  0  0  0  0  0  0  0  0  0  0
## 52396: 0  0  0  0  0  0  0  0  0  0  0  0  0
## 52397: 0  0  0  0  0  0  0  0  0  0  0  0  0
##     V124 V125 V126 V127 V128 V129 V130 V131 V132 V133 V134 V135 V136
## 1:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 3:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 4:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 5:   0    0    0    0    0    0    0    0    0    0    0    0    0
##    ---
## 52393: 0  0  0  0  0  0  0  0  0  0  0  0  0
## 52394: 0  0  0  0  0  0  0  0  0  0  0  0  0
## 52395: 0  0  0  0  0  0  0  0  0  0  0  0  0
## 52396: 0  0  0  0  0  0  0  0  0  0  0  0  0
## 52397: 0  0  0  0  0  0  0  0  0  0  0  0  0
##     V137 V138 V139 V140 V141 V142 V143 V144 V145 V146 V147 V148 V149
## 1:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 3:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 4:   0    0    0    0    0    0    0    0    0    0    0    0    0
## 5:   0    0    0    0    0    0    0    0    0    0    0    0    0
##    ---
## 52393: 0  1  0  0  0  0  1  0  0  0  0  0  0
## 52394: 0  1  0  0  0  0  1  0  0  0  0  0  0
## 52395: 0  0  0  0  0  0  0  0  0  0  0  0  0
```

```
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0
##      V150 V151 V152 V153 V154 V155 V156 V157 V158 V159 V160 V161 V162
## 1:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 2:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 3:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 4:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 5:    0   0   0   0   0   0   0   0   0   0   0   0   0
##    ---
## 52393:   0   0   0   0   0   0   0   0   0   0   0   0   0 ## 52394:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52395:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0
##      V163 V164 V165 V166 V167 V168 V169 V170 V171 V172 V173 V174 V175
## 1:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 2:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 3:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 4:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 5:    0   0   0   0   0   0   0   0   0   0   0   0   0
##    ---
## 52393:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52394:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52395:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0
##      V176 V177 V178 V179 V180 V181 V182 V183 V184 V185 V186 V187 V188
## 1:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 2:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 3:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 4:    0   0   0   0   0   0   0   0   0   0   0   0   0
## 5:    0   0   0   0   0   0   0   0   0   0   0   0   0
##    ---
## 52393:   0   0   0   0   0   1   0   0   0   0   0   0   0
## 52394:   0   0   0   0   0   1   0   0   0   0   0   0   0
## 52395:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0
##      V189 V190 V191 V192 V193 V194 V195 V196 V197 V198 V199 V200 V201
## 1:    0   0   0   0   0   0   0   0   0   0   0   0   0
```

```
##    2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    3:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 52393:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52394:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52395:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52396:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52397:  0  0  0  0  0  0  0  0  0  0  0  0  0
##       V202 V203 V204 V205 V206 V207 V208 V209 V210 V211 V212 V213 V214
##    1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    3:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 52393:  0  0  0  0  0  0  0  0  0  0  0  1  0
## 52394:  0  0  0  0  0  0  0  0  0  0  0  1  0
## 52395:  0  0  0  0  0  0  0  0  0  0  0  0  0 ## 52396:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52397:  0  0  0  0  0  0  0  0  0  0  0  0  0
##       V215 V216 V217 V218 V219 V220 V221 V222 V223 V224 V225 V226 V227
##    1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    3:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 52393:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52394:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52395:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52396:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 52397:  0  0  0  0  0  0  0  0  0  0  0  0  0
##       V228 V229 V230 V231 V232 V233 V234 V235 V236 V237 V238 V239 V240
##    1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    3:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    5:  0  0  0  0  0  0  0  0  0  0  0  0  0
```

```
##     ---
## 52393:   1   0   0   0   1   0   0   0   0   0   0   0   0
## 52394:   1   0   0   0   1   0   0   0   0   0   0   0   0
## 52395:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0
##      V241 V242 V243 V244 V245 V246 V247 V248 V249 V250 V251 V252 V253
##    1:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    2:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    3:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    4:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    5:   0   0   0   0   0   0   0   0   0   0   0   0   0
##     ---
## 52393:   0   0   0   0   0   1   0   0   0   0   0   0   0
## 52394:   0   0   0   0   0   1   0   0   0   0   0   0   0
## 52395:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0
##      V254 V255 V256 V257 V258 V259 V260 V261 V262 V263 V264 V265 V266
##    1:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    2:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    3:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    4:   0   0   0   0   0   0   0   0   0   0   0   0   0
##    5:   0   0   0   0   0   0   0   0   0   0   0   0   0
##     ---
## 52393:   0   0   0   0   0   0   0   0   0   0   0   1   0
## 52394:   0   0   0   0   0   0   0   0   0   0   0   0   1
## 52395:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52396:   0   0   0   0   0   0   0   0   0   0   0   0   0
## 52397:   0   0   0   0   0   0   0   0   0   0   0   0   0 ##      V267 V268 V269 V270 V271 V272 V273 V274 V275 V276 V277 V279 V280
##    1:   1   0   0   0   0   0   1   0   0   0   0   0   0
##    2:   1   0   0   0   0   1   0   0   0   0   0   0   0
##    3:   1   0   0   0   0   1   0   0   0   0   0   0   0
##    4:   1   0   0   0   0   0   1   0   0   0   0   0   0
##    5:   0   1   0   0   0   0   1   0   0   0   0   0   0
##     ---
## 52393:   0   0   0   1   0   0   0   0   0   0   0   0   0
## 52394:   0   0   0   1   0   0   0   0   0   0   0   0   0
## 52395:   1   0   0   0   0   0   1   0   0   0   0   0   0
```

```
## 52396:   0   1   0   0   0   0   1   0   0   0   0   0   0 ## 52397:   0   0   1   0   0   0   1   0   0   0
0   0   0
##         V281
##    1: 0.6931472
##    2: 0.0000000
##    3: 0.0000000
##    4: 0.6931472
##    5: 3.3322045
##    ---
## 52393: 0.0000000
## 52394: 0.0000000
## 52395: 0.0000000
## 52396: 0.0000000 ##
52397: 0.0000000 test

##         V1        V2 V3  V4   V5        V6       V7 V9 V10
##    1: 10.630660 17.882992  1 259  5.0  4.0182760 10.39679 235 1.0
##    2: 43.435825 75.590485  0 634 20.0 15.9985895 44.56087 473 2.0
##    3:  1.733333  3.043390  0   9  0.0  0.7333333  1.52607   5 0.0
##    4: 27.230215 45.970950  0 371 14.0 10.7841730 24.20994 228 4.0
##    5:  4.500000  6.677075  0  18  0.5  3.0000000  4.00000  10 0.5
##    ---
## 7620: 0.000000   0.000000  0   0  0.0  0.0000000  0.00000   0 0.0
## 7621: 56.512093 77.442830  0 438 32.0 19.2965300 49.22134 432 0.0
## 7622: 49.442368 112.620125  1 849  9.0 20.4454820 62.61939 506 2.0
## 7623: 16.593575 19.671364  1 144 10.0  6.5124497 11.05121 111 2.0
## 7624: 0.000000   0.000000  0   0  0.0  0.0000000  0.00000   0 0.0
##         V11       V12 V14 V15      V16       V17 V18 V19  V20
##    1:  3.8172395 10.297346 235   1  9.776869 16.073494   1 192  5.0
##    2: 15.4696760 44.685085 473   1 40.971790 70.307840   0 479 18.0
##    3:  0.6666667  1.534782   5   0  1.133333  1.820867   0   5 0.0
##    4:  9.9976015 24.400290 228   2 22.563549 39.761290   0 337 10.0
##    5:  1.3333334  2.560382   7   0  2.833333  3.670453   0   8 0.5
##    ---
## 7620: 0.0000000  0.000000   0   0  0.000000  0.000000   0   0 0.0
## 7621: 18.9663500 49.304424 432   0 55.904312 76.864080   0 438 31.0
## 7622: 19.2211840 62.536453 506   1 38.274143 85.508520   1 574  7.0
## 7623:  5.8257027 11.001102 111   1 13.765462 15.641400   1 112  9.0
## 7624: 0.0000000  0.000000   0   0  0.000000  0.000000   0   0 0.0
##         V21        V22  V23 V24 V25      V26       V27 V29 V30
##    1: 0.20103656 13.948867 -229 217 0.0 0.25177306 0.9038038  14   0
##    2: 0.52891400 62.134968 -461 473 0.0 0.19322990 0.4576994   2   0
```

```
##    3: 0.06666667  1.730767   -5   4 0.0 0.33333334 0.6992059   2   0
##    4: 0.78657070 30.358133 -156 228 0.0 0.11031175 0.3562584   2   0
##    5: 1.66666660  2.211083    0   6 0.5 0.00000000 0.0000000   0   0
##   ---
## 7620: 0.00000000  0.000000    0   0 0.0 0.00000000 0.0000000   0   0
## 7621: 0.33017877 72.227750 -426 432 0.0 0.00000000 0.0000000   0   0
## 7622: 1.22429910 78.975365 -474 506 0.0 1.07476640 2.2341206  16   0
## 7623: 0.68674700 14.777326 -104 111 0.0 0.01526104 0.1350592   2   0
## 7624: 0.00000000  0.000000    0   0 0.0 0.00000000 0.0000000   0   0
##            V31        V32 V34 V35        V36        V37 V39        V41
##    1: 0.09438080 0.50673160  12   0 0.09192581 0.50421600  12 0.23349700
##    2: 0.07334273 0.28647503   2   0 0.06770099 0.27788836   2 0.17630465
##    3: 0.13333334 0.33993465   1   0 0.13333334 0.33993465   1 0.20000000
##    4: 0.04316547 0.21470532   2   0 0.04076739 0.20952702   2 0.09832134
##    5: 0.00000000 0.00000000   0   0 0.00000000 0.00000000   0 0.00000000
##   ---
## 7620: 0.00000000 0.00000000   0   0 0.00000000 0.00000000   0 0.00000000
## 7621: 0.00000000 0.00000000   0   0 0.00000000 0.00000000   0 0.00000000
## 7622: 0.42679128 1.34016500  13   0 0.40809968 1.33201530  13 0.95015574
## 7623: 0.00562249 0.08483692   2   0 0.00562249 0.08483692   2 0.01526104
## 7624: 0.00000000 0.00000000   0   0 0.00000000 0.00000000   0 0.00000000
##           V42 V44 V45         V46       V47 V48 V49 V51 V52 V53 V54 V55
##    1: 0.8547111  13   0 0.002454992 0.6747285 -10  12  35  35   0  35  35
##    2: 0.4297832   2   0 0.005641749 0.4044489  -2   2  21   0   2  21  -2
##    3: 0.4000000   1   0 0.000000000 0.3651484  -1   1   2   2   0   2   2
##    4: 0.3210027   2   0 0.002398082 0.2897018  -2   2   3   3   0   3   3
##    5: 0.0000000   0   0 0.000000000 0.0000000   0   0   0   0   0   0   0
##   ---
## 7620: 0.0000000   0   0 0.000000000 0.0000000   0   0   1   1   0   0   1
## 7621: 0.0000000   0   0 0.000000000 0.0000000   0   0   2   1   1   1   0
## 7622: 1.9263725  14   0 0.018691588 1.7894533 -11  13   3   1   0   2   1
## 7623: 0.1350592   2   0 0.000000000 0.1202407  -2   2   8   8   0   8   8
## 7624: 0.0000000   0   0 0.000000000 0.0000000   0   0   1   1   0   1   1
##      V56 V57 V58 V59 V60 V61  V62 V63 V64 V65 V66 V67 V68 V69 V70 V71 V72
##    1:  0   0   0   0   0   9    0   0   0   0   0   0   0   0   0   0   0
##    2:  0   0   0   0   0  62  696   0   0   0   0   0   1   0   0   0   0
##    3:  2   2   0   2   2  13 8361   0   1   0   0   1   1   1   0   0   0
##    4:  0   0   0   0   0   9 2751   0   0   0   0   0   0   0   0   0   0
##    5:  0   0   0   0   0   5  187   0   0   0   0   0   0   0   0   0   0
##   ---
```

```
## 7620:  0  0  0  0  0 64 1478  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  0 47 4196  0  0  0  0  0  0  0  0  0  0  0
## 7622:  0  0  0  0  0 63   0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0 14   0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  9   0  0  0  0  0  0  0  0  0  0  0  0
##      V73 V74 V75 V76 V77 V78 V79 V80 V81 V82 V83 V84 V85 V86 V87 V88 V89 ##   1:  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0
##   2: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##   3: 0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
##   4: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##   5: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 7620: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621: 0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0
## 7622: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624: 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##      V90 V91 V92 V93 V94 V95 V96 V97 V98 V99 V100 V101 V102 V103 V104
##   1: 0  0  0  0  0  0  0  0  0  0  0   0   0   0   0
##   2: 0  0  0  0  0  0  0  0  0  0  0   1   0   0   0
##   3: 0  0  0  0  0  0  1  0  0  0  0   1   1   0   0
##   4: 0  0  0  0  0  0  0  0  0  0  0   1   0   0   0
##   5: 0  0  0  0  0  0  0  0  0  0  0   0   0   0   0
##   ---
## 7620: 0  0  0  0  0  0  0  0  0  0  0   0   0   0   0
## 7621: 0  0  0  0  0  0  0  0  0  0  0   0   0   1   0
## 7622: 0  0  0  0  0  0  0  0  0  0  0   0   0   0   0
## 7623: 0  0  0  0  0  0  0  0  0  0  0   0   0   0   0
## 7624: 0  0  0  0  0  0  0  0  0  0  0   0   0   0   0
##      V105 V106 V107 V108 V109 V110 V111 V112 V113 V114 V115 V116 V117
##   1: 0   0   0   0   0   0   0   0   0   0   0   0   0
##   2: 0   0   0   0   0   0   0   0   0   0   0   0   0
##   3: 0   0   0   0   0   0   0   0   0   0   0   0   0
##   4: 0   0   0   0   0   0   0   0   0   0   0   0   0
##   5: 0   0   0   0   0   0   0   0   0   0   0   0   0
##   ---
## 7620: 0   0   0   0   0   0   0   0   0   0   0   0   0
## 7621: 0   0   0   0   0   0   0   0   0   0   0   0   0
## 7622: 0   0   0   0   0   0   0   0   0   0   0   0   0
## 7623: 0   0   0   0   0   0   0   0   0   0   0   0   0
```

```
## 7624:   0  0  0  0  0  0  0  0  0  0  0  0  0
##      V118 V119 V120 V121 V122 V123 V124 V125 V126 V127 V128 V129 V130
## 1:    0   0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0   0    0    0    0    0    0    0    0    0    0    0    0
## 3:    0   0    1    0    1    0    0    0    0    0    0    0    0
## 4:    0   1    0    0    1    0    0    0    0    0    0    0    0
## 5:    0   0    0    0    0    0    0    0    0    0    0    0    0
##   ---
## 7620:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:   0  0  1  0  0  0  0  0  0  0  0  0  0
## 7622:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:   0  0  0  0  0  0  0  0  0  0  0  0  0
##      V131 V132 V133 V134 V135 V136 V137 V138 V139 V140 V141 V142 V143
## 1:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0    0    0    0    0    0    0    0    1    0    0    0    0
## 3:    0    0    0    0    0    0    0    0    0    0    0    0    1
## 4:    0    0    0    0    0    0    0    0    0    0    0    0    1
## 5:    0    0    0    0    0    0    0    0    0    0    0    0    1
##   ---
## 7620:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:   0  0  0  0  0  0  0  0  1  0  0  0  1
## 7622:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:   0  0  0  0  0  0  0  0  0  0  0  0  0
##      V144 V145 V146 V147 V148 V149 V150 V151 V152 V153 V154 V155 V156
## 1:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0    0    0    0    0    0    0    1    0    0    0    0    0
## 3:    0    0    0    0    0    0    0    1    0    1    0    0    0
## 4:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5:    0    0    0    0    0    0    0    0    0    0    0    0    0
##   ---
## 7620:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7622:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:   0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:   0  0  0  0  0  0  0  0  0  0  0  0  0
##      V157 V158 V159 V160 V161 V162 V163 V164 V165 V166 V167 V168 V169
## 1:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0    0    0    0    0    0    0    0    0    0    0    0    0
```

```
##   3:  0  1  1  0  0  0  0  0  0  0  0  0  0
##   4:  0  1  0  0  0  0  0  0  0  0  0  0  0
##   5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  1  0  0  0  0  0  0  0  0  0  0  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##      V170 V171 V172 V173 V174 V175 V176 V177 V178 V179 V180 V181 V182
##   1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   3:  1  0  0  0  0  0  0  0  0  0  1  1  0
##   4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##      V183 V184 V185 V186 V187 V188 V189 V190 V191 V192 V193 V194 V195
##   1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   3:  0  0  0  0  0  0  0  0  1  0  0  0  0
##   4:  0  0  0  0  0  0  0  0  0  0  0  0  0 ##   5:  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  0  0  0  0  0  0  1  1  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##      V196 V197 V198 V199 V200 V201 V202 V203 V204 V205 V206 V207 V208
##   1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   3:  0  0  0  0  0  0  1  0  0  0  0  1  0
##   4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
```

```
## 7621:  0  1  0  0  0  0  1  0  0  0  0  0  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##     V209 V210 V211 V212 V213 V214 V215 V216 V217 V218 V219 V220 V221
## 1:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3:    0    1    0    0    1    0    0    0    0    0    0    0    0
## 4:    0    0    0    0    1    0    0    0    0    0    0    0    0
## 5:    0    0    0    0    0    0    0    0    0    0    0    0    0
##  ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  1  0  0  0  0  0  0  0  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##     V222 V223 V224 V225 V226 V227 V228 V229 V230 V231 V232 V233 V234
## 1:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0    0    0    0    1    0    0    0    0    0    1    0    0
## 3:    0    0    0    0    1    0    1    0    0    0    1    0    0
## 4:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5:    0    0    0    0    0    0    0    0    0    0    0    0    0
##  ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  0  0  0  0  1  0  1  0  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##     V235 V236 V237 V238 V239 V240 V241 V242 V243 V244 V245 V246 V247
## 1:    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2:    0    0    0    0    0    0    0    0    0    0    0    1    0
## 3:    0    0    0    0    0    0    0    0    0    0    0    1    0
## 4:    0    0    0    0    0    0    0    0    0    0    0    1    1
## 5:    0    0    0    0    0    0    0    0    0    0    0    1    0
##  ---                                              ## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  0  0  0  0  0  0  0  1  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##     V248 V249 V250 V251 V252 V253 V254 V255 V256 V257 V258 V259 V260
```

```
##    1:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    2:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    3:  1  0  0  0  0  0  1  0  0  0  0  0  0
##    4:  0  0  0  0  0  0  0  0  0  0  0  0  0
##    5:  0  0  0  0  0  0  0  0  0  0  0  0  0
##   ---
## 7620:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7621:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7622:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7623:  0  0  0  0  0  0  0  0  0  0  0  0  0
## 7624:  0  0  0  0  0  0  0  0  0  0  0  0  0
##      V261 V262 V263 V264 V265 V266 V267 V268 V269 V270 V271 V272 V273
##    1:  0   0    0    0    1    0    0    0    0    0    1    0    0
##    2:  0   0    0    0    1    0    0    0    0    0    0    0    0
##    3:  0   0    0    0    1    0    0    0    0    0    1    0    0
##    4:  0   0    0    0    1    0    0    0    0    0    1    0    0
##    5:  0   0    0    0    1    0    0    0    0    0    1    0    0
##   ---
## 7620:  0   0    0    0    0    0    0    1    0    0    0    1    0
## 7621:  0   0    0    0    0    0    0    1    0    0    0    0    1
## 7622:  0   0    0    0    0    0    0    1    0    0    0    1    0
## 7623:  0   0    0    0    0    0    0    1    0    0    0    0    0  ## 7624:  0   0    0    0    0    0    0    1    0    0    0    0    0
##      V274 V275 V276 V277 V279 V280     V281
##    1:  0   0    0    0    0    0 1.6094379
##    2:  0   0    1    0    0    0 0.0000000
##    3:  0   0    0    0    0    0 0.6931472
##    4:  0   0    0    0    0    0 1.7917595
##    5:  0   0    0    0    0    0 0.0000000
##   ---
## 7620:  0   0    0    0    0    0 0.0000000
## 7621:  0   0    0    0    0    0 0.0000000
## 7622:  0   0    0    0    0    0 0.0000000
## 7623:  1   0    0    0    0    0 1.3862944
## 7624:  1   0    0    0    0    0 0.0000000
```

Basic Models ### library(data.table)
library(MatrixModels)

library(e1071) library(FNN)
library(glmnet)

```
## Loading required package: Matrix

## Loaded glmnet 2.0-16

library(ranger) library(xgboost)

# load and combine dataset
train = fread("BlogFeedback-Train.csv") test =
fread("BlogFeedback-Test.csv")

# error measure
mse = function(y_hat, y) {   mse =
mean((y - y_hat)^2)
    return(mse)
}

# create design matrices
train_x = model.Matrix(V281 ~ . - 1, data = train, sparse = F) train_x_sparse = model.Matrix(V281 ~ . -
1, data = train, sparse = T) train_y = train$V281

test_x = model.Matrix(V281 ~ . - 1, data = test, sparse = F) test_y = test$V281

train_xgb = xgb.DMatrix(data = as.matrix(train_x), label = train_y) test_xgb = xgb.DMatrix(data =
as.matrix(test_x), label = test_y)

# try kNN
pred_knn = knn.reg(train_x, test_x, train_y, k = 19)$pred mse(pred_knn, test_y)

## [1] 0.6383154

# try LASSO
mdl_lasso = cv.glmnet(train_x_sparse, train_y, family = "gaussian", alpha = 1
)
pred_lasso = predict(mdl_lasso, newx = test_x) mse(pred_lasso, test_y)

## [1] 0.6365795

# try random forest
mdl_rf = ranger(V281 ~ ., data = train, num.trees = 1000, mtry = 120, write.f orest = T)

## Growing trees.. Progress: 3%. Estimated remaining time: 21 minutes, 27 sec onds.
## Growing trees.. Progress: 5%. Estimated remaining time: 19 minutes, 39 sec onds.
## Growing trees.. Progress: 8%. Estimated remaining time: 18 minutes, 54 sec
onds.
## Growing trees.. Progress: 11%. Estimated remaining time: 18 minutes, 7 sec onds.
## Growing trees.. Progress: 14%. Estimated remaining time: 17 minutes, 19 se conds.
## Growing trees.. Progress: 17%. Estimated remaining time: 16 minutes, 36 se conds.
```

```
## Growing trees.. Progress: 19%. Estimated remaining time: 16 minutes, 1 sec onds.
## Growing trees.. Progress: 22%. Estimated remaining time: 15 minutes, 27 se conds.
## Growing trees.. Progress: 25%. Estimated remaining time: 14 minutes, 51  se conds.
## Growing trees.. Progress: 28%. Estimated remaining time: 14 minutes, 17 se conds.
## Growing trees.. Progress: 30%. Estimated remaining time: 13 minutes, 41 se conds.
## Growing trees.. Progress: 33%. Estimated remaining time: 13 minutes, 8 sec onds.
## Growing trees.. Progress: 36%. Estimated remaining time: 12 minutes, 35 se conds.
## Growing trees.. Progress: 39%. Estimated remaining time: 12 minutes, 2 sec onds.
## Growing trees.. Progress: 42%. Estimated remaining time: 11 minutes, 29 se conds.
## Growing trees.. Progress: 44%. Estimated remaining time: 10 minutes, 57 se conds.
## Growing trees.. Progress: 47%. Estimated remaining time: 10 minutes, 25 se conds.
## Growing trees.. Progress: 49%. Estimated remaining time: 10 minutes, 4 sec onds.
## Growing trees.. Progress: 52%. Estimated remaining time: 9 minutes, 45 sec onds.
## Growing trees.. Progress: 54%. Estimated remaining time: 9 minutes, 19 sec onds.
## Growing trees.. Progress: 57%. Estimated remaining time: 8 minutes, 44 sec onds.
## Growing trees.. Progress: 59%. Estimated remaining time: 8 minutes, 11 sec onds.
## Growing trees.. Progress: 62%. Estimated remaining time: 7 minutes, 41 sec onds.
## Growing trees.. Progress: 65%. Estimated remaining time: 7 minutes, 7 seco nds.
## Growing trees.. Progress: 67%. Estimated remaining time: 6 minutes, 39 sec onds.
## Growing trees.. Progress: 70%. Estimated remaining time: 6 minutes, 11 sec onds.
## Growing trees.. Progress: 72%. Estimated remaining time: 5 minutes, 38 sec
onds.
## Growing trees.. Progress: 75%. Estimated remaining time: 5 minutes, 3 seco
nds.
## Growing trees.. Progress: 78%. Estimated remaining time: 4 minutes, 29 sec onds.
## Growing trees.. Progress: 80%. Estimated remaining time: 3 minutes, 59 sec onds.
## Growing trees.. Progress: 83%. Estimated remaining time: 3 minutes, 26 sec onds.
## Growing trees.. Progress: 86%. Estimated remaining time: 2 minutes, 52 sec onds.
## Growing trees.. Progress: 89%. Estimated remaining time: 2 minutes, 18 sec onds.
## Growing trees.. Progress: 91%. Estimated remaining time: 1 minute, 44 seco nds.
## Growing trees.. Progress: 94%. Estimated remaining time: 1 minute, 10 seco nds.
## Growing trees.. Progress: 97%. Estimated remaining time: 36 seconds. ## Growing trees..
Progress: 100%. Estimated remaining time: 2 seconds.

pred_rf = predict(mdl_rf, test) mse(pred_rf$predictions, test_y)

## [1] 0.397223

# try SVM
mdl_svm = svm(V281 ~ V52 + V55 + V61 + V51 + V54 + V21 + V6 + V10, data = tra in, kernel = "radial",
cost = 2, gamma = 0.25) pred_svm = predict(mdl_svm, test) mse(pred_svm, test_y)
```

```
## [1] 0.4454636
```

```
# try XGboost
mdl_xgb = xgboost(data = train_xgb, nround = 750, nthread = 4, max_depth = 6, eta = 0.025, subsample = 0.7, gamma = 3)
```

```
## [1]  train-rmse:1.123211
## [2]  train-rmse:1.105587
## [3]  train-rmse:1.088751
## [4]  train-rmse:1.072364
## [5]  train-rmse:1.056541
## [6]  train-rmse:1.041299
## [7]  train-rmse:1.026474
## [8]  train-rmse:1.012151
## [9]  train-rmse:0.998236
## [10] train-rmse:0.984944
## [11] train-rmse:0.972046
## [12] train-rmse:0.959660
## [13] train-rmse:0.947695
## [14] train-rmse:0.936049
## [15] train-rmse:0.924799
```

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## [16] train-rmse:0.913825
## [17] train-rmse:0.903303
## [18] train-rmse:0.893156
## [19] train-rmse:0.883414
## [20] train-rmse:0.874059
## [21] train-rmse:0.865047
## [22] train-rmse:0.856306
## [23] train-rmse:0.848055
## [24] train-rmse:0.840064
## [25] train-rmse:0.832164
## [26] train-rmse:0.824686
## [27] train-rmse:0.817432
## [28] train-rmse:0.810481
## [29] train-rmse:0.803617
## [30] train-rmse:0.797115
## [31] train-rmse:0.790814
## [32] train-rmse:0.784595
## [33] train-rmse:0.778755
## [34] train-rmse:0.773094
## [35] train-rmse:0.767748
## [36] train-rmse:0.762395
## [37] train-rmse:0.757345
## [38] train-rmse:0.752488
## [39] train-rmse:0.747817
## [40] train-rmse:0.743399
## [41] train-rmse:0.739041
## [42] train-rmse:0.734814
```

