Untitled

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The purpose of this project is to predict sales of four different product types and assess the impact of service reviews and customer reviews have on sales.

Target variable: ‘Volume’ for the product types: PC, Laptops, Netbooks, and Smartphones

Loading packages

```r
library(tidyverse)
```

```
## -- Attaching packages ------------------------------------------------------------------ tidyverse 1
```

```
## v ggplot2 3.3.1     v purrr   0.3.4
## v tibble  3.0.1     v dplyr   1.0.0
## v tidyr   1.1.0     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0
```

```
## -- Conflicts --------------------------------------------------------------------- tidyverse_conflic
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```r
library(caret)
```

```
## Loading required package: lattice
```

```
##
## Attaching package: ’caret’
```

```
## The following object is masked from ’package:purrr’:
##
##     lift
```

```r
library(ggplot2)
library(corrplot)
```

```
## corrplot 0.84 loaded
```

```r
library(openxlsx)
library(h2o)
```

```
##
## ----------------------------------------------------------------------
##
## Your next step is to start H2O:
##     > h2o.init()
##
## For H2O package documentation, ask for help:
##     > ??h2o
##
## After starting H2O, you can use the Web UI at http://localhost:54321
## For more information visit http://docs.h2o.ai
##
## ----------------------------------------------------------------------
```

```
##
## Attaching package: 'h2o'
```

```
## The following objects are masked from 'package:stats':
##
##     cor, sd, var
```

```
## The following objects are masked from 'package:base':
##
##     %*%, %in%, &&, ||, apply, as.factor, as.numeric, colnames,
##     colnames<-, ifelse, is.character, is.factor, is.numeric, log,
##     log10, log1p, log2, round, signif, trunc
```

Importing data

```r
existing <- read.csv(file.path('C:/Users/jlbro/OneDrive/C3T3', 'existing.csv'),
                     stringsAsFactors = TRUE)
```

Checking structure

```r
str(existing)
```

```
## 'data.frame':    80 obs. of  18 variables:
##  $ ProductType          : Factor w/ 12 levels "Accessories",..: 7 7 7 5 5 1 1 1 1 1 ...
##  $ ProductNum           : int  101 102 103 104 105 106 107 108 109 110 ...
##  $ Price                : num  949 2250 399 410 1080 ...
##  $ x5StarReviews        : int  3 2 3 49 58 83 11 33 16 10 ...
##  $ x4StarReviews        : int  3 1 0 19 31 30 3 19 9 1 ...
##  $ x3StarReviews        : int  2 0 0 8 11 10 0 12 2 1 ...
##  $ x2StarReviews        : int  0 0 0 3 7 9 0 5 0 0 ...
##  $ x1StarReviews        : int  0 0 0 9 36 40 1 9 2 0 ...
##  $ PositiveServiceReview: int  2 1 1 7 7 12 3 5 2 2 ...
##  $ NegativeServiceReview: int  0 0 0 8 20 5 0 3 1 0 ...
##  $ Recommendproduct     : num  0.9 0.9 0.9 0.8 0.7 0.3 0.9 0.7 0.8 0.9 ...
##  $ BestSellersRank      : int  1967 4806 12076 109 268 64 NA 2 NA 18 ...
##  $ ShippingWeight       : num  25.8 50 17.4 5.7 7 1.6 7.3 12 1.8 0.75 ...
##  $ ProductDepth         : num  23.9 35 10.5 15 12.9 ...
##  $ ProductWidth         : num  6.62 31.75 8.3 9.9 0.3 ...
##  $ ProductHeight        : num  16.9 19 10.2 1.3 8.9 ...
##  $ ProfitMargin         : num  0.15 0.25 0.08 0.08 0.09 0.05 0.05 0.05 0.05 0.05 ...
##  $ Volume               : int  12 8 12 196 232 332 44 132 64 40 ...
```

Because regression algorithms can easily misinterpret categorical variables in which there are more than 2 values, we will dummify categorical data for regression modeling to binarize the values.

```
existingDummy <- dummyVars(' ~ .', data = existing)
existing2 <- data.frame(predict(existingDummy, newdata = existing))
```

Check structure again

```
str(existing2)
```

```
## 'data.frame':    80 obs. of  29 variables:
##  $ ProductType.Accessories     : num  0 0 0 0 0 1 1 1 1 1 ...
##  $ ProductType.Display         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.ExtendedWarranty: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.GameConsole     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Laptop          : num  0 0 0 1 1 0 0 0 0 0 ...
##  $ ProductType.Netbook         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PC              : num  1 1 1 0 0 0 0 0 0 0 ...
##  $ ProductType.Printer         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PrinterSupplies : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Software        : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Tablet          : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductNum                  : num  101 102 103 104 105 106 107 108 109 110 ...
##  $ Price                       : num  949 2250 399 410 1080 ...
##  $ x5StarReviews               : num  3 2 3 49 58 83 11 33 16 10 ...
##  $ x4StarReviews               : num  3 1 0 19 31 30 3 19 9 1 ...
##  $ x3StarReviews               : num  2 0 0 8 11 10 0 12 2 1 ...
##  $ x2StarReviews               : num  0 0 0 3 7 9 0 5 0 0 ...
##  $ x1StarReviews               : num  0 0 0 9 36 40 1 9 2 0 ...
##  $ PositiveServiceReview       : num  2 1 1 7 7 12 3 5 2 2 ...
##  $ NegativeServiceReview       : num  0 0 0 8 20 5 0 3 1 0 ...
##  $ Recommendproduct            : num  0.9 0.9 0.9 0.8 0.7 0.3 0.9 0.7 0.8 0.9 ...
##  $ BestSellersRank             : num  1967 4806 12076 109 268 ...
##  $ ShippingWeight              : num  25.8 50 17.4 5.7 7 1.6 7.3 12 1.8 0.75 ...
##  $ ProductDepth                : num  23.9 35 10.5 15 12.9 ...
##  $ ProductWidth                : num  6.62 31.75 8.3 9.9 0.3 ...
##  $ ProductHeight               : num  16.9 19 10.2 1.3 8.9 ...
##  $ ProfitMargin                : num  0.15 0.25 0.08 0.08 0.09 0.05 0.05 0.05 0.05 0.05 ...
##  $ Volume                      : num  12 8 12 196 232 332 44 132 64 40 ...
```

Check summary for descriptive and NAs

```
summary(existing2)
```

```
##  ProductType.Accessories ProductType.Display ProductType.ExtendedWarranty
##  Min.   :0.000           Min.   :0.0000      Min.   :0.000              
##  1st Qu.:0.000           1st Qu.:0.0000      1st Qu.:0.000              
##  Median :0.000           Median :0.0000      Median :0.000              
##  Mean   :0.325           Mean   :0.0625      Mean   :0.125              
##  3rd Qu.:1.000           3rd Qu.:0.0000      3rd Qu.:0.000              
##  Max.   :1.000           Max.   :1.0000      Max.   :1.000              
##                                                                         
##  ProductType.GameConsole ProductType.Laptop ProductType.Netbook ProductType.PC
##  Min.   :0.000           Min.   :0.0000     Min.   :0.000       Min.   :0.00  
##  1st Qu.:0.000           1st Qu.:0.0000     1st Qu.:0.000       1st Qu.:0.00  
##  Median :0.000           Median :0.0000     Median :0.000       Median :0.00  
##  Mean   :0.025           Mean   :0.0375     Mean   :0.025       Mean   :0.05  
##  3rd Qu.:0.000           3rd Qu.:0.0000     3rd Qu.:0.000       3rd Qu.:0.00  
##  Max.   :1.000           Max.   :1.0000     Max.   :1.000       Max.   :1.00  
##                                                                               
##  ProductType.Printer ProductType.PrinterSupplies ProductType.Smartphone
##  Min.   :0.00        Min.   :0.0000              Min.   :0.00          
##  1st Qu.:0.00        1st Qu.:0.0000              1st Qu.:0.00          
##  Median :0.00        Median :0.0000              Median :0.00          
##  Mean   :0.15        Mean   :0.0375              Mean   :0.05          
##  3rd Qu.:0.00        3rd Qu.:0.0000              3rd Qu.:0.00          
##  Max.   :1.00        Max.   :1.0000              Max.   :1.00          
##                                                                        
##  ProductType.Software ProductType.Tablet   ProductNum        Price        
##  Min.   :0.000        Min.   :0.0000     Min.   :101.0   Min.   :   3.60  
##  1st Qu.:0.000        1st Qu.:0.0000     1st Qu.:120.8   1st Qu.:  52.66  
##  Median :0.000        Median :0.0000     Median :140.5   Median : 132.72  
##  Mean   :0.075        Mean   :0.0375     Mean   :142.6   Mean   : 247.25  
##  3rd Qu.:0.000        3rd Qu.:0.0000     3rd Qu.:160.2   3rd Qu.: 352.49  
##  Max.   :1.000        Max.   :1.0000     Max.   :200.0   Max.   :2249.99  
##                                                                           
##  x5StarReviews    x4StarReviews    x3StarReviews    x2StarReviews   
##  Min.   :   0.0   Min.   :  0.00   Min.   :  0.00   Min.   :  0.00  
##  1st Qu.:  10.0   1st Qu.:  2.75   1st Qu.:  2.00   1st Qu.:  1.00  
##  Median :  50.0   Median : 22.00   Median :  7.00   Median :  3.00  
##  Mean   : 176.2   Mean   : 40.20   Mean   : 14.79   Mean   : 13.79  
##  3rd Qu.: 306.5   3rd Qu.: 33.00   3rd Qu.: 11.25   3rd Qu.:  7.00  
##  Max.   :2801.0   Max.   :431.00   Max.   :162.00   Max.   :370.00  
##                                                                     
##  x1StarReviews     PositiveServiceReview NegativeServiceReview Recommendproduct
##  Min.   :   0.00   Min.   :  0.00        Min.   : 0.000        Min.   :0.100   
##  1st Qu.:   2.00   1st Qu.:  2.00        1st Qu.: 1.000        1st Qu.:0.700   
##  Median :   8.50   Median :  5.50        Median : 3.000        Median :0.800   
##  Mean   :  37.67   Mean   : 51.75        Mean   : 6.225        Mean   :0.745   
##  3rd Qu.:  15.25   3rd Qu.: 42.00        3rd Qu.:  6.250       3rd Qu.:0.900
##  Max.   :1654.00   Max.   :536.00        Max.   :112.000       Max.   :1.000
##
##  BestSellersRank ShippingWeight     ProductDepth      ProductWidth
##  Min.   :    1   Min.   : 0.0100   Min.   :  0.000   Min.   : 0.000
##  1st Qu.:    7   1st Qu.: 0.5125   1st Qu.:  4.775   1st Qu.: 1.750
##  Median :   27   Median : 2.1000   Median :  7.950   Median : 6.800
##  Mean   : 1126   Mean   : 9.6681   Mean   : 14.425   Mean   : 7.819
##  3rd Qu.:  281   3rd Qu.:11.2050   3rd Qu.: 15.025   3rd Qu.:11.275
##  Max.   :17502   Max.   :63.0000   Max.   :300.000   Max.   :31.750
##  NA’s   :15
##  ProductHeight     ProfitMargin        Volume
##  Min.   : 0.000   Min.   :0.0500   Min.   :    0
##  1st Qu.: 0.400   1st Qu.:0.0500   1st Qu.:   40
##  Median : 3.950   Median :0.1200   Median :  200
##  Mean   : 6.259   Mean   :0.1545   Mean   :  705
##  3rd Qu.:10.300   3rd Qu.:0.2000   3rd Qu.: 1226
##  Max.   :25.800   Max.   :0.4000   Max.   :11204
##
```

Reveals 15 NA’s for ‘BestSellersRank’

Deleting BestSellersRank, only variable with NAs

```
existing2$BestSellersRank <- NULL
```

Correlation matrix of all variables

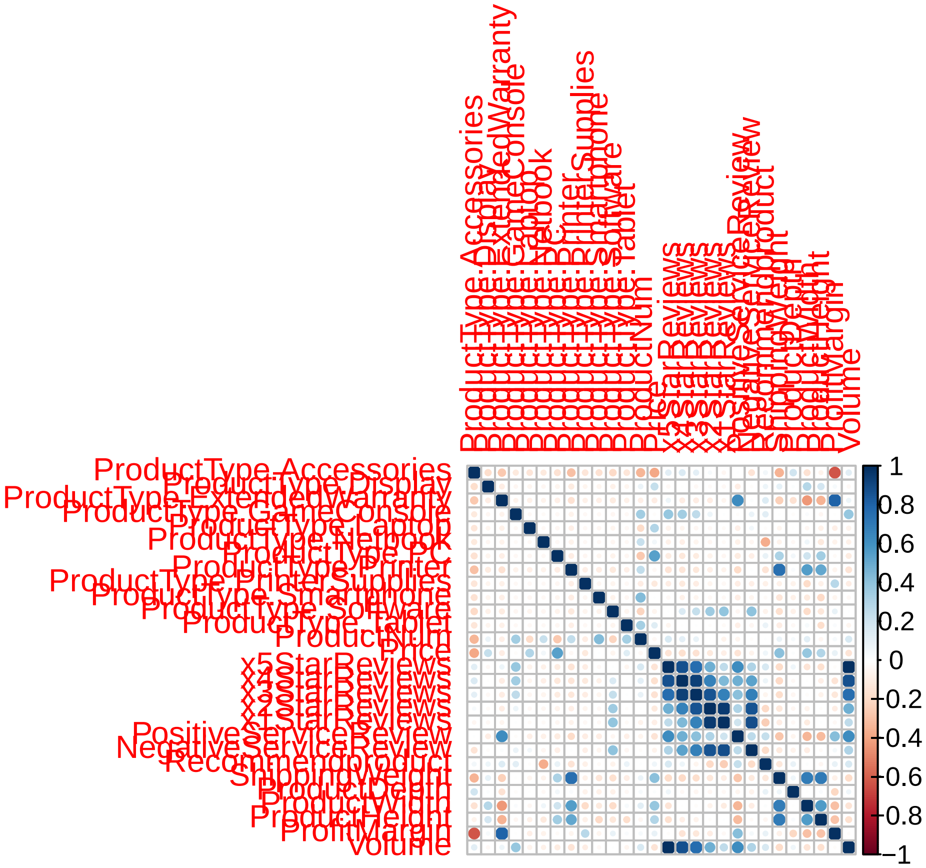
```
corrData <- cor(existing2)
```

Exporting correlation to excel

```
write.xlsx(corrData, file = "corrData.xlsx", row.names=TRUE)
write.xlsx(existing2, file = 'existing2.xlsx')
```

Viewing correlation heatmap, as you can see, it’s unreadable with so many variables

```
corrplot(corrData)
```



Removing 5 Star since perfect correlation of 1 to target variable, risks overfitting

Also removing low correlated variables

```
existing3 <- subset(existing2, select = -c(1:4, 8:9, 11:12, 15, 24:27))
str(existing3)
```

```
## 'data.frame':    80 obs. of  15 variables:
##  $ ProductType.Laptop    : num  0 0 0 1 1 0 0 0 0 0 ...
##  $ ProductType.Netbook   : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PC        : num  1 1 1 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductNum            : num  101 102 103 104 105 106 107 108 109 110 ...
##  $ Price                 : num  949 2250 399 410 1080 ...
##  $ x4StarReviews         : num  3 1 0 19 31 30 3 19 9 1 ...
##  $ x3StarReviews         : num  2 0 0 8 11 10 0 12 2 1 ...
##  $ x2StarReviews         : num  0 0 0 3 7 9 0 5 0 0 ...
##  $ x1StarReviews         : num  0 0 0 9 36 40 1 9 2 0 ...
##  $ PositiveServiceReview : num  2 1 1 7 7 12 3 5 2 2 ...
##  $ NegativeServiceReview : num  0 0 0 8 20 5 0 3 1 0 ...
##  $ Recommendproduct      : num  0.9 0.9 0.9 0.8 0.7 0.3 0.9 0.7 0.8 0.9 ...
##  $ ShippingWeight        : num  25.8 50 17.4 5.7 7 1.6 7.3 12 1.8 0.75 ...
##  $ Volume                : num  12 8 12 196 232 332 44 132 64 40 ...
```

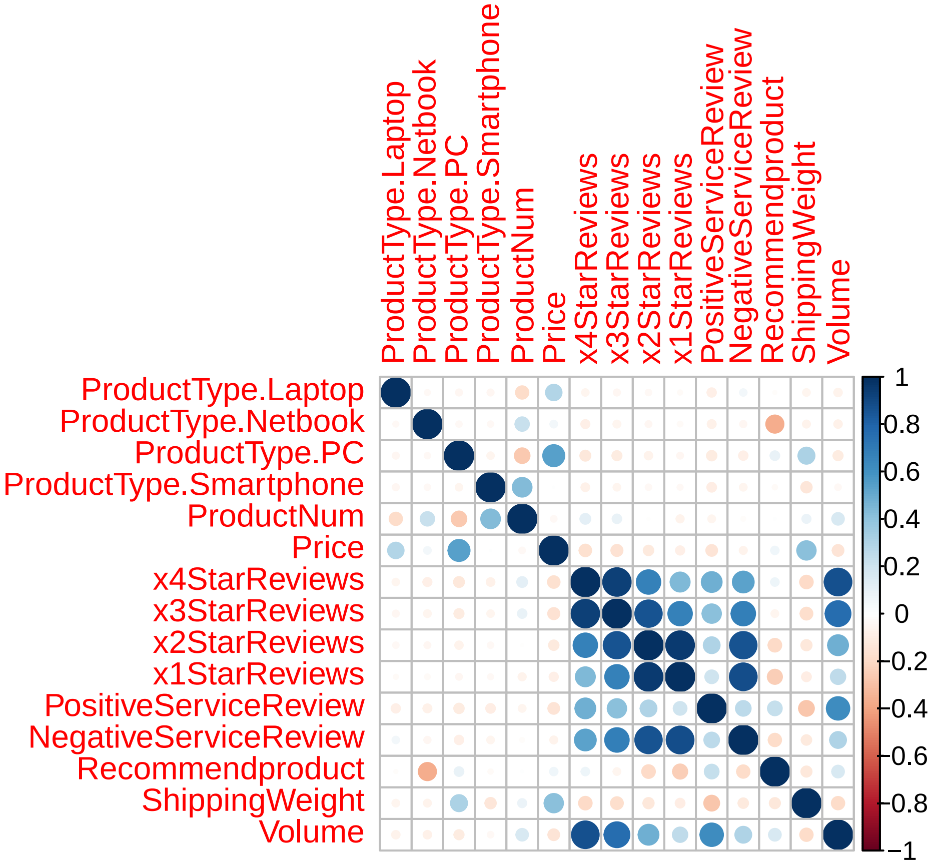
Transmute new column that is average of all Star Reviews to try as form of PCA

```
existing4 <- existing3 %>%
  rowwise() %>% mutate(AvgStarReviews = (mean(c(x4StarReviews, x3StarReviews, x2StarReviews, x1StarRevi
```

EDA

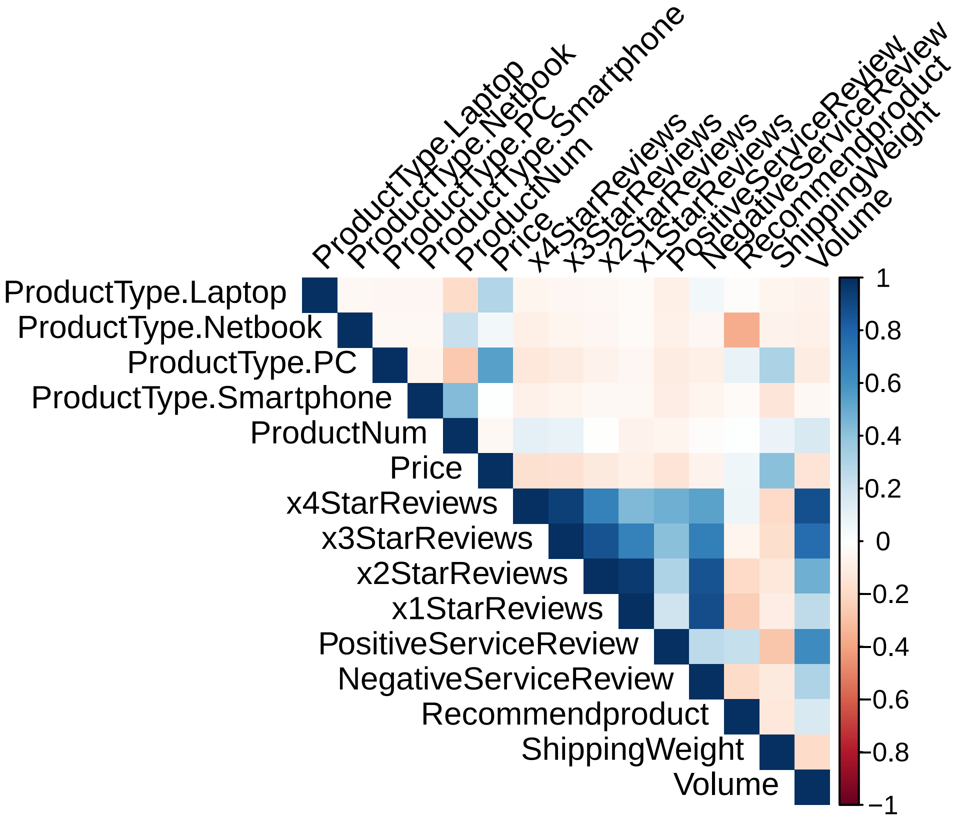
viewing correlation heatmap

```
corrData3 <- cor(existing3)
corrplot(corrData3)
```



Enhancing the correlation heatmap

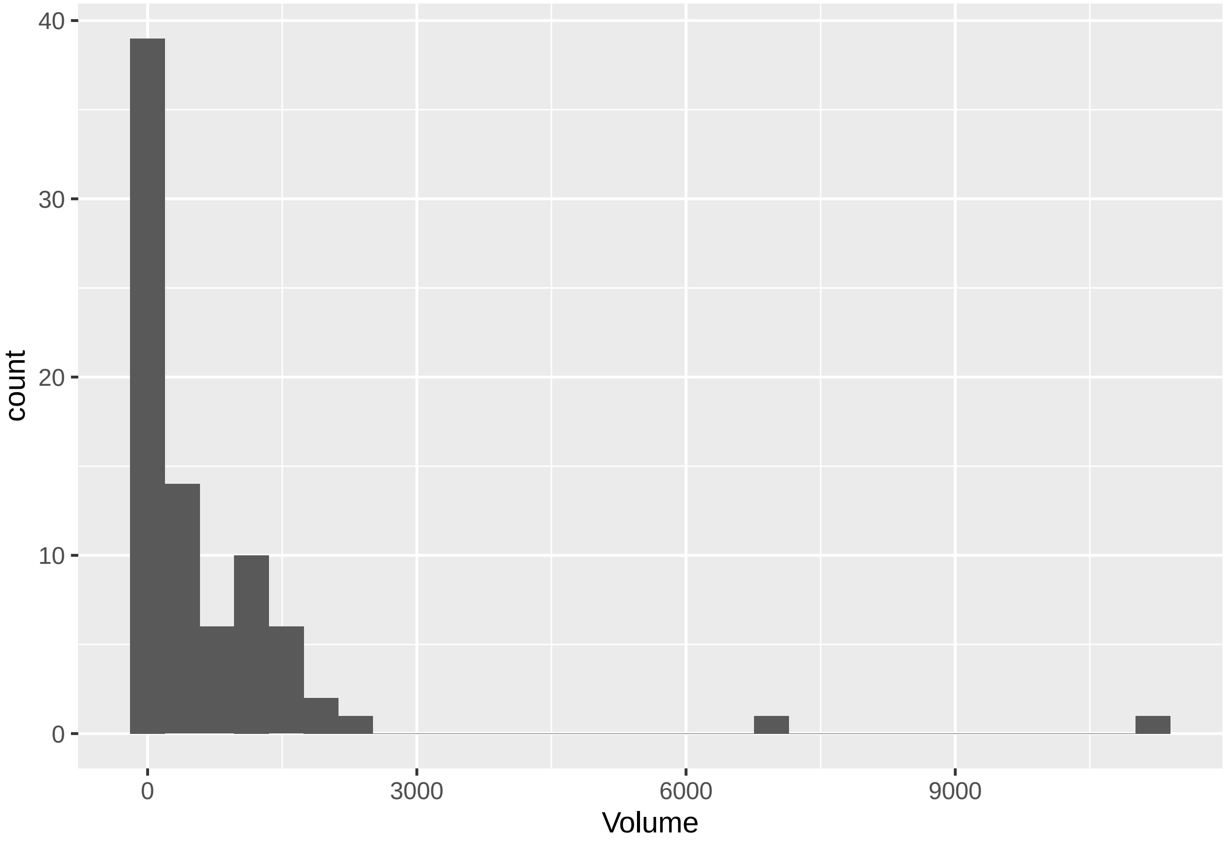
```
color <- colorRampPalette(c('#BB4444','#EE9988','#FFFFFF','#77AADD','#4477AA'))
corrplot(corrData3, method = 'shade', shade.col = NA, tl.col = 'black',
         type = 'upper', tl.srt = 45)
```



Histogram of Volume, reveals couple outliers

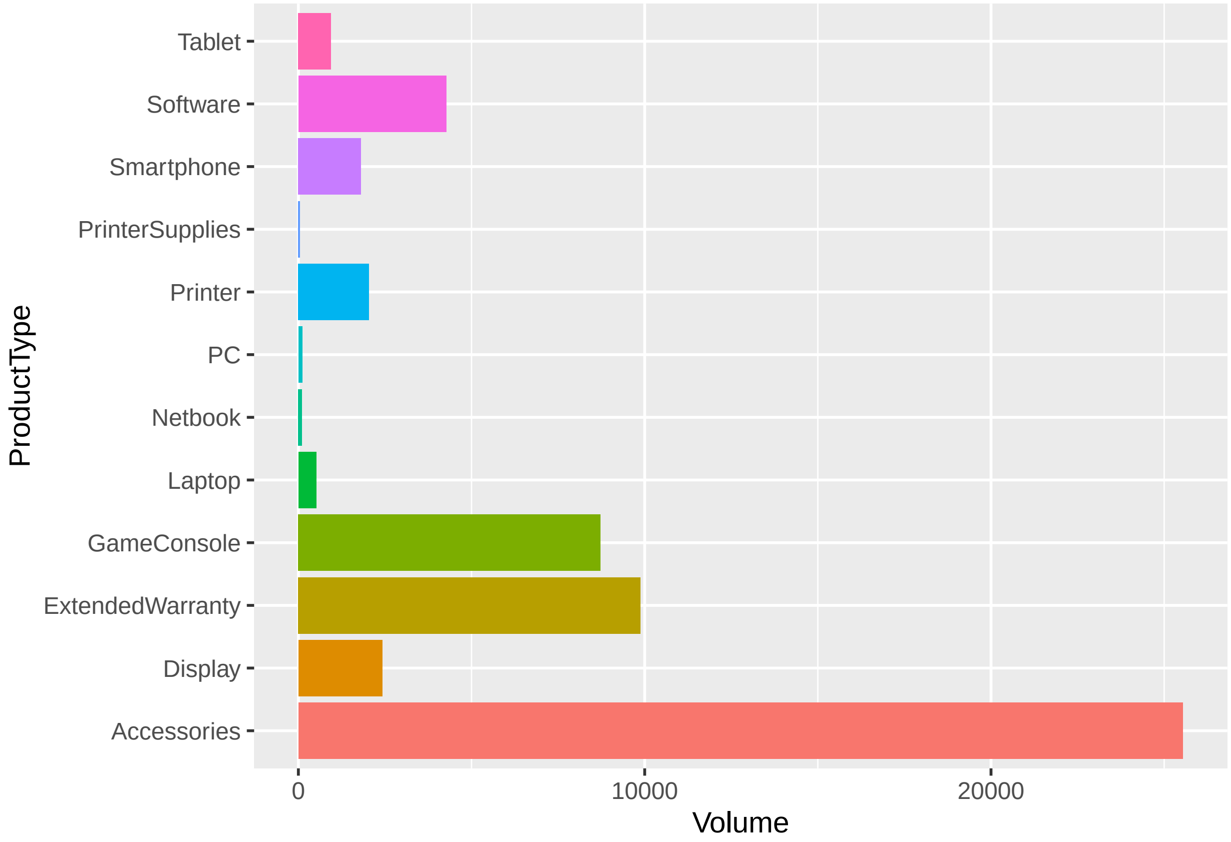
```
ggplot(data = existing3, mapping = aes(x = Volume)) +
  geom_histogram()
```

```
## ‘stat_bin()‘ using ‘bins = 30‘. Pick better value with ‘binwidth‘.
```



Plotting Sales Volume by Product Type

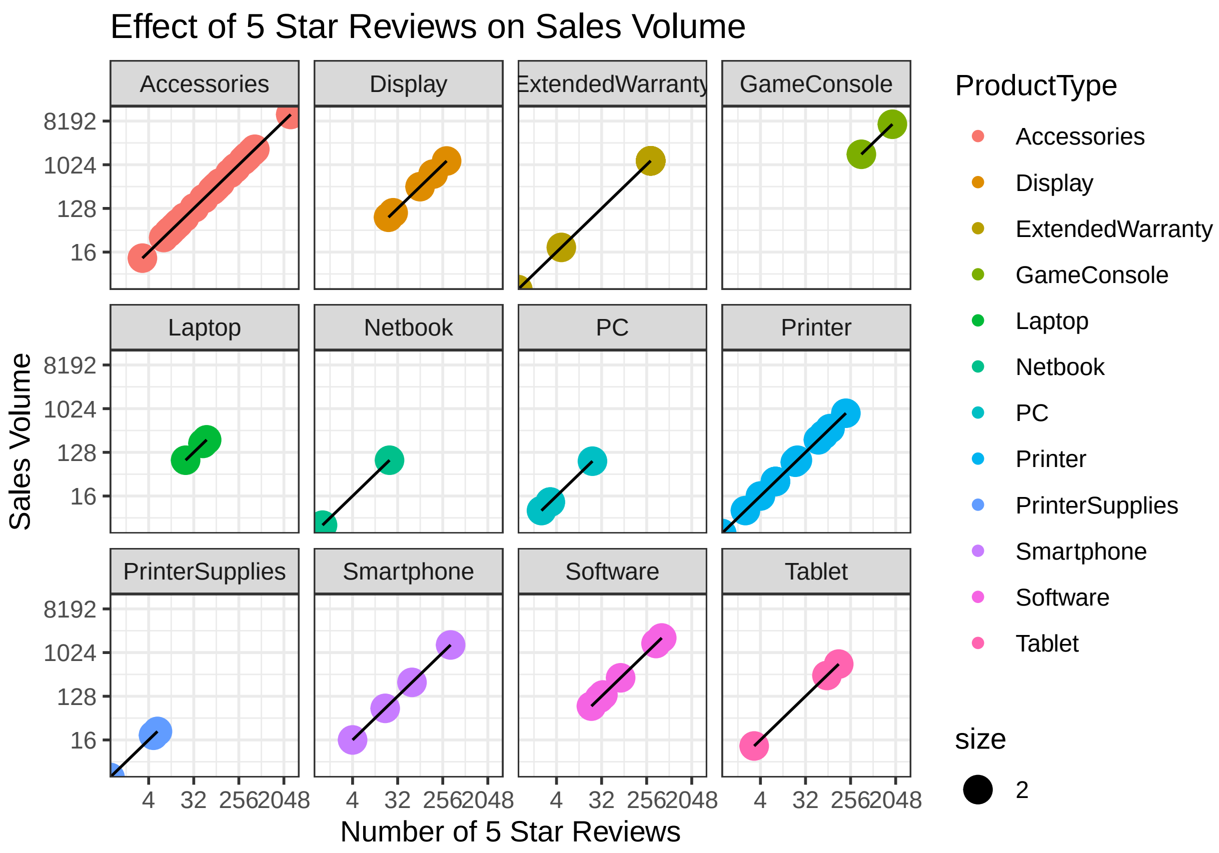
```
ggplot(data = existing, aes(x = ProductType, y = Volume, fill = ProductType)) +
  geom_bar(stat = 'identity') +
  guides(fill=FALSE) +
  coord_flip()
```



