#Set up

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.4.0      v purrr   0.3.5
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.3      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(caret)
```

```
## Loading required package: lattice
##
## Attaching package: 'caret'
##
## The following object is masked from 'package:purrr':
##
##     lift
```

```
library(reticulate)
library(recipes)
```

```
##
## Attaching package: 'recipes'
##
## The following object is masked from 'package:stringr':
##
##     fixed
##
## The following object is masked from 'package:stats':
##
##     step
```

```
library(vip)
```

```
##
## Attaching package: 'vip'
##
## The following object is masked from 'package:utils':
##
##     vi
```

```
library(rpart)
library(beepr)
library(cutpointr)
```

```
##
## Attaching package: 'cutpointr'
##
## The following objects are masked from 'package:caret':
##
##     precision, recall, sensitivity, specificity
```

```
library(gt)

#Read in data
train <- read.csv("tweet_train.csv")
test <- read.csv("tweet_test.csv")

#Drop ID
train <- train[-c(1)]
test <- test[-c(1)]
```

#Load in encoding model

```
use_condaenv('r-reticulate')

#conda_install(envname  = 'r-reticulate',
#              packages = 'sentence_transformers',
#              pip      = TRUE)

st <- import('sentence_transformers')

model.name <- 'bert-base-uncased'

longformer      <- st$models$Transformer(model.name)
pooling_model   <- st$models$Pooling(longformer$get_word_embedding_dimension())
LFmodel         <- st$SentenceTransformer(modules = list(longformer,pooling_model))
```

#Recipe and folds

```
#Create recipe
blueprint <- recipe(x = train,vars = colnames(train),
                    roles = c('outcome', rep('predictor',773))) %>%
  step_dummy('month', one_hot = T) %>%
  step_harmonic('day',frequency=1,cycle_size=7, role='predictor') %>%
  step_harmonic('date',frequency=1,cycle_size=31,role='predictor') %>%
  step_harmonic('hour',frequency=1,cycle_size=24,role='predictor') %>%
  step_normalize(paste0('V',1:768)) %>%
  step_normalize(c('day_sin_1','day_cos_1',
                   'date_sin_1','date_cos_1',
                   'hour_sin_1','hour_cos_1')) %>%
  step_normalize(all_numeric_predictors())

#Create fold
folds = cut(seq(1, nrow(train)), breaks = 10, labels = F)

#Index list
index <-vector('list', 10)
```

```r
for (i in 1:10){
  index[[i]] <- which(folds != i)
}



cv <- trainControl(method = "cv",
                   index  = index,
                   classProbs = TRUE)


#Hyperparameter grid
grid <- data.frame(alpha = 0 ,
               lambda = seq(0,3, 0.01))

beepr::beep(4)
```

#GLM

```r
set.seed(0294875)
model_glmnet <- caret::train(blueprint,
                             data = train,
                             method= "glmnet",
                             trainControl = cv,
                             family = 'binomial',
                             tuneGrid = grid)
```

```
## Loading required namespace: glmnet

## Loading required package: Matrix

##
## Attaching package: 'Matrix'

## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack

## Loaded glmnet 4.1-4
```

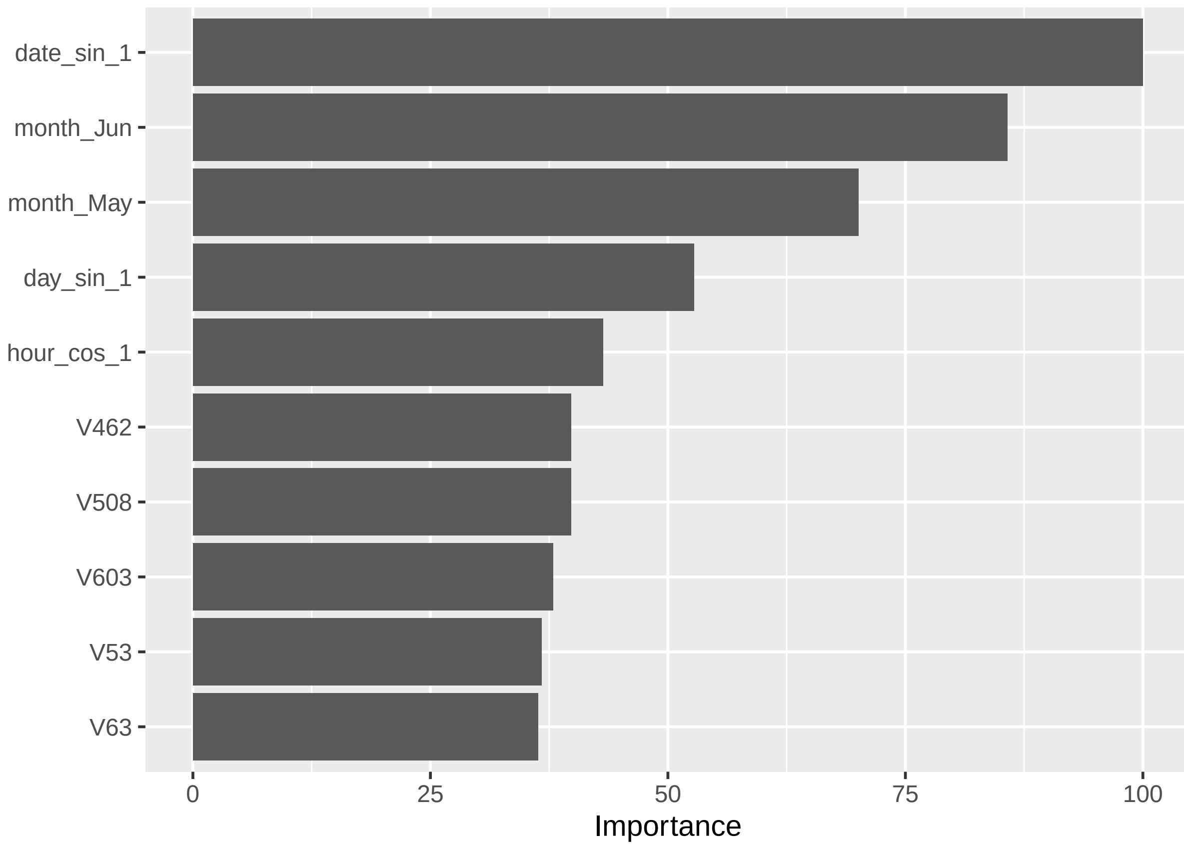
```r
prediction_glm <- predict(model_glmnet, test, type = 'prob')