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## [43] train-rmse:0.730827
## [44] train-rmse:0.726892
## [45] train-rmse:0.723121
## [46] train-rmse:0.719583
## [47] train-rmse:0.716088
## [48] train-rmse:0.712764
## [49] train-rmse:0.709580
## [50] train-rmse:0.706472
## [51] train-rmse:0.703511
## [52] train-rmse:0.700691
## [53] train-rmse:0.697894
## [54] train-rmse:0.695273
## [55] train-rmse:0.692620
## [56] train-rmse:0.690116
## [57] train-rmse:0.687650
## [58] train-rmse:0.685264
## [59] train-rmse:0.683066
## [60] train-rmse:0.680842
## [61] train-rmse:0.678713
## [62] train-rmse:0.676759
## [63] train-rmse:0.674839
## [64] train-rmse:0.672873
## [65] train-rmse:0.671013  ## [66] train-
rmse:0.669334
## [67] train-rmse:0.667636
## [68] train-rmse:0.665990
## [69] train-rmse:0.664497
```

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## [70] train-rmse:0.662978
## [71] train-rmse:0.661438
## [72] train-rmse:0.659984
## [73] train-rmse:0.658645
## [74] train-rmse:0.657361
## [75] train-rmse:0.656081
## [76] train-rmse:0.654839
## [77] train-rmse:0.653571
## [78] train-rmse:0.652382
## [79] train-rmse:0.651310
## [80] train-rmse:0.650165
## [81] train-rmse:0.649082
## [82] train-rmse:0.647973
## [83] train-rmse:0.646989
## [84] train-rmse:0.645910
## [85] train-rmse:0.644910
## [86] train-rmse:0.643895
## [87] train-rmse:0.642963
## [88] train-rmse:0.642045
## [89] train-rmse:0.641064
## [90] train-rmse:0.640266
## [91] train-rmse:0.639491
## [92] train-rmse:0.638624
## [93] train-rmse:0.637817
## [94] train-rmse:0.636958
## [95] train-rmse:0.636172
## [96] train-rmse:0.635401
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[97] train-rmse:0.634687
[98] train-rmse:0.633978
[99] train-rmse:0.633370
[100]   train-rmse:0.632676
[101]   train-rmse:0.632104
[102]   train-rmse:0.631501
[103]   train-rmse:0.630874
[104]   train-rmse:0.630224
[105]   train-rmse:0.629601
[106]   train-rmse:0.628939
[107]   train-rmse:0.628386
[108]   train-rmse:0.627850
[109]   train-rmse:0.627310
[110]   train   rmse:0.626764
[111]   train   rmse:0.626267
[112]   train   rmse:0.625726
[113]   train   rmse:0.625219
[114]   train   rmse:0.624769
[115]   train   rmse:0.624165 ## [116]
train-rmse:0.623743
[117]   train-rmse:0.623251
[118]   train-rmse:0.622832
[119]   train-rmse:0.622405
[120]   train-rmse:0.621988
[121]   train-rmse:0.621555
[122]   train-rmse:0.621146
[123]   train-rmse:0.620705

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## [124]    train-rmse:0.620241
## [125]    train-rmse:0.619832
## [126]    train-rmse:0.619472
## [127]    train-rmse:0.619107
## [128]    train-rmse:0.618744
## [129]    train-rmse:0.618414
## [130]    train-rmse:0.618085
## [131]    train-rmse:0.617714
## [132]    train-rmse:0.617314
## [133]    train-rmse:0.616918
## [134]    train-rmse:0.616511
## [135]    train-rmse:0.616181
## [136]    train-rmse:0.615858
## [137]    train-rmse:0.615557
## [138]    train-rmse:0.615228
## [139]    train-rmse:0.614889
## [140]    train-rmse:0.614607
## [141]    train-rmse:0.614281
## [142]    train-rmse:0.613947
## [143]    train-rmse:0.613651
## [144]    train-rmse:0.613283
## [145]    train-rmse:0.612968
## [146]    train-rmse:0.612614
## [147]    train-rmse:0.612378
## [148]    train-rmse:0.612145
## [149]    train-rmse:0.611861
## [150]    train-rmse:0.611578
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[151]   train-rmse:0.611311
[152]   train-rmse:0.611049
[153]   train-rmse:0.610834
[154]   train-rmse:0.610536
[155]   train-rmse:0.610197
[156]   train-rmse:0.609999
[157]   train-rmse:0.609664
[158]   train-rmse:0.609409
[159]   train-rmse:0.609206
[160]   train-rmse:0.608919
[161]   train-rmse:0.608690 ## [162]
train-rmse:0.608475 ## [163]   train-rmse:0.608148
[164]   train rmse:0.607911
[165]   train rmse:0.607605

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## [166]    train rmse:0.607276
## [167]    train rmse:0.607037
## [168]    train rmse:0.606763
## [169]    train rmse:0.606605 ## [170]
train-rmse:0.606398 ## [171]        train-
rmse:0.606151
## [172]    train-rmse:0.605972
## [173]    train-rmse:0.605751
## [174]    train-rmse:0.605503
## [175]    train-rmse:0.605364
## [176]    train-rmse:0.605119
## [177]    train-rmse:0.604999
## [178]    train-rmse:0.604829
## [179]    train-rmse:0.604616
## [180]    train-rmse:0.604328
## [181]    train-rmse:0.604144
## [182]    train-rmse:0.603980
## [183]    train-rmse:0.603702
## [184]    train-rmse:0.603520
## [185]    train-rmse:0.603301
## [186]    train-rmse:0.603089
## [187]    train-rmse:0.602896
## [188]    train-rmse:0.602779
## [189]    train-rmse:0.602619
## [190]    train-rmse:0.602334
## [191]    train-rmse:0.602113
## [192]    train-rmse:0.601964
## [193]    train-rmse:0.601723
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[194]   train-rmse:0.601552
[195]   train-rmse:0.601356
[196]   train-rmse:0.601204
[197]   train-rmse:0.601073
[198]   train-rmse:0.600908
[199]   train-rmse:0.600630
[200]   train-rmse:0.600489
[201]   train-rmse:0.600313
[202]   train-rmse:0.600121
[203]   train-rmse:0.599887
[204]   train-rmse:0.599679
[205]   train-rmse:0.599521
[206]   train-rmse:0.599354
[207]   train-rmse:0.599247
[208]   train-rmse:0.599107
[209]   train-rmse:0.598965
[210]   train rmse:0.598744
[211]   train rmse:0.598487
[212]   train rmse:0.598296
[213]   train rmse:0.598070
[214]   train rmse:0.597886
[215]   train rmse:0.597762 ## [216]
train rmse:0.597645
[217]   train rmse:0.597460
[218]   train rmse:0.597303
[219]   train rmse:0.597139
[220]   train rmse:0.596993

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[221]   train-rmse:0.596816
[222]   train-rmse:0.596681
[223]   train-rmse:0.596480
[224]   train-rmse:0.596426
[225]   train-rmse:0.596275
[226]   train-rmse:0.596172
[227]   train-rmse:0.595988
[228]   train-rmse:0.595882
[229]   train-rmse:0.595630
[230]   train-rmse:0.595542
[231]   train-rmse:0.595425
[232]   train-rmse:0.595331
[233]   train-rmse:0.595270
[234]   train-rmse:0.595097
[235]   train-rmse:0.594997
[236]   train-rmse:0.594835
[237]   train-rmse:0.594682
[238]   train-rmse:0.594490
[239]   train-rmse:0.594297
[240]   train-rmse:0.594169
[241]   train-rmse:0.594046
[242]   train-rmse:0.593920
[243]   train-rmse:0.593817
[244]   train-rmse:0.593687
[245]   train-rmse:0.593586
[246]   train-rmse:0.593454
[247]   train-rmse:0.593321

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## [248]   train-rmse:0.593222
## [249]   train-rmse:0.593181
## [250]   train-rmse:0.592997
## [251]   train-rmse:0.592903
## [252]   train-rmse:0.592765
## [253]   train-rmse:0.592608
## [254]   train-rmse:0.592558
## [255]   train-rmse:0.592379
## [256]   train-rmse:0.592238
## [257]   train-rmse:0.592165
## [258]   train-rmse:0.592014
## [259]   train-rmse:0.591937
## [260]   train-rmse:0.591843
## [261]   train-rmse:0.591645
## [262]   train-rmse:0.591610 ## [263]
train-rmse:0.591453  ## [264]        train
rmse:0.591344
## [265]   train rmse:0.591215 ## [266]
train   rmse:0.591102
## [267]   train   rmse:0.590949
## [268]   train   rmse:0.590880
## [269]   train   rmse:0.590764
## [270]   train   rmse:0.590543
## [271]   train-rmse:0.590363
## [272]   train-rmse:0.590315
## [273]   train-rmse:0.590080
## [274]   train-rmse:0.590054
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```
## [275]   train-rmse:0.589934
## [276]   train-rmse:0.589857
## [277]   train-rmse:0.589768
## [278]   train-rmse:0.589655
## [279]   train-rmse:0.589459
## [280]   train-rmse:0.589386
## [281]   train-rmse:0.589320
## [282]   train-rmse:0.589181
## [283]   train-rmse:0.589132
## [284]   train-rmse:0.589030
## [285]   train-rmse:0.588961
## [286]   train-rmse:0.588802
## [287]   train-rmse:0.588653
## [288]   train-rmse:0.588475
## [289]   train-rmse:0.588426
## [290]   train-rmse:0.588306
## [291]   train-rmse:0.588197
## [292]   train-rmse:0.588082
## [293]   train-rmse:0.588006
## [294]   train-rmse:0.587925
## [295]   train-rmse:0.587716
## [296]   train-rmse:0.587591
## [297]   train-rmse:0.587550
## [298]   train-rmse:0.587409
## [299]   train-rmse:0.587306
## [300]   train-rmse:0.587163
## [301]   train-rmse:0.587017
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[302]   train-rmse:0.586815
[303]   train-rmse:0.586702
[304]   train-rmse:0.586673
[305]   train-rmse:0.586496
[306]   train-rmse:0.586417
[307]   train-rmse:0.586257
[308]   train rmse:0.586121
[309]   train rmse:0.586019
[310]   train rmse:0.585898
[311]   train rmse:0.585771
[312]   train rmse:0.585720
[313]   train rmse:0.585694
[314]   train rmse:0.585623
[315]   train rmse:0.585546

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[316]   train   rmse:0.585434
[317]   train   rmse:0.585341
[318]   train   rmse:0.585197
[319]   train   rmse:0.585064
[320]   train   rmse:0.584906
[321]   train-rmse:0.584764
[322]   train-rmse:0.584669
[323]   train-rmse:0.584574
[324]   train-rmse:0.584480
[325]   train-rmse:0.584352
[326]   train-rmse:0.584258
[327]   train-rmse:0.584143
[328]   train-rmse:0.584022
[329]   train-rmse:0.583946
[330]   train-rmse:0.583865
[331]   train-rmse:0.583774
[332]   train-rmse:0.583719
[333]   train-rmse:0.583699
[334]   train-rmse:0.583626
[335]   train-rmse:0.583604
[336]   train-rmse:0.583479
[337]   train-rmse:0.583429
[338]   train-rmse:0.583309
[339]   train-rmse:0.583219
[340]   train-rmse:0.583077
[341]   train-rmse:0.583017
[342]   train-rmse:0.582943

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[343]   train-rmse:0.582840
[344]   train-rmse:0.582736
[345]   train-rmse:0.582674
[346]   train-rmse:0.582566
[347]   train-rmse:0.582422
[348]   train-rmse:0.582391
[349]   train-rmse:0.582216
[350]   train-rmse:0.582118
[351]   train-rmse:0.581957
[352]   train-rmse:0.581898
[353]   train-rmse:0.581815
[354]   train-rmse:0.581705
[355]   train-rmse:0.581627
[356]   train-rmse:0.581525
[357]   train-rmse:0.581373
[358]   train rmse:0.581311
[359]   train rmse:0.581221
[360]   train rmse:0.581165
[361]   train rmse:0.581068
[362]   train rmse:0.580975
[363]   train-rmse:0.580781
[364]   train rmse:0.580692
[365]   train rmse:0.580597 ## [366]
train rmse:0.580532
[367]   train rmse:0.580456
[368]   train rmse:0.580359
[369]   train rmse:0.580331

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## [370]   train   rmse:0.580254
## [371]   train   rmse:0.580146
## [372]   train-rmse:0.580111
## [373]   train-rmse:0.580012
## [374]   train-rmse:0.579900
## [375]   train-rmse:0.579844
## [376]   train-rmse:0.579720
## [377]   train-rmse:0.579586
## [378]   train-rmse:0.579516
## [379]   train-rmse:0.579450
## [380]   train-rmse:0.579348
## [381]   train-rmse:0.579222
## [382]   train-rmse:0.579168
## [383]   train-rmse:0.579048
## [384]   train-rmse:0.578874
## [385]   train-rmse:0.578801
## [386]   train-rmse:0.578768
## [387]   train-rmse:0.578689
## [388]   train-rmse:0.578618
## [389]   train-rmse:0.578392
## [390]   train-rmse:0.578252
## [391]   train-rmse:0.578165
## [392]   train-rmse:0.578061
## [393]   train-rmse:0.578029
## [394]   train-rmse:0.577999
## [395]   train-rmse:0.577939
## [396]   train-rmse:0.577862
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[397]   train-rmse:0.577771
[398]   train-rmse:0.577677
[399]   train-rmse:0.577659
[400]   train-rmse:0.577577
[401]   train-rmse:0.577495
[402]   train-rmse:0.577423
[403]   train-rmse:0.577302
[404]   train-rmse:0.577277
[405]   train-rmse:0.577195
[406]   train-rmse:0.577108
[407]   train-rmse:0.576930
[408]   train rmse:0.576894
[409]   train rmse:0.576704
[410]   train rmse:0.576591
[411]   train rmse:0.576478
[412]   train rmse:0.576355
[413]   train rmse:0.576223
[414]   train rmse:0.576164
[415]   train rmse:0.576025 ## [416]
train rmse:0.575934
[417]   train rmse:0.575787 ## [418]
train-rmse:0.575667 ## [419]   train-
rmse:0.575629
[420]   train-rmse:0.575554
[421]   train-rmse:0.575457
[422]   train-rmse:0.575337
[423]   train-rmse:0.575294

```
## [424]    train-rmse:0.575159
## [425]    train-rmse:0.575129
## [426]    train-rmse:0.575080
## [427]    train-rmse:0.574957
## [428]    train-rmse:0.574844
## [429]    train-rmse:0.574693
## [430]    train-rmse:0.574661
## [431]    train-rmse:0.574566
## [432]    train-rmse:0.574498
## [433]    train-rmse:0.574464
## [434]    train-rmse:0.574339
## [435]    train-rmse:0.574178
## [436]    train-rmse:0.573983
## [437]    train-rmse:0.573906
## [438]    train-rmse:0.573833
## [439]    train-rmse:0.573796
## [440]    train-rmse:0.573760
## [441]    train-rmse:0.573682
## [442]    train-rmse:0.573672
## [443]    train-rmse:0.573636
## [444]    train-rmse:0.573617
## [445]    train-rmse:0.573511
## [446]    train-rmse:0.573419
## [447]    train-rmse:0.573375
## [448]    train-rmse:0.573367
## [449]    train-rmse:0.573174
## [450]    train-rmse:0.573073
```

```
## [451]    train-rmse:0.572968
## [452]    train-rmse:0.572944
## [453]    train-rmse:0.572868
## [454]    train-rmse:0.572804
## [455]    train-rmse:0.572663
## [456]    train-rmse:0.572548
## [457]    train-rmse:0.572497
## [458]    train-rmse:0.572488
## [459]    train-rmse:0.572454
## [460]    train-rmse:0.572387
## [461]    train-rmse:0.572279
## [462]    train-rmse:0.572225
## [463]    train-rmse:0.572164
## [464]    train-rmse:0.572049
## [465]    train-rmse:0.571998
```

```
## [466]	train	rmse:0.571910
## [467]	train	rmse:0.571850
## [468]	train	rmse:0.571795
## [469]	train	rmse:0.571724
## [470]	train	rmse:0.571706
## [471]	train	rmse:0.571653
## [472]	train	rmse:0.571525
## [473]	train	rmse:0.571452
## [474]	train-rmse:0.571361
## [475]	train-rmse:0.571296
## [476]	train-rmse:0.571231
## [477]	train-rmse:0.571131
## [478]	train-rmse:0.571033
## [479]	train-rmse:0.570871
## [480]	train-rmse:0.570778
## [481]	train-rmse:0.570702
## [482]	train-rmse:0.570683
## [483]	train-rmse:0.570646
## [484]	train-rmse:0.570574
## [485]	train-rmse:0.570507
## [486]	train-rmse:0.570464
## [487]	train-rmse:0.570412
## [488]	train-rmse:0.570293
## [489]	train-rmse:0.570253
## [490]	train-rmse:0.570198
## [491]	train-rmse:0.570159
## [492]	train-rmse:0.569999
```

[493]   train-rmse:0.569918
[494]   train-rmse:0.569878
[495]   train-rmse:0.569785
[496]   train-rmse:0.569762
[497]   train-rmse:0.569638
[498]   train-rmse:0.569563
[499]   train-rmse:0.569455
[500]   train-rmse:0.569361
[501]   train-rmse:0.569276
[502]   train-rmse:0.569145
[503]   train-rmse:0.569077
[504]   train-rmse:0.568910
[505]   train-rmse:0.568881
[506]   train-rmse:0.568771
[507]   train-rmse:0.568645
[508]   train-rmse:0.568599
[509]   train-rmse:0.568498
[510]   train-rmse:0.568325 ## [511]
train-rmse:0.568307 ## [512]   train
rmse:0.568236
[513]   train rmse:0.568184
[514]   train rmse:0.568010
[515]   train rmse:0.567941 ## [516]
train rmse:0.567885
[517]   train rmse:0.567806
[518]   train rmse:0.567749 ## [519]
train-rmse:0.567681 ## [520]   train-
rmse:0.567623

```
## [521]   train-rmse:0.567616
## [522]   train-rmse:0.567568
## [523]   train-rmse:0.567534
## [524]   train-rmse:0.567467
## [525]   train-rmse:0.567419
## [526]   train-rmse:0.567347
## [527]   train-rmse:0.567301
## [528]   train-rmse:0.567241
## [529]   train-rmse:0.567115
## [530]   train-rmse:0.566992
## [531]   train-rmse:0.566880
## [532]   train-rmse:0.566776
## [533]   train-rmse:0.566767
## [534]   train-rmse:0.566682
## [535]   train-rmse:0.566648
## [536]   train-rmse:0.566616
## [537]   train-rmse:0.566559
## [538]   train-rmse:0.566436
## [539]   train-rmse:0.566272
## [540]   train-rmse:0.566219
## [541]   train-rmse:0.566118
## [542]   train-rmse:0.566002
## [543]   train-rmse:0.565902
## [544]   train-rmse:0.565860
## [545]   train-rmse:0.565821
## [546]   train-rmse:0.565777
## [547]   train-rmse:0.565669
## [548]   train-rmse:0.565545
```

```
## [549]    train-rmse:0.565493
## [550]    train-rmse:0.565397
## [551]    train-rmse:0.565293
## [552]    train-rmse:0.565227
## [553]    train-rmse:0.565163
## [554]    train-rmse:0.565128
## [555]    train-rmse:0.565094
## [556]    train-rmse:0.565016
## [557]    train-rmse:0.564951
## [558]    train-rmse:0.564919
## [559]    train-rmse:0.564887
## [560]    train-rmse:0.564845
## [561]    train-rmse:0.564843
## [562]    train-rmse:0.564814
## [563]    train rmse:0.564748
## [564]    train rmse:0.564695
## [565]    train rmse:0.564633 ## [566]
train  rmse:0.564608
## [567]    train  rmse:0.564497
## [568]    train  rmse:0.564447
## [569]    train  rmse:0.564351
## [570]    train  rmse:0.564281
## [571]    train  rmse:0.564208
## [572]    train  rmse:0.564140
## [573]    train  rmse:0.563984
## [574]    train-rmse:0.563906
## [575]    train-rmse:0.563906
## [576]    train-rmse:0.563770
```

```
## [577]    train-rmse:0.563611
## [578]    train-rmse:0.563554
## [579]    train-rmse:0.563479
## [580]    train-rmse:0.563369
## [581]    train-rmse:0.563289
## [582]    train-rmse:0.563202
## [583]    train-rmse:0.563183
## [584]    train-rmse:0.563166
## [585]    train-rmse:0.563067
## [586]    train-rmse:0.562960
## [587]    train-rmse:0.562906
## [588]    train-rmse:0.562832
## [589]    train-rmse:0.562766
## [590]    train-rmse:0.562666
## [591]    train-rmse:0.562583
## [592]    train-rmse:0.562487
## [593]    train-rmse:0.562445
## [594]    train-rmse:0.562371
## [595]    train-rmse:0.562295
## [596]    train-rmse:0.562152
## [597]    train-rmse:0.562133
## [598]    train-rmse:0.562080
## [599]    train-rmse:0.562019
## [600]    train-rmse:0.561969
## [601]    train-rmse:0.561853
## [602]    train-rmse:0.561769
## [603]    train-rmse:0.561704
## [604]    train-rmse:0.561692
```

[605]   train-rmse:0.561538
[606]   train-rmse:0.561490
[607]   train-rmse:0.561445
[608]   train-rmse:0.561399
[609]   train-rmse:0.561362
[610]   train-rmse:0.561260
[611]   train-rmse:0.561170 ## [612]
train-rmse:0.561084 ## [613]   train
rmse:0.561050
[614]   train rmse:0.561009
[615]   train rmse:0.560896

```
## [616]    train   rmse:0.560808
## [617]    train   rmse:0.560802
## [618]    train   rmse:0.560758
## [619]    train   rmse:0.560704
## [620]    train   rmse:0.560695
## [621]    train   rmse:0.560661
## [622]    train   rmse:0.560614
## [623]    train   rmse:0.560526
## [624]    train-rmse:0.560416
## [625]    train-rmse:0.560366
## [626]    train-rmse:0.560359
## [627]    train-rmse:0.560258
## [628]    train-rmse:0.560213
## [629]    train-rmse:0.560183
## [630]    train-rmse:0.560118
## [631]    train-rmse:0.560045
## [632]    train-rmse:0.560045
## [633]    train-rmse:0.560005
## [634]    train-rmse:0.559984
## [635]    train-rmse:0.559852
## [636]    train-rmse:0.559780
## [637]    train-rmse:0.559732
## [638]    train-rmse:0.559652
## [639]    train-rmse:0.559571
## [640]    train-rmse:0.559488
## [641]    train-rmse:0.559424
## [642]    train-rmse:0.559350
```

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[643]   train-rmse:0.559271
[644]   train-rmse:0.559177
[645]   train-rmse:0.559133
[646]   train-rmse:0.559046
[647]   train-rmse:0.558994
[648]   train-rmse:0.558894
[649]   train-rmse:0.558822
[650]   train-rmse:0.558729
[651]   train-rmse:0.558702
[652]   train-rmse:0.558696
[653]   train-rmse:0.558690
[654]   train-rmse:0.558603
[655]   train-rmse:0.558501
[656]   train-rmse:0.558426
[657]   train-rmse:0.558357
[658]   train-rmse:0.558322
[659]   train-rmse:0.558279
[660]   train-rmse:0.558240
[661]   train-rmse:0.558210
[662]   train-rmse:0.558096
[663]   train rmse:0.558074
[664]   train rmse:0.557961
[665]   train rmse:0.557920 ## [666]
train   rmse:0.557846
[667]   train   rmse:0.557839
[668]   train   rmse:0.557823
[669]   train   rmse:0.557763
[670]   train   rmse:0.557678
[671]   train   rmse:0.557651
[672]   train   rmse:0.557560
[673]   train   rmse:0.557560
[674]   train-rmse:0.557556
[675]   train-rmse:0.557420
[676]   train-rmse:0.557382

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```

[677]   train-rmse:0.557361
[678]   train-rmse:0.557331
[679]   train-rmse:0.557165
[680]   train-rmse:0.557043
[681]   train-rmse:0.557010
[682]   train-rmse:0.556883
[683]   train-rmse:0.556822
[684]   train-rmse:0.556749
[685]   train-rmse:0.556685
[686]   train-rmse:0.556656
[687]   train-rmse:0.556534
[688]   train-rmse:0.556433
[689]   train-rmse:0.556387
[690]   train-rmse:0.556345
[691]   train-rmse:0.556276
[692]   train-rmse:0.556196
[693]   train-rmse:0.556129
[694]   train-rmse:0.556098
[695]   train-rmse:0.556087
[696]   train-rmse:0.556022
[697]   train-rmse:0.555907
[698]   train-rmse:0.555800
[699]   train-rmse:0.555728
[700]   train-rmse:0.555708
[701]   train-rmse:0.555664
[702]   train-rmse:0.555613
[703]   train-rmse:0.555506
[704]   train-rmse:0.555434
[705]   train-rmse:0.555411
[706]   train-rmse:0.555359
[707]   train-rmse:0.555323
[708]   train-rmse:0.555262
[709]   train-rmse:0.555186
[710]   train-rmse:0.555164

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[711]   train-rmse:0.555138
[712]   train-rmse:0.555086 ## [713]
train-rmse:0.555059 ## [714]   train
rmse:0.555029
[715]   train rmse:0.554960 ## [716]
train rmse:0.554933
[717]   train rmse:0.554918
[718]   train rmse:0.554870
[719]   train rmse:0.554847
[720]   train rmse:0.554830
[721]   train-rmse:0.554803
[722]   train-rmse:0.554764
[723]   train-rmse:0.554724
[724]   train-rmse:0.554703
[725]   train-rmse:0.554668
[726]   train-rmse:0.554668
[727]   train-rmse:0.554567
[728]   train-rmse:0.554499
[729]   train-rmse:0.554499
[730]   train-rmse:0.554475
[731]   train-rmse:0.554445
[732]   train-rmse:0.554418
[733]   train-rmse:0.554371
[734]   train-rmse:0.554298
[735]   train-rmse:0.554248
[736]   train-rmse:0.554165
[737]   train-rmse:0.554048
[738]   train-rmse:0.553964
[739]   train-rmse:0.553785
[740]   train-rmse:0.553774
[741]   train-rmse:0.553748
[742]   train-rmse:0.553698
[743]   train-rmse:0.553636
[744]   train-rmse:0.553566
[745]   train-rmse:0.553554

```
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                    -
                    -
                    -
                    -
```

```
## [746]    train-rmse:0.553521
## [747]    train-rmse:0.553512
## [748]    train-rmse:0.553420
## [749]    train-rmse:0.553361  ## [750]
train-rmse:0.553349
```

```r
pred_xgb = predict(mdl_xgb, test_xgb) mse(pred_xgb, test_y)
```

```
## [1] 0.3820247
```

```r
### Stacked Generalization ###
library(data.table) library(foreach)
library(MatrixModels)

library(e1071) library(FNN)
library(glmnet) library(ranger)
```

```r
library(xgboost)

# load and combine dataset
train = fread("BlogFeedback-Train.csv")
test = fread("BlogFeedback-Test.csv")

# error measure
mse = function(y_hat, y) {
  mse = mean((y - y_hat)^2)
  return(mse)
}

# create design matrices
test_x = model.Matrix(V281 ~ . - 1, data = test, sparse = F)
test_x_sparse = model.Matrix(V281 ~ . - 1, data = test, sparse = T)
#test_xgb = xgb.DMatrix(data = as.matrix(test_x), label = test_y)

train_y = train$V281
test_y = test$V281

# divide training set into k folds
k = 5
cv_index = 1:nrow(train)
cv_index_split = split(cv_index, cut(seq_along(cv_index), k, labels = FALSE))

# meta features from kNN
meta_knn_test = rep(0, nrow(test))
meta_knn_train = foreach(i = 1:k, .combine = c) %do% {
  # split the raining set into two disjoint sets
  train_index = setdiff(1:nrow(train), cv_index_split[[i]])
  train_set1 = model.Matrix(V281 ~ . - 1, data = train[train_index], sparse = T)
  train_set2 = model.Matrix(V281 ~ . - 1, data = train[cv_index_split[[i]]], sparse = T)

  # level 0 prediction
  meta_pred = knn.reg(train_set1, train_set2, train[train_index]$V281, k = 19)$pred
  meta_knn_test = meta_knn_test + knn.reg( train_set1, test_x_sparse, train[train_index]$ V281, k = 19)$pred / k

  return(
    meta_pred
  )
}

# meta features from LASSO
meta_knn_test = rep(0, nrow(test))
foreach(i = 1:k, .combine = c) %do% {
  # split the raining set into two disjoint sets
```

```r
  meta_glm_test =
 meta_glm_train =
```

```r
train_index = setdiff(1:nrow(train), cv_index_split[[i]])
```

```r
train_set1 = model.Matrix(V281 ~ . - 1, data = train[train_index], T)
train_set2 = model.Matrix(V281 ~ . - 1, data = sparse = T)

# level 0 prediction
temp_glm = cv.glmnet(train_set1, train[train_index]$ V281, n", alpha = 1)
meta_pred = predict(temp_glm, newx = train_set2)   meta_glm_test =
meta_glm_test + predict(temp_glm, newx =
  return(meta_pred)
}
```

```r
# meta features from SVM meta_svm_test = rep(0, nrow(test))
meta_svm_train = foreach(i = 1:k, .combine = c) %do% {   # split the raining
set into two disjoint sets   train_index = setdiff(1:nrow(train),
cv_index_split[[i]])   train_set1 = train[train_index]   train_set2 =
train[cv_index_split[[i]]]

 # level 0 prediction
 temp_svm = svm(V281 ~ V52 + V55 + V61 + V51 + V54 + V21 + train_set1,
       kernel = "radial", cost = 2, gamma = 0.25)   meta_pred =
predict(temp_svm, train_set2)
 meta_svm_test = meta_svm_test + predict(temp_svm, test) /
  return(meta_pred)
}
```

```r
# meta features from random forest meta_rf_test = rep(0, nrow(test))
meta_rf_train = foreach(i = 1:k, .combine = c) %do% {   # split the raining set
into two disjoint sets   train_index = setdiff(1:nrow(train), cv_index_split[[i]])
train_set1 = train[train_index]   train_set2 = train[cv_index_split[[i]]]

 # level 0 prediction
 temp_rf = ranger(V281 ~ ., data = train_set1, num.trees = write.forest = T)
 meta_pred = predict(temp_rf, train_set2)$predictions   meta_rf_test =
meta_rf_test + predict(temp_rf, test)$

  return(meta_pred)
```

sparse =

train[cv_index_split[[i]]],

family = "gaussia

test_x_sparse) / k

V6 + V10, data =

k

500, mtry = 120,

predictions / k

}
Growin

g trees.. Progress: 7%. Estimated remaining time: 7 minutes, 18 seco

nds. onds.

Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 33 sec

onds.
Growing trees.
onds. onds.

Growing trees.. Progress: 21%. Estimated remaining time: 5 minutes, 57 sec

onds.
Growing trees.. Progr

. Progress: 28%. Estimated remaining time: 5 minutes,

25 sec ## Growing trees.. Progress: 35%. Estimated remaining time: 4

onds. onds.

minutes, 51 sec

onds.
Growing trees..

Progress: 71 nds. nds.

Growing trees.. Progress: 43%. Estimated remaining time: 4 minutes, 18 sec

ds.

ess: 50%. Estimated remaining time: 3 minutes, 45 sec

nds. onds.
onds. onds.
onds. onds.
onds. onds.
onds. onds.
nds.

Growing trees.. Progress: 57%. Estimated remaining time: 3 minutes, 13 sec

Growing trees.. Progress: 64%. Estimated remaining time: 2 minutes, 40 sec

%. Estimated remaining time: 2

minutes, 8 seco ## Growing trees.. Progress: 79%. Estimated remaining time:

1 minute, 36 seco

Growing trees.. Progress: 86%. Estimated remaining time: 1 minute, 3 secon

Growing trees.. Progress: 93%. Estimated remaining time: 31 seconds.
Growing trees.. Progress: 7%. Estimated remaining time: 7 minutes, 18 seco

Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 33 sec

Growing trees.. Progress: 21%. Estimated remaining time: 5 minutes, 57 sec

Growing trees.. Progress: 28%. Estimated remaining time: 5 minutes, 26 sec

Growing trees.. Progress: 35%. Estimated remaining time: 4 minutes, 56 sec

Growing trees.. Progress: 41%. Estimated remaining time: 4 minutes, 31 sec

Growing trees.. Progress: 48%. Estimated remaining time: 3 minutes, 58 sec

Growing trees.. Progress: 55%. Estimated remaining time: 3 minutes, 24 sec

Growing trees.. Progress: 62%. Estimated remaining time: 2 minutes, 51 sec

Growing trees.. Progress: 70%. Estimated remaining time: 2 minutes, 18 sec

Growing trees.. Progress: 77%. Estimated remaining time: 1 minute, 46 seco

Growing trees.. Progress: 84%. Estimated remaining time: 1 minute, 13 seco nds.

Growing trees.. Progress: 91%. Estimated remaining time: 40 seconds. ## Growing trees.. Progress: 98%. Estimated remaining time: 8 seconds.
Growing trees.. Progress: 7%. Estimated remaining time: 6 minutes, 51 seco nds.
Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 20 sec onds.
Growing trees.. Progress: 21%. Estimated remaining time: 5 minutes, 45 sec onds.
Growing trees.. Progress: 29%. Estimated remaining time: 5 minutes, 9 seco nds.
Growing trees.. Progress: 36%. Estimated remaining time: 4 minutes, 39 sec onds.
Growing trees.. Progress: 43%. Estimated remaining time: 4 minutes, 8 seco nds.
Growing trees.. Progress: 51%. Estimated remaining time: 3 minutes, 34 sec onds.
Growing trees.. Progress: 58%. Estimated remaining time: 3 minutes, 3 seco nds.
Growing trees.. Progress: 65%. Estimated remaining time: 2 minutes, 33 sec onds.
Growing trees.. Progress: 71%. Estimated remaining time: 2 minutes, 5 seco nds.
Growing trees.. Progress: 78%. Estimated remaining time: 1 minute, 35 seco nds.
Growing trees.. Progress: 86%. Estimated remaining time: 1 minute, 2 secon ds.
Growing trees.. Progress: 93%. Estimated remaining time: 31 seconds.
Growing trees.. Progress: 100%. Estimated remaining time: 0 seconds.
Growing trees.. Progress: 7%. Estimated remaining time: 7 minutes, 32 seco nds.
Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 46 sec onds.
Growing trees.. Progress: 21%. Estimated remaining time: 6 minutes, 4 seco nds.
Growing trees.. Progress: 28%. Estimated remaining time: 5 minutes, 33 sec onds.
Growing trees.. Progress: 35%. Estimated remaining time: 4 minutes, 57 sec onds.
Growing trees.. Progress: 43%. Estimated remaining time: 4 minutes, 22 sec onds.
Growing trees.. Progress: 50%. Estimated remaining time: 3 minutes, 51 sec onds.
Growing trees.. Progress: 57%. Estimated remaining time: 3 minutes, 18 sec onds.
Growing trees.. Progress: 63%. Estimated remaining time: 2 minutes, 47 sec onds.
Growing trees.. Progress: 70 %. Estimated remaining time: 2 minutes, 15 sec onds.

