

Session 13

Acadgild assignment 13.1

Dataset used here is the *BlogFeedback Data Set* by Krisztian Buza, it can be found on [UC Irvine Machine Learning Repository](#). There are 60 test files and one training file in the dataset.

In total, 281 attributes are available for each observation. Our goal is to predict the number of comments in the next 24 hours. Certain variables are removed in prepossessing due to lack of variations.

The models are fitted on the log-transformed responses. Model performances are measured by mean squared error

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, 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"
setwd("C:/Users/manojnagapudi/Desktop/BlogFeedback")

# [1] "C:/Users/manojnagapudi/Downloads/New folder"
blogData_train <- read_csv("C:/Users/Seshan/Desktop/BlogFeedback/blogData_train.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' =>
```

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## '0.0_35' [77], '0.0' => '0.0_36' [78], '0.0' => '0.0_37' [79], '0.0' =>
## '0.0_38' [80], '0.0' => '0.0_39' [81], '0.0' => '0.0_40' [82], '0.0' =>
## '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' =>
## '0.0_53' [95], '0.0' => '0.0_54' [96], '0.0' => '0.0_55' [97], '0.0' =>
## '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' =>
## '0.0_86' [128], '0.0' => '0.0_87' [129], '0.0' => '0.0_88' [130], '0.0' =>
## '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' =>

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## '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)

# 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)]

# drop continuous variables without variation

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drop = c(8, 13, 28, 33, 38, 40, 43, 50, 278)
train[, (drop) := NULL]
test[, (drop) := NULL]

# write to files
write.csv(train, "BlogFeedback-Train.csv", row.names = F)
write.csv(test, "BlogFeedback-Test.csv", row.names = F)

train

##          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 14.04423
## 3: 40.30467 53.84566 0 401 15 15.52416 32.44188 377 3 14.04423
## 4: 40.30467 53.84566 0 401 15 15.52416 32.44188 377 3 14.04423
## 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
## 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 0.00000
## 52396: 0.00000 0.00000 0 0 0 0.00000 0.00000 0 0 0.00000
## 52397: 0.00000 0.00000 0 0 0 0.00000 0.00000 0 0 0.00000
##          V12  V14  V15        V16        V17  V18  V19  V20        V21        V22
## 1: 32.61542 377 2 34.56757 48.47518 0 378 12 1.479934 46.18691
## 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 1.479934 46.18691
## 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 33 33 33 0.000000 26.94439
## 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 0 0 0.000000 0.00000
##          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 0
## 2: -356 377 0 1.076167 1.795416 11 0 0.4004914 1.0780969 9 0
## 3: -356 377 0 1.076167 1.795416 11 0 0.4004914 1.0780969 9 0
## 4: -356 377 0 1.076167 1.795416 11 0 0.4004914 1.0780969 9 0
## 5: -356 377 0 1.076167 1.795416 11 0 0.4004914 1.0780969 9 0
## ...
## 52393: -33 33 0 0.000000 0.000000 0 0 0.0000000 0.0000000 0 0
## 52394: -33 33 0 0.000000 0.000000 0 0 0.0000000 0.0000000 0 0
## 52395: 0 0 0 2.000000 0.000000 2 2 0.6666667 0.9428091 2 0
## 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 0 0.02293202
## 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

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## 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 0 10 0
## 2: 1.521174 -8 9 6 2 4 5 -2 0 0 0 0 0 0 35 0
## 3: 1.521174 -8 9 6 2 4 5 -2 0 0 0 0 0 0 35 0
## 4: 1.521174 -8 9 2 2 0 2 2 0 0 0 0 0 0 10 0
## 5: 1.521174 -8 9 3 1 2 2 -1 0 0 0 0 0 0 34 0
## ---
## 52393: 0.000000 0 0 33 0 33 33 -33 0 0 0 0 0 0 38 3137
## 52394: 0.000000 0 0 33 0 0 33 0 0 0 0 0 0 0 0 62 3137
## 52395: 1.632993 -2 2 0 0 0 0 0 0 2 2 0 0 2 2 13 0
## 52396: 1.632993 -2 2 0 0 0 0 0 0 2 0 0 2 2 -2 37 0
## 52397: 1.632993 -2 2 0 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 0 0
## 2: 0 0 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 0 0
## 4: 0 0 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 0 0
## ---
## 52393: 0 1 0 0 0 0 1 0 0 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 0 0
## 52395: 0 0 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 0 0
## 52397: 0 0 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 0 0
## 2: 0 0 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 0 0
## 4: 0 0 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 0 0
## ---
## 52393: 0 0 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 0 0
## 52395: 0 0 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 0 0
## 52397: 0 0 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 0 0 0 0 0
## 2: 0 0 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 0 0
## 4: 0 0 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 0 0

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##  ---
## 52393: 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
## 52394: 0 0 0 0 1 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
## 52396: 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
##      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 0 0 0
## 2: 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
## 4: 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
##  ---
## 52393: 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
## 52394: 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
## 52395: 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
## 52397: 0 0 0 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 0 0 0
## 2: 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
## 4: 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
##  ---
## 52393: 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
## 52395: 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
## 52397: 0 0 0 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 0 0 0
## 2: 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
## 4: 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
##  ---
## 52393: 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0
## 52394: 0 1 0 0 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 0 0 0
## 52396: 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
##      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 0 0 0
## 2: 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
## 4: 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
##  ---
## 52393: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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## 52394: 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
## 52396: 