Plotting the impact 5 Star Reviews have on Sales Volume

```r
ggplot(data=existing, aes(x=x5StarReviews, y=Volume)) +
  geom_point(aes(color=ProductType, size=2)) +
  theme_bw() +
  scale_x_continuous(trans = 'log2') +
  scale_y_continuous(trans = 'log2') +
  geom_line() +
  facet_wrap(~ProductType) +
  xlab('Number of 5 Star Reviews') +
  ylab('Sales Volume') +
  ggtitle('Effect of 5 Star Reviews on Sales Volume')
```

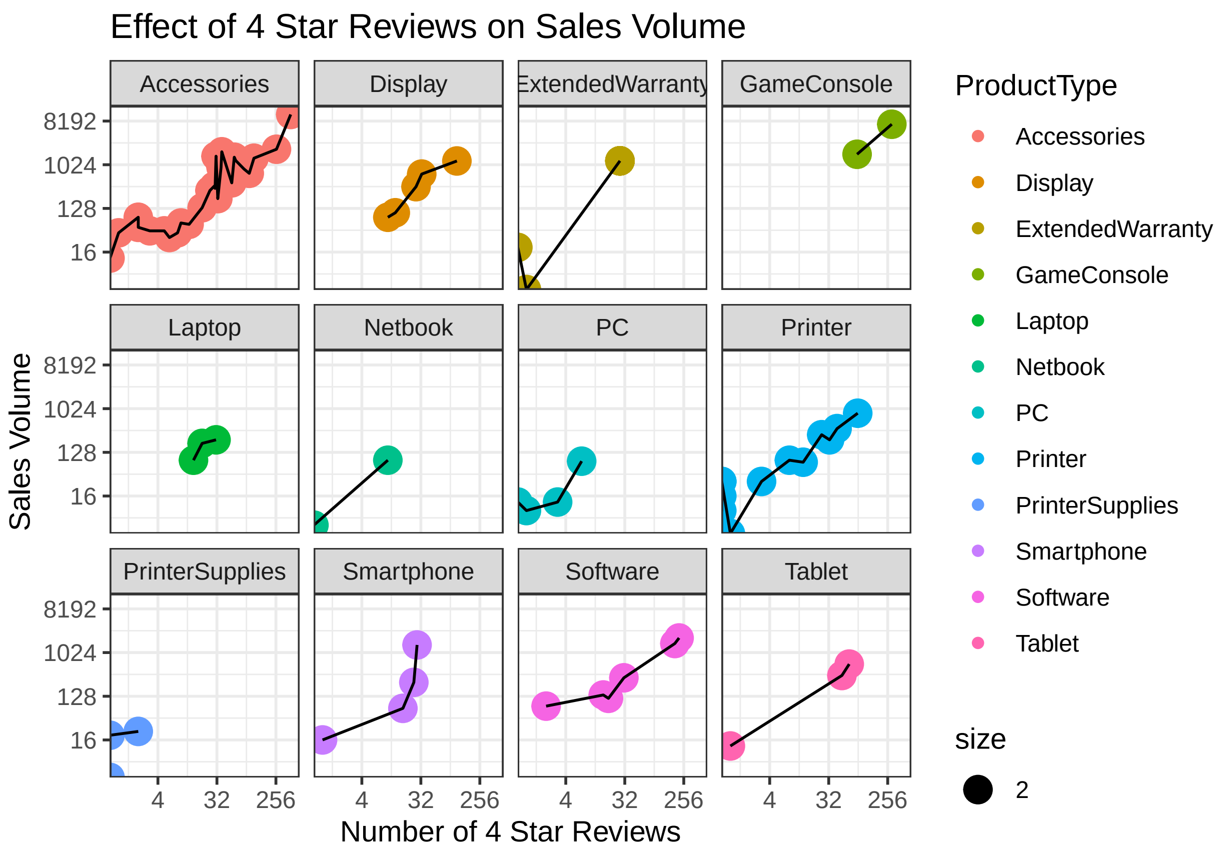
```
## Warning: Transformation introduced infinite values in continuous x-axis

## Warning: Transformation introduced infinite values in continuous y-axis

## Warning: Transformation introduced infinite values in continuous x-axis

## Warning: Transformation introduced infinite values in continuous y-axis
```



Now plotting impact of 4 Star Reviews on Sales Volume

```
ggplot(data=existing, aes(x=x4StarReviews, y=Volume)) +
  geom_point(aes(color=ProductType, size=2)) +
  theme_bw() +
  scale_x_continuous(trans = 'log2') +
  scale_y_continuous(trans = 'log2') +
  geom_line() +
  facet_wrap(~ProductType) +
  xlab('Number of 4 Star Reviews') +
  ylab('Sales Volume') +
  ggtitle('Effect of 4 Star Reviews on Sales Volume')
```

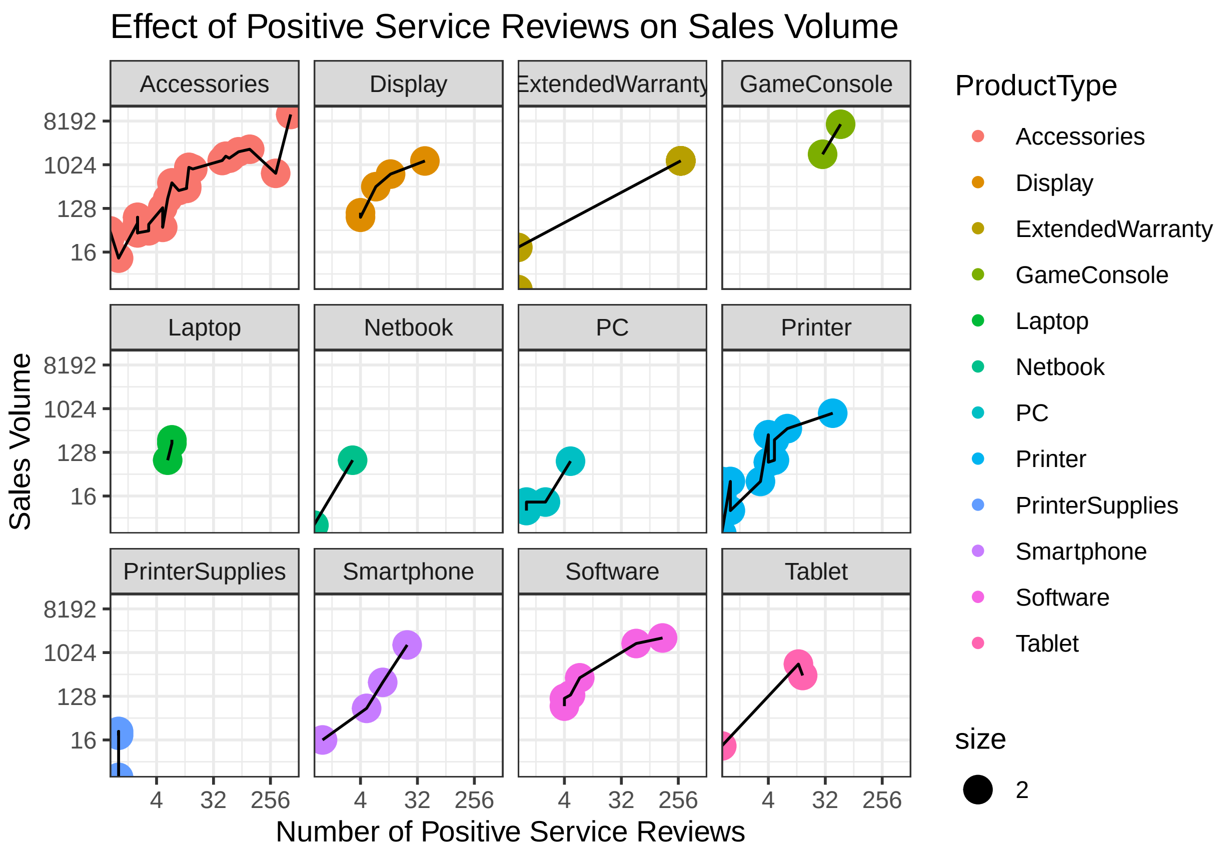
```
## Warning: Transformation introduced infinite values in continuous x-axis

## Warning: Transformation introduced infinite values in continuous y-axis

## Warning: Transformation introduced infinite values in continuous x-axis

## Warning: Transformation introduced infinite values in continuous y-axis
```



Now plotting impact of Positive Service Reviews on Sales Volume

```
ggplot(data=existing, aes(x=PositiveServiceReview, y=Volume)) +
  geom_point(aes(color=ProductType, size=2)) +
  theme_bw() +
  scale_x_continuous(trans = 'log2') +
  scale_y_continuous(trans = 'log2') +
  geom_line() +
  facet_wrap(~ProductType) +
  xlab('Number of Positive Service Reviews') +
  ylab('Sales Volume') +
  ggtitle('Effect of Positive Service Reviews on Sales Volume')
```

```
## Warning: Transformation introduced infinite values in continuous x-axis

## Warning: Transformation introduced infinite values in continuous y-axis

## Warning: Transformation introduced infinite values in continuous x-axis

## Warning: Transformation introduced infinite values in continuous y-axis
```



Modeling

Creating data partition and setting cross validation

Two rows eventually were removed due to outlier volumes

```
set.seed(123)

# CreateDataPartition() 75% and 25%
index1 <- createDataPartition(existing3$Volume, p=0.75, list = FALSE)
train1 <- existing3[ index1,]
test1 <- existing3[-index1,]

# Removing 2 outlier rows #18 and #48 from test set
test1_rem_out <- test1[!rownames(test1) %in% c('18', '48'), ]

# Checking structure of train1
str(train1)
```

```
## 'data.frame':    61 obs. of  15 variables:
##  $ ProductType.Laptop    : num  0 0 0 1 0 0 0 0 0 0 ...
##  $ ProductType.Netbook   : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PC        : num  1 1 1 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductNum            : num  101 102 103 104 106 107 108 109 110 111 ...
##  $ Price                 : num  949 2250 399 410 114 ...
##  $ x4StarReviews         : num  3 1 0 19 30 3 19 9 1 2 ...
##  $ x3StarReviews         : num  2 0 0 8 10 0 12 2 1 2 ...
##  $ x2StarReviews         : num  0 0 0 3 9 0 5 0 0 4 ...
##  $ x1StarReviews         : num  0 0 0 9 40 1 9 2 0 15 ...
##  $ PositiveServiceReview : num  2 1 1 7 12 3 5 2 2 2 ...
##  $ NegativeServiceReview : num  0 0 0 8 5 0 3 1 0 1 ...
##  $ Recommendproduct      : num  0.9 0.9 0.9 0.8 0.3 0.9 0.7 0.8 0.9 0.5 ...
##  $ ShippingWeight        : num  25.8 50 17.4 5.7 1.6 7.3 12 1.8 0.75 1 ...
##  $ Volume                : num  12 8 12 196 332 44 132 64 40 84 ...
```

```
# Setting cross validation
control1 <- trainControl(method = 'repeatedcv',
                         number = 10,
                         repeats = 1)
```

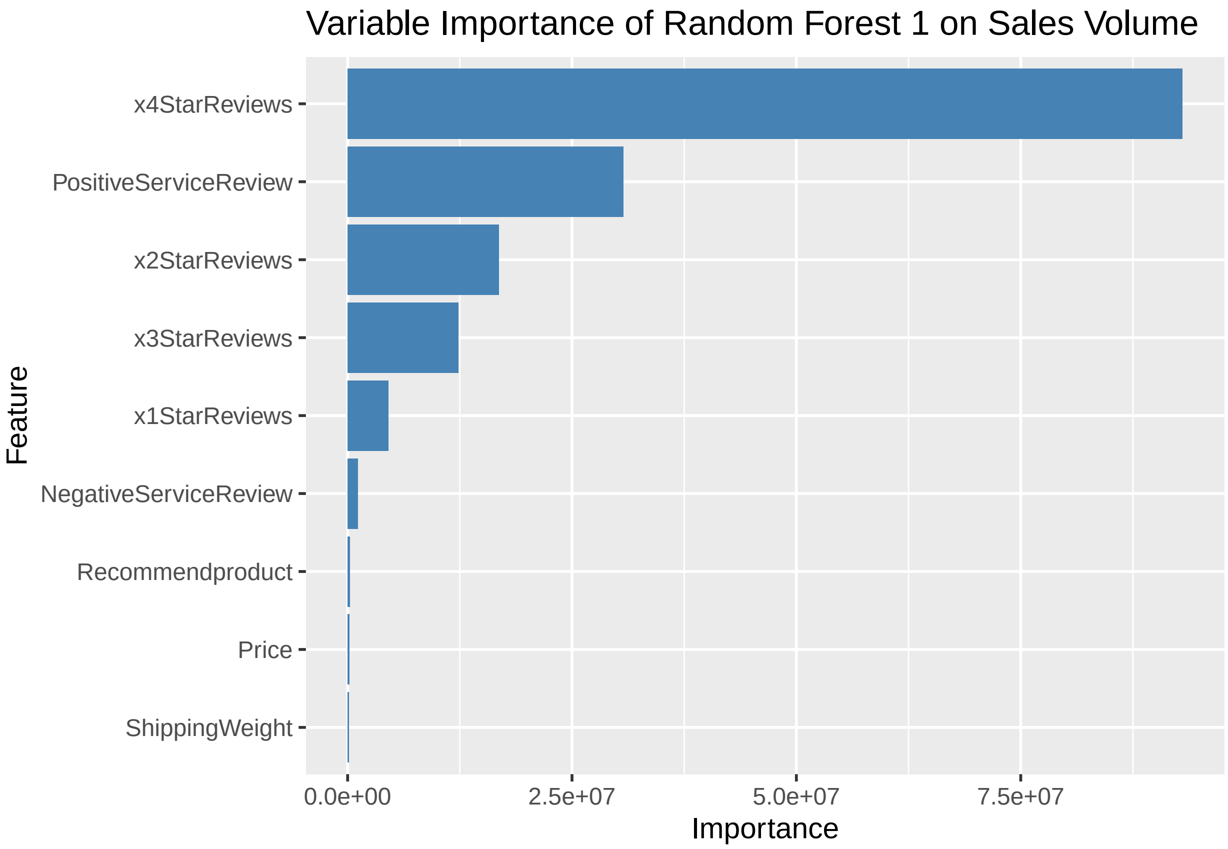
Random forest model and tuning

```
# set seed
set.seed(123)

# Creating dataframe for manual tuning
rfGrid <- expand.grid(mtry = c(2,3,4,5,6,7,8))

rf1 <- train(Volume ~ x4StarReviews + PositiveServiceReview + x2StarReviews + x3StarReviews +
               x1StarReviews + NegativeServiceReview + Recommendproduct + ShippingWeight + Price,
             data = train1,
             method = 'rf',
             trControl = control1,
             tuneGrid = rfGrid)

rf1
```

```
## Random Forest
##
## 61 samples
##  9 predictor
##
## No pre-processing
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   mtry  RMSE      Rsquared   MAE
##   2     869.2921  0.8755901  416.0646
##   3     849.5229  0.8871013  400.1741
##   4     824.7775  0.8939530  386.7741
##   5     827.7373  0.8980015  384.5929
##   6     801.6069  0.9043345  372.1979
##   7     802.9288  0.9073910  372.2425
##   8     788.6419  0.9081729  365.2084
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was mtry = 8.
```

Level of importance for variables in model

```
ggplot(varImp(rf1, scale=FALSE)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  ggtitle('Variable Importance of Random Forest 1 on Sales Volume')
```

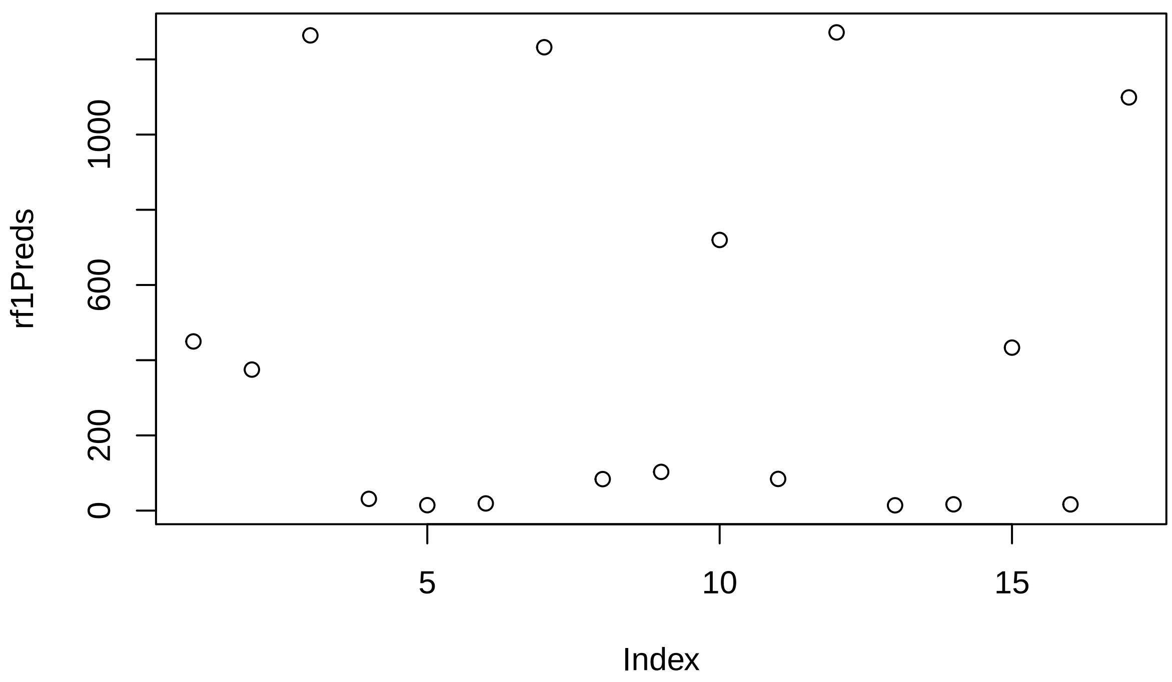


Predicting rf on test1

```
rf1Preds <- predict(rf1, newdata = test1_rem_out)
summary(rf1Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   14.11   19.05  102.97  425.15  719.71 1271.74
```

```
plot(rf1Preds)
```



A symmetrical pattern means a good residual plot!

postResample to test if it will do well on new data or if overfitting

```
postResample(rf1Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 190.4253816   0.9452884  98.7387608
```

CV RMSE=788, R2=.908

PostResample RMSE=190, R2=.945

Random Forest using feature selection

```
set.seed(123)

rf2 <- train(Volume ~ x4StarReviews + PositiveServiceReview + x2StarReviews,
             data = train1,
             method = 'rf',
             trControl = control1)
```

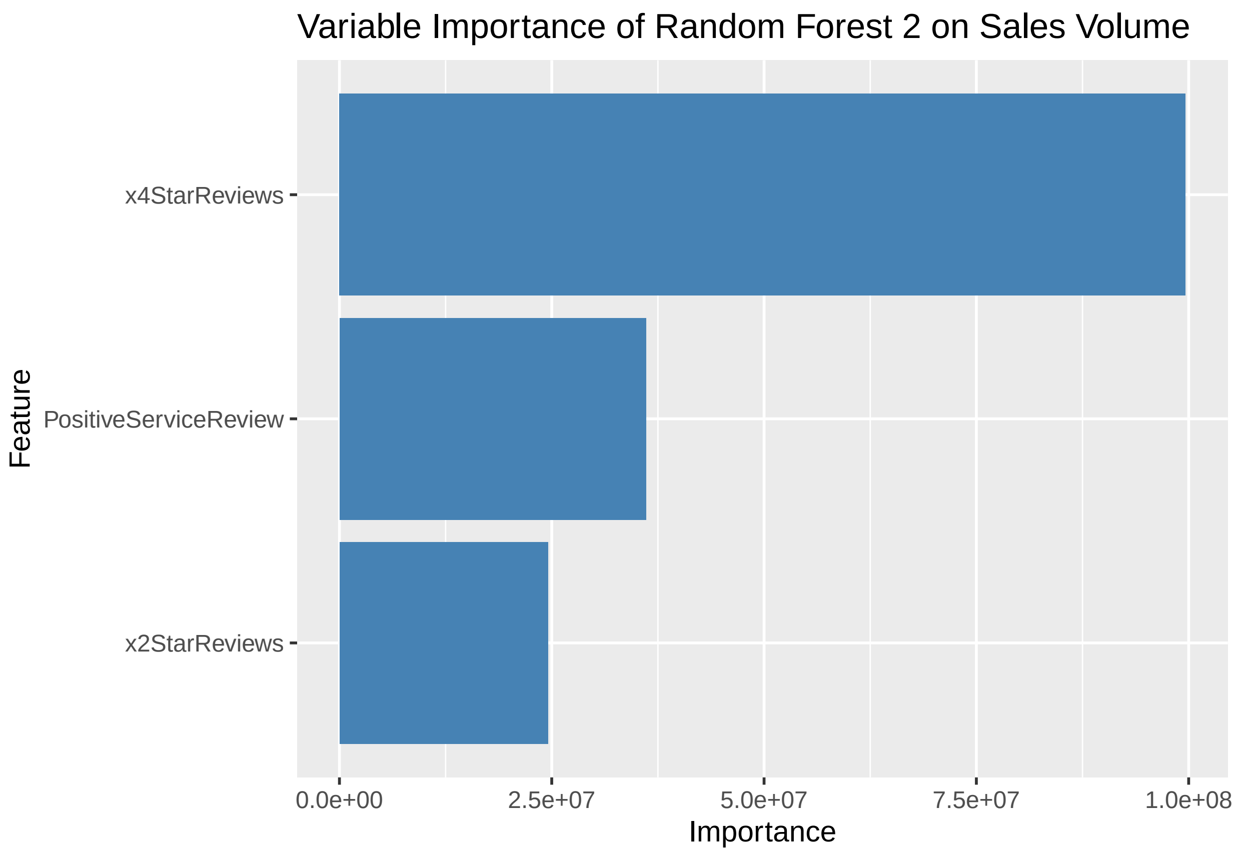
```
## note: only 2 unique complexity parameters in default grid. Truncating the grid to 2 .
```

```
rf2
```

```
## Random Forest
##
## 61 samples
##  3 predictor
##
## No pre-processing
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   mtry  RMSE      Rsquared   MAE
##   2     771.2710  0.9218973  349.2301
##   3     745.3771  0.9284383  338.8776
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was mtry = 3.
```

Variable importance

```
ggplot(varImp(rf2, scale=FALSE)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  ggtitle('Variable Importance of Random Forest 2 on Sales Volume')
```

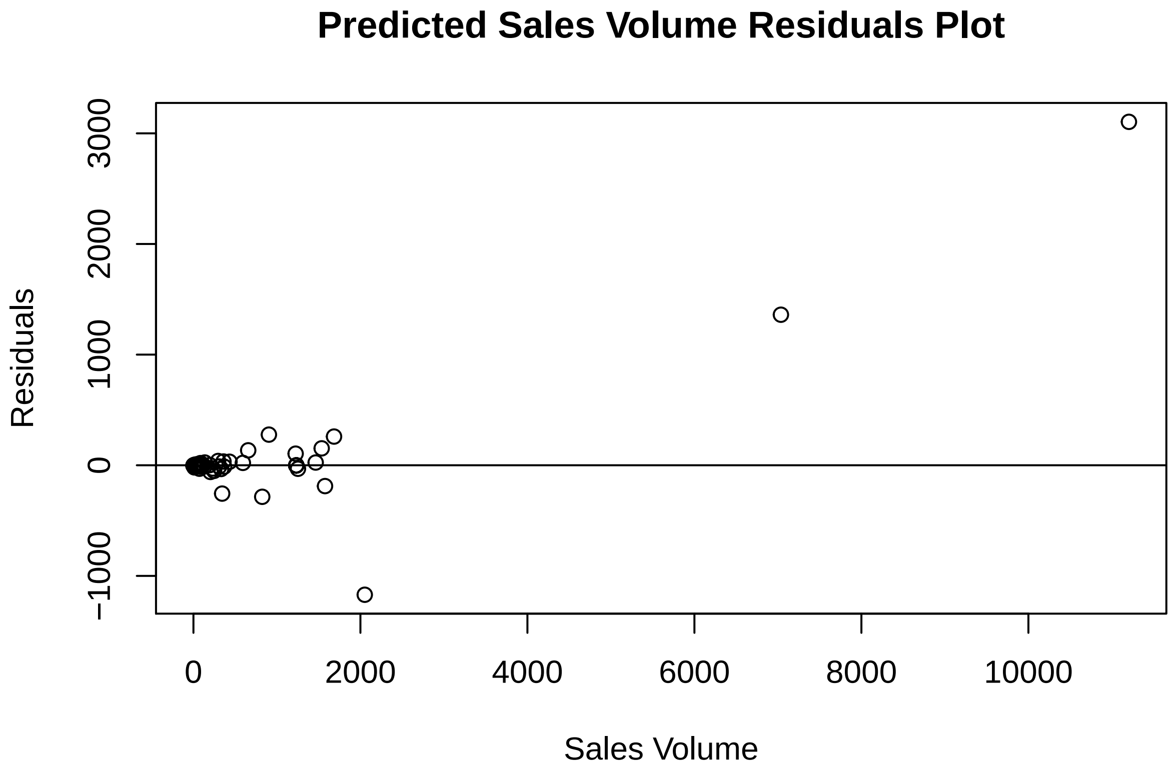


Variable Importance of Random Forest 2 on Sales Volume

Plotting the residuals against the actual values for Volume

This graph shows volume outlier

```
resid_rf2 <- residuals(rf2)
plot(train1$Volume, resid_rf2,
     xlab = 'Sales Volume',
     ylab = 'Residuals',
     main ='Predicted Sales Volume Residuals Plot',
     abline(0,0))
```

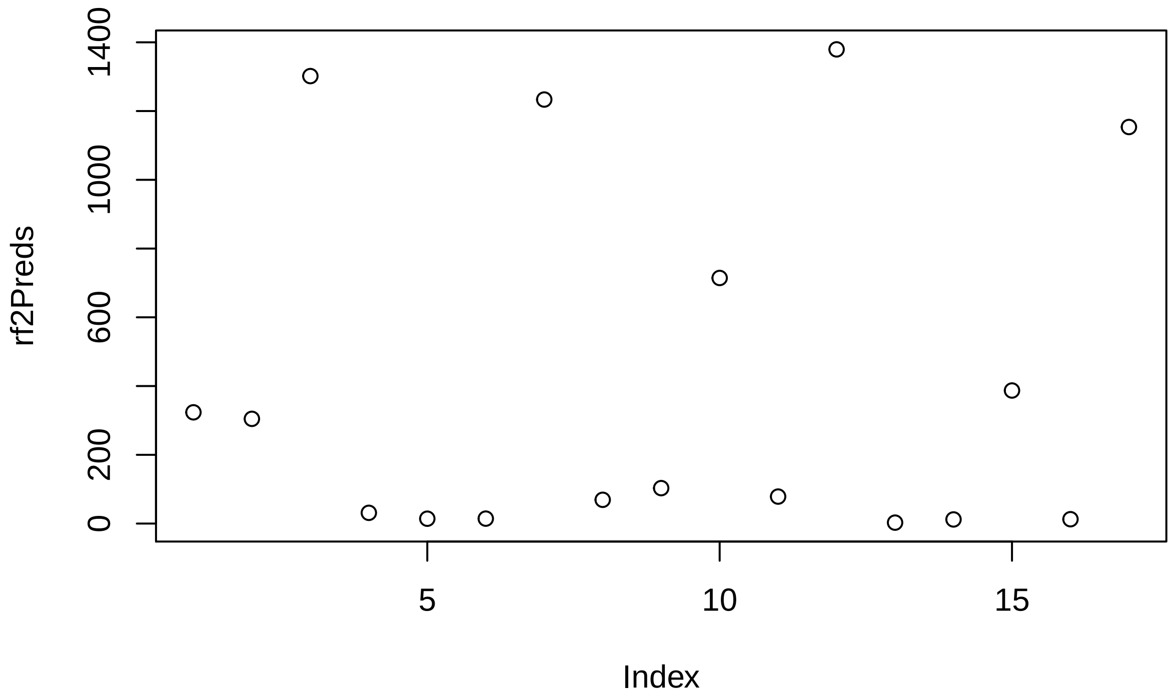


Predicting rf2 on test1

```
rf2Preds <- predict(rf2, newdata = test1_rem_out)
summary(rf2Preds)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##    2.742   14.336  103.066  419.753  714.428 1379.420
```

```
plot(rf2Preds)
```



Another excellent residual plot, showing our predictions are consistent with regression

postResample to test if it will do well on new data or if overfitting

```
postResample(rf2Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 153.8183544   0.9718405  74.7555212
```

CV RMSE = 745, R2=.928

PostResample RMSE=153, R2=.972

The postResample R2 and RMSE for a regression model is excellent. This is our top model!