```
## Growing trees.. Progress: 77%. Estimated remaining time: 1 minute, 44 seco nds.
## Growing trees.. Progress: 84%. Estimated remaining time: 1 minute, 14 seco nds.
## Growing trees.. Progress: 91%. Estimated remaining time: 43 seconds.
## Growing trees.. Progress: 98%. Estimated remaining time: 11 seconds.
## Growing trees.. Progress: 7%. Estimated remaining time: 7 minutes, 32 seco nds.
## Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 46 sec onds.
## Growing trees.. Progress: 20%. Estimated remaining time: 6 minutes, 19 sec onds.
## Growing trees.. Progress: 27%. Estimated remaining time: 5 minutes, 39 sec onds.
## Growing trees.. Progress: 34%. Estimated remaining time: 5 minutes, 7 seco nds.
## Growing trees.. Progress: 41%. Estimated remaining time: 4 minutes, 36 sec onds.
## Growing trees.. Progress: 48%. Estimated remaining time: 4 minutes, 1 seco nds.
## Growing trees.. Progress: 55%. Estimated remaining time: 3 minutes, 28 sec onds.
## Growing trees.. Progress: 62%. Estimated remaining time: 2 minutes, 54 sec onds.
## Growing trees.. Progress: 69%. Estimated remaining time: 2 minutes, 23 sec onds.
## Growing trees.. Progress: 76%. Estimated remaining time: 1 minute, 52 seco nds.
## Growing trees.. Progress: 83%. Estimated remaining time: 1 minute, 18 seco nds.
## Growing trees.. Progress: 90%. Estimated remaining time: 46 seconds.
## Growing trees.. Progress: 97%. Estimated remaining time: 14 seconds.

# meta features from XGBoost meta_xgb_test = rep(0,
nrow(test))
meta_xgb_train = foreach(i = 1:k, .combine = c) %do% {   # split the raining set
into two disjoint sets   train_index = setdiff(1:nrow(train), cv_index_split[[i]])
  train_set1 = model.Matrix(V281 ~ . - 1, data = train[train_index], sparse = F)
  train_set2 = model.Matrix(V281 ~ . - 1, data = train[cv_index_split[[i]]], sparse = F)

  # xgb data
  train_set1_xgb = xgb.DMatrix(data = as.matrix(train_set1), label = train[tr ain_index]$V281)
  train_set2_xgb = xgb.DMatrix(data = as.matrix(train_set2), label = train[cv _index_split[[i]]]$V281)

  # level 0 prediction
  temp_xgb = xgboost(data = train_set1_xgb, nround = 750, nthread = 4, max_d e
```

```r
pth = 6, eta = 0.025, subsample = 0.7, gamma = 3)   meta_pred =
predict(temp_xgb, train_set2_xgb)
  meta_xgb_test = meta_xgb_test + predict(temp_xgb, test_xgb) / k
    return(meta_pred)
}
```

```
## [1]  train-rmse:1.041304
## [2]  train-rmse:1.025138
## [3]  train-rmse:1.009468
## [4]  train-rmse:0.994396
## [5]  train-rmse:0.979805
## [6]  train-rmse:0.965819
## [7]  train-rmse:0.952242
## [8]  train-rmse:0.938961
## [9]  train-rmse:0.926142
## [10] train-rmse:0.913679
## [11] train-rmse:0.901632
## [12] train-rmse:0.890118
## [13] train-rmse:0.879104
## [14] train-rmse:0.868265
## [15] train-rmse:0.857938
## [16] train-rmse:0.847930
## [17] train-rmse:0.838117
## [18] train-rmse:0.828828
## [19] train-rmse:0.819844
## [20] train-rmse:0.811192
## [21] train-rmse:0.802804
## [22] train-rmse:0.794738
## [23] train-rmse:0.786939
## [24] train-rmse:0.779281
## [25] train-rmse:0.772032
## [26] train-rmse:0.765034
## [27] train-rmse:0.758150
## [28] train-rmse:0.751556
## [29] train-rmse:0.745162
## [30] train-rmse:0.738988
## [31] train-rmse:0.733033
## [32] train-rmse:0.727371
## [33] train-rmse:0.721907
## [34] train-rmse:0.716632
## [35] train-rmse:0.711528
## [36] train-rmse:0.706603
## [37] train-rmse:0.701833
## [38] train-rmse:0.697339
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## [39] train-rmse:0.692959
## [40] train-rmse:0.688686
## [41] train-rmse:0.684591
## [42] train-rmse:0.680710
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## [43] train-rmse:0.676987
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## [44] train-rmse:0.673420
## [45] train-rmse:0.669937
## [46] train-rmse:0.666470
## [47] train-rmse:0.663170
## [48] train-rmse:0.659887
## [49] train-rmse:0.656942
## [50] train-rmse:0.654029
## [51] train-rmse:0.651252
## [52] train-rmse:0.648544
## [53] train-rmse:0.645853
## [54] train-rmse:0.643262
## [55] train-rmse:0.640855
## [56] train-rmse:0.638452
## [57] train-rmse:0.636037
## [58] train-rmse:0.633881
## [59] train-rmse:0.631824
## [60] train-rmse:0.629722
## [61] train-rmse:0.627795
## [62] train-rmse:0.625924
## [63] train-rmse:0.624025
## [64] train-rmse:0.622272
## [65] train-rmse:0.620612
## [66] train-rmse:0.618893
## [67] train-rmse:0.617301
## [68] train-rmse:0.615680
## [69] train-rmse:0.614201
## [70] train-rmse:0.612790
## [71] train-rmse:0.611406
## [72] train-rmse:0.609982
## [73] train-rmse:0.608664
## [74] train-rmse:0.607451
## [75] train-rmse:0.606257
## [76] train-rmse:0.605031
## [77] train-rmse:0.603883
## [78] train-rmse:0.602673
## [79] train-rmse:0.601605
## [80] train-rmse:0.600529
## [81] train-rmse:0.599481
## [82] train-rmse:0.598504
## [83] train-rmse:0.597522
## [84] train-rmse:0.596601
## [85] train-rmse:0.595565
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## [86] train-rmse:0.594706
## [87] train-rmse:0.593736
## [88] train-rmse:0.592889
## [89] train-rmse:0.592043
## [90] train-rmse:0.591197
## [91] train-rmse:0.590398
## [92] train-rmse:0.589569
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## [93] train-rmse:0.588803
## [94] train-rmse:0.588114
## [95] train-rmse:0.587365
## [96] train-rmse:0.586666
## [97] train-rmse:0.585963
## [98] train-rmse:0.585389
## [99] train-rmse:0.584810
## [100]   train-rmse:0.584207
## [101]   train-rmse:0.583510
## [102]   train-rmse:0.582837
## [103]   train-rmse:0.582250
## [104]   train-rmse:0.581665
## [105]   train-rmse:0.581103
## [106]   train-rmse:0.580512
## [107]   train-rmse:0.579937
## [108]   train-rmse:0.579300
## [109]   train-rmse:0.578757
## [110]   train-rmse:0.578228
## [111]   train-rmse:0.577688
## [112]   train-rmse:0.577155
## [113]   train-rmse:0.576657
## [114]   train-rmse:0.576173
## [115]   train-rmse:0.575697
## [116]   train-rmse:0.575326
## [117]   train-rmse:0.574880
## [118]   train-rmse:0.574347
## [119]   train-rmse:0.573986
## [120]   train-rmse:0.573505
## [121]   train-rmse:0.573115
## [122]   train-rmse:0.572708
## [123]   train-rmse:0.572298
## [124]   train-rmse:0.571827
## [125]   train-rmse:0.571466
## [126]   train-rmse:0.571032
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## [127]    train-rmse:0.570626
## [128]    train-rmse:0.570148
## [129]    train-rmse:0.569776
## [130]    train-rmse:0.569470
## [131]    train-rmse:0.569090
## [132]    train-rmse:0.568737
## [133]    train-rmse:0.568360
## [134]    train-rmse:0.568049
## [135]    train-rmse:0.567715
## [136]    train-rmse:0.567371
## [137]    train-rmse:0.567020
## [138]    train-rmse:0.566689
## [139]    train-rmse:0.566347
## [140]    train-rmse:0.566013
## [141]    train-rmse:0.565750
## [142]    train-rmse:0.565471 ## [143]
train rmse:0.565110
## [144]    train rmse:0.564727
## [145]    train rmse:0.564471
## [146]    train-rmse:0.564225
## [147]    train-rmse:0.563932
## [148]    train-rmse:0.563577 ## [149]
train-rmse:0.563256 ## [150]    train-
rmse:0.563028
## [151]    train-rmse:0.562719
## [152]    train-rmse:0.562415
## [153]    train-rmse:0.562205
## [154]    train-rmse:0.561917
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## [155]    train-rmse:0.561658
## [156]    train-rmse:0.561369
## [157]    train-rmse:0.561143
## [158]    train-rmse:0.560925
## [159]    train-rmse:0.560655
## [160]    train-rmse:0.560424
## [161]    train-rmse:0.560131
## [162]    train-rmse:0.559763
## [163]    train-rmse:0.559522
## [164]    train-rmse:0.559328
## [165]    train-rmse:0.559075
## [166]    train-rmse:0.558931
## [167]    train-rmse:0.558620
## [168]    train-rmse:0.558413
## [169]    train-rmse:0.558190
## [170]    train-rmse:0.558079
## [171]    train-rmse:0.557883
## [172]    train-rmse:0.557693
## [173]    train-rmse:0.557473
## [174]    train-rmse:0.557158
## [175]    train-rmse:0.557041
## [176]    train-rmse:0.556877
## [177]    train-rmse:0.556647
## [178]    train-rmse:0.556519
## [179]    train-rmse:0.556265
## [180]    train-rmse:0.556113
## [181]    train-rmse:0.555914
## [182]    train-rmse:0.555580
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## [183]    train-rmse:0.555344
## [184]    train-rmse:0.555076
## [185]    train-rmse:0.554812
## [186]    train-rmse:0.554548
## [187]    train-rmse:0.554261
## [188]    train-rmse:0.554151
## [189]    train-rmse:0.553976
## [190]    train-rmse:0.553875
## [191]    train rmse:0.553720
## [192]    train rmse:0.553471 ## [193]
train rmse:0.553234
## [194]    train rmse:0.552966
## [195]    train rmse:0.552788
## [196]    train-rmse:0.552578
## [197]    train-rmse:0.552358
## [198]    train-rmse:0.552172
## [199]    train-rmse:0.552110
## [200]    train-rmse:0.551842
## [201]    train-rmse:0.551738
## [202]    train-rmse:0.551462
## [203]    train-rmse:0.551204
## [204]    train-rmse:0.551094
## [205]    train-rmse:0.550971
## [206]    train-rmse:0.550798
## [207]    train-rmse:0.550492
## [208]    train-rmse:0.550343
## [209]    train-rmse:0.550230
## [210]    train-rmse:0.549997
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## [211]   train-rmse:0.549829
## [212]   train-rmse:0.549615
## [213]   train-rmse:0.549500
## [214]   train-rmse:0.549288
## [215]   train-rmse:0.549072
## [216]   train-rmse:0.548910
## [217]   train-rmse:0.548705
## [218]   train-rmse:0.548536
## [219]   train-rmse:0.548396
## [220]   train-rmse:0.548258
## [221]   train-rmse:0.548169
## [222]   train-rmse:0.547988
## [223]   train-rmse:0.547903
## [224]   train-rmse:0.547728
## [225]   train-rmse:0.547590
## [226]   train-rmse:0.547446
## [227]   train-rmse:0.547378
## [228]   train-rmse:0.547210
## [229]   train-rmse:0.547029
## [230]   train-rmse:0.546962
## [231]   train-rmse:0.546850
## [232]   train-rmse:0.546792
## [233]   train-rmse:0.546601
## [234]   train-rmse:0.546404
## [235]   train-rmse:0.546226
## [236]   train-rmse:0.546130
## [237]   train-rmse:0.546053
## [238]   train-rmse:0.545856
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## [239]   train-rmse:0.545750
## [240]   train-rmse:0.545608
## [241]   train-rmse:0.545456 ## [242]
train-rmse:0.545295 ## [243]   train
rmse:0.545172
## [244]   train rmse:0.545072
## [245]   train rmse:0.545016
## [246]   train-rmse:0.544894
## [247]   train-rmse:0.544784
## [248]   train-rmse:0.544686
## [249]     train-rmse:0.544635 ## [250]
train-rmse:0.544475
## [251]   train-rmse:0.544194
## [252]   train-rmse:0.544027
## [253]   train-rmse:0.543878
## [254]   train-rmse:0.543809
## [255]   train-rmse:0.543664
## [256]   train-rmse:0.543567
## [257]   train-rmse:0.543361
## [258]   train-rmse:0.543193
## [259]   train-rmse:0.543054
## [260]   train-rmse:0.542987
## [261]   train-rmse:0.542866
## [262]   train-rmse:0.542677
## [263]   train-rmse:0.542582
## [264]   train-rmse:0.542403
## [265]   train-rmse:0.542232
## [266]   train-rmse:0.542173
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## [267]    train-rmse:0.541937
## [268]    train-rmse:0.541883
## [269]    train-rmse:0.541779
## [270]    train-rmse:0.541598
## [271]    train-rmse:0.541383
## [272]    train-rmse:0.541218
## [273]    train-rmse:0.541059
## [274]    train-rmse:0.540888
## [275]    train-rmse:0.540766
## [276]    train-rmse:0.540668
## [277]    train-rmse:0.540529
## [278]    train-rmse:0.540385
## [279]    train-rmse:0.540367
## [280]    train-rmse:0.540215
## [281]    train-rmse:0.540161
## [282]    train-rmse:0.540049
## [283]    train-rmse:0.539990
## [284]    train-rmse:0.539913
## [285]    train-rmse:0.539810
## [286]    train-rmse:0.539741
## [287]    train-rmse:0.539622
## [288]    train-rmse:0.539567
## [289]    train-rmse:0.539459
## [290]    train-rmse:0.539335
## [291]    train rmse:0.539175
## [292]    train rmse:0.539105
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[293]   train   rmse:0.539012
[294]   train   rmse:0.538840
[295]   train   rmse:0.538675
[296]   train   rmse:0.538570
[297]   train   rmse:0.538447
[298]   train-rmse:0.538242
[299]   train-rmse:0.538105
[300]   train-rmse:0.538015
[301]   train-rmse:0.537866
[302]   train-rmse:0.537726
[303]   train-rmse:0.537668
[304]   train-rmse:0.537553
[305]   train-rmse:0.537456
[306]   train-rmse:0.537315
[307]   train-rmse:0.537206
[308]   train-rmse:0.537166
[309]   train-rmse:0.537135
[310]   train-rmse:0.537108
[311]   train-rmse:0.537037
[312]   train-rmse:0.536979
[313]   train-rmse:0.536822
[314]   train-rmse:0.536725
[315]   train-rmse:0.536663
[316]   train-rmse:0.536589
[317]   train-rmse:0.536527
[318]   train-rmse:0.536472
[319]   train-rmse:0.536401

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[320]   train-rmse:0.536269
[321]   train-rmse:0.536194
[322]   train-rmse:0.536043
[323]   train-rmse:0.535924
[324]   train-rmse:0.535859
[325]   train-rmse:0.535809
[326]   train-rmse:0.535725
[327]   train-rmse:0.535662
[328]   train-rmse:0.535554
[329]   train-rmse:0.535509
[330]   train-rmse:0.535261
[331]   train-rmse:0.535185
[332]   train-rmse:0.535105
[333]   train-rmse:0.535044
[334]   train-rmse:0.534862
[335]   train-rmse:0.534779 ## [336]
train-rmse:0.534729
[337]   train-rmse:0.534579
[338]   train   rmse:0.534524
[339]   train   rmse:0.534406
[340]   train   rmse:0.534304
[341]   train   rmse:0.534275
[342]   train   rmse:0.534205 ## [343]
train-rmse:0.534108 ## [344]   train-
rmse:0.533977
[345]   train-rmse:0.533888
[346]   train-rmse:0.533726

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## [347]	train-rmse:0.533637
## [348]	train-rmse:0.533508
## [349]	train-rmse:0.533356
## [350]	train-rmse:0.533283
## [351]	train-rmse:0.533232
## [352]	train-rmse:0.533087
## [353]	train-rmse:0.532931
## [354]	train-rmse:0.532860
## [355]	train-rmse:0.532825
## [356]	train-rmse:0.532754
## [357]	train-rmse:0.532637
## [358]	train-rmse:0.532562
## [359]	train-rmse:0.532501
## [360]	train-rmse:0.532393
## [361]	train-rmse:0.532259
## [362]	train-rmse:0.532086
## [363]	train-rmse:0.532029
## [364]	train-rmse:0.531969
## [365]	train-rmse:0.531899
## [366]	train-rmse:0.531771
## [367]	train-rmse:0.531737
## [368]	train-rmse:0.531640
## [369]	train-rmse:0.531543
## [370]	train-rmse:0.531421
## [371]	train-rmse:0.531401
## [372]	train-rmse:0.531305
## [373]	train-rmse:0.531256

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[374]   train-rmse:0.531139
[375]   train-rmse:0.531038
[376]   train-rmse:0.530934
[377]   train-rmse:0.530827
[378]   train-rmse:0.530780
[379]   train-rmse:0.530714
[380]   train-rmse:0.530560
[381]   train-rmse:0.530478
[382]   train-rmse:0.530281
[383]   train-rmse:0.530255
[384]   train-rmse:0.530220
[385]   train-rmse:0.530057
[386]   train-rmse:0.530001
[387]   train-rmse:0.529904
[388]   train-rmse:0.529832
[389]   train-rmse:0.529662
[390]   train-rmse:0.529565
[391]   train rmse:0.529415
[392]   train rmse:0.529348 ## [393]
train rmse:0.529241
[394]   train rmse:0.529125
[395]   train rmse:0.529058
[396]   train rmse:0.529045
[397]   train rmse:0.528920
[398]   train-rmse:0.528892
[399]   train-rmse:0.528801
[400]   train-rmse:0.528714

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[401]   train-rmse:0.528664
[402]   train-rmse:0.528589
[403]   train-rmse:0.528589
[404]   train-rmse:0.528506
[405]   train-rmse:0.528437
[406]   train-rmse:0.528384
[407]   train-rmse:0.528274
[408]   train-rmse:0.528144
[409]   train-rmse:0.528095
[410]   train-rmse:0.528030
[411]   train-rmse:0.527959
[412]   train-rmse:0.527942
[413]   train-rmse:0.527872
[414]   train-rmse:0.527831
[415]   train-rmse:0.527705
[416]   train-rmse:0.527641
[417]   train-rmse:0.527542
[418]   train-rmse:0.527478
[419]   train-rmse:0.527297
[420]   train-rmse:0.527206
[421]   train-rmse:0.527083
[422]   train-rmse:0.526983
[423]   train-rmse:0.526937
[424]   train-rmse:0.526904
[425]   train-rmse:0.526877
[426]   train-rmse:0.526735
[427]   train-rmse:0.526630

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[428]   train-rmse:0.526603
[429]   train-rmse:0.526575
[430]   train-rmse:0.526427
[431]   train-rmse:0.526319
[432]   train-rmse:0.526265
[433]   train-rmse:0.526157
[434]   train-rmse:0.526103
[435]   train-rmse:0.526045 ## [436]

train-rmse:0.525971 ## [437]   train-rmse:0.525805

[438]   train rmse:0.525745
[439]   train rmse:0.525713
[440]   train rmse:0.525679
[441]   train rmse:0.525602
[442]   train rmse:0.525544

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## [443]    train rmse:0.525538
## [444]    train rmse:0.525366
## [445]    train-rmse:0.525323
## [446]    train rmse:0.525207
## [447]    train rmse:0.525075
## [448]    train-rmse:0.524969
## [449]    train-rmse:0.524840
## [450]    train-rmse:0.524700
## [451]    train-rmse:0.524546
## [452]    train-rmse:0.524527
## [453]    train-rmse:0.524466
## [454]    train-rmse:0.524395
## [455]    train-rmse:0.524353
## [456]    train-rmse:0.524317
## [457]    train-rmse:0.524219
## [458]    train-rmse:0.524105
## [459]    train-rmse:0.524032
## [460]    train-rmse:0.523972
## [461]    train-rmse:0.523788
## [462]    train-rmse:0.523741
## [463]    train-rmse:0.523625
## [464]    train-rmse:0.523515
## [465]    train-rmse:0.523477
## [466]    train-rmse:0.523384
## [467]    train-rmse:0.523384
## [468]    train-rmse:0.523275
## [469]    train-rmse:0.523177
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[470]   train-rmse:0.523073
[471]   train-rmse:0.523048
[472]   train-rmse:0.522883
[473]   train-rmse:0.522737
[474]   train-rmse:0.522737
[475]   train-rmse:0.522672
[476]   train-rmse:0.522620
[477]   train-rmse:0.522606
[478]   train-rmse:0.522598
[479]   train-rmse:0.522494
[480]   train-rmse:0.522376
[481]   train-rmse:0.522242
[482]   train-rmse:0.522212
[483]   train-rmse:0.522166
[484]   train-rmse:0.522080
[485]   train-rmse:0.521946
[486]   train-rmse:0.521882
[487]   train-rmse:0.521882
[488]   train   rmse:0.521756
[489]   train   rmse:0.521684
[490]   train   rmse:0.521632
[491]   train   rmse:0.521562
[492]   train   rmse:0.521542 ## [493]
train   rmse:0.521492
[494]   train   rmse:0.521456
[495]   train   rmse:0.521371
[496]   train   rmse:0.521219

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[497]   train   rmse:0.521085 ## [498]
train-rmse:0.521021 ## [499]   train-
rmse:0.520894
[500]   train-rmse:0.520772
[501]   train-rmse:0.520682
[502]   train-rmse:0.520642
[503]   train-rmse:0.520623
[504]   train-rmse:0.520483
[505]   train-rmse:0.520362
[506]   train-rmse:0.520312
[507]   train-rmse:0.520220
[508]   train-rmse:0.520161
[509]   train-rmse:0.520091
[510]   train-rmse:0.520018
[511]   train-rmse:0.519946
[512]   train-rmse:0.519911
[513]   train-rmse:0.519829
[514]   train-rmse:0.519650
[515]   train-rmse:0.519525
[516]   train-rmse:0.519468
[517]   train-rmse:0.519401
[518]   train-rmse:0.519322
[519]   train-rmse:0.519210
[520]   train-rmse:0.519134
[521]   train-rmse:0.519042
[522]   train-rmse:0.519023
[523]   train-rmse:0.518987

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[524]   train-rmse:0.518961
[525]   train-rmse:0.518899
[526]   train-rmse:0.518874
[527]   train-rmse:0.518793
[528]   train-rmse:0.518700
[529]   train-rmse:0.518542
[530]   train-rmse:0.518507
[531]   train-rmse:0.518498
[532]   train-rmse:0.518377
[533]   train-rmse:0.518353
[534]   train-rmse:0.518274
[535]   train-rmse:0.518217
[536]   train-rmse:0.518193 ## [537]
train-rmse:0.518095 ## [538]   train
rmse:0.518062
[539]   train   rmse:0.517943
[540]   train   rmse:0.517914
[541]   train   rmse:0.517869
[542]   train   rmse:0.517835 ## [543]
train rmse:0.517786
[544]   train rmse:0.517702
[545]   train-rmse:0.517572
[546]   train-rmse:0.517520
[547]   train-rmse:0.517446
[548]   train-rmse:0.517410
[549]   train-rmse:0.517338
[550]   train-rmse:0.517228

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## [551]   train-rmse:0.517167
## [552]   train-rmse:0.517134
## [553]   train-rmse:0.517093
## [554]   train-rmse:0.516976
## [555]   train-rmse:0.516958
## [556]   train-rmse:0.516905
## [557]   train-rmse:0.516895
## [558]   train-rmse:0.516835
## [559]   train-rmse:0.516794
## [560]   train-rmse:0.516785
## [561]   train-rmse:0.516743
## [562]   train-rmse:0.516733
## [563]   train-rmse:0.516618
## [564]   train-rmse:0.516607
## [565]   train-rmse:0.516546
## [566]   train-rmse:0.516471
## [567]   train-rmse:0.516443
## [568]   train-rmse:0.516326
## [569]   train-rmse:0.516241
## [570]   train-rmse:0.516157
## [571]   train-rmse:0.516139
## [572]   train-rmse:0.516059
## [573]   train-rmse:0.516010
## [574]   train-rmse:0.515970
## [575]   train-rmse:0.515895
## [576]   train-rmse:0.515834
## [577]   train-rmse:0.515825
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[578]   train-rmse:0.515799
[579]   train-rmse:0.515701
[580]   train-rmse:0.515621
[581]   train-rmse:0.515568
[582]   train-rmse:0.515568
[583]   train-rmse:0.515436
[584]   train-rmse:0.515373
[585]   train-rmse:0.515331
[586]   train-rmse:0.515327
[587]   train-rmse:0.515218
[588]   train-rmse:0.515218
[589]   train-rmse:0.515176
[590]   train-rmse:0.515078 ## [591]
train-rmse:0.515046 ## [592]   train
rmse:0.514971

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[593]   train   rmse:0.514860
[594]   train   rmse:0.514784
[595]   train   rmse:0.514743
[596]   train   rmse:0.514696
[597]   train   rmse:0.514635
[598]   train-rmse:0.514617 ## [599] train-rmse:0.514499 ## [600]   train-rmse:0.514453
[601]   train-rmse:0.514417
[602]   train-rmse:0.514308
[603]   train-rmse:0.514194
[604]   train-rmse:0.514179
[605]   train-rmse:0.514074
[606]   train-rmse:0.514009
[607]   train-rmse:0.513919
[608]   train-rmse:0.513816
[609]   train-rmse:0.513780
[610]   train-rmse:0.513780
[611]   train-rmse:0.513703
[612]   train-rmse:0.513658
[613]   train-rmse:0.513564
[614]   train-rmse:0.513517
[615]   train-rmse:0.513476
[616]   train-rmse:0.513404
[617]   train-rmse:0.513222
[618]   train-rmse:0.513183
[619]   train-rmse:0.513102

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## [620]   train-rmse:0.512933
## [621]   train-rmse:0.512933
## [622]   train-rmse:0.512848
## [623]   train-rmse:0.512837
## [624]   train-rmse:0.512802
## [625]   train-rmse:0.512709
## [626]   train-rmse:0.512696
## [627]   train-rmse:0.512672
## [628]   train-rmse:0.512658
## [629]   train-rmse:0.512510
## [630]   train-rmse:0.512435
## [631]   train-rmse:0.512364
## [632]   train-rmse:0.512345
## [633]   train-rmse:0.512316
## [634]   train-rmse:0.512251
## [635]   train-rmse:0.512251
## [636]   train-rmse:0.512178
## [637]   train-rmse:0.512131
## [638]   train-rmse:0.512071
## [639]   train rmse:0.511981
## [640]   train rmse:0.511927
## [641]   train-rmse:0.511892
## [642]    train rmse:0.511886 ## [643]
train rmse:0.511861
## [644]   train rmse:0.511850
## [645]   train rmse:0.511715
## [646]   train-rmse:0.511659
## [647]   train-rmse:0.511559
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## [648]   train-rmse:0.511507
## [649]   train-rmse:0.511484
## [650]   train-rmse:0.511469
## [651]   train-rmse:0.511443
## [652]   train-rmse:0.511398
## [653]   train-rmse:0.511364
## [654]   train-rmse:0.511206
## [655]   train-rmse:0.511145
## [656]   train-rmse:0.511134
## [657]   train-rmse:0.510977
## [658]   train-rmse:0.510924
## [659]   train-rmse:0.510831
## [660]   train-rmse:0.510734
## [661]   train-rmse:0.510636
## [662]   train-rmse:0.510594
## [663]   train-rmse:0.510564
## [664]   train-rmse:0.510535
## [665]   train-rmse:0.510487
## [666]   train-rmse:0.510472
## [667]   train-rmse:0.510439
## [668]   train-rmse:0.510420
## [669]   train-rmse:0.510347
## [670]   train-rmse:0.510285
## [671]   train-rmse:0.510209
## [672]   train-rmse:0.510100
## [673]   train-rmse:0.510012
## [674]   train-rmse:0.509960
## [675]   train-rmse:0.509853
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## [676]    train-rmse:0.509787
## [677]    train-rmse:0.509784
## [678]    train-rmse:0.509725
## [679]    train-rmse:0.509626
## [680]    train-rmse:0.509525
## [681]    train-rmse:0.509511
## [682]    train-rmse:0.509473
## [683]    train-rmse:0.509462
## [684]    train-rmse:0.509397
## [685]    train-rmse:0.509331
## [686]    train-rmse:0.509287
## [687]    train-rmse:0.509240
## [688]    train-rmse:0.509240
## [689]    train-rmse:0.509241
## [690]    train-rmse:0.509241
## [691]    train-rmse:0.509233 ## [692]
train-rmse:0.509101 ## [693]    train
rmse:0.509019
## [694]    train rmse:0.508969
## [695]    train rmse:0.508927
## [696]    train-rmse:0.508863
## [697]    train-rmse:0.508793
## [698]    train-rmse:0.508683
## [699]    train-rmse:0.508611
## [700]    train-rmse:0.508580
## [701]    train-rmse:0.508503
## [702]    train-rmse:0.508467
## [703]    train-rmse:0.508455
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## [704]   train-rmse:0.508417
## [705]   train-rmse:0.508367
## [706]   train-rmse:0.508236
## [707]   train-rmse:0.508236
## [708]   train-rmse:0.508152
## [709]   train-rmse:0.508153
## [710]   train-rmse:0.508111
## [711]   train-rmse:0.508102
## [712]   train-rmse:0.508087
## [713]   train-rmse:0.508076
## [714]   train-rmse:0.508050
## [715]   train-rmse:0.507983
## [716]   train-rmse:0.507953
## [717]   train-rmse:0.507909
## [718]   train-rmse:0.507897
## [719]   train-rmse:0.507844
## [720]   train-rmse:0.507746
## [721]   train-rmse:0.507729
## [722]   train-rmse:0.507676
## [723]   train-rmse:0.507573
## [724]   train-rmse:0.507507
## [725]   train-rmse:0.507489
## [726]   train-rmse:0.507400
## [727]   train-rmse:0.507384
## [728]   train-rmse:0.507354
## [729]   train-rmse:0.507345
## [730]   train-rmse:0.507282
## [731]   train-rmse:0.507270
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## [732]    train-rmse:0.507222
## [733]    train-rmse:0.507192
## [734]    train-rmse:0.507161
## [735]    train-rmse:0.507111
## [736]    train-rmse:0.507017
## [737]    train-rmse:0.506940
## [738]    train-rmse:0.506906
## [739]    train-rmse:0.506854
## [740]    train-rmse:0.506829
## [741]    train-rmse:0.506806
## [742]     train-rmse:0.506789 ## [743]
train rmse:0.506742
## [744]    train rmse:0.506670
## [745]    train rmse:0.506581
## [746]    train-rmse:0.506581
## [747]    train-rmse:0.506509
## [748]    train-rmse:0.506468
## [749]    train-rmse:0.506461
## [750]    train-rmse:0.506437
## [1]  train-rmse:1.018655
## [2]  train-rmse:1.003946
## [3]  train-rmse:0.989538
## [4]  train-rmse:0.975828
## [5]  train-rmse:0.962640
## [6]  train-rmse:0.949864
## [7]  train-rmse:0.937224
## [8]  train-rmse:0.925069
## [9]  train-rmse:0.913437
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## [10] train-rmse:0.902096
## [11] train-rmse:0.891230
## [12] train-rmse:0.880851
## [13] train-rmse:0.870718
## [14] train-rmse:0.861060
## [15] train-rmse:0.851711
## [16] train-rmse:0.842587
## [17] train-rmse:0.833747
## [18] train-rmse:0.825244
## [19] train-rmse:0.816911
## [20] train-rmse:0.809049
## [21] train-rmse:0.801463
## [22] train-rmse:0.794179
## [23] train-rmse:0.787223
## [24] train-rmse:0.780367
## [25] train-rmse:0.773792
## [26] train-rmse:0.767575
## [27] train-rmse:0.761424
## [28] train-rmse:0.755614
## [29] train-rmse:0.749969
## [30] train-rmse:0.744510
## [31] train-rmse:0.739273
## [32] train-rmse:0.734099
## [33] train-rmse:0.729237
## [34] train-rmse:0.724521
## [35] train-rmse:0.719953
## [36] train-rmse:0.715568
## [37] train-rmse:0.711449
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## [38] train-rmse:0.707342
## [39] train-rmse:0.703360
## [40] train-rmse:0.699657
## [41] train-rmse:0.696041
## [42] train-rmse:0.692522
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## [43] train-rmse:0.689138
## [44] train-rmse:0.685843
## [45] train-rmse:0.682719
## [46] train-rmse:0.679671
## [47] train-rmse:0.676668
## [48] train-rmse:0.673813
## [49] train-rmse:0.671009
## [50] train-rmse:0.668377
## [51] train-rmse:0.665830
## [52] train-rmse:0.663392
## [53] train-rmse:0.661117
## [54] train-rmse:0.658782
## [55] train-rmse:0.656539
## [56] train-rmse:0.654498
## [57] train-rmse:0.652459
## [58] train-rmse:0.650478
## [59] train-rmse:0.648540
## [60] train-rmse:0.646707
## [61] train-rmse:0.644943
## [62] train-rmse:0.643228
## [63] train-rmse:0.641595
## [64] train-rmse:0.639874
## [65] train-rmse:0.638177
## [66] train-rmse:0.636597
## [67] train-rmse:0.635101
## [68] train-rmse:0.633624
## [69] train-rmse:0.632208
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[70] train-rmse:0.630866
[71] train-rmse:0.629644
[72] train-rmse:0.628351
[73] train-rmse:0.627195
[74] train-rmse:0.626002
[75] train-rmse:0.624815
[76] train-rmse:0.623668
[77] train-rmse:0.622592
[78] train-rmse:0.621544
[79] train-rmse:0.620460
[80] train-rmse:0.619357
[81] train-rmse:0.618384
[82] train-rmse:0.617393
[83] train-rmse:0.616434
[84] train-rmse:0.615495
[85] train-rmse:0.614525
[86] train-rmse:0.613729
[87] train-rmse:0.612842
[88] train-rmse:0.612062
[89] train-rmse:0.611348
[90] train-rmse:0.610628
[91] train-rmse:0.609886
[92] train-rmse:0.609079 ## [93] train-rmse:0.608458
[94] train-rmse:0.607685
[95] train-rmse:0.606970
[96] train-rmse:0.606259

