Assignment1

Jordan Whitaker

6/20/2020

#install.packages(c("tidyverse", "caret", "nnet", "rpart", "ranger", "caretEnsemble", "xgboost"))  
  
library("tidyverse")

## Warning: package 'tidyverse' was built under R version 3.6.3

## -- Attaching packages ------------------------------------------------------------------------------ tidyverse 1.3.0 --

## v ggplot2 3.3.1 v purrr 0.3.3  
## v tibble 2.1.3 v dplyr 1.0.0  
## v tidyr 1.1.0 v stringr 1.4.0  
## v readr 1.3.1 v forcats 0.4.0

## Warning: package 'ggplot2' was built under R version 3.6.3

## Warning: package 'tidyr' was built under R version 3.6.3

## Warning: package 'readr' was built under R version 3.6.3

## Warning: package 'dplyr' was built under R version 3.6.3

## Warning: package 'stringr' was built under R version 3.6.3

## -- Conflicts --------------------------------------------------------------------------------- tidyverse\_conflicts() --  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

library("caret")

## Warning: package 'caret' was built under R version 3.6.3

## Loading required package: lattice

##   
## Attaching package: 'caret'

## The following object is masked from 'package:purrr':  
##   
## lift

library("nnet")

## Warning: package 'nnet' was built under R version 3.6.3

library("rpart")

## Warning: package 'rpart' was built under R version 3.6.3

library("ranger")

## Warning: package 'ranger' was built under R version 3.6.3

library("caretEnsemble")

## Warning: package 'caretEnsemble' was built under R version 3.6.3

##   
## Attaching package: 'caretEnsemble'

## The following object is masked from 'package:ggplot2':  
##   
## autoplot

library("xgboost")

## Warning: package 'xgboost' was built under R version 3.6.3

##   
## Attaching package: 'xgboost'

## The following object is masked from 'package:dplyr':  
##   
## slice

fin = read\_csv("2018Fin.csv")

## Warning: Missing column names filled in: 'X1' [1]

## Parsed with column specification:  
## cols(  
## .default = col\_double(),  
## X1 = col\_character(),  
## Sector = col\_character()  
## )

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

#str(fin)  
#summary(fin)

fin = fin %>% select('Class',  
`Revenue Growth`, `EPS Diluted`, `EBITDA Margin`, 'priceBookValueRatio', 'debtEquityRatio', 'debtRatio', `PE ratio`, 'Sector', `5Y Revenue Growth (per Share)`, 'returnOnAssets', 'returnOnEquity', 'returnOnCapitalEmployed',  
'quickRatio')

fin$Sector = as.factor(fin$Sector)  
  
fin$Class = as.factor(fin$Class)  
  
fin$Class = (case\_when(fin$Class == '0' ~ 'No',  
 fin$Class == '1' ~ 'Yes'))  
  
fin$Class = as.factor(fin$Class)

fin = drop\_na(fin)  
  
  
fin = fin %>% filter(`Revenue Growth` <= 1)  
fin = fin %>% filter(`EPS Diluted` >= -10, `EPS Diluted` <= 10)  
fin = fin %>% filter(`EBITDA Margin` >= -5, `EBITDA Margin` <= 5)  
fin = fin %>% filter(priceBookValueRatio >= 0, priceBookValueRatio <= 5)  
fin = fin %>% filter(debtEquityRatio >= -1, debtEquityRatio <= 2)  
fin = fin %>% filter(debtRatio <= 1)  
fin = fin %>% filter(`PE ratio` <= 100)  
fin = fin %>% filter(returnOnAssets >= -5, returnOnAssets <= 5)  
fin = fin %>% filter(returnOnEquity >= -5, returnOnEquity <= 5)  
fin = fin %>% filter(returnOnCapitalEmployed >= -2, returnOnCapitalEmployed <= 2)  
fin = fin %>% filter(quickRatio <= 20)

#summary(fin)

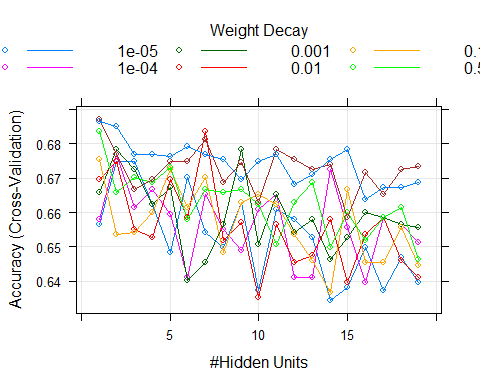
set.seed(12345)  
train.rows = createDataPartition(y = fin$Class, p=0.7, list = FALSE)  
train = dplyr::slice(fin, train.rows)  
test = dplyr::slice(fin, -train.rows)

fitControl = trainControl(method = "cv",  
 number = 10)  
nnetGrid = expand.grid(size = 1:19,  
 decay = c(0.5, 0.1, 1e-2, 1e-3, 1e-4, 1e-5,1e-6, 1e-7))  
  
set.seed(1234)  
nnetFit = train(x=fin[,-1], y=fin$Class,  
 method = "nnet",  
 trControl = fitControl,  
 tuneGrid = nnetGrid,  
 verbose = FALSE,  
 trace = FALSE)

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saveRDS(nnetFit, "neural\_net.rds")  
rm(nnetFit)  
  
nnetFit = readRDS("neural\_net.rds")

plot(nnetFit)