Random Forest using feature selection

```
set.seed(123)

rf3 <- train(Volume ~ x4StarReviews + PositiveServiceReview + x3StarReviews,
             data = train1,
             method = 'rf',
             trControl = control1)
```

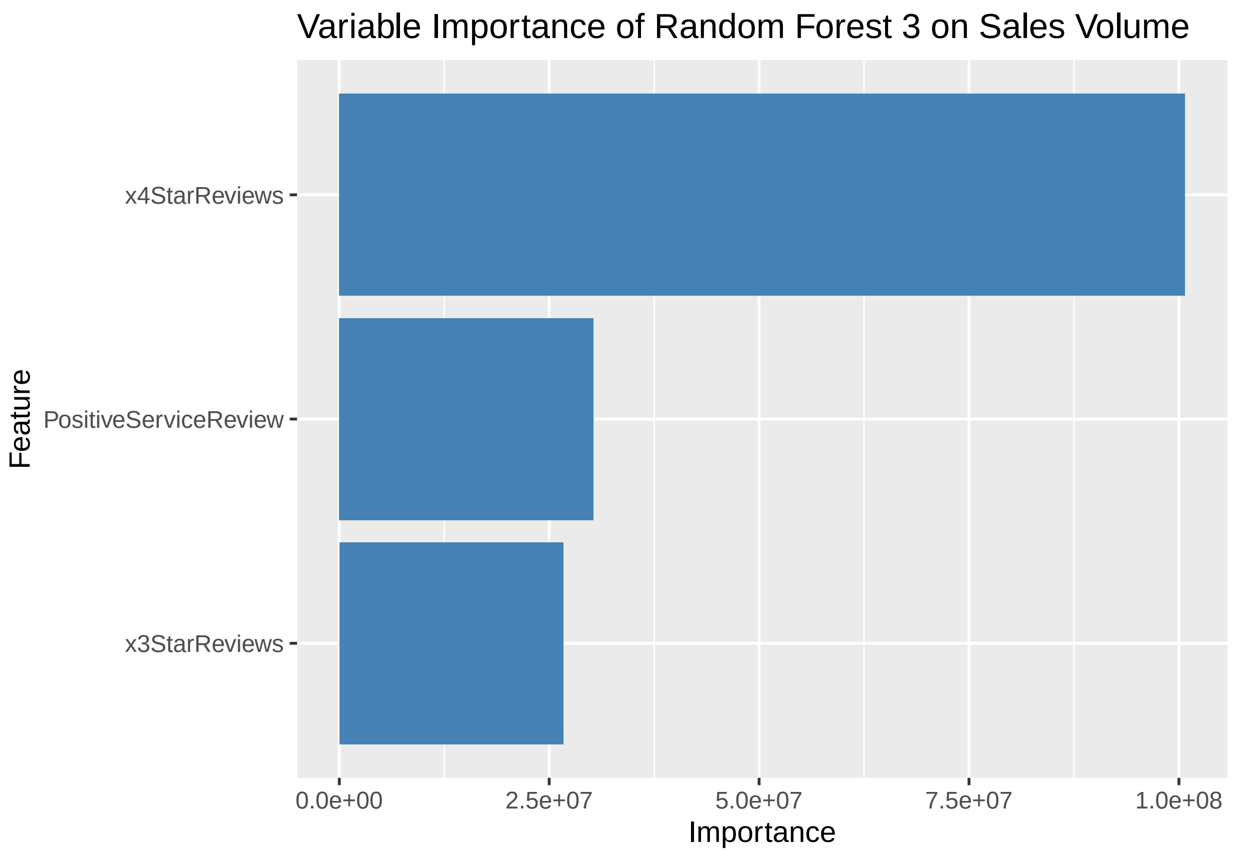
```
## note: only 2 unique complexity parameters in default grid. Truncating the grid to 2 .
```

```
rf3
```

```
## Random Forest
##
## 61 samples
##  3 predictor
##
## No pre-processing
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   mtry  RMSE      Rsquared   MAE
##   2     710.5834  0.9285459  323.8009
##   3     684.5642  0.9346194  313.5800
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was mtry = 3.
```

Variable importance

```
ggplot(varImp(rf3, scale=FALSE)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  ggtitle('Variable Importance of Random Forest 3 on Sales Volume')
```



Predicting rf3 on test1

```
rf3Preds <- predict(rf3, newdata = test1_rem_out)
summary(rf3Preds)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##    5.789   11.959   94.221  425.461  737.133 1358.924
```

postResample to test if it will do well on new data or if overfitting

```
postResample(rf3Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 167.7971733   0.9549701  83.4029171
```

CV RMSe=648, R2=.934

PostResample RMSE=167, R2=.954

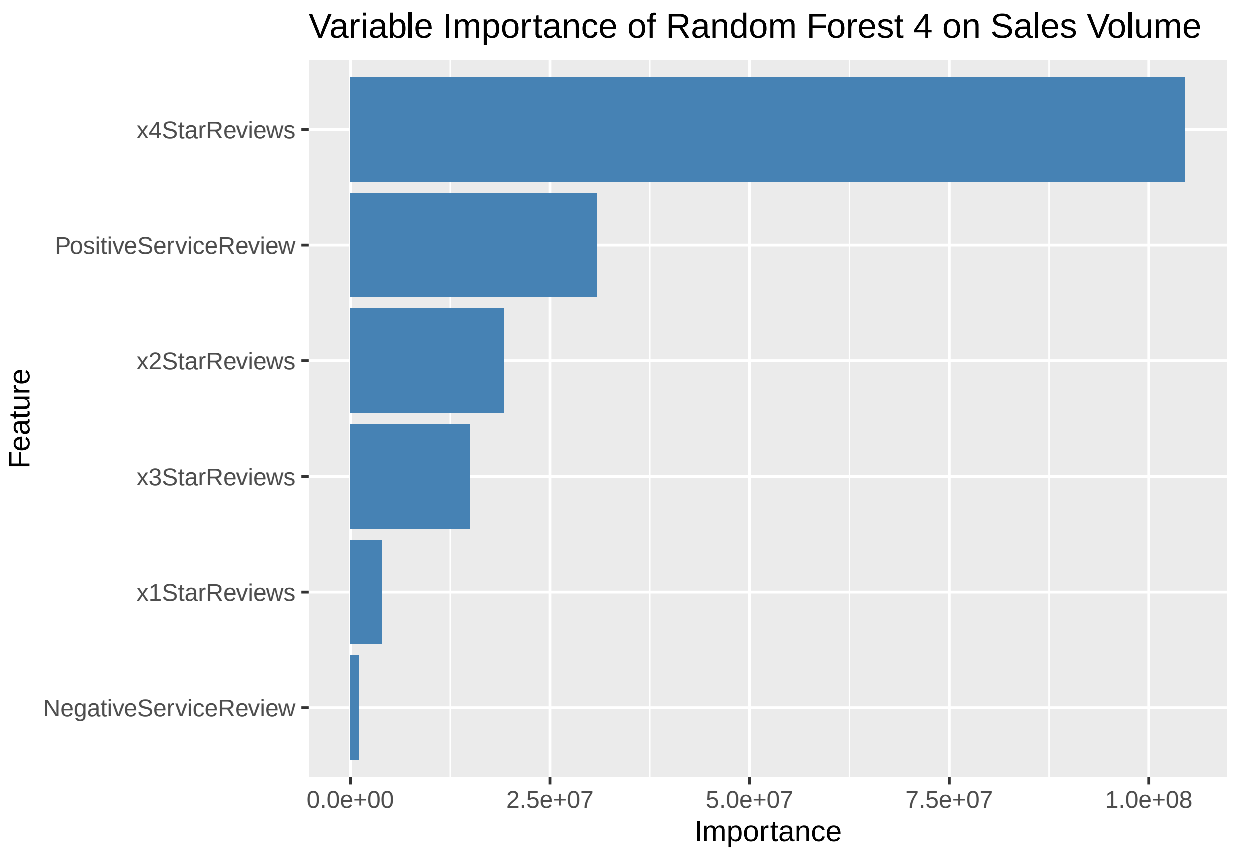
Random Forest using feature selection

```
set.seed(123)
rf4 <- train(Volume ~ x4StarReviews + PositiveServiceReview + x3StarReviews + x2StarReviews +
               x1StarReviews + NegativeServiceReview,
             data = train1,
             method = 'rf',
             trControl = control1)

rf4
```

```
## Random Forest
##
## 61 samples
##  6 predictor
##
## No pre-processing
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   mtry  RMSE      Rsquared   MAE
##   2     844.5227  0.8864850  396.6254
##   4     801.2553  0.9052961  370.6409
##   6     790.8997  0.9072861  362.8766
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was mtry = 6.
```

Variable importance using ggplot

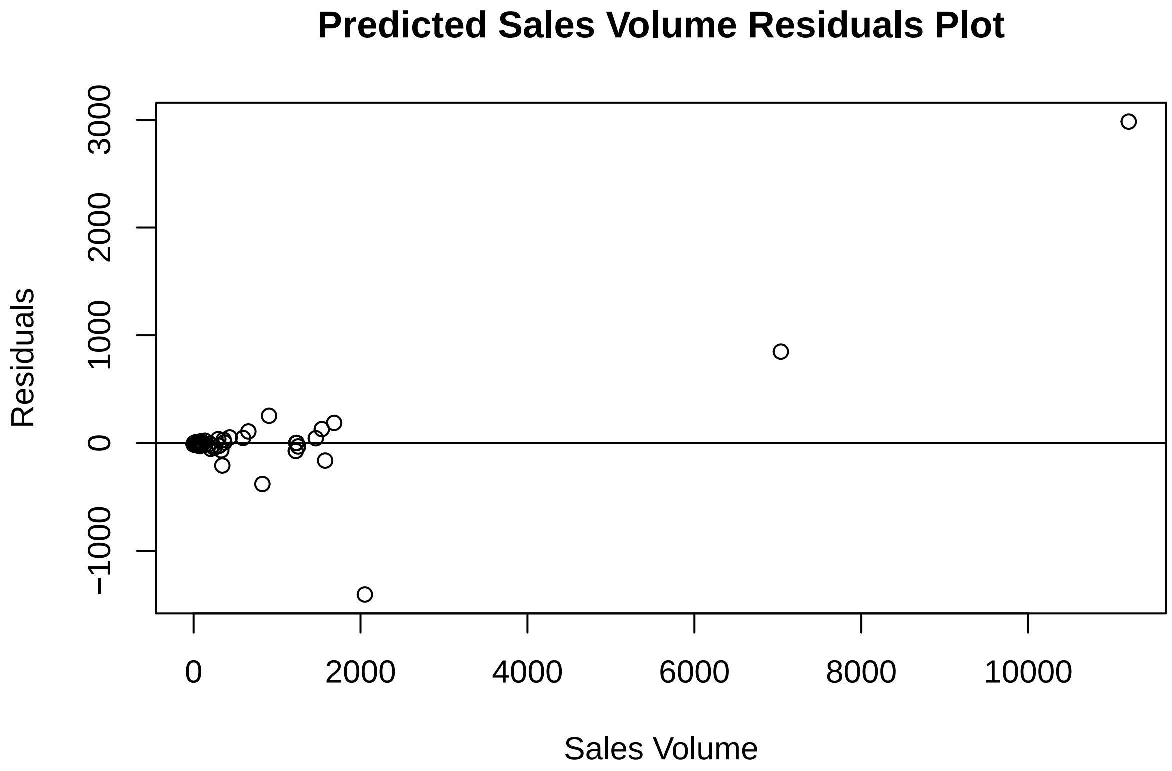
```
ggplot(varImp(rf4, scale=FALSE)) +
  geom_bar(stat = 'identity', fill = 'steelblue') +
  ggtitle('Variable Importance of Random Forest 4 on Sales Volume')
```



Plotting the residuals against the actual values for Volume

Graph shows outlier

```
resid_rf4 <- residuals(rf4)
plot(train1$Volume, resid_rf4, xlab = 'Sales Volume', ylab = 'Residuals',
     main='Predicted Sales Volume Residuals Plot',
     abline(0,0))
```



Predicting rf4 on test1

```
rf4Preds <- predict(rf4, newdata = test1_rem_out)
summary(rf4Preds)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max. 
##    7.937   15.732   98.618  426.150  782.476 1304.662
```

postResample to test if it will do well on new data or if overfitting

```
postResample(rf4Preds, test1_rem_out$Volume)
```

```
##       RMSE   Rsquared        MAE 
## 177.453911   0.952956  87.506546
```

CV RMSE=783, R2=.909

RMSE=177, R2=.952

Support Vector Machines – RBF Kernel

Set seed

```r
set.seed(123)

# Creating dataframe for manual tuning
rbfGrid <- expand.grid(sigma = c(.01, .015, .2),
                       C = c(10, 100, 1000))

rbf1 <- train(Volume ~ x4StarReviews + x3StarReviews + PositiveServiceReview,
              data = train1,
              method = 'svmRadial',
              trControl = control1,
              tuneGrid = rbfGrid,
              preProc = c('center','scale'))

rbf1
```

```
## Support Vector Machines with Radial Basis Function Kernel
##
## 61 samples
##  3 predictor
##
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   sigma  C     RMSE       Rsquared   MAE
##   0.010    10   944.2228  0.8594778  489.1231
##   0.010   100   930.7863  0.8149199  473.1634
##   0.010  1000  1190.2695  0.8309208  580.6230
##   0.015    10   986.8673  0.8419784  507.9508
##   0.015   100   940.5278  0.8123009  480.0726
##   0.015  1000  1236.2804  0.8613697  590.2852
##   0.200    10   913.7802  0.9182651  467.5324
##   0.200   100   879.2184  0.9194906  436.6931
##   0.200  1000   949.7834  0.9093674  462.1128
##
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were sigma = 0.2 and C = 100.
```

Predicting rbf on test1

```r
rbf1Preds <- predict(rbf1, newdata = test1_rem_out)
summary(rbf1Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   29.81   94.91  267.83  463.59  552.12 2146.20
```

postResample to test if it will do well on new data or if overfitting

```r
postResample(rbf1Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 264.0730623   0.8148197 177.1172248
```

CV RMSE=879, R2=.919

PostResample RMSE=264, R2=.815

Support Vector Machines – RBF Kernel feature selection

Set seed

```r
set.seed(123)

# Creating dataframe for manual tuning
rbfGrid <- expand.grid(sigma = c(.01, .015, .2),
                       C = c(10, 100, 1000))

rbf2 <- train(Volume ~ x4StarReviews + PositiveServiceReview + x2StarReviews,
              data = train1,
              method = 'svmRadial',
              trControl = control1,
              tuneGrid = rbfGrid,
              preProc = c('center','scale'))

rbf2
```

```
## Support Vector Machines with Radial Basis Function Kernel
##
## 61 samples
##  3 predictor
##
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   sigma  C     RMSE      Rsquared   MAE
##   0.010    10  935.7611  0.8655808  465.7621
##   0.010   100  774.4498  0.8457538  408.1163
##   0.010  1000  729.0330  0.8563199  400.4417
##   0.015    10  879.8614  0.8620022  452.0967
##   0.015   100  761.7506  0.8470788  417.3052
##   0.015  1000  791.0228  0.8280795  418.6904
##   0.200    10  838.7191  0.9322844  436.6363
##   0.200   100  783.3714  0.9512888  398.3164
##   0.200  1000  657.2931  0.9099973  356.3912
##
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were sigma = 0.2 and C = 1000.
```

Predicting rbf on test1

```
rbf2Preds <- predict(rbf2, newdata = test1_rem_out)
summary(rbf2Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -253.3    71.6   256.6   512.9   343.3  2499.2
```

```
# postResample to test if it will do well on new data or if overfitting
postResample(rbf2Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 420.0433306   0.7040338 243.6208248
```

CV RMSE=657, R2=.909

PostResample RMSE=420, R2=.704

Negatives

Support Vector Machines – Linear

Set seed

```
set.seed(123)

### Creating dataframe for manual tuning
linearGrid <- expand.grid(C = c(1, 10, 100, 1000))

linear1 <- train(Volume ~ x4StarReviews + x3StarReviews + PositiveServiceReview,
                 data = train1,
                 method = 'svmLinear',
                 trControl = control1,
                 tuneGrid = linearGrid,
                 preProc = c('center','scale'))

linear1
```

```
## Support Vector Machines with Linear Kernel
##
## 61 samples
##  3 predictor
##
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   C     RMSE      Rsquared   MAE
##      1  873.4355  0.8664637  456.9757
##     10  843.0240  0.8585048  447.9310
##    100  848.6679  0.8571624  453.5503
##   1000  847.9066  0.8571915  452.4325
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was C = 10.
```

Predicting rbf on test1

```r
linearPreds <- predict(linear1, newdata = test1_rem_out)
summary(linearPreds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -196.9  -129.0   124.7   388.2   561.6  2364.1
```

postResample to test if it will do well on new data or if overfitting

```r
lin_PR <- postResample(linearPreds, test1_rem_out$Volume)
```

CV RMSE=843, R2=.858

PR RMSE=462, R2=.583

Negative predictions, move on

SVM – Linear

Changing features

Set seed

```r
set.seed(123)

# Creating dataframe for manual tuning
```

```r
linearGrid <- expand.grid(C = c(1, 10, 100, 1000))

linear2 <- train(Volume ~ x4StarReviews + x3StarReviews + PositiveServiceReview +
                   NegativeServiceReview + Price,
                 data = train1,
                 method = 'svmLinear',
                 trControl = control1,
                 tuneGrid = linearGrid,
                 preProc = c('center','scale'))

linear2
```

```
## Support Vector Machines with Linear Kernel
##
## 61 samples
##  5 predictor
##
## Pre-processing: centered (5), scaled (5)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   C     RMSE      Rsquared   MAE
##      1  553.1088  0.8300446  328.9984
##     10  538.0562  0.8151764  327.8059
##    100  538.1027  0.8148848  327.7453
##   1000  538.5593  0.8146058  327.9203
##
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was C = 10.
```

```r
# Predicting rbf on test1
linear2Preds <- predict(linear2, newdata = test1_rem_out)
summary(linear2Preds)
```

```
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
## -155.3142 -102.7355    0.5217  435.3928  496.4102 2631.1579
```

postResample to test if it will do well on new data or if overfitting

```r
postResample(linear2Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 501.1605728   0.5858754 334.9077977
```

RMSE=1120, R2=56.9

Negative predictions, move on

Support Vector Machines – Polynomial

Set seed

```
set.seed(123)

# Creating dataframe for manual tuning
polyGrid <- expand.grid(degree = c(2,3,4),
                        scale = c(1,2),
                        C = c(.1, 1, 10, 100))

poly1 <- train(Volume ~ x4StarReviews + x3StarReviews + PositiveServiceReview,
               data = train1,
               method = 'svmPoly',
               trControl = control1,
               tuneGrid = polyGrid,
               preProc = c('center','scale'))

poly1
```

```
## Support Vector Machines with Polynomial Kernel
##
## 61 samples
##  3 predictor
##
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   degree  scale  C      RMSE       Rsquared   MAE
##   2       1        0.1   1155.408  0.7966076    571.6401
##   2       1        1.0   4104.003  0.8301827   1770.0867
##   2       1       10.0   6987.814  0.8557033   2939.2082
##   2       1      100.0   9796.456  0.8389599   4083.3127
##   2       2        0.1   2104.421  0.8267500    966.7124
##   2       2        1.0   6491.915  0.8763071   2740.5152
##   2       2       10.0   9245.414  0.8522459   3859.6825
##   2       2      100.0  10042.438  0.8331194   4185.3819
##   3       1        0.1   1118.828  0.8898300    534.3918
##   3       1        1.0   3755.882  0.9381422   1597.5451
##   3       1       10.0   7095.492  0.9176351   2965.7635
##   3       1      100.0  39627.409  0.9024923  16252.9238
##   3       2        0.1   2667.568  0.8509251   1166.7636
##   3       2        1.0   4472.345  0.8879559   1896.1439
##   3       2       10.0  31802.988  0.9179907  13053.9787
##   3       2      100.0  86413.899  0.8848359  35365.6943
##   4       1        0.1   6877.359  0.8003001   2881.4997
##   4       1        1.0   54000.769  0.8216935  22115.1070
##   4       1       10.0  197327.453  0.9111491  80637.6759
##   4       1      100.0   25145.120  0.9146607  10346.8229
##   4       2        0.1   31923.943  0.8869538  13115.3285
##   4       2        1.0  167176.011  0.8980690  68329.9630
##   4       2       10.0   68279.157  0.9005098  27957.4632
##   4       2      100.0  157877.892  0.9005079  64537.4960
##
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were degree = 3, scale = 1 and C = 0.1.
```

Predicting rbf on test1

```r
polyPreds <- predict(poly1, newdata = test1_rem_out)
summary(polyPreds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##  -31.78  -20.75  218.56  370.45  536.88 1240.00
```

postResample to test if it will do well on new data or if overfitting

```r
postResample(polyPreds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE 
## 334.4330248   0.7687032 174.1454650
```

RMSE=688, R2=60.2

Negative predictions, move on

SVM – Polynomial

Set seed

```r
set.seed(123)

# Creating dataframe for manual tuning
polyGrid <- expand.grid(degree = c(2,3,4),
                        scale = c(1,2),
                        C = c(.1, 1, 10, 100))

poly2 <- train(Volume ~ x4StarReviews + x2StarReviews + PositiveServiceReview +
                 NegativeServiceReview,
               data = train1,
               method = 'svmPoly',
               trControl = control1,
               tuneGrid = polyGrid,
               preProc = c('center','scale'))

poly2
```

```
## Support Vector Machines with Polynomial Kernel
##
## 61 samples
##  4 predictor
##
## Pre-processing: centered (4), scaled (4)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   degree  scale  C      RMSE         Rsquared   MAE
##   2       1        0.1     876.0226  0.8081674     469.4007
##   2       1        1.0    1532.8601  0.8154286     722.1496
##   2       1       10.0   14512.8090  0.8528996    6032.6490
##   2       1      100.0   11848.1045  0.9129566    4942.3458
##   2       2        0.1    1115.2333  0.8751110     559.6023
##   2       2        1.0    5251.8265  0.8636670    2247.9786
##   2       2       10.0   11368.9766  0.8529120    4751.2822
##   2       2      100.0   11354.9053  0.9063491    4732.0598
##   3       1        0.1   18313.5053  0.8935899    7558.3279
##   3       1        1.0   24882.0057  0.8523866   10250.6328
##   3       1       10.0   61551.6914  0.9182948   25214.9606
##   3       1      100.0   36782.7066  0.8210000   15136.3743
##   3       2        0.1   37470.6589  0.8460612   15381.2988
##   3       2        1.0   34037.7172  0.8417435   13992.1891
##   3       2       10.0   62873.4712  0.8259141   25775.7687
##   3       2      100.0  100280.0776  0.8102818   41118.1724
##   4       1        0.1   96870.0477  0.8372587   39632.3275
##   4       1        1.0    9912.6724  0.8582925    4146.7389
##   4       1       10.0  174996.0882  0.8816298   71529.9157
##   4       1      100.0  334667.4580  0.7981803  136752.8839
##   4       2        0.1  233541.8543  0.8434558   95446.7978
##   4       2        1.0  404176.1594  0.8485852  165110.5747
##   4       2       10.0  704939.6023  0.8342341  287898.1043
##   4       2      100.0  790317.3179  0.8342340  322758.2980
##
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were degree = 2, scale = 1 and C = 0.1.
```

Predicting rbf on test1

```
poly2Preds <- predict(poly2, newdata = test1_rem_out)
summary(poly2Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   132.6   154.0   256.1   469.9   472.7  1710.2
```

postResample to test if it will do well on new data or if overfitting

```
postResample(poly2Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 402.3116913   0.5699793 256.8209379
```