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## [97] train-rmse:0.605593
## [98] train-rmse:0.604868
## [99] train-rmse:0.604231
## [100]   train-rmse:0.603608
## [101]   train-rmse:0.603016
## [102]   train-rmse:0.602459
## [103]   train-rmse:0.601834
## [104]   train-rmse:0.601331
## [105]   train-rmse:0.600724
## [106]   train-rmse:0.600227
## [107]   train-rmse:0.599653
## [108]   train-rmse:0.599180
## [109]   train-rmse:0.598596
## [110]   train-rmse:0.598089
## [111]   train-rmse:0.597647
## [112]   train-rmse:0.597165
## [113]   train-rmse:0.596768
## [114]   train-rmse:0.596346
## [115]   train-rmse:0.595890
## [116]   train-rmse:0.595419
## [117]   train-rmse:0.594939
## [118]   train-rmse:0.594470
## [119]   train-rmse:0.593984
## [120]   train-rmse:0.593589
## [121]   train-rmse:0.593064
## [122]   train-rmse:0.592723
## [123]   train-rmse:0.592389
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[124]   train-rmse:0.592037
[125]   train-rmse:0.591612
[126]   train-rmse:0.591232
[127]   train-rmse:0.590827
[128]   train-rmse:0.590425
[129]   train-rmse:0.590046
[130]   train-rmse:0.589733
[131]   train-rmse:0.589419
[132]   train-rmse:0.589109
[133]   train-rmse:0.588786
[134]   train-rmse:0.588489
[135]   train-rmse:0.588124
[136]   train-rmse:0.587761
[137]   train-rmse:0.587440
[138]   train-rmse:0.587150
[139]   train-rmse:0.586807
[140]   train-rmse:0.586483
[141]   train-rmse:0.586130
[142]   train rmse:0.585781 ## [143]
train   rmse:0.585455
[144]   train   rmse:0.585199
[145]   train   rmse:0.584897
[146]   train   rmse:0.584651
[147]   train   rmse:0.584469 ## [148]
train-rmse:0.584278 ## [149]   train-
rmse:0.583970
[150]   train-rmse:0.583680

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[151]   train-rmse:0.583485
[152]   train-rmse:0.583236
[153]   train-rmse:0.582955
[154]   train-rmse:0.582686
[155]   train-rmse:0.582513
[156]   train-rmse:0.582374
[157]   train-rmse:0.582040
[158]   train-rmse:0.581788
[159]   train-rmse:0.581555
[160]   train-rmse:0.581292
[161]   train-rmse:0.581096
[162]   train-rmse:0.580897
[163]   train-rmse:0.580705
[164]   train-rmse:0.580473
[165]   train-rmse:0.580280
[166]   train-rmse:0.580118
[167]   train-rmse:0.579837
[168]   train-rmse:0.579560
[169]   train-rmse:0.579334
[170]   train-rmse:0.579031
[171]   train-rmse:0.578846
[172]   train-rmse:0.578687
[173]   train-rmse:0.578463
[174]   train-rmse:0.578229
[175]   train-rmse:0.577969
[176]   train-rmse:0.577732
[177]   train-rmse:0.577457

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## [178]   train-rmse:0.577226
## [179]   train-rmse:0.577029
## [180]   train-rmse:0.576951
## [181]   train-rmse:0.576673
## [182]   train-rmse:0.576524
## [183]   train-rmse:0.576346
## [184]   train-rmse:0.576229
## [185]   train-rmse:0.576050
## [186]   train-rmse:0.575785
## [187]   train-rmse:0.575472
## [188]   train-rmse:0.575290
## [189]   train rmse:0.575168
## [190]   train rmse:0.574970
## [191]   train rmse:0.574847
## [192]   train rmse:0.574644
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## [193]    train rmse:0.574494
## [194]    train rmse:0.574306
## [195]    train-rmse:0.574244
## [196]    train-rmse:0.574062
## [197]    train-rmse:0.573990
## [198]    train-rmse:0.573886
## [199]    train-rmse:0.573774
## [200]    train-rmse:0.573665
## [201]    train-rmse:0.573549
## [202]    train-rmse:0.573351
## [203]    train-rmse:0.573064
## [204]    train-rmse:0.572955
## [205]    train-rmse:0.572809
## [206]    train-rmse:0.572727
## [207]    train-rmse:0.572581
## [208]    train-rmse:0.572483
## [209]    train-rmse:0.572378
## [210]    train-rmse:0.572207
## [211]    train-rmse:0.572160
## [212]    train-rmse:0.571985
## [213]    train-rmse:0.571770
## [214]    train-rmse:0.571524
## [215]    train-rmse:0.571362
## [216]    train-rmse:0.571086
## [217]    train-rmse:0.570876
## [218]    train-rmse:0.570682
## [219]    train-rmse:0.570491
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[220]   train-rmse:0.570281
[221]   train-rmse:0.570060
[222]   train-rmse:0.569862
[223]   train-rmse:0.569759
[224]   train-rmse:0.569632
[225]   train-rmse:0.569500
[226]   train-rmse:0.569395
[227]   train-rmse:0.569350
[228]   train-rmse:0.569166
[229]   train-rmse:0.569067
[230]   train-rmse:0.568815
[231]   train-rmse:0.568710
[232]   train-rmse:0.568602
[233]   train-rmse:0.568447
[234]   train-rmse:0.568312
[235]   train-rmse:0.568210
[236]   train-rmse:0.567994
[237]   train-rmse:0.567948
[238]   train-rmse:0.567780
[239]   train-rmse:0.567627
[240]   train-rmse:0.567598 ## [241]
train-rmse:0.567536 ## [242]   train
rmse:0.567353   ## [243]   train
rmse:0.567202
[244]   train   rmse:0.567101
[245]   train   rmse:0.566890
[246]   train   rmse:0.566745
[247]   train   rmse:0.566633

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[248]   train   rmse:0.566519 ## [249]
train-rmse:0.566400 ## [250]   train-
rmse:0.566311

[251]   train-rmse:0.566127
[252]   train-rmse:0.565999
[253]   train-rmse:0.565859
[254]   train-rmse:0.565810
[255]   train-rmse:0.565673
[256]   train-rmse:0.565496
[257]   train-rmse:0.565364
[258]   train-rmse:0.565134
[259]   train-rmse:0.565070
[260]   train-rmse:0.564992
[261]   train-rmse:0.564915
[262]   train-rmse:0.564865
[263]   train-rmse:0.564797
[264]   train-rmse:0.564711
[265]   train-rmse:0.564629
[266]   train-rmse:0.564526
[267]   train-rmse:0.564295
[268]   train-rmse:0.564234
[269]   train-rmse:0.564185
[270]   train-rmse:0.563946
[271]   train-rmse:0.563881
[272]   train-rmse:0.563701
[273]   train-rmse:0.563547
[274]   train-rmse:0.563374
[275]   train-rmse:0.563336

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##  [276]    train-rmse:0.563137
##  [277]    train-rmse:0.562940
##  [278]    train-rmse:0.562743
##  [279]    train-rmse:0.562610
##  [280]    train-rmse:0.562502
##  [281]    train-rmse:0.562311
##  [282]    train-rmse:0.562235
##  [283]    train-rmse:0.562205
##  [284]    train-rmse:0.562122
##  [285]    train-rmse:0.562069
##  [286]    train-rmse:0.561931
##  [287]    train-rmse:0.561873
##  [288]    train-rmse:0.561794
##  [289]    train rmse:0.561733
##  [290]    train rmse:0.561612
##  [291]    train rmse:0.561426
##  [292]     train rmse:0.561360 ## [293]
train   rmse:0.561203
##  [294]    train   rmse:0.561097
##  [295]    train   rmse:0.561081
##  [296]    train   rmse:0.561065
##  [297]    train   rmse:0.561031
##  [298]    train   rmse:0.560960
##  [299]    train   rmse:0.560909
##  [300]    train-rmse:0.560861
##  [301]    train-rmse:0.560850
##  [302]    train-rmse:0.560750
##  [303]    train-rmse:0.560687
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## [304]   train-rmse:0.560646
## [305]   train-rmse:0.560453
## [306]   train-rmse:0.560366
## [307]   train-rmse:0.560307
## [308]   train-rmse:0.560242
## [309]   train-rmse:0.560176
## [310]   train-rmse:0.559960
## [311]   train-rmse:0.559906
## [312]   train-rmse:0.559806
## [313]   train-rmse:0.559742
## [314]   train-rmse:0.559691
## [315]   train-rmse:0.559467
## [316]   train-rmse:0.559405
## [317]   train-rmse:0.559286
## [318]   train-rmse:0.559226
## [319]   train-rmse:0.559176
## [320]   train-rmse:0.559140
## [321]   train-rmse:0.559025
## [322]   train-rmse:0.558960
## [323]   train-rmse:0.558787
## [324]   train-rmse:0.558722
## [325]   train-rmse:0.558701
## [326]   train-rmse:0.558539
## [327]   train-rmse:0.558375
## [328]   train-rmse:0.558329
## [329]   train-rmse:0.558305
## [330]   train-rmse:0.558164
## [331]   train-rmse:0.558041
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[332]   train-rmse:0.557938
[333]   train-rmse:0.557825
[334]   train-rmse:0.557621
[335]   train-rmse:0.557533
[336]   train-rmse:0.557470
[337]   train-rmse:0.557401
[338]   train-rmse:0.557347
[339]   train-rmse:0.557296
[340]   train-rmse:0.557058
[341]   train-rmse:0.556919 ## [342]
train-rmse:0.556837

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[343]   train   rmse:0.556688
[344]   train   rmse:0.556677
[345]   train   rmse:0.556540
[346]   train   rmse:0.556456
[347]   train   rmse:0.556378
[348]   train   rmse:0.556326
[349]   train   rmse:0.556231
[350]   train-rmse:0.556161
[351]   train-rmse:0.555980
[352]   train-rmse:0.555960
[353]   train-rmse:0.555917
[354]   train-rmse:0.555908
[355]   train-rmse:0.555874
[356]   train-rmse:0.555735
[357]   train-rmse:0.555696
[358]   train-rmse:0.555640
[359]   train-rmse:0.555547
[360]   train-rmse:0.555522
[361]   train-rmse:0.555452
[362]   train-rmse:0.555399
[363]   train-rmse:0.555337
[364]   train-rmse:0.555254
[365]   train-rmse:0.555207
[366]   train-rmse:0.555045
[367]   train-rmse:0.554883
[368]   train-rmse:0.554792
[369]   train-rmse:0.554690
[370]   train-rmse:0.554662
[371]   train-rmse:0.554561

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## [372]   train-rmse:0.554397
## [373]   train-rmse:0.554397
## [374]   train-rmse:0.554318
## [375]   train-rmse:0.554254
## [376]   train-rmse:0.554120
## [377]   train-rmse:0.553976
## [378]   train-rmse:0.553918
## [379]   train-rmse:0.553854
## [380]   train-rmse:0.553746
## [381]   train-rmse:0.553629
## [382]   train-rmse:0.553549
## [383]   train-rmse:0.553412
## [384]   train-rmse:0.553356
## [385]   train-rmse:0.553223
## [386]   train  rmse:0.553169
## [387]   train  rmse:0.553121
## [388]   train  rmse:0.553081
## [389]   train  rmse:0.552938
## [390]   train  rmse:0.552853
## [391]   train  rmse:0.552719
## [392]   train   rmse:0.552650 ## [393]
train  rmse:0.552510
## [394]   train  rmse:0.552480
## [395]   train  rmse:0.552450
## [396]   train  rmse:0.552421
## [397]   train  rmse:0.552342
## [398]   train  rmse:0.552238
## [399]   train  rmse:0.552207
## [400]   train-rmse:0.552181
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## [401]   train-rmse:0.552071
## [402]   train-rmse:0.551949
## [403]   train-rmse:0.551767
## [404]   train-rmse:0.551709
## [405]   train-rmse:0.551691
## [406]   train-rmse:0.551578
## [407]   train-rmse:0.551509
## [408]   train-rmse:0.551392
## [409]   train-rmse:0.551279
## [410]   train-rmse:0.551096
## [411]   train-rmse:0.551060
## [412]   train-rmse:0.550971
## [413]   train-rmse:0.550763
## [414]   train-rmse:0.550665
## [415]   train-rmse:0.550603
## [416]   train-rmse:0.550536
## [417]   train-rmse:0.550331
## [418]   train-rmse:0.550272
## [419]   train-rmse:0.550136
## [420]   train-rmse:0.549949
## [421]   train-rmse:0.549896
## [422]   train-rmse:0.549868
## [423]   train-rmse:0.549717
## [424]   train-rmse:0.549657
## [425]   train-rmse:0.549567
## [426]   train-rmse:0.549548
## [427]   train-rmse:0.549388
## [428]   train-rmse:0.549327
## [429]   train-rmse:0.549277
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```
[430]   train-rmse:0.549233
[431]   train-rmse:0.549078
[432]   train-rmse:0.549023
[433]   train-rmse:0.548962
[434]   train-rmse:0.548892
[435]   train-rmse:0.548858 ## [436]
train   rmse:0.548772
[437]   train   rmse:0.548772
[438]   train   rmse:0.548654
[439]   train   rmse:0.548584
[440]   train   rmse:0.548523
[441]   train   rmse:0.548412
[442]   train   rmse:0.548341 ## [443]
train   rmse:0.548245
[444]   train   rmse:0.548136
[445]   train   rmse:0.548052
[446]   train   rmse:0.548010
[447]   train   rmse:0.547901
[448]   train   rmse:0.547776
[449]   train   rmse:0.547683
[450]   train-rmse:0.547614
[451]   train-rmse:0.547494
[452]   train-rmse:0.547424
[453]   train-rmse:0.547309
[454]   train-rmse:0.547231
[455]   train-rmse:0.547125
[456]   train-rmse:0.547096
[457]   train-rmse:0.546976
[458]   train-rmse:0.546965

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## [459]   train-rmse:0.546796
## [460]   train-rmse:0.546715
## [461]   train-rmse:0.546662
## [462]   train-rmse:0.546594
## [463]   train-rmse:0.546501
## [464]   train-rmse:0.546454
## [465]   train-rmse:0.546288
## [466]   train-rmse:0.546263
## [467]   train-rmse:0.546225
## [468]   train-rmse:0.546218
## [469]   train-rmse:0.546099
## [470]   train-rmse:0.546047
## [471]   train-rmse:0.545994
## [472]   train-rmse:0.545922
## [473]   train-rmse:0.545776
## [474]   train-rmse:0.545734
## [475]   train-rmse:0.545630
## [476]   train-rmse:0.545525
## [477]   train-rmse:0.545466
## [478]   train-rmse:0.545346
## [479]   train-rmse:0.545331
## [480]   train-rmse:0.545262
## [481]   train-rmse:0.545179
## [482]   train-rmse:0.545171
## [483]   train-rmse:0.545155
## [484]   train-rmse:0.545071
## [485]   train-rmse:0.544995
## [486]   train   rmse:0.544910
## [487]   train   rmse:0.544793
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##  [488]  train  rmse:0.544680
##  [489]  train  rmse:0.544626
##  [490]  train  rmse:0.544590
##  [491]  train  rmse:0.544540
##  [492]  train  rmse:0.544515
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[493]   train rmse:0.544345
[494]   train rmse:0.544249
[495]   train rmse:0.544162
[496]   train rmse:0.544128 ## [497]
train-rmse:0.544101 ## [498]   train-
rmse:0.543890
[499]   train-rmse:0.543837
[500]   train-rmse:0.543815
[501]   train-rmse:0.543781
[502]   train-rmse:0.543721
[503]   train-rmse:0.543678
[504]   train-rmse:0.543575
[505]   train-rmse:0.543475
[506]   train-rmse:0.543393
[507]   train-rmse:0.543257
[508]   train-rmse:0.543130
[509]   train-rmse:0.543087
[510]   train-rmse:0.542961
[511]   train-rmse:0.542855
[512]   train-rmse:0.542797
[513]   train-rmse:0.542762
[514]   train-rmse:0.542732
[515]   train-rmse:0.542658
[516]   train-rmse:0.542598
[517]   train-rmse:0.542503
[518]   train-rmse:0.542452
[519]   train-rmse:0.542433
[520]   train-rmse:0.542296

[521]   train-rmse:0.542243
[522]   train-rmse:0.542168
[523]   train-rmse:0.542015
[524]   train-rmse:0.541921
[525]   train-rmse:0.541842
[526]   train-rmse:0.541781
[527]   train-rmse:0.541757
[528]   train-rmse:0.541723
[529]   train-rmse:0.541563
[530]   train-rmse:0.541469
[531]   train-rmse:0.541449
[532]   train-rmse:0.541389
[533]   train-rmse:0.541232
[534]   train-rmse:0.541218
[535]   train-rmse:0.541164 ## [536]
train-rmse:0.541095 ## [537]   train
rmse:0.540986
[538]   train   rmse:0.540904
[539]   train   rmse:0.540839
[540]   train   rmse:0.540684
[541]   train   rmse:0.540565
[542]   train   rmse:0.540545 ## [543]
train rmse:0.540489
[544]   train-rmse:0.540452
[545]   train-rmse:0.540288
[546]   train-rmse:0.540197
[547]   train-rmse:0.540041

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## [548]   train-rmse:0.539919
## [549]   train-rmse:0.539865
## [550]   train-rmse:0.539840
## [551]   train-rmse:0.539822
## [552]   train-rmse:0.539689
## [553]   train-rmse:0.539582
## [554]   train-rmse:0.539497
## [555]   train-rmse:0.539420
## [556]   train-rmse:0.539344
## [557]   train-rmse:0.539300
## [558]   train-rmse:0.539200
## [559]   train-rmse:0.539189
## [560]   train-rmse:0.539161
## [561]   train-rmse:0.539044
## [562]   train-rmse:0.538944
## [563]   train-rmse:0.538909
## [564]   train-rmse:0.538855
## [565]   train-rmse:0.538820
## [566]   train-rmse:0.538735
## [567]   train-rmse:0.538735
## [568]   train-rmse:0.538624
## [569]   train-rmse:0.538624
## [570]   train-rmse:0.538623
## [571]   train-rmse:0.538519
## [572]   train-rmse:0.538426
## [573]   train-rmse:0.538404
## [574]   train-rmse:0.538377
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[575]   train-rmse:0.538313
[576]   train-rmse:0.538269
[577]   train-rmse:0.538198
[578]   train-rmse:0.538107
[579]   train-rmse:0.538055
[580]   train-rmse:0.537983
[581]   train-rmse:0.537882
[582]   train-rmse:0.537842
[583]   train-rmse:0.537787
[584]   train-rmse:0.537677
[585]   train-rmse:0.537504
[586]   train-rmse:0.537474
[587]   train-rmse:0.537425
[588]   train-rmse:0.537382
[589]   train-rmse:0.537264 ## [590] train-rmse:0.537203 ## [591]   train rmse:0.537145
[592]   train rmse:0.537122 ## [593] train   rmse:0.537040
[594]   train   rmse:0.536954
[595]   train   rmse:0.536858
[596]   train   rmse:0.536813
[597]   train   rmse:0.536747 ## [598] train-rmse:0.536673 ## [599]   train-rmse:0.536609
[600]   train-rmse:0.536492
[601]   train-rmse:0.536402

[602]   train-rmse:0.536386
[603]   train-rmse:0.536321
[604]   train-rmse:0.536198
[605]   train-rmse:0.536087
[606]   train-rmse:0.536033
[607]   train-rmse:0.536026
[608]   train-rmse:0.535945
[609]   train-rmse:0.535918
[610]   train-rmse:0.535906
[611]   train-rmse:0.535859
[612]   train-rmse:0.535749
[613]   train-rmse:0.535695
[614]   train-rmse:0.535543
[615]   train-rmse:0.535483
[616]   train-rmse:0.535464
[617]   train-rmse:0.535374
[618]   train-rmse:0.535248
[619]   train-rmse:0.535227
[620]   train-rmse:0.535193
[621]   train-rmse:0.535193
[622]   train-rmse:0.535146
[623]   train-rmse:0.535112
[624]   train-rmse:0.535067
[625]   train-rmse:0.535011
[626]   train-rmse:0.534940
[627]   train-rmse:0.534874
[628]   train-rmse:0.534766

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## [629]   train-rmse:0.534766
## [630]   train-rmse:0.534760
## [631]   train-rmse:0.534684
## [632]   train-rmse:0.534636
## [633]   train-rmse:0.534585
## [634]   train-rmse:0.534503
## [635]   train-rmse:0.534455
## [636]   train-rmse:0.534410
## [637]   train-rmse:0.534410
## [638]   train-rmse:0.534367
## [639]   train-rmse:0.534344
## [640]   train-rmse:0.534232
## [641]   train rmse:0.534223
## [642]   train rmse:0.534201
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[643]   train   rmse:0.534177
[644]   train   rmse:0.534070
[645]   train   rmse:0.534006
[646]   train   rmse:0.533954
[647]   train   rmse:0.533922
[648]   train   rmse:0.533918
[649]   train   rmse:0.533901
[650]   train   rmse:0.533879
[651]   train-rmse:0.533749
[652]   train-rmse:0.533723
[653]   train-rmse:0.533634
[654]   train-rmse:0.533568
[655]   train-rmse:0.533538
[656]   train-rmse:0.533452
[657]   train-rmse:0.533428
[658]   train-rmse:0.533332
[659]   train-rmse:0.533324
[660]   train-rmse:0.533270
[661]   train-rmse:0.533241
[662]   train-rmse:0.533189
[663]   train-rmse:0.533153
[664]   train-rmse:0.533108
[665]   train-rmse:0.532999
[666]   train-rmse:0.532906
[667]   train-rmse:0.532876
[668]   train-rmse:0.532781
[669]   train-rmse:0.532761

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[670]   train-rmse:0.532688
[671]   train-rmse:0.532632
[672]   train-rmse:0.532512
[673]   train-rmse:0.532368
[674]   train-rmse:0.532243
[675]   train-rmse:0.532186
[676]   train-rmse:0.532102
[677]   train-rmse:0.532054
[678]   train-rmse:0.531958
[679]   train-rmse:0.531928
[680]   train-rmse:0.531900
[681]   train-rmse:0.531861
[682]   train-rmse:0.531812
[683]   train-rmse:0.531789
[684]   train-rmse:0.531756
[685]   train-rmse:0.531687
[686]   train-rmse:0.531687
[687]   train-rmse:0.531669
[688]   train-rmse:0.531629
[689]   train-rmse:0.531565
[690]   train-rmse:0.531516 ## [691]
train-rmse:0.531509 ## [692]   train
rmse:0.531467   ## [693]   train
rmse:0.531455
[694]   train   rmse:0.531429
[695]   train   rmse:0.531402
[696]   train   rmse:0.531317

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[697]   train   rmse:0.531208
[698]   train   rmse:0.531100
[699]   train   rmse:0.531042
[700]   train   rmse:0.530907
[701]   train-rmse:0.530883
[702]   train-rmse:0.530824
[703]   train-rmse:0.530766
[704]   train-rmse:0.530749
[705]   train-rmse:0.530691
[706]   train-rmse:0.530627
[707]   train-rmse:0.530585
[708]   train-rmse:0.530510
[709]   train-rmse:0.530428
[710]   train-rmse:0.530371
[711]   train-rmse:0.530264
[712]   train-rmse:0.530226
[713]   train-rmse:0.530195
[714]   train-rmse:0.530138
[715]   train-rmse:0.530090
[716]   train-rmse:0.530050
[717]   train-rmse:0.529995
[718]   train-rmse:0.529978
[719]   train-rmse:0.529897
[720]   train-rmse:0.529871
[721]   train-rmse:0.529871
[722]   train-rmse:0.529805
[723]   train-rmse:0.529760

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[724]   train-rmse:0.529658
[725]   train-rmse:0.529629
[726]   train-rmse:0.529579
[727]   train-rmse:0.529554
[728]   train-rmse:0.529529
[729]   train-rmse:0.529488
[730]   train-rmse:0.529479
[731]   train-rmse:0.529458
[732]   train-rmse:0.529429
[733]   train-rmse:0.529395
[734]   train-rmse:0.529257
[735]   train-rmse:0.529118
[736]   train-rmse:0.529024
[737]   train-rmse:0.528987
[738]   train-rmse:0.528883
[739]   train-rmse:0.528807
[740]   train-rmse:0.528792
[741]   train-rmse:0.528753
[742]   train rmse:0.528685 ## [743]
train   rmse:0.528521
[744]   train   rmse:0.528467
[745]   train   rmse:0.528444
[746]   train   rmse:0.528408
[747]   train   rmse:0.528360
[748]   train   rmse:0.528303
[749]   train   rmse:0.528226
[750]   train   rmse:0.528208

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[1] train-rmse:1.161683
[2] train-rmse:1.143133
[3] train-rmse:1.125206
[4] train-rmse:1.107772
[5] train-rmse:1.091099
[6] train-rmse:1.074865
[7] train-rmse:1.059192
[8] train-rmse:1.043896
[9] train-rmse:1.029055
[10] train-rmse:1.014614
[11] train-rmse:1.000773
[12] train-rmse:0.987474
[13] train-rmse:0.974642
[14] train-rmse:0.962295
[15] train-rmse:0.950283
[16] train-rmse:0.938791
[17] train-rmse:0.927567
[18] train-rmse:0.916680
[19] train-rmse:0.906146
[20] train-rmse:0.896131
[21] train-rmse:0.886427
[22] train-rmse:0.877029
[23] train-rmse:0.868053
[24] train-rmse:0.859466
[25] train-rmse:0.851039
[26] train-rmse:0.843099
[27] train-rmse:0.835254

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[28] train-rmse:0.827716
[29] train-rmse:0.820298
[30] train-rmse:0.813303
[31] train-rmse:0.806560
[32] train-rmse:0.800049
[33] train-rmse:0.793697
[34] train-rmse:0.787652
[35] train-rmse:0.781851
[36] train-rmse:0.776292
[37] train-rmse:0.770987
[38] train-rmse:0.765786
[39] train-rmse:0.760735
[40] train-rmse:0.755948
[41] train-rmse:0.751331
[42] train-rmse:0.746972

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## [43] train-rmse:0.742665
## [44] train-rmse:0.738684
## [45] train-rmse:0.734597
## [46] train-rmse:0.730821
## [47] train-rmse:0.727074
## [48] train-rmse:0.723445
## [49] train-rmse:0.720019
## [50] train-rmse:0.716697
## [51] train-rmse:0.713503
## [52] train-rmse:0.710355
## [53] train-rmse:0.707188
## [54] train-rmse:0.704328
## [55] train-rmse:0.701559
## [56] train-rmse:0.698825
## [57] train-rmse:0.696272
## [58] train-rmse:0.693618
## [59] train-rmse:0.691206
## [60] train-rmse:0.688847
## [61] train-rmse:0.686518
## [62] train-rmse:0.684265
## [63] train-rmse:0.682183
## [64] train-rmse:0.680115
## [65] train-rmse:0.678127
## [66] train-rmse:0.676253
## [67] train-rmse:0.674402
## [68] train-rmse:0.672629
## [69] train-rmse:0.670927
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## [70] train-rmse:0.669272
## [71] train-rmse:0.667697
## [72] train-rmse:0.666204
## [73] train-rmse:0.664707
## [74] train-rmse:0.663302
## [75] train-rmse:0.661715
## [76] train-rmse:0.660242
## [77] train-rmse:0.658900
## [78] train-rmse:0.657622
## [79] train-rmse:0.656444
## [80] train-rmse:0.655186
## [81] train-rmse:0.653945
## [82] train-rmse:0.652711
## [83] train-rmse:0.651544
## [84] train-rmse:0.650441
## [85] train-rmse:0.649490
## [86] train-rmse:0.648405
## [87] train-rmse:0.647297
## [88] train-rmse:0.646411
## [89] train-rmse:0.645470
## [90] train-rmse:0.644518
## [91] train-rmse:0.643578
## [92] train-rmse:0.642756  ## [93] train-rmse:0.641870
## [94] train-rmse:0.641031
## [95] train-rmse:0.640184
## [96] train-rmse:0.639378
## [97] train-rmse:0.638587
## [98] train-rmse:0.637713
## [99] train-rmse:0.636965
## [100]    train-rmse:0.636248
## [101]    train-rmse:0.635633
## [102]    train-rmse:0.635014
## [103]    train-rmse:0.634347
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## [104]   train-rmse:0.633661
## [105]   train-rmse:0.633024
## [106]   train-rmse:0.632436
## [107]   train-rmse:0.631918
## [108]   train-rmse:0.631335
## [109]   train-rmse:0.630802
## [110]   train-rmse:0.630256
## [111]   train-rmse:0.629679
## [112]   train-rmse:0.629133
## [113]   train-rmse:0.628602
## [114]   train-rmse:0.628055
## [115]   train-rmse:0.627497
## [116]   train-rmse:0.627005
## [117]   train-rmse:0.626556
## [118]   train-rmse:0.626081
## [119]   train-rmse:0.625588
## [120]   train-rmse:0.625156
## [121]   train-rmse:0.624651
## [122]   train-rmse:0.624199
## [123]   train-rmse:0.623673
## [124]   train-rmse:0.623177
## [125]   train-rmse:0.622745
## [126]   train-rmse:0.622401
## [127]   train-rmse:0.622028
## [128]   train-rmse:0.621555
## [129]   train-rmse:0.621099
## [130]   train-rmse:0.620758
## [131]   train-rmse:0.620338
## [132]   train-rmse:0.620034
## [133]   train-rmse:0.619644
## [134]   train-rmse:0.619265
## [135]   train-rmse:0.618950
## [136]   train-rmse:0.618627
## [137]   train-rmse:0.618291
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[138]   train-rmse:0.617896 ## [139]
train-rmse:0.617521 ## [140]   train-
rmse:0.617175