nnetFit

## Neural Network   
##   
## 1362 samples  
## 13 predictor  
## 2 classes: 'No', 'Yes'   
##   
## No pre-processing  
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 1226, 1226, 1226, 1226, 1226, 1226, ...   
## Resampling results across tuning parameters:  
##   
## size decay Accuracy Kappa   
## 1 1e-07 0.6563761 0.1200205  
## 1 1e-06 0.6578736 0.1343476  
## 1 1e-05 0.6659618 0.1868847  
## 1 1e-04 0.6696383 0.1696873  
## 1 1e-03 0.6754669 0.1646470  
## 1 1e-02 0.6835981 0.2436855  
## 1 1e-01 0.6872638 0.2448838  
## 1 5e-01 0.6865125 0.2298185  
## 2 1e-07 0.6747799 0.1781188  
## 2 1e-06 0.6770019 0.2010610  
## 2 1e-05 0.6784296 0.1438866  
## 2 1e-04 0.6747531 0.1472797  
## 2 1e-03 0.6534833 0.1279282  
## 2 1e-02 0.6659350 0.1737603  
## 2 1e-01 0.6769805 0.2086718  
## 2 5e-01 0.6850472 0.2138935  
## 3 1e-07 0.6747853 0.1589864  
## 3 1e-06 0.6615232 0.1851943  
## 3 1e-05 0.6725526 0.2111883  
## 3 1e-04 0.6549485 0.1551731  
## 3 1e-03 0.6541541 0.1558400  
## 3 1e-02 0.6703252 0.1902078  
## 3 1e-01 0.6666863 0.1866244  
## 3 5e-01 0.6769590 0.1930445  
## 4 1e-07 0.6622960 0.1684972  
## 4 1e-06 0.6666810 0.1810929  
## 4 1e-05 0.6622746 0.1888337  
## 4 1e-04 0.6527426 0.1121083  
## 4 1e-03 0.6600902 0.1798976  
## 4 1e-02 0.6688815 0.1794077  
## 4 1e-01 0.6696275 0.1978295  
## 4 5e-01 0.6769590 0.1979702  
## 5 1e-07 0.6483201 0.1353328  
## 5 1e-06 0.6593817 0.1657255  
## 5 1e-05 0.6674163 0.1643429  
## 5 1e-04 0.6695900 0.1985746  
## 5 1e-03 0.6725472 0.2030386  
## 5 1e-02 0.6732772 0.2130789  
## 5 1e-01 0.6747692 0.2100696  
## 5 5e-01 0.6762183 0.2043576  
## 6 1e-07 0.6703145 0.2207152  
## 6 1e-06 0.6409296 0.1681007  
## 6 1e-05 0.6402372 0.1627503  
## 6 1e-04 0.6585981 0.1816479  
## 6 1e-03 0.6615447 0.1996820  
## 6 1e-02 0.6578736 0.1957844  
## 6 1e-01 0.6747692 0.2047450  
## 6 5e-01 0.6791810 0.2029075  
## 7 1e-07 0.6541327 0.1963648  
## 7 1e-06 0.6651836 0.1853141  
## 7 1e-05 0.6453843 0.1556288  
## 7 1e-04 0.6835498 0.2359049  
## 7 1e-03 0.6703521 0.2190589  
## 7 1e-02 0.6666863 0.1934384  
## 7 1e-01 0.6813761 0.2273043  
## 7 5e-01 0.6769375 0.2046825  
## 8 1e-07 0.6498283 0.1603078  
## 8 1e-06 0.6549270 0.2014038  
## 8 1e-05 0.6563761 0.2045361  
## 8 1e-04 0.6519805 0.1590099  
## 8 1e-03 0.6483469 0.1724363  
## 8 1e-02 0.6659725 0.2001168  
## 8 1e-01 0.6688708 0.2088010  
## 8 5e-01 0.6755099 0.1994630  
## 9 1e-07 0.6630528 0.1946269  
## 9 1e-06 0.6490608 0.1586172  
## 9 1e-05 0.6784242 0.2241809  
## 9 1e-04 0.6571490 0.1829216  
## 9 1e-03 0.6630367 0.1987362  
## 9 1e-02 0.6666810 0.2153259  
## 9 1e-01 0.6747316 0.2285286  
## 9 5e-01 0.6696114 0.1795473  
## 10 1e-07 0.6373229 0.1580303  
## 10 1e-06 0.6608040 0.2152294  
## 10 1e-05 0.6505689 0.1747682  
## 10 1e-04 0.6350955 0.1369134  
## 10 1e-03 0.6652158 0.2076522  
## 10 1e-02 0.6622585 0.2115221  
## 10 1e-01 0.6630099 0.2027287  
## 10 5e-01 0.6747692 0.1932449  
## 11 1e-07 0.6607986 0.1975662  
## 11 1e-06 0.6652158 0.1973210  
## 11 1e-05 0.6652265 0.2142519  
## 11 1e-04 0.6563761 0.1951146  
## 11 1e-03 0.6623175 0.2222463  
## 11 1e-02 0.6505743 0.1897201  
## 11 1e-01 0.6784350 0.2368374  
## 11 5e-01 0.6769751 0.1983189  
## 12 1e-07 0.6578574 0.1973113  
## 12 1e-06 0.6409725 0.1427235  
## 12 1e-05 0.6542239 0.1714581  
## 12 1e-04 0.6453574 0.1680951  
## 12 1e-03 0.6534725 0.1789332  
## 12 1e-02 0.6629830 0.1929058  
## 12 1e-01 0.6755260 0.2319516  
## 12 5e-01 0.6681516 0.1787149  
## 13 1e-07 0.6526889 0.1995291  
## 13 1e-06 0.6409672 0.1726682  
## 13 1e-05 0.6579111 0.1868589  
## 13 1e-04 0.6475741 0.1858710  
## 13 1e-03 0.6461357 0.1789440  
## 13 1e-02 0.6688761 0.2161296  
## 13 1e-01 0.6725848 0.2270178  
## 13 5e-01 0.6710659 0.1841593  
## 14 1e-07 0.6343012 0.1670059  
## 14 1e-06 0.6726063 0.2332492  
## 14 1e-05 0.6461571 0.1821566  
## 14 1e-04 0.6578574 0.1903505  
## 14 1e-03 0.6365500 0.1647328  
## 14 1e-02 0.6497585 0.1821306  
## 14 1e-01 0.6740393 0.2258187  
## 14 5e-01 0.6754938 0.1917505  
## 15 1e-07 0.6380743 0.1643051  
## 15 1e-06 0.6556945 0.2028656  
## 15 1e-05 0.6527426 0.1944371  
## 15 1e-04 0.6395180 0.1488106  
## 15 1e-03 0.6667561 0.2162781  
## 15 1e-02 0.6601116 0.2117473  
## 15 1e-01 0.6586410 0.1925809  
## 15 5e-01 0.6784350 0.2044210  
## 16 1e-07 0.6497907 0.1898153  
## 16 1e-06 0.6395341 0.1539588  
## 16 1e-05 0.6601116 0.1973531  
## 16 1e-04 0.6535369 0.1911373  
## 16 1e-03 0.6453574 0.1814989  
## 16 1e-02 0.6519751 0.1897594  
## 16 1e-01 0.6717905 0.2241805  
## 16 5e-01 0.6637452 0.1742363  
## 17 1e-07 0.6373229 0.1596553  
## 17 1e-06 0.6585820 0.2039420  
## 17 1e-05 0.6586088 0.1992996  
## 17 1e-04 0.6586464 0.2322962  
## 17 1e-03 0.6453628 0.1860282  
## 17 1e-02 0.6586088 0.2036525  
## 17 1e-01 0.6652587 0.2045870  
## 17 5e-01 0.6673841 0.1786603  
## 18 1e-07 0.6468656 0.1766982  
## 18 1e-06 0.6564405 0.2026321  
## 18 1e-05 0.6563761 0.2035307  
## 18 1e-04 0.6461249 0.1803872  
## 18 1e-03 0.6556623 0.1918532  
## 18 1e-02 0.6615339 0.2119803  
## 18 1e-01 0.6725633 0.2283487  
## 18 5e-01 0.6674109 0.1838964  
## 19 1e-07 0.6395824 0.1673055  
## 19 1e-06 0.6512666 0.2035573  
## 19 1e-05 0.6557160 0.1966022  
## 19 1e-04 0.6409725 0.1692310  
## 19 1e-03 0.6446436 0.1769594  
## 19 1e-02 0.6461571 0.1751792  
## 19 1e-01 0.6732986 0.2301432  
## 19 5e-01 0.6688815 0.1830464  
##   
## Accuracy was used to select the optimal model using the largest value.  
## The final values used for the model were size = 1 and decay = 0.1.

# Accuracy was used to select the optimal model using the largest value.  
# The final values used for the model were size = 1 and decay = 0.1.  
  
predNet = predict(nnetFit, train)  
  
  
confusionMatrix(predNet, train$Class, positive = "Yes")

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction No Yes  
## No 138 95  
## Yes 183 538  
##   
## Accuracy : 0.7086   
## 95% CI : (0.6786, 0.7373)  
## No Information Rate : 0.6635   
## P-Value [Acc > NIR] : 0.001625   
##   
## Kappa : 0.3001   
##   
## Mcnemar's Test P-Value : 1.81e-07   
##   
## Sensitivity : 0.8499   
## Specificity : 0.4299   
## Pos Pred Value : 0.7462   
## Neg Pred Value : 0.5923   
## Prevalence : 0.6635   
## Detection Rate : 0.5639   
## Detection Prevalence : 0.7558   
## Balanced Accuracy : 0.6399   
##   
## 'Positive' Class : Yes   
##

This model has an accuracy of around 71% compared to the naive model (No Information Rate), of 66% this model is performing okay on training data. Now to pump in testing data..

predNet = predict(nnetFit, newdata = test)  
  
  
confusionMatrix(predNet, test$Class, positive = "Yes")