RMSE=402, R2=0.57

Gradient Boosting

Set seed

```
set.seed(123)

gbm1 <- train(Volume ~ x4StarReviews + x2StarReviews + PositiveServiceReview,
              data = train1,
              method = 'gbm',
              trControl = control1,
              preProc = c('center','scale'))
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2262979.9194             nan     0.1000 50753.5120
##      2  2187640.5146             nan     0.1000 51177.8262
##      3  2140085.0369             nan     0.1000 55884.8979
##      4  2119804.1063             nan     0.1000 16353.3706
##      5  2100350.9717             nan     0.1000 18006.2880
##      6  2088652.3812             nan     0.1000 5634.3370
##      7  2071267.6596             nan     0.1000 19435.9292
##      8  2000591.0212             nan     0.1000 18321.7278
##      9  1951048.5330             nan     0.1000 13052.9121
##     10  1942952.6063             nan     0.1000 7507.2463
##     20  1852021.0090             nan     0.1000 -14547.1313
##     40  1776852.2671             nan     0.1000 -11040.5487
##     60  1752258.6295             nan     0.1000 -13082.6736
##     80  1674082.0120             nan     0.1000 -11664.6392
##    100  1638017.0030             nan     0.1000 -28525.0084
##    120  1609883.0047             nan     0.1000 -14319.8681
##    140  1629745.4477             nan     0.1000 -26778.4312
##    150  1613703.0714             nan     0.1000 -20008.9222
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2261149.4817             nan     0.1000 90433.1178
##      2  2177478.6574             nan     0.1000 49051.6495
##      3  2103729.9013             nan     0.1000 29071.1127
##      4  2083433.2241             nan     0.1000 16149.0064
##      5  2054782.7983             nan     0.1000 35585.4858
##      6  2015850.8286             nan     0.1000 51383.4386
##      7  1943725.5287             nan     0.1000 30669.8238
##      8  1936072.1908             nan     0.1000 4334.8826
##      9  1928693.0550             nan     0.1000 7035.9848
##     10  1886640.9086             nan     0.1000 -204.5888
##     20  1773051.6864             nan     0.1000 -5397.9315
##     40  1731097.0050             nan     0.1000 -6959.5081
##     60  1690813.3705             nan     0.1000 -21227.1997
##     80  1662740.3941             nan     0.1000 -35703.0838
##    100  1640362.2217             nan     0.1000 -13902.5905
##    120  1624560.9651             nan     0.1000 -31293.9611
##    140  1618365.8572             nan     0.1000 -11484.9595
##    150  1613451.6687             nan     0.1000 -8668.0878
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2314036.1340             nan     0.1000 75208.4269
##      2  2176140.7271             nan     0.1000 76403.7968
##      3  2130683.3430             nan     0.1000 58832.7298
##      4  2100358.4790             nan     0.1000 39280.9194
##      5  2073057.4689             nan     0.1000 38398.9470
##      6  2042955.4650             nan     0.1000 39969.2553
##      7  1975389.2904             nan     0.1000 28053.6954
##      8  1967579.3643             nan     0.1000 3215.1862
##      9  1923954.7232             nan     0.1000 19434.4113
##     10  1882373.9751             nan     0.1000 -8745.3661
##     20  1758257.2968             nan     0.1000 -2741.4803
##     40  1690773.0131             nan     0.1000 -12792.2923
##     60  1667967.1752             nan     0.1000 -6418.7500
##     80  1637313.0243             nan     0.1000 -12373.2401
##    100  1625466.8528             nan     0.1000 -15343.8628
##    120  1613313.0810             nan     0.1000 -19108.8284
##    140  1610218.6232             nan     0.1000 -23698.4308
##    150  1601612.1009             nan     0.1000 -8422.7245
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3093452.1976             nan     0.1000 139712.5650
##      2  2974878.8268             nan     0.1000 132796.8088
##      3  2880495.5763             nan     0.1000 91409.9118
##      4  2827442.8966             nan     0.1000 52961.4731
##      5  2747788.8580             nan     0.1000 91197.0110
##      6  2629086.5756             nan     0.1000 36067.8748
##      7  2568359.2561             nan     0.1000 56317.0665
##      8  2502552.1346             nan     0.1000 -23912.7942
##      9  2474903.3502             nan     0.1000 32616.0012
##     10  2426039.8502             nan     0.1000 -17078.0996
##     20  2306283.7639             nan     0.1000 -27781.9705
##     40  2239679.7335             nan     0.1000 4137.2398
##     60  2156812.2871             nan     0.1000 -31312.5282
##     80  2125065.0100             nan     0.1000 -1290.8621
##    100  2117989.5407             nan     0.1000 -44371.2537
##    120  2064989.8638             nan     0.1000 -13330.0101
##    140  2042437.4284             nan     0.1000 -72028.9161
##    150  2035886.7821             nan     0.1000 -10540.4241
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3017626.4188             nan     0.1000 72008.9933
##      2  2915242.5558             nan     0.1000 86662.5496
##      3  2881575.4922             nan     0.1000 29722.9334
##      4  2815717.8731             nan     0.1000 64966.6540
##      5  2728420.1895             nan     0.1000 -19428.4138
##      6  2614600.8128             nan     0.1000 45000.1867
##      7  2581466.7489             nan     0.1000 35064.9043
##      8  2527970.4085             nan     0.1000 44097.8229
##      9  2433162.0212             nan     0.1000 12681.4009
##     10  2436747.7394             nan     0.1000 -34155.9413
##     20  2304617.3029             nan     0.1000 14213.1106
##     40  2199806.4588             nan     0.1000 -13957.1126
##     60  2115320.6778             nan     0.1000 -19184.8060
##     80  2099014.7655             nan     0.1000 -5381.4844
##    100  2060015.8938             nan     0.1000  119.6064
##    120  2043215.3195             nan     0.1000 -1952.0719
##    140  2035822.8015             nan     0.1000 -2503.8764
##    150  2033033.8851             nan     0.1000 -35585.7718
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3064423.3658             nan     0.1000 148577.9037
##      2  2914770.1203             nan     0.1000 125762.8929
##      3  2818467.9575             nan     0.1000 80130.6102
##      4  2786313.2361             nan     0.1000 34153.7649
##      5  2701505.0399             nan     0.1000 1946.9990
##      6  2648087.3810             nan     0.1000 39998.3103
##      7  2616743.4409             nan     0.1000 33397.3514
##      8  2531220.7567             nan     0.1000 6142.8986
##      9  2469259.1791             nan     0.1000 -1176.7252
##     10  2454357.9628             nan     0.1000 -5680.7991
##     20  2282288.5888             nan     0.1000 2651.2276
##     40  2176666.0968             nan     0.1000 2522.2121
##     60  2132554.3994             nan     0.1000 -43285.2722
##     80  2114446.9660             nan     0.1000 -57332.6326
##    100  2102904.8048             nan     0.1000 -53625.7533
##    120  2092645.2164             nan     0.1000  109.5375
##    140  2088660.5144             nan     0.1000 -1994.3235
##    150  2074172.4260             nan     0.1000 -41883.2250
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2964046.0261             nan     0.1000 128495.8415
##      2  2828651.4640             nan     0.1000 141980.0581
##      3  2781031.8205             nan     0.1000 55276.7950
##      4  2742448.1778             nan     0.1000 40785.1929
##      5  2652159.5456             nan     0.1000 98352.8790
##      6  2509079.5643             nan     0.1000 25357.5265
##      7  2498537.8948             nan     0.1000 2086.6868
##      8  2454046.0625             nan     0.1000 55834.4184
##      9  2408380.0222             nan     0.1000 53430.8926
##     10  2355867.8847             nan     0.1000 42708.2777
##     20  2127852.4531             nan     0.1000 -31933.0232
##     40  1993137.0765             nan     0.1000 -35537.1085
##     60  1940590.6137             nan     0.1000 -22565.7985
##     80  1915533.1868             nan     0.1000 -15997.6686
##    100  1919460.7846             nan     0.1000 -29881.4896
##    120  1872765.5457             nan     0.1000 -179.0483
##    140  1840519.1192             nan     0.1000 -265.2589
##    150  1836065.9991             nan     0.1000 -2005.5944
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2960923.1984             nan     0.1000 103996.4347
##      2  2806751.3379             nan     0.1000 127874.9308
##      3  2722674.8166             nan     0.1000 91664.5027
##      4  2697573.8515             nan     0.1000 19467.7698
##      5  2588218.0563             nan     0.1000 84814.2325
##      6  2565106.1302             nan     0.1000 25387.2533
##      7  2551051.4971             nan     0.1000 8222.9826
##      8  2501341.3316             nan     0.1000 62180.3279
##      9  2464930.9088             nan     0.1000 44168.1112
##     10  2398934.1586             nan     0.1000 47926.7904
##     20  2170581.3449             nan     0.1000 9311.6193
##     40  2016947.8662             nan     0.1000 -30221.6708
##     60  1977830.9542             nan     0.1000 -2021.8299
##     80  1933714.0051             nan     0.1000 -43807.8712
##    100  1929162.3685             nan     0.1000 2977.5284
##    120  1894140.8353             nan     0.1000 -39427.7828
##    140  1831778.3475             nan     0.1000 -42132.6252
##    150  1818224.7436             nan     0.1000 -33458.5980
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2876259.6733             nan     0.1000 109117.4571
##      2  2777101.6181             nan     0.1000 104796.6916
##      3  2671290.1454             nan     0.1000 80012.5131
##      4  2622700.6754             nan     0.1000 64620.6262
##      5  2556401.5828             nan     0.1000 40893.1502
##      6  2538644.8804             nan     0.1000 11084.3636
##      7  2439612.1109             nan     0.1000 8874.7503
##      8  2405329.3311             nan     0.1000 41699.0528
##      9  2366154.7296             nan     0.1000 35217.7479
##     10  2365140.2912             nan     0.1000 -12932.7728
##     20  2186843.0150             nan     0.1000 6063.3175
##     40  2073352.0534             nan     0.1000 -13730.0570
##     60  1951937.5550             nan     0.1000 -26163.7056
##     80  1899221.0845             nan     0.1000 -19310.0739
##    100  1875792.9283             nan     0.1000 -1048.5587
##    120  1874103.3576             nan     0.1000 -48168.9582
##    140  1861519.2260             nan     0.1000 -5159.9767
##    150  1848759.5356             nan     0.1000 -9711.1705
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2963379.9423             nan     0.1000 141120.1790
##      2  2760918.8959             nan     0.1000 83605.5304
##      3  2687744.9644             nan     0.1000 86258.4624
##      4  2560992.2218             nan     0.1000 7855.3328
##      5  2490425.2302             nan     0.1000 78658.7690
##      6  2470806.9762             nan     0.1000 17014.8362
##      7  2436519.2723             nan     0.1000 40187.4054
##      8  2386496.4656             nan     0.1000 30507.9897
##      9  2335416.3162             nan     0.1000 -52072.9567
##     10  2291919.9987             nan     0.1000 -11321.2304
##     20  2144835.9068             nan     0.1000 -26409.3777
##     40  2037800.1382             nan     0.1000 -8722.5378
##     60  1966333.8169             nan     0.1000  641.6366
##     80  1961748.0299             nan     0.1000 -8799.3376
##    100  1945402.4169             nan     0.1000 2002.2537
##    120  1950222.4886             nan     0.1000 -42690.7447
##    140  1896170.7304             nan     0.1000 -36899.8643
##    150  1885198.9517             nan     0.1000 1320.2230
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3030933.0877             nan     0.1000 68570.0080
##      2  2875292.0306             nan     0.1000 140830.2562
##      3  2800110.9008             nan     0.1000 80324.9104
##      4  2707871.4047             nan     0.1000 87131.1746
##      5  2671263.9096             nan     0.1000 44708.4612
##      6  2597957.9288             nan     0.1000 84327.4065
##      7  2536071.3039             nan     0.1000 56196.7439
##      8  2505694.6860             nan     0.1000 38746.9429
##      9  2466450.0356             nan     0.1000 38742.4664
##     10  2422447.9169             nan     0.1000 32334.3412
##     20  2174762.6753             nan     0.1000 5063.7143
##     40  2061629.6886             nan     0.1000 -944.5556
##     60  2030621.1161             nan     0.1000 -37539.2272
##     80  1972957.5489             nan     0.1000  978.7011
##    100  1946980.4708             nan     0.1000 -20765.9907
##    120  1943531.0780             nan     0.1000 -31807.3283
##    140  1898958.7899             nan     0.1000 -65084.5811
##    150  1893002.0459             nan     0.1000 4027.3433
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2949162.4384             nan     0.1000 129252.7966
##      2  2864592.4857             nan     0.1000 111588.3005
##      3  2789564.5597             nan     0.1000 90780.7552
##      4  2763187.3270             nan     0.1000 25872.5521
##      5  2730612.5029             nan     0.1000 40973.6162
##      6  2616499.0796             nan     0.1000 86770.7470
##      7  2486495.9093             nan     0.1000 16148.7231
##      8  2480732.8121             nan     0.1000 -3968.8755
##      9  2424848.4335             nan     0.1000 40329.1124
##     10  2351700.8324             nan     0.1000 -20094.4653
##     20  2183613.2281             nan     0.1000 -32611.3544
##     40  2088827.9657             nan     0.1000 -25213.5626
##     60  2058422.1464             nan     0.1000 8477.9510
##     80  2029953.7020             nan     0.1000 -29844.5876
##    100  1969542.5735             nan     0.1000 -4243.2481
##    120  1948775.9907             nan     0.1000 -1536.6292
##    140  1935485.3945             nan     0.1000 -26858.3941
##    150  1919517.4529             nan     0.1000 -7052.3764
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2892998.4125             nan     0.1000 81864.7977
##      2  2815803.3886             nan     0.1000 93813.3290
##      3  2734395.3060             nan     0.1000 86728.0827
##      4  2625758.9667             nan     0.1000 15871.0494
##      5  2554504.5041             nan     0.1000 -2391.2500
##      6  2466633.2086             nan     0.1000 31052.3478
##      7  2431342.5639             nan     0.1000 41447.5516
##      8  2413488.6563             nan     0.1000 20312.4830
##      9  2391294.6386             nan     0.1000 11985.1313
##     10  2345905.3577             nan     0.1000  810.2119
##     20  2235962.4208             nan     0.1000 -29357.4719
##     40  2179127.1643             nan     0.1000 -3274.7280
##     60  2090034.6824             nan     0.1000 10593.0056
##     80  2041007.4035             nan     0.1000 -9759.6622
##    100  2020114.0612             nan     0.1000 -4178.8091
##    120  1995235.1777             nan     0.1000 -38965.0057
##    140  1978349.6331             nan     0.1000 -12798.7344
##    150  1987815.7731             nan     0.1000 -25546.7150
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2941540.8773             nan     0.1000 114825.0713
##      2  2844671.2762             nan     0.1000 107431.5772
##      3  2765829.9220             nan     0.1000 88861.6210
##      4  2703337.2912             nan     0.1000 69251.6452
##      5  2684489.8364             nan     0.1000 13179.5413
##      6  2665029.9457             nan     0.1000 21579.5381
##      7  2632013.8494             nan     0.1000 48041.9193
##      8  2562183.0483             nan     0.1000 49446.5545
##      9  2521513.3756             nan     0.1000 34850.8537
##     10  2497368.1526             nan     0.1000 31691.1484
##     20  2297109.3580             nan     0.1000 12429.0545
##     40  2135988.1294             nan     0.1000 5311.4495
##     60  2099365.2326             nan     0.1000 -4066.6073
##     80  2042432.8761             nan     0.1000 -1656.5895
##    100  2052048.0403             nan     0.1000 -5301.4741
##    120  1990455.5920             nan     0.1000 -876.4276
##    140  1957699.2222             nan     0.1000 -2538.3523
##    150  1956275.1120             nan     0.1000 -923.8947
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2999722.8742             nan     0.1000 72116.9727
##      2  2890936.3532             nan     0.1000 115258.8624
##      3  2782039.9402             nan     0.1000 119690.7824
##      4  2629887.4700             nan     0.1000 51726.2668
##      5  2554695.4399             nan     0.1000 62398.8788
##      6  2515135.6975             nan     0.1000 48385.4495
##      7  2473614.7912             nan     0.1000 45127.5600
##      8  2445047.0581             nan     0.1000 31792.7833
##      9  2418246.7176             nan     0.1000 29467.3930
##     10  2420103.9499             nan     0.1000 -18748.8949
##     20  2275122.0078             nan     0.1000  831.0861
##     40  2164259.9287             nan     0.1000 -53404.1885
##     60  2109431.4163             nan     0.1000 -46211.3122
##     80  2082801.4512             nan     0.1000  223.3291
##    100  2040734.1457             nan     0.1000 -8797.6789
##    120  1999650.9739             nan     0.1000 -8694.8075
##    140  1991301.0609             nan     0.1000 -36573.0710
##    150  1977171.6351             nan     0.1000  -88.6500
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2893009.8477             nan     0.1000 128629.7775
##      2  2770810.5606             nan     0.1000 130701.6158
##      3  2606852.3370             nan     0.1000 60785.6761
##      4  2583376.0419             nan     0.1000 22427.1497
##      5  2516737.5060             nan     0.1000 64297.5170
##      6  2489114.4295             nan     0.1000 37005.7128
##      7  2448512.7200             nan     0.1000 45202.6147
##      8  2343332.5601             nan     0.1000 8330.1315
##      9  2341528.6196             nan     0.1000 -12515.2574
##     10  2298228.6475             nan     0.1000 53184.9007
##     20  2069800.8097             nan     0.1000   -6.5835
##     40  1999976.1632             nan     0.1000 -15882.4510
##     60  1965918.9734             nan     0.1000 3774.1931
##     80  1872066.8920             nan     0.1000 -28458.8167
##    100  1860647.0335             nan     0.1000 -3235.3553
##    120  1856317.1905             nan     0.1000 -41077.0408
##    140  1842813.2663             nan     0.1000 -18819.3022
##    150  1828137.0478             nan     0.1000 -12085.2300
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2813812.8572             nan     0.1000 93270.1817
##      2  2762328.5667             nan     0.1000 55597.2092
##      3  2714736.8272             nan     0.1000 53688.9122
##      4  2600268.5466             nan     0.1000 95434.7173
##      5  2485703.1372             nan     0.1000 20220.8908
##      6  2412323.3893             nan     0.1000 15795.3197
##      7  2399542.5405             nan     0.1000 7182.3577
##      8  2330826.1732             nan     0.1000  502.3398
##      9  2269563.0306             nan     0.1000 -2153.4356
##     10  2192336.3331             nan     0.1000 17383.9194
##     20  2075783.3665             nan     0.1000 20047.6946
##     40  1942293.8583             nan     0.1000 -6199.8140
##     60  1871777.6953             nan     0.1000 -71787.6049
##     80  1827937.9663             nan     0.1000 -2268.3595
##    100  1817062.9094             nan     0.1000  443.7220
##    120  1796090.0584             nan     0.1000 -39187.6281
##    140  1795351.9576             nan     0.1000 -15817.1609
##    150  1789946.6953             nan     0.1000 -5148.2871
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2838428.3585             nan     0.1000 84567.7069
##      2  2646033.6284             nan     0.1000 63164.8311
##      3  2585009.4319             nan     0.1000 61187.4993
##      4  2491723.7670             nan     0.1000 82971.7000
##      5  2430122.5765             nan     0.1000 52645.9711
##      6  2409165.6398             nan     0.1000 20535.6869
##      7  2323150.4957             nan     0.1000 4263.7366
##      8  2317782.4684             nan     0.1000 -6243.6781
##      9  2317073.6287             nan     0.1000 -15538.7996
##     10  2276832.8440             nan     0.1000 34334.6587
##     20  2031592.6804             nan     0.1000 8718.6121
##     40  1963292.6677             nan     0.1000 -41609.1117
##     60  1903512.1646             nan     0.1000 -13838.3788
##     80  1814473.3203             nan     0.1000 -5820.3902
##    100  1803319.7328             nan     0.1000 -481.6812
##    120  1797032.2782             nan     0.1000 1270.2110
##    140  1782316.2975             nan     0.1000 -11013.8280
##    150  1781384.8565             nan     0.1000 -3488.7943
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  1029682.7753             nan     0.1000 49600.8153
##      2   940611.9002             nan     0.1000 56812.0701
##      3   904411.9231             nan     0.1000 45167.5774
##      4   841532.7492             nan     0.1000 48091.0908
##      5   822176.0781             nan     0.1000 23195.1345
##      6   795873.0196             nan     0.1000 31961.4334
##      7   779085.7523             nan     0.1000 19005.3120
##      8   745893.3159             nan     0.1000 22110.3731
##      9   721335.5883             nan     0.1000 6666.2477
##     10   703912.7736             nan     0.1000 11352.4893
##     20   609298.7782             nan     0.1000 2405.2606
##     40   577485.8104             nan     0.1000 -2285.9493
##     60   560064.5844             nan     0.1000 -7194.7952
##     80   555011.7748             nan     0.1000 -658.3092
##    100   550992.6644             nan     0.1000 -5152.5835
##    120   543425.9828             nan     0.1000 -4419.9719
##    140   530157.6079             nan     0.1000 -2253.0268
##    150   527607.6948             nan     0.1000 -2638.4524
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  1028341.0165             nan     0.1000 69489.0779
##      2   935340.4867             nan     0.1000 59719.0708
##      3   886568.1203             nan     0.1000 35267.4232
##      4   824815.7036             nan     0.1000 43019.4285
##      5   783084.3813             nan     0.1000 28230.8542
##      6   754502.2317             nan     0.1000 33980.8022
##      7   743078.1504             nan     0.1000 13399.2335
##      8   726154.1302             nan     0.1000 20650.4740
##      9   716410.5689             nan     0.1000 10905.5714
##     10   686460.6478             nan     0.1000 11180.5172
##     20   596191.3489             nan     0.1000 -1950.6238
##     40   557836.0433             nan     0.1000 -2500.3810
##     60   548734.7363             nan     0.1000 -2525.9858
##     80   545867.3061             nan     0.1000 -9738.4193
##    100   541119.1099             nan     0.1000 -8105.4613
##    120   539045.9097             nan     0.1000 -3861.4786
##    140   533913.0445             nan     0.1000 -4971.4825
##    150   532206.9183             nan     0.1000 -4146.7950
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  1025336.9168             nan     0.1000 73081.6556
##      2   944991.8552             nan     0.1000 57672.6837
##      3   913193.0485             nan     0.1000 40962.7211
##      4   868331.1746             nan     0.1000 50440.3914
##      5   810784.9100             nan     0.1000 34553.5263
##      6   773282.8798             nan     0.1000 19594.2559
##      7   761583.2209             nan     0.1000 13669.7956
##      8   740307.9201             nan     0.1000 15071.5922
##      9   732215.0281             nan     0.1000 8757.3229
##     10   717311.4706             nan     0.1000 3895.9963
##     20   632755.1816             nan     0.1000 -8528.0391
##     40   610538.2020             nan     0.1000 -3688.9605
##     60   589126.3715             nan     0.1000 -6053.5343
##     80   575052.6890             nan     0.1000 -5568.2188
##    100   571210.6280             nan     0.1000 -1418.2441
##    120   565234.2199             nan     0.1000 -7249.8576
##    140   559560.5471             nan     0.1000 -5377.0800
##    150   559091.4202             nan     0.1000 -2268.0644
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2881468.1474             nan     0.1000 80013.1146
##      2  2812590.3545             nan     0.1000 85635.5688
##      3  2777417.4392             nan     0.1000 28189.8568
##      4  2694044.3785             nan     0.1000 83693.9609
##      5  2543199.3174             nan     0.1000 33268.9190
##      6  2504210.5524             nan     0.1000 40561.4521
##      7  2456858.3951             nan     0.1000 35179.9781
##      8  2400234.3151             nan     0.1000 6066.3034
##      9  2398539.3839             nan     0.1000 -16469.2506
##     10  2373833.3949             nan     0.1000 15301.9402
##     20  2167086.7782             nan     0.1000 3071.3594
##     40  2098241.4839             nan     0.1000 -19798.4215
##     60  2021570.6947             nan     0.1000 -50200.5862
##     80  2002345.6647             nan     0.1000 -611.8821
##    100  1977137.0888             nan     0.1000 -30084.6609
##    120  1930012.2126             nan     0.1000 -53060.7212
##    140  1895141.8892             nan     0.1000 -18559.6491
##    150  1880450.4664             nan     0.1000 -7908.3212
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2969840.0641             nan     0.1000 141298.0195
##      2  2794102.0210             nan     0.1000 54324.4936
##      3  2703482.7374             nan     0.1000 66232.5995
##      4  2642628.7952             nan     0.1000 67215.3037
##      5  2615394.8058             nan     0.1000 28256.1849
##      6  2544192.0277             nan     0.1000 48389.3158
##      7  2490145.8694             nan     0.1000 34064.4384
##      8  2483169.3134             nan     0.1000 -5333.2274
##      9  2448562.2156             nan     0.1000 35223.3139
##     10  2402575.4606             nan     0.1000 -12417.7093
##     20  2220916.6705             nan     0.1000 -44811.8831
##     40  2079629.8898             nan     0.1000 -18586.2744
##     60  2016900.7216             nan     0.1000 -34200.8606
##     80  1991037.4192             nan     0.1000 -43923.8915
##    100  1993424.3061             nan     0.1000 -50558.5890
##    120  1947515.7572             nan     0.1000 -68636.5667
##    140  1913565.4518             nan     0.1000 -65237.4467
##    150  1898679.5590             nan     0.1000 -31048.3489
##
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2935432.1157             nan     0.1000 108097.3202
##      2  2819491.1126             nan     0.1000 132235.3635
##      3  2782286.9488             nan     0.1000 36713.5422
##      4  2642380.3348             nan     0.1000 48782.7365
##      5  2565195.3409             nan     0.1000 60807.0496
##      6  2503583.4889             nan     0.1000 50802.2061
##      7  2444713.7938             nan     0.1000 16045.4644
##      8  2448184.0875             nan     0.1000 -29607.5392
##      9  2443189.5658             nan     0.1000 -6714.6151
##     10  2404166.5410             nan     0.1000 49706.1273
##     20  2350990.6839             nan     0.1000 22336.7609
##     40  2100037.6334             nan     0.1000 -22466.9778
##     60  2036802.9119             nan     0.1000 -32557.8208
##     80  2020750.6147             nan     0.1000 -21722.9700
##    100  1999005.6478             nan     0.1000 -3478.9048
##    120  1996711.4084             nan     0.1000 -4297.9883
##    140  1978649.6732             nan     0.1000  294.9916
##    150  1967240.3131             nan     0.1000 -62187.7345
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2909422.8789             nan     0.1000 151329.7142
##      2  2835789.1764             nan     0.1000 91199.4752
##      3  2786884.8359             nan     0.1000 56286.7607
##      4  2659437.2842             nan     0.1000 97634.0406
##      5  2628708.5010             nan     0.1000 33913.7755
##      6  2612174.9303             nan     0.1000 7092.9918
##      7  2556021.4069             nan     0.1000 66377.6452
##      8  2547697.7391             nan     0.1000 1638.4490
##      9  2483541.0904             nan     0.1000 48114.0894
##     10  2423759.5606             nan     0.1000 37344.0464
##     20  2136837.2794             nan     0.1000 10681.3551
##     40  1979722.4541             nan     0.1000 -11584.3038
##     60  1921072.4858             nan     0.1000 -5932.4095
##     80  1915247.0202             nan     0.1000 -44088.1423
##    100  1869022.2086             nan     0.1000 -4919.6585
##    120  1862662.0139             nan     0.1000 -8262.3171
##    140  1833209.0618             nan     0.1000 -5589.8490
##    150  1809570.7400             nan     0.1000   78.3065
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3032807.3919             nan     0.1000 51905.7565
##      2  2913114.2890             nan     0.1000 99135.2908
##      3  2829150.9320             nan     0.1000 96616.1696
##      4  2700477.5539             nan     0.1000 105529.1990
##      5  2643011.6440             nan     0.1000 65281.1316
##      6  2553096.6310             nan     0.1000 73006.4714
##      7  2502301.4488             nan     0.1000 34824.6302
##      8  2492646.9563             nan     0.1000 5419.0778
##      9  2433435.7052             nan     0.1000 47651.2486
##     10  2395615.2199             nan     0.1000 25880.5312
##     20  2225567.8837             nan     0.1000 3570.8681
##     40  2180477.5972             nan     0.1000 -2678.3940
##     60  2083715.2070             nan     0.1000 -27891.2658
##     80  2054651.3390             nan     0.1000 3113.7108
##    100  1996696.5409             nan     0.1000 -31296.9486
##    120  1936382.7313             nan     0.1000  743.3873
##    140  1940526.2217             nan     0.1000 -2262.8388
##    150  1940101.5937             nan     0.1000 -69940.7493
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3014706.3808             nan     0.1000 95378.2473
##      2  2906957.6775             nan     0.1000 124913.3467
##      3  2857859.8820             nan     0.1000 58073.6979
##      4  2762981.3839             nan     0.1000 75253.9012
##      5  2652210.1584             nan     0.1000 14947.6797
##      6  2565430.7142             nan     0.1000 98351.1605
##      7  2466895.0681             nan     0.1000 79242.4496
##      8  2421912.5849             nan     0.1000 29885.3299
##      9  2385158.3658             nan     0.1000 20677.6077
##     10  2303952.5424             nan     0.1000 18347.4709
##     20  2134363.9842             nan     0.1000 6213.1896
##     40  1998980.9333             nan     0.1000 -32131.7984
##     60  1942108.9562             nan     0.1000 -9559.9167
##     80  1886612.6290             nan     0.1000 -1082.3157
##    100  1843693.2757             nan     0.1000 -3295.7247
##    120  1805399.0921             nan     0.1000 -31847.9547
##    140  1783370.3704             nan     0.1000 -530.8753
##    150  1768580.7101             nan     0.1000 -1348.6766
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3038854.5256             nan     0.1000 61370.4236
##      2  2975890.3344             nan     0.1000 78893.0998
##      3  2906849.1319             nan     0.1000 89087.8230
##      4  2742505.3715             nan     0.1000 42656.2945
##      5  2683822.9258             nan     0.1000 71008.1848
##      6  2617524.1257             nan     0.1000 39669.6659
##      7  2485222.2862             nan     0.1000 29207.1978
##      8  2429153.6500             nan     0.1000 63515.8467
##      9  2392951.9360             nan     0.1000 43382.0358
##     10  2357062.3855             nan     0.1000 24748.9242
##     20  2203447.6062             nan     0.1000 11469.5106
##     40  2075462.9299             nan     0.1000 -42664.8013
##     60  2041582.1414             nan     0.1000 -18582.4903
##     80  2049591.9119             nan     0.1000 2731.5266
##    100  1984294.5849             nan     0.1000 -19201.4475
##    120  1957039.4612             nan     0.1000 -18123.3670
##    140  1924417.1953             nan     0.1000  992.1798
##    150  1909840.6833             nan     0.1000 -25836.1898
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3019898.5869             nan     0.1000 92216.5845
##      2  2840767.0957             nan     0.1000 76307.2961
##      3  2779309.9033             nan     0.1000 67750.5622
##      4  2711016.8057             nan     0.1000 65458.5903
##      5  2690149.5946             nan     0.1000 13519.8531
##      6  2552303.6400             nan     0.1000 30412.7545
##      7  2494888.7796             nan     0.1000 68834.8587
##      8  2484102.6750             nan     0.1000 7711.7301
##      9  2486086.2675             nan     0.1000 -19767.9267
##     10  2453852.5234             nan     0.1000 33154.5813
##     20  2138117.4024             nan     0.1000 -17653.1799
##     40  2061015.2283             nan     0.1000 -23205.8164
##     60  1991804.7829             nan     0.1000 3775.2173
##     80  1926265.5827             nan     0.1000 -64509.5815
##    100  1915157.7307             nan     0.1000 -4086.0511
##    120  1884418.0274             nan     0.1000 -3217.2552
##    140  1847531.1697             nan     0.1000 -1438.5898
##    150  1848287.3989             nan     0.1000 -29475.9671
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2950011.3167             nan     0.1000 145190.5254
##      2  2760888.6938             nan     0.1000 80810.3120
##      3  2673676.3000             nan     0.1000 93014.0236
##      4  2619242.5000             nan     0.1000 56945.8305
##      5  2556263.0647             nan     0.1000 42074.3568
##      6  2510321.7729             nan     0.1000 53806.4154
##      7  2432340.4355             nan     0.1000 10722.5986
##      8  2430045.2070             nan     0.1000 -14492.1858
##      9  2372132.1346             nan     0.1000 -7366.5993
##     10  2375775.3475             nan     0.1000 -23724.7425
##     20  2215833.9838             nan     0.1000 -33406.3443
##     40  2162766.0145             nan     0.1000 -34351.7269
##     60  2078526.0673             nan     0.1000 -23503.1332
##     80  1992508.1563             nan     0.1000 -1093.0625
##    100  1977094.2301             nan     0.1000 -3941.6160
##    120  1952210.0964             nan     0.1000 -1256.5428
##    140  1905559.7834             nan     0.1000 -10535.3124
##    150  1891163.0335             nan     0.1000 -5688.2580
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2730530.2713             nan     0.1000 121613.5842
##      2  2580704.5269             nan     0.1000 129697.3224
##      3  2430381.1387             nan     0.1000 45643.2206
##      4  2358294.1189             nan     0.1000 79691.6565
##      5  2340176.6254             nan     0.1000 15605.0852
##      6  2278381.1437             nan     0.1000 70515.4095
##      7  2189240.5697             nan     0.1000 25102.0909
##      8  2185103.7885             nan     0.1000 -5394.1528
##      9  2121754.9693             nan     0.1000 -12246.5444
##     10  2095177.4182             nan     0.1000 31575.7257
##     20  1917330.1848             nan     0.1000 -25630.5757
##     40  1846093.0564             nan     0.1000 -17090.7622
##     50  1849396.0543             nan     0.1000  494.4342
```

```
gbm1
```

```
## Stochastic Gradient Boosting 
## 
## 61 samples
##  3 predictor
## 
```

```
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   interaction.depth  n.trees  RMSE      Rsquared   MAE
##   1                   50      1010.966  0.8249911  571.2535
##   1                  100      1054.100  0.8371555  585.4725
##   1                  150      1024.901  0.8667286  552.3807
##   2                   50      1010.350  0.8575585  557.7797
##   2                  100      1046.985  0.8593534  568.5074
##   2                  150      1053.486  0.8588568  578.0264
##   3                   50      1010.362  0.8472539  564.3698
##   3                  100      1038.869  0.8615773  564.2031
##   3                  150      1055.289  0.8588360  567.2579
##
## Tuning parameter 'shrinkage' was held constant at a value of 0.1
##
## Tuning parameter 'n.minobsinnode' was held constant at a value of 10
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were n.trees = 50, interaction.depth =
##  2, shrinkage = 0.1 and n.minobsinnode = 10.
```

Predicting gbm on test1

```
gbmPreds <- predict(gbm1, newdata = test1_rem_out)
summary(gbmPreds)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##    9.966   35.707   40.684  587.565 1340.268 2091.828
```

postResample to test if it will do well on new data or if overfitting

```
postResample(gbmPreds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 266.4904990   0.9105057 172.6952417
```

awesome step! provides comparison of predictions to actual within same DF!

```
compare_gbm1 <- data.frame(test1_rem_out,gbmPreds)
```