[141]   train rmse:0.616731
[142]   train rmse:0.616292 ## [143]
train rmse:0.615962

[144]   train rmse:0.615580
[145]   train rmse:0.615268
[146]   train rmse:0.614831 ## [147]
train-rmse:0.614453 ## [148]   train-
rmse:0.614104

[149]   train-rmse:0.613848
[150]   train-rmse:0.613504
[151]   train-rmse:0.613284
[152]   train-rmse:0.612992
[153]   train-rmse:0.612698
[154]   train-rmse:0.612366
[155]   train-rmse:0.612083
[156]   train-rmse:0.611804
[157]   train-rmse:0.611543
[158]   train-rmse:0.611274
[159]   train-rmse:0.611006
[160]   train-rmse:0.610565
[161]   train-rmse:0.610286
[162]   train-rmse:0.609970
[163]   train-rmse:0.609593
[164]   train-rmse:0.609329
[165]   train-rmse:0.609098
[166]   train-rmse:0.608963
[167]   train-rmse:0.608656
[168]   train-rmse:0.608476
[169]   train-rmse:0.608147
[170]   train-rmse:0.607974
[171]   train-rmse:0.607743

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## [172]   train-rmse:0.607534
## [173]   train-rmse:0.607331
## [174]   train-rmse:0.607102
## [175]   train-rmse:0.606893
## [176]   train-rmse:0.606620
## [177]   train-rmse:0.606400
## [178]   train-rmse:0.606190
## [179]   train-rmse:0.605903
## [180]   train-rmse:0.605720
## [181]   train-rmse:0.605450
## [182]   train-rmse:0.605218
## [183]   train-rmse:0.604910
## [184]   train-rmse:0.604672
## [185]   train-rmse:0.604511
## [186]   train-rmse:0.604267
## [187]   train-rmse:0.604038
## [188]   train   rmse:0.603890
## [189]   train   rmse:0.603597
## [190]   train   rmse:0.603413
## [191]   train   rmse:0.603273
## [192]   train   rmse:0.602997
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## [193]	train rmse:0.602875
## [194]	train-rmse:0.602659
## [195]	train-rmse:0.602527
## [196]	train-rmse:0.602380
## [197]	train-rmse:0.602137
## [198]	train-rmse:0.601893
## [199]	train-rmse:0.601697
## [200]	train-rmse:0.601416
## [201]	train-rmse:0.601220
## [202]	train-rmse:0.600953
## [203]	train-rmse:0.600734
## [204]	train-rmse:0.600584
## [205]	train-rmse:0.600378
## [206]	train-rmse:0.600221
## [207]	train-rmse:0.600012
## [208]	train-rmse:0.599784
## [209]	train-rmse:0.599588
## [210]	train-rmse:0.599494
## [211]	train-rmse:0.599319
## [212]	train-rmse:0.599116
## [213]	train-rmse:0.598896
## [214]	train-rmse:0.598700
## [215]	train-rmse:0.598525
## [216]	train-rmse:0.598317
## [217]	train-rmse:0.598084
## [218]	train-rmse:0.598021
## [219]	train-rmse:0.597825

[220]   train-rmse:0.597688
[221]   train-rmse:0.597443
[222]   train-rmse:0.597338
[223]   train-rmse:0.597100
[224]   train-rmse:0.596953
[225]   train-rmse:0.596801
[226]   train-rmse:0.596638
[227]   train-rmse:0.596386
[228]   train-rmse:0.596192
[229]   train-rmse:0.595982
[230]   train-rmse:0.595764
[231]   train-rmse:0.595694
[232]   train-rmse:0.595529
[233]   train-rmse:0.595361
[234]   train-rmse:0.595291
[235]   train-rmse:0.595144
[236]   train-rmse:0.595019
[237]   train-rmse:0.594862
[238]   train-rmse:0.594715
[239]   train-rmse:0.594575 ## [240]
train-rmse:0.594427 ## [241]   train
rmse:0.594235
[242]   train rmse:0.594116 ## [243]
train   rmse:0.594045
[244]   train   rmse:0.593901
[245]   train   rmse:0.593834
[246]   train   rmse:0.593639
[247]   train   rmse:0.593579

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## [248]   train   rmse:0.593321
## [249]   train-rmse:0.593224
## [250]   train-rmse:0.593109
## [251]   train-rmse:0.592970
## [252]   train-rmse:0.592904
## [253]   train-rmse:0.592777
## [254]   train-rmse:0.592667
## [255]   train-rmse:0.592486
## [256]   train-rmse:0.592403
## [257]   train-rmse:0.592267
## [258]   train-rmse:0.591995
## [259]   train-rmse:0.591856
## [260]   train-rmse:0.591730
## [261]   train-rmse:0.591661
## [262]   train-rmse:0.591580
## [263]   train-rmse:0.591392
## [264]   train-rmse:0.591307
## [265]   train-rmse:0.591108
## [266]   train-rmse:0.590968
## [267]   train-rmse:0.590773
## [268]   train-rmse:0.590564
## [269]   train-rmse:0.590369
## [270]   train-rmse:0.590236
## [271]   train-rmse:0.590100
## [272]   train-rmse:0.589955
## [273]   train-rmse:0.589842
## [274]   train-rmse:0.589655
## [275]   train-rmse:0.589508
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[276]   train-rmse:0.589458
[277]   train-rmse:0.589334
[278]   train-rmse:0.589183
[279]   train-rmse:0.589054
[280]   train-rmse:0.589022
[281]   train-rmse:0.588922
[282]   train-rmse:0.588825
[283]   train-rmse:0.588666
[284]   train-rmse:0.588555
[285]   train-rmse:0.588430
[286]   train-rmse:0.588220
[287]   train-rmse:0.588021
[288]   train   rmse:0.587859
[289]   train   rmse:0.587654
[290]   train   rmse:0.587501
[291]   train   rmse:0.587445
[292]   train   rmse:0.587344 ## [293]
train   rmse:0.587223
[294]   train   rmse:0.587074
[295]   train   rmse:0.587011
[296]   train   rmse:0.586910
[297]   train   rmse:0.586834
[298]   train   rmse:0.586704
[299]   train-rmse:0.586573
[300]   train-rmse:0.586461
[301]   train-rmse:0.586442
[302]   train-rmse:0.586364
[303]   train-rmse:0.586217

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## [304]    train-rmse:0.586030
## [305]    train-rmse:0.585878
## [306]    train-rmse:0.585828
## [307]    train-rmse:0.585627
## [308]    train-rmse:0.585586
## [309]    train-rmse:0.585398
## [310]    train-rmse:0.585261
## [311]    train-rmse:0.585162
## [312]    train-rmse:0.585073
## [313]    train-rmse:0.584989
## [314]    train-rmse:0.584833
## [315]    train-rmse:0.584768
## [316]    train-rmse:0.584609
## [317]    train-rmse:0.584470
## [318]    train-rmse:0.584433
## [319]    train-rmse:0.584258
## [320]    train-rmse:0.584114
## [321]    train-rmse:0.584035
## [322]    train-rmse:0.583927
## [323]    train-rmse:0.583859
## [324]    train-rmse:0.583637
## [325]    train-rmse:0.583554
## [326]    train-rmse:0.583455
## [327]    train-rmse:0.583352
## [328]    train-rmse:0.583221
## [329]    train-rmse:0.583081
## [330]    train-rmse:0.582932
## [331]    train-rmse:0.582914
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[332]   train-rmse:0.582874
[333]   train-rmse:0.582791
[334]   train-rmse:0.582708
[335]   train-rmse:0.582570
[336]   train-rmse:0.582435
[337]   train-rmse:0.582337
[338]   train-rmse:0.582263
[339]   train-rmse:0.582135
[340]   train-rmse:0.582011 ## [341]
train-rmse:0.581820 ## [342]   train
rmse:0.581747   ##   [343]   train
rmse:0.581621
[344]   train   rmse:0.581482
[345]   train   rmse:0.581387
[346]   train   rmse:0.581306
[347]   train   rmse:0.581161
[348]   train   rmse:0.581085
[349]   train-rmse:0.580887
[350]   train-rmse:0.580817
[351]   train-rmse:0.580739
[352]   train-rmse:0.580682
[353]   train-rmse:0.580575
[354]   train-rmse:0.580471
[355]   train-rmse:0.580358
[356]   train-rmse:0.580216
[357]   train-rmse:0.580092
[358]   train-rmse:0.580005
[359]   train-rmse:0.579935

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## [360]   train-rmse:0.579892
## [361]   train-rmse:0.579770
## [362]   train-rmse:0.579738
## [363]   train-rmse:0.579675
## [364]   train-rmse:0.579536
## [365]   train-rmse:0.579494
## [366]   train-rmse:0.579441
## [367]   train-rmse:0.579345
## [368]   train-rmse:0.579228
## [369]   train-rmse:0.579174
## [370]   train-rmse:0.579068
## [371]   train-rmse:0.578977
## [372]   train-rmse:0.578916
## [373]   train-rmse:0.578726
## [374]   train-rmse:0.578605
## [375]   train-rmse:0.578566
## [376]   train-rmse:0.578545
## [377]   train-rmse:0.578467
## [378]   train-rmse:0.578331
## [379]   train-rmse:0.578236
## [380]   train-rmse:0.578096
## [381]   train-rmse:0.578054
## [382]   train-rmse:0.577883
## [383]   train-rmse:0.577733
## [384]   train-rmse:0.577659
## [385]   train-rmse:0.577491
## [386]   train-rmse:0.577457
## [387]   train-rmse:0.577267
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## [388]   train   rmse:0.577149
## [389]   train   rmse:0.577127
## [390]   train   rmse:0.577078
## [391]   train   rmse:0.577004
## [392]   train   rmse:0.576918
```

[393]   train rmse:0.576883

[394]   train rmse:0.576764 ## [395]
train-rmse:0.576645 ## [396]   train-
rmse:0.576614

[397]   train-rmse:0.576560

[398]   train-rmse:0.576479

[399]   train-rmse:0.576357

[400]   train-rmse:0.576271

[401]   train-rmse:0.576253

[402]   train-rmse:0.576133

[403]   train-rmse:0.576079

[404]   train-rmse:0.575882

[405]   train-rmse:0.575828

[406]   train-rmse:0.575807

[407]   train-rmse:0.575772

[408]   train-rmse:0.575697

[409]   train-rmse:0.575570

[410]   train-rmse:0.575380

[411]   train-rmse:0.575345

[412]   train-rmse:0.575285

[413]   train-rmse:0.575236

[414]   train-rmse:0.575137

[415]   train-rmse:0.575070

[416]   train-rmse:0.574955

[417]   train-rmse:0.574932

[418]   train-rmse:0.574799

[419]   train-rmse:0.574776

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## [420]    train-rmse:0.574711
## [421]    train-rmse:0.574630
## [422]    train-rmse:0.574496
## [423]    train-rmse:0.574393
## [424]    train-rmse:0.574267
## [425]    train-rmse:0.574221
## [426]    train-rmse:0.574121
## [427]    train-rmse:0.573948
## [428]    train-rmse:0.573845
## [429]    train-rmse:0.573743
## [430]    train-rmse:0.573598
## [431]    train-rmse:0.573497
## [432]    train-rmse:0.573431
## [433]    train-rmse:0.573386
## [434]    train-rmse:0.573288
## [435]    train-rmse:0.573102
## [436]    train-rmse:0.573024
## [437]    train-rmse:0.572850
## [438]    train-rmse:0.572814
## [439]    train-rmse:0.572734
## [440]    train-rmse:0.572667
## [441]    train-rmse:0.572599
## [442]    train-rmse:0.572504 ## [443]
train rmse:0.572475
## [444]    train rmse:0.572310
## [445]    train rmse:0.572234
## [446]    train rmse:0.572138
## [447]    train-rmse:0.572067
```

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## [448]   train-rmse:0.571988
## [449]   train-rmse:0.571889
## [450]   train-rmse:0.571659
## [451]   train-rmse:0.571559
## [452]   train-rmse:0.571339
## [453]   train-rmse:0.571151
## [454]   train-rmse:0.571113
## [455]   train-rmse:0.571069
## [456]   train-rmse:0.570913
## [457]   train-rmse:0.570876
## [458]   train-rmse:0.570670
## [459]   train-rmse:0.570499
## [460]   train-rmse:0.570450
## [461]   train-rmse:0.570383
## [462]   train-rmse:0.570269
## [463]   train-rmse:0.570199
## [464]   train-rmse:0.570110
## [465]   train-rmse:0.570028
## [466]   train-rmse:0.569925
## [467]   train-rmse:0.569813
## [468]   train-rmse:0.569777
## [469]   train-rmse:0.569621
## [470]   train-rmse:0.569474
## [471]   train-rmse:0.569370
## [472]   train-rmse:0.569210
## [473]   train-rmse:0.569085
## [474]   train-rmse:0.568934
## [475]   train-rmse:0.568846
```

[476]   train-rmse:0.568765
[477]   train-rmse:0.568711
[478]   train-rmse:0.568670
[479]   train-rmse:0.568583
[480]   train-rmse:0.568492
[481]   train-rmse:0.568432
[482]   train-rmse:0.568300
[483]   train-rmse:0.568210
[484]   train-rmse:0.568051
[485]   train-rmse:0.567839
[486]   train-rmse:0.567747
[487]   train-rmse:0.567663
[488]   train rmse:0.567552
[489]   train rmse:0.567523
[490]   train rmse:0.567449
[491]   train rmse:0.567348
[492]   train rmse:0.567167 ## [493]
train rmse:0.567113
[494]   train rmse:0.566961
[495]   train rmse:0.566898 ## [496]
train-rmse:0.566825 ## [497]   train-
rmse:0.566685
[498]   train-rmse:0.566595
[499]   train-rmse:0.566415
[500]   train-rmse:0.566387
[501]   train-rmse:0.566255
[502]   train-rmse:0.566154
[503]   train-rmse:0.566100

```
## [504]   train-rmse:0.566066
## [505]   train-rmse:0.565952
## [506]   train-rmse:0.565929
## [507]   train-rmse:0.565871
## [508]   train-rmse:0.565751
## [509]   train-rmse:0.565668
## [510]   train-rmse:0.565565
## [511]   train-rmse:0.565423
## [512]   train-rmse:0.565250
## [513]   train-rmse:0.565157
## [514]   train-rmse:0.565057
## [515]   train-rmse:0.565014
## [516]   train-rmse:0.564895
## [517]   train-rmse:0.564807
## [518]   train-rmse:0.564794
## [519]   train-rmse:0.564748
## [520]   train-rmse:0.564609
## [521]   train-rmse:0.564574
## [522]   train-rmse:0.564487
## [523]   train-rmse:0.564356
## [524]   train-rmse:0.564312
## [525]   train-rmse:0.564144
## [526]   train-rmse:0.564144
## [527]   train-rmse:0.564022
## [528]   train-rmse:0.563968
## [529]   train-rmse:0.563889
## [530]   train-rmse:0.563746
## [531]   train-rmse:0.563634
```

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## [532]   train-rmse:0.563571
## [533]   train-rmse:0.563544
## [534]   train-rmse:0.563476
## [535]     train-rmse:0.563344 ## [536]
train-rmse:0.563291
## [537]   train-rmse:0.563196
## [538]   train-rmse:0.563180
## [539]   train-rmse:0.563180
## [540]   train rmse:0.563099
## [541]   train rmse:0.563008
## [542]   train rmse:0.562998
```

```
## [543]   train-rmse:0.562872
## [544]   train-rmse:0.562825
## [545]   train-rmse:0.562815
## [546]   train-rmse:0.562771
## [547]   train-rmse:0.562758
## [548]   train-rmse:0.562703
## [549]   train-rmse:0.562658
## [550]   train-rmse:0.562531
## [551]   train-rmse:0.562433
## [552]   train-rmse:0.562392
## [553]   train-rmse:0.562279
## [554]   train-rmse:0.562167
## [555]   train-rmse:0.562140
## [556]   train-rmse:0.562084
## [557]   train-rmse:0.562034
## [558]   train-rmse:0.561939
## [559]   train-rmse:0.561922
## [560]   train-rmse:0.561845
## [561]   train-rmse:0.561761
## [562]   train-rmse:0.561685
## [563]   train-rmse:0.561595
## [564]   train-rmse:0.561552
## [565]   train-rmse:0.561539
## [566]   train-rmse:0.561531
## [567]   train-rmse:0.561413
## [568]   train-rmse:0.561290
## [569]   train-rmse:0.561188
```

[570]   train-rmse:0.561181
[571]   train-rmse:0.561130
[572]   train-rmse:0.561121
[573]   train-rmse:0.561004
[574]   train-rmse:0.560959
[575]   train-rmse:0.560891
[576]   train-rmse:0.560787
[577]   train-rmse:0.560646
[578]   train-rmse:0.560622
[579]   train-rmse:0.560457
[580]   train-rmse:0.560405
[581]   train-rmse:0.560235
[582]   train-rmse:0.560134
[583]   train-rmse:0.560047
[584]   train-rmse:0.559913
[585]   train-rmse:0.559834
[586]   train-rmse:0.559798
[587]   train-rmse:0.559644
[588]   train-rmse:0.559635 ## [589]
train-rmse:0.559542 ## [590]   train
rmse:0.559399
[591]   train rmse:0.559238
[592]   train rmse:0.559182 ## [593]
train rmse:0.559081
[594]   train rmse:0.559030
[595]   train rmse:0.558967

[596]   train rmse:0.558919 ## [597]   train-rmse:0.558825 ## [598]   train-rmse:0.558711
[599]   train-rmse:0.558683
[600]   train-rmse:0.558617
[601]   train-rmse:0.558536
[602]   train-rmse:0.558516
[603]   train-rmse:0.558427
[604]   train-rmse:0.558367
[605]   train-rmse:0.558367
[606]   train-rmse:0.558289
[607]   train-rmse:0.558209
[608]   train-rmse:0.558146
[609]   train-rmse:0.558088
[610]   train-rmse:0.558051
[611]   train-rmse:0.557993
[612]   train-rmse:0.557859
[613]   train-rmse:0.557813
[614]   train-rmse:0.557688
[615]   train-rmse:0.557640
[616]   train-rmse:0.557552
[617]   train-rmse:0.557491
[618]   train-rmse:0.557409
[619]   train-rmse:0.557341
[620]   train-rmse:0.557232
[621]   train-rmse:0.557134
[622]   train-rmse:0.557029
[623]   train-rmse:0.557020

```
## [624]   train-rmse:0.556951
## [625]   train-rmse:0.556878
## [626]   train-rmse:0.556741
## [627]   train-rmse:0.556674
## [628]   train-rmse:0.556536
## [629]   train-rmse:0.556518
## [630]   train-rmse:0.556393
## [631]   train-rmse:0.556324
## [632]   train-rmse:0.556288
## [633]   train-rmse:0.556214
## [634]   train-rmse:0.556091
## [635]   train-rmse:0.556016
## [636]   train-rmse:0.556005
## [637]   train-rmse:0.555868
## [638]   train-rmse:0.555809
## [639]   train-rmse:0.555779
## [640]   train rmse:0.555750
## [641]   train rmse:0.555631
## [642]    train rmse:0.555571 ## [643]
train  rmse:0.555512
## [644]   train  rmse:0.555468
## [645]   train  rmse:0.555400
## [646]   train  rmse:0.555290
## [647]   train  rmse:0.555268
## [648]   train-rmse:0.555261
## [649]   train-rmse:0.555219
## [650]   train-rmse:0.555189
## [651]   train-rmse:0.555093
```

```
## [652]   train-rmse:0.554921
## [653]   train-rmse:0.554819
## [654]   train-rmse:0.554747
## [655]   train-rmse:0.554649
## [656]   train-rmse:0.554626
## [657]   train-rmse:0.554474
## [658]   train-rmse:0.554419
## [659]   train-rmse:0.554390
## [660]   train-rmse:0.554382
## [661]   train-rmse:0.554369
## [662]   train-rmse:0.554352
## [663]   train-rmse:0.554241
## [664]   train-rmse:0.554204
## [665]   train-rmse:0.554204
## [666]   train-rmse:0.554204
## [667]   train-rmse:0.554092
## [668]   train-rmse:0.554006
## [669]   train-rmse:0.553913
## [670]   train-rmse:0.553877
## [671]   train-rmse:0.553782
## [672]   train-rmse:0.553694
## [673]   train-rmse:0.553669
## [674]   train-rmse:0.553588
## [675]   train-rmse:0.553518
## [676]   train-rmse:0.553434
## [677]   train-rmse:0.553371
## [678]   train-rmse:0.553340
## [679]   train-rmse:0.553225
```

## [680]	train-rmse:0.553208
## [681]	train-rmse:0.553161
## [682]	train-rmse:0.553105
## [683]	train-rmse:0.553011
## [684]	train-rmse:0.552883
## [685]	train-rmse:0.552783
## [686]	train-rmse:0.552749
## [687]	train-rmse:0.552588
## [688]	train-rmse:0.552468
## [689]	train-rmse:0.552331 ## [690]
train-rmse:0.552265 ## [691]	train
rmse:0.552153
## [692]	train rmse:0.552098

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```
## [693]   train  rmse:0.551968
## [694]   train  rmse:0.551954
## [695]   train  rmse:0.551860
## [696]   train  rmse:0.551748
## [697]   train  rmse:0.551588
## [698]   train-rmse:0.551496
## [699]   train-rmse:0.551359
## [700]   train-rmse:0.551268
## [701]   train-rmse:0.551235
## [702]   train-rmse:0.551141
## [703]   train-rmse:0.551126
## [704]   train-rmse:0.551082
## [705]   train-rmse:0.551053
## [706]   train-rmse:0.550942
## [707]   train-rmse:0.550886
## [708]   train-rmse:0.550835
## [709]   train-rmse:0.550755
## [710]   train-rmse:0.550682
## [711]   train-rmse:0.550592
## [712]   train-rmse:0.550516
## [713]   train-rmse:0.550396
## [714]   train-rmse:0.550367
## [715]   train-rmse:0.550309
## [716]   train-rmse:0.550209
## [717]   train-rmse:0.550177
## [718]   train-rmse:0.550149
## [719]   train-rmse:0.550089
```

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-
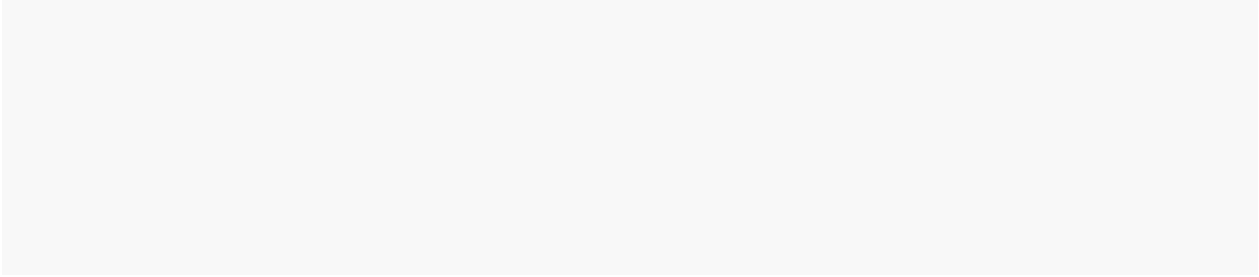
```
## [720]   train-rmse:0.550059
## [721]   train-rmse:0.549973
## [722]   train-rmse:0.549923
## [723]   train-rmse:0.549874
## [724]   train-rmse:0.549832
## [725]   train-rmse:0.549791
## [726]   train-rmse:0.549711
## [727]   train-rmse:0.549669
## [728]   train-rmse:0.549607
## [729]   train-rmse:0.549484
## [730]   train-rmse:0.549451
## [731]   train-rmse:0.549386
## [732]   train-rmse:0.549289
## [733]   train-rmse:0.549228
## [734]   train-rmse:0.549190
## [735]   train-rmse:0.549114
## [736]   train-rmse:0.549058
## [737]   train-rmse:0.549031
## [738]   train-rmse:0.548999
## [739]   train-rmse:0.548954
## [740]   train-rmse:0.548874
## [741]   train rmse:0.548721
## [742]    train rmse:0.548647 ## [743]
train   rmse:0.548602
## [744]   train   rmse:0.548563
## [745]   train   rmse:0.548532
## [746]   train   rmse:0.548457
```
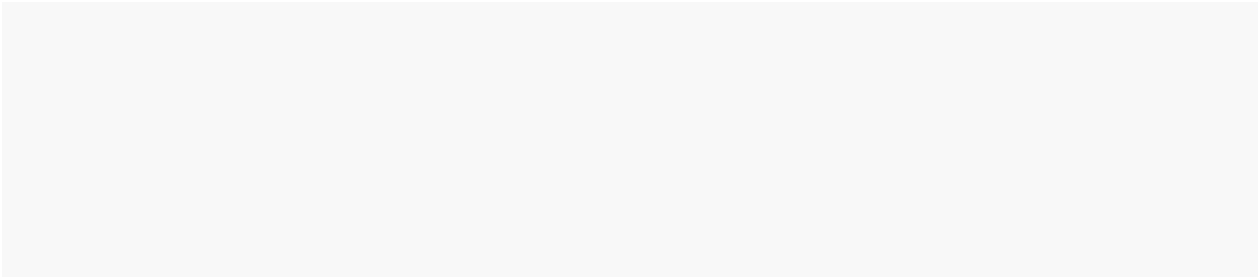
```
## [747]   train  rmse:0.548445
## [748]   train-rmse:0.548392
## [749]   train-rmse:0.548288
## [750]   train-rmse:0.548217
## [1] train-rmse:1.197026
## [2] train-rmse:1.178051
## [3] train-rmse:1.159671
## [4] train-rmse:1.141825
## [5] train-rmse:1.124480
## [6] train-rmse:1.107832
## [7] train-rmse:1.091675
## [8] train-rmse:1.075699
## [9] train-rmse:1.060577
## [10] train-rmse:1.045904
## [11] train-rmse:1.031827
## [12] train-rmse:1.018114
## [13] train-rmse:1.004731
## [14] train-rmse:0.991977
## [15] train-rmse:0.979595
## [16] train-rmse:0.967661
## [17] train-rmse:0.956062
## [18] train-rmse:0.944796
## [19] train-rmse:0.934093
## [20] train-rmse:0.923795
## [21] train-rmse:0.913696
## [22] train-rmse:0.904029
## [23] train-rmse:0.894772
```

```
## [24] train-rmse:0.885949
## [25] train-rmse:0.877362
## [26] train-rmse:0.869010
## [27] train-rmse:0.861044
## [28] train-rmse:0.853233
## [29] train-rmse:0.845857
## [30] train-rmse:0.838656
## [31] train-rmse:0.831775
## [32] train-rmse:0.825014
## [33] train-rmse:0.818587
## [34] train-rmse:0.812539
## [35] train-rmse:0.806648
## [36] train-rmse:0.800992
## [37] train-rmse:0.795542
## [38] train-rmse:0.790206
## [39] train-rmse:0.785085
## [40] train-rmse:0.779874
## [41] train-rmse:0.774906
## [42] train-rmse:0.770240
## [43] train-rmse:0.765683
## [44] train-rmse:0.761345
## [45] train-rmse:0.757230
## [46] train-rmse:0.753217
## [47] train-rmse:0.749472
## [48] train-rmse:0.745785
## [49] train-rmse:0.742329
## [50] train-rmse:0.738902
```

```
## [51] train-rmse:0.735452
## [52] train-rmse:0.732359
## [53] train-rmse:0.729296
## [54] train-rmse:0.726333
## [55] train-rmse:0.723467
## [56] train-rmse:0.720552
## [57] train-rmse:0.717843
## [58] train-rmse:0.715298
## [59] train-rmse:0.712859
## [60] train-rmse:0.710421
## [61] train-rmse:0.708144
## [62] train-rmse:0.705961
## [63] train-rmse:0.703670
## [64] train-rmse:0.701651
## [65] train-rmse:0.699604
## [66] train-rmse:0.697843
## [67] train-rmse:0.696019
## [68] train-rmse:0.694244
## [69] train-rmse:0.692408
## [70] train-rmse:0.690776
## [71] train-rmse:0.689162
## [72] train-rmse:0.687492
## [73] train-rmse:0.685975
## [74] train-rmse:0.684430
## [75] train-rmse:0.682960
## [76] train-rmse:0.681454
## [77] train-rmse:0.680061
```

```
## [78] train-rmse:0.678624
## [79] train-rmse:0.677380
## [80] train-rmse:0.676107
## [81] train-rmse:0.674808
## [82] train-rmse:0.673596
## [83] train-rmse:0.672441
## [84] train-rmse:0.671316
## [85] train-rmse:0.670122
## [86] train-rmse:0.669113
## [87] train-rmse:0.668073
## [88] train-rmse:0.667077
## [89] train-rmse:0.666077
## [90] train-rmse:0.665224
## [91] train-rmse:0.664218
## [92] train-rmse:0.663404
```