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
##      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 0 0
## 2: 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
## 4: 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
## ---
## 52393: 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
## 52395: 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
## 52397: 0 0 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 0 0
## 2: 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
## 4: 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
## ---
## 52393: 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
## 52394: 0 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 0
## 52396: 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
##      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 0 0
## 2: 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
## 4: 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
## ---
## 52393: 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
## 52395: 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
## 52397: 0 0 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 0 0
## 2: 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
## 4: 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
## ---
## 52393: 0 0 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 0 1 0
## 52395: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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## 52396: 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
##      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 0 0 0
## 2: 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
## 4: 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
## ---
## 52393: 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
## 52395: 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
## 52397: 0 0 0 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 0 0 0
## 2: 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
## 4: 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
## ---
## 52393: 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
## 52394: 1 0 0 0 1 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
## 52396: 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
##      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 0 0 0
## 2: 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
## 4: 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
## ---
## 52393: 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
## 52394: 0 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
## 52396: 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
##      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 0 0 0
## 2: 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
## 4: 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
## ---
## 52393: 0 0 0 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 0 0 0 1
## 52395: 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
## 52397: 0 0 0 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: 0.0000000 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: 0.0000000 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: 0.0000000 0.0000000 0 0 0.0 0.00000000 0.0000000 0 0.00000000
## 7621: 0.0000000 0.0000000 0 0 0.0 0.00000000 0.0000000 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: 0.0000000 0.0000000 0 0 0.0 0.00000000 0.0000000 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 0
## 2: 0 0 0 0 0 62 696 0 0 0 0 0 0 1 0 0 0
## 3: 2 2 0 2 2 13 8361 0 1 0 0 0 1 1 1 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
## 7621: 0 0 0 0 0 47 4196 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	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
##	7621:	0	0	0	0	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	0	0	0	0
##	7623:	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
##		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	0	0
##	2:	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
##	3:	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0
##	4:	0	0	0	0	0	0	0	0	0	0	0	0	1	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
##	7621:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
##	7622:	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
##	7624:	0	0	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	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
##	---																	
##	7620:	0	0	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	0	0	0	0
##	7622:	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
##	7624:	0	0	0	0	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	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	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
##	4:	0	1	0	0	1	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
##	7621:	0	0	1	0	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	0	0	0	0
##	7623:	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
##		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	0	0	0	0
##	2:	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0


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## 5: 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
## 7621: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1
## 7622: 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
## 7624: 0 0 0 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 0 0 0
## 2: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 3: 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1
## 4: 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
## ---
## 7620: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 7621: 0 1 0 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 0 0 0
## 7623: 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
##   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 0 0 0
## 2: 0 0 0 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 0 0 0
## 4: 0 0 0 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 0 0 0
## ---
## 7620: 0 0 0 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 0 0 0
## 7622: 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
## 7624: 0 0 0 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 0 0 0
## 2: 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0
## 3: 0 0 0 0 1 0 0 1 0 0 0 0 0 1 0 0
## 4: 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
## ---
## 7620: 0 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 1 0 1 0 0
## 7622: 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
## 7624: 0 0 0 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 0 0 0
## 2: 0 0 0 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 0 0 0 0 1
## 4: 0 0 0 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 0 0 0 1
## ---