CV RMSE=1010, R2=.858

PostResample RMSE=266, R2=.911

Gradient Boosting Manual Tuning

Set seed

```
set.seed(123)

# Creating dataframe for manual tuning
gbmGrid <- expand.grid(n.trees = c(10,50,100),
                       interaction.depth = c(2,3),
                       shrinkage = c(.1, .15, .2),
                       n.minobsinnode = c(5,10,15))

gbm2 <- train(Volume ~ x4StarReviews + x2StarReviews + PositiveServiceReview,
              data = train1,
              method = 'gbm',
              trControl = control1,
              tuneGrid = gbmGrid,
              preProc = c('center','scale'))
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2180127.9842             nan     0.1000 76902.4013
##      2  2034912.4109             nan     0.1000 56433.8236
##      3  1982344.6911             nan     0.1000 67251.2191
##      4  1942620.6077             nan     0.1000 49945.7343
##      5  1894182.4928             nan     0.1000 64209.4036
##      6  1868292.1778             nan     0.1000 33163.8444
##      7  1847220.4830             nan     0.1000 26700.8313
##      8  1741692.7922             nan     0.1000 16274.2389
##      9  1668386.1650             nan     0.1000 3723.7348
##     10  1664177.6778             nan     0.1000  644.8657
##     20  1450131.5560             nan     0.1000 -25317.1220
##     40  1178538.4698             nan     0.1000 5030.6048
##     60   972341.2749             nan     0.1000 -4889.4390
##     80   905709.8446             nan     0.1000 -3830.8056
##    100   826742.6740             nan     0.1000 -20030.9123
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2261149.4817             nan     0.1000 90433.1178
##      2  2177478.6574             nan     0.1000 49051.6495
##      3  2103729.9013             nan     0.1000 29071.1127
##      4  2083433.2241             nan     0.1000 16149.0064
##      5  2054782.7983             nan     0.1000 35585.4858
##      6  2015850.8286             nan     0.1000 51383.4386
##      7  1943725.5287             nan     0.1000 30669.8238
##      8  1936072.1908             nan     0.1000 4334.8826
##      9  1928693.0550             nan     0.1000 7035.9848
##     10  1886640.9086             nan     0.1000 -204.5888
##     20  1773051.6864             nan     0.1000 -5397.9315
##     40  1731097.0050             nan     0.1000 -6959.5081
##     60  1690813.3705             nan     0.1000 -21227.1997
##     80  1662740.3941             nan     0.1000 -35703.0838
##    100  1640362.2217             nan     0.1000 -13902.5905

## Warning: model fit failed for Fold01.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2282467.8602             nan     0.1000 120227.5384
##      2  2086591.5412             nan     0.1000 117559.2005
##      3  2045076.6315             nan     0.1000 54174.3854
##      4  1927166.0931             nan     0.1000 23675.1457
##      5  1825798.3263             nan     0.1000 30091.2068
##      6  1740744.4407             nan     0.1000 19986.0914
##      7  1666634.2593             nan     0.1000 10022.5984
##      8  1594820.3149             nan     0.1000  787.8302
##      9  1585076.4321             nan     0.1000 7467.1579
##     10  1531606.2544             nan     0.1000 -516.7593
##     20  1354313.4053             nan     0.1000 -27916.0864
##     40  1249552.9256             nan     0.1000 -23367.2109
##     60  1170866.9353             nan     0.1000 -22670.6896
##     80  1054110.5791             nan     0.1000 -26932.5390
##    100   997758.6612             nan     0.1000 -41396.0208
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2235689.3567             nan     0.1000 86367.1801
##      2  2136714.4073             nan     0.1000 60733.5424
##      3  2053310.7134             nan     0.1000 44999.9054
##      4  1966111.6725             nan     0.1000 39878.7685
##      5  1914760.5689             nan     0.1000 20025.4302
##      6  1903120.5341             nan     0.1000 8745.3593
##      7  1856587.1622             nan     0.1000 17176.0449
##      8  1830402.1461             nan     0.1000 2099.5355
##      9  1826575.2734             nan     0.1000 -2948.7164
##     10  1797406.2588             nan     0.1000 -8940.5789
##     20  1737983.9543             nan     0.1000  460.7451
##     40  1688243.9004             nan     0.1000 -21905.4218
##     60  1646020.6396             nan     0.1000 -12329.0470
##     80  1631187.5325             nan     0.1000 -18839.0761
##    100  1628347.7467             nan     0.1000 -29018.9320

## Warning: model fit failed for Fold01.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2258806.7265             nan     0.1500 138357.1829
##      2  2054498.8980             nan     0.1500 54926.3522
##      3  1978534.1986             nan     0.1500 96897.6654
##      4  1796383.8864             nan     0.1500 26214.0404
##      5  1768937.0296             nan     0.1500 35917.5581
##      6  1732048.3604             nan     0.1500 50964.9661
##      7  1709632.4364             nan     0.1500 32617.0273
##      8  1687171.7191             nan     0.1500 34046.0393
##      9  1582609.7744             nan     0.1500 17216.0017
##     10  1491724.6209             nan     0.1500 -16523.3813
##     20  1310171.1586             nan     0.1500 -26408.6800
##     40  1111832.5901             nan     0.1500 -82605.2671
##     60   963841.8336             nan     0.1500 -41546.3294
##     80   766152.0515             nan     0.1500 -33865.8510
##    100   724746.9078             nan     0.1500 -43642.9373
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2258045.4892             nan     0.1500 139371.6678
##      2  2068979.2863             nan     0.1500 90383.8812
##      3  1969456.0325             nan     0.1500 54343.4767
##      4  1937565.5848             nan     0.1500 42218.8189
##      5  1922609.3014             nan     0.1500 16536.2678
##      6  1850228.9934             nan     0.1500 -13952.7050
##      7  1811737.5060             nan     0.1500 -11069.3555
##      8  1813589.1561             nan     0.1500 -19186.4835
##      9  1820646.6074             nan     0.1500 -26685.2958
##     10  1771410.0682             nan     0.1500 -13089.1126
##     20  1735292.8040             nan     0.1500 -27178.5466
##     40  1674529.0421             nan     0.1500 -24760.0106
##     60  1647180.2412             nan     0.1500 -39889.3217
##     80  1610368.5332             nan     0.1500 -37546.9575
##    100  1609242.5193             nan     0.1500 -24073.9877
```

```
## Warning: model fit failed for Fold01.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2237987.2294             nan     0.1500 174786.7199
##      2  2037152.9849             nan     0.1500 53372.8210
##      3  1965538.2947             nan     0.1500 98209.4617
##      4  1790140.3157             nan     0.1500 16381.3992
##      5  1755043.0743             nan     0.1500 44626.6898
##      6  1716923.3018             nan     0.1500 53228.9139
##      7  1702074.2203             nan     0.1500 19658.2546
##      8  1611043.3471             nan     0.1500 1374.9116
##      9  1512424.3990             nan     0.1500 -2463.3861
##     10  1454324.7212             nan     0.1500 -26585.0643
##     20  1289408.9731             nan     0.1500 -32626.1698
##     40  1107989.9298             nan     0.1500 -42500.8545
##     60   915505.0102             nan     0.1500 -50087.9903
##     80   779799.1204             nan     0.1500 -20946.1355
##    100   668153.2179             nan     0.1500  386.3101
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2269868.1296             nan     0.1500 127445.9599
##      2  2106391.8579             nan     0.1500 54547.4295
##      3  2070443.4245             nan     0.1500 41102.0116
##      4  1985456.2065             nan     0.1500 4001.2345
##      5  1967399.4479             nan     0.1500 18090.4345
##      6  1952352.3492             nan     0.1500 15288.4073
##      7  1888088.8185             nan     0.1500 -2819.6285
##      8  1891401.8635             nan     0.1500 -18064.6530
##      9  1854346.2043             nan     0.1500 3444.0486
##     10  1829381.2127             nan     0.1500 -11405.7597
##     20  1769039.7110             nan     0.1500 -61440.1105
##     40  1699909.1131             nan     0.1500 -22220.2317
##     60  1655015.4387             nan     0.1500 -44986.9403
##     80  1641512.8609             nan     0.1500 -33869.2882
##    100  1618103.7943             nan     0.1500 -24397.7984

## Warning: model fit failed for Fold01.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2212503.1939             nan     0.2000 212519.8889
##      2  1905090.8333             nan     0.2000 118615.3251
##      3  1697661.4963             nan     0.2000 48238.9335
##      4  1570732.7830             nan     0.2000 11030.6268
##      5  1476991.5655             nan     0.2000 -12006.7231
##      6  1478364.7514             nan     0.2000 -28874.8731
##      7  1426201.0455             nan     0.2000 -79467.7326
##      8  1343198.4661             nan     0.2000 19299.6858
##      9  1335030.6021             nan     0.2000 -103660.2740
##     10  1323749.1486             nan     0.2000 -54115.2290
##     20  1150950.8947             nan     0.2000 -85679.1428
##     40   935839.0597             nan     0.2000 -54208.7630
##     60   822021.8634             nan     0.2000 -28705.0969
##     80   646171.9120             nan     0.2000 -18320.6220
##    100   597260.2117             nan     0.2000 -19269.3696
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2218969.2787             nan     0.2000 73106.0643
##      2  2043442.3179             nan     0.2000 113604.5466
##      3  1913533.3604             nan     0.2000 6041.4507
##      4  1862092.0604             nan     0.2000 65057.3791
##      5  1867456.3152             nan     0.2000 -28656.2570
##      6  1855630.5123             nan     0.2000 14275.2810
##      7  1802461.6282             nan     0.2000 -81202.7680
##      8  1789613.2336             nan     0.2000 -29897.2969
##      9  1790474.9390             nan     0.2000 -35408.8228
##     10  1793624.4978             nan     0.2000 -14854.6043
##     20  1772476.6731             nan     0.2000 -31822.5385
##     40  1734726.2114             nan     0.2000 -46583.7533
##     60  1701439.6249             nan     0.2000 -35718.5167
##     80  1675261.4827             nan     0.2000 -33662.6766
##    100  1637323.6302             nan     0.2000 -29445.8009

## Warning: model fit failed for Fold01.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2216742.7634             nan     0.2000 201234.1473
##      2  2107633.3016             nan     0.2000 137564.4446
##      3  2024094.3483             nan     0.2000 116229.2062
##      4  1794512.2466             nan     0.2000 33542.0564
##      5  1639841.5664             nan     0.2000 9088.7953
##      6  1546891.3287             nan     0.2000 -60690.7744
##      7  1540179.1083             nan     0.2000 3652.7636
##      8  1463490.3489             nan     0.2000 -69726.9077
##      9  1444346.7715             nan     0.2000 -94332.4408
##     10  1441748.5345             nan     0.2000 -38903.8117
##     20  1265224.4109             nan     0.2000 -28808.7291
##     40  1020423.4463             nan     0.2000 -9879.0677
##     60   993770.3008             nan     0.2000 -40001.3488
##     80   775345.2614             nan     0.2000 -53402.3369
##    100   655461.9111             nan     0.2000 -30115.3610
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2099358.4596             nan     0.2000 147465.9283
##      2  2020394.2864             nan     0.2000 99021.4702
##      3  1916157.6729             nan     0.2000 18551.6382
##      4  1841393.0529             nan     0.2000 -372.2466
##      5  1834785.6111             nan     0.2000 -11971.4570
##      6  1822833.1735             nan     0.2000 1431.3257
##      7  1787553.7827             nan     0.2000 -23090.4004
##      8  1761179.7403             nan     0.2000 -10083.3556
##      9  1765239.7958             nan     0.2000 -28695.2222
##     10  1768460.6781             nan     0.2000 -15774.3912
##     20  1752104.7724             nan     0.2000 -29834.5478
##     40  1695824.9671             nan     0.2000 -34922.8363
##     60  1686147.6760             nan     0.2000 -30495.0517
##     80  1657528.9422             nan     0.2000 -11411.3061
##    100  1647909.5570             nan     0.2000 -11028.7693

## Warning: model fit failed for Fold01.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobsi

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3019339.0363             nan     0.1000 172069.7669
##      2  2795970.3530             nan     0.1000 163392.2923
##      3  2717142.9869             nan     0.1000 99925.2931
##      4  2573275.8860             nan     0.1000 168832.4164
##      5  2528831.7231             nan     0.1000 54000.6042
##      6  2496168.6109             nan     0.1000 37131.0910
##      7  2305962.8090             nan     0.1000 21910.1438
##      8  2151263.8564             nan     0.1000 11398.9289
##      9  2137525.4178             nan     0.1000 12590.6770
##     10  2078233.0689             nan     0.1000 71730.3351
##     20  1644216.1764             nan     0.1000 16928.9856
##     40  1419111.2806             nan     0.1000 6847.0948
##     60  1225338.2168             nan     0.1000 -58733.0395
##     80  1107457.3164             nan     0.1000  921.3864
##    100  1026397.8013             nan     0.1000 -37831.5622
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3023828.1577             nan     0.1000 151105.2785
##      2  2910555.2452             nan     0.1000 87557.5404
##      3  2794282.5835             nan     0.1000 101040.7165
##      4  2766751.8809             nan     0.1000 23202.0740
##      5  2707791.4609             nan     0.1000 58286.1871
##      6  2618405.0639             nan     0.1000 73937.2243
##      7  2576622.8819             nan     0.1000 50347.6663
##      8  2565591.2458             nan     0.1000 6221.5201
##      9  2498433.6786             nan     0.1000 -11183.5583
##     10  2505763.4513             nan     0.1000 -38481.2563
##     20  2328646.5392             nan     0.1000 -28006.2162
##     40  2263998.5412             nan     0.1000 -54545.1529
##     60  2188551.5924             nan     0.1000 -9629.8032
##     80  2163574.6322             nan     0.1000 -2898.2320
##    100  2158714.7947             nan     0.1000 -13991.9298

## Warning: model fit failed for Fold02.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3091633.0362             nan     0.1000 144543.2516
##      2  2801075.0998             nan     0.1000 54922.1539
##      3  2735370.1845             nan     0.1000 82929.0197
##      4  2626532.8604             nan     0.1000 133200.7961
##      5  2421945.6673             nan     0.1000 8398.6444
##      6  2277532.4517             nan     0.1000 105777.3041
##      7  2223975.5625             nan     0.1000 56282.4768
##      8  2161272.0692             nan     0.1000 73650.9944
##      9  2043748.1319             nan     0.1000 -9152.7025
##     10  1947743.4474             nan     0.1000 -12764.7310
##     20  1622103.2062             nan     0.1000 -80765.3920
##     40  1412501.8240             nan     0.1000 -85510.4284
##     60  1294037.6568             nan     0.1000 -50812.2398
##     80  1242294.3482             nan     0.1000 -55046.8976
##    100  1150057.6245             nan     0.1000 -3437.2287
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3121398.3849             nan     0.1000 94060.0797
##      2  3057491.2465             nan     0.1000 70766.1112
##      3  3012005.7678             nan     0.1000 49045.2399
##      4  2822286.2297             nan     0.1000 46967.9076
##      5  2755880.1337             nan     0.1000 82079.8124
##      6  2688209.3134             nan     0.1000 49120.1028
##      7  2626739.5425             nan     0.1000 36453.4239
##      8  2598451.5321             nan     0.1000 31498.4192
##      9  2588228.5083             nan     0.1000 6777.3450
##     10  2479975.7105             nan     0.1000 13387.3402
##     20  2301962.4020             nan     0.1000 -35299.4039
##     40  2175070.0831             nan     0.1000 -55713.7465
##     60  2110600.5849             nan     0.1000 -5106.8257
##     80  2085032.5287             nan     0.1000 -42255.8112
##    100  2089185.5441             nan     0.1000 -2945.8921

## Warning: model fit failed for Fold02.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2953545.0107             nan     0.1500 278289.1430
##      2  2724546.8333             nan     0.1500 255373.6327
##      3  2639537.0371             nan     0.1500 109405.7324
##      4  2577838.7099             nan     0.1500 87004.6484
##      5  2529272.7111             nan     0.1500 65006.8089
##      6  2256847.2257             nan     0.1500 -19280.6447
##      7  2148093.1678             nan     0.1500 129972.8570
##      8  2016518.2368             nan     0.1500 80710.5946
##      9  1929452.4289             nan     0.1500 28147.6472
##     10  1858283.9930             nan     0.1500 -144337.0691
##     20  1625222.3881             nan     0.1500 -96715.1918
##     40  1312219.1244             nan     0.1500 -152590.4812
##     60  1304651.7909             nan     0.1500 11413.3723
##     80  1147202.1319             nan     0.1500 -744.4846
##    100  1075441.4118             nan     0.1500 -2740.0106
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2976534.4292             nan     0.1500 230194.4120
##      2  2922646.7620             nan     0.1500 50808.3512
##      3  2739042.4182             nan     0.1500 63606.6770
##      4  2621023.8071             nan     0.1500 -24549.3409
##      5  2565085.6109             nan     0.1500 34081.2836
##      6  2523058.0318             nan     0.1500 47351.2296
##      7  2413996.4281             nan     0.1500 14675.1313
##      8  2365973.5346             nan     0.1500 -89620.5003
##      9  2346747.9696             nan     0.1500 6405.1098
##     10  2330655.4427             nan     0.1500 -56184.2190
##     20  2289685.9665             nan     0.1500 -12309.4018
##     40  2259562.5029             nan     0.1500 -99838.9125
##     60  2143713.0382             nan     0.1500 -226.5344
##     80  2102163.0406             nan     0.1500 -10531.7881
##    100  2118549.4062             nan     0.1500 -5195.1262
```

```
## Warning: model fit failed for Fold02.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2833875.2402             nan     0.1500 295116.2151
##      2  2739780.1223             nan     0.1500 109622.7462
##      3  2392700.9537             nan     0.1500 42864.5280
##      4  2115094.9855             nan     0.1500 -30224.9116
##      5  1901045.6828             nan     0.1500 29609.1749
##      6  1746456.4415             nan     0.1500 -65121.3509
##      7  1629364.5306             nan     0.1500 -50884.0490
##      8  1600550.8595             nan     0.1500 31012.6500
##      9  1535500.7832             nan     0.1500 -12304.1448
##     10  1477006.7774             nan     0.1500 -70585.4532
##     20  1335455.4520             nan     0.1500 -53717.5130
##     40  1134531.1839             nan     0.1500 2008.2668
##     60  1081956.9206             nan     0.1500 -48582.6277
##     80  1068386.3029             nan     0.1500 -55122.4414
##    100   923025.1825             nan     0.1500 -2198.4778
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3084666.0597             nan     0.1500 130630.1763
##      2  2999843.1114             nan     0.1500 101101.7602
##      3  2830651.2287             nan     0.1500 187324.0032
##      4  2791352.4858             nan     0.1500 38838.6356
##      5  2666848.5525             nan     0.1500 78530.8517
##      6  2549989.9153             nan     0.1500 -1180.3540
##      7  2457951.3813             nan     0.1500 82955.6480
##      8  2469952.9217             nan     0.1500 -51142.0723
##      9  2396572.4201             nan     0.1500 41481.7374
##     10  2325670.7962             nan     0.1500 -46910.1452
##     20  2258613.9294             nan     0.1500 -71150.4141
##     40  2172047.9802             nan     0.1500 -4818.4162
##     60  2081816.8108             nan     0.1500 2954.8451
##     80  2045119.8115             nan     0.1500 -113108.2595
##    100  2029262.9580             nan     0.1500 -9168.8782

## Warning: model fit failed for Fold02.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2600271.8174             nan     0.2000 148937.6132
##      2  2353246.6468             nan     0.2000 84211.4297
##      3  2164584.1751             nan     0.2000 188379.3946
##      4  2071912.4374             nan     0.2000 -13807.4837
##      5  1931476.1418             nan     0.2000 124689.9706
##      6  1752272.3649             nan     0.2000 -121572.7667
##      7  1796139.3326             nan     0.2000 -187135.7122
##      8  1727845.2520             nan     0.2000 60505.1713
##      9  1632248.4755             nan     0.2000 -117536.5223
##     10  1644000.7346             nan     0.2000 -72018.8798
##     20  1517232.4803             nan     0.2000 -21434.0307
##     40  1257437.6019             nan     0.2000 -76766.6474
##     60  1083192.9205             nan     0.2000 -23663.1012
##     80   884862.5895             nan     0.2000 7349.4300
##    100   819700.0239             nan     0.2000 2017.6547
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3106301.6335             nan     0.2000 70983.8850
##      2  2816365.3428             nan     0.2000 19777.8265
##      3  2591509.5083             nan     0.2000 60092.6492
##      4  2470369.7703             nan     0.2000 -2480.1135
##      5  2413352.2632             nan     0.2000 63190.6065
##      6  2380500.3231             nan     0.2000 23584.3993
##      7  2367220.0406             nan     0.2000 12050.7925
##      8  2355589.6169             nan     0.2000 14094.1267
##      9  2369314.3398             nan     0.2000 -88630.4246
##     10  2334654.0569             nan     0.2000 1849.1564
##     20  2286576.1329             nan     0.2000 -42909.1610
##     40  2218463.2042             nan     0.2000 1387.8225
##     60  2143186.0584             nan     0.2000 -107300.3180
##     80  2132182.8636             nan     0.2000 -40593.1567
##    100  2042535.8590             nan     0.2000 -147037.3050

## Warning: model fit failed for Fold02.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2840012.5711             nan     0.2000 394270.5229
##      2  2508608.8318             nan     0.2000 233855.3443
##      3  2143577.0936             nan     0.2000 4340.6801
##      4  2041899.5361             nan     0.2000 124890.9340
##      5  2055785.8694             nan     0.2000 -61192.9957
##      6  2087294.8198             nan     0.2000 -100991.4789
##      7  2015170.8613             nan     0.2000 91792.0337
##      8  1909207.8257             nan     0.2000 10463.3474
##      9  1822075.1381             nan     0.2000 94256.2817
##     10  1792762.3564             nan     0.2000 30723.2031
##     20  1501809.1850             nan     0.2000 2708.5297
##     40  1119564.3657             nan     0.2000 16598.4183
##     60   938532.2650             nan     0.2000 7849.5609
##     80   852287.0519             nan     0.2000 3365.4191
##    100   706373.5629             nan     0.2000 -5145.3700
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3039567.4531             nan     0.2000 197300.5632
##      2  2768373.6345             nan     0.2000 79871.5064
##      3  2714092.0628             nan     0.2000 54799.0937
##      4  2672863.2835             nan     0.2000 39335.3208
##      5  2622373.7659             nan     0.2000 61508.0160
##      6  2574026.1070             nan     0.2000 60115.1501
##      7  2495540.7466             nan     0.2000 65278.0374
##      8  2426404.8190             nan     0.2000 33276.9995
##      9  2378018.6442             nan     0.2000 45956.7754
##     10  2379488.8619             nan     0.2000 -5437.2695
##     20  2301942.2697             nan     0.2000 -26305.0844
##     40  2187871.1445             nan     0.2000 38974.5459
##     60  2114990.1123             nan     0.2000 -104475.6309
##     80  2110341.7012             nan     0.2000 -117723.9031
##    100  2109162.2409             nan     0.2000 -104489.5815

## Warning: model fit failed for Fold02.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2848789.6173             nan     0.1000 209254.1070
##      2  2588491.3783             nan     0.1000 81767.8050
##      3  2546258.0510             nan     0.1000 48879.1654
##      4  2340070.2916             nan     0.1000 -19632.1951
##      5  2315222.3787             nan     0.1000 18990.7048
##      6  2201238.9223             nan     0.1000 78092.3502
##      7  2051497.8237             nan     0.1000 24069.4170
##      8  2048695.3095             nan     0.1000 -11513.2774
##      9  1965020.8819             nan     0.1000 47671.5381
##     10  1890789.2231             nan     0.1000 55970.5841
##     20  1667849.7594             nan     0.1000 9952.5813
##     40  1381919.7097             nan     0.1000 -18459.6197
##     60  1204429.7330             nan     0.1000 2006.4813
##     80   969551.2492             nan     0.1000 -26765.4520
##    100   816335.0424             nan     0.1000 -43501.0698
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2960504.1127             nan     0.1000 134171.8394
##      2  2829467.7449             nan     0.1000 140932.7992
##      3  2791834.4923             nan     0.1000 30044.4099
##      4  2689130.3708             nan     0.1000 111502.7063
##      5  2606645.9030             nan     0.1000 74668.8251
##      6  2520058.6321             nan     0.1000 73156.7314
##      7  2455421.8646             nan     0.1000 44397.3983
##      8  2408292.5065             nan     0.1000 34194.5486
##      9  2404907.8970             nan     0.1000 -6066.2228
##     10  2370002.9440             nan     0.1000 24106.5916
##     20  2089174.7754             nan     0.1000 -131.1338
##     40  2015844.9416             nan     0.1000  251.7140
##     60  1989123.4814             nan     0.1000 -44407.5873
##     80  1980821.3084             nan     0.1000 -1445.8321
##    100  1953252.1098             nan     0.1000 -26073.3351

## Warning: model fit failed for Fold03.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2862504.3704             nan     0.1000 168079.5178
##      2  2711987.8986             nan     0.1000 62619.3940
##      3  2651491.9442             nan     0.1000 74824.9731
##      4  2608820.1078             nan     0.1000 48193.7384
##      5  2494319.5207             nan     0.1000 135164.8978
##      6  2354573.5884             nan     0.1000 95409.9313
##      7  2329492.7033             nan     0.1000 30387.3212
##      8  2246606.0253             nan     0.1000 99801.0128
##      9  2180293.5631             nan     0.1000 74567.0845
##     10  2124270.2576             nan     0.1000 65833.2631
##     20  1733607.9077             nan     0.1000 -67948.4558
##     40  1401576.3623             nan     0.1000 10476.5852
##     60  1132907.4829             nan     0.1000 -43104.8081
##     80   997087.1519             nan     0.1000 -13764.9802
##    100   920430.0967             nan     0.1000 -6173.2467
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2934245.3105             nan     0.1000 77250.7800
##      2  2870778.5849             nan     0.1000 75174.5891
##      3  2741177.1640             nan     0.1000 66234.7546
##      4  2626097.3060             nan     0.1000 17011.5816
##      5  2557727.1679             nan     0.1000 -43470.2494
##      6  2452286.7621             nan     0.1000 23568.6348
##      7  2431977.0708             nan     0.1000 12989.9424
##      8  2397447.9777             nan     0.1000 -50300.6637
##      9  2390584.8206             nan     0.1000 -16763.0768
##     10  2373086.1992             nan     0.1000 19953.8663
##     20  2188746.1503             nan     0.1000 -30557.1691
##     40  2075336.7018             nan     0.1000 -1323.3996
##     60  2015302.7673             nan     0.1000 -6664.4766
##     80  1965757.1504             nan     0.1000 -11121.2049
##    100  1940720.9570             nan     0.1000 -42845.3998

## Warning: model fit failed for Fold03.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobsi

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2855296.6554             nan     0.1500 238363.0559
##      2  2559452.2093             nan     0.1500 239752.0508
##      3  2259794.8224             nan     0.1500 -29592.2451
##      4  2124645.7203             nan     0.1500 26275.9866
##      5  2093537.3923             nan     0.1500 25652.6608
##      6  2017887.4886             nan     0.1500 82842.0238
##      7  2032452.8963             nan     0.1500 -50759.4410
##      8  2030890.4293             nan     0.1500 -12764.7576
##      9  1930883.5612             nan     0.1500 55454.4760
##     10  1947542.8896             nan     0.1500 -51189.5363
##     20  1429782.4920             nan     0.1500 27499.2584
##     40  1273584.9444             nan     0.1500 -52158.1118
##     60  1064450.6635             nan     0.1500 -62970.0069
##     80   908167.0831             nan     0.1500 -28563.9742
##    100   711929.9206             nan     0.1500  628.2012
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2993161.9535             nan     0.1500 85114.2854
##      2  2897435.3176             nan     0.1500 120818.9360
##      3  2684718.9527             nan     0.1500 77460.5774
##      4  2547336.3253             nan     0.1500 6894.5064
##      5  2500255.3490             nan     0.1500 54694.9721
##      6  2419369.5353             nan     0.1500 -49128.6974
##      7  2422309.1698             nan     0.1500 -33116.3805
##      8  2356629.7186             nan     0.1500 44985.7768
##      9  2346726.2131             nan     0.1500 11901.5963
##     10  2329742.0865             nan     0.1500 4846.1132
##     20  2222764.8150             nan     0.1500 -25692.9371
##     40  2119880.1543             nan     0.1500 -57886.8891
##     60  1926028.5194             nan     0.1500 -28175.6773
##     80  1858377.3442             nan     0.1500 -2602.2171
##    100  1815959.5255             nan     0.1500 -18596.5156

## Warning: model fit failed for Fold03.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobsi

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2933521.6942             nan     0.1500 185820.3989
##      2  2563060.5883             nan     0.1500 1653.7399
##      3  2297982.8774             nan     0.1500 43706.6784
##      4  2231902.7007             nan     0.1500 79133.9613
##      5  2095139.0232             nan     0.1500 34817.0234
##      6  1883395.3255             nan     0.1500 -11577.0108
##      7  1890526.5618             nan     0.1500 -46405.9516
##      8  1897918.1688             nan     0.1500 -35444.0561
##      9  1859293.2534             nan     0.1500 -52596.1868
##     10  1813653.2632             nan     0.1500 54662.5523
##     20  1582588.9367             nan     0.1500 -45602.3694
##     40  1138933.0874             nan     0.1500 -135962.5144
##     60   890883.2555             nan     0.1500 -21684.6417
##     80   740157.6574             nan     0.1500 6832.3452
##    100   654560.5953             nan     0.1500 -9806.0803
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2871642.9289             nan     0.1500 228734.0744
##      2  2792297.3170             nan     0.1500 101353.4709
##      3  2649048.5247             nan     0.1500 125425.4328
##      4  2494109.5497             nan     0.1500 -8112.3276
##      5  2398681.0277             nan     0.1500 -28996.2899
##      6  2342726.7621             nan     0.1500 -66035.6522
##      7  2346819.9880             nan     0.1500 -50854.1196
##      8  2295678.6153             nan     0.1500 -29205.9068
##      9  2286358.6985             nan     0.1500 9343.2466
##     10  2189991.7096             nan     0.1500 5763.7933
##     20  2144407.7603             nan     0.1500 -42642.1244
##     40  2043443.9245             nan     0.1500 -39922.4065
##     60  1944310.0289             nan     0.1500 5353.3465
##     80  1904172.4731             nan     0.1500 -95196.0368
##    100  1900609.6433             nan     0.1500 -51680.3481

## Warning: model fit failed for Fold03.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2913961.8815             nan     0.2000 205006.8631
##      2  2627607.8271             nan     0.2000 325572.3575
##      3  2410409.7990             nan     0.2000 276287.1698
##      4  2350552.8043             nan     0.2000 80142.9915
##      5  2033149.2446             nan     0.2000 -26850.7382
##      6  1792193.2588             nan     0.2000 -51995.1065
##      7  1754785.3832             nan     0.2000 48728.9434
##      8  1670521.8541             nan     0.2000 -6335.4589
##      9  1570675.7729             nan     0.2000 62695.9944
##     10  1531227.9269             nan     0.2000 8788.1331
##     20  1348089.5220             nan     0.2000 -37090.1980
##     40  1005966.0568             nan     0.2000 1576.2221
##     60   732121.0056             nan     0.2000 -66085.9669
##     80   561973.1984             nan     0.2000 -18909.3327
##    100   475402.0195             nan     0.2000 9680.0063
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2676505.8337             nan     0.2000 156692.9887
##      2  2415188.8630             nan     0.2000 50582.8056
##      3  2299043.3429             nan     0.2000 -52283.2824
##      4  2268968.7269             nan     0.2000 -314.0650
##      5  2234687.9118             nan     0.2000 38457.0416
##      6  2236823.0603             nan     0.2000 -36958.3320
##      7  2210825.0709             nan     0.2000 34432.3282
##      8  2067888.9242             nan     0.2000 13401.1892
##      9  2061416.0875             nan     0.2000 7253.0777
##     10  2054533.8946             nan     0.2000 10538.8449
##     20  1994763.8913             nan     0.2000 5511.0114
##     40  1843570.3134             nan     0.2000 -1479.0454
##     60  1815298.0270             nan     0.2000 -56066.9171
##     80  1810722.9103             nan     0.2000 -4945.6702
##    100  1768828.0340             nan     0.2000 -19379.8464

## Warning: model fit failed for Fold03.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2893744.3545             nan     0.2000 238991.9032
##      2  2436894.4544             nan     0.2000 45556.3450
##      3  2156204.7654             nan     0.2000 214976.1502
##      4  2120570.6600             nan     0.2000 40181.5039
##      5  2135699.7785             nan     0.2000 -61869.8574
##      6  2036164.8722             nan     0.2000 -25428.3016
##      7  1961648.0774             nan     0.2000 75929.6704
##      8  1877415.8473             nan     0.2000 26012.5494
##      9  1891725.0736             nan     0.2000 -79671.9380
##     10  1726722.7287             nan     0.2000 -81985.6904
##     20  1627157.2358             nan     0.2000 -70968.5045
##     40  1158683.5498             nan     0.2000 -40560.5567
##     60   894764.1074             nan     0.2000 -84008.2448
##     80   685102.7772             nan     0.2000 -22124.2123
##    100   511509.4575             nan     0.2000 -23773.4267
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2785249.6407             nan     0.2000 243396.4281
##      2  2667842.1242             nan     0.2000 117989.6563
##      3  2406350.1547             nan     0.2000 47540.8638
##      4  2362370.2027             nan     0.2000 39397.6179
##      5  2303618.8382             nan     0.2000 53543.0059
##      6  2275921.3830             nan     0.2000 29499.9009
##      7  2218095.0150             nan     0.2000 -77080.8450
##      8  2203904.7121             nan     0.2000 7495.8028
##      9  2191945.3676             nan     0.2000 3823.5079
##     10  2175037.3650             nan     0.2000 17043.4847
##     20  2066891.3143             nan     0.2000 -11516.9200
##     40  1949680.3330             nan     0.2000 -66013.3610
##     60  1869835.1667             nan     0.2000 -39342.6427
##     80  1855899.1418             nan     0.2000 -8012.1382
##    100  1845362.9551             nan     0.2000 -68937.6781

## Warning: model fit failed for Fold03.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2915131.2302             nan     0.1000 85335.4601
##      2  2832495.8262             nan     0.1000 104175.8206
##      3  2702101.5780             nan     0.1000 148582.3555
##      4  2656289.0885             nan     0.1000 58386.8617
##      5  2474171.8026             nan     0.1000 134774.6167
##      6  2435518.8798             nan     0.1000 51854.3688
##      7  2241160.8327             nan     0.1000 21921.0975
##      8  2129059.0262             nan     0.1000 83306.0669
##      9  2003680.2048             nan     0.1000 -49848.7517
##     10  1960795.0652             nan     0.1000 53902.8852
##     20  1653786.0677             nan     0.1000 -116337.4049
##     40  1316111.0200             nan     0.1000 -7758.4780
##     60  1178946.3295             nan     0.1000 5529.5768
##     80  1140166.0834             nan     0.1000 -58489.8701
##    100  1003421.1270             nan     0.1000 -68759.4030
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3024408.4243             nan     0.1000 82636.0547
##      2  2913397.7946             nan     0.1000 88988.1931
##      3  2813310.6016             nan     0.1000 107714.1075
##      4  2671539.6385             nan     0.1000 24253.0945
##      5  2609134.0992             nan     0.1000 34319.8380
##      6  2591147.0593             nan     0.1000 14685.7506
##      7  2544549.4192             nan     0.1000 30376.9550
##      8  2479698.5597             nan     0.1000 -16630.9155
##      9  2461163.9079             nan     0.1000 17149.5802
##     10  2440762.9311             nan     0.1000 23559.3408
##     20  2267355.1708             nan     0.1000 -48608.3305
##     40  2191077.1668             nan     0.1000 -13491.7977
##     60  2071507.3096             nan     0.1000 -9799.4550
##     80  2014222.2091             nan     0.1000 -7938.8869
##    100  1969374.5533             nan     0.1000 -22665.6747

## Warning: model fit failed for Fold04.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2779066.3128             nan     0.1000 103093.7070
##      2  2523912.0288             nan     0.1000 64902.6447
##      3  2390791.4416             nan     0.1000 163217.7135
##      4  2280924.9771             nan     0.1000 34092.1998
##      5  2200263.3448             nan     0.1000 90207.0634
##      6  2090913.0566             nan     0.1000 79382.5685
##      7  1994323.9900             nan     0.1000 70951.8300
##      8  1879148.1787             nan     0.1000 -21693.6239
##      9  1836217.0785             nan     0.1000 53801.6358
##     10  1788088.9909             nan     0.1000 10341.4330
##     20  1551050.7376             nan     0.1000 15237.0326
##     40  1344555.7326             nan     0.1000 3418.5906
##     60  1241013.7566             nan     0.1000 -33277.7593
##     80  1107858.3256             nan     0.1000 -7514.6531
##    100   998814.9146             nan     0.1000 -3141.6952
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2962287.1622             nan     0.1000 93036.8159
##      2  2887208.0584             nan     0.1000 74973.0136
##      3  2800834.0759             nan     0.1000 98929.8806
##      4  2744250.0609             nan     0.1000 58711.6179
##      5  2724629.8991             nan     0.1000 9707.1749
##      6  2644328.5535             nan     0.1000 18221.7606
##      7  2500725.1237             nan     0.1000 48063.3734
##      8  2447132.2254             nan     0.1000 64872.2823
##      9  2423201.5892             nan     0.1000 26969.4702
##     10  2362049.7281             nan     0.1000 -6231.9667
##     20  2233546.8667             nan     0.1000 -33068.7361
##     40  2100538.1579             nan     0.1000 -31261.8762
##     60  2034343.0505             nan     0.1000 -16798.2382
##     80  2003270.9505             nan     0.1000 -5559.0222
##    100  1973087.0189             nan     0.1000 -9351.5449

## Warning: model fit failed for Fold04.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2830423.0225             nan     0.1500 100873.4333
##      2  2440954.9671             nan     0.1500 93407.4287
##      3  2290737.0791             nan     0.1500 165694.0624
##      4  2169564.5590             nan     0.1500 140993.4235
##      5  2092706.7113             nan     0.1500 87635.4708
##      6  2019744.8981             nan     0.1500 80910.5194
##      7  1850224.7100             nan     0.1500 -38377.6330
##      8  1820413.8133             nan     0.1500 34644.9586
##      9  1839703.4750             nan     0.1500 -68195.7818
##     10  1723884.9595             nan     0.1500 -50175.9141
##     20  1458502.1796             nan     0.1500 -35277.3393
##     40  1212021.5389             nan     0.1500 -1875.2249
##     60   982270.5592             nan     0.1500 -4660.5439
##     80   929421.7435             nan     0.1500 6308.5469
##    100   814739.7007             nan     0.1500 -9073.9073
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2881492.8337             nan     0.1500 221653.5650