```
## [93] train-rmse:0.662565
## [94] train-rmse:0.661658
## [95] train-rmse:0.660785
## [96] train-rmse:0.660040
## [97] train-rmse:0.659166
## [98] train-rmse:0.658354
## [99] train-rmse:0.657575
## [100]   train-rmse:0.656798
## [101]   train-rmse:0.656188
## [102]   train-rmse:0.655489
## [103]   train-rmse:0.654844
## [104]   train-rmse:0.654146
## [105]   train-rmse:0.653519
## [106]   train-rmse:0.652806
## [107]   train-rmse:0.652167
## [108]   train-rmse:0.651531
## [109]   train-rmse:0.650902
## [110]   train-rmse:0.650311
## [111]   train-rmse:0.649728
## [112]   train-rmse:0.649150
## [113]   train-rmse:0.648583
## [114]   train-rmse:0.648093
## [115]   train-rmse:0.647559
## [116]   train-rmse:0.647007
## [117]   train-rmse:0.646552
## [118]   train-rmse:0.646008
## [119]   train-rmse:0.645562
## [120]   train-rmse:0.645068
## [121]   train-rmse:0.644611
## [122]   train-rmse:0.644122
## [123]   train-rmse:0.643657
## [124]   train-rmse:0.643298
## [125]   train-rmse:0.642868
## [126]   train-rmse:0.642476
```

[127]   train-rmse:0.642040
[128]   train-rmse:0.641674
[129]   train-rmse:0.641289
[130]   train-rmse:0.640936
[131]   train-rmse:0.640572
[132]   train-rmse:0.640196
[133]   train-rmse:0.639831
[134]   train-rmse:0.639499
[135]   train-rmse:0.639100
[136]   train-rmse:0.638743
[137]   train-rmse:0.638416 ## [138] train-rmse:0.638094 ## [139]   train-rmse:0.637766
[140]   train rmse:0.637444
[141]   train rmse:0.637091
[142]   train rmse:0.636712 ## [143] train rmse:0.636384
[144]   train rmse:0.636076
[145]   train rmse:0.635711 ## [146] train-rmse:0.635370 ## [147]   train-rmse:0.635086
[148]   train-rmse:0.634784
[149]   train-rmse:0.634595
[150]   train-rmse:0.634366
[151]   train-rmse:0.634089
[152]   train-rmse:0.633709
[153]   train-rmse:0.633269
[154]   train-rmse:0.632971

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## [155]   train-rmse:0.632644
## [156]   train-rmse:0.632391
## [157]   train-rmse:0.632158
## [158]   train-rmse:0.631899
## [159]   train-rmse:0.631599
## [160]   train-rmse:0.631388
## [161]   train-rmse:0.631154
## [162]   train-rmse:0.630910
## [163]   train-rmse:0.630649
## [164]   train-rmse:0.630441
## [165]   train-rmse:0.630203
## [166]   train-rmse:0.629947
## [167]   train-rmse:0.629690
## [168]   train-rmse:0.629452
## [169]   train-rmse:0.629171
## [170]   train-rmse:0.628873
## [171]   train-rmse:0.628585
## [172]   train-rmse:0.628284
## [173]   train-rmse:0.628040
## [174]   train-rmse:0.627821
## [175]   train-rmse:0.627539
## [176]   train-rmse:0.627220
## [177]   train-rmse:0.626989
## [178]   train-rmse:0.626780
## [179]   train-rmse:0.626591
## [180]   train-rmse:0.626278
## [181]   train-rmse:0.625994
## [182]   train-rmse:0.625783
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[183]   train-rmse:0.625534
[184]   train-rmse:0.625356
[185]   train-rmse:0.625260
[186]   train-rmse:0.625157
[187]   train   rmse:0.624925
[188]   train   rmse:0.624759
[189]   train   rmse:0.624617
[190]   train   rmse:0.624312
[191]   train   rmse:0.624146
[192]   train   rmse:0.623913 ## [193]
train   rmse:0.623683
[194]   train   rmse:0.623445
[195]   train   rmse:0.623303
[196]   train   rmse:0.623073
[197]   train   rmse:0.622847
[198]   train   rmse:0.622637
[199]   train   rmse:0.622459
[200]   train   rmse:0.622278
[201]   train-rmse:0.622010
[202]   train-rmse:0.621762
[203]   train-rmse:0.621631
[204]   train-rmse:0.621506
[205]   train-rmse:0.621337
[206]   train-rmse:0.621265
[207]   train-rmse:0.621059
[208]   train-rmse:0.620876
[209]   train-rmse:0.620593
[210]   train-rmse:0.620365

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## [211]   train-rmse:0.620279
## [212]   train-rmse:0.620150
## [213]   train-rmse:0.619959
## [214]   train-rmse:0.619778
## [215]   train-rmse:0.619530
## [216]   train-rmse:0.619365
## [217]   train-rmse:0.619079
## [218]   train-rmse:0.618993
## [219]   train-rmse:0.618853
## [220]   train-rmse:0.618724
## [221]   train-rmse:0.618499
## [222]   train-rmse:0.618439
## [223]   train-rmse:0.618315
## [224]   train-rmse:0.618161
## [225]   train-rmse:0.618038
## [226]   train-rmse:0.617857
## [227]   train-rmse:0.617628
## [228]   train-rmse:0.617443
## [229]   train-rmse:0.617392
## [230]   train-rmse:0.617187
## [231]   train-rmse:0.617036
## [232]   train-rmse:0.616826
## [233]   train-rmse:0.616686
## [234]   train-rmse:0.616585
## [235]   train-rmse:0.616387
## [236]   train-rmse:0.616297
## [237]   train-rmse:0.616215
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[238]   train-rmse:0.615978 ## [239]
train-rmse:0.615894 ## [240]   train
rmse:0.615832
[241]   train rmse:0.615680
[242]   train rmse:0.615396

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## [243]   train   rmse:0.615237
## [244]   train   rmse:0.615037
## [245]   train   rmse:0.614818
## [246]   train   rmse:0.614594
## [247]   train   rmse:0.614528
## [248]   train   rmse:0.614460
## [249]   train   rmse:0.614260
## [250]   train   rmse:0.614062
## [251]   train-rmse:0.613989
## [252]   train-rmse:0.613921
## [253]   train-rmse:0.613794
## [254]   train-rmse:0.613704
## [255]   train-rmse:0.613569
## [256]   train-rmse:0.613431
## [257]   train-rmse:0.613310
## [258]   train-rmse:0.613207
## [259]   train-rmse:0.613091
## [260]   train-rmse:0.613023
## [261]   train-rmse:0.612881
## [262]   train-rmse:0.612695
## [263]   train-rmse:0.612630
## [264]   train-rmse:0.612583
## [265]   train-rmse:0.612490
## [266]   train-rmse:0.612355
## [267]   train-rmse:0.612285
## [268]   train-rmse:0.612222
## [269]   train-rmse:0.612175
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[270]   train-rmse:0.612084
[271]   train-rmse:0.611941
[272]   train-rmse:0.611870
[273]   train-rmse:0.611713
[274]   train-rmse:0.611607
[275]   train-rmse:0.611477
[276]   train-rmse:0.611404
[277]   train-rmse:0.611273
[278]   train-rmse:0.611164
[279]   train-rmse:0.611075
[280]   train-rmse:0.610979
[281]   train-rmse:0.610880
[282]   train-rmse:0.610750
[283]   train-rmse:0.610555
[284]   train-rmse:0.610449
[285]   train-rmse:0.610336
[286]   train-rmse:0.610216
[287]   train rmse:0.610052
[288]   train rmse:0.609869
[289]   train rmse:0.609748
[290]   train rmse:0.609525
[291]   train rmse:0.609431
[292]   train rmse:0.609306 ## [293]
train rmse:0.609139
[294]   train rmse:0.609063
[295]   train rmse:0.608999
[296]   train rmse:0.608854

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## [297]   train   rmse:0.608792
## [298]   train   rmse:0.608723
## [299]   train   rmse:0.608612
## [300]   train   rmse:0.608448
## [301]   train-rmse:0.608390
## [302]   train-rmse:0.608356
## [303]   train-rmse:0.608210
## [304]   train-rmse:0.608155
## [305]   train-rmse:0.608051
## [306]   train-rmse:0.607913
## [307]   train-rmse:0.607837
## [308]   train-rmse:0.607706
## [309]   train-rmse:0.607507
## [310]   train-rmse:0.607337
## [311]   train-rmse:0.607274
## [312]   train-rmse:0.607146
## [313]   train-rmse:0.607098
## [314]   train-rmse:0.607068
## [315]   train-rmse:0.607002
## [316]   train-rmse:0.606902
## [317]   train-rmse:0.606799
## [318]   train-rmse:0.606681
## [319]   train-rmse:0.606655
## [320]   train-rmse:0.606547
## [321]   train-rmse:0.606431
## [322]   train-rmse:0.606318
## [323]   train-rmse:0.606225
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## [324]    train-rmse:0.606115
## [325]    train-rmse:0.605972
## [326]    train-rmse:0.605773
## [327]    train-rmse:0.605591
## [328]    train-rmse:0.605482
## [329]    train-rmse:0.605430
## [330]    train-rmse:0.605261
## [331]    train-rmse:0.605173
## [332]    train-rmse:0.605079
## [333]    train-rmse:0.604959
## [334]    train-rmse:0.604834
## [335]    train-rmse:0.604631
## [336]    train-rmse:0.604485
## [337]    train-rmse:0.604426
## [338]    train-rmse:0.604246
## [339]    train-rmse:0.604141 ## [340]
train-rmse:0.604014  ## [341]        train
rmse:0.603852
## [342]    train rmse:0.603806 ## [343]
train   rmse:0.603722
## [344]    train   rmse:0.603614
## [345]    train   rmse:0.603469
## [346]    train   rmse:0.603401
## [347]    train   rmse:0.603335
## [348]    train-rmse:0.603203
## [349]    train-rmse:0.603106
## [350]    train-rmse:0.603035
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[351]   train-rmse:0.602994
[352]   train-rmse:0.602899
[353]   train-rmse:0.602858
[354]   train-rmse:0.602766
[355]   train-rmse:0.602706
[356]   train-rmse:0.602569
[357]   train-rmse:0.602520
[358]   train-rmse:0.602441
[359]   train-rmse:0.602231
[360]   train-rmse:0.602143
[361]   train-rmse:0.602063
[362]   train-rmse:0.601898
[363]   train-rmse:0.601775
[364]   train-rmse:0.601695
[365]   train-rmse:0.601567
[366]   train-rmse:0.601475
[367]   train-rmse:0.601372
[368]   train-rmse:0.601318
[369]   train-rmse:0.601267
[370]   train-rmse:0.601127
[371]   train-rmse:0.601010
[372]   train-rmse:0.600848
[373]   train-rmse:0.600714
[374]   train-rmse:0.600526
[375]   train-rmse:0.600419
[376]   train-rmse:0.600355
[377]   train-rmse:0.600303

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[378]   train-rmse:0.600228
[379]   train-rmse:0.600181
[380]   train-rmse:0.600007
[381]   train-rmse:0.599896
[382]   train-rmse:0.599813
[383]   train-rmse:0.599633
[384]   train-rmse:0.599499
[385]   train-rmse:0.599406
[386]   train-rmse:0.599317
[387]   train   rmse:0.599182
[388]   train   rmse:0.599074
[389]   train   rmse:0.599031
[390]   train   rmse:0.598971
[391]   train   rmse:0.598836
[392]   train   rmse:0.598749

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[393]   train rmse:0.598652 ## [394]
train-rmse:0.598571 ## [395]   train-
rmse:0.598390
[396]   train-rmse:0.598334
[397]   train-rmse:0.598169
[398]   train-rmse:0.598072
[399]   train-rmse:0.597987
[400]   train-rmse:0.597958
[401]   train-rmse:0.597913
[402]   train-rmse:0.597835
[403]   train-rmse:0.597802
[404]   train-rmse:0.597613
[405]   train-rmse:0.597479
[406]   train-rmse:0.597385
[407]   train-rmse:0.597308
[408]   train-rmse:0.597255
[409]   train-rmse:0.597192
[410]   train-rmse:0.597114
[411]   train-rmse:0.596960
[412]   train-rmse:0.596816
[413]   train-rmse:0.596696
[414]   train-rmse:0.596663
[415]   train-rmse:0.596591
[416]   train-rmse:0.596480
[417]   train-rmse:0.596335
[418]   train-rmse:0.596284
[419]   train-rmse:0.596158

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[420]   train-rmse:0.596068
[421]   train-rmse:0.596039
[422]   train-rmse:0.595914
[423]   train-rmse:0.595896
[424]   train-rmse:0.595863
[425]   train-rmse:0.595794
[426]   train-rmse:0.595753
[427]   train-rmse:0.595682
[428]   train-rmse:0.595526
[429]   train-rmse:0.595424
[430]   train-rmse:0.595301
[431]   train-rmse:0.595123
[432]   train-rmse:0.595047
[433]   train-rmse:0.594975
[434]   train-rmse:0.594808
[435]   train-rmse:0.594686
[436]   train-rmse:0.594594
[437]   train-rmse:0.594534
[438]   train-rmse:0.594494
[439]   train-rmse:0.594269
[440]   train-rmse:0.594207
[441]   train-rmse:0.594137
[442]   train rmse:0.594076 ## [443]
train   rmse:0.594054
[444]   train   rmse:0.593926
[445]   train   rmse:0.593787
[446]   train   rmse:0.593598
[447]   train   rmse:0.593422
[448]   train   rmse:0.593382

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## [449]   train   rmse:0.593258
## [450]   train-rmse:0.593179
## [451]   train-rmse:0.593119
## [452]   train-rmse:0.593003
## [453]   train-rmse:0.592994
## [454]   train-rmse:0.592911
## [455]   train-rmse:0.592837
## [456]   train-rmse:0.592705
## [457]   train-rmse:0.592571
## [458]   train-rmse:0.592505
## [459]   train-rmse:0.592416
## [460]   train-rmse:0.592249
## [461]   train-rmse:0.592158
## [462]   train-rmse:0.592004
## [463]   train-rmse:0.591962
## [464]   train-rmse:0.591898
## [465]   train-rmse:0.591747
## [466]   train-rmse:0.591695
## [467]   train-rmse:0.591671
## [468]   train-rmse:0.591565
## [469]   train-rmse:0.591422
## [470]   train-rmse:0.591363
## [471]   train-rmse:0.591340
## [472]   train-rmse:0.591256
## [473]   train-rmse:0.591092
## [474]   train-rmse:0.590923
## [475]   train-rmse:0.590814
## [476]   train-rmse:0.590685
## [477]   train-rmse:0.590572
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[478]   train-rmse:0.590529
[479]   train-rmse:0.590507
[480]   train-rmse:0.590453
[481]   train-rmse:0.590382
[482]   train-rmse:0.590259
[483]   train-rmse:0.590172
[484]   train-rmse:0.590094
[485]   train-rmse:0.590024
[486]   train-rmse:0.589956
[487]   train rmse:0.589765
[488]   train rmse:0.589681
[489]   train rmse:0.589562
[490]   train rmse:0.589525
[491]   train rmse:0.589434
[492]   train   rmse:0.589428 ## [493]
train rmse:0.589380
[494]   train rmse:0.589284 ## [495]
train-rmse:0.589194 ## [496]   train-
rmse:0.589152
[497]   train-rmse:0.589098
[498]   train-rmse:0.589035
[499]   train-rmse:0.588955
[500]   train-rmse:0.588920
[501]   train-rmse:0.588868
[502]   train-rmse:0.588726
[503]   train-rmse:0.588609
[504]   train-rmse:0.588591
[505]   train-rmse:0.588418
[506]   train-rmse:0.588328

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## [507]   train-rmse:0.588265
## [508]   train-rmse:0.588231
## [509]   train-rmse:0.588106
## [510]   train-rmse:0.588044
## [511]   train-rmse:0.588023
## [512]   train-rmse:0.587864
## [513]   train-rmse:0.587687
## [514]   train-rmse:0.587539
## [515]   train-rmse:0.587459
## [516]   train-rmse:0.587313
## [517]   train-rmse:0.587254
## [518]   train-rmse:0.587225
## [519]   train-rmse:0.587136
## [520]   train-rmse:0.587119
## [521]   train-rmse:0.587070
## [522]   train-rmse:0.587044
## [523]   train-rmse:0.586971
## [524]   train-rmse:0.586920
## [525]   train-rmse:0.586819
## [526]   train-rmse:0.586772
## [527]   train-rmse:0.586733
## [528]   train-rmse:0.586653
## [529]   train-rmse:0.586593
## [530]   train-rmse:0.586445
## [531]   train-rmse:0.586379
## [532]   train-rmse:0.586277
## [533]   train-rmse:0.586124
## [534]   train-rmse:0.586047
## [535]   train-rmse:0.585934
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[536]   train-rmse:0.585871
[537]   train-rmse:0.585794
[538]   train-rmse:0.585743
[539]   train-rmse:0.585650
[540]   train-rmse:0.585566
[541]   train-rmse:0.585511
[542]   train-rmse:0.585489

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[543]   train rmse:0.585440
[544]   train rmse:0.585370
[545]   train rmse:0.585268
[546]   train rmse:0.585248
[547]   train rmse:0.585162
[548]   train rmse:0.584972
[549]   train rmse:0.584866
[550]   train-rmse:0.584800
[551]   train-rmse:0.584748
[552]   train-rmse:0.584706
[553]   train-rmse:0.584622
[554]   train-rmse:0.584549
[555]   train-rmse:0.584368
[556]   train-rmse:0.584259
[557]   train-rmse:0.584222
[558]   train-rmse:0.584205
[559]   train-rmse:0.584065
[560]   train-rmse:0.583961
[561]   train-rmse:0.583860
[562]   train-rmse:0.583647
[563]   train-rmse:0.583563
[564]   train-rmse:0.583523
[565]   train-rmse:0.583473
[566]   train-rmse:0.583418
[567]   train-rmse:0.583303
[568]   train-rmse:0.583282
[569]   train-rmse:0.583263
[570]   train-rmse:0.583207
[571]   train-rmse:0.583154

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## [572]    train-rmse:0.583119
## [573]    train-rmse:0.583049
## [574]    train-rmse:0.582968
## [575]    train-rmse:0.582879
## [576]    train-rmse:0.582713
## [577]    train-rmse:0.582598
## [578]    train-rmse:0.582462
## [579]    train-rmse:0.582358
## [580]    train-rmse:0.582263
## [581]    train-rmse:0.582141
## [582]    train-rmse:0.582035
## [583]    train-rmse:0.581985
## [584]    train-rmse:0.581971
## [585]    train-rmse:0.581958
## [586]    train-rmse:0.581863
## [587]    train-rmse:0.581777 ## [588] train-rmse:0.581721 ## [589]    train rmse:0.581668
## [590]    train rmse:0.581540
## [591]    train rmse:0.581454
## [592]    train rmse:0.581386 ## [593] train rmse:0.581343
## [594]    train rmse:0.581309
## [595]    train rmse:0.581255 ## [596] train-rmse:0.581073 ## [597]    train-rmse:0.581055
## [598]    train-rmse:0.581052
## [599]    train-rmse:0.581045
## [600]    train-rmse:0.581031
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## [601]   train-rmse:0.580923
## [602]   train-rmse:0.580849
## [603]   train-rmse:0.580817
## [604]   train-rmse:0.580691
## [605]   train-rmse:0.580619
## [606]   train-rmse:0.580599
## [607]   train-rmse:0.580584
## [608]   train-rmse:0.580485
## [609]   train-rmse:0.580383
## [610]   train-rmse:0.580271
## [611]   train-rmse:0.580135
## [612]   train-rmse:0.580098
## [613]   train-rmse:0.580032
## [614]   train-rmse:0.579964
## [615]   train-rmse:0.579837
## [616]   train-rmse:0.579730
## [617]   train-rmse:0.579687
## [618]   train-rmse:0.579640
## [619]   train-rmse:0.579564
## [620]   train-rmse:0.579511
## [621]   train-rmse:0.579368
## [622]   train-rmse:0.579225
## [623]   train-rmse:0.579206
## [624]   train-rmse:0.579200
## [625]   train-rmse:0.579157
## [626]   train-rmse:0.579129
## [627]   train-rmse:0.579061
## [628]   train-rmse:0.579016
## [629]   train-rmse:0.578932
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[630]   train-rmse:0.578838
[631]   train-rmse:0.578712
[632]   train-rmse:0.578629
[633]   train-rmse:0.578587
[634]   train-rmse:0.578571
[635]   train-rmse:0.578491
[636]   train-rmse:0.578471
[637]   train-rmse:0.578391
[638]   train-rmse:0.578329
[639]   train-rmse:0.578225
[640]   train rmse:0.578046
[641]   train rmse:0.577950
[642]   train rmse:0.577915 ## [643]
train   rmse:0.577809
[644]   train   rmse:0.577744
[645]   train   rmse:0.577566
[646]   train   rmse:0.577509
[647]   train   rmse:0.577427
[648]   train   rmse:0.577280
[649]   train   rmse:0.577161 ## [650]
train-rmse:0.577136
[651]   train-rmse:0.577005
[652]   train-rmse:0.576849
[653]   train-rmse:0.576779
[654]   train-rmse:0.576755
[655]   train-rmse:0.576733
[656]   train-rmse:0.576682
[657]   train-rmse:0.576624
[658]   train-rmse:0.576533

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[659]   train-rmse:0.576460
[660]   train-rmse:0.576327
[661]   train-rmse:0.576263
[662]   train-rmse:0.576194
[663]   train-rmse:0.576106
[664]   train-rmse:0.576059
[665]   train-rmse:0.575972
[666]   train-rmse:0.575927
[667]   train-rmse:0.575828
[668]   train-rmse:0.575757
[669]   train-rmse:0.575663
[670]   train-rmse:0.575592
[671]   train-rmse:0.575586
[672]   train-rmse:0.575496
[673]   train-rmse:0.575489
[674]   train-rmse:0.575441
[675]   train-rmse:0.575316
[676]   train-rmse:0.575316
[677]   train-rmse:0.575175
[678]   train-rmse:0.575108
[679]   train-rmse:0.575022
[680]   train-rmse:0.575003
[681]   train-rmse:0.574907
[682]   train-rmse:0.574831
[683]   train-rmse:0.574747
[684]   train-rmse:0.574674
[685]   train-rmse:0.574674
[686]   train-rmse:0.574612
[687]   train-rmse:0.574612

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[688]   train-rmse:0.574511 ## [689]
train-rmse:0.574402 ## [690]   train
rmse:0.574318
[691]   train rmse:0.574233
[692]   train rmse:0.574202

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## [693]    train rmse:0.574110
## [694]    train rmse:0.574049
## [695]    train rmse:0.574033
## [696]    train rmse:0.573954
## [697]    train-rmse:0.573861
## [698]    train-rmse:0.573788
## [699]    train-rmse:0.573753
## [700]    train-rmse:0.573706
## [701]    train-rmse:0.573693
## [702]    train-rmse:0.573589
## [703]    train-rmse:0.573455
## [704]    train-rmse:0.573405
## [705]    train-rmse:0.573307
## [706]    train-rmse:0.573250
## [707]    train-rmse:0.573155
## [708]    train-rmse:0.572998
## [709]    train-rmse:0.572941
## [710]    train-rmse:0.572840
## [711]    train-rmse:0.572761
## [712]    train-rmse:0.572679
## [713]    train-rmse:0.572658
## [714]    train-rmse:0.572603
## [715]    train-rmse:0.572566
## [716]    train-rmse:0.572424
## [717]    train-rmse:0.572400
## [718]    train-rmse:0.572331
## [719]    train-rmse:0.572242
## [720]    train-rmse:0.572166
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## [721]    train-rmse:0.572150
## [722]    train-rmse:0.572066
## [723]    train-rmse:0.571917
## [724]    train-rmse:0.571875
## [725]    train-rmse:0.571798
## [726]    train-rmse:0.571723
## [727]    train-rmse:0.571671
## [728]    train-rmse:0.571605
## [729]    train-rmse:0.571500
## [730]    train-rmse:0.571379
## [731]    train-rmse:0.571321
## [732]    train-rmse:0.571246
## [733]    train-rmse:0.571217
## [734]    train-rmse:0.571136
## [735]    train-rmse:0.571099
## [736]    train-rmse:0.571077
## [737]    train-rmse:0.571001
## [738]    train-rmse:0.570920
## [739]    train-rmse:0.570873
## [740]    train rmse:0.570817
## [741]    train rmse:0.570718
## [742]      train rmse:0.570566 ## [743]
train rmse:0.570480
## [744]    train rmse:0.570408
## [745]    train rmse:0.570308
## [746]    train rmse:0.570209
## [747]    train-rmse:0.570162
## [748]    train-rmse:0.570096
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## [749]    train-rmse:0.570047
## [750]    train-rmse:0.570025
## [1]  train-rmse:1.184072
## [2]  train-rmse:1.165147
## [3]  train-rmse:1.146789
## [4]  train-rmse:1.129150
## [5]  train-rmse:1.111969
## [6]  train-rmse:1.095369
## [7]  train-rmse:1.079280
## [8]  train-rmse:1.063887
## [9]  train-rmse:1.048770
## [10] train-rmse:1.034262
## [11] train-rmse:1.020203
## [12] train-rmse:1.006623
## [13] train-rmse:0.993732
## [14] train-rmse:0.980935
## [15] train-rmse:0.968688
## [16] train-rmse:0.956809
## [17] train-rmse:0.945406
## [18] train-rmse:0.934433
## [19] train-rmse:0.923748
## [20] train-rmse:0.913468
## [21] train-rmse:0.903502
## [22] train-rmse:0.893777
## [23] train-rmse:0.884659
## [24] train-rmse:0.875755
## [25] train-rmse:0.867066
## [26] train-rmse:0.858730
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## [27] train-rmse:0.850791
## [28] train-rmse:0.843126
## [29] train-rmse:0.835749
## [30] train-rmse:0.828553
## [31] train-rmse:0.821634
## [32] train-rmse:0.814971
## [33] train-rmse:0.808476
## [34] train-rmse:0.802308
## [35] train-rmse:0.796388
## [36] train-rmse:0.790688
## [37] train-rmse:0.785039
## [38] train-rmse:0.779735
## [39] train-rmse:0.774648
## [40] train-rmse:0.769796
## [41] train-rmse:0.765018
## [42] train-rmse:0.760585
## [43] train-rmse:0.756267
## [44] train-rmse:0.752107
## [45] train-rmse:0.747966
## [46] train-rmse:0.744032
## [47] train-rmse:0.740189
## [48] train-rmse:0.736544
## [49] train-rmse:0.733083
## [50] train-rmse:0.729701
## [51] train-rmse:0.726514
## [52] train-rmse:0.723341
## [53] train-rmse:0.720299
## [54] train-rmse:0.717237
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## [55] train-rmse:0.714380
## [56] train-rmse:0.711612
## [57] train-rmse:0.708998
## [58] train-rmse:0.706475
## [59] train-rmse:0.703992
## [60] train-rmse:0.701611
## [61] train-rmse:0.699330
## [62] train-rmse:0.697113
## [63] train-rmse:0.694988
## [64] train-rmse:0.692854
## [65] train-rmse:0.690789
## [66] train-rmse:0.688918
## [67] train-rmse:0.687105
## [68] train-rmse:0.685360
## [69] train-rmse:0.683587
## [70] train-rmse:0.681918
## [71] train-rmse:0.680322
## [72] train-rmse:0.678701
## [73] train-rmse:0.677226
## [74] train-rmse:0.675707
## [75] train-rmse:0.674309
## [76] train-rmse:0.672913
## [77] train-rmse:0.671466
## [78] train-rmse:0.670144
## [79] train-rmse:0.668926
## [80] train-rmse:0.667572
## [81] train-rmse:0.666304
## [82] train-rmse:0.665198
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## [83] train-rmse:0.664021
## [84] train-rmse:0.662811
## [85] train-rmse:0.661638
## [86] train-rmse:0.660670
## [87] train-rmse:0.659674
## [88] train-rmse:0.658753
## [89] train-rmse:0.657724
## [90] train-rmse:0.656791
## [91] train-rmse:0.655910
## [92] train-rmse:0.654953
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## [93] train-rmse:0.654085
## [94] train-rmse:0.653205
## [95] train-rmse:0.652302
## [96] train-rmse:0.651521
## [97] train-rmse:0.650837
## [98] train-rmse:0.650129
## [99] train-rmse:0.649419
## [100]   train-rmse:0.648697
## [101]   train-rmse:0.648034
## [102]   train-rmse:0.647422
## [103]   train-rmse:0.646711
## [104]   train-rmse:0.646070
## [105]   train-rmse:0.645452
## [106]   train-rmse:0.644826
## [107]   train-rmse:0.644175
## [108]   train-rmse:0.643497
## [109]   train-rmse:0.642925
## [110]   train-rmse:0.642344
## [111]   train-rmse:0.641792
## [112]   train-rmse:0.641171
## [113]   train-rmse:0.640596
## [114]   train-rmse:0.639920
## [115]   train-rmse:0.639357
## [116]   train-rmse:0.638907
## [117]   train-rmse:0.638398
## [118]   train-rmse:0.637835
## [119]   train-rmse:0.637456
## [120]   train-rmse:0.636969
## [121]   train-rmse:0.636536
## [122]   train-rmse:0.635917
## [123]   train-rmse:0.635395
## [124]   train-rmse:0.635051
## [125]   train-rmse:0.634661
## [126]   train-rmse:0.634274
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[127]   train-rmse:0.633818
[128]   train-rmse:0.633393
[129]   train-rmse:0.633026
[130]   train-rmse:0.632576
[131]   train-rmse:0.632095
[132]   train-rmse:0.631668
[133]   train-rmse:0.631259
[134]   train-rmse:0.630834
[135]   train-rmse:0.630418
[136]   train-rmse:0.630069 ## [137]
train-rmse:0.629570 ## [138]   train-
rmse:0.629214
[139]   train rmse:0.628817
[140]   train rmse:0.628503
[141]   train rmse:0.628166
[142]   train rmse:0.627859 ## [143]
train rmse:0.627515
[144]   train rmse:0.627210 ## [145]
train-rmse:0.626928 ## [146]   train-
rmse:0.626598
[147]   train-rmse:0.626266
[148]   train-rmse:0.626038
[149]   train-rmse:0.625755
[150]   train-rmse:0.625423
[151]   train-rmse:0.625059
[152]   train-rmse:0.624809
[153]   train-rmse:0.624482
[154]   train-rmse:0.624151

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## [155]	train-rmse:0.623954
## [156]	train-rmse:0.623601
## [157]	train-rmse:0.623319
## [158]	train-rmse:0.623003
## [159]	train-rmse:0.622701
## [160]	train-rmse:0.622355
## [161]	train-rmse:0.622163
## [162]	train-rmse:0.621853
## [163]	train-rmse:0.621590
## [164]	train-rmse:0.621346
## [165]	train-rmse:0.621058
## [166]	train-rmse:0.620827
## [167]	train-rmse:0.620609
## [168]	train-rmse:0.620431
## [169]	train-rmse:0.620171
## [170]	train-rmse:0.619838
## [171]	train-rmse:0.619540
## [172]	train-rmse:0.619208
## [173]	train-rmse:0.618900
## [174]	train-rmse:0.618632
## [175]	train-rmse:0.618407
## [176]	train-rmse:0.618230
## [177]	train-rmse:0.617958
## [178]	train-rmse:0.617774
## [179]	train-rmse:0.617546
## [180]	train-rmse:0.617385
## [181]	train-rmse:0.617137
## [182]	train-rmse:0.616811
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[183]   train-rmse:0.616578
[184]   train-rmse:0.616358
[185]   train-rmse:0.616157
[186]   train rmse:0.615912
[187]   train rmse:0.615620
[188]   train rmse:0.615402
[189]   train rmse:0.615282
[190]   train rmse:0.615181
[191]   train rmse:0.614824
[192]   train   rmse:0.614664 ## [193]
train rmse:0.614381
[194]   train rmse:0.614224
[195]   train rmse:0.613905
[196]   train-rmse:0.613611
[197]   train-rmse:0.613445
[198]   train-rmse:0.613186 ## [199]
train-rmse:0.612988 ## [200]   train-
rmse:0.612757
[201]   train-rmse:0.612492
[202]   train-rmse:0.612380
[203]   train-rmse:0.612219
[204]   train-rmse:0.612065
[205]   train-rmse:0.611934
[206]   train-rmse:0.611858
[207]   train-rmse:0.611673
[208]   train-rmse:0.611500
[209]   train-rmse:0.611268
[210]   train-rmse:0.611154

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## [211]   train-rmse:0.610987
## [212]   train-rmse:0.610774
## [213]   train-rmse:0.610560
## [214]   train-rmse:0.610352
## [215]   train-rmse:0.610130
## [216]   train-rmse:0.610012
## [217]   train-rmse:0.609821
## [218]   train-rmse:0.609694
## [219]   train-rmse:0.609450
## [220]   train-rmse:0.609277
## [221]   train-rmse:0.609171
## [222]   train-rmse:0.609044
## [223]   train-rmse:0.608782
## [224]   train-rmse:0.608600
## [225]   train-rmse:0.608334
## [226]   train-rmse:0.608170
## [227]   train-rmse:0.608069
## [228]   train-rmse:0.607838
## [229]   train-rmse:0.607693
## [230]   train-rmse:0.607575
## [231]   train-rmse:0.607357
## [232]   train-rmse:0.607261
## [233]   train-rmse:0.607095
## [234]   train-rmse:0.606992
## [235]   train-rmse:0.606883
## [236]   train-rmse:0.606637
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[237]   train-rmse:0.606559 ## [238]
train-rmse:0.606432 ## [239]   train
rmse:0.606372
[240]   train rmse:0.606206
[241]   train rmse:0.606024
[242]   train rmse:0.605942

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## [243]    train rmse:0.605747
## [244]    train rmse:0.605579
## [245]    train rmse:0.605422
## [246]    train-rmse:0.605309
## [247]    train-rmse:0.605088
## [248]    train-rmse:0.604901
## [249]    train-rmse:0.604806
## [250]    train-rmse:0.604753
## [251]    train-rmse:0.604629
## [252]    train-rmse:0.604507
## [253]    train-rmse:0.604388
## [254]    train-rmse:0.604206
## [255]    train-rmse:0.603971
## [256]    train-rmse:0.603876
## [257]    train-rmse:0.603751
## [258]    train-rmse:0.603596
## [259]    train-rmse:0.603496
## [260]    train-rmse:0.603430
## [261]    train-rmse:0.603321
## [262]    train-rmse:0.603246
## [263]    train-rmse:0.603100
## [264]    train-rmse:0.602898
## [265]    train-rmse:0.602867
## [266]    train-rmse:0.602765
## [267]    train-rmse:0.602697
## [268]    train-rmse:0.602563
## [269]    train-rmse:0.602514
## [270]    train-rmse:0.602373
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[271]   train-rmse:0.602200
[272]   train-rmse:0.602085
[273]   train-rmse:0.602031
[274]   train-rmse:0.601891
[275]   train-rmse:0.601762
[276]   train-rmse:0.601660
[277]   train-rmse:0.601553
[278]   train-rmse:0.601399
[279]   train-rmse:0.601260
[280]   train-rmse:0.601018
[281]   train-rmse:0.600854
[282]   train-rmse:0.600782
[283]   train-rmse:0.600745
[284]   train-rmse:0.600537
[285]   train-rmse:0.600476
[286]   train   rmse:0.600284
[287]   train   rmse:0.600155
[288]   train   rmse:0.599981
[289]   train   rmse:0.599803
[290]   train   rmse:0.599541
[291]   train   rmse:0.599408
[292]   train   rmse:0.599289 ## [293]
train rmse:0.599221
[294]   train rmse:0.599126
[295]   train rmse:0.599025
[296]   train-rmse:0.598899
[297]   train-rmse:0.598729
[298]   train-rmse:0.598660

[299]   train-rmse:0.598554 ## [300]
train-rmse:0.598405
[301]   train-rmse:0.598405
[302]   train-rmse:0.598365
[303]   train-rmse:0.598249
[304]   train-rmse:0.598111
[305]   train-rmse:0.598032
[306]   train-rmse:0.597858
[307]   train-rmse:0.597804
[308]   train-rmse:0.597700
[309]   train-rmse:0.597547
[310]   train-rmse:0.597411
[311]   train-rmse:0.597273
[312]   train-rmse:0.597124
[313]   train-rmse:0.596849
[314]   train-rmse:0.596782
[315]   train-rmse:0.596645
[316]   train-rmse:0.596440
[317]   train-rmse:0.596354
[318]   train-rmse:0.596209
[319]   train-rmse:0.596180
[320]   train-rmse:0.596113
[321]   train-rmse:0.596054
[322]   train-rmse:0.595936
[323]   train-rmse:0.595799
[324]   train-rmse:0.595643
[325]   train-rmse:0.595572
[326]   train-rmse:0.595489

[327]   train-rmse:0.595325
[328]   train-rmse:0.595273
[329]   train-rmse:0.595142
[330]   train-rmse:0.595031
[331]   train-rmse:0.594909
[332]   train-rmse:0.594772
[333]   train-rmse:0.594725
[334]   train-rmse:0.594554
[335]   train-rmse:0.594366
[336]   train-rmse:0.594178
[337]   train-rmse:0.594008
[338]   train-rmse:0.593964 ## [339]
train-rmse:0.593909 ## [340]   train
rmse:0.593862
[341]   train rmse:0.593830
[342]   train rmse:0.593796 ## [343]
train rmse:0.593675
[344]   train rmse:0.593607
[345]   train rmse:0.593535
[346]   train rmse:0.593449
[347]   train-rmse:0.593340
[348]   train-rmse:0.593217
[349]   train-rmse:0.593001
[350]   train-rmse:0.592929
[351]   train-rmse:0.592742
[352]   train-rmse:0.592629
[353]   train-rmse:0.592593
[354]   train-rmse:0.592473

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## [355]   train-rmse:0.592405
## [356]   train-rmse:0.592314
## [357]   train-rmse:0.592165
## [358]   train-rmse:0.591930
## [359]   train-rmse:0.591837
## [360]   train-rmse:0.591798
## [361]   train-rmse:0.591639
## [362]   train-rmse:0.591600
## [363]   train-rmse:0.591520
## [364]   train-rmse:0.591396
## [365]   train-rmse:0.591310
## [366]   train-rmse:0.591148
## [367]   train-rmse:0.591059
## [368]   train-rmse:0.590955
## [369]   train-rmse:0.590840
## [370]   train-rmse:0.590805
## [371]   train-rmse:0.590720
## [372]   train-rmse:0.590602
## [373]   train-rmse:0.590516
## [374]   train-rmse:0.590436
## [375]   train-rmse:0.590332
## [376]   train-rmse:0.590122
## [377]   train-rmse:0.590063
## [378]   train-rmse:0.589870
## [379]   train-rmse:0.589763
## [380]   train-rmse:0.589662
## [381]   train-rmse:0.589519
## [382]   train-rmse:0.589354
```

```
## [383]   train-rmse:0.589267
## [384]   train-rmse:0.589083
## [385]   train-rmse:0.589028
## [386]   train  rmse:0.588930
## [387]   train  rmse:0.588855
## [388]   train  rmse:0.588780
## [389]   train  rmse:0.588649
## [390]   train  rmse:0.588514
## [391]   train  rmse:0.588426
## [392]   train  rmse:0.588219
```