#Best fit
model_glmnet$bestTune
```

```
##    alpha lambda
## 31     0    0.3
```

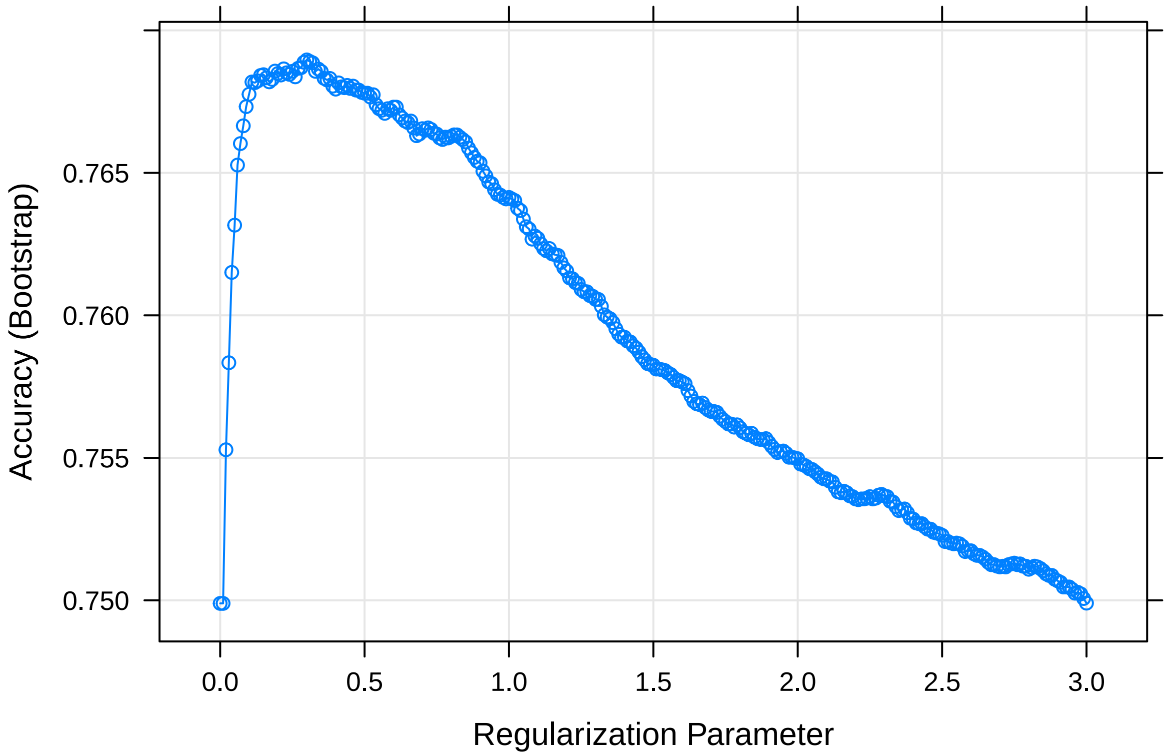
```r
model_glmnet$results[29,]
```

```
##    alpha lambda  Accuracy     Kappa  AccuracySD    KappaSD
## 29     0   0.28 0.7686897 0.5373852 0.009457094 0.01891813
```

```r
vip(model_glmnet)
```




```r
plot(model_glmnet)
```




```
saveRDS(model_glmnet,"./GLM_Model")
```

#GLM accuracy

```
#Confusion matrix
glm_pred_class <- ifelse(prediction_glm$positive>.6, 1,0)
glm_confusion <- table(test$sentiment,
                        glm_pred_class)
  #AUC
glm_cut <- cutpointr(x = prediction_glm$positive,
                     class = test$sentiment)
```

```
## Assuming the positive class is positive

## Assuming the positive class has higher x values
```

```
glm_auc <- auc(glm_cut)
  #ACC
glm_acc <-model_glmnet$results[29,][3]
glm_rsq <- glm_acc^2
  #TPR
glm_tpr <- glm_confusion[2,2]/
  (glm_confusion[2,1]+
     glm_confusion[2,2])
```

```
  #TNR
glm_tnr <- glm_confusion[1,1]/
  (glm_confusion[1,1] +
     glm_confusion[1,2])

  #PRE
glm_pre <- glm_confusion[2,2]/
  (glm_confusion[1,2] +
     glm_confusion[2,2])
```

#Decision tree model

```
set.seed(0294875)
cv_tree <- trainControl(method = "cv",
                   index  = index,
                   classProbs = F)

grid_tree <- data.frame(cp=seq(0,0.02,.001)) #Hyper parameter: complexity parameter




model_tree <- caret::train(blueprint,
                             data      = train,
                             method    = 'rpart',
                             tuneGrid  = grid_tree,
                             trControl = cv_tree,
                             control   = list(minsplit=20,
                                         minbucket = 2,
                                         maxdepth = 30))

model_tree$bestTune
```

```
##      cp
## 4 0.003
```

```
model_tree$results[4,]
```

```
##      cp Accuracy     Kappa AccuracySD    KappaSD
## 4 0.003 0.658831 0.3179721 0.03134496 0.06280724
```

```
predict_tree <- predict(model_tree, test,type = 'prob')
predict_tree
```

```
##       negative   positive
## 1   1.00000000 0.00000000
## 2   0.13445378 0.86554622
## 3   0.82051282 0.17948718
## 4   0.81566820 0.18433180
## 5   0.25869565 0.74130435
## 6   0.29032258 0.70967742
```