##      2  2811408.8480             nan     0.1500 78148.3932
##      3  2639194.3042             nan     0.1500 36815.7175
##      4  2428493.2239             nan     0.1500 44990.9344
##      5  2367178.2504             nan     0.1500 76872.1135
##      6  2318492.7434             nan     0.1500 60984.0216
##      7  2285831.1009             nan     0.1500 39954.0512
##      8  2257652.9388             nan     0.1500 -1540.9308
##      9  2264370.2271             nan     0.1500 -44638.4692
##     10  2272715.4886             nan     0.1500 -33382.8185
##     20  2077638.9517             nan     0.1500 -62954.5983
##     40  1940885.6162             nan     0.1500 -26200.2599
##     60  1873739.6763             nan     0.1500 -38405.2364
##     80  1805240.5311             nan     0.1500 -6675.9049
##    100  1831379.6938             nan     0.1500 -40127.2855

## Warning: model fit failed for Fold04.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2625089.4083             nan     0.1500 201825.7985
##      2  2442181.2527             nan     0.1500 194808.8933
##      3  2301082.4489             nan     0.1500 152649.7969
##      4  2058125.0286             nan     0.1500 40161.6075
##      5  1908936.8630             nan     0.1500 -81879.3992
##      6  1835413.6178             nan     0.1500 14077.5445
##      7  1840943.6164             nan     0.1500 -65408.7112
##      8  1800300.1532             nan     0.1500 48948.6749
##      9  1711214.7558             nan     0.1500 55995.2492
##     10  1644557.1866             nan     0.1500 -124426.7345
##     20  1544021.0723             nan     0.1500 -59594.9173
##     40  1475582.0941             nan     0.1500 -128648.1053
##     60  1056841.2187             nan     0.1500 -40807.6845
##     80   960528.8967             nan     0.1500 -139667.2505
##    100   780671.4346             nan     0.1500 -35611.5993
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2983419.4664             nan     0.1500 143590.6386
##      2  2720440.7362             nan     0.1500 72563.2340
##      3  2580373.5347             nan     0.1500 153633.1465
##      4  2490750.5550             nan     0.1500 73601.1247
##      5  2414367.5832             nan     0.1500 57729.2140
##      6  2354952.1336             nan     0.1500 28167.0924
##      7  2314096.6487             nan     0.1500 28221.7664
##      8  2246317.2393             nan     0.1500 65774.2893
##      9  2237869.3533             nan     0.1500 9460.2628
##     10  2243131.9411             nan     0.1500 -27759.6287
##     20  2078050.1534             nan     0.1500 1804.5842
##     40  2010132.1126             nan     0.1500  436.9751
##     60  1922892.5447             nan     0.1500 -87044.2574
##     80  1864466.9448             nan     0.1500 -8016.3854
##    100  1846072.7771             nan     0.1500 -5079.4513

## Warning: model fit failed for Fold04.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobsi

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2744923.0933             nan     0.2000 374413.2088
##      2  2470890.2402             nan     0.2000 110958.1408
##      3  2381681.7024             nan     0.2000 106870.2082
##      4  2330411.2082             nan     0.2000 60372.5605
##      5  2286082.3933             nan     0.2000 46760.6459
##      6  2264503.8757             nan     0.2000 14271.4289
##      7  1984880.7972             nan     0.2000 -53704.4472
##      8  1999940.6618             nan     0.2000 -42999.8739
##      9  1762761.5302             nan     0.2000 -3895.0375
##     10  1665139.9154             nan     0.2000 -164235.8896
##     20  1515607.9635             nan     0.2000 3804.6241
##     40  1102769.2604             nan     0.2000 -755.6577
##     60   936298.2831             nan     0.2000 8097.7520
##     80   791099.4300             nan     0.2000 15032.4164
##    100   770526.9732             nan     0.2000 -48669.7496
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2906826.6475             nan     0.2000 209408.3467
##      2  2548539.7445             nan     0.2000 127321.4234
##      3  2522897.0854             nan     0.2000 1935.8555
##      4  2494255.4744             nan     0.2000 28260.2238
##      5  2474985.8675             nan     0.2000 18625.6475
##      6  2395577.9313             nan     0.2000 91986.7565
##      7  2393071.3555             nan     0.2000 -8798.3265
##      8  2312616.8797             nan     0.2000 51943.3948
##      9  2329234.5178             nan     0.2000 -48739.1592
##     10  2270417.9665             nan     0.2000 70423.4899
##     20  2121946.8981             nan     0.2000 -7937.1596
##     40  2007204.2904             nan     0.2000 13326.2618
##     60  1955643.6931             nan     0.2000 -20199.9151
##     80  1888777.3482             nan     0.2000 -37701.4965
##    100  1867022.0903             nan     0.2000 -29050.7870
```

```
## Warning: model fit failed for Fold04.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2901483.5412             nan     0.2000 255532.9077
##      2  2357397.9842             nan     0.2000 89698.3503
##      3  2274347.1110             nan     0.2000 114696.6925
##      4  1943953.0075             nan     0.2000 17314.8202
##      5  1821208.9842             nan     0.2000 -7284.7284
##      6  1746243.5164             nan     0.2000 85971.7236
##      7  1609146.1069             nan     0.2000 -73427.7760
##      8  1536627.7189             nan     0.2000 83013.5808
##      9  1502646.1365             nan     0.2000 38710.8499
##     10  1458503.7270             nan     0.2000 13590.9687
##     20  1257571.0327             nan     0.2000 19094.6093
##     40  1083817.5930             nan     0.2000 -36939.2977
##     60   909446.0867             nan     0.2000 -38241.7155
##     80   772962.1013             nan     0.2000 -23001.2094
##    100   669078.2395             nan     0.2000 -6940.1149
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2870701.0014             nan     0.2000 262075.6724
##      2  2789473.6413             nan     0.2000 92459.8398
##      3  2681977.5986             nan     0.2000 124137.9566
##      4  2470837.8570             nan     0.2000 156313.9797
##      5  2469014.0724             nan     0.2000 -17709.6054
##      6  2337007.1287             nan     0.2000 99776.6261
##      7  2340859.2486             nan     0.2000 -19888.5562
##      8  2249478.3160             nan     0.2000 48114.3196
##      9  2165673.3421             nan     0.2000 -29594.5438
##     10  2156328.0522             nan     0.2000 12340.4470
##     20  2084687.1461             nan     0.2000 -49444.4843
##     40  2096895.1853             nan     0.2000 -149679.0377
##     60  1976688.3573             nan     0.2000 -91113.9142
##     80  1917655.4626             nan     0.2000 -8862.9691
##    100  1905829.6209             nan     0.2000 17277.6194
```

```
## Warning: model fit failed for Fold04.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2746948.8893             nan     0.1000 99507.6100
##      2  2486913.6775             nan     0.1000 35570.5735
##      3  2334831.4589             nan     0.1000 113129.8067
##      4  2308718.3203             nan     0.1000 22215.7269
##      5  2286599.9982             nan     0.1000 15103.5608
##      6  2129393.2367             nan     0.1000 2231.2456
##      7  2062228.5853             nan     0.1000 80716.5806
##      8  2051138.2251             nan     0.1000 7071.4414
##      9  1995778.4286             nan     0.1000 65982.0156
##     10  1992610.3285             nan     0.1000 -4022.2045
##     20  1623942.2512             nan     0.1000 6802.6620
##     40  1296928.2004             nan     0.1000 -3199.7328
##     60  1142440.7100             nan     0.1000 -76127.3929
##     80  1002892.9230             nan     0.1000 -5234.8265
##    100   960234.0919             nan     0.1000 -31784.2106
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2964211.1121             nan     0.1000 114205.7838
##      2  2776974.1623             nan     0.1000 80851.0891
##      3  2679295.5358             nan     0.1000 83800.4291
##      4  2602444.8408             nan     0.1000 50407.0801
##      5  2586344.2498             nan     0.1000 8504.1837
##      6  2527145.5834             nan     0.1000 48586.9117
##      7  2516306.8976             nan     0.1000 2682.0327
##      8  2482135.6821             nan     0.1000 38815.7915
##      9  2440917.3174             nan     0.1000 31573.5266
##     10  2421963.1813             nan     0.1000 22992.7364
##     20  2225068.5834             nan     0.1000 -9847.6298
##     40  2144390.4735             nan     0.1000 -55844.6958
##     60  2120857.5564             nan     0.1000 -40972.3898
##     80  1999903.5540             nan     0.1000 -10961.6081
##    100  1974220.4000             nan     0.1000 -4856.6188

## Warning: model fit failed for Fold05.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2848425.5997             nan     0.1000 158456.1285
##      2  2597113.7246             nan     0.1000 37455.0154
##      3  2355962.3599             nan     0.1000 53225.2854
##      4  2224674.8181             nan     0.1000 98768.5246
##      5  2052573.9880             nan     0.1000 15686.0217
##      6  1929883.9033             nan     0.1000 -380.1644
##      7  1877678.6184             nan     0.1000 63054.3163
##      8  1798630.9236             nan     0.1000 -39128.9230
##      9  1720037.8675             nan     0.1000 48301.0957
##     10  1662217.3077             nan     0.1000 -76281.9355
##     20  1368403.9143             nan     0.1000 -46063.8272
##     40  1250764.1955             nan     0.1000 -7034.5283
##     60  1078442.9652             nan     0.1000 -25519.9406
##     80   892053.0386             nan     0.1000 -52434.5293
##    100   802755.6381             nan     0.1000 -2781.6605
##
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2879205.9910             nan     0.1000 88415.0876
##      2  2738013.3663             nan     0.1000 120385.8944
##      3  2651916.1067             nan     0.1000 69574.4775
##      4  2596691.7075             nan     0.1000 63074.0901
##      5  2529806.0092             nan     0.1000 42593.6791
##      6  2432178.3455             nan     0.1000 21038.1498
##      7  2401022.6332             nan     0.1000 34617.1245
##      8  2358911.5798             nan     0.1000 38713.4178
##      9  2364209.2504             nan     0.1000 -32899.3763
##     10  2347065.5891             nan     0.1000 20119.7697
##     20  2218298.2027             nan     0.1000 5719.9285
##     40  2127009.6587             nan     0.1000 -41189.2251
##     60  2104672.8226             nan     0.1000 -3502.0658
##     80  2074449.0823             nan     0.1000 -50602.1333
##    100  2030913.8474             nan     0.1000 -28880.2365

## Warning: model fit failed for Fold05.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2910332.6897             nan     0.1500 203464.6244
##      2  2806893.7681             nan     0.1500 141494.5270
##      3  2526458.6793             nan     0.1500 213867.9299
##      4  2262923.8927             nan     0.1500 -32600.0192
##      5  2171580.3473             nan     0.1500 109918.7686
##      6  2174364.5613             nan     0.1500 -28813.9885
##      7  2009869.0443             nan     0.1500 -59414.1132
##      8  2018713.6197             nan     0.1500 -38148.5051
##      9  1974743.1069             nan     0.1500 61587.5132
##     10  1917704.2209             nan     0.1500 61100.9383
##     20  1614060.6611             nan     0.1500 -51909.0587
##     40  1301531.8213             nan     0.1500 -71307.2096
##     60  1218443.7520             nan     0.1500 -72334.3118
##     80   893888.1351             nan     0.1500 -16221.1653
##    100   749422.1676             nan     0.1500 4755.2225
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2919136.4557             nan     0.1500 144756.0270
##      2  2799084.4527             nan     0.1500 138092.4678
##      3  2655780.5230             nan     0.1500 105781.9395
##      4  2551828.3089             nan     0.1500 70008.2859
##      5  2461054.9024             nan     0.1500 -21854.3141
##      6  2437444.1006             nan     0.1500 23234.5298
##      7  2407922.4680             nan     0.1500 11454.2631
##      8  2386258.8346             nan     0.1500 2894.3437
##      9  2367115.4286             nan     0.1500 -107863.0435
##     10  2339527.1501             nan     0.1500 14392.9522
##     20  2326228.3038             nan     0.1500 3571.8649
##     40  2164345.7110             nan     0.1500 2497.7327
##     60  2098656.4703             nan     0.1500 -89648.3309
##     80  2087692.4592             nan     0.1500 -53095.9530
##    100  1951324.9499             nan     0.1500  209.7782
## Warning: model fit failed for Fold05.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2803385.1994             nan     0.1500 299908.8748
##      2  2520446.0814             nan     0.1500 182847.4879
##      3  2458675.0084             nan     0.1500 75684.9541
##      4  2194182.3913             nan     0.1500 -29338.7034
##      5  2070101.1431             nan     0.1500 145357.7511
##      6  1887199.4359             nan     0.1500 5879.1354
##      7  1741719.8465             nan     0.1500 9752.4007
##      8  1747742.0583             nan     0.1500 -27195.4761
##      9  1774908.9711             nan     0.1500 -82447.7668
##     10  1771938.6992             nan     0.1500 -309.5455
##     20  1379411.4709             nan     0.1500 26154.9470
##     40  1072493.4919             nan     0.1500 -25590.7524
##     60   922536.4302             nan     0.1500 1736.7189
##     80   763279.7579             nan     0.1500 -526.4461
##    100   650095.0028             nan     0.1500 -76504.6283
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2858589.3313             nan     0.1500 227081.1667
##      2  2671391.6637             nan     0.1500 86234.5947
##      3  2642697.5925             nan     0.1500 9253.6646
##      4  2632822.5538             nan     0.1500 -24380.5088
##      5  2495683.1907             nan     0.1500 29855.9186
##      6  2492234.3798             nan     0.1500 -18924.7141
##      7  2444605.3792             nan     0.1500 31944.3354
##      8  2349397.2777             nan     0.1500 -11511.0581
##      9  2312274.6717             nan     0.1500 21183.7681
##     10  2321821.3687             nan     0.1500 -44494.8263
##     20  2167364.7110             nan     0.1500 -9004.4434
##     40  2042119.5623             nan     0.1500 -1993.8722
##     60  2035427.3645             nan     0.1500 -1910.0311
##     80  2019980.2389             nan     0.1500 -3284.3923
##    100  1960572.6679             nan     0.1500 -21870.8817

## Warning: model fit failed for Fold05.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2514740.6099             nan     0.2000 87696.2489
##      2  2262171.3783             nan     0.2000 278686.3982
##      3  1992549.9626             nan     0.2000  906.7818
##      4  1831624.1449             nan     0.2000 -94430.6086
##      5  1745970.7717             nan     0.2000 88203.6439
##      6  1684695.2060             nan     0.2000 54917.9216
##      7  1553955.2697             nan     0.2000 -44764.2471
##      8  1509615.3092             nan     0.2000 -117449.2711
##      9  1511541.8745             nan     0.2000 -38251.5558
##     10  1471000.7965             nan     0.2000 8299.0235
##     20  1365344.9130             nan     0.2000 4981.8917
##     40  1221777.5738             nan     0.2000 -70069.6855
##     60  1026189.1606             nan     0.2000 11002.9557
##     80   927846.9122             nan     0.2000 -53544.8215
##    100   607774.6626             nan     0.2000 -52569.9769
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2811371.2388             nan     0.2000 286264.1015
##      2  2617217.8769             nan     0.2000 137072.8009
##      3  2445755.9825             nan     0.2000 146148.7133
##      4  2289029.0181             nan     0.2000 24418.5986
##      5  2176383.3377             nan     0.2000 -1901.3746
##      6  2153157.9636             nan     0.2000 25444.8566
##      7  2113331.9549             nan     0.2000 28010.8877
##      8  2091325.8942             nan     0.2000 -9443.8930
##      9  2072676.2997             nan     0.2000 8142.9479
##     10  2070537.3298             nan     0.2000 -3020.6514
##     20  2025404.6580             nan     0.2000 -80158.3443
##     40  1925736.1152             nan     0.2000 -1201.1519
##     60  1900192.8038             nan     0.2000 -60482.8089
##     80  1851750.4736             nan     0.2000 -44549.8402
##    100  1811793.8651             nan     0.2000 -49606.9255

## Warning: model fit failed for Fold05.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2520614.0384             nan     0.2000 61460.8045
##      2  2307601.2541             nan     0.2000 231586.5325
##      3  2141899.1457             nan     0.2000 187748.0336
##      4  1980922.4529             nan     0.2000 -132799.1583
##      5  1885475.5061             nan     0.2000 116877.1579
##      6  1701645.5403             nan     0.2000 5033.6134
##      7  1714261.9836             nan     0.2000 -61327.9165
##      8  1677197.1842             nan     0.2000 43487.6282
##      9  1691794.6760             nan     0.2000 -46414.5349
##     10  1638615.5014             nan     0.2000 -32865.7406
##     20  1243273.5503             nan     0.2000 -11315.6556
##     40   837120.8424             nan     0.2000 -66972.3170
##     60   649687.5026             nan     0.2000 -100936.0073
##     80   536426.8006             nan     0.2000 -33811.0473
##    100   414778.9706             nan     0.2000 -3085.2352
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2759064.4408             nan     0.2000 264662.4314
##      2  2623287.9819             nan     0.2000 161601.8013
##      3  2587848.9052             nan     0.2000 16415.2937
##      4  2449861.4424             nan     0.2000 97066.0660
##      5  2387381.5693             nan     0.2000 14973.9923
##      6  2354491.1359             nan     0.2000 28345.0759
##      7  2329073.1175             nan     0.2000 32428.1458
##      8  2343723.7294             nan     0.2000 -61425.0060
##      9  2356765.4966             nan     0.2000 -40579.7698
##     10  2299731.3744             nan     0.2000 49017.1635
##     20  2064590.7689             nan     0.2000 -15703.8275
##     40  2033525.8496             nan     0.2000 -43791.5249
##     60  1979743.8037             nan     0.2000 -3012.3267
##     80  1940601.1028             nan     0.2000 -8322.5428
##    100  1884849.8142             nan     0.2000 2762.3124

## Warning: model fit failed for Fold05.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2803510.9404             nan     0.1000 189433.7451
##      2  2672115.2515             nan     0.1000 57277.3868
##      3  2544637.2621             nan     0.1000 32051.6686
##      4  2381048.1875             nan     0.1000 114385.5243
##      5  2172561.3948             nan     0.1000 21340.0394
##      6  2145715.4597             nan     0.1000 28940.4825
##      7  2068684.8971             nan     0.1000 92141.5573
##      8  2010506.1627             nan     0.1000 67455.3432
##      9  1929745.1311             nan     0.1000 55187.5945
##     10  1862756.1872             nan     0.1000 41240.7879
##     20  1574954.0429             nan     0.1000 16957.7702
##     40  1259976.4689             nan     0.1000 5636.3790
##     60  1132567.7408             nan     0.1000 -4977.5050
##     80   992035.8811             nan     0.1000 -28128.0812
##    100   875854.0055             nan     0.1000 -14374.5003
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2958921.2458             nan     0.1000 98185.7586
##      2  2818991.1788             nan     0.1000 122703.6093
##      3  2679762.4941             nan     0.1000 121164.8231
##      4  2627925.3587             nan     0.1000 67296.3070
##      5  2576086.5048             nan     0.1000 57740.1408
##      6  2568360.4213             nan     0.1000 -9527.9685
##      7  2527757.7712             nan     0.1000 46280.4821
##      8  2434240.5195             nan     0.1000 72179.0807
##      9  2421792.4028             nan     0.1000 14006.5325
##     10  2370081.4132             nan     0.1000 35099.4345
##     20  2079202.0269             nan     0.1000 -46570.3004
##     40  2018330.9277             nan     0.1000 -10078.3995
##     60  1909011.5487             nan     0.1000 -4114.5783
##     80  1856635.2443             nan     0.1000 -1070.9186
##    100  1826658.8999             nan     0.1000 -20362.0647

## Warning: model fit failed for Fold06.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2815878.0221             nan     0.1000 188454.6563
##      2  2691215.9425             nan     0.1000 144336.7397
##      3  2633099.0534             nan     0.1000 75718.2048
##      4  2499008.1331             nan     0.1000 147973.0077
##      5  2458680.6596             nan     0.1000 53669.2300
##      6  2253087.8027             nan     0.1000 35336.6017
##      7  2230144.3551             nan     0.1000 26307.0676
##      8  2073265.5664             nan     0.1000 9185.8928
##      9  2008073.3146             nan     0.1000 -5599.7302
##     10  2011864.6839             nan     0.1000 -17926.1781
##     20  1551940.0878             nan     0.1000 7368.6694
##     40  1267476.1263             nan     0.1000 -12299.8692
##     60  1112605.8725             nan     0.1000 -35580.5490
##     80   999221.5372             nan     0.1000 -23488.5659
##    100   901796.5025             nan     0.1000 -16522.7659
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2951012.4929             nan     0.1000 93027.0540
##      2  2782026.7389             nan     0.1000 72538.1364
##      3  2707080.5861             nan     0.1000 83266.4354
##      4  2651216.6413             nan     0.1000 57590.8688
##      5  2611349.5162             nan     0.1000 45480.6480
##      6  2542861.5004             nan     0.1000 57079.1689
##      7  2464468.5336             nan     0.1000 -3668.1112
##      8  2387314.8204             nan     0.1000 66049.1081
##      9  2334167.7957             nan     0.1000 -6486.4184
##     10  2281962.9101             nan     0.1000 -5353.8658
##     20  2103180.8996             nan     0.1000 -34825.0252
##     40  2015628.9175             nan     0.1000 3406.0650
##     60  1953464.4275             nan     0.1000 -5937.4754
##     80  1908075.8846             nan     0.1000 2152.7959
##    100  1852201.2807             nan     0.1000 -17690.3946

## Warning: model fit failed for Fold06.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2808764.0690             nan     0.1500 96044.1716
##      2  2426050.4456             nan     0.1500 124753.3406
##      3  2165783.4175             nan     0.1500 25322.3561
##      4  2066507.6451             nan     0.1500 117919.5728
##      5  1911584.6812             nan     0.1500 -33429.7618
##      6  1822354.0378             nan     0.1500 -92075.4618
##      7  1727992.8179             nan     0.1500 78136.7156
##      8  1671013.8570             nan     0.1500 63316.7678
##      9  1693832.3992             nan     0.1500 -113928.3138
##     10  1656660.9422             nan     0.1500 39460.2436
##     20  1420841.3419             nan     0.1500 -9977.4260
##     40  1148035.2983             nan     0.1500 -17684.1036
##     60   971910.1425             nan     0.1500 -12712.4693
##     80   848160.3044             nan     0.1500 -8383.9338
##    100   722129.8196             nan     0.1500 -16564.5915
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2904456.9536             nan     0.1500 183086.0865
##      2  2840361.7599             nan     0.1500 56261.7042
##      3  2748214.0115             nan     0.1500 122855.7507
##      4  2499033.9970             nan     0.1500 72048.1967
##      5  2349927.2380             nan     0.1500 -7567.1197
##      6  2348333.3180             nan     0.1500 -20382.1543
##      7  2300253.4725             nan     0.1500 58137.8889
##      8  2250863.3168             nan     0.1500 57191.3117
##      9  2254843.5787             nan     0.1500 -19644.4813
##     10  2180614.1452             nan     0.1500 -41592.4190
##     20  2109464.1392             nan     0.1500 1448.3095
##     40  1953928.2095             nan     0.1500 -34487.8751
##     60  1863589.4848             nan     0.1500 -9755.9396
##     80  1792242.2907             nan     0.1500 4282.9993
##    100  1784946.7989             nan     0.1500 3525.8229

## Warning: model fit failed for Fold06.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobsi

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2700259.4272             nan     0.1500 299674.6908
##      2  2619396.7006             nan     0.1500 94712.2187
##      3  2371947.2974             nan     0.1500 192222.5303
##      4  2195110.7592             nan     0.1500 115445.0927
##      5  2170436.6618             nan     0.1500 22051.5706
##      6  2024963.3408             nan     0.1500 104458.7066
##      7  2014649.4773             nan     0.1500 4698.4140
##      8  1900508.0859             nan     0.1500 72275.1176
##      9  1812110.4311             nan     0.1500 44837.3804
##     10  1762641.0592             nan     0.1500 -22313.5350
##     20  1516035.0357             nan     0.1500 -39409.5753
##     40  1159910.6341             nan     0.1500 -128126.2792
##     60   975566.5303             nan     0.1500 -26537.4526
##     80   828743.9846             nan     0.1500 2935.4287
##    100   697250.3441             nan     0.1500 4055.3159
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2836215.3526             nan     0.1500 191678.9174
##      2  2772753.6156             nan     0.1500 64360.2346
##      3  2661179.2395             nan     0.1500 130607.8947
##      4  2642242.1829             nan     0.1500 2615.8739
##      5  2491507.3777             nan     0.1500 24194.8165
##      6  2421001.7240             nan     0.1500 85387.1058
##      7  2422222.3782             nan     0.1500 -20477.6256
##      8  2377221.6396             nan     0.1500 28694.6219
##      9  2279626.3195             nan     0.1500 -8038.7905
##     10  2244491.1017             nan     0.1500 30526.1277
##     20  2072503.8783             nan     0.1500 -2085.5249
##     40  1965958.5396             nan     0.1500 7472.2024
##     60  1905148.0023             nan     0.1500 -39857.8658
##     80  1826178.4182             nan     0.1500 -9570.3003
##    100  1816679.1508             nan     0.1500 -3261.4763

## Warning: model fit failed for Fold06.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobsi

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2819936.7910             nan     0.2000 284269.7605
##      2  2515962.8596             nan     0.2000 260951.6290
##      3  2448815.2721             nan     0.2000 93344.6189
##      4  2118070.8646             nan     0.2000 -27078.6795
##      5  2069251.7745             nan     0.2000 61289.7891
##      6  1955636.1313             nan     0.2000 142224.4731
##      7  1873389.6154             nan     0.2000 105882.3661
##      8  1811618.9449             nan     0.2000 79494.3603
##      9  1763353.2207             nan     0.2000 61062.3065
##     10  1710492.4987             nan     0.2000 -46289.7641
##     20  1362745.4569             nan     0.2000 -91301.9604
##     40   980286.4185             nan     0.2000 -111313.5044
##     60   722049.5297             nan     0.2000 -64030.2535
##     80   556975.4194             nan     0.2000 -1968.4894
##    100   458429.4922             nan     0.2000 -29031.0743
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2811378.5330             nan     0.2000 261453.2638
##      2  2556797.6932             nan     0.2000 93863.1490
##      3  2493292.3144             nan     0.2000 76620.4893
##      4  2412563.5293             nan     0.2000 42630.8699
##      5  2260026.8016             nan     0.2000 20889.1993
##      6  2226477.3192             nan     0.2000 -8548.0289
##      7  2159450.6152             nan     0.2000 -29358.4071
##      8  2150708.6854             nan     0.2000 6443.7508
##      9  2153992.3101             nan     0.2000 -62053.0725
##     10  2119400.0504             nan     0.2000 29997.5471
##     20  2103854.6866             nan     0.2000 -23039.8437
##     40  2006466.7078             nan     0.2000 -80900.2742
##     60  1895941.5715             nan     0.2000 8793.3948
##     80  1800093.2267             nan     0.2000 -12381.0839
##    100  1794388.0636             nan     0.2000 -73496.2727
```

```
## Warning: model fit failed for Fold06.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2703977.8595             nan     0.2000 397345.2284
##      2  2447418.0724             nan     0.2000 300408.1304
##      3  2394255.1602             nan     0.2000 61202.6544
##      4  2149629.7184             nan     0.2000 160491.2917
##      5  2127272.8451             nan     0.2000 14576.5244
##      6  1862220.4666             nan     0.2000 -82476.3341
##      7  1708630.0184             nan     0.2000 -21929.0428
##      8  1671619.5840             nan     0.2000 -61664.3346
##      9  1687634.8327             nan     0.2000 -57418.5606
##     10  1659548.8644             nan     0.2000 -60715.5755
##     20  1325336.3442             nan     0.2000 -22773.6507
##     40   990651.5292             nan     0.2000 -38335.9164
##     60   772106.9642             nan     0.2000  854.9266
##     80   585517.0383             nan     0.2000 -36096.5148
##    100   543992.7091             nan     0.2000 -42636.3552
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2778157.5781             nan     0.2000 299708.7210
##      2  2606704.5853             nan     0.2000 125884.0703
##      3  2528857.2019             nan     0.2000 105592.0188
##      4  2308623.7140             nan     0.2000 48588.9682
##      5  2310703.7279             nan     0.2000 -36007.9347
##      6  2259383.5880             nan     0.2000 65671.7388
##      7  2129470.3555             nan     0.2000 5784.0165
##      8  2106184.2081             nan     0.2000 22023.9088
##      9  2121086.0132             nan     0.2000 -64067.5660
##     10  2097043.8653             nan     0.2000 28498.2521
##     20  1981242.1699             nan     0.2000 -7389.1241
##     40  1937117.6043             nan     0.2000 -11353.5867
##     60  1833505.1727             nan     0.2000 -4111.0980
##     80  1740968.8090             nan     0.2000 -37185.7479
##    100  1715240.2964             nan     0.2000 -3458.6794

## Warning: model fit failed for Fold06.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   987697.6505             nan     0.1000 76387.1661
##      2   922774.7468             nan     0.1000 81748.0397
##      3   840243.8938             nan     0.1000 31823.3545
##      4   803805.6021             nan     0.1000 44005.7425
##      5   773603.8617             nan     0.1000 37761.3337
##      6   743000.0542             nan     0.1000 37856.6490
##      7   719566.5686             nan     0.1000 31735.6405
##      8   665237.4201             nan     0.1000 37979.6862
##      9   652404.1978             nan     0.1000 15164.1965
##     10   617863.8217             nan     0.1000 10404.6472
##     20   530173.9082             nan     0.1000 1869.3876
##     40   475699.9350             nan     0.1000 -14045.5067
##     60   427629.1886             nan     0.1000 -726.8511
##     80   380507.2912             nan     0.1000 -2728.9136
##    100   367975.2658             nan     0.1000 -7706.6742
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  1038224.0781             nan     0.1000 60818.6546
##      2   969285.2596             nan     0.1000 61427.2272
##      3   935672.0003             nan     0.1000 41779.8908
##      4   900557.8398             nan     0.1000 41933.6281
##      5   868018.0971             nan     0.1000 39138.6324
##      6   807102.0954             nan     0.1000 32460.1159
##      7   778631.2650             nan     0.1000 17997.9693
##      8   753816.2469             nan     0.1000 9546.7891
##      9   740915.1819             nan     0.1000 15180.4228
##     10   730498.9265             nan     0.1000 11410.3190
##     20   641242.5360             nan     0.1000 4282.0777
##     40   594489.1582             nan     0.1000 -2119.0753
##     60   592050.3670             nan     0.1000 -8381.6841
##     80   582958.6294             nan     0.1000 -3104.7031
##    100   563706.2547             nan     0.1000 -10222.4431

## Warning: model fit failed for Fold07.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  1008981.2588             nan     0.1000 98126.4352
##      2   953460.5153             nan     0.1000 68814.1768
##      3   859265.5605             nan     0.1000 50432.9667
##      4   793744.8027             nan     0.1000 17793.5464
##      5   720907.0521             nan     0.1000 24441.8931
##      6   672938.6756             nan     0.1000 23157.5958
##      7   633434.7712             nan     0.1000 16090.3964
##      8   620780.2415             nan     0.1000 16567.6617
##      9   586915.2285             nan     0.1000 12164.3242
##     10   579600.5861             nan     0.1000 8351.6722
##     20   467750.6136             nan     0.1000 -9580.1128
##     40   398773.8170             nan     0.1000 -8613.7031
##     60   343173.3936             nan     0.1000 -7091.6989
##     80   339046.2823             nan     0.1000 -1316.5207
##    100   333450.1423             nan     0.1000 -4896.1483
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   997898.6047             nan     0.1000 66154.0477
##      2   941265.1548             nan     0.1000 42519.9280
##      3   893203.4348             nan     0.1000 31651.4423
##      4   868971.7328             nan     0.1000 25222.2965
##      5   813988.7167             nan     0.1000 41213.8995
##      6   786559.4642             nan     0.1000 8508.0044
##      7   736531.0034             nan     0.1000 19961.0369
##      8   716241.2123             nan     0.1000 13963.6052
##      9   703790.6836             nan     0.1000 16453.0053
##     10   700206.3171             nan     0.1000  862.9446
##     20   620646.4307             nan     0.1000 -1595.3875
##     40   581999.9845             nan     0.1000 -3430.1294
##     60   567105.1710             nan     0.1000 -7259.4894
##     80   560114.8945             nan     0.1000 -5099.1777
##    100   557439.3286             nan     0.1000 -16701.7320

## Warning: model fit failed for Fold07.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   929129.9358             nan     0.1500 95423.7605
##      2   867259.5997             nan     0.1500 70889.0639
##      3   817867.7674             nan     0.1500 60017.2246
##      4   772404.5989             nan     0.1500 59791.2488
##      5   684406.6972             nan     0.1500 38971.8157
##      6   659366.0942             nan     0.1500 31612.9284
##      7   602934.8285             nan     0.1500 9299.6597
##      8   563943.7414             nan     0.1500 -455.4168
##      9   553193.2716             nan     0.1500 13177.2567
##     10   545444.7167             nan     0.1500 10364.2391
##     20   441190.7789             nan     0.1500 -10615.9922
##     40   375734.5724             nan     0.1500 -23384.9434
##     60   320446.1762             nan     0.1500 -6665.0639
##     80   267563.7674             nan     0.1500 -6651.7445
##    100   225201.4051             nan     0.1500 -733.5903
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   994434.8220             nan     0.1500 108169.5084
##      2   925445.7571             nan     0.1500 80641.6048
##      3   831354.5942             nan     0.1500 71875.0372
##      4   806813.9945             nan     0.1500 27685.4919
##      5   765602.2323             nan     0.1500 14774.1252
##      6   750511.9903             nan     0.1500 16437.3938
##      7   698049.6470             nan     0.1500 24802.5203
##      8   671537.8255             nan     0.1500 4306.0441
##      9   668306.6468             nan     0.1500  749.4719
##     10   665186.5618             nan     0.1500 3009.2798
##     20   601585.7349             nan     0.1500 -6659.0731
##     40   577312.8763             nan     0.1500 -4468.6581
##     60   557752.8856             nan     0.1500 -8689.0880
##     80   567231.8343             nan     0.1500 1119.4488
##    100   557751.7313             nan     0.1500 -4401.5207

## Warning: model fit failed for Fold07.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: `nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   916757.6753             nan     0.1500 94695.2458
##      2   819428.7188             nan     0.1500 55764.6651
##      3   766074.6931             nan     0.1500 67720.1755
##      4   734006.4269             nan     0.1500 44174.6404
##      5   656500.0791             nan     0.1500 22342.0156
##      6   635070.7617             nan     0.1500 27491.9457
##      7   595104.5040             nan     0.1500 8935.4793
##      8   556286.4026             nan     0.1500 11408.8846
##      9   546723.1213             nan     0.1500 12592.4068
##     10   540401.2794             nan     0.1500 7718.7145
##     20   439544.7635             nan     0.1500 -13463.2318
##     40   402899.8898             nan     0.1500 -18434.4287
##     60   358135.1433             nan     0.1500 -10848.0350
##     80   306328.8580             nan     0.1500 -11078.6453
##    100   257719.8438             nan     0.1500  392.7385
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   979041.5901             nan     0.1500 73157.1989
##      2   872247.1939             nan     0.1500 88691.0167
##      3   800661.6691             nan     0.1500 50840.3886
##      4   757741.1220             nan     0.1500 19707.4342
##      5   710564.2040             nan     0.1500 32788.3955
##      6   700800.5535             nan     0.1500 9377.3715
##      7   682675.9967             nan     0.1500 21230.2814
##      8   675799.3581             nan     0.1500 7507.8592
##      9   642983.9888             nan     0.1500 11089.7901
##     10   641099.6927             nan     0.1500  308.4835
##     20   612181.5119             nan     0.1500 -15304.6106
##     40   576181.2512             nan     0.1500 -12978.5107
##     60   559186.0979             nan     0.1500 -1919.7995
##     80   558528.2146             nan     0.1500 -23826.5395
##    100   560489.2635             nan     0.1500 -3229.1845

## Warning: model fit failed for Fold07.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   938589.4691             nan     0.2000 184211.2985
##      2   834556.4632             nan     0.2000 123116.7710
##      3   709025.6066             nan     0.2000 62759.0681
##      4   628334.5665             nan     0.2000 56586.6067
##      5   574833.9581             nan     0.2000 17878.2440
##      6   562794.0882             nan     0.2000 16804.2154
##      7   553433.3863             nan     0.2000 8702.4835
##      8   547238.2049             nan     0.2000 7269.1153
##      9   525295.5371             nan     0.2000 -20968.9082
##     10   528344.6182             nan     0.2000 -21617.7957
##     20   462953.0632             nan     0.2000 -23163.0919
##     40   351205.9455             nan     0.2000 -21200.9926
##     60   322285.9176             nan     0.2000 -21878.4307
##     80   307975.2323             nan     0.2000 -18037.8057
##    100   276206.4991             nan     0.2000 -7457.6419
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  1025332.4216             nan     0.2000 68399.2726
##      2   855478.9995             nan     0.2000 117887.7606
##      3   743179.6813             nan     0.2000 59386.0660
##      4   716420.5975             nan     0.2000 33666.8765
##      5   665778.3273             nan     0.2000 27582.0354
##      6   632528.6921             nan     0.2000 15151.5021
##      7   603407.2958             nan     0.2000 -2153.4316
##      8   582765.9559             nan     0.2000 -336.4716
##      9   581481.8161             nan     0.2000 -3344.0546
##     10   585233.1042             nan     0.2000 -15822.6975
##     20   556377.3713             nan     0.2000 -6610.2991
##     40   540155.2075             nan     0.2000 -13193.9094
##     60   539484.4083             nan     0.2000 -22247.9770
##     80   532300.5484             nan     0.2000 -14510.4185
##    100   529681.6065             nan     0.2000 -11118.0332

## Warning: model fit failed for Fold07.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   946519.6110             nan     0.2000 174345.5517
##      2   761469.5264             nan     0.2000 116272.7931
##      3   723293.2105             nan     0.2000 46408.1862
##      4   615674.0683             nan     0.2000 6392.0234
##      5   597746.1322             nan     0.2000 21578.5987
##      6   543361.2523             nan     0.2000 13826.8868
##      7   542161.3337             nan     0.2000 -4460.3908
##      8   504413.0441             nan     0.2000 1721.4300
##      9   475028.6041             nan     0.2000 -7623.1716
##     10   453173.3007             nan     0.2000 -6639.9585
##     20   383773.6041             nan     0.2000 7185.1343
##     40   319589.3895             nan     0.2000 -6573.3494
##     60   288820.4835             nan     0.2000 -6200.5873
##     80   269784.8065             nan     0.2000 -15782.7693
##    100   236921.4585             nan     0.2000 -18788.6447
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1   942665.4010             nan     0.2000 99051.2778
##      2   834526.6531             nan     0.2000 73923.3347
##      3   772350.2932             nan     0.2000 43037.5360
##      4   709959.3276             nan     0.2000 36612.0689
##      5   670306.7814             nan     0.2000 18907.0500
##      6   659536.7295             nan     0.2000 -10876.0265
##      7   657119.7338             nan     0.2000 -7851.7162
##      8   633417.6056             nan     0.2000 12500.5211
##      9   633023.9584             nan     0.2000 -3229.7508
##     10   616802.8564             nan     0.2000 2132.3100
##     20   599526.4919             nan     0.2000  369.1275
##     40   577339.1619             nan     0.2000 -27671.2664
##     60   546177.2148             nan     0.2000 -15179.8141
##     80   543575.8461             nan     0.2000 -22041.8500
##    100   551683.1996             nan     0.2000 -1873.7160
```

```
## Warning: model fit failed for Fold07.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: `nTrain * bag.fraction <= n.minobsi
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2858287.7324             nan     0.1000 188807.0565