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction No Yes  
## No 47 45  
## Yes 90 226  
##   
## Accuracy : 0.6691   
## 95% CI : (0.6211, 0.7146)  
## No Information Rate : 0.6642   
## P-Value [Acc > NIR] : 0.4397493   
##   
## Kappa : 0.1927   
##   
## Mcnemar's Test P-Value : 0.0001525   
##   
## Sensitivity : 0.8339   
## Specificity : 0.3431   
## Pos Pred Value : 0.7152   
## Neg Pred Value : 0.5109   
## Prevalence : 0.6642   
## Detection Rate : 0.5539   
## Detection Prevalence : 0.7745   
## Balanced Accuracy : 0.5885   
##   
## 'Positive' Class : Yes   
##

The model is not performing well and is actually almost as bad as the naive model. When the model is applied to the testing data, it has an accuracy of 66.91 compared to the naive model at 66.42 this is a poor model.

control = trainControl(  
 method = "cv",  
 number = 5,  
 savePredictions = "final",  
 classProbs = TRUE,  
 summaryFunction = twoClassSummary,  
 index = createResample(train$Class)  
)

set.seed(111)  
  
model\_list = caretList(  
 x=train[,-1], y = train$Class,  
 metric = "ROC",  
 trControl = control,  
 methodList = c("glm", "ranger", "rpart", "nnet"),  
 tuneList = list(  
 ranger = caretModelSpec(method="ranger", max.depth = 5, tuneGrid =  
 expand.grid(mtry = 1:13,  
 splitrule = c("gini","extratrees","hellinger"),  
 min.node.size=1:5)),  
 nn = caretModelSpec(method="nnet", tuneGrid =  
 expand.grid(size = 1:23,  
 decay = c(0.5, 0.1, 1e-2, 1e-3, 1e-4, 1e-5, 1e-6, 1e-7)),trace=FALSE)))

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## # weights: 25  
## initial value 596.366009   
## iter 10 value 551.582479  
## iter 20 value 516.047074  
## iter 30 value 495.358911  
## iter 40 value 487.030854  
## iter 50 value 487.021743  
## final value 487.021584   
## converged

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

## # weights: 73  
## initial value 625.717947   
## iter 10 value 565.128418  
## iter 20 value 508.392842  
## iter 30 value 480.679802  
## iter 40 value 460.036184  
## iter 50 value 446.804836  
## iter 60 value 446.105352  
## final value 446.103491   
## converged

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

## # weights: 121  
## initial value 688.692462   
## iter 10 value 562.486478  
## iter 20 value 508.857371  
## iter 30 value 444.041553  
## iter 40 value 407.649335  
## iter 50 value 377.936181  
## iter 60 value 358.296709  
## iter 70 value 339.454738  
## iter 80 value 318.030204  
## iter 90 value 307.987149  
## iter 100 value 305.077195  
## final value 305.077195   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 649.712768   
## iter 10 value 567.935750  
## iter 20 value 536.609278  
## iter 30 value 531.124312  
## iter 40 value 524.009437  
## iter 50 value 521.577139  
## iter 60 value 521.334804  
## iter 70 value 521.257677  
## final value 521.255402   
## converged

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

## # weights: 73  
## initial value 596.138010   
## iter 10 value 546.487037  
## iter 20 value 507.235230  
## iter 30 value 492.880553  
## iter 40 value 487.521930  
## iter 50 value 482.621778  
## iter 60 value 476.577544  
## iter 70 value 471.255256  
## iter 80 value 469.374413  
## iter 90 value 466.309143  
## iter 100 value 465.527625  
## final value 465.527625   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 975.701905   
## iter 10 value 574.165324  
## iter 20 value 544.047337  
## iter 30 value 517.842470  
## iter 40 value 503.846506  
## iter 50 value 464.818531  
## iter 60 value 455.043600  
## iter 70 value 446.091239  
## iter 80 value 441.691604  
## iter 90 value 437.881833  
## iter 100 value 431.897186  
## final value 431.897186   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 679.712084   
## iter 10 value 570.364803  
## iter 20 value 519.746687  
## iter 30 value 512.106288  
## iter 40 value 508.302416  
## iter 50 value 506.554238  
## iter 60 value 506.413409  
## iter 70 value 506.358477  
## iter 80 value 506.291373  
## iter 90 value 506.118865  
## iter 100 value 505.981227  
## final value 505.981227   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 635.467683   
## iter 10 value 565.921785  
## iter 20 value 511.513851  
## iter 30 value 462.866109  
## iter 40 value 437.807758  
## iter 50 value 428.421015  
## iter 60 value 426.617877  
## iter 70 value 425.520198  
## iter 80 value 423.732456  
## iter 90 value 422.913598  
## iter 100 value 422.570622  
## final value 422.570622   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 814.542503   
## iter 10 value 561.550630  
## iter 20 value 516.249315  
## iter 30 value 464.687133  
## iter 40 value 408.275029  
## iter 50 value 376.062108  
## iter 60 value 351.698834  
## iter 70 value 336.287483  
## iter 80 value 327.842366  
## iter 90 value 323.651106  
## iter 100 value 322.049294  
## final value 322.049294   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 606.634923   
## iter 10 value 581.583763  
## iter 20 value 534.260147  
## iter 30 value 520.994300  
## iter 40 value 518.773733  
## iter 50 value 506.166619  
## iter 60 value 501.445041  
## iter 70 value 501.245272  
## iter 80 value 499.884798  
## iter 90 value 499.516765  
## iter 100 value 497.314027  
## final value 497.314027   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 812.604237   
## iter 10 value 573.373198  
## iter 20 value 518.390737  
## iter 30 value 479.162847  
## iter 40 value 458.693590  
## iter 50 value 439.639261  
## iter 60 value 437.146035  
## iter 70 value 437.107689  
## final value 437.107644   
## converged

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

## # weights: 121  
## initial value 735.729211   
## iter 10 value 560.266693  
## iter 20 value 510.934608  
## iter 30 value 466.482168  
## iter 40 value 415.672509  
## iter 50 value 387.253609  
## iter 60 value 370.227887  
## iter 70 value 337.605669  
## iter 80 value 325.111632  
## iter 90 value 322.708137  
## iter 100 value 322.689673  
## final value 322.689673   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 665.073233   
## iter 10 value 564.743178  
## iter 20 value 538.437531  
## iter 30 value 528.083289  
## iter 40 value 525.919717  
## iter 50 value 525.799787  
## final value 525.799749   
## converged