```
## 7   0.13445378 0.86554622
## 8   0.25869565 0.74130435
## 9   0.29032258 0.70967742
## 10  0.21951220 0.78048780
## 11  0.82857143 0.17142857
## 12  0.24736842 0.75263158
## 13  0.21052632 0.78947368
## 14  0.24736842 0.75263158
## 15  1.00000000 0.00000000
## 16  1.00000000 0.00000000
## 17  0.82051282 0.17948718
## 18  0.19424460 0.80575540
## 19  0.29032258 0.70967742
## 20  0.13445378 0.86554622
## 21  0.79487179 0.20512821
## 22  0.29032258 0.70967742
## 23  0.81566820 0.18433180
## 24  0.82051282 0.17948718
## 25  0.24736842 0.75263158
## 26  0.13445378 0.86554622
## 27  0.30000000 0.70000000
## 28  0.24736842 0.75263158
## 29  0.74809160 0.25190840
## 30  0.19424460 0.80575540
## 31  0.23893805 0.76106195
## 32  0.13445378 0.86554622
## 33  0.88888889 0.11111111
## 34  0.24736842 0.75263158
## 35  0.31578947 0.68421053
## 36  0.79487179 0.20512821
## 37  1.00000000 0.00000000
## 38  0.82051282 0.17948718
## 39  0.82857143 0.17142857
## 40  0.19424460 0.80575540
## 41  1.00000000 0.00000000
## 42  0.21052632 0.78947368
## 43  0.00000000 1.00000000
## 44  0.00000000 1.00000000
## 45  0.13445378 0.86554622
## 46  0.24736842 0.75263158
## 47  0.82000000 0.18000000
## 48  0.74809160 0.25190840
## 49  0.25869565 0.74130435
## 50  0.82051282 0.17948718
## 51  0.21951220 0.78048780
## 52  0.25869565 0.74130435
## 53  0.82000000 0.18000000
## 54  0.81566820 0.18433180
## 55  0.81566820 0.18433180
## 56  0.25869565 0.74130435
## 57  0.81818182 0.18181818
## 58  0.79487179 0.20512821
## 59  0.24000000 0.76000000
## 60  0.25869565 0.74130435
```

```
## 61  0.81818182 0.18181818
## 62  0.24736842 0.75263158
## 63  0.00000000 1.00000000
## 64  1.00000000 0.00000000
## 65  0.23728814 0.76271186
## 66  0.21951220 0.78048780
## 67  0.20000000 0.80000000
## 68  0.13445378 0.86554622
## 69  0.77500000 0.22500000
## 70  0.25869565 0.74130435
## 71  0.25869565 0.74130435
## 72  0.25869565 0.74130435
## 73  0.74809160 0.25190840
## 74  0.21951220 0.78048780
## 75  1.00000000 0.00000000
## 76  1.00000000 0.00000000
## 77  0.90000000 0.10000000
## 78  0.29032258 0.70967742
## 79  0.24736842 0.75263158
## 80  0.23893805 0.76106195
## 81  0.81566820 0.18433180
## 82  0.13445378 0.86554622
## 83  0.25869565 0.74130435
## 84  0.18181818 0.81818182
## 85  0.83783784 0.16216216
## 86  0.81566820 0.18433180
## 87  0.79487179 0.20512821
## 88  0.81566820 0.18433180
## 89  0.81818182 0.18181818
## 90  0.25869565 0.74130435
## 91  1.00000000 0.00000000
## 92  0.74809160 0.25190840
## 93  0.88888889 0.11111111
## 94  1.00000000 0.00000000
## 95  0.83783784 0.16216216
## 96  0.13445378 0.86554622
## 97  0.25869565 0.74130435
## 98  0.74809160 0.25190840
## 99  0.79487179 0.20512821
## 100 1.00000000 0.00000000
## 101 0.25869565 0.74130435
## 102 0.21428571 0.78571429
## 103 0.13445378 0.86554622
## 104 1.00000000 0.00000000
## 105 0.13445378 0.86554622
## 106 0.81566820 0.18433180
## 107 0.81566820 0.18433180
## 108 1.00000000 0.00000000
## 109 0.17391304 0.82608696
## 110 0.81566820 0.18433180
## 111 0.25869565 0.74130435
## 112 0.13445378 0.86554622
## 113 0.24000000 0.76000000
## 114 0.81566820 0.18433180
```

```
## 115 0.23893805 0.76106195
## 116 0.29032258 0.70967742
## 117 0.81818182 0.18181818
## 118 0.25869565 0.74130435
## 119 0.81566820 0.18433180
## 120 0.25869565 0.74130435
## 121 0.74809160 0.25190840
## 122 0.21428571 0.78571429
## 123 0.76642336 0.23357664
## 124 0.88888889 0.11111111
## 125 0.04878049 0.95121951
## 126 0.25869565 0.74130435
## 127 1.00000000 0.00000000
## 128 0.13445378 0.86554622
## 129 0.25869565 0.74130435
## 130 0.82051282 0.17948718
## 131 0.25869565 0.74130435
## 132 1.00000000 0.00000000
## 133 0.13445378 0.86554622
## 134 0.88888889 0.11111111
## 135 0.25869565 0.74130435
## 136 0.13445378 0.86554622
## 137 0.83783784 0.16216216
## 138 0.25869565 0.74130435
## 139 0.19424460 0.80575540
## 140 0.13445378 0.86554622
## 141 0.25869565 0.74130435
## 142 0.82857143 0.17142857
## 143 0.24000000 0.76000000
## 144 0.25869565 0.74130435
## 145 0.74809160 0.25190840
## 146 1.00000000 0.00000000
## 147 0.82051282 0.17948718
## 148 0.13445378 0.86554622
## 149 0.13445378 0.86554622
## 150 0.13445378 0.86554622
## 151 0.19424460 0.80575540
## 152 1.00000000 0.00000000
## 153 0.92857143 0.07142857
## 154 0.13445378 0.86554622
## 155 0.23893805 0.76106195
## 156 1.00000000 0.00000000
## 157 1.00000000 0.00000000
## 158 0.13445378 0.86554622
## 159 0.25869565 0.74130435
## 160 0.25869565 0.74130435
## 161 0.76642336 0.23357664
## 162 0.79487179 0.20512821
## 163 1.00000000 0.00000000
## 164 0.21052632 0.78947368
## 165 0.21052632 0.78947368
## 166 0.24528302 0.75471698
## 167 0.25869565 0.74130435
## 168 0.24000000 0.76000000
```