##      2  2632778.9199             nan     0.1000 185873.2152
##      3  2407703.3179             nan     0.1000 45771.9595
##      4  2373231.7810             nan     0.1000 35866.9390
##      5  2196045.3158             nan     0.1000 31847.9538
##      6  2084214.1878             nan     0.1000 81651.3711
##      7  2018124.7938             nan     0.1000 6546.0757
##      8  2014632.0003             nan     0.1000 -11094.6481
##      9  2005546.8683             nan     0.1000 6636.0386
##     10  1890809.8132             nan     0.1000 -20769.9659
##     20  1588263.9098             nan     0.1000 -32860.0119
##     40  1321742.4940             nan     0.1000 -7613.7051
##     60  1172279.3812             nan     0.1000 -62971.1171
##     80  1158494.0372             nan     0.1000 -55916.5215
##    100   983097.2955             nan     0.1000 -18943.6401
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2961027.6958             nan     0.1000 144089.0959
##      2  2906943.7491             nan     0.1000 56081.1180
##      3  2738406.7559             nan     0.1000 50719.5819
##      4  2711980.3754             nan     0.1000 22729.4070
##      5  2668205.8098             nan     0.1000 52665.4621
##      6  2659755.9123             nan     0.1000 -6318.6298
##      7  2641213.4843             nan     0.1000 22302.3560
##      8  2629644.7973             nan     0.1000 9458.5783
##      9  2556933.9505             nan     0.1000 54518.2848
##     10  2559238.2752             nan     0.1000 -16077.6630
##     20  2355554.6710             nan     0.1000 -13316.0790
##     40  2207390.0994             nan     0.1000 -31700.0810
##     60  2103087.2430             nan     0.1000 -43553.8946
##     80  2038717.3145             nan     0.1000 -42789.2231
##    100  2003431.9449             nan     0.1000 -57888.7469

## Warning: model fit failed for Fold08.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2806406.4835             nan     0.1000 123320.2778
##      2  2668132.3559             nan     0.1000 157264.2835
##      3  2480442.9517             nan     0.1000 118646.5451
##      4  2346965.8474             nan     0.1000 93575.2096
##      5  2317193.0612             nan     0.1000 36597.3586
##      6  2296889.8691             nan     0.1000 18073.6783
##      7  2212493.2046             nan     0.1000 10978.1276
##      8  2113036.1378             nan     0.1000 72097.0445
##      9  2109686.4693             nan     0.1000 -6402.5859
##     10  2073597.9938             nan     0.1000 44195.2758
##     20  1657923.8123             nan     0.1000 15144.4347
##     40  1379092.9370             nan     0.1000 -92391.5376
##     60  1092820.8272             nan     0.1000 9773.5894
##     80   980371.1689             nan     0.1000 -4069.0758
##    100   856293.7492             nan     0.1000 -20399.5949
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2877999.3375             nan     0.1000 111657.1801
##      2  2817058.2091             nan     0.1000 82427.6504
##      3  2727243.6590             nan     0.1000 82992.9325
##      4  2617119.6107             nan     0.1000 17747.7407
##      5  2543950.2821             nan     0.1000 87103.0638
##      6  2492493.8156             nan     0.1000 42502.6425
##      7  2420216.1977             nan     0.1000 43435.0947
##      8  2413001.4992             nan     0.1000 -4493.3395
##      9  2409912.0901             nan     0.1000 -9924.5953
##     10  2359270.8950             nan     0.1000 27656.0242
##     20  2180240.6657             nan     0.1000 -8247.2911
##     40  2095400.3208             nan     0.1000 -1677.3523
##     60  2037641.4795             nan     0.1000 1155.2448
##     80  1997497.4659             nan     0.1000 -19371.9422
##    100  1961262.9350             nan     0.1000 -112.5868

## Warning: model fit failed for Fold08.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2644326.7281             nan     0.1500 100238.9853
##      2  2371051.4558             nan     0.1500 -22511.8308
##      3  2197900.4007             nan     0.1500 42995.8062
##      4  2071844.3404             nan     0.1500 141887.1380
##      5  2047411.1448             nan     0.1500 8844.4541
##      6  1867257.4557             nan     0.1500 14038.8820
##      7  1731638.8278             nan     0.1500 -7251.5802
##      8  1639164.3462             nan     0.1500 -72362.2613
##      9  1621101.6899             nan     0.1500 15193.1805
##     10  1556264.2860             nan     0.1500 18737.9623
##     20  1619262.8402             nan     0.1500 -42119.9740
##     40  1203495.3925             nan     0.1500 -62439.1192
##     60  1034190.8496             nan     0.1500 -19827.0053
##     80   900697.4721             nan     0.1500 -42805.3375
##    100   815288.7262             nan     0.1500 -36917.3037
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2866095.3707             nan     0.1500 195204.2876
##      2  2731530.7912             nan     0.1500 149686.1574
##      3  2636128.4833             nan     0.1500 108272.7711
##      4  2523584.1989             nan     0.1500 90993.0030
##      5  2425944.1114             nan     0.1500 -19347.5372
##      6  2349085.8486             nan     0.1500 -61357.7782
##      7  2323264.7080             nan     0.1500 7945.7407
##      8  2307657.4403             nan     0.1500 17793.2299
##      9  2287906.9672             nan     0.1500 20874.5445
##     10  2270692.5940             nan     0.1500 -75392.2221
##     20  2140109.6576             nan     0.1500 -40307.0252
##     40  2002265.3238             nan     0.1500 -5712.1459
##     60  1985743.7505             nan     0.1500 -810.7387
##     80  1963861.0705             nan     0.1500 -2735.0372
##    100  1940866.5340             nan     0.1500 -16128.3595

## Warning: model fit failed for Fold08.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2662351.1510             nan     0.1500 131016.5233
##      2  2361648.5653             nan     0.1500 99635.4495
##      3  2184132.8776             nan     0.1500 139725.7294
##      4  2092881.0844             nan     0.1500 12464.2728
##      5  2003438.4172             nan     0.1500 -1564.9144
##      6  1897347.9222             nan     0.1500 66824.3120
##      7  1735258.1242             nan     0.1500 -7747.9356
##      8  1625305.4814             nan     0.1500 -35539.3538
##      9  1565888.1439             nan     0.1500 66454.4657
##     10  1552239.5874             nan     0.1500 15727.4330
##     20  1391125.2272             nan     0.1500 9868.6923
##     40  1010900.6476             nan     0.1500 -7222.7641
##     60   841947.4035             nan     0.1500 -40114.2232
##     80   684882.2728             nan     0.1500 -2309.5252
##    100   592725.5913             nan     0.1500 -29492.8196
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2807181.5949             nan     0.1500 119925.6216
##      2  2690135.9925             nan     0.1500 131568.0074
##      3  2631424.4152             nan     0.1500 58076.2718
##      4  2602945.4974             nan     0.1500 23843.1230
##      5  2474778.1621             nan     0.1500 -18056.7129
##      6  2429832.9437             nan     0.1500 20555.8641
##      7  2372234.3844             nan     0.1500 -49351.8680
##      8  2347942.6906             nan     0.1500 17692.8882
##      9  2354226.8759             nan     0.1500 -63560.0540
##     10  2362520.4283             nan     0.1500 -41386.5718
##     20  2272232.5918             nan     0.1500 12915.8076
##     40  2205489.0491             nan     0.1500 -2554.4110
##     60  2062607.0255             nan     0.1500 -9341.5490
##     80  2025145.0322             nan     0.1500 -4731.8256
##    100  1988638.7123             nan     0.1500 -32028.4268

## Warning: model fit failed for Fold08.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2640527.6155             nan     0.2000 371622.1434
##      2  2549384.8760             nan     0.2000 103408.2102
##      3  2243715.6047             nan     0.2000 221824.6913
##      4  2031163.9576             nan     0.2000 172161.5673
##      5  1815935.6491             nan     0.2000 -12239.5945
##      6  1736391.3500             nan     0.2000 18118.9230
##      7  1683987.8382             nan     0.2000 -53141.7773
##      8  1637506.0871             nan     0.2000 -18781.0115
##      9  1562343.8540             nan     0.2000 -125848.1568
##     10  1468181.4208             nan     0.2000 -20707.1339
##     20  1269089.5277             nan     0.2000 45672.6863
##     40   994996.7271             nan     0.2000 1537.7885
##     60   790648.9380             nan     0.2000 -33993.5847
##     80   658567.6970             nan     0.2000 -30418.5417
##    100   591501.4370             nan     0.2000 -77997.2751
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2813209.6990             nan     0.2000 253945.0550
##      2  2617968.4170             nan     0.2000 -52567.0844
##      3  2498123.5892             nan     0.2000 70808.9581
##      4  2416131.9002             nan     0.2000 -86096.3218
##      5  2382173.0158             nan     0.2000 19016.4463
##      6  2369576.3223             nan     0.2000 -48101.7139
##      7  2370965.7340             nan     0.2000 -40598.6755
##      8  2352075.8100             nan     0.2000 20614.8214
##      9  2344371.7526             nan     0.2000 8418.5056
##     10  2317096.9800             nan     0.2000 16652.0941
##     20  2260529.5259             nan     0.2000 -100486.1682
##     40  2138245.2784             nan     0.2000 -83588.5319
##     60  2058350.0350             nan     0.2000  489.6362
##     80  2046347.1732             nan     0.2000 -44517.8661
##    100  2001562.1097             nan     0.2000 -55187.5941

## Warning: model fit failed for Fold08.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2728866.2259             nan     0.2000 405062.1329
##      2  2375034.8717             nan     0.2000 273206.6680
##      3  2196553.1826             nan     0.2000 213375.2954
##      4  2063772.4793             nan     0.2000 156566.6916
##      5  1856704.5120             nan     0.2000 -43650.8423
##      6  1767067.3484             nan     0.2000 -192570.5852
##      7  1718992.4023             nan     0.2000 -86198.9569
##      8  1682474.8949             nan     0.2000 30165.4121
##      9  1577446.0391             nan     0.2000 -33086.3203
##     10  1579546.7153             nan     0.2000 -44160.1742
##     20  1327725.3769             nan     0.2000 -24444.3484
##     40   994455.9875             nan     0.2000 -128312.0406
##     60   832995.8017             nan     0.2000 -18666.4717
##     80   656171.8052             nan     0.2000 -19626.3380
##    100   504663.6893             nan     0.2000 -76198.5549
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2820325.5933             nan     0.2000 306483.2045
##      2  2730026.0108             nan     0.2000 102782.7726
##      3  2610033.9650             nan     0.2000 141443.1421
##      4  2498929.7339             nan     0.2000 79213.8920
##      5  2471924.4834             nan     0.2000 26293.6919
##      6  2464812.7619             nan     0.2000 -8045.9485
##      7  2366498.0652             nan     0.2000 88833.1830
##      8  2281888.4878             nan     0.2000 52759.5511
##      9  2295991.3423             nan     0.2000 -42504.0943
##     10  2147316.8406             nan     0.2000 -25318.3878
##     20  2008149.8363             nan     0.2000 9255.9611
##     40  1945527.2629             nan     0.2000 -637.7431
##     60  1885415.2148             nan     0.2000 -9853.0990
##     80  1805214.9508             nan     0.2000 -114029.3795
##    100  1781197.4168             nan     0.2000 -5453.8778

## Warning: model fit failed for Fold08.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3017706.1054             nan     0.1000 80602.0823
##      2  2724461.3758             nan     0.1000 73265.1667
##      3  2652073.4012             nan     0.1000 95395.2604
##      4  2515563.8638             nan     0.1000 53476.1668
##      5  2413464.6518             nan     0.1000 116640.4588
##      6  2328190.7960             nan     0.1000 100623.1401
##      7  2300402.5540             nan     0.1000 35534.2381
##      8  2138289.7372             nan     0.1000 14775.8949
##      9  2117718.3411             nan     0.1000 27588.1474
##     10  2097458.6906             nan     0.1000 26553.2527
##     20  1689933.1879             nan     0.1000 -36729.3773
##     40  1386362.7551             nan     0.1000 -14426.3968
##     60  1187209.0921             nan     0.1000 -22033.2469
##     80   951824.2308             nan     0.1000 -19508.3046
##    100   823716.2412             nan     0.1000 2027.7977
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3013084.1535             nan     0.1000 95149.7259
##      2  2951123.7822             nan     0.1000 70406.2098
##      3  2798345.4008             nan     0.1000 124493.5196
##      4  2723935.0924             nan     0.1000 88395.1458
##      5  2618069.5979             nan     0.1000 10570.3851
##      6  2490128.8544             nan     0.1000 36048.9487
##      7  2460242.0493             nan     0.1000 31030.9685
##      8  2368628.4918             nan     0.1000 8507.0996
##      9  2351964.5286             nan     0.1000 18979.3957
##     10  2322589.9653             nan     0.1000 9181.4928
##     20  2142235.0199             nan     0.1000 -3214.6183
##     40  2008366.4119             nan     0.1000 -4422.9189
##     60  1940503.8753             nan     0.1000 -28925.6844
##     80  1896766.9215             nan     0.1000 -20853.1474
##    100  1876360.2327             nan     0.1000 -8413.1316

## Warning: model fit failed for Fold09.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2900740.7424             nan     0.1000 79011.8283
##      2  2796243.3140             nan     0.1000 37776.4192
##      3  2609874.8032             nan     0.1000 156555.1225
##      4  2390799.6901             nan     0.1000 23423.6469
##      5  2293236.0963             nan     0.1000 103018.7111
##      6  2218921.6903             nan     0.1000 91572.4600
##      7  2146176.5222             nan     0.1000 49658.8354
##      8  2037259.8014             nan     0.1000 -18070.0497
##      9  1977432.5837             nan     0.1000 18866.4664
##     10  1993861.3852             nan     0.1000 -71249.3186
##     20  1761175.2242             nan     0.1000 -4599.2925
##     40  1571484.0935             nan     0.1000 10832.5620
##     60  1437511.2852             nan     0.1000 -36650.2968
##     80  1273202.9429             nan     0.1000 -11614.1238
##    100  1188387.2840             nan     0.1000 -73236.8968
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2883328.4721             nan     0.1000 109351.0932
##      2  2768700.2956             nan     0.1000 105870.4985
##      3  2658907.3037             nan     0.1000 13681.2765
##      4  2538509.6739             nan     0.1000 39755.8860
##      5  2502824.0091             nan     0.1000 36182.3702
##      6  2488287.0931             nan     0.1000 5515.4866
##      7  2455264.3048             nan     0.1000 36662.1924
##      8  2434589.1795             nan     0.1000 22009.9366
##      9  2362225.0132             nan     0.1000 -10870.9193
##     10  2319618.5595             nan     0.1000 39049.5107
##     20  2235408.7715             nan     0.1000 -21238.4171
##     40  2082370.7985             nan     0.1000 -35668.5664
##     60  2009618.4116             nan     0.1000 -5777.0948
##     80  1983427.8194             nan     0.1000 -52155.7770
##    100  1933469.7981             nan     0.1000 -50759.2910

## Warning: model fit failed for Fold09.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2706372.4454             nan     0.1500 323501.6602
##      2  2464154.0398             nan     0.1500 160144.2538
##      3  2246999.3259             nan     0.1500 -90159.7442
##      4  2134325.8031             nan     0.1500 121992.8642
##      5  2035891.2854             nan     0.1500 110241.2983
##      6  1896143.2157             nan     0.1500 -88007.8353
##      7  1854878.2538             nan     0.1500 40112.6117
##      8  1830254.5336             nan     0.1500 -63862.6089
##      9  1787852.1958             nan     0.1500 -30297.1985
##     10  1743570.6321             nan     0.1500 25369.5373
##     20  1449335.9395             nan     0.1500 -33500.5460
##     40  1033012.1513             nan     0.1500 -87463.6868
##     60   839875.9124             nan     0.1500 -37741.5791
##     80   660480.9842             nan     0.1500 -35480.7533
##    100   571793.1319             nan     0.1500 -30246.5289
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2886972.9979             nan     0.1500 209092.9895
##      2  2826253.2055             nan     0.1500 59111.8423
##      3  2752238.4061             nan     0.1500 96016.9411
##      4  2676438.9935             nan     0.1500 90516.9365
##      5  2650610.4243             nan     0.1500 29753.3236
##      6  2559133.8469             nan     0.1500 73992.8518
##      7  2493049.5974             nan     0.1500 56934.6110
##      8  2376472.1767             nan     0.1500 -3588.5746
##      9  2302024.6175             nan     0.1500 -43343.3198
##     10  2290418.9848             nan     0.1500 12794.2858
##     20  2099198.0723             nan     0.1500 -20740.0811
##     40  2017881.9204             nan     0.1500 -35288.3864
##     60  1896015.2481             nan     0.1500 -9148.7347
##     80  1867088.0237             nan     0.1500 7252.9734
##    100  1845369.1518             nan     0.1500 -1858.6234
```

```
## Warning: model fit failed for Fold09.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2794077.9824             nan     0.1500 145131.4345
##      2  2421629.8091             nan     0.1500 84608.0549
##      3  2280722.8486             nan     0.1500 40279.1852
##      4  2245505.1446             nan     0.1500 35544.6468
##      5  2203044.6825             nan     0.1500 52484.8133
##      6  2117962.0781             nan     0.1500 94433.3676
##      7  2109197.4279             nan     0.1500 -3110.7932
##      8  1973794.1501             nan     0.1500 107387.2123
##      9  1962738.8432             nan     0.1500 10826.8055
##     10  1859287.7989             nan     0.1500 56966.3865
##     20  1409599.8633             nan     0.1500 -7545.6436
##     40  1179803.8966             nan     0.1500 6963.8391
##     60   870714.9452             nan     0.1500 -47840.6446
##     80   672859.1551             nan     0.1500 -13523.9224
##    100   594097.4744             nan     0.1500 1286.5153
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2988809.1800             nan     0.1500 115559.4653
##      2  2804012.1680            nan     0.1500 172468.5613
##      3  2740151.8727            nan     0.1500 73053.6097
##      4  2620939.2987            nan     0.1500 135454.7066
##      5  2449535.3973            nan     0.1500 35768.4418
##      6  2412900.7751            nan     0.1500 44043.3348
##      7  2299163.0854            nan     0.1500 -745.9416
##      8  2255649.4394            nan     0.1500 -65659.3344
##      9  2224458.4453            nan     0.1500 37734.1641
##     10  2233473.2369            nan     0.1500 -52289.5868
##     20  2054166.9959            nan     0.1500 29671.7920
##     40  2005384.0395            nan     0.1500 2978.0726
##     60  1973198.1093            nan     0.1500 7709.2058
##     80  1934115.6185            nan     0.1500 -6022.9436
##    100  1947743.0448            nan     0.1500 -1860.6436
```

```
## Warning: model fit failed for Fold09.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2785187.9256            nan     0.2000 326002.6226
##      2  2495072.5323            nan     0.2000 325390.6828
##      3  2445214.4280            nan     0.2000 58481.4843
##      4  2123706.3996            nan     0.2000 -44374.9982
##      5  2018720.6065            nan     0.2000 124504.6008
##      6  2036281.6136            nan     0.2000 -70099.2089
##      7  1948666.8046            nan     0.2000 121111.6148
##      8  1797915.2371            nan     0.2000 -133798.3828
##      9  1737956.3725            nan     0.2000 16273.9608
##     10  1762854.6964            nan     0.2000 -103719.5974
##     20  1553502.9291            nan     0.2000 -66596.8964
##     40  1136599.2522            nan     0.2000 -87449.1472
##     60   963655.9173            nan     0.2000 -18445.2668
##     80   935445.7563            nan     0.2000 -12222.3253
##    100   667208.6390            nan     0.2000 7888.3095
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2891570.5883            nan     0.2000 195557.8352
##      2  2747047.7665            nan     0.2000 151646.3082
##      3  2476079.4219            nan     0.2000 54063.2706
##      4  2332935.1240            nan     0.2000 127189.4631
##      5  2339694.0203            nan     0.2000 -49712.0769
##      6  2274180.0873            nan     0.2000 47853.1503
##      7  2224666.7923            nan     0.2000 30039.7806
##      8  2233955.8967            nan     0.2000 -43015.1063
##      9  2245556.6293            nan     0.2000 -35531.5483
##     10  2220714.2869            nan     0.2000 29231.6598
##     20  2144939.1716            nan     0.2000 -7189.5339
##     40  2026966.7402            nan     0.2000 -57973.5857
##     60  1864034.1891            nan     0.2000 -57047.9262
##     80  1799446.6473            nan     0.2000 -3007.9841
##    100  1752165.4900            nan     0.2000  228.0331
```

```
## Warning: model fit failed for Fold09.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2599822.6882             nan     0.2000 391468.5856
##      2  2400998.8216             nan     0.2000 228763.4408
##      3  2152346.7806             nan     0.2000 187599.2931
##      4  1996792.7237             nan     0.2000 86880.6644
##      5  1919376.0113             nan     0.2000 -12686.4468
##      6  1860670.6527             nan     0.2000 65655.8767
##      7  1880984.2015             nan     0.2000 -87801.7758
##      8  1896620.6928             nan     0.2000 -44205.0920
##      9  1826979.8107             nan     0.2000 68093.5273
##     10  1863268.9144             nan     0.2000 -104359.2451
##     20  1535947.7484             nan     0.2000 -33491.3393
##     40  1031544.8778             nan     0.2000 -188450.8154
##     60   812722.0175             nan     0.2000 -14441.2666
##     80   687385.6111             nan     0.2000 -4578.6646
##    100   547650.1746             nan     0.2000 2244.5995
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2824096.2621             nan     0.2000 256131.8039
##      2  2770541.6035             nan     0.2000 33423.9522
##      3  2677098.0207             nan     0.2000 117178.0765
##      4  2563288.2724             nan     0.2000 84190.2693
##      5  2427500.7268             nan     0.2000 9412.3343
##      6  2362048.4855             nan     0.2000 41981.0929
##      7  2312228.6012             nan     0.2000 58552.6748
##      8  2294817.0790             nan     0.2000 22315.0663
##      9  2254257.3006             nan     0.2000 -85326.6769
##     10  2227110.9816             nan     0.2000 35847.5782
##     20  2008403.6418             nan     0.2000 -47270.9879
##     40  1882789.8121             nan     0.2000 -40065.4324
##     60  1865487.2913             nan     0.2000 -77128.0584
##     80  1844657.8467             nan     0.2000 -8282.1619
##    100  1806762.4148             nan     0.2000  644.2175

## Warning: model fit failed for Fold09.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2991520.0891             nan     0.1000 129284.7134
##      2  2818459.9122             nan     0.1000 183110.9775
##      3  2587354.7717             nan     0.1000 68265.8744
##      4  2475321.7201             nan     0.1000 130288.1286
##      5  2448916.0038             nan     0.1000 27725.6425
##      6  2422301.3746             nan     0.1000 33854.7051
##      7  2290417.2084             nan     0.1000 84032.6305
##      8  2134798.8091             nan     0.1000 -1579.3759
##      9  2014092.8559             nan     0.1000 -17630.8390
##     10  1916576.2244             nan     0.1000 -22977.5233
##     20  1683255.3672             nan     0.1000 20688.1139
##     40  1439172.4066             nan     0.1000 3392.7630
##     60  1351498.4673             nan     0.1000 -59773.4388
##     80  1206010.7997             nan     0.1000 -34522.0671
##    100  1087598.2607             nan     0.1000 -9583.8326
##
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3018462.7907             nan     0.1000 90759.1284
##      2  2962337.1081             nan     0.1000 59885.0738
##      3  2761902.7425             nan     0.1000 67409.0946
##      4  2656818.6729             nan     0.1000 76982.9024
##      5  2560653.1038             nan     0.1000 -15156.4612
##      6  2524277.4430             nan     0.1000 36381.0362
##      7  2493727.1579             nan     0.1000 30059.3334
##      8  2491454.1184             nan     0.1000 -16172.1003
##      9  2417470.5682             nan     0.1000 -1887.7153
##     10  2327352.2530             nan     0.1000 18189.6741
##     20  2161248.3107             nan     0.1000 -43265.8907
##     40  2028310.2402             nan     0.1000 -37009.5014
##     60  1995432.1002             nan     0.1000 -29912.6393
##     80  1959782.3631             nan     0.1000 -38545.8706
##    100  1942483.4940             nan     0.1000 -64683.8698

## Warning: model fit failed for Fold10.Rep1: shrinkage=0.10, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2988266.3445             nan     0.1000 137850.2663
##      2  2899052.4462             nan     0.1000 113376.9748
##      3  2836054.0036             nan     0.1000 83930.0499
##      4  2704484.3059             nan     0.1000 147368.1984
##      5  2592864.7224             nan     0.1000 133525.6810
##      6  2431981.4442             nan     0.1000 132684.8135
##      7  2240982.9892             nan     0.1000 22415.8333
##      8  2087788.1819             nan     0.1000 -3184.6306
##      9  1994867.5800             nan     0.1000 66726.7648
##     10  1998256.5390             nan     0.1000 -21484.9665
##     20  1787828.5248             nan     0.1000 -30136.5539
##     40  1431671.8117             nan     0.1000 -32795.5983
##     60  1225852.7004             nan     0.1000 -35986.3817
##     80  1182563.7436             nan     0.1000 -16116.1734
##    100  1029065.1895             nan     0.1000 -6780.3487
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3008655.4787             nan     0.1000 109419.8300
##      2  2940977.9734             nan     0.1000 83842.1921
##      3  2754822.6663             nan     0.1000 76632.4250
##      4  2724362.7500             nan     0.1000 28609.9236
##      5  2710219.4274             nan     0.1000 3428.1377
##      6  2567627.8119             nan     0.1000 28948.4302
##      7  2522876.7608             nan     0.1000 49614.1003
##      8  2473485.4735             nan     0.1000 54721.8261
##      9  2414287.7693             nan     0.1000 -8013.7348
##     10  2375047.2589             nan     0.1000 25915.7652
##     20  2232593.0465             nan     0.1000 8914.3611
##     40  2075346.9572             nan     0.1000 -31806.1275
##     60  2004844.9391             nan     0.1000 -866.6273
##     80  1945174.0206             nan     0.1000 -36568.6242
##    100  1917722.1425             nan     0.1000 5296.2623
## Warning: model fit failed for Fold10.Rep1: shrinkage=0.10, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2750759.6561             nan     0.1500 252933.8439
##      2  2537913.5124             nan     0.1500 235931.8284
##      3  2457224.3399             nan     0.1500 105194.3109
##      4  2423498.9253             nan     0.1500 27356.9957
##      5  2219963.5924             nan     0.1500 126907.3667
##      6  1988796.6103             nan     0.1500 21286.4695
##      7  1997790.2658             nan     0.1500 -34031.2995
##      8  1934073.5253             nan     0.1500 67486.1201
##      9  1943507.6638             nan     0.1500 -29444.7786
##     10  1833536.2551             nan     0.1500 -133799.1965
##     20  1652352.3111             nan     0.1500 30800.2612
##     40  1202449.9445             nan     0.1500 10522.8561
##     60  1065250.8696             nan     0.1500 -45227.1075
##     80   849303.7453             nan     0.1500 -16266.2413
##    100   800463.7455             nan     0.1500 -22484.6615
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2880809.9304             nan     0.1500 202132.2196
##      2  2786430.0412             nan     0.1500 110344.0638
##      3  2643041.7186             nan     0.1500 122222.6735
##      4  2585465.2585             nan     0.1500 65522.9956
##      5  2522783.4919             nan     0.1500 68895.5927
##      6  2466083.2958             nan     0.1500 53119.1985
##      7  2437004.3329             nan     0.1500 35178.8424
##      8  2399895.9528             nan     0.1500 36744.5765
##      9  2340664.1544             nan     0.1500 -42711.9938
##     10  2331949.9269             nan     0.1500 10404.9557
##     20  2255105.7272             nan     0.1500 -33594.1911
##     40  2119882.7394             nan     0.1500 -54399.6661
##     60  2030500.1782             nan     0.1500 -55616.0848
##     80  1997021.6890             nan     0.1500 -735.2720
##    100  1979968.7203             nan     0.1500 -3891.3130

## Warning: model fit failed for Fold10.Rep1: shrinkage=0.15, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2853068.0102             nan     0.1500 98880.8541
##      2  2645634.4859             nan     0.1500 207280.4483
##      3  2502654.2405             nan     0.1500 16229.7445
##      4  2436486.0428             nan     0.1500 90920.6938
##      5  2218857.3332             nan     0.1500 175316.1989
##      6  2004733.2065             nan     0.1500 14766.7388
##      7  1833171.0432             nan     0.1500 -53416.0474
##      8  1769621.2870             nan     0.1500 33094.4676
##      9  1754376.4514             nan     0.1500 11827.7654
##     10  1711873.7007             nan     0.1500 -34404.8169
##     20  1411742.8907             nan     0.1500 -18451.9714
##     40  1153903.8832             nan     0.1500 -40145.3754
##     60   996629.8819             nan     0.1500  819.3258
##     80   841122.6362             nan     0.1500 -7759.6408
##    100   785976.7614             nan     0.1500 -42286.5246
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  3010089.2365             nan     0.1500 83469.3963
##      2  2855804.6401             nan     0.1500 176405.9545
##      3  2740931.1174             nan     0.1500 136609.2384
##      4  2735168.1117             nan     0.1500 -27396.4251
##      5  2542121.3301             nan     0.1500 -12556.5987
##      6  2401499.6503             nan     0.1500 19754.5179
##      7  2325415.2041             nan     0.1500 1610.9077
##      8  2297764.4524             nan     0.1500 34569.7358
##      9  2259757.4217             nan     0.1500 49551.4508
##     10  2265678.3578             nan     0.1500 -21677.4110
##     20  2200180.9341             nan     0.1500 7652.6934
##     40  2042061.6377             nan     0.1500 6403.8075
##     60  1981310.2164             nan     0.1500 -82160.4333
##     80  1893480.2705             nan     0.1500 -6827.8704
##    100  1899593.0017             nan     0.1500 -111262.4088
```

```
## Warning: model fit failed for Fold10.Rep1: shrinkage=0.15, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2654658.0457             nan     0.2000 360782.7861
##      2  2403220.1796             nan     0.2000 276227.8407
##      3  2339126.8209             nan     0.2000 81757.3799
##      4  2287051.4184             nan     0.2000 64158.4165
##      5  2151634.9816             nan     0.2000 172748.8857
##      6  2139675.5958             nan     0.2000 12618.8904
##      7  1890832.4664             nan     0.2000 -16695.5315
##      8  1891054.6303             nan     0.2000 -5773.4634
##      9  1808860.1971             nan     0.2000 101160.2116
##     10  1711960.8907             nan     0.2000 51817.1715
##     20  1425704.2124             nan     0.2000 -49792.2107
##     40  1036302.2188             nan     0.2000 -52258.8840
##     60   807438.1261             nan     0.2000 -98737.0142
##     80   733977.4294             nan     0.2000 -48499.4078
##    100   640047.8754             nan     0.2000 -8776.2784
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2697471.3538             nan     0.2000 191647.8614
##      2  2522076.6517             nan     0.2000 147273.1334
##      3  2500147.6248             nan     0.2000 -3268.0459
##      4  2391999.7223             nan     0.2000 63880.6222
##      5  2287545.5433             nan     0.2000 -22933.0775
##      6  2245049.8606             nan     0.2000 -4443.9061
##      7  2233901.0532             nan     0.2000 9213.0518
##      8  2178342.2078             nan     0.2000 -59247.5503
##      9  2159565.8435             nan     0.2000 -614.2939
##     10  2157112.6603             nan     0.2000 2339.8182
##     20  2166058.6052             nan     0.2000 -53775.0313
##     40  2045945.8930             nan     0.2000 -2977.1764
##     60  1985654.5472             nan     0.2000 -52672.4154
##     80  1983709.5079             nan     0.2000 -27792.6015
##    100  1988289.7447             nan     0.2000 -92000.9135

## Warning: model fit failed for Fold10.Rep1: shrinkage=0.20, interaction.depth=2, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2783594.0971             nan     0.2000 336613.8336
##      2  2287669.2156             nan     0.2000 83943.8015
##      3  2245789.2065             nan     0.2000 44354.4856
##      4  2129589.8297             nan     0.2000 140955.6849
##      5  2107692.9345             nan     0.2000 24082.2224
##      6  2093111.2968             nan     0.2000 17380.2547
##      7  1830164.7816             nan     0.2000 -20371.0987
##      8  1747244.8656             nan     0.2000 -18263.6057
##      9  1760273.4252             nan     0.2000 -33060.5729
##     10  1691088.2560             nan     0.2000 60148.5747
##     20  1281074.3133             nan     0.2000 2057.7678
##     40  1162777.2931             nan     0.2000 -126160.6841
##     60   798724.5926             nan     0.2000 -1724.1257
##     80   748917.8317             nan     0.2000 -50125.9851
##    100   691513.2875             nan     0.2000 -25765.7222
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2852587.2400             nan     0.2000 274424.2477
##      2  2692344.0875             nan     0.2000 146481.9833
##      3  2440566.3531             nan     0.2000 37023.6027
##      4  2386201.5878             nan     0.2000 64057.8008
##      5  2380782.3920             nan     0.2000 -19169.4648
##      6  2393163.9315             nan     0.2000 -49785.2124
##      7  2324015.7966             nan     0.2000 50945.1614
##      8  2236919.7189             nan     0.2000 -10978.7208
##      9  2221964.4132             nan     0.2000 19926.3368
##     10  2207474.6638             nan     0.2000 6598.9662
##     20  2169250.1421             nan     0.2000 22484.9550
##     40  2097591.9410             nan     0.2000 -53541.2912
##     60  2026718.3551             nan     0.2000 -12174.5899
##     80  1997519.1324             nan     0.2000 -34225.5833
##    100  1975547.7637             nan     0.2000 -2133.1993

## Warning: model fit failed for Fold10.Rep1: shrinkage=0.20, interaction.depth=3, n.minobsinnode=15, n
##   The data set is too small or the subsampling rate is too large: ‘nTrain * bag.fraction <= n.minobs

## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info = trainInfo, :
## There were missing values in resampled performance measures.

## Warning in train.default(x, y, weights = w, ...): missing values found in
## aggregated results

## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1  2621843.3896             nan     0.2000 251944.6702
##      2  2500278.6377             nan     0.2000 158136.0896
##      3  2182922.9481             nan     0.2000 256844.4882
##      4  2017849.6706             nan     0.2000 198057.6213
##      5  1831352.7782             nan     0.2000 128815.1636
##      6  1760879.4527             nan     0.2000 73623.7405
##      7  1775619.9493             nan     0.2000 -46389.5438
##      8  1701963.6903             nan     0.2000 87355.1940
##      9  1657366.6598             nan     0.2000 -51452.3036
##     10  1597727.5155             nan     0.2000 76483.0988
```

```
gbm2
```

```
## Stochastic Gradient Boosting
##
## 61 samples
##  3 predictor
##
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   shrinkage  interaction.depth  n.minobsinnode  n.trees  RMSE       Rsquared
##   0.10       2                   5               10        891.0882  0.9118653
##   0.10       2                   5               50       1002.0715  0.9052148
##   0.10       2                   5              100       1071.0478  0.8856237
##   0.10       2                  10               10        921.8382  0.8211780
##   0.10       2                  10               50       1039.5201  0.8285063
##   0.10       2                  10              100       1078.3580  0.8376732
##   0.10       2                  15               10             NaN        NaN
##   0.10       2                  15               50             NaN        NaN
##   0.10       2                  15              100             NaN        NaN
##   0.10       3                   5               10        880.3443  0.8848206
##   0.10       3                   5               50       1001.0834  0.8573247
##   0.10       3                   5              100       1110.0836  0.7984490
##   0.10       3                  10               10        942.9323  0.8202718
##   0.10       3                  10               50       1021.7383  0.8416989
##   0.10       3                  10              100       1054.5092  0.8446230
##   0.10       3                  15               10             NaN        NaN
##   0.10       3                  15               50             NaN        NaN
##   0.10       3                  15              100             NaN        NaN
##   0.15       2                   5               10        937.7011  0.8504806
##   0.15       2                   5               50       1078.8380  0.8335356
##   0.15       2                   5              100       1118.1606  0.8548391
##   0.15       2                  10               10        986.9916  0.7906947
##   0.15       2                  10               50       1017.9749  0.8368233
##   0.15       2                  10              100       1016.2261  0.8590212
##   0.15       2                  15               10             NaN        NaN
##   0.15       2                  15               50             NaN        NaN
##   0.15       2                  15              100             NaN        NaN
##   0.15       3                   5               10        958.4450  0.8689360
##   0.15       3                   5               50       1060.1234  0.8740476
##   0.15       3                   5              100       1171.7182  0.7919667
##   0.15       3                  10               10        930.2459  0.8157897
##   0.15       3                  10               50      1027.8066  0.8168332
##   0.15       3                  10              100      1042.3186  0.8578018
##   0.15       3                  15               10            NaN        NaN
##   0.15       3                  15               50            NaN        NaN
##   0.15       3                  15              100            NaN        NaN
##   0.20       2                   5               10       983.8076  0.8654607
##   0.20       2                   5               50      1198.9075  0.7244216
##   0.20       2                   5              100      1371.3810  0.6798423
##   0.20       2                  10               10       949.9361  0.8239179
##   0.20       2                  10               50      1071.8018  0.8105117
##   0.20       2                  10              100      1135.2928  0.8127442
##   0.20       2                  15               10            NaN        NaN
##   0.20       2                  15               50            NaN        NaN
##   0.20       2                  15              100            NaN        NaN
##   0.20       3                   5               10       813.9248  0.9627133
##   0.20       3                   5               50      1108.0154  0.8350850
##   0.20       3                   5              100      1178.1583  0.7578330
##   0.20       3                  10               10       932.6875  0.8342557
##   0.20       3                  10               50      1003.2810  0.8494569
##   0.20       3                  10              100      1066.4599  0.8404815
##   0.20       3                  15               10            NaN        NaN
##   0.20       3                  15               50            NaN        NaN
##   0.20       3                  15              100            NaN        NaN
##   MAE
##   517.1165
##   528.2833
##   562.4945
##   530.3265
##   574.5000
##   595.5081
##        NaN
##        NaN
##        NaN
##   518.1077
##   517.5187
##   578.9786
##   559.5578
##   569.3625
##   574.0151
##        NaN
##        NaN
##        NaN
##   529.6006
##   570.3690
##   569.1896
##   549.8750
##   569.7088
##   551.9935
##        NaN
##        NaN
##        NaN
##   551.1686
##   547.5088
##   589.0885
##   511.6806
##   551.6563
##   553.3406
##        NaN
##        NaN
##        NaN
##   531.4022
##   614.7804
##   678.3728
##   510.4978
##   580.8428
##   623.3629
##        NaN
##        NaN
##        NaN
##   430.5785
##   572.0150
##   586.1419
##   494.8249
##   543.8161
##   574.5581
##        NaN
##        NaN
##        NaN
##
## RMSE was used to select the optimal model using the smallest value.
## The final values used for the model were n.trees = 10, interaction.depth =
##  3, shrinkage = 0.2 and n.minobsinnode = 5.
```