```

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## 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
## 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 0 0
## 2: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## 3: 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0
## 4: 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
## ---
## 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 0 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
## V261 V262 V263 V264 V265 V266 V267 V268 V269 V270 V271 V272 V273
## 1: 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0
## 2: 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
## 3: 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0
## 4: 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0
## 5: 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0
## ---
## 7620: 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0
## 7621: 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1
## 7622: 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1
## 7623: 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
## 7624: 0 0 0 0 0 0 0 0 1 0 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.forest = T)

## Growing trees.. Progress: 3%. Estimated remaining time: 21 minutes, 27 seconds.
## Growing trees.. Progress: 5%. Estimated remaining time: 19 minutes, 39 seconds.

```

```
## Growing trees.. Progress: 8%. Estimated remaining time: 18 minutes, 54 seconds.
## Growing trees.. Progress: 11%. Estimated remaining time: 18 minutes, 7 seconds.
## Growing trees.. Progress: 14%. Estimated remaining time: 17 minutes, 19 seconds.
## Growing trees.. Progress: 17%. Estimated remaining time: 16 minutes, 36 seconds.
## Growing trees.. Progress: 19%. Estimated remaining time: 16 minutes, 1 seconds.
## Growing trees.. Progress: 22%. Estimated remaining time: 15 minutes, 27 seconds.
## Growing trees.. Progress: 25%. Estimated remaining time: 14 minutes, 51 seconds.
## Growing trees.. Progress: 28%. Estimated remaining time: 14 minutes, 17 seconds.
## Growing trees.. Progress: 30%. Estimated remaining time: 13 minutes, 41 seconds.
## Growing trees.. Progress: 33%. Estimated remaining time: 13 minutes, 8 seconds.
## Growing trees.. Progress: 36%. Estimated remaining time: 12 minutes, 35 seconds.
## Growing trees.. Progress: 39%. Estimated remaining time: 12 minutes, 2 seconds.
## Growing trees.. Progress: 42%. Estimated remaining time: 11 minutes, 29 seconds.
## Growing trees.. Progress: 44%. Estimated remaining time: 10 minutes, 57 seconds.
## Growing trees.. Progress: 47%. Estimated remaining time: 10 minutes, 25 seconds.
## Growing trees.. Progress: 49%. Estimated remaining time: 10 minutes, 4 seconds.
## Growing trees.. Progress: 52%. Estimated remaining time: 9 minutes, 45 seconds.
## Growing trees.. Progress: 54%. Estimated remaining time: 9 minutes, 19 seconds.
## Growing trees.. Progress: 57%. Estimated remaining time: 8 minutes, 44 seconds.
## Growing trees.. Progress: 59%. Estimated remaining time: 8 minutes, 11 seconds.
## Growing trees.. Progress: 62%. Estimated remaining time: 7 minutes, 41 seconds.
## Growing trees.. Progress: 65%. Estimated remaining time: 7 minutes, 7 seconds.
## Growing trees.. Progress: 67%. Estimated remaining time: 6 minutes, 39 seconds.
## Growing trees.. Progress: 70%. Estimated remaining time: 6 minutes, 11 seconds.
## Growing trees.. Progress: 72%. Estimated remaining time: 5 minutes, 38 seconds.
```

```

## Growing trees.. Progress: 75%. Estimated remaining time: 5 minutes, 3 seconds.
## Growing trees.. Progress: 78%. Estimated remaining time: 4 minutes, 29 seconds.
## Growing trees.. Progress: 80%. Estimated remaining time: 3 minutes, 59 seconds.
## Growing trees.. Progress: 83%. Estimated remaining time: 3 minutes, 26 seconds.
## Growing trees.. Progress: 86%. Estimated remaining time: 2 minutes, 52 seconds.
## Growing trees.. Progress: 89%. Estimated remaining time: 2 minutes, 18 seconds.
## Growing trees.. Progress: 91%. Estimated remaining time: 1 minute, 44 seconds.
## Growing trees.. Progress: 94%. Estimated remaining time: 1 minute, 10 seconds.
## 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 = train,
               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
## [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
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## [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
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## [66] train-rmse:0.669334
## [67] train-rmse:0.667636
## [68] train-rmse:0.665990
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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
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## [82] train-rmse:0.647973
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## [366] train-rmse:0.580532
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## [414] train-rmse:0.576164
## [415] train-rmse:0.576025
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## [416] train-rmse:0.575934
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## [665] train-rmse:0.557920
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## [748] train-rmse:0.553420
## [749] train-rmse:0.553361
## [750] train-rmse:0.553349