```
## 169 0.29032258 0.70967742
## 170 0.11428571 0.88571429
## 171 0.00000000 1.00000000
## 172 1.00000000 0.00000000
## 173 0.25869565 0.74130435
## 174 0.82857143 0.17142857
## 175 0.13445378 0.86554622
## 176 0.27586207 0.72413793
## 177 0.77500000 0.22500000
## 178 0.82051282 0.17948718
## 179 0.23893805 0.76106195
## 180 0.17391304 0.82608696
## 181 0.30000000 0.70000000
## 182 1.00000000 0.00000000
## 183 0.00000000 1.00000000
## 184 0.27586207 0.72413793
## 185 1.00000000 0.00000000
## 186 0.25869565 0.74130435
## 187 0.13445378 0.86554622
## 188 0.24528302 0.75471698
## 189 0.77500000 0.22500000
## 190 1.00000000 0.00000000
## 191 0.04878049 0.95121951
## 192 0.13445378 0.86554622
## 193 0.23728814 0.76271186
## 194 0.79487179 0.20512821
## 195 0.25869565 0.74130435
## 196 0.74809160 0.25190840
## 197 1.00000000 0.00000000
## 198 0.81566820 0.18433180
## 199 0.13445378 0.86554622
## 200 0.13445378 0.86554622
## 201 0.25869565 0.74130435
## 202 1.00000000 0.00000000
## 203 0.24736842 0.75263158
## 204 0.84444444 0.15555556
## 205 0.13445378 0.86554622
## 206 0.25869565 0.74130435
## 207 1.00000000 0.00000000
## 208 0.24736842 0.75263158
## 209 0.29032258 0.70967742
## 210 0.81566820 0.18433180
## 211 0.68750000 0.31250000
## 212 0.27586207 0.72413793
## 213 0.13445378 0.86554622
## 214 0.81566820 0.18433180
## 215 1.00000000 0.00000000
## 216 0.13445378 0.86554622
## 217 0.29032258 0.70967742
## 218 0.25869565 0.74130435
## 219 0.81566820 0.18433180
## 220 0.81250000 0.18750000
## 221 0.24528302 0.75471698
## 222 1.00000000 0.00000000
```

```
## 223 0.74074074 0.25925926
## 224 0.19424460 0.80575540
## 225 0.13445378 0.86554622
## 226 1.00000000 0.00000000
## 227 0.11428571 0.88571429
## 228 0.81566820 0.18433180
## 229 0.82000000 0.18000000
## 230 0.84444444 0.15555556
## 231 0.24736842 0.75263158
## 232 0.25869565 0.74130435
## 233 0.90000000 0.10000000
## 234 1.00000000 0.00000000
## 235 0.29032258 0.70967742
## 236 0.14285714 0.85714286
## 237 0.24736842 0.75263158
## 238 0.25869565 0.74130435
## 239 0.17391304 0.82608696
## 240 1.00000000 0.00000000
## 241 0.19424460 0.80575540
## 242 0.24736842 0.75263158
## 243 0.13445378 0.86554622
## 244 0.82000000 0.18000000
## 245 0.13445378 0.86554622
## 246 0.77500000 0.22500000
## 247 0.23728814 0.76271186
## 248 0.24736842 0.75263158
## 249 0.76642336 0.23357664
## 250 0.13445378 0.86554622
## 251 0.83783784 0.16216216
## 252 0.30000000 0.70000000
## 253 0.25869565 0.74130435
## 254 0.81566820 0.18433180
## 255 0.82857143 0.17142857
## 256 0.23893805 0.76106195
## 257 0.25869565 0.74130435
## 258 0.25869565 0.74130435
## 259 0.25869565 0.74130435
## 260 1.00000000 0.00000000
## 261 0.76642336 0.23357664
## 262 1.00000000 0.00000000
## 263 0.19424460 0.80575540
## 264 0.83783784 0.16216216
## 265 0.18367347 0.81632653
## 266 0.29032258 0.70967742
## 267 1.00000000 0.00000000
## 268 0.24000000 0.76000000
## 269 0.13445378 0.86554622
## 270 0.17391304 0.82608696
## 271 0.81566820 0.18433180
## 272 0.24736842 0.75263158
## 273 0.13445378 0.86554622
## 274 0.14285714 0.85714286
## 275 0.82000000 0.18000000
## 276 0.25869565 0.74130435
```

```
## 277 0.29032258 0.70967742
## 278 0.30000000 0.70000000
## 279 0.13445378 0.86554622
## 280 0.81818182 0.18181818
## 281 0.82051282 0.17948718
## 282 0.82051282 0.17948718
## 283 0.24736842 0.75263158
## 284 0.83783784 0.16216216
## 285 0.18181818 0.81818182
## 286 0.13445378 0.86554622
## 287 0.24000000 0.76000000
## 288 0.24000000 0.76000000
## 289 0.00000000 1.00000000
## 290 0.81566820 0.18433180
## 291 0.24736842 0.75263158
## 292 0.84444444 0.15555556
## 293 0.00000000 1.00000000
## 294 0.24000000 0.76000000
## 295 0.81566820 0.18433180
## 296 0.25869565 0.74130435
## 297 0.74809160 0.25190840
## 298 1.00000000 0.00000000
## 299 1.00000000 0.00000000
## 300 0.30000000 0.70000000
## 301 0.13445378 0.86554622
## 302 0.76642336 0.23357664
## 303 0.83783784 0.16216216
## 304 0.13445378 0.86554622
## 305 0.76642336 0.23357664
## 306 0.77777778 0.22222222
## 307 0.19424460 0.80575540
## 308 0.79487179 0.20512821
## 309 0.82000000 0.18000000
## 310 0.81566820 0.18433180
## 311 0.13445378 0.86554622
## 312 0.76642336 0.23357664
## 313 0.23728814 0.76271186
## 314 0.82857143 0.17142857
## 315 0.25869565 0.74130435
## 316 0.84444444 0.15555556
## 317 0.68750000 0.31250000
## 318 0.27586207 0.72413793
## 319 0.81566820 0.18433180
## 320 1.00000000 0.00000000
## 321 0.23893805 0.76106195
## 322 0.24736842 0.75263158
## 323 0.76642336 0.23357664
## 324 0.29032258 0.70967742
## 325 0.21052632 0.78947368
## 326 0.81250000 0.18750000
## 327 0.13445378 0.86554622
## 328 0.88888889 0.11111111
## 329 1.00000000 0.00000000
## 330 0.83783784 0.16216216
```