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

## # weights: 73  
## initial value 634.541972   
## iter 10 value 545.088776  
## iter 20 value 512.130656  
## iter 30 value 497.774245  
## iter 40 value 485.516182  
## iter 50 value 477.118126  
## iter 60 value 474.171150  
## iter 70 value 471.984403  
## iter 80 value 471.225974  
## iter 90 value 471.098622  
## iter 100 value 471.090550  
## final value 471.090550   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 645.823322   
## iter 10 value 567.394156  
## iter 20 value 532.496992  
## iter 30 value 484.381438  
## iter 40 value 459.438807  
## iter 50 value 438.287034  
## iter 60 value 420.460079  
## iter 70 value 413.248836  
## iter 80 value 409.268132  
## iter 90 value 406.656218  
## iter 100 value 405.789793  
## final value 405.789793   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 627.484540   
## iter 10 value 609.779337  
## iter 20 value 587.957898  
## iter 30 value 544.540482  
## iter 40 value 525.201455  
## iter 50 value 506.439600  
## iter 60 value 500.898067  
## iter 70 value 500.650330  
## iter 80 value 500.484382  
## iter 90 value 500.148578  
## iter 100 value 500.133202  
## final value 500.133202   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 658.510551   
## iter 10 value 575.092755  
## iter 20 value 526.527604  
## iter 30 value 498.114978  
## iter 40 value 494.617359  
## iter 50 value 493.607088  
## iter 60 value 492.865647  
## iter 70 value 492.345799  
## iter 80 value 491.979952  
## iter 90 value 491.436528  
## iter 100 value 491.165439  
## final value 491.165439   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 695.485753   
## iter 10 value 572.779097  
## iter 20 value 517.530546  
## iter 30 value 452.785574  
## iter 40 value 426.462017  
## iter 50 value 410.290189  
## iter 60 value 408.159840  
## iter 70 value 406.734787  
## iter 80 value 403.611296  
## iter 90 value 402.191576  
## iter 100 value 401.679428  
## final value 401.679428   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 707.203679   
## iter 10 value 561.907765  
## iter 20 value 515.552891  
## iter 30 value 506.855698  
## iter 40 value 500.374562  
## iter 50 value 488.851847  
## iter 60 value 486.285617  
## iter 70 value 486.008522  
## iter 80 value 485.945829  
## iter 90 value 485.716652  
## iter 100 value 485.222127  
## final value 485.222127   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 629.888589   
## iter 10 value 549.813700  
## iter 20 value 497.192490  
## iter 30 value 462.750288  
## iter 40 value 447.878543  
## iter 50 value 436.785068  
## iter 60 value 427.550319  
## iter 70 value 419.475640  
## iter 80 value 413.784011  
## iter 90 value 405.787981  
## iter 100 value 401.925711  
## final value 401.925711   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 806.707309   
## iter 10 value 572.065969  
## iter 20 value 525.520101  
## iter 30 value 473.652930  
## iter 40 value 416.724320  
## iter 50 value 376.109885  
## iter 60 value 351.921600  
## iter 70 value 333.276120  
## iter 80 value 329.953311  
## iter 90 value 329.565880  
## iter 100 value 329.557290  
## final value 329.557290   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 639.593222   
## iter 10 value 576.825431  
## iter 20 value 547.975629  
## iter 30 value 522.332469  
## iter 40 value 517.249636  
## iter 50 value 517.107094  
## final value 517.107078   
## converged

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

## # weights: 73  
## initial value 646.996807   
## iter 10 value 552.471162  
## iter 20 value 512.134425  
## iter 30 value 501.753853  
## iter 40 value 491.414624  
## iter 50 value 481.385767  
## iter 60 value 479.549008  
## iter 70 value 478.168969  
## iter 80 value 476.989807  
## iter 90 value 475.759553  
## iter 100 value 475.336798  
## final value 475.336798   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 1170.803574   
## iter 10 value 585.939402  
## iter 20 value 530.933270  
## iter 30 value 494.822496  
## iter 40 value 470.605267  
## iter 50 value 460.516738  
## iter 60 value 453.202801  
## iter 70 value 445.183381  
## iter 80 value 440.253960  
## iter 90 value 433.327136  
## iter 100 value 430.012277  
## final value 430.012277   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 757.546139   
## iter 10 value 579.676607  
## iter 20 value 563.444718  
## iter 30 value 559.200162  
## iter 40 value 558.863709  
## iter 50 value 558.304842  
## iter 60 value 558.184576  
## iter 70 value 558.084591  
## iter 80 value 558.050038  
## iter 90 value 558.013910  
## iter 100 value 558.005458  
## final value 558.005458   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 636.667370   
## iter 10 value 571.698415  
## iter 20 value 506.532210  
## iter 30 value 465.673183  
## iter 40 value 440.090705  
## iter 50 value 419.103525  
## iter 60 value 415.448423  
## iter 70 value 413.646112  
## iter 80 value 412.233603  
## iter 90 value 410.775639  
## iter 100 value 410.350595  
## final value 410.350595   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 704.455103   
## iter 10 value 580.443688  
## iter 20 value 526.341762  
## iter 30 value 465.258609  
## iter 40 value 424.187955  
## iter 50 value 401.538004  
## iter 60 value 386.807711  
## iter 70 value 381.977039  
## iter 80 value 379.379458  
## iter 90 value 378.240884  
## iter 100 value 376.734973  
## final value 376.734973   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 746.209366   
## iter 10 value 584.666121  
## iter 20 value 572.606129  
## iter 30 value 559.476073  
## iter 40 value 556.624057  
## iter 50 value 554.675706  
## iter 60 value 554.317393  
## iter 70 value 553.621594  
## iter 80 value 553.011674  
## iter 90 value 551.896116  
## iter 100 value 544.120638  
## final value 544.120638   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 650.333330   
## iter 10 value 572.944623  
## iter 20 value 521.182678  
## iter 30 value 489.090630  
## iter 40 value 462.750132  
## iter 50 value 451.594963  
## iter 60 value 441.566751  
## iter 70 value 438.109405  
## iter 80 value 435.976987  
## iter 90 value 435.749725  
## final value 435.747876   
## converged

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

## # weights: 121  
## initial value 686.317174   
## iter 10 value 569.538359  
## iter 20 value 540.182698  
## iter 30 value 513.171677  
## iter 40 value 461.351006  
## iter 50 value 418.700806  
## iter 60 value 375.347463  
## iter 70 value 347.282148  
## iter 80 value 330.051152  
## iter 90 value 316.238128  
## iter 100 value 306.371744  
## final value 306.371744   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 693.631226   
## iter 10 value 563.501568  
## iter 20 value 529.562652  
## iter 30 value 514.706133  
## iter 40 value 506.781291  
## iter 50 value 506.297014  
## iter 60 value 506.292584  
## final value 506.292512   
## converged

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

## # weights: 73  
## initial value 764.024677   
## iter 10 value 597.714059  
## iter 20 value 558.880143  
## iter 30 value 525.866385  
## iter 40 value 498.830284  
## iter 50 value 490.349655  
## iter 60 value 479.762540  
## iter 70 value 470.779213  
## iter 80 value 470.129895  
## iter 90 value 470.073266  
## iter 100 value 470.050212  
## final value 470.050212   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 674.723580   
## iter 10 value 560.443552  
## iter 20 value 500.036232  
## iter 30 value 469.785640  
## iter 40 value 458.919396  
## iter 50 value 451.990844  
## iter 60 value 438.049222  
## iter 70 value 432.403606  
## iter 80 value 428.662075  
## iter 90 value 423.150819  
## iter 100 value 420.089249  
## final value 420.089249   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 668.124915   
## iter 10 value 590.112419  
## iter 20 value 518.605227  
## iter 30 value 507.239016  
## iter 40 value 505.546202  
## iter 50 value 502.066919  
## iter 60 value 501.298144  
## iter 70 value 500.437342  
## iter 80 value 499.518002  
## iter 90 value 499.145289  
## iter 100 value 498.514181  
## final value 498.514181   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 692.331816   
## iter 10 value 566.095924  
## iter 20 value 507.354949  
## iter 30 value 490.001092  
## iter 40 value 468.012032  
## iter 50 value 460.341507  
## iter 60 value 459.523866  
## iter 70 value 459.176511  
## iter 80 value 458.957135  
## iter 90 value 458.698310  
## iter 100 value 458.563970  
## final value 458.563970   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 860.797624   
## iter 10 value 576.413759  
## iter 20 value 509.325810  
## iter 30 value 462.291887  
## iter 40 value 431.047476  
## iter 50 value 410.982402  
## iter 60 value 407.412733  
## iter 70 value 406.448899  
## iter 80 value 405.886289  
## iter 90 value 405.653225  
## iter 100 value 405.427548  
## final value 405.427548   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 694.596431   
## iter 10 value 554.341520  
## iter 20 value 516.643042  
## iter 30 value 499.687444  
## iter 40 value 488.568902  
## iter 50 value 481.079716  
## iter 60 value 474.830817  
## iter 70 value 473.686420  
## iter 80 value 473.683106  
## final value 473.683088   
## converged