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

## [1] 0.3820247

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

library(e1071)
library(FNN)
library(glmnet)
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
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_glm_test = rep(0, nrow(test))
meta_glm_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
temp_glm = cv.glmnet(train_set1, train[train_index]$V281, family = "gaussian",
alpha = 1)
meta_pred = predict(temp_glm, newx = train_set2)
meta_glm_test = meta_glm_test + predict(temp_glm, newx = test_x_sparse) / k

return(meta_pred)
}

# 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 + V6 + V10, data =
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) / k

  return(meta_pred)
}

# 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 = 500, mtry = 120,
write.forest = T)
  meta_pred = predict(temp_rf, train_set2)$predictions
  meta_rf_test = meta_rf_test + predict(temp_rf, test)$predictions / k

```

```
    return(meta_pred)
}

## Growing trees.. Progress: 7%. Estimated remaining time: 7 minutes, 18 seconds.
## Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 33 seconds.
## Growing trees.. Progress: 21%. Estimated remaining time: 5 minutes, 57 seconds.
## Growing trees.. Progress: 28%. Estimated remaining time: 5 minutes, 25 seconds.
## Growing trees.. Progress: 35%. Estimated remaining time: 4 minutes, 51 seconds.
## Growing trees.. Progress: 43%. Estimated remaining time: 4 minutes, 18 seconds.
## Growing trees.. Progress: 50%. Estimated remaining time: 3 minutes, 45 seconds.
## Growing trees.. Progress: 57%. Estimated remaining time: 3 minutes, 13 seconds.
## Growing trees.. Progress: 64%. Estimated remaining time: 2 minutes, 40 seconds.
## Growing trees.. Progress: 71%. Estimated remaining time: 2 minutes, 8 seconds.
## Growing trees.. Progress: 79%. Estimated remaining time: 1 minute, 36 seconds.
## Growing trees.. Progress: 86%. Estimated remaining time: 1 minute, 3 seconds.
## Growing trees.. Progress: 93%. Estimated remaining time: 31 seconds.
## Growing trees.. Progress: 7%. Estimated remaining time: 7 minutes, 18 seconds.
## Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 33 seconds.
## Growing trees.. Progress: 21%. Estimated remaining time: 5 minutes, 57 seconds.
## Growing trees.. Progress: 28%. Estimated remaining time: 5 minutes, 26 seconds.
## Growing trees.. Progress: 35%. Estimated remaining time: 4 minutes, 56 seconds.
## Growing trees.. Progress: 41%. Estimated remaining time: 4 minutes, 31 seconds.
## Growing trees.. Progress: 48%. Estimated remaining time: 3 minutes, 58 seconds.
## Growing trees.. Progress: 55%. Estimated remaining time: 3 minutes, 24 seconds.
## Growing trees.. Progress: 62%. Estimated remaining time: 2 minutes, 51 seconds.
## Growing trees.. Progress: 70%. Estimated remaining time: 2 minutes, 18 seconds.
## Growing trees.. Progress: 77%. Estimated remaining time: 1 minute, 46 seconds.
```

```
## Growing trees.. Progress: 84%. Estimated remaining time: 1 minute, 13 seconds.
## 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 seconds.
## Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 20 seconds.
## Growing trees.. Progress: 21%. Estimated remaining time: 5 minutes, 45 seconds.
## Growing trees.. Progress: 29%. Estimated remaining time: 5 minutes, 9 seconds.
## Growing trees.. Progress: 36%. Estimated remaining time: 4 minutes, 39 seconds.
## Growing trees.. Progress: 43%. Estimated remaining time: 4 minutes, 8 seconds.
## Growing trees.. Progress: 51%. Estimated remaining time: 3 minutes, 34 seconds.
## Growing trees.. Progress: 58%. Estimated remaining time: 3 minutes, 3 seconds.
## Growing trees.. Progress: 65%. Estimated remaining time: 2 minutes, 33 seconds.
## Growing trees.. Progress: 71%. Estimated remaining time: 2 minutes, 5 seconds.
## Growing trees.. Progress: 78%. Estimated remaining time: 1 minute, 35 seconds.
## Growing trees.. Progress: 86%. Estimated remaining time: 1 minute, 2 seconds.
## 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 seconds.
## Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 46 seconds.
## Growing trees.. Progress: 21%. Estimated remaining time: 6 minutes, 4 seconds.
## Growing trees.. Progress: 28%. Estimated remaining time: 5 minutes, 33 seconds.
## Growing trees.. Progress: 35%. Estimated remaining time: 4 minutes, 57 seconds.
## Growing trees.. Progress: 43%. Estimated remaining time: 4 minutes, 22 seconds.
## Growing trees.. Progress: 50%. Estimated remaining time: 3 minutes, 51 seconds.
## Growing trees.. Progress: 57%. Estimated remaining time: 3 minutes, 18 seconds.
## Growing trees.. Progress: 63%. Estimated remaining time: 2 minutes, 47 seconds.
## Growing trees.. Progress: 70%. Estimated remaining time: 2 minutes, 15 seconds.
```