```
## 331 0.13445378 0.86554622
## 332 0.76642336 0.23357664
## 333 0.13445378 0.86554622
## 334 0.74809160 0.25190840
## 335 0.74809160 0.25190840
## 336 0.79487179 0.20512821
## 337 0.19424460 0.80575540
## 338 0.76642336 0.23357664
## 339 0.25869565 0.74130435
## 340 1.00000000 0.00000000
## 341 0.29032258 0.70967742
## 342 0.74809160 0.25190840
## 343 0.74074074 0.25925926
## 344 0.00000000 1.00000000
## 345 0.18367347 0.81632653
## 346 0.81566820 0.18433180
## 347 0.81566820 0.18433180
## 348 0.29032258 0.70967742
## 349 0.30000000 0.70000000
## 350 1.00000000 0.00000000
## 351 0.81818182 0.18181818
## 352 0.25869565 0.74130435
## 353 0.29032258 0.70967742
## 354 0.19424460 0.80575540
## 355 0.24736842 0.75263158
## 356 0.24736842 0.75263158
## 357 0.19424460 0.80575540
## 358 0.25869565 0.74130435
## 359 0.17391304 0.82608696
## 360 0.81566820 0.18433180
## 361 0.24736842 0.75263158
## 362 0.13445378 0.86554622
## 363 0.82051282 0.17948718
## 364 0.81566820 0.18433180
## 365 0.29032258 0.70967742
## 366 0.04878049 0.95121951
## 367 0.25869565 0.74130435
## 368 0.79487179 0.20512821
## 369 0.29032258 0.70967742
## 370 0.83783784 0.16216216
## 371 0.13445378 0.86554622
## 372 0.24736842 0.75263158
## 373 0.18367347 0.81632653
## 374 0.76642336 0.23357664
## 375 0.74809160 0.25190840
## 376 0.76642336 0.23357664
## 377 0.23893805 0.76106195
## 378 0.25869565 0.74130435
## 379 0.23728814 0.76271186
## 380 0.24000000 0.76000000
## 381 0.24000000 0.76000000
## 382 0.29032258 0.70967742
## 383 0.13445378 0.86554622
## 384 1.00000000 0.00000000
```

```
## 385 1.00000000 0.00000000
## 386 0.79487179 0.20512821
## 387 0.25869565 0.74130435
## 388 0.81566820 0.18433180
## 389 0.20000000 0.80000000
## 390 0.81566820 0.18433180
## 391 0.25869565 0.74130435
## 392 0.81566820 0.18433180
## 393 1.00000000 0.00000000
## 394 0.74074074 0.25925926
## 395 0.21951220 0.78048780
## 396 0.11428571 0.88571429
## 397 1.00000000 0.00000000
## 398 0.81566820 0.18433180
## 399 0.25869565 0.74130435
## 400 0.13445378 0.86554622
## 401 0.74809160 0.25190840
## 402 0.14285714 0.85714286
## 403 0.29032258 0.70967742
## 404 0.84444444 0.15555556
## 405 0.24000000 0.76000000
## 406 0.18367347 0.81632653
## 407 0.25869565 0.74130435
## 408 0.24000000 0.76000000
## 409 0.25869565 0.74130435
## 410 0.18367347 0.81632653
## 411 0.74809160 0.25190840
## 412 0.24736842 0.75263158
## 413 0.27586207 0.72413793
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## 438 0.68750000 0.31250000
```

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## 577 0.81566820 0.18433180
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```

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```
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```

```
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```

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## 962 0.13445378 0.86554622
## 963 0.76642336 0.23357664
## 964 0.14285714 0.85714286
## 965 0.25869565 0.74130435
## 966 0.83783784 0.16216216
## 967 0.29032258 0.70967742
## 968 0.25869565 0.74130435
## 969 0.25869565 0.74130435
## 970 0.81566820 0.18433180
## 971 0.81566820 0.18433180
## 972 0.18181818 0.81818182
## 973 1.00000000 0.00000000
## 974 0.29032258 0.70967742
## 975 0.82000000 0.18000000
## 976 0.19424460 0.80575540
## 977 0.74809160 0.25190840
## 978 0.25869565 0.74130435
```

```
## 979 0.13445378 0.86554622
## 980 0.81250000 0.18750000
## 981 0.24736842 0.75263158
## 982 0.83783784 0.16216216
## 983 1.00000000 0.00000000
## 984 0.74809160 0.25190840
## 985 0.21052632 0.78947368
## 986 0.79487179 0.20512821
## 987 0.79487179 0.20512821
## 988 1.00000000 0.00000000
## 989 0.17391304 0.82608696
## 990 0.25869565 0.74130435
## 991 0.24000000 0.76000000
## 992 0.04878049 0.95121951
## 993 1.00000000 0.00000000
## 994 0.21052632 0.78947368
## 995 0.29032258 0.70967742
## 996 1.00000000 0.00000000
## 997 0.74809160 0.25190840
## 998 0.82051282 0.17948718
## 999 0.25869565 0.74130435
```

```
saveRDS(model_tree,"./Tree_Model")
```

#Tree accuracy

```
#Confusion matrix
tree_pred_class <- ifelse(predict_tree$positive>.6, 1,0)
tree_confusion <- table(test$sentiment,
                        tree_pred_class)
  #AUC
tree_cut <- cutpointr(x = predict_tree$positive,
                 class = test$sentiment)
```

```
## Assuming the positive class is positive

## Assuming the positive class has higher x values
```

```
tree_auc <- auc(glm_cut)
  #ACC
tree_acc <-model_tree$results[4,][2]
tree_rsq <- tree_acc^2
  #TPR
tree_tpr <- tree_confusion[2,2]/
  (tree_confusion[2,1]+
     tree_confusion[2,2])
  #TNR
tree_tnr <- tree_confusion[1,1]/
  (tree_confusion[1,1] +
     tree_confusion[1,2])

  #PRE
```

```r
tree_pre <- tree_confusion[2,2]/
  (tree_confusion[1,2] +
     tree_confusion[2,2])
```

#Gradient boosting forest

```r
#Grid
grid_forest <- expand.grid(shrinkage = 0.1,
                    n.trees = 1:500,
                    interaction.depth = 5,
                    n.minobsinnode = 10)

model_gbm <- caret::train(blueprint,
                             data      = train,
                             method    = 'gbm',
                             tuneGrid  = grid_forest,
                             trControl = cv,
                             bag.fraction = 1,
                             verbose = F)
```

```
## Loading required namespace: gbm

## Loaded gbm 2.1.8.1

## ------------------------------------------------------------------------------

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## ------------------------------------------------------------------------------