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

## # weights: 73  
## initial value 774.142746   
## iter 10 value 567.007969  
## iter 20 value 486.324057  
## iter 30 value 457.308071  
## iter 40 value 432.642260  
## iter 50 value 415.264456  
## iter 60 value 411.265036  
## iter 70 value 410.978414  
## final value 410.976855   
## converged

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

## # weights: 121  
## initial value 618.736618   
## iter 10 value 529.110965  
## iter 20 value 473.200346  
## iter 30 value 428.816726  
## iter 40 value 403.507216  
## iter 50 value 387.242903  
## iter 60 value 384.046727  
## iter 70 value 383.445465  
## iter 80 value 383.442074  
## final value 383.442056   
## converged

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

## # weights: 25  
## initial value 769.122231   
## iter 10 value 556.099932  
## iter 20 value 515.650408  
## iter 30 value 503.752330  
## iter 40 value 502.938680  
## final value 502.935044   
## converged

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

## # weights: 73  
## initial value 653.646577   
## iter 10 value 553.647457  
## iter 20 value 507.358521  
## iter 30 value 482.544330  
## iter 40 value 466.989679  
## iter 50 value 462.406934  
## iter 60 value 460.343817  
## iter 70 value 459.046819  
## iter 80 value 457.594154  
## iter 90 value 457.077423  
## iter 100 value 457.022497  
## final value 457.022497   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 780.053522   
## iter 10 value 576.446849  
## iter 20 value 534.106938  
## iter 30 value 500.146238  
## iter 40 value 463.747947  
## iter 50 value 442.644445  
## iter 60 value 435.820645  
## iter 70 value 428.329863  
## iter 80 value 425.875096  
## iter 90 value 424.379303  
## iter 100 value 423.883504  
## final value 423.883504   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 683.281098   
## iter 10 value 570.119912  
## iter 20 value 518.708476  
## iter 30 value 499.429156  
## iter 40 value 485.677936  
## iter 50 value 484.021033  
## iter 60 value 483.256301  
## iter 70 value 483.029409  
## iter 80 value 482.522815  
## iter 90 value 482.102639  
## iter 100 value 481.897227  
## final value 481.897227   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 607.066893   
## iter 10 value 539.568565  
## iter 20 value 519.623012  
## iter 30 value 468.377903  
## iter 40 value 426.884279  
## iter 50 value 396.861260  
## iter 60 value 379.160800  
## iter 70 value 374.249868  
## iter 80 value 372.201557  
## iter 90 value 370.882863  
## iter 100 value 370.686378  
## final value 370.686378   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 725.754737   
## iter 10 value 558.728470  
## iter 20 value 499.577393  
## iter 30 value 422.087765  
## iter 40 value 387.693094  
## iter 50 value 375.359838  
## iter 60 value 355.957801  
## iter 70 value 338.901306  
## iter 80 value 331.329825  
## iter 90 value 328.736944  
## iter 100 value 328.151133  
## final value 328.151133   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 812.372839   
## iter 10 value 627.046326  
## final value 627.032741   
## converged

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

## # weights: 73  
## initial value 630.281481   
## iter 10 value 577.673295  
## iter 20 value 524.541343  
## iter 30 value 490.457786  
## iter 40 value 465.130007  
## iter 50 value 446.791769  
## iter 60 value 438.581073  
## iter 70 value 438.131750  
## final value 438.130601   
## converged

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

## # weights: 121  
## initial value 898.157855   
## iter 10 value 582.217428  
## iter 20 value 518.295288  
## iter 30 value 489.486229  
## iter 40 value 452.054959  
## iter 50 value 442.847687  
## iter 60 value 438.442984  
## iter 70 value 436.411046  
## iter 80 value 434.146699  
## iter 90 value 432.800574  
## iter 100 value 429.986693  
## final value 429.986693   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 667.578712   
## iter 10 value 599.546559  
## iter 20 value 571.836976  
## iter 30 value 546.975290  
## iter 40 value 533.509562  
## iter 50 value 531.121439  
## iter 60 value 530.846767  
## iter 70 value 530.794867  
## iter 80 value 530.776917  
## final value 530.776835   
## converged

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

## # weights: 73  
## initial value 649.515765   
## iter 10 value 592.183768  
## iter 20 value 562.398118  
## iter 30 value 530.196275  
## iter 40 value 509.405908  
## iter 50 value 498.464430  
## iter 60 value 487.222181  
## iter 70 value 477.628823  
## iter 80 value 475.119200  
## iter 90 value 474.974832  
## iter 100 value 474.964535  
## final value 474.964535   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 636.447955   
## iter 10 value 581.794583  
## iter 20 value 536.222628  
## iter 30 value 506.935016  
## iter 40 value 486.642232  
## iter 50 value 476.423461  
## iter 60 value 472.359081  
## iter 70 value 467.320477  
## iter 80 value 464.666857  
## iter 90 value 461.282777  
## iter 100 value 460.743870  
## final value 460.743870   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 624.787522   
## iter 10 value 583.898334  
## iter 20 value 552.455754  
## iter 30 value 519.829944  
## iter 40 value 510.638140  
## iter 50 value 509.606497  
## iter 60 value 509.520706  
## iter 70 value 509.211295  
## iter 80 value 509.024981  
## iter 90 value 508.914029  
## iter 100 value 508.848833  
## final value 508.848833   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 705.086078   
## iter 10 value 592.139744  
## iter 20 value 538.580424  
## iter 30 value 517.390108  
## iter 40 value 495.647336  
## iter 50 value 480.628446  
## iter 60 value 476.715185  
## iter 70 value 475.180860  
## iter 80 value 474.619814  
## iter 90 value 474.211624  
## iter 100 value 473.619152  
## final value 473.619152   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 696.373542   
## iter 10 value 583.729873  
## iter 20 value 519.796415  
## iter 30 value 449.708724  
## iter 40 value 406.363988  
## iter 50 value 383.018031  
## iter 60 value 368.927252  
## iter 70 value 366.184814  
## iter 80 value 365.705010  
## iter 90 value 365.303597  
## iter 100 value 364.800348  
## final value 364.800348   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 781.414542   
## iter 10 value 575.857265  
## iter 20 value 560.569156  
## iter 30 value 516.870128  
## iter 40 value 503.525582  
## iter 50 value 500.554251  
## iter 60 value 494.949431  
## iter 70 value 491.239143  
## iter 80 value 491.157049  
## iter 90 value 491.068762  
## iter 100 value 491.045361  
## final value 491.045361   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 764.933474   
## iter 10 value 575.353930  
## iter 20 value 523.311524  
## iter 30 value 486.221387  
## iter 40 value 453.441319  
## iter 50 value 427.660872  
## iter 60 value 423.292889  
## iter 70 value 423.010003  
## iter 80 value 422.999262  
## final value 422.998447   
## converged

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

## # weights: 121  
## initial value 648.286940   
## iter 10 value 567.471907  
## iter 20 value 518.638476  
## iter 30 value 481.669925  
## iter 40 value 436.967179  
## iter 50 value 405.357675  
## iter 60 value 381.592419  
## iter 70 value 370.338888  
## iter 80 value 366.345977  
## iter 90 value 365.982498  
## final value 365.981859   
## converged