[393]   train-rmse:0.588164 ## [394]
train-rmse:0.588128

[395]   train-rmse:0.587949

[396]   train-rmse:0.587883

[397]   train-rmse:0.587827

[398]   train-rmse:0.587739

[399]   train-rmse:0.587563

[400]   train-rmse:0.587481

[401]   train-rmse:0.587421

[402]   train-rmse:0.587345

[403]   train-rmse:0.587282

[404]   train-rmse:0.587203

[405]   train-rmse:0.587045

[406]   train-rmse:0.587008

[407]   train-rmse:0.586961

[408]   train-rmse:0.586816

[409]   train-rmse:0.586579

[410]   train-rmse:0.586482

[411]   train-rmse:0.586426

[412]   train-rmse:0.586327

[413]   train-rmse:0.586234

[414]   train-rmse:0.586122

[415]   train-rmse:0.586111

[416]   train-rmse:0.586037

[417]   train-rmse:0.585954

[418]   train-rmse:0.585906

[419]   train-rmse:0.585874

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-

```
## [420]   train-rmse:0.585799
## [421]   train-rmse:0.585618
## [422]   train-rmse:0.585572
## [423]   train-rmse:0.585473
## [424]   train-rmse:0.585373
## [425]   train-rmse:0.585270
## [426]   train-rmse:0.585166
## [427]   train-rmse:0.585061
## [428]   train-rmse:0.585026
## [429]   train-rmse:0.585000
## [430]   train-rmse:0.584934
## [431]   train-rmse:0.584781
## [432]   train-rmse:0.584653
## [433]   train-rmse:0.584641
## [434]   train-rmse:0.584589
## [435]   train-rmse:0.584464
## [436]   train-rmse:0.584393
## [437]   train-rmse:0.584243
## [438]   train-rmse:0.584149
## [439]   train-rmse:0.584028
## [440]   train-rmse:0.583922
## [441]   train rmse:0.583804
## [442]    train rmse:0.583601 ## [443]
train   rmse:0.583494
## [444]   train   rmse:0.583454
## [445]   train   rmse:0.583443
## [446]   train   rmse:0.583416
```

```
## [447]    train   rmse:0.583292
## [448]    train   rmse:0.583239
## [449]    train-rmse:0.583120
## [450]    train-rmse:0.582975
## [451]    train-rmse:0.582841
## [452]    train-rmse:0.582789
## [453]    train-rmse:0.582619
## [454]    train-rmse:0.582526
## [455]    train-rmse:0.582411
## [456]    train-rmse:0.582278
## [457]    train-rmse:0.582165
## [458]    train-rmse:0.582052
## [459]    train-rmse:0.581963
## [460]    train-rmse:0.581954
## [461]    train-rmse:0.581851
## [462]    train-rmse:0.581747
## [463]    train-rmse:0.581741
## [464]    train-rmse:0.581565
## [465]    train-rmse:0.581474
## [466]    train-rmse:0.581447
## [467]    train-rmse:0.581355
## [468]    train-rmse:0.581218
## [469]    train-rmse:0.581099
## [470]    train-rmse:0.581017
## [471]    train-rmse:0.580888
## [472]    train-rmse:0.580848
## [473]    train-rmse:0.580750
```

[474] train-rmse:0.580595
[475] train-rmse:0.580499
[476] train-rmse:0.580438
[477] train-rmse:0.580322
[478] train-rmse:0.580213
[479] train-rmse:0.580176
[480] train-rmse:0.580052
[481] train-rmse:0.580036
[482] train-rmse:0.579990
[483] train-rmse:0.579972
[484] train-rmse:0.579868
[485] train-rmse:0.579798
[486] train rmse:0.579718
[487] train rmse:0.579673
[488] train rmse:0.579603
[489] train rmse:0.579504
[490] train rmse:0.579486
[491] train rmse:0.579438
[492] train rmse:0.579373 ## [493] train rmse:0.579275 ## [494] train-rmse:0.579227 ## [495] train-rmse:0.579151
[496] train-rmse:0.579114
[497] train-rmse:0.579099
[498] train-rmse:0.579027
[499] train-rmse:0.578975
[500] train-rmse:0.578947

```
## [501]    train-rmse:0.578848
## [502]    train-rmse:0.578778
## [503]    train-rmse:0.578755
## [504]    train-rmse:0.578650
## [505]    train-rmse:0.578578
## [506]    train-rmse:0.578430
## [507]    train-rmse:0.578324
## [508]    train-rmse:0.578285
## [509]    train-rmse:0.578186
## [510]    train-rmse:0.578052
## [511]    train-rmse:0.577937
## [512]    train-rmse:0.577881
## [513]    train-rmse:0.577849
## [514]    train-rmse:0.577830
## [515]    train-rmse:0.577703
## [516]    train-rmse:0.577632
## [517]    train-rmse:0.577459
## [518]    train-rmse:0.577438
## [519]    train-rmse:0.577355
## [520]    train-rmse:0.577316
## [521]    train-rmse:0.577198
## [522]    train-rmse:0.577135
## [523]    train-rmse:0.577031
## [524]    train-rmse:0.577000
## [525]    train-rmse:0.576863
## [526]    train-rmse:0.576813
## [527]    train-rmse:0.576676
```

```
## [528]   train-rmse:0.576642
## [529]   train-rmse:0.576607
## [530]   train-rmse:0.576587
## [531]   train-rmse:0.576444
## [532]   train-rmse:0.576405
## [533]   train-rmse:0.576353
## [534]   train-rmse:0.576258
## [535]   train-rmse:0.576197
## [536]   train-rmse:0.576025
## [537]   train-rmse:0.576015
## [538]   train-rmse:0.575987
## [539]   train-rmse:0.575932
## [540]   train-rmse:0.575890
## [541]   train-rmse:0.575828
## [542]   train rmse:0.575828
```

```
## [543]    train   rmse:0.575700
## [544]    train   rmse:0.575552
## [545]    train   rmse:0.575466
## [546]    train   rmse:0.575452
## [547]    train   rmse:0.575407
## [548]    train   rmse:0.575345
## [549]    train-rmse:0.575288
## [550]    train-rmse:0.575214
## [551]    train-rmse:0.575118
## [552]    train-rmse:0.575058
## [553]    train-rmse:0.574975
## [554]    train-rmse:0.574852
## [555]    train-rmse:0.574727
## [556]    train-rmse:0.574719
## [557]    train-rmse:0.574606
## [558]    train-rmse:0.574534
## [559]    train-rmse:0.574454
## [560]    train-rmse:0.574315
## [561]    train-rmse:0.574213
## [562]    train-rmse:0.574199
## [563]    train-rmse:0.574078
## [564]    train-rmse:0.573973
## [565]    train-rmse:0.573828
## [566]    train-rmse:0.573788
## [567]    train-rmse:0.573755
## [568]    train-rmse:0.573701
## [569]    train-rmse:0.573662
## [570]    train-rmse:0.573578
```

```
## [571]    train-rmse:0.573510
## [572]    train-rmse:0.573482
## [573]    train-rmse:0.573453
## [574]    train-rmse:0.573415
## [575]    train-rmse:0.573280
## [576]    train-rmse:0.573251
## [577]    train-rmse:0.573243
## [578]    train-rmse:0.573171
## [579]    train-rmse:0.573086
## [580]    train-rmse:0.572927
## [581]    train-rmse:0.572892
## [582]    train-rmse:0.572825
## [583]    train-rmse:0.572714
## [584]    train-rmse:0.572636
## [585]    train-rmse:0.572551
## [586]    train-rmse:0.572476 ## [587]
train-rmse:0.572314  ## [588]    train
rmse:0.572216
## [589]    train  rmse:0.572173
## [590]    train  rmse:0.572110
## [591]    train  rmse:0.572070
## [592]    train    rmse:0.571984 ## [593]
train rmse:0.571900
## [594]    train rmse:0.571890 ## [595]
train-rmse:0.571814  ## [596]        train-
rmse:0.571717
## [597]    train-rmse:0.571675
```

```
## [598]   train-rmse:0.571629
## [599]   train-rmse:0.571510
## [600]   train-rmse:0.571363
## [601]   train-rmse:0.571273
## [602]   train-rmse:0.571222
## [603]   train-rmse:0.571180
## [604]   train-rmse:0.571051
## [605]   train-rmse:0.570917
## [606]   train-rmse:0.570895
## [607]   train-rmse:0.570870
## [608]   train-rmse:0.570832
## [609]   train-rmse:0.570753
## [610]   train-rmse:0.570715
## [611]   train-rmse:0.570657
## [612]   train-rmse:0.570547
## [613]   train-rmse:0.570511
## [614]   train-rmse:0.570396
## [615]   train-rmse:0.570296
## [616]   train-rmse:0.570204
## [617]   train-rmse:0.570146
## [618]   train-rmse:0.570102
## [619]   train-rmse:0.570076
## [620]   train-rmse:0.569997
## [621]   train-rmse:0.569940
## [622]   train-rmse:0.569937
## [623]   train-rmse:0.569832
## [624]   train-rmse:0.569770
```

[625]   train-rmse:0.569722
[626]   train-rmse:0.569611
[627]   train-rmse:0.569571
[628]   train-rmse:0.569525
[629]   train-rmse:0.569469
[630]   train-rmse:0.569390
[631]   train-rmse:0.569273
[632]   train-rmse:0.569199
[633]   train-rmse:0.569161
[634]   train-rmse:0.569129
[635]   train-rmse:0.569080
[636]   train-rmse:0.568958
[637]   train-rmse:0.568838
[638]   train-rmse:0.568744
[639]   train rmse:0.568696
[640]   train rmse:0.568593
[641]   train rmse:0.568512
[642]   train rmse:0.568433 ## [643]
train   rmse:0.568418
[644]   train   rmse:0.568412
[645]   train   rmse:0.568349
[646]   train   rmse:0.568301
[647]   train   rmse:0.568238
[648]   train   rmse:0.568168 ## [649]
train-rmse:0.568100 ## [650]   train-
rmse:0.567967
[651]   train-rmse:0.567810

```
## [652]   train-rmse:0.567733
## [653]   train-rmse:0.567622
## [654]   train-rmse:0.567587
## [655]   train-rmse:0.567543
## [656]   train-rmse:0.567436
## [657]   train-rmse:0.567406
## [658]   train-rmse:0.567276
## [659]   train-rmse:0.567133
## [660]   train-rmse:0.567097
## [661]   train-rmse:0.567039
## [662]   train-rmse:0.566956
## [663]   train-rmse:0.566911
## [664]   train-rmse:0.566822
## [665]   train-rmse:0.566759
## [666]   train-rmse:0.566711
## [667]   train-rmse:0.566646
## [668]   train-rmse:0.566619
## [669]   train-rmse:0.566537
## [670]   train-rmse:0.566468
## [671]   train-rmse:0.566387
## [672]   train-rmse:0.566305
## [673]   train-rmse:0.566241
## [674]   train-rmse:0.566241
## [675]   train-rmse:0.566230
## [676]   train-rmse:0.566126
## [677]   train-rmse:0.566054
## [678]   train-rmse:0.566010
```

-
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[679]   train-rmse:0.565874
[680]   train-rmse:0.565812
[681]   train-rmse:0.565755
[682]   train-rmse:0.565715
[683]   train-rmse:0.565651
[684]   train-rmse:0.565637
[685]   train-rmse:0.565482
[686]   train-rmse:0.565442
[687]   train-rmse:0.565429 ## [688]
train-rmse:0.565388 ## [689]   train
rmse:0.565270
[690]   train rmse:0.565209
[691]   train rmse:0.565160
[692]   train rmse:0.565064

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-

```
## [693]   train rmse:0.565028
## [694]   train rmse:0.564922
## [695]   train rmse:0.564890
## [696]   train-rmse:0.564833
## [697]   train-rmse:0.564769
## [698]   train-rmse:0.564721
## [699]   train-rmse:0.564715
## [700]   train-rmse:0.564608
## [701]   train-rmse:0.564535
## [702]   train-rmse:0.564495
## [703]   train-rmse:0.564447
## [704]   train-rmse:0.564421
## [705]   train-rmse:0.564350
## [706]   train-rmse:0.564268
## [707]   train-rmse:0.564212
## [708]   train-rmse:0.564169
## [709]   train-rmse:0.564148
## [710]   train-rmse:0.564094
## [711]   train-rmse:0.564010
## [712]   train-rmse:0.563996
## [713]   train-rmse:0.563991
## [714]   train-rmse:0.563948
## [715]   train-rmse:0.563918
## [716]   train-rmse:0.563885
## [717]   train-rmse:0.563860
## [718]   train-rmse:0.563777
## [719]   train-rmse:0.563762
## [720]   train-rmse:0.563702
```

```
## [721]    train-rmse:0.563575
## [722]    train-rmse:0.563509
## [723]    train-rmse:0.563446
## [724]    train-rmse:0.563326
## [725]    train-rmse:0.563325
## [726]    train-rmse:0.563301
## [727]    train-rmse:0.563282
## [728]    train-rmse:0.563237
## [729]    train-rmse:0.563123
## [730]    train-rmse:0.563030
## [731]    train-rmse:0.562968
## [732]    train-rmse:0.562924
## [733]    train-rmse:0.562902
## [734]    train-rmse:0.562880
## [735]    train-rmse:0.562843
## [736]    train-rmse:0.562843
## [737]    train-rmse:0.562831
## [738]    train-rmse:0.562796
## [739]    train rmse:0.562747
## [740]    train rmse:0.562686
## [741]    train rmse:0.562656
## [742]    train rmse:0.562643 ## [743]    train rmse:0.562534
## [744]    train rmse:0.562509
## [745]    train rmse:0.562502
## [746]    train-rmse:0.562473
## [747]    train-rmse:0.562455
## [748]    train-rmse:0.562373
## [749]    train-rmse:0.562366
## [750]    train-rmse:0.562289
```

```r
# combine meta features
sg_col = c("meta_knn", "meta_glm", "meta_svm", "meta_rf", "meta_xgb", "y") train_sg = data.frame(
meta_knn_train, meta_glm_train, meta_svm_train, meta_rf
_train, meta_xgb_train, train_y)
test_sg = data.frame(meta_knn_test, meta_glm_test, meta_svm_test, meta_rf_tes t, meta_xgb_test,
test_y) colnames(train_sg) = sg_col colnames(test_sg) = sg_col

# ensemble with elastic-net regression train_sg_sparse = model.Matrix(y ~ . - 1, data = train_sg, sparse
= T) test_sg_sparse = model.Matrix(y ~ . - 1, data = test_sg, sparse = T) mdl_glm =
cv.glmnet(train_sg_sparse, train_y, family = "gaussian", alpha = 0.
2)
pred_glm = predict(mdl_glm, newx = test_sg_sparse, s = "lambda.min") mse(pred_glm, test_y)
```

train-   train-   train-   train-   train-   train-   train-   train-

```
## [1] 0.3840147
```

```r
library(data.table)

library(foreach)

library(MatrixModels)

library(xgboost)

library(ranger)

# load and combine dataset train =

fread("BlogFeedback-Train.csv") test =

fread("BlogFeedback-Test.csv")

# error measure mse = function(y_hat, y) {  mse = mean((y - y_hat)^2)
return(mse)}
```

train-   train-   train-   train-   train-   train-   train-   train-

```r
# create
design
matrices
                    train_x = model.Matrix(V281 ~ . - 1, data = train, sparse = F)

train_y =
train$V281
                    test_x = model.Matrix(V281 ~ . - 1, data = test, sparse = F)


test_y =
test$V281           train_xgb = xgb.DMatrix(data = as.matrix(train_x), label = train_y) test_xgb =

                    xgb.DMatrix(data = as.matrix(test_x), label = test_y)



#  number  of

models n = 5


# fit XGBoost     pred_xgb = foreach(i = 1:n, .combine = cbind) %do% {  mdl_xgb = xgboost(data
                   train_xgb, nround = 750, nthread = 4, max_depth = 6, eta = 0.025, subsample

=
=  0.7, gamma       return(predict(mdl_xgb, test_xgb))}
= 3)

                   pred_rf = foreach(i = 1:n, .combine = cbind) %do% { mdl_rf = ranger(V281 ~ ., data =
                   train, num.trees = 1000, mtry = 120, write.forest = T) return(predict(mdl_rf,
# fit random
forest             test)$predictions)}


                   mse(rowMeans(pred_rf) * 0.25 + rowMeans(pred_xgb) * 0.75, test_y)

# weighted
average
```

```
|-------------------------------------------------|
|=================================================|
|-------------------------------------------------|
|=================================================|
 [1]                    rmse:1.123122
```

train-   train-   train-   train-   train-   train-   train-   train-

```
[2]          rmse:1.105641
[3]          rmse:1.088758
[4]          rmse:1.072427
[5]          rmse:1.056559
[6]          rmse:1.041096
[7]          rmse:1.026287
[8]          rmse:1.011939
```

train-   train-   train-   train-   train-   train-   train-   train-

[9]   rmse:0.998131
[10]   rmse:0.984787
[11]   rmse:0.971762
[12]   rmse:0.959325
[13]   rmse:0.947338
[14]   rmse:0.935682
[15]   rmse:0.924345
[16]   train-rmse:0.913451
[17]   train-rmse:0.903073
[18]   train-rmse:0.893087
[19]   train-rmse:0.883354
[20]   train-rmse:0.873861
[21]   train-rmse:0.864709
[22]   train-rmse:0.856002
[23]   train-rmse:0.847568
[24]   train-rmse:0.839455
[25]   train-rmse:0.831521
[26]   train-rmse:0.824004
[27]   train-rmse:0.816727
[28]   train-rmse:0.809749
[29]   train-rmse:0.803047
[30]   train-rmse:0.796569
[31]   train-rmse:0.790335
[32]   train-rmse:0.784175
[33]   train-rmse:0.778386
[34]   train-rmse:0.772695
[35]   train-rmse:0.767116
[36]   train-rmse:0.761938
[37]   train-rmse:0.756940
[38]   train-rmse:0.752111
[39]   train-rmse:0.747458
[40]   train-rmse:0.742959
[41]   train-rmse:0.738648
[42]   train-rmse:0.734499
[43]   train-rmse:0.730367
[44]   train-rmse:0.726442
[45]   train-rmse:0.722791
[46]   train-rmse:0.719198
[47]   train-rmse:0.715713
[48]   train-rmse:0.712466
[49]   train-rmse:0.709212

train-   train-   train-   train-   train-   train-   train-   train-

[50]   train-rmse:0.706178
[51]   train-rmse:0.703222
[52]   train-rmse:0.700330
[53]   train-rmse:0.697545
[54]   train-rmse:0.694790
[55]   rmse:0.692126
[56]   rmse:0.689663
[57]   rmse:0.687291
[58]   rmse:0.684980
[59]   rmse:0.682716
[60]   rmse:0.680483
[61]   rmse:0.678363
[62]   rmse:0.676362
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train-   train-

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[659]    train-rmse:0.558559
[660]    train-rmse:0.558538
[661]    train-rmse:0.558453
[662]    train-rmse:0.558363
[663]    train-rmse:0.558281
[664]    train-rmse:0.558203
[665]    train-rmse:0.558108
[666]    train-rmse:0.558078
[667]    train-rmse:0.557986
[668]    train-rmse:0.557870
[669]    train-rmse:0.557842
[670]    train-rmse:0.557830
[671]    train-rmse:0.557719
[672]    train-rmse:0.557580
[673]    train-rmse:0.557566
[674]    train-rmse:0.557482
[675]    train-rmse:0.557406
[676]    train-rmse:0.557375
[677]    train-rmse:0.557332
[678]    train-rmse:0.557276
[679]    train-rmse:0.557252
[680]    train-rmse:0.557177
[681]    train-rmse:0.557120
[682]    train-rmse:0.557091
[683]    train-rmse:0.557014
[684]    train-rmse:0.556905
[685]    train-rmse:0.556838
```

train-   train-   train-   train-   train-   train-   train-   train-

[686]   train-rmse:0.556756
[687]   train-rmse:0.556715
[688]   train-rmse:0.556581
[689]   train-rmse:0.556581
[690]   train-rmse:0.556509
[691]   train-rmse:0.556483
[692]   train-rmse:0.556443
[693]   train-rmse:0.556382
[694]   train-rmse:0.556267
[695]   train-rmse:0.556135
[696]   train-rmse:0.556079
[697]   train-rmse:0.556018
[698]   train-rmse:0.555967
[699]   train-rmse:0.555880
[700]   train-rmse:0.555837
[701]   rmse:0.555775
[702]   rmse:0.555678
[703]   rmse:0.555657
[704]   rmse:0.555644
[705]   rmse:0.555516
[706]   rmse:0.555469
[707]   rmse:0.555361
[708]   rmse:0.555297
[709]   rmse:0.555142
[710]   rmse:0.555082
[711]   rmse:0.554983
[712]   train-rmse:0.554905
[713]   train-rmse:0.554889
[714]   train-rmse:0.554818
[715]   train-rmse:0.554733
[716]   train-rmse:0.554649
[717]   train-rmse:0.554615
[718]   train-rmse:0.554519
[719]   train-rmse:0.554463
[720]   train-rmse:0.554411
[721]   train-rmse:0.554411
[722]   train-rmse:0.554404
[723]   train-rmse:0.554394
[724]   train-rmse:0.554267
[725]   train-rmse:0.554242

train-   train-   train-   train-   train-   train-   train-   train-