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize

## The following object is masked from 'package:purrr':
##
##     compact
```

```r
#Optimized parameters
model_gbm$bestTune
```

```
##     n.trees interaction.depth shrinkage n.minobsinnode
## 166     166                 5       0.1             10
```

```r
model_gbm$results[399,] #399 iteration
```

```
##     shrinkage interaction.depth n.minobsinnode n.trees  Accuracy     Kappa
## 399       0.1                 5             10     399 0.7645567 0.5287304
##     AccuracySD    KappaSD
## 399 0.02451047 0.04872453
```

```r
#Predict against test data
predict_gbm <- predict(model_gbm, test,type = 'prob')

saveRDS(model_gbm,"./GBM_model")
```

#GBM accuracy

```r
#Confusion matrix
gbm_pred_class <- ifelse(predict_gbm$positive>.6, 1,0)
gbm_confusion <- table(test$sentiment,
                       gbm_pred_class)
  #AUC
gbm_cut <- cutpointr(x = gbm_pred_class,
                 class = test$sentiment)
```

```
## Assuming the positive class is positive

## Assuming the positive class has higher x values
```

```r
gbm_auc <- auc(gbm_cut)
  #ACC
gbm_acc <-model_gbm$results[399,][5]
gbm_rsq <- gbm_acc^2
  #TPR
gbm_tpr <- gbm_confusion[2,2]/
  (gbm_confusion[2,1]+
     gbm_confusion[2,2])
  #TNR
gbm_tnr <- gbm_confusion[1,1]/
  (gbm_confusion[1,1] +
     gbm_confusion[1,2])

  #PRE
gbm_pre <- gbm_confusion[2,2]/
  (gbm_confusion[1,2] +
     gbm_confusion[2,2])
```

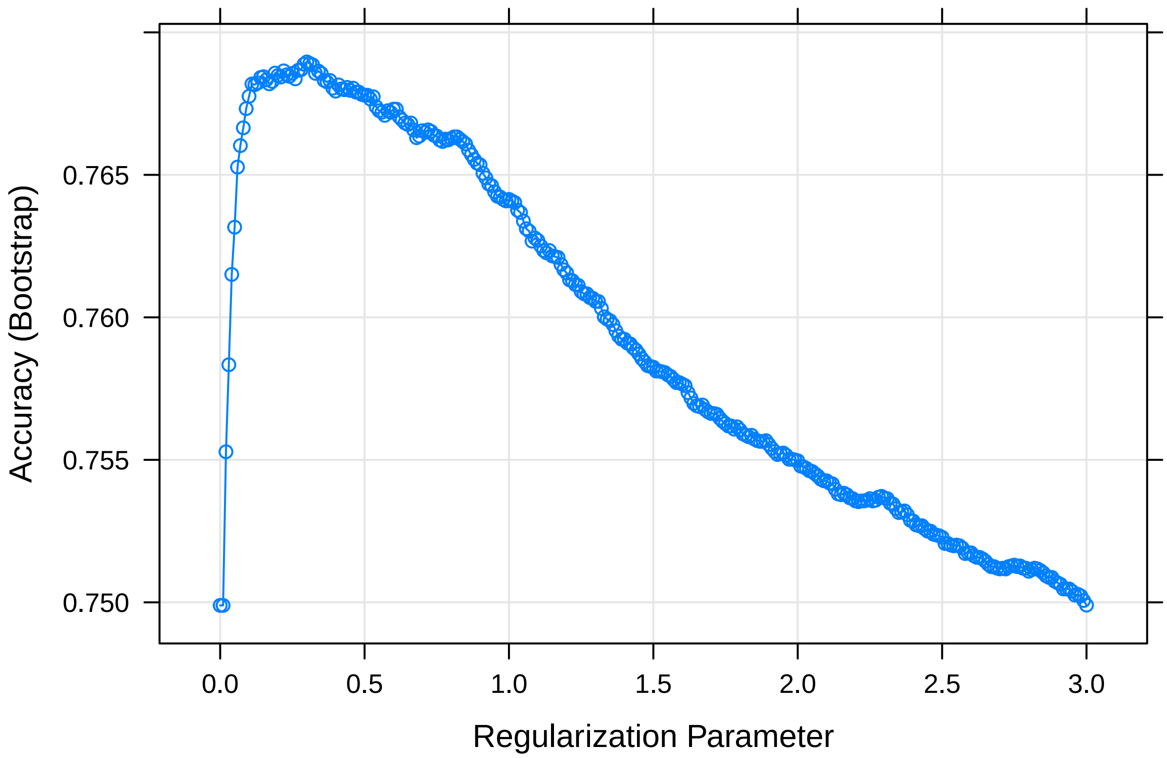
#Compare

```r
df <- tibble(auc = c(glm_auc, tree_auc, gbm_auc),
                    acc = c(glm_acc$Accuracy,tree_acc$Accuracy,gbm_acc$Accuracy),
                    tpr = c(glm_tpr,tree_tpr,gbm_tpr),
                    tnr = c(glm_tnr,tree_tnr, gbm_tnr),
                    pre = c(glm_pre,tree_pre,gbm_pre),
                    Rsq = c(glm_rsq, tree_rsq, gbm_rsq))
rownames(df) <- c("GLM", "Tree", "GBM")
```