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

## # weights: 25  
## initial value 892.917493   
## iter 10 value 576.037638  
## iter 20 value 568.706992  
## iter 30 value 566.386763  
## iter 40 value 551.856428  
## iter 50 value 512.689177  
## iter 60 value 506.361533  
## iter 70 value 505.755042  
## final value 505.745521   
## converged

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

## # weights: 73  
## initial value 660.891973   
## iter 10 value 549.958537  
## iter 20 value 519.210340  
## iter 30 value 484.478908  
## iter 40 value 473.306353  
## iter 50 value 460.940668  
## iter 60 value 456.737990  
## iter 70 value 453.843446  
## iter 80 value 452.653786  
## iter 90 value 452.612987  
## iter 100 value 452.610399  
## final value 452.610399   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 743.040710   
## iter 10 value 561.992863  
## iter 20 value 506.686366  
## iter 30 value 471.433846  
## iter 40 value 452.332282  
## iter 50 value 440.617099  
## iter 60 value 434.532385  
## iter 70 value 430.140879  
## iter 80 value 425.496721  
## iter 90 value 422.805697  
## iter 100 value 421.982064  
## final value 421.982064   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 609.414009   
## iter 10 value 570.192203  
## iter 20 value 522.139363  
## iter 30 value 499.656630  
## iter 40 value 488.972930  
## iter 50 value 487.808793  
## iter 60 value 487.557186  
## iter 70 value 487.417237  
## iter 80 value 486.899747  
## iter 90 value 486.702702  
## iter 100 value 486.323375  
## final value 486.323375   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 895.921633   
## iter 10 value 576.297988  
## iter 20 value 525.625197  
## iter 30 value 473.888567  
## iter 40 value 443.540829  
## iter 50 value 426.256467  
## iter 60 value 422.540637  
## iter 70 value 420.769584  
## iter 80 value 420.164250  
## iter 90 value 419.830911  
## iter 100 value 419.708297  
## final value 419.708297   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 684.855024   
## iter 10 value 565.668327  
## iter 20 value 514.670482  
## iter 30 value 473.345093  
## iter 40 value 447.811006  
## iter 50 value 427.178268  
## iter 60 value 411.943135  
## iter 70 value 408.363283  
## iter 80 value 406.509348  
## iter 90 value 403.213492  
## iter 100 value 402.639095  
## final value 402.639095   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 602.805583   
## iter 10 value 557.102181  
## iter 20 value 518.936730  
## iter 30 value 504.209550  
## iter 40 value 497.856003  
## iter 50 value 487.223044  
## iter 60 value 486.412255  
## final value 486.402112   
## converged

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

## # weights: 73  
## initial value 793.678359   
## iter 10 value 564.368062  
## iter 20 value 539.732168  
## iter 30 value 488.798082  
## iter 40 value 454.642275  
## iter 50 value 433.653673  
## iter 60 value 426.113037  
## iter 70 value 425.829073  
## final value 425.827647   
## converged

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

## # weights: 121  
## initial value 692.629109   
## iter 10 value 551.664327  
## iter 20 value 513.425636  
## iter 30 value 472.641278  
## iter 40 value 429.690729  
## iter 50 value 395.067375  
## iter 60 value 370.712941  
## iter 70 value 368.132244  
## iter 80 value 367.920238  
## iter 80 value 367.920237  
## iter 80 value 367.920237  
## final value 367.920237   
## converged

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

## # weights: 25  
## initial value 835.590180   
## iter 10 value 537.397144  
## iter 20 value 519.806302  
## iter 30 value 513.981323  
## iter 40 value 512.205615  
## final value 512.201209   
## converged

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

## # weights: 73  
## initial value 704.706843   
## iter 10 value 550.534253  
## iter 20 value 513.364325  
## iter 30 value 494.400791  
## iter 40 value 481.863216  
## iter 50 value 477.212160  
## iter 60 value 475.704319  
## iter 70 value 473.032660  
## iter 80 value 472.720929  
## iter 90 value 472.105601  
## iter 100 value 470.009614  
## final value 470.009614   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 600.248329   
## iter 10 value 549.932110  
## iter 20 value 510.415611  
## iter 30 value 492.194312  
## iter 40 value 478.296203  
## iter 50 value 454.896879  
## iter 60 value 439.136691  
## iter 70 value 433.253225  
## iter 80 value 431.718721  
## iter 90 value 431.141191  
## iter 100 value 429.467778  
## final value 429.467778   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 757.155777   
## iter 10 value 604.435195  
## iter 20 value 541.205496  
## iter 30 value 517.841665  
## iter 40 value 509.995704  
## iter 50 value 505.753568  
## iter 60 value 502.798494  
## iter 70 value 495.533353  
## iter 80 value 492.832143  
## iter 90 value 485.161696  
## iter 100 value 482.397496  
## final value 482.397496   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 725.577379   
## iter 10 value 538.280605  
## iter 20 value 508.335323  
## iter 30 value 485.541033  
## iter 40 value 450.890361  
## iter 50 value 426.852185  
## iter 60 value 419.701101  
## iter 70 value 418.813333  
## iter 80 value 418.078223  
## iter 90 value 416.108176  
## iter 100 value 415.327051  
## final value 415.327051   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 933.939814   
## iter 10 value 529.876901  
## iter 20 value 472.953935  
## iter 30 value 423.959277  
## iter 40 value 400.188858  
## iter 50 value 389.664394  
## iter 60 value 379.996019  
## iter 70 value 372.658671  
## iter 80 value 371.184581  
## iter 90 value 370.471992  
## iter 100 value 369.966538  
## final value 369.966538   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 675.302134   
## iter 10 value 571.403743  
## iter 20 value 555.902035  
## iter 30 value 544.783024  
## iter 40 value 543.638497  
## final value 543.633507   
## converged

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

## # weights: 73  
## initial value 686.592592   
## iter 10 value 569.616984  
## iter 20 value 502.675452  
## iter 30 value 441.997558  
## iter 40 value 414.108645  
## iter 50 value 395.952479  
## iter 60 value 374.271516  
## iter 70 value 366.535284  
## iter 80 value 364.948992  
## iter 90 value 364.905166  
## iter 100 value 364.891335  
## final value 364.891335   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 673.214038   
## iter 10 value 541.690194  
## iter 20 value 501.191136  
## iter 30 value 469.294313  
## iter 40 value 429.025282  
## iter 50 value 409.335462  
## iter 60 value 390.658896  
## iter 70 value 381.730258  
## iter 80 value 379.695228  
## iter 90 value 378.924834  
## iter 100 value 378.602275  
## final value 378.602275   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 675.885514   
## iter 10 value 593.994964  
## iter 20 value 539.460602  
## iter 30 value 508.139643  
## iter 40 value 496.771814  
## iter 50 value 493.018091  
## iter 60 value 492.579767  
## iter 70 value 492.474330  
## final value 492.471150   
## converged