```

## Growing trees.. Progress: 77%. Estimated remaining time: 1 minute, 44 seconds.
## Growing trees.. Progress: 84%. Estimated remaining time: 1 minute, 14 seconds.
## 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 seconds.
## Growing trees.. Progress: 14%. Estimated remaining time: 6 minutes, 46 seconds.
## Growing trees.. Progress: 20%. Estimated remaining time: 6 minutes, 19 seconds.
## Growing trees.. Progress: 27%. Estimated remaining time: 5 minutes, 39 seconds.
## Growing trees.. Progress: 34%. Estimated remaining time: 5 minutes, 7 seconds.
## Growing trees.. Progress: 41%. Estimated remaining time: 4 minutes, 36 seconds.
## Growing trees.. Progress: 48%. Estimated remaining time: 4 minutes, 1 seconds.
## Growing trees.. Progress: 55%. Estimated remaining time: 3 minutes, 28 seconds.
## Growing trees.. Progress: 62%. Estimated remaining time: 2 minutes, 54 seconds.
## Growing trees.. Progress: 69%. Estimated remaining time: 2 minutes, 23 seconds.
## Growing trees.. Progress: 76%. Estimated remaining time: 1 minute, 52 seconds.
## Growing trees.. Progress: 83%. Estimated remaining time: 1 minute, 18 seconds.
## 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[train_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_depth = 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
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## [592] train-rmse:0.571984
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## [735] train-rmse:0.562843
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## [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
```

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## [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

# 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_test, 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)

## [1] 0.3840147

```

```

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)}

# 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 = 3)

return(predict(mdl_xgb, test_xgb))}

# fit random forest

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, test)$predictions)}

# weighted average

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