```
## Warning: Setting row names on a tibble is deprecated.
```

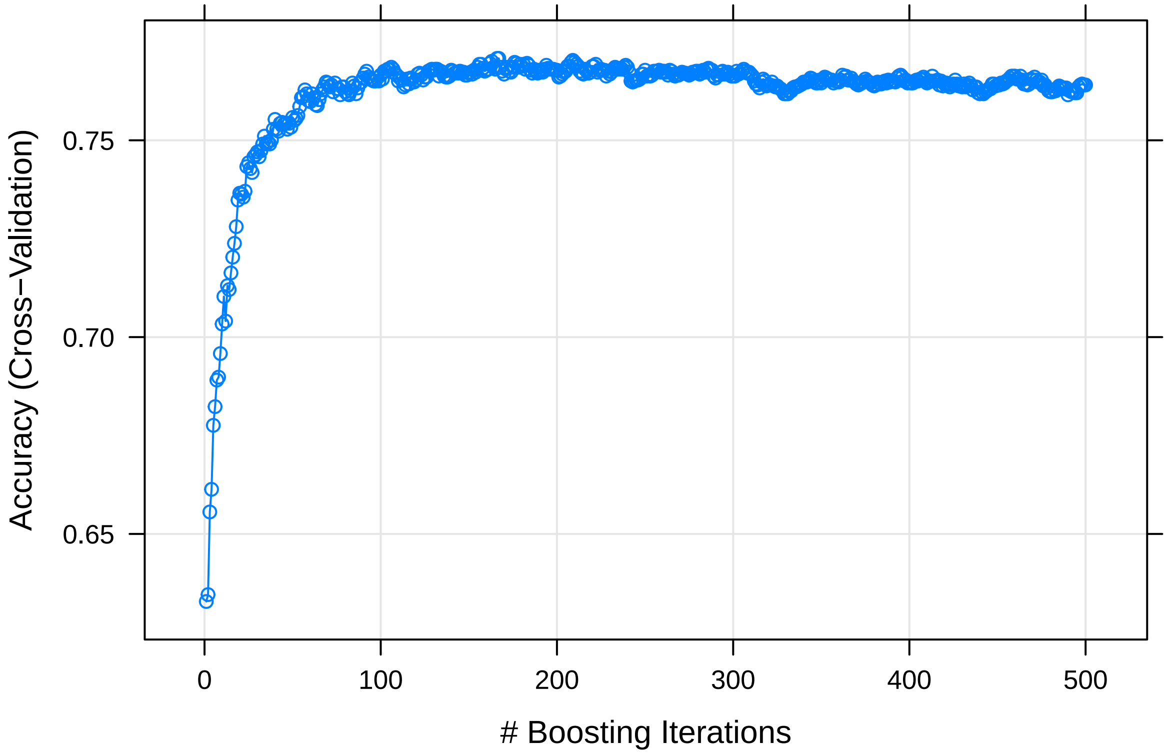
```
tab <- df %>% gt( rownames_to_stub = T) %>%
  tab_header("Machine learning model comparison",
             subtitle = "General linear model,
             Forest model, and Gradient boosted foest model")
#gtsave(tab,"table.html")