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

## # weights: 73  
## initial value 757.077599   
## iter 10 value 568.784525  
## iter 20 value 509.512162  
## iter 30 value 473.177905  
## iter 40 value 462.526235  
## iter 50 value 457.140339  
## iter 60 value 451.456153  
## iter 70 value 446.681247  
## iter 80 value 443.732447  
## iter 90 value 439.130744  
## iter 100 value 437.801642  
## final value 437.801642   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 663.914661   
## iter 10 value 551.735269  
## iter 20 value 505.514723  
## iter 30 value 470.661128  
## iter 40 value 458.310826  
## iter 50 value 447.632113  
## iter 60 value 437.128074  
## iter 70 value 433.148598  
## iter 80 value 430.505538  
## iter 90 value 427.652530  
## iter 100 value 425.173795  
## final value 425.173795   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 637.285611   
## iter 10 value 565.926927  
## iter 20 value 530.900126  
## iter 30 value 505.796146  
## iter 40 value 496.807148  
## iter 50 value 492.742084  
## iter 60 value 488.653826  
## iter 70 value 482.359182  
## iter 80 value 481.210558  
## iter 90 value 481.000371  
## iter 100 value 479.412693  
## final value 479.412693   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 1043.342322   
## iter 10 value 572.618866  
## iter 20 value 517.085552  
## iter 30 value 462.830626  
## iter 40 value 426.877718  
## iter 50 value 405.882435  
## iter 60 value 400.359339  
## iter 70 value 398.785160  
## iter 80 value 397.638545  
## iter 90 value 396.991528  
## iter 100 value 396.453388  
## final value 396.453388   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 617.980318   
## iter 10 value 528.549851  
## iter 20 value 468.910300  
## iter 30 value 433.011789  
## iter 40 value 390.483608  
## iter 50 value 369.445288  
## iter 60 value 358.124941  
## iter 70 value 355.095377  
## iter 80 value 354.016264  
## iter 90 value 352.947012  
## iter 100 value 351.597258  
## final value 351.597258   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 792.563217   
## iter 10 value 573.100215  
## iter 20 value 506.821093  
## iter 30 value 492.272954  
## iter 40 value 490.868204  
## iter 50 value 490.826027  
## iter 60 value 490.809932  
## iter 70 value 490.800362  
## final value 490.777214   
## converged

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

## # weights: 73  
## initial value 623.226408   
## iter 10 value 591.636155  
## iter 20 value 540.786866  
## iter 30 value 469.325204  
## iter 40 value 447.572197  
## iter 50 value 437.317753  
## iter 60 value 430.498867  
## iter 70 value 428.399627  
## iter 80 value 428.209983  
## iter 90 value 428.152658  
## final value 428.152573   
## converged

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

## # weights: 121  
## initial value 737.518930   
## iter 10 value 570.823989  
## iter 20 value 507.977194  
## iter 30 value 463.448892  
## iter 40 value 427.088918  
## iter 50 value 405.096056  
## iter 60 value 390.096987  
## iter 70 value 379.430578  
## iter 80 value 370.304075  
## iter 90 value 367.619272  
## iter 100 value 367.405787  
## final value 367.405787   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 629.249119   
## iter 10 value 589.945155  
## iter 20 value 562.437101  
## iter 30 value 512.786130  
## iter 40 value 501.601020  
## iter 50 value 499.357477  
## iter 60 value 499.322820  
## final value 499.322739   
## converged

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

## # weights: 73  
## initial value 722.070585   
## iter 10 value 576.831621  
## iter 20 value 543.794779  
## iter 30 value 497.049748  
## iter 40 value 478.807844  
## iter 50 value 469.143644  
## iter 60 value 465.592503  
## iter 70 value 461.724566  
## iter 80 value 460.273187  
## iter 90 value 459.537942  
## iter 100 value 459.356558  
## final value 459.356558   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 619.719036   
## iter 10 value 579.880410  
## iter 20 value 546.099475  
## iter 30 value 507.669133  
## iter 40 value 479.705942  
## iter 50 value 455.270378  
## iter 60 value 440.809312  
## iter 70 value 428.640855  
## iter 80 value 421.687752  
## iter 90 value 421.379139  
## iter 100 value 420.898571  
## final value 420.898571   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 837.305638   
## iter 10 value 585.107650  
## iter 20 value 570.417104  
## iter 30 value 565.884111  
## iter 40 value 565.285148  
## iter 50 value 565.217304  
## iter 60 value 565.185259  
## iter 70 value 565.169484  
## iter 80 value 565.166961  
## iter 90 value 565.164394  
## iter 100 value 565.163260  
## final value 565.163260   
## stopped after 100 iterations

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

## # weights: 73  
## initial value 664.078331   
## iter 10 value 583.290137  
## iter 20 value 528.710755  
## iter 30 value 477.507598  
## iter 40 value 454.082811  
## iter 50 value 437.287629  
## iter 60 value 428.311243  
## iter 70 value 425.769897  
## iter 80 value 424.841448  
## iter 90 value 424.535423  
## iter 100 value 424.392697  
## final value 424.392697   
## stopped after 100 iterations

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

## # weights: 121  
## initial value 603.922808   
## iter 10 value 556.902316  
## iter 20 value 492.182764  
## iter 30 value 447.958875  
## iter 40 value 411.514351  
## iter 50 value 385.703518  
## iter 60 value 353.536816  
## iter 70 value 347.169378  
## iter 80 value 342.976143  
## iter 90 value 340.999994  
## iter 100 value 340.146837  
## final value 340.146837   
## stopped after 100 iterations

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

## # weights: 25  
## initial value 685.114358   
## iter 10 value 590.339594  
## iter 20 value 546.112912  
## iter 30 value 526.586003  
## iter 40 value 522.993190  
## iter 50 value 522.552792  
## final value 522.547233   
## converged

saveRDS(model\_list, "model\_list.rds")  
rm(model\_list)  
model\_list = readRDS("model\_list.rds")

modelCor(resamples(model\_list))

## ranger nn glm ranger.1 rpart nnet  
## ranger 1.0000000 0.6344851 0.72431851 0.8166207 0.28590823 0.7045017  
## nn 0.6344851 1.0000000 0.89036565 0.4834733 -0.20711394 0.9095609  
## glm 0.7243185 0.8903657 1.00000000 0.6921230 0.02909798 0.9907123  
## ranger.1 0.8166207 0.4834733 0.69212303 1.0000000 0.49685372 0.6929567  
## rpart 0.2859082 -0.2071139 0.02909798 0.4968537 1.00000000 -0.0325153  
## nnet 0.7045017 0.9095609 0.99071227 0.6929567 -0.03251530 1.0000000

Between the models that were implemented, there is a high degree of correlation between them. The highest correlated models are nnet and glm with a correlation of nearly 1 (0.99).

ensemble = caretEnsemble(  
 model\_list,  
 metric = "ROC",  
 trControl=control  
)  
  
  
  
  
saveRDS(ensemble, "ensemble.rds")  
rm(ensemble)  
ensemble = readRDS("ensemble.rds")  
  
  
summary(ensemble)

## The following models were ensembled: ranger, nn, glm, ranger.1, rpart, nnet   
## They were weighted:   
## 2.5765 -1.8388 1.0164 -1.2777 -3.2923 0.5243 -0.3121  
## The resulting ROC is: 0.72  
## The fit for each individual model on the ROC is:   
## method ROC ROCSD  
## ranger 0.7283904 0.02415615  
## nn 0.7043567 0.02743524  
## glm 0.6986381 0.02702541  
## ranger.1 0.7326405 0.01970585  
## rpart 0.6358841 0.03522952  
## nnet 0.7009330 0.02649610

The random forest model performed the best with a ROC of .73

#training set  
pred\_ensemble = predict(ensemble, train, type = "raw")  
confusionMatrix(pred\_ensemble, train$Class)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction No Yes  
## No 316 0  
## Yes 5 633  
##   
## Accuracy : 0.9948   
## 95% CI : (0.9878, 0.9983)  
## No Information Rate : 0.6635   
## P-Value [Acc > NIR] : < 2e-16   
##   
## Kappa : 0.9882   
##   
## Mcnemar's Test P-Value : 0.07364   
##   
## Sensitivity : 0.9844   
## Specificity : 1.0000   
## Pos Pred Value : 1.0000   
## Neg Pred Value : 0.9922   
## Prevalence : 0.3365   
## Detection Rate : 0.3312   
## Detection Prevalence : 0.3312   
## Balanced Accuracy : 0.9922   
##   
## 'Positive' Class : No   
##

#testing set  
pred\_ensemble\_test = predict(ensemble, test, type = "raw")  
confusionMatrix(pred\_ensemble\_test, test$Class)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction No Yes  
## No 37 38  
## Yes 100 233  
##   
## Accuracy : 0.6618   
## 95% CI : (0.6136, 0.7076)  
## No Information Rate : 0.6642   
## P-Value [Acc > NIR] : 0.5647   
##   
## Kappa : 0.1462   
##   
## Mcnemar's Test P-Value : 2.073e-07   
##   
## Sensitivity : 0.27007   
## Specificity : 0.85978   
## Pos Pred Value : 0.49333   
## Neg Pred Value : 0.69970   
## Prevalence : 0.33578   
## Detection Rate : 0.09069   
## Detection Prevalence : 0.18382   
## Balanced Accuracy : 0.56493   
##   
## 'Positive' Class : No   
##

Wow. On the training data, the model was 99% accurate. However, when the model was applied to the testing data, there was significant degredation, nearly 33% drop down to .66. Unfortunately, the model also dipped below the naive model. This is still a poor performing model….