```
[726]    train-rmse:0.554147
[727]    train-rmse:0.554110
[728]    train-rmse:0.554047
[729]    train-rmse:0.554043
[730]    train-rmse:0.554006
[731]    train-rmse:0.553936
[732]    train-rmse:0.553853
[733]    train-rmse:0.553817
[734]    train-rmse:0.553679
[735]    train-rmse:0.553603
[736]    train-rmse:0.553502
[737]    train-rmse:0.553451
[738]    train-rmse:0.553324
[739]    train-rmse:0.553319
[740]    train-rmse:0.553248
[741]    train-rmse:0.553129
[742]    train-rmse:0.553102
[743]    train-rmse:0.552974
[744]    train-rmse:0.552942
[745]    train-rmse:0.552909
[746]    train-rmse:0.552863
[747]    train-rmse:0.552789
[748]    train-rmse:0.552741
[749]    train-rmse:0.552729
[750]    train-rmse:0.552696
```
Growing trees.. Progress: 1%. Estimated remaining time: 48 minutes, 5 seconds.
Growing trees.. Progress: 3%. Estimated remaining time: 42 minutes, 2 seconds.
Growing trees.. Progress: 4%. Estimated remaining time: 41 minutes, 42 seconds.
Growing trees.. Progress: 6%. Estimated remaining time: 39 minutes, 48

train-   train-   train-   train-   train-   train-   train-   train-

Growing trees.. Progress: 7%. Estimated remaining time: 39 minutes, 17 seconds.
Growing trees.. Progress: 8%. Estimated remaining time: 38 minutes, 45 seconds.
Growing trees.. Progress: 10%. Estimated remaining time: 38 minutes, 8 seconds.
Growing trees.. Progress: 11%. Estimated remaining time: 36 minutes, 42 seconds.
Growing trees.. Progress: 12%. Estimated remaining time: 36 minutes, 44 seconds.
Growing trees.. Progress: 14%. Estimated remaining time: 35 minutes, 30 seconds.
Growing trees.. Progress: 15%. Estimated remaining time: 35 minutes, 25 seconds.
Growing trees.. Progress: 17%. Estimated remaining time: 34 minutes, 25 seconds.
Growing trees.. Progress: 18%. Estimated remaining time: 34 minutes, 5 seconds.
Growing trees.. Progress: 19%. Estimated remaining time: 33 minutes, 18 seconds.
Growing trees.. Progress: 21%. Estimated remaining time: 32 minutes, 48 seconds.
Growing trees.. Progress: 22%. Estimated remaining time: 32 minutes, 18 seconds.
Growing trees.. Progress: 24%. Estimated remaining time: 31 minutes, 31 seconds.
Growing trees.. Progress: 25%. Estimated remaining time: 31 minutes, 4 seconds.
Growing trees.. Progress: 26%. Estimated remaining time: 30 minutes, 37 seconds.
Growing trees.. Progress: 28%. Estimated remaining time: 29 minutes, 55 seconds.
Growing trees.. Progress: 29%. Estimated remaining time: 29 minutes, 22 seconds.
Growing trees.. Progress: 30%. Estimated remaining time: 29 minutes, 0 seconds.
Growing trees.. Progress: 31%. Estimated remaining time: 28 minutes, 32 seconds.
Growing trees.. Progress: 33%. Estimated remaining time: 28 minutes, 4 seconds.
Growing trees.. Progress: 34%. Estimated remaining time: 27 minutes, 25 seconds.
Growing trees.. Progress: 35%. Estimated remaining time: 26 minutes, 58 seconds.
Growing trees.. Progress: 37%. Estimated remaining time: 26 minutes, 18 seconds.
Growing trees.. Progress: 38%. Estimated remaining time: 25 minutes, 50 seconds.
Growing trees.. Progress: 39%. Estimated remaining time: 25 minutes, 18 Growing trees.. Progress: 41%.
Estimated remaining time: 24 minutes, 45 seconds.
Growing trees.. Progress: 42%. Estimated remaining time: 24 minutes, 11 seconds.
Growing trees.. Progress: 43%. Estimated remaining time: 23 minutes, 41 seconds.
Growing trees.. Progress: 45%. Estimated remaining time: 23 minutes, 1 seconds.
Growing trees.. Progress: 46%. Estimated remaining time: 22 minutes, 33 seconds.
Growing trees.. Progress: 47%. Estimated remaining time: 21 minutes, 58 seconds.
Growing trees.. Progress: 49%. Estimated remaining time: 21 minutes, 25 seconds.
Growing trees.. Progress: 50%. Estimated remaining time: 20 minutes, 53 seconds.
Growing trees.. Progress: 51%. Estimated remaining time: 20 minutes, 16 seconds.
Growing trees.. Progress: 53%. Estimated remaining time: 19 minutes, 44 seconds.
Growing trees.. Progress: 54%. Estimated remaining time: 19 minutes, 12 seconds.
Growing trees.. Progress: 55%. Estimated remaining time: 18 minutes, 34 seconds.
Growing trees.. Progress: 57%. Estimated remaining time: 18 minutes, 5 seconds.
Growing trees.. Progress: 58%. Estimated remaining time: 17 minutes, 35 seconds.
Growing trees.. Progress: 59%. Estimated remaining time: 16 minutes, 55 seconds.

seconds.

Growing trees.. Progress: 61%. Estimated remaining time: 16 minutes, 13 seconds.
Growing trees.. Progress: 62%. Estimated remaining time: 15 minutes, 43 seconds.
Growing trees.. Progress: 64%. Estimated remaining time: 15 minutes, 4 seconds.
Growing trees.. Progress: 65%. Estimated remaining time: 14 minutes, 33 seconds.
Growing trees.. Progress: 66%. Estimated remaining time: 13 minutes, 56 seconds.
Growing trees.. Progress: 68%. Estimated remaining time: 13 minutes, 25 seconds.
Growing trees.. Progress: 69%. Estimated remaining time: 12 minutes, 57 seconds.
Growing trees.. Progress: 70%. Estimated remaining time: 12 minutes, 18 seconds.
Growing trees.. Progress: 72%. Estimated remaining time: 11 minutes, 47 seconds.
Growing trees.. Progress: 73%. Estimated remaining time: 11 minutes, 10 Growing trees.. Progress: 74%.
Estimated remaining time: 10 minutes, 38 seconds.
Growing trees.. Progress: 76%. Estimated remaining time: 10 minutes, 7 seconds.
Growing trees.. Progress: 77%. Estimated remaining time: 9 minutes, 31 seconds.
Growing trees.. Progress: 78%. Estimated remaining time: 8 minutes, 58 seconds.
Growing trees.. Progress: 80%. Estimated remaining time: 8 minutes, 26 seconds.
Growing trees.. Progress: 81%. Estimated remaining time: 7 minutes, 57 seconds.
Growing trees.. Progress: 82%. Estimated remaining time: 7 minutes, 21 seconds.
Growing trees.. Progress: 84%. Estimated remaining time: 6 minutes, 49 seconds.
Growing trees.. Progress: 85%. Estimated remaining time: 6 minutes, 17 seconds.
Growing trees.. Progress: 86%. Estimated remaining time: 5 minutes, 44 seconds.
Growing trees.. Progress: 88%. Estimated remaining time: 5 minutes, 11 seconds.
Growing trees.. Progress: 89%. Estimated remaining time: 4 minutes, 39 seconds.
Growing trees.. Progress: 90%. Estimated remaining time: 4 minutes, 7 seconds.
Growing trees.. Progress: 92%. Estimated remaining time: 3 minutes, 31 seconds.
Growing trees.. Progress: 93%. Estimated remaining time: 2 minutes, 59 seconds.
Growing trees.. Progress: 94%. Estimated remaining time: 2 minutes, 30 seconds.
Growing trees.. Progress: 95%. Estimated remaining time: 1 minute, 57 seconds.
Growing trees.. Progress: 97%. Estimated remaining time: 1 minute, 25 seconds.
Growing trees.. Progress: 98%. Estimated remaining time: 50 seconds.
Growing trees.. Progress: 99%. Estimated remaining time: 17 seconds. Growing trees.. Progress: 1%.
Estimated remaining time: 43 minutes, 54 seconds.
Growing trees.. Progress: 3%. Estimated remaining time: 43 minutes, 33 seconds.
Growing trees.. Progress: 4%. Estimated remaining time: 41 minutes, 4 seconds.
Growing trees.. Progress: 5%. Estimated remaining time: 40 minutes, 47 seconds.
Growing trees.. Progress: 7%. Estimated remaining time: 39 minutes, 27 seconds.
Growing trees.. Progress: 8%. Estimated remaining time: 38 minutes, 34 Growing trees.. Progress: 9%.
Estimated remaining time: 37 minutes, 54 seconds.
Growing trees.. Progress: 11%. Estimated remaining time: 37 minutes, 10 seconds.
Growing trees.. Progress: 12%. Estimated remaining time: 36 minutes, 55 seconds.
Growing trees.. Progress: 14%. Estimated remaining time: 35 minutes, 52 seconds.

seconds.

Growing trees.. Progress: 15%. Estimated remaining time: 35 minutes, 24 seconds.
Growing trees.. Progress: 16%. Estimated remaining time: 34 minutes, 44 seconds.
Growing trees.. Progress: 18%. Estimated remaining time: 34 minutes, 10 seconds.
Growing trees.. Progress: 19%. Estimated remaining time: 33 minutes, 23 seconds.
Growing trees.. Progress: 20%. Estimated remaining time: 32 minutes, 58 seconds.
Growing trees.. Progress: 22%. Estimated remaining time: 32 minutes, 16 seconds.
Growing trees.. Progress: 23%. Estimated remaining time: 31 minutes, 40 seconds.
Growing trees.. Progress: 25%. Estimated remaining time: 30 minutes, 57 seconds.
Growing trees.. Progress: 26%. Estimated remaining time: 30 minutes, 28 seconds.
Growing trees.. Progress: 27%. Estimated remaining time: 30 minutes, 1 seconds.
Growing trees.. Progress: 28%. Estimated remaining time: 29 minutes, 28 seconds.
Growing trees.. Progress: 30%. Estimated remaining time: 28 minutes, 56 seconds.
Growing trees.. Progress: 31%. Estimated remaining time: 28 minutes, 21 seconds.
Growing trees.. Progress: 32%. Estimated remaining time: 27 minutes, 51 seconds.
Growing trees.. Progress: 34%. Estimated remaining time: 27 minutes, 15 seconds.
Growing trees.. Progress: 35%. Estimated remaining time: 26 minutes, 41 seconds.
Growing trees.. Progress: 37%. Estimated remaining time: 26 minutes, 2 seconds.
Growing trees.. Progress: 38%. Estimated remaining time: 25 minutes, 33 seconds.
Growing trees.. Progress: 39%. Estimated remaining time: 24 minutes, 51 seconds.
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Growing trees.. Progress: 42%. Estimated remaining time: 23 minutes, 41 Growing trees.. Progress: 44%.
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Growing trees.. Progress: 45%. Estimated remaining time: 22 minutes, 32 seconds.
Growing trees.. Progress: 46%. Estimated remaining time: 22 minutes, 2 seconds.
Growing trees.. Progress: 48%. Estimated remaining time: 21 minutes, 30 seconds.
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Growing trees.. Progress: 53%. Estimated remaining time: 19 minutes, 18 seconds.
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Growing trees.. Progress: 57%. Estimated remaining time: 17 minutes, 36 seconds.
Growing trees.. Progress: 59%. Estimated remaining time: 16 minutes, 57 seconds.
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Growing trees.. Progress: 61%. Estimated remaining time: 15 minutes, 50 seconds.
Growing trees.. Progress: 63%. Estimated remaining time: 15 minutes, 17 seconds.
Growing trees.. Progress: 64%. Estimated remaining time: 14 minutes, 54 seconds.
Growing trees.. Progress: 65%. Estimated remaining time: 14 minutes, 42 seconds.
Growing trees.. Progress: 65%. Estimated remaining time: 14 minutes, 30 seconds.
Growing trees.. Progress: 66%. Estimated remaining time: 14 minutes, 16 seconds.

seconds.

Growing trees.. Progress: 67%. Estimated remaining time: 14 minutes, 4 seconds.
Growing trees.. Progress: 68%. Estimated remaining time: 13 minutes, 52 seconds.
Growing trees.. Progress: 69%. Estimated remaining time: 13 minutes, 37 seconds.
Growing trees.. Progress: 69%. Estimated remaining time: 13 minutes, 22 seconds.
Growing trees.. Progress: 70%. Estimated remaining time: 13 minutes, 7 seconds.
Growing trees.. Progress: 71%. Estimated remaining time: 12 minutes, 54 Growing trees.. Progress: 72%.
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Growing trees.. Progress: 73%. Estimated remaining time: 12 minutes, 21 seconds.
Growing trees.. Progress: 73%. Estimated remaining time: 12 minutes, 4 seconds.
Growing trees.. Progress: 74%. Estimated remaining time: 11 minutes, 47 seconds.
Growing trees.. Progress: 75%. Estimated remaining time: 11 minutes, 31 seconds.
Growing trees.. Progress: 76%. Estimated remaining time: 11 minutes, 14 seconds.
Growing trees.. Progress: 76%. Estimated remaining time: 10 minutes, 56 seconds.
Growing trees.. Progress: 77%. Estimated remaining time: 10 minutes, 37 seconds.
Growing trees.. Progress: 78%. Estimated remaining time: 10 minutes, 18 seconds.
Growing trees.. Progress: 79%. Estimated remaining time: 9 minutes, 58 seconds.
Growing trees.. Progress: 80%. Estimated remaining time: 9 minutes, 39 seconds.
Growing trees.. Progress: 80%. Estimated remaining time: 9 minutes, 19 seconds.
Growing trees.. Progress: 81%. Estimated remaining time: 8 minutes, 59 seconds.
Growing trees.. Progress: 82%. Estimated remaining time: 8 minutes, 38 seconds.
Growing trees.. Progress: 83%. Estimated remaining time: 8 minutes, 21 seconds.
Growing trees.. Progress: 83%. Estimated remaining time: 8 minutes, 3 seconds.
Growing trees.. Progress: 84%. Estimated remaining time: 7 minutes, 42 seconds.
Growing trees.. Progress: 85%. Estimated remaining time: 7 minutes, 20 seconds.
Growing trees.. Progress: 86%. Estimated remaining time: 6 minutes, 59 seconds.
Growing trees.. Progress: 87%. Estimated remaining time: 6 minutes, 37 seconds.
Growing trees.. Progress: 87%. Estimated remaining time: 6 minutes, 14 seconds.
Growing trees.. Progress: 88%. Estimated remaining time: 5 minutes, 52 seconds.
Growing trees.. Progress: 89%. Estimated remaining time: 5 minutes, 32 seconds.
Growing trees.. Progress: 90%. Estimated remaining time: 5 minutes, 10 seconds.
Growing trees.. Progress: 91%. Estimated remaining time: 4 minutes, 47 Growing trees.. Progress: 92%.
Estimated remaining time: 4 minutes, 3 seconds.
Growing trees.. Progress: 93%. Estimated remaining time: 3 minutes, 24 seconds.
Growing trees.. Progress: 95%. Estimated remaining time: 2 minutes, 44 seconds.
Growing trees.. Progress: 96%. Estimated remaining time: 2 minutes, 5 seconds.
Growing trees.. Progress: 97%. Estimated remaining time: 1 minute, 32 seconds.
Growing trees.. Progress: 98%. Estimated remaining time: 1 minute, 9 seconds.
Growing trees.. Progress: 99%. Estimated remaining time: 45 seconds.
Growing trees.. Progress: 99%. Estimated remaining time: 18 seconds.

seconds.

Growing trees.. Progress: 100%. Estimated remaining time: 3 seconds. Growing trees.. Progress: 1%. Estimated remaining time: 51 minutes, 9 seconds.

Growing trees.. Progress: 2%. Estimated remaining time: 45 minutes, 56 seconds.
Growing trees.. Progress: 3%. Estimated remaining time: 45 minutes, 54 seconds.
Growing trees.. Progress: 5%. Estimated remaining time: 47 minutes, 42 seconds.
Growing trees.. Progress: 6%. Estimated remaining time: 45 minutes, 59 seconds.
Growing trees.. Progress: 7%. Estimated remaining time: 44 minutes, 55 seconds.
Growing trees.. Progress: 8%. Estimated remaining time: 43 minutes, 4 seconds.
Growing trees.. Progress: 10%. Estimated remaining time: 42 minutes, 13 seconds.
Growing trees.. Progress: 11%. Estimated remaining time: 41 minutes, 43 seconds.
Growing trees.. Progress: 12%. Estimated remaining time: 40 minutes, 55 seconds.
Growing trees.. Progress: 13%. Estimated remaining time: 40 minutes, 5 seconds.
Growing trees.. Progress: 14%. Estimated remaining time: 39 minutes, 30 seconds.
Growing trees.. Progress: 16%. Estimated remaining time: 38 minutes, 27 seconds.
Growing trees.. Progress: 17%. Estimated remaining time: 37 minutes, 23 seconds.
Growing trees.. Progress: 19%. Estimated remaining time: 37 minutes, 4 seconds.
Growing trees.. Progress: 20%. Estimated remaining time: 36 minutes, 1 seconds.
Growing trees.. Progress: 21%. Estimated remaining time: 35 minutes, 23 seconds.
Growing trees.. Progress: 23%. Estimated remaining time: 34 minutes, 18 Growing trees.. Progress: 24%. Estimated remaining time: 33 minutes, 38 seconds.
Growing trees.. Progress: 25%. Estimated remaining time: 33 minutes, 7 seconds.
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Growing trees.. Progress: 28%. Estimated remaining time: 31 minutes, 53 seconds.
Growing trees.. Progress: 29%. Estimated remaining time: 30 minutes, 55 seconds.
Growing trees.. Progress: 31%. Estimated remaining time: 30 minutes, 14 seconds.
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Growing trees.. Progress: 33%. Estimated remaining time: 29 minutes, 10 seconds.
Growing trees.. Progress: 35%. Estimated remaining time: 28 minutes, 26 seconds.
Growing trees.. Progress: 36%. Estimated remaining time: 27 minutes, 51 seconds.
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Growing trees.. Progress: 39%. Estimated remaining time: 26 minutes, 42 seconds.
Growing trees.. Progress: 40%. Estimated remaining time: 26 minutes, 12 seconds.
Growing trees.. Progress: 41%. Estimated remaining time: 25 minutes, 29 seconds.
Growing trees.. Progress: 42%. Estimated remaining time: 24 minutes, 59 seconds.
Growing trees.. Progress: 44%. Estimated remaining time: 24 minutes, 23 seconds.
Growing trees.. Progress: 45%. Estimated remaining time: 23 minutes, 52 seconds.
Growing trees.. Progress: 46%. Estimated remaining time: 23 minutes, 21 seconds.
Growing trees.. Progress: 47%. Estimated remaining time: 22 minutes, 46 seconds.
Growing trees.. Progress: 49%. Estimated remaining time: 22 minutes, 11 seconds.
Growing trees.. Progress: 50%. Estimated remaining time: 21 minutes, 40 seconds.

seconds.

Growing trees.. Progress: 51%. Estimated remaining time: 21 minutes, 4 seconds.
Growing trees.. Progress: 53%. Estimated remaining time: 20 minutes, 29 seconds.
Growing trees.. Progress: 54%. Estimated remaining time: 19 minutes, 58 seconds.
Growing trees.. Progress: 55%. Estimated remaining time: 19 minutes, 27 Growing trees.. Progress: 56%. Estimated remaining time: 18 minutes, 55 seconds.
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Growing trees.. Progress: 60%. Estimated remaining time: 17 minutes, 15 seconds.
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Growing trees.. Progress: 67%. Estimated remaining time: 14 minutes, 6 seconds.
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Growing trees.. Progress: 71%. Estimated remaining time: 12 minutes, 30 seconds.
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Growing trees.. Progress: 80%. Estimated remaining time: 8 minutes, 44 seconds.
Growing trees.. Progress: 81%. Estimated remaining time: 8 minutes, 10 seconds.
Growing trees.. Progress: 82%. Estimated remaining time: 7 minutes, 36 seconds.
Growing trees.. Progress: 84%. Estimated remaining time: 7 minutes, 2 seconds.
Growing trees.. Progress: 85%. Estimated remaining time: 6 minutes, 33 seconds.
Growing trees.. Progress: 86%. Estimated remaining time: 6 minutes, 14

seconds.

Growing trees.. Progress: 86%. Estimated remaining time: 5 minutes, 58 seconds.
Growing trees.. Progress: 87%. Estimated remaining time: 5 minutes, 33 seconds.
Growing trees.. Progress: 88%. Estimated remaining time: 5 minutes, 14 seconds.
Growing trees.. Progress: 89%. Estimated remaining time: 4 minutes, 54 seconds.
Growing trees.. Progress: 90%. Estimated remaining time: 4 minutes, 34 seconds.
Growing trees.. Progress: 91%. Estimated remaining time: 4 minutes, 14 seconds.
Growing trees.. Progress: 91%. Estimated remaining time: 3 minutes, 54 seconds.
Growing trees.. Progress: 92%. Estimated remaining time: 3 minutes, 33 seconds.
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Growing trees.. Progress: 94%. Estimated remaining time: 2 minutes, 51 seconds.
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Growing trees.. Progress: 95%. Estimated remaining time: 2 minutes, 11 seconds.
Growing trees.. Progress: 96%. Estimated remaining time: 1 minute, 55 seconds.
Growing trees.. Progress: 97%. Estimated remaining time: 1 minute, 33 seconds.
Growing trees.. Progress: 98%. Estimated remaining time: 1 minute, 11 seconds.
Growing trees.. Progress: 98%. Estimated remaining time: 48 seconds.
Growing trees.. Progress: 99%. Estimated remaining time: 25 seconds.
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Growing trees.. Progress: 32%. Estimated remaining time: 27 minutes, 35 seconds.
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Growing trees.. Progress: 39%. Estimated remaining time: 24 minutes, 45 seconds.
Growing trees.. Progress: 40%. Estimated remaining time: 24 minutes, 5 seconds.
Growing trees.. Progress: 42%. Estimated remaining time: 23 minutes, 36 seconds.
Growing trees.. Progress: 43%. Estimated remaining time: 23 minutes, 0 seconds.
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Growing trees.. Progress: 50%. Estimated remaining time: 20 minutes, 10 seconds.
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Growing trees.. Progress: 53%. Estimated remaining time: 19 minutes, 3 seconds.
Growing trees.. Progress: 54%. Estimated remaining time: 18 minutes, 28 seconds.
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Growing trees.. Progress: 57%. Estimated remaining time: 17 minutes, 16 seconds.
Growing trees.. Progress: 59%. Estimated remaining time: 16 minutes, 42 seconds.
Growing trees.. Progress: 60%. Estimated remaining time: 16 minutes, 8 seconds.
Growing trees.. Progress: 61%. Estimated remaining time: 15 minutes, 38 seconds.
Growing trees.. Progress: 63%. Estimated remaining time: 15 minutes, 3 seconds.
Growing trees.. Progress: 64%. Estimated remaining time: 14 minutes, 32 seconds.
Growing trees.. Progress: 65%. Estimated remaining time: 14 minutes, 1 seconds.
Growing trees.. Progress: 67%. Estimated remaining time: 13 minutes, 26 seconds.
Growing trees.. Progress: 68%. Estimated remaining time: 12 minutes, 55 seconds.
Growing trees.. Progress: 69%. Estimated remaining time: 12 minutes, 24 seconds.
Growing trees.. Progress: 71%. Estimated remaining time: 11 minutes, 54 seconds.
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Growing trees.. Progress: 75%. Estimated remaining time: 10 minutes, 16 seconds.
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Growing trees.. Progress: 83%. Estimated remaining time: 6 minutes, 59 seconds.
Growing trees.. Progress: 84%. Estimated remaining time: 6 minutes, 33 seconds.
Growing trees.. Progress: 85%. Estimated remaining time: 6 minutes, 5 seconds.

seconds.

Growing trees.. Progress: 86%. Estimated remaining time: 5 minutes, 33 seconds.
Growing trees.. Progress: 88%. Estimated remaining time: 4 minutes, 57 seconds.
Growing trees.. Progress: 89%. Estimated remaining time: 4 minutes, 25 seconds.
Growing trees.. Progress: 91%. Estimated remaining time: 3 minutes, 48 seconds.
Growing trees.. Progress: 92%. Estimated remaining time: 3 minutes, 27 seconds.
Growing trees.. Progress: 93%. Estimated remaining time: 2 minutes, 59 seconds.
Growing trees.. Progress: 94%. Estimated remaining time: 2 minutes, 40 seconds.
Growing trees.. Progress: 95%. Estimated remaining time: 2 minutes, 10 seconds.
Growing trees.. Progress: 96%. Estimated remaining time: 1 minute, 43 seconds.
Growing trees.. Progress: 97%. Estimated remaining time: 1 minute, 24 seconds.
Growing trees.. Progress: 97%. Estimated remaining time: 1 minute, 5 seconds.
Growing trees.. Progress: 98%. Estimated remaining time: 47 seconds.
Growing trees.. Progress: 99%. Estimated remaining time: 27 seconds.
Growing trees.. Progress: 100%. Estimated remaining time: 7 seconds. Growing trees.. Progress: 1%. Estimated remaining time: 51 minutes, 9 seconds.
Growing trees.. Progress: 2%. Estimated remaining time: 42 minutes, 42 seconds.
Growing trees.. Progress: 4%. Estimated remaining time: 44 minutes, 14 seconds.
Growing trees.. Progress: 5%. Estimated remaining time: 40 minutes, 24 seconds.
Growing trees.. Progress: 7%. Estimated remaining time: 40 minutes, 45 seconds.
Growing trees.. Progress: 8%. Estimated remaining time: 38 minutes, 43 seconds.
Growing trees.. Progress: 9%. Estimated remaining time: 38 minutes, 41 seconds.
Growing trees.. Progress: 11%. Estimated remaining time: 37 minutes, 18 seconds.
Growing trees.. Progress: 12%. Estimated remaining time: 36 minutes, 48 Growing trees.. Progress: 13%. Estimated remaining time: 36 minutes, 11 seconds.
Growing trees.. Progress: 15%. Estimated remaining time: 35 minutes, 30 seconds.
Growing trees.. Progress: 16%. Estimated remaining time: 34 minutes, 44 seconds.
Growing trees.. Progress: 18%. Estimated remaining time: 34 minutes, 5 seconds.
Growing trees.. Progress: 19%. Estimated remaining time: 33 minutes, 36 seconds.
Growing trees.. Progress: 20%. Estimated remaining time: 32 minutes, 50 seconds.
Growing trees.. Progress: 22%. Estimated remaining time: 32 minutes, 17 seconds.
Growing trees.. Progress: 23%. Estimated remaining time: 31 minutes, 44 seconds.
Growing trees.. Progress: 24%. Estimated remaining time: 31 minutes, 5 seconds.
Growing trees.. Progress: 26%. Estimated remaining time: 30 minutes, 32 seconds.
Growing trees.. Progress: 27%. Estimated remaining time: 30 minutes, 0 seconds.
Growing trees.. Progress: 28%. Estimated remaining time: 29 minutes, 22 seconds.
Growing trees.. Progress: 30%. Estimated remaining time: 28 minutes, 52 seconds.
Growing trees.. Progress: 31%. Estimated remaining time: 28 minutes, 10 seconds.
Growing trees.. Progress: 32%. Estimated remaining time: 27 minutes, 40 seconds.
Growing trees.. Progress: 34%. Estimated remaining time: 27 minutes, 8 seconds.
Growing trees.. Progress: 35%. Estimated remaining time: 26 minutes, 30 seconds.

seconds.

Growing trees.. Progress: 37%. Estimated remaining time: 26 minutes, 0 seconds.
Growing trees.. Progress: 38%. Estimated remaining time: 25 minutes, 23 seconds.
Growing trees.. Progress: 39%. Estimated remaining time: 24 minutes, 53 seconds.
Growing trees.. Progress: 41%. Estimated remaining time: 24 minutes, 15 seconds.
Growing trees.. Progress: 42%. Estimated remaining time: 23 minutes, 43 seconds.
Growing trees.. Progress: 44%. Estimated remaining time: 23 minutes, 5 seconds.
Growing trees.. Progress: 45%. Estimated remaining time: 22 minutes, 36 seconds.
Growing trees.. Progress: 46%. Estimated remaining time: 21 minutes, 59 Growing trees.. Progress: 48%.
Estimated remaining time: 21 minutes, 27 seconds.
Growing trees.. Progress: 49%. Estimated remaining time: 20 minutes, 46 seconds.
Growing trees.. Progress: 50%. Estimated remaining time: 20 minutes, 16 seconds.
Growing trees.. Progress: 52%. Estimated remaining time: 19 minutes, 39 seconds.
Growing trees.. Progress: 53%. Estimated remaining time: 19 minutes, 7 seconds.
Growing trees.. Progress: 54%. Estimated remaining time: 18 minutes, 36 seconds.
Growing trees.. Progress: 56%. Estimated remaining time: 18 minutes, 4 seconds.
Growing trees.. Progress: 57%. Estimated remaining time: 17 minutes, 32 seconds.
Growing trees.. Progress: 58%. Estimated remaining time: 16 minutes, 59 seconds.
Growing trees.. Progress: 60%. Estimated remaining time: 16 minutes, 22 seconds.
Growing trees.. Progress: 61%. Estimated remaining time: 15 minutes, 50 seconds.
Growing trees.. Progress: 63%. Estimated remaining time: 15 minutes, 11 seconds.
Growing trees.. Progress: 64%. Estimated remaining time: 14 minutes, 42 seconds.
Growing trees.. Progress: 65%. Estimated remaining time: 14 minutes, 6 seconds.
Growing trees.. Progress: 67%. Estimated remaining time: 13 minutes, 32 seconds.
Growing trees.. Progress: 68%. Estimated remaining time: 12 minutes, 58 seconds.
Growing trees.. Progress: 70%. Estimated remaining time: 12 minutes, 24 seconds.
Growing trees.. Progress: 71%. Estimated remaining time: 11 minutes, 50 seconds.
Growing trees.. Progress: 72%. Estimated remaining time: 11 minutes, 18 seconds.
Growing trees.. Progress: 74%. Estimated remaining time: 10 minutes, 46 seconds.
Growing trees.. Progress: 75%. Estimated remaining time: 10 minutes, 14 seconds.
Growing trees.. Progress: 76%. Estimated remaining time: 9 minutes, 39 seconds.
Growing trees.. Progress: 78%. Estimated remaining time: 9 minutes, 8 seconds.
Growing trees.. Progress: 79%. Estimated remaining time: 8 minutes, 36 seconds.
Growing trees.. Progress: 80%. Estimated remaining time: 8 minutes, 4

seconds.

Growing trees.. Progress: 82%. Estimated remaining time: 7 minutes, 30 seconds.
Growing trees.. Progress: 83%. Estimated remaining time: 6 minutes, 58 seconds.
Growing trees.. Progress: 84%. Estimated remaining time: 6 minutes, 24 seconds.
Growing trees.. Progress: 86%. Estimated remaining time: 5 minutes, 52 seconds.
Growing trees.. Progress: 87%. Estimated remaining time: 5 minutes, 20 seconds.
Growing trees.. Progress: 88%. Estimated remaining time: 4 minutes, 43 seconds.
Growing trees.. Progress: 90%. Estimated remaining time: 4 minutes, 12 seconds.
Growing trees.. Progress: 91%. Estimated remaining time: 3 minutes, 35 seconds.
Growing trees.. Progress: 93%. Estimated remaining time: 3 minutes, 3 seconds.
Growing trees.. Progress: 94%. Estimated remaining time: 2 minutes, 26 seconds.
Growing trees.. Progress: 95%. Estimated remaining time: 1 minute, 55 seconds.
Growing trees.. Progress: 97%. Estimated remaining time: 1 minute, 20 seconds.
Growing trees.. Progress: 98%. Estimated remaining time: 48 seconds.
Growing trees.. Progress: 99%. Estimated remaining time: 17 seconds. [1] 0.3810031

Basic testing model

Model	Error
k-NN	0.638315
LASSO	0.635483
SVM	0.445464
Random Forest	0.396741
Boosting	0.382399

Weighted Average

Model		Error	
Best RF		0.396415	
Best BST		0.382642	
Mean RF		0.396803	
Mean BST		0.382934	
Best RF + BST		0.380572	
Mean RF + BST		0.381167	

Stacked Generalization

1. Split the training dataset in to k folds.

2. For i-th fold of training data, train models with each of the level-0 learners on the rest of the training data.

3. Make predictions using the models we trained:

   • make predictions on i-th fold of data.

   • make predictions on the test set.

4. Repeat 2. and 3. until we used all k folds of training data. 5. Generate the level-1 data using predictions we obtained:

- generate level-1 training data by concatenating the predictions we made on each fold of the training data.

- generate level-1 test data by averaging the predictions we made on the test set.

6. Train a level-1 generalizer using the level-1 data and the correct responses, make predictions.

| Model	Error
LV-1 k-NN	0.631110
LV-1 LASSO	0.624957
LV-1 SVM	0.443895
LV-1 RF	0.393018
LV-1 BST	0.379804
Stacked	0.382274

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see http://rmarkdown.rstudio.com.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
#
                ##     speed        dist
                ## Min.   : 4.0  Min.   : 2.00
                #  1st Qu.:12.0   1st Qu.: 26.00
                ## Median :15.0   Median : 36.00
                ## Mean   :15.4   Mean   : 42.98
                ## 3rd Qu.:19.0   3rd Qu.: 56.00
                ## Max.   :25.0  Max.   :120.00
```

Including Plots

You can also embed plots, for example:
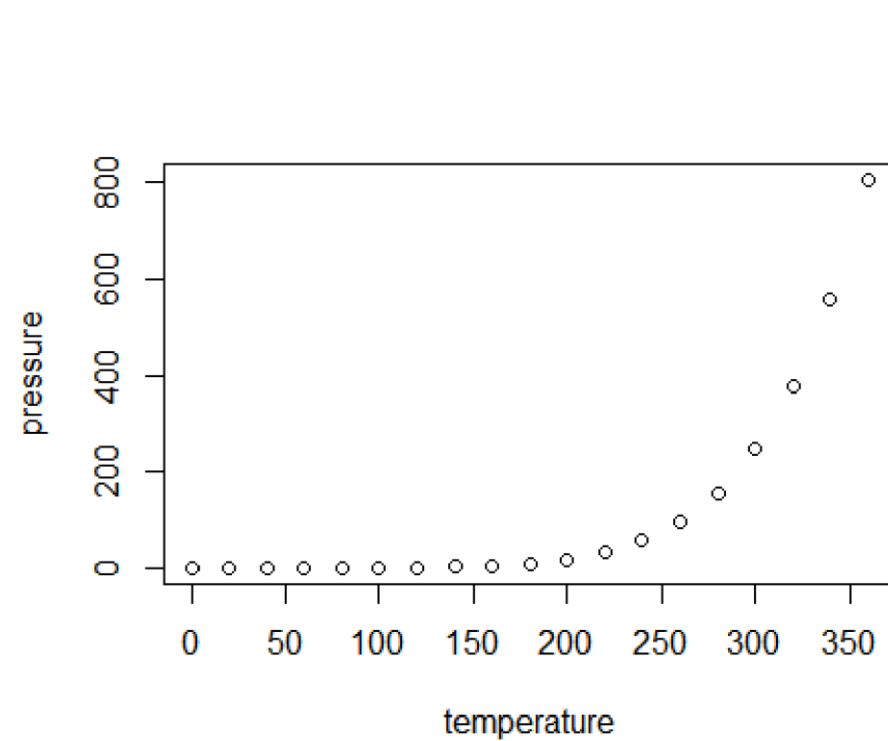
Note that the echo = FALSE parameter was added to the code chunk to prevent printing of the R code that generated the plot.

6. Expected Format

1. R file should be submitted where applicable.
2. R file should be in PDF or in .r format
3. Proper screenshots of the outputs should be submitted as well
4. The r codes, if submitted in any other format, will be subjected to deduction in marks

Note: Your solution will not be entertained if it is any other format, e.g., .zip, .doc, .rtf etc.

7. Approximate Time to Complete Task

20 mins.