plot(model_glmnet)
```

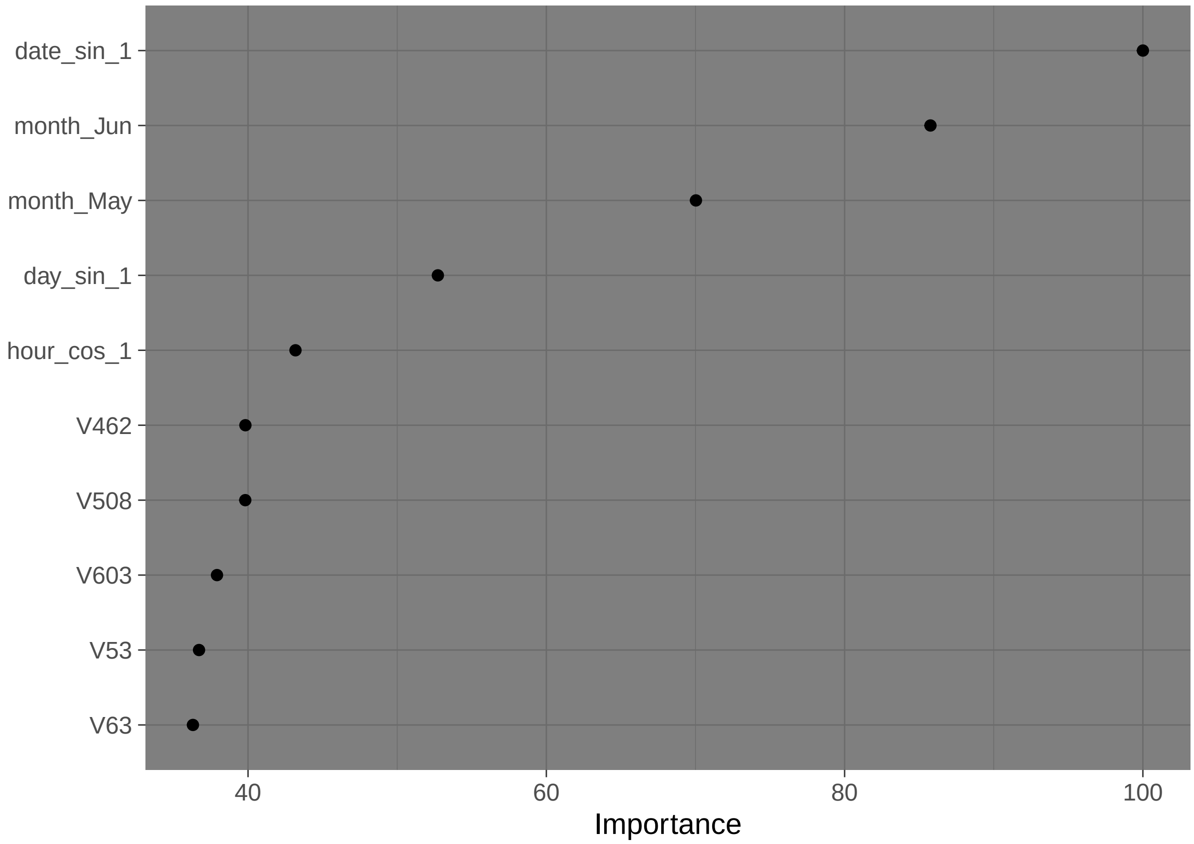



```
plot(model_tree)
```

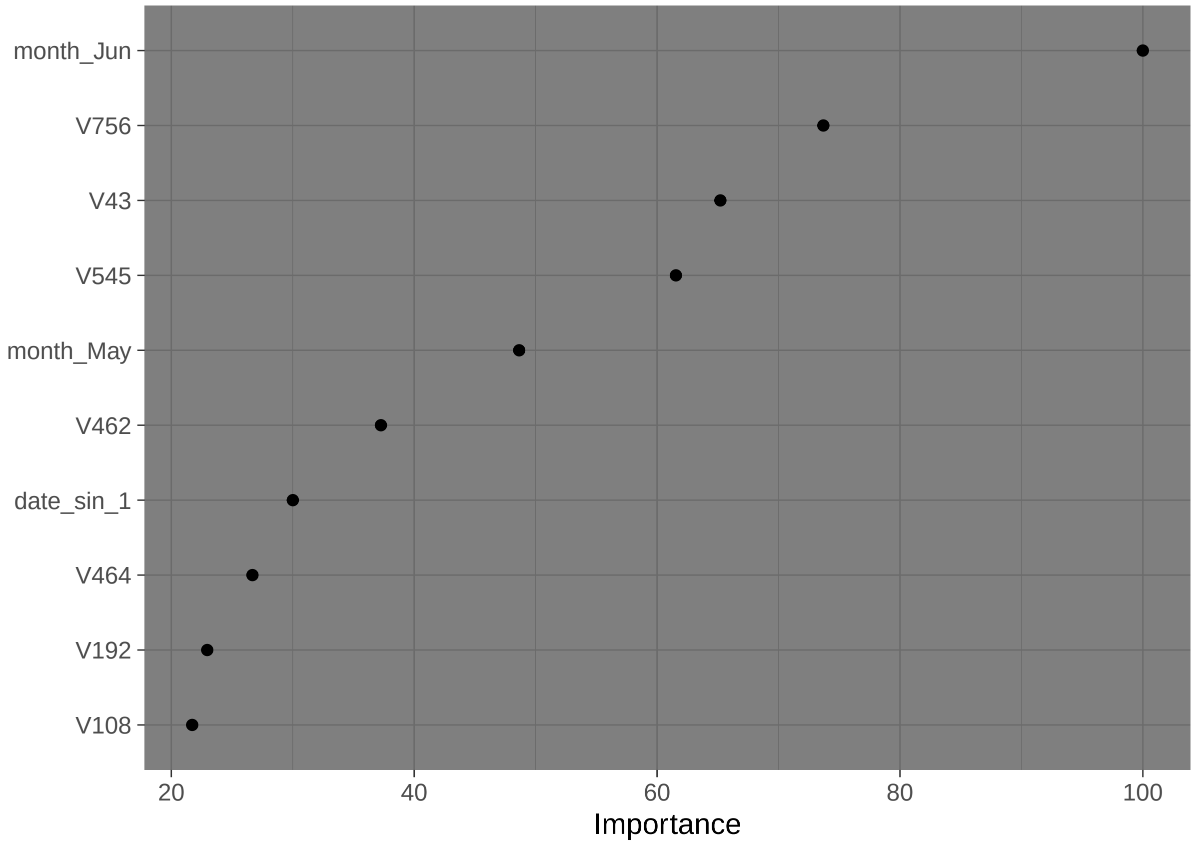

```
plot(model_gbm)
```



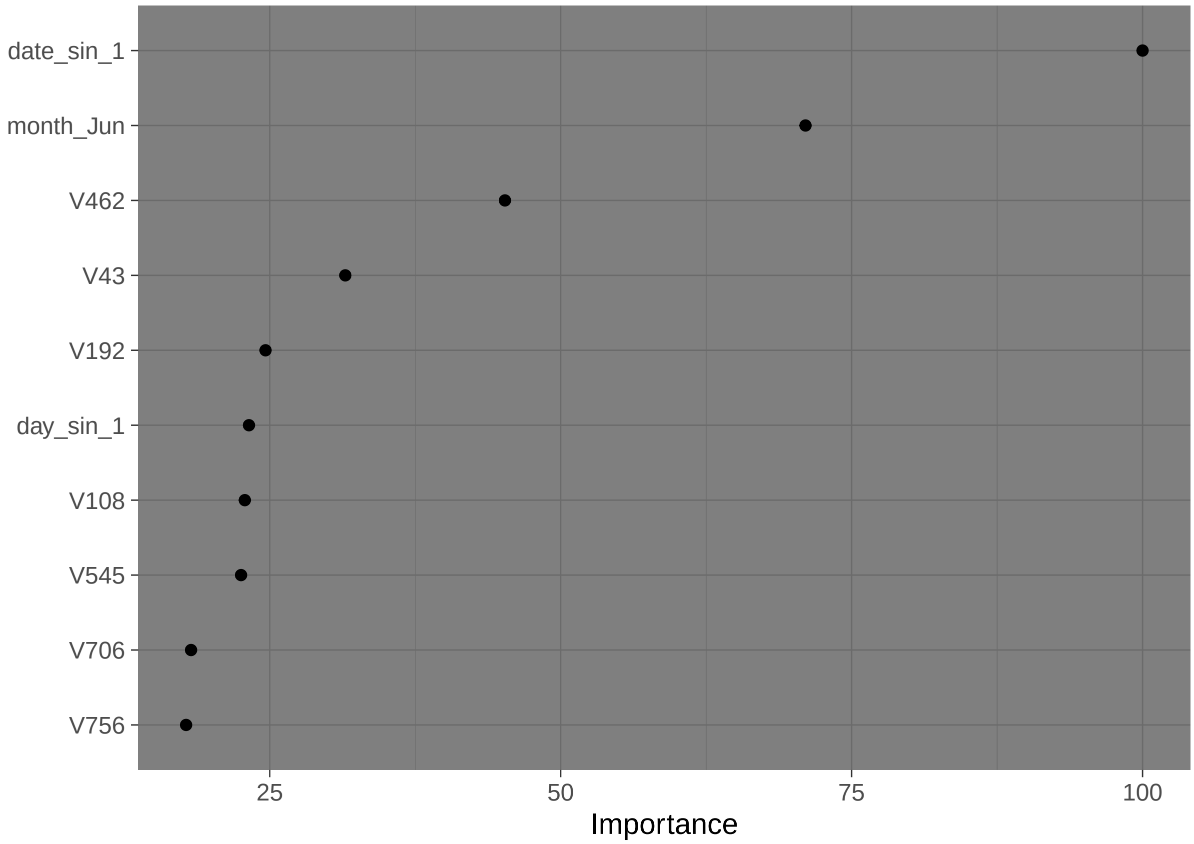

```
vip(model_glmnet,num_features = 10, geom = "point") + theme_dark()
```




```r
vip(model_tree,num_features = 10, geom = "point") + theme_dark()
```




```
vip(model_gbm,num_features = 10, geom = "point") + theme_dark()
```



date_sin_1
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day_sin_1
V108
V545
V706
V756
25
50
75
100
Importance