Stacked Model

stack\_control = trainControl(  
 method = "cv",  
 number = 10,  
 classProbs = TRUE)  
  
stack = caretStack(model\_list,  
 method ="glm",  
 metric = "ROC",  
 trControl = stack\_control)

## Warning in train.default(predobs$preds, predobs$obs, ...): The metric "ROC" was  
## not in the result set. Accuracy will be used instead.

print(stack)

## A glm ensemble of 6 base models: ranger, nn, glm, ranger.1, rpart, nnet  
##   
## Ensemble results:  
## Generalized Linear Model   
##   
## 3563 samples  
## 6 predictor  
## 2 classes: 'No', 'Yes'   
##   
## No pre-processing  
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 3207, 3206, 3208, 3206, 3207, 3206, ...   
## Resampling results:  
##   
## Accuracy Kappa   
## 0.7038939 0.2533224

#training set for stacked model  
pred\_stack = predict(stack, train, type = "raw")  
confusionMatrix(pred\_stack, train$Class)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction No Yes  
## No 316 0  
## Yes 5 633  
##   
## Accuracy : 0.9948   
## 95% CI : (0.9878, 0.9983)  
## No Information Rate : 0.6635   
## P-Value [Acc > NIR] : < 2e-16   
##   
## Kappa : 0.9882   
##   
## Mcnemar's Test P-Value : 0.07364   
##   
## Sensitivity : 0.9844   
## Specificity : 1.0000   
## Pos Pred Value : 1.0000   
## Neg Pred Value : 0.9922   
## Prevalence : 0.3365   
## Detection Rate : 0.3312   
## Detection Prevalence : 0.3312   
## Balanced Accuracy : 0.9922   
##   
## 'Positive' Class : No   
##

#testing set for stacked model  
pred\_stack\_test = predict(stack, test, type = "raw")  
confusionMatrix(pred\_stack\_test, test$Class)

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction No Yes  
## No 37 38  
## Yes 100 233  
##   
## Accuracy : 0.6618   
## 95% CI : (0.6136, 0.7076)  
## No Information Rate : 0.6642   
## P-Value [Acc > NIR] : 0.5647   
##   
## Kappa : 0.1462   
##   
## Mcnemar's Test P-Value : 2.073e-07   
##   
## Sensitivity : 0.27007   
## Specificity : 0.85978   
## Pos Pred Value : 0.49333   
## Neg Pred Value : 0.69970   
## Prevalence : 0.33578   
## Detection Rate : 0.09069   
## Detection Prevalence : 0.18382   
## Balanced Accuracy : 0.56493   
##   
## 'Positive' Class : No   
##

The stacked model performed just as poorly as the other models when applied to the testing data.. Still no improvements. On to the XGBoost model.

XGBoost Model

train\_dummy = dummyVars(" ~ .", data = train)  
train\_xgb = data.frame(predict(train\_dummy, newdata = train))  
#str(train\_xgb)

test\_dummy = dummyVars(" ~ .", data = test)  
test\_xgb = data.frame(predict(train\_dummy, newdata = test))

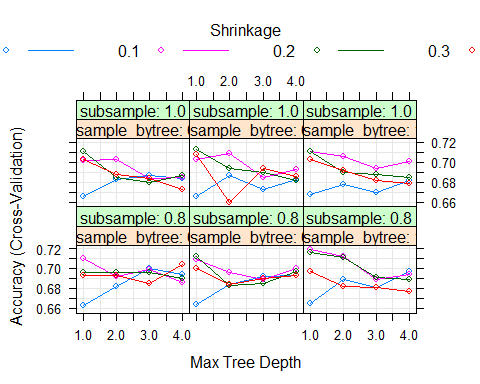
train\_xgb = train\_xgb %>% dplyr::select(-Class.No)  
test\_xgb = test\_xgb %>% dplyr::select(-Class.No)

XGBoost Tuning

set.seed(999)  
ctrl = trainControl(method = "cv",  
 number = 5)  
  
tgrid = expand.grid(  
 nrounds = 100,  
 max\_depth = c(1,2,3,4),  
 eta = c(0.01, 0.1, 0.2, 0.3),  
 gamma = 0,  
 colsample\_bytree = c(0.6, 0.8, 1),  
 min\_child\_weight = 1,  
 subsample = c(0.8, 1)  
)  
  
  
fitxgb2 = train(as.factor(Class.Yes)~.,  
 data = train\_xgb,  
 method="xgbTree",  
 tuneGrid = tgrid,  
 trControl = ctrl)

saveRDS(fitxgb2, "fitxgb2.rds")  
rm(fitxgb2)

fitxgb2 = readRDS("fitxgb2.rds")  
plot(fitxgb2)



#fitxgb2

predxgbtrain2 = predict(fitxgb2, train\_xgb)  
confusionMatrix(as.factor(train\_xgb$Class.Yes), predxgbtrain2, positive = "1")

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction 0 1  
## 0 116 205  
## 1 45 588  
##   
## Accuracy : 0.7379   
## 95% CI : (0.7088, 0.7656)  
## No Information Rate : 0.8312   
## P-Value [Acc > NIR] : 1   
##   
## Kappa : 0.3309   
##   
## Mcnemar's Test P-Value : <2e-16   
##   
## Sensitivity : 0.7415   
## Specificity : 0.7205   
## Pos Pred Value : 0.9289   
## Neg Pred Value : 0.3614   
## Prevalence : 0.8312   
## Detection Rate : 0.6164   
## Detection Prevalence : 0.6635   
## Balanced Accuracy : 0.7310   
##   
## 'Positive' Class : 1   
##

predxgbtest2 = predict(fitxgb2, test\_xgb)  
confusionMatrix(as.factor(test\_xgb$Class.Yes), predxgbtest2, positive = "1")

## Confusion Matrix and Statistics  
##   
## Reference  
## Prediction 0 1  
## 0 32 105  
## 1 33 238  
##   
## Accuracy : 0.6618   
## 95% CI : (0.6136, 0.7076)  
## No Information Rate : 0.8407   
## P-Value [Acc > NIR] : 1   
##   
## Kappa : 0.1285   
##   
## Mcnemar's Test P-Value : 1.504e-09   
##   
## Sensitivity : 0.6939   
## Specificity : 0.4923   
## Pos Pred Value : 0.8782   
## Neg Pred Value : 0.2336   
## Prevalence : 0.8407   
## Detection Rate : 0.5833   
## Detection Prevalence : 0.6642   
## Balanced Accuracy : 0.5931   
##   
## 'Positive' Class : 1   
##