```

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[1]    train-rmse:1.123122
[2]    train-rmse:1.105641
[3]    train-rmse:1.088758
[4]    train-rmse:1.072427
[5]    train-rmse:1.056559
[6]    train-rmse:1.041096
[7]    train-rmse:1.026287
[8]    train-rmse:1.011939

```

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[11]   train-rmse:0.971762
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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 seconds.
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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.

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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.

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Growing trees.. Progress: 34%. Estimated remaining time: 27 minutes, 25 seconds.

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Growing trees.. Progress: 37%. Estimated remaining time: 26 minutes, 18 seconds.

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Growing trees.. Progress: 39%. Estimated remaining time: 25 minutes, 18 seconds.

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Growing trees.. Progress: 78%. Estimated remaining time: 8 minutes, 58 seconds.

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Growing trees.. Progress: 21%. Estimated remaining time: 32 minutes, 18 seconds.

Growing trees.. Progress: 22%. Estimated remaining time: 31 minutes, 32 seconds.

Growing trees.. Progress: 24%. Estimated remaining time: 31 minutes, 7 seconds.

Growing trees.. Progress: 25%. Estimated remaining time: 30 minutes, 17 seconds.

Growing trees.. Progress: 26%. Estimated remaining time: 29 minutes, 58 seconds.

Growing trees.. Progress: 28%. Estimated remaining time: 29 minutes, 18 seconds.

Growing trees.. Progress: 29%. Estimated remaining time: 28 minutes, 46 seconds.

Growing trees.. Progress: 31%. Estimated remaining time: 28 minutes, 5 seconds.

Growing trees.. Progress: 32%. Estimated remaining time: 27 minutes, 35 seconds.

Growing trees.. Progress: 33%. Estimated remaining time: 27 minutes, 4 seconds.

Growing trees.. Progress: 35%. Estimated remaining time: 26 minutes, 26 seconds.

Growing trees.. Progress: 36%. Estimated remaining time: 25 minutes, 55 seconds.

Growing trees.. Progress: 38%. Estimated remaining time: 25 minutes, 18 seconds.

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.

Growing trees.. Progress: 45%. Estimated remaining time: 22 minutes, 28 seconds.

Growing trees.. Progress: 46%. Estimated remaining time: 21 minutes, 53 seconds.

Growing trees.. Progress: 47%. Estimated remaining time: 21 minutes, 19 seconds.

Growing trees.. Progress: 49%. Estimated remaining time: 20 minutes, 45 seconds.

Growing trees.. Progress: 50%. Estimated remaining time: 20 minutes, 10 seconds.

Growing trees.. Progress: 51%. Estimated remaining time: 19 minutes, 39 seconds.

Growing trees.. Progress: 53%. Estimated remaining time: 19 minutes, 3 seconds.

Growing trees.. Progress: 54%. Estimated remaining time: 18 minutes, 28 seconds.

Growing trees.. Progress: 56%. Estimated remaining time: 17 minutes, 58 seconds.

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.

Growing trees.. Progress: 72%. Estimated remaining time: 11 minutes, 20 seconds.

Growing trees.. Progress: 73%. Estimated remaining time: 10 minutes, 46 seconds.

Growing trees.. Progress: 75%. Estimated remaining time: 10 minutes, 16 seconds.

Growing trees.. Progress: 76%. Estimated remaining time: 9 minutes, 41 seconds.

Growing trees.. Progress: 77%. Estimated remaining time: 9 minutes, 10 seconds.

Growing trees.. Progress: 79%. Estimated remaining time: 8 minutes, 39 seconds.

Growing trees.. Progress: 80%. Estimated remaining time: 8 minutes, 1 seconds.

Growing trees.. Progress: 81%. Estimated remaining time: 7 minutes, 30 seconds.

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.

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.

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Growing trees.. Progress: 13%. Estimated remaining time: 36 minutes, 11 seconds.

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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.

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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.

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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.

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.

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Growing trees.. Progress: 45%. Estimated remaining time: 22 minutes, 36 seconds.

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Growing trees.. Progress: 53%. Estimated remaining time: 19 minutes, 7 seconds.

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Growing trees.. Progress: 56%. Estimated remaining time: 18 minutes, 4 seconds.

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Growing trees.. Progress: 58%. Estimated remaining time: 16 minutes, 59 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, 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>.

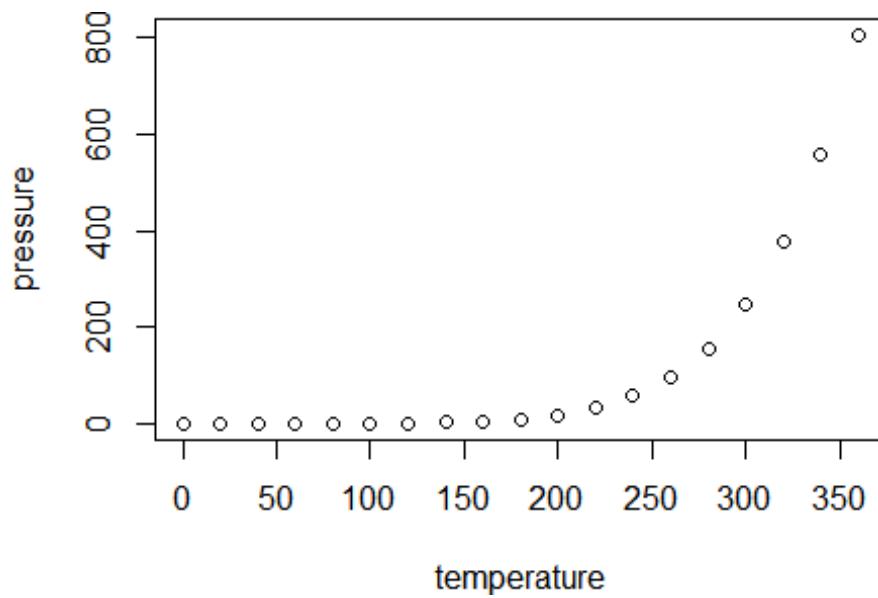
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
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.