Predicting gbm on test1

```
gbm2Preds <- predict(gbm2, newdata = test1_rem_out)
summary(gbm2Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   100.7   100.7   185.2   589.6   519.0  2437.8
```

postResample to test if it will do well on new data or if overfitting

```
postResample(gbm2Preds, test1_rem_out$Volume)
```

```
##        RMSE    Rsquared         MAE
## 415.0999818   0.7057675 244.4735938
```

CV RMSE=813, R2=.962

PostResample RMSE=415, R2=.706

Bayesian Ridge Regression, L1

Set seed

```
set.seed(123)

bay1 <- train(Volume ~ x4StarReviews + PositiveServiceReview + x2StarReviews,
              data = train1,
              method = 'blassoAveraged',
              trControl = control1,
              preProc = c('center','scale'))
```

```
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=2
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=2
## t=800, m=2
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
## t=100, m=3
## t=200, m=3
## t=300, m=3
## t=400, m=3
## t=500, m=3
## t=600, m=3
## t=700, m=3
## t=800, m=3
## t=900, m=3
```

```
bay1
```

```
## Bayesian Ridge Regression (Model Averaged)
##
## 61 samples
##  3 predictor
##
## Pre-processing: centered (3), scaled (3)
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results:
##
##   RMSE      Rsquared   MAE
##   742.8701  0.8689584  421.7571
```

Predicting gbm on test1

```
bay1Preds <- predict(bay1, newdata = test1_rem_out)
summary(bay1Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -211.99 -187.44   79.51  397.59  667.00 2491.79
```

postResample to test if it will do well on new data or if overfitting

```
postResample(bay1Preds, test1$Volume)
```

```
## Warning in pred - obs: longer object length is not a multiple of shorter object
## length

## Warning in pred - obs: longer object length is not a multiple of shorter object
## length

##     RMSE Rsquared      MAE
## 925.6151       NA 716.4564
```

Negative predictions regardless of feature selection, high RMSE, doesn’t work with this task

CV RMSE=1148, R2=.753

After deleting problem outlier rows in test set - 17 observations

Actual_vs_Predicted_NoOutlier <- data.frame(test1_rem_out %>% select(ProductNum, Volume), rf1Preds, rf2Preds, rf3Preds, rf4Preds, rbf1Preds, rbf2Preds, linearPreds, linear2Preds, polyPreds, poly2Preds, gbmPreds, gbm2Preds)

exporting to excel

write.xlsx(Actual_vs_Predicted_NoOutlier, file = “Actual_vs_Predicted_NoOutlier.xlsx”, row.names=TRUE)

Now modeling with our transmuted column, AvgStarReviews to see if it helps with predictions

Set seed

```r
set.seed(123)

# CreateDataPartition() 75% and 25%
index2 <- createDataPartition(existing4$Volume, p=0.75, list = FALSE)
train2 <- existing4[ index2,]
```

```
## Warning: The ‘i‘ argument of ‘‘[‘()‘ can’t be a matrix as of tibble 3.0.0.
## Convert to a vector.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_warnings()‘ to see where this warning was generated.
```

```r
test2 <- existing4[-index2,]

# Checking structure of train1
str(train2)
```

```
## tibble [61 x 16] (S3: rowwise_df/tbl_df/tbl/data.frame)
##  $ ProductType.Laptop    : num [1:61] 0 0 0 1 0 0 0 0 0 0 ...
##  $ ProductType.Netbook   : num [1:61] 0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PC        : num [1:61] 1 1 1 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone: num [1:61] 0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductNum            : num [1:61] 101 102 103 104 106 107 108 109 110 111 ...
##  $ Price                 : num [1:61] 949 2250 399 410 114 ...
##  $ x4StarReviews         : num [1:61] 3 1 0 19 30 3 19 9 1 2 ...
##  $ x3StarReviews         : num [1:61] 2 0 0 8 10 0 12 2 1 2 ...
##  $ x2StarReviews         : num [1:61] 0 0 0 3 9 0 5 0 0 4 ...
##  $ x1StarReviews         : num [1:61] 0 0 0 9 40 1 9 2 0 15 ...
##  $ PositiveServiceReview : num [1:61] 2 1 1 7 12 3 5 2 2 2 ...
##  $ NegativeServiceReview : num [1:61] 0 0 0 8 5 0 3 1 0 1 ...
##  $ Recommendproduct      : num [1:61] 0.9 0.9 0.9 0.8 0.3 0.9 0.7 0.8 0.9 0.5 ...
##  $ ShippingWeight        : num [1:61] 25.8 50 17.4 5.7 1.6 7.3 12 1.8 0.75 1 ...
##  $ Volume                : num [1:61] 12 8 12 196 332 44 132 64 40 84 ...
##  $ AvgStarReviews        : num [1:61] 1.25 0.25 0 9.75 22.25 ...
##  - attr(*, "groups")= tibble [61 x 1] (S3: tbl_df/tbl/data.frame)
##   ..$ .rows: list<int> [1:61]
##   .. ..$ : int 1
##   .. ..$ : int 2
##   .. ..$ : int 3
##   .. ..$ : int 4
##   .. ..$ : int 5
##   .. ..$ : int 6
##   .. ..$ : int 7
##   .. ..$ : int 8
##   .. ..$ : int 9
##   .. ..$ : int 10
##   .. ..$ : int 11
##   .. ..$ : int 12
##   .. ..$ : int 13
##   .. ..$ : int 14
##   .. ..$ : int 15
##   .. ..$ : int 16
##   .. ..$ : int 17
##   .. ..$ : int 18
##   .. ..$ : int 19
##   .. ..$ : int 20
##   .. ..$ : int 21
##   .. ..$ : int 22
##   .. ..$ : int 23
##   .. ..$ : int 24
##   .. ..$ : int 25
##   .. ..$ : int 26
##   .. ..$ : int 27
##   .. ..$ : int 28
##   .. ..$ : int 29
##   .. ..$ : int 30
##   .. ..$ : int 31
##   .. ..$ : int 32
##   .. ..$ : int 33
##   .. ..$ : int 34
##   .. ..$ : int 35
##   .. ..$ : int 36
##   .. ..$ : int 37
##   .. ..$ : int 38
##   .. ..$ : int 39
##   .. ..$ : int 40
##   .. ..$ : int 41
##   .. ..$ : int 42
##   .. ..$ : int 43
##   .. ..$ : int 44
##   .. ..$ : int 45
##   .. ..$ : int 46
##   .. ..$ : int 47
##   .. ..$ : int 48
##   .. ..$ : int 49
##   .. ..$ : int 50
##   .. ..$ : int 51
##   .. ..$ : int 52
##   .. ..$ : int 53
##   .. ..$ : int 54
##   .. ..$ : int 55
##   .. ..$ : int 56
##   .. ..$ : int 57
##   .. ..$ : int 58
##   .. ..$ : int 59
##   .. ..$ : int 60
##   .. ..$ : int 61
##   .. ..@ ptype: int(0)
```

```r
# Setting cross validation
control1 <- trainControl(method = 'repeatedcv',
                         number = 10,
                         repeats = 1)
```

set seed

```r
set.seed(123)

# Creating dataframe for manual tuning
rfGrid <- expand.grid(mtry = c(2,3,4,5,6,7,8))

rf_1 <- train(Volume ~ .,
              data = train2,
              method = 'rf',
              trControl = control1,
              tuneGrid = rfGrid)

rf_1
```

```
## Random Forest
##
## 61 samples
## 15 predictors
##
## No pre-processing
## Resampling: Cross-Validated (10 fold, repeated 1 times)
## Summary of sample sizes: 55, 53, 55, 55, 55, 56, ...
## Resampling results across tuning parameters:
##
##   mtry  RMSE      Rsquared   MAE
##   2     890.2517  0.8684611  434.8184
##   3     860.1573  0.8812491  403.8704
##   4     869.6858  0.8853209  404.3859
##   5     877.7167  0.8894399  405.0399
##   6     833.4313  0.9025322  382.2740
##   7     858.2201  0.8943709  391.7704
##   8     841.2111  0.9013432  384.3876
##
```

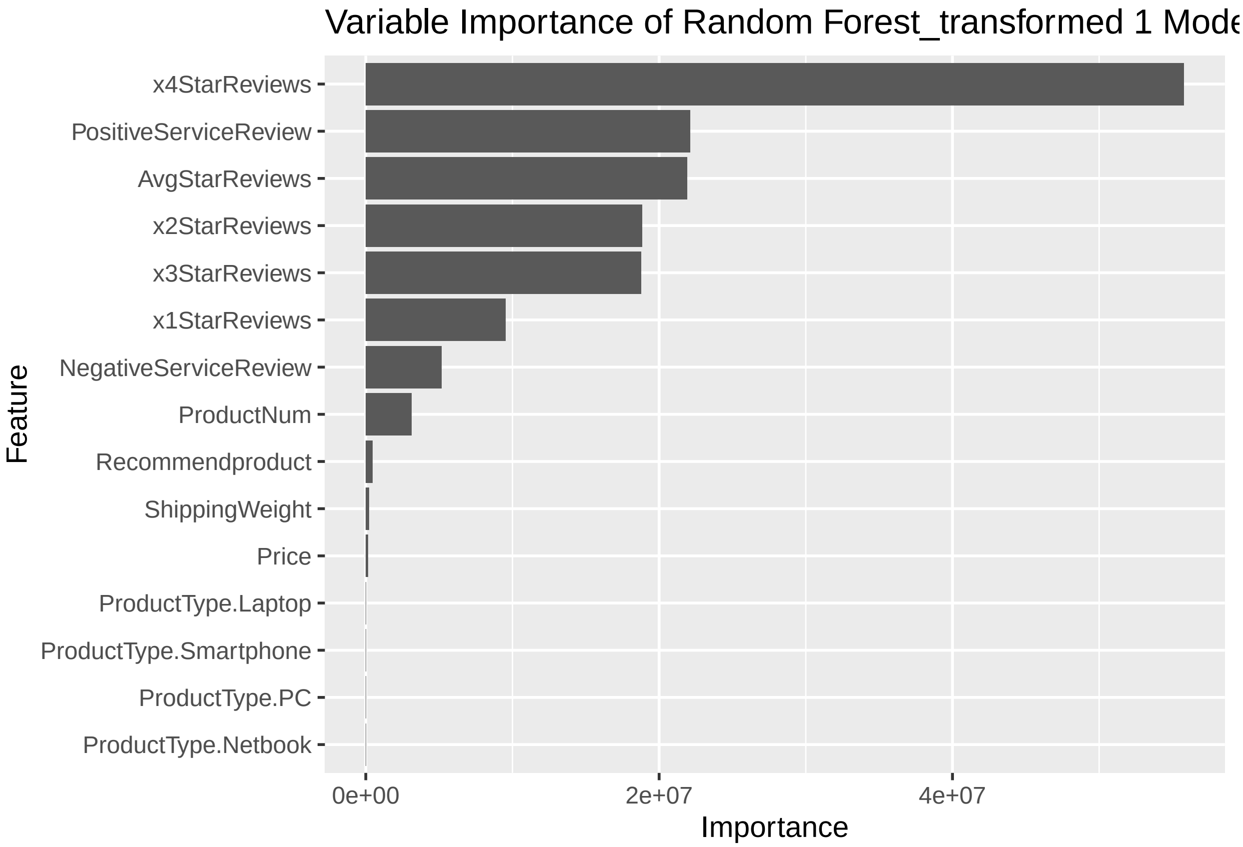
```
## RMSE was used to select the optimal model using the smallest value.
## The final value used for the model was mtry = 6.
```

```
summary(rf_1)
```

```
##                 Length Class      Mode     
## call              4    -none-     call     
## type              1    -none-     character
## predicted        61    -none-     numeric  
## mse             500    -none-     numeric  
## rsq             500    -none-     numeric  
## oob.times        61    -none-     numeric  
## importance       15    -none-     numeric  
## importanceSD      0    -none-     NULL     
## localImportance   0    -none-     NULL     
## proximity         0    -none-     NULL     
## ntree             1    -none-     numeric  
## mtry              1    -none-     numeric  
## forest           11    -none-     list     
## coefs             0    -none-     NULL     
## y                61    -none-     numeric  
## test              0    -none-     NULL     
## inbag             0    -none-     NULL     
## xNames           15    -none-     character
## problemType       1    -none-     character
## tuneValue         1    data.frame list     
## obsLevels         1    -none-     logical  
## param             0    -none-     list     
```

Variable importance using ggplot

```
ggplot(varImp(rf_1, scale=FALSE)) +
  ggtitle('Variable Importance of Random Forest_transformed 1 Model')
```



Predicting rf on test2

```
rf_1Preds <- predict(rf_1, newdata = test2)
summary(rf_1Preds)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   12.40   28.42  258.18  758.58 1062.08 5708.03
```

postResample to test if it will do well on new data or if overfitting

```
postResample(rf_1Preds, test2$Volume)
```

```
##        RMSE    Rsquared         MAE 
## 867.1132444   0.6025625 341.3013774
```

RMSE=1545 and R2=.217, poor, it does not

Using Top Model rf2 algorithm to make predictions on new product data

Target variable: ‘Volume’ for PC, Laptops, Netbooks, and Smartphones product types

importing data

```
new <- read.csv(file.path('C:/Users/jlbro/OneDrive/C3T3', 'new.csv'), stringsAsFactors = TRUE)
```

checking structure

```
str(new)
```

```
## 'data.frame':    24 obs. of  18 variables:
##  $ ProductType          : Factor w/ 12 levels "Accessories",..: 7 7 5 5 5 6 6 6 6 12 ...
##  $ ProductNum           : int  171 172 173 175 176 178 180 181 183 186 ...
##  $ Price                : num  699 860 1199 1199 1999 ...
##  $ x5StarReviews        : int  96 51 74 7 1 19 312 23 3 296 ...
##  $ x4StarReviews        : int  26 11 10 2 1 8 112 18 4 66 ...
##  $ x3StarReviews        : int  14 10 3 1 1 4 28 7 0 30 ...
##  $ x2StarReviews        : int  14 10 3 1 3 1 31 22 1 21 ...
##  $ x1StarReviews        : int  25 21 11 1 0 10 47 18 0 36 ...
##  $ PositiveServiceReview: int  12 7 11 2 0 2 28 5 1 28 ...
##  $ NegativeServiceReview: int  3 5 5 1 1 4 16 16 0 9 ...
##  $ Recommendproduct     : num  0.7 0.6 0.8 0.6 0.3 0.6 0.7 0.4 0.7 0.8 ...
##  $ BestSellersRank      : int  2498 490 111 4446 2820 4140 2699 1704 5128 34 ...
##  $ ShippingWeight       : num  19.9 27 6.6 13 11.6 5.8 4.6 4.8 4.3 3 ...
##  $ ProductDepth         : num  20.63 21.89 8.94 16.3 16.81 ...
##  $ ProductWidth         : num  19.2 27 12.8 10.8 10.9 ...
##  $ ProductHeight        : num  8.39 9.13 0.68 1.4 0.88 1.2 0.95 1.5 0.97 0.37 ...
##  $ ProfitMargin         : num  0.25 0.2 0.1 0.15 0.23 0.08 0.09 0.11 0.09 0.1 ...
##  $ Volume               : int  0 0 0 0 0 0 0 0 0 0 ...
```

Making new dataframe same column wise as trained dataframes

```
newDummy <- dummyVars(' ~ .', data = new)
```

```
new2 <- data.frame(predict(newDummy, newdata = new))
```

check structure again

```
str(new2)
```

```
## 'data.frame':    24 obs. of  29 variables:
##  $ ProductType.Accessories     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Display         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.ExtendedWarranty: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.GameConsole     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Laptop          : num  0 0 1 1 1 0 0 0 0 0 ...
##  $ ProductType.Netbook         : num  0 0 0 0 0 1 1 1 1 0 ...
##  $ ProductType.PC              : num  1 1 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Printer         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PrinterSupplies : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Software        : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Tablet          : num  0 0 0 0 0 0 0 0 0 1 ...
##  $ ProductNum                  : num  171 172 173 175 176 178 180 181 183 186 ...
##  $ Price                       : num  699 860 1199 1199 1999 ...
##  $ x5StarReviews               : num  96 51 74 7 1 19 312 23 3 296 ...
##  $ x4StarReviews               : num  26 11 10 2 1 8 112 18 4 66 ...
##  $ x3StarReviews               : num  14 10 3 1 1 4 28 7 0 30 ...
##  $ x2StarReviews               : num  14 10 3 1 3 1 31 22 1 21 ...
##  $ x1StarReviews               : num  25 21 11 1 0 10 47 18 0 36 ...
##  $ PositiveServiceReview       : num  12 7 11 2 0 2 28 5 1 28 ...
##  $ NegativeServiceReview       : num  3 5 5 1 1 4 16 16 0 9 ...
##  $ Recommendproduct            : num  0.7 0.6 0.8 0.6 0.3 0.6 0.7 0.4 0.7 0.8 ...
##  $ BestSellersRank             : num  2498 490 111 4446 2820 ...
##  $ ShippingWeight              : num  19.9 27 6.6 13 11.6 5.8 4.6 4.8 4.3 3 ...
##  $ ProductDepth                : num  20.63 21.89 8.94 16.3 16.81 ...
##  $ ProductWidth                : num  19.2 27 12.8 10.8 10.9 ...
##  $ ProductHeight               : num  8.39 9.13 0.68 1.4 0.88 1.2 0.95 1.5 0.97 0.37 ...
##  $ ProfitMargin                : num  0.25 0.2 0.1 0.15 0.23 0.08 0.09 0.11 0.09 0.1 ...
##  $ Volume                      : num  0 0 0 0 0 0 0 0 0 0 ...
```

Removing 'BestSellersRank' since not in modeling dataset

```
new2$BestSellersRank <- NULL

str(new2)
```

```
## 'data.frame':    24 obs. of  28 variables:
##  $ ProductType.Accessories     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Display         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.ExtendedWarranty: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.GameConsole     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Laptop          : num  0 0 1 1 1 0 0 0 0 0 ...
##  $ ProductType.Netbook         : num  0 0 0 0 0 1 1 1 1 0 ...
##  $ ProductType.PC              : num  1 1 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Printer         : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.PrinterSupplies : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Software        : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Tablet          : num  0 0 0 0 0 0 0 0 0 1 ...
##  $ ProductNum                  : num  171 172 173 175 176 178 180 181 183 186 ...
##  $ Price                       : num  699 860 1199 1199 1999 ...
##  $ x5StarReviews               : num  96 51 74 7 1 19 312 23 3 296 ...
##  $ x4StarReviews               : num  26 11 10 2 1 8 112 18 4 66 ...
##  $ x3StarReviews               : num  14 10 3 1 1 4 28 7 0 30 ...
##  $ x2StarReviews               : num  14 10 3 1 3 1 31 22 1 21 ...
##  $ x1StarReviews               : num  25 21 11 1 0 10 47 18 0 36 ...
##  $ PositiveServiceReview       : num  12 7 11 2 0 2 28 5 1 28 ...
##  $ NegativeServiceReview       : num  3 5 5 1 1 4 16 16 0 9 ...
##  $ Recommendproduct            : num  0.7 0.6 0.8 0.6 0.3 0.6 0.7 0.4 0.7 0.8 ...
##  $ ShippingWeight              : num  19.9 27 6.6 13 11.6 5.8 4.6 4.8 4.3 3 ...
##  $ ProductDepth                : num  20.63 21.89 8.94 16.3 16.81 ...
##  $ ProductWidth                : num  19.2 27 12.8 10.8 10.9 ...
##  $ ProductHeight               : num  8.39 9.13 0.68 1.4 0.88 1.2 0.95 1.5 0.97 0.37 ...
##  $ ProfitMargin                : num  0.25 0.2 0.1 0.15 0.23 0.08 0.09 0.11 0.09 0.1 ...
##  $ Volume                      : num  0 0 0 0 0 0 0 0 0 0 ...
```

Removing same columns as training datasets

```
new3 <- subset(new2, select = -c(1:4, 8:9, 11:12, 15, 24:27))

str(new3)
```

```
## ’data.frame’:    24 obs. of  15 variables:
##  $ ProductType.Laptop    : num  0 0 1 1 1 0 0 0 0 0 ...
##  $ ProductType.Netbook   : num  0 0 0 0 0 1 1 1 1 0 ...
##  $ ProductType.PC        : num  1 1 0 0 0 0 0 0 0 0 ...
##  $ ProductType.Smartphone: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ ProductNum            : num  171 172 173 175 176 178 180 181 183 186 ...
##  $ Price                 : num  699 860 1199 1199 1999 ...
##  $ x4StarReviews         : num  26 11 10 2 1 8 112 18 4 66 ...
##  $ x3StarReviews         : num  14 10 3 1 1 4 28 7 0 30 ...
##  $ x2StarReviews         : num  14 10 3 1 3 1 31 22 1 21 ...
##  $ x1StarReviews         : num  25 21 11 1 0 10 47 18 0 36 ...
##  $ PositiveServiceReview : num  12 7 11 2 0 2 28 5 1 28 ...
##  $ NegativeServiceReview : num  3 5 5 1 1 4 16 16 0 9 ...
##  $ Recommendproduct      : num  0.7 0.6 0.8 0.6 0.3 0.6 0.7 0.4 0.7 0.8 ...
##  $ ShippingWeight        : num  19.9 27 6.6 13 11.6 5.8 4.6 4.8 4.3 3 ...
##  $ Volume                : num  0 0 0 0 0 0 0 0 0 0 ...
```

```
set.seed(123)

# Predicting rbf1 on 'new3' product data
Predicted_Volume <- predict(rf2, newdata = new3)
```

Adding our predictions to the ‘new’ product dataframe

```
Preds_rf2_df <- data.frame(new3 %>% select(ProductType.Laptop, ProductType.Netbook, ProductType.PC, Pro
```

exporting to excel

```r
write.xlsx(Preds_rf2_df,"TopModel_rf2_Preds.xlsx")
```