Data Science II Final Project Analysis

Camille Okonkwo

Contents

```r
library(tidymodels)
library(splines)
library(caret)
library(glmnet)
library(table1)
library(kableExtra)
library(summarytools)
library(corrplot)
library(cowplot)

library(vip)
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library(tidymodels)
library(mlbench)
library(pROC)
library(pdp)
library(vip)
library(AppliedPredictiveModeling)

library(rpart)
library(rpart.plot)
```

Background

A research study aims to identify key factors that predict the severity of COVID-19 illness. This study collects demographic information, clinical variables, and disease severity among participants infected with COVID-19 between 2021 and 2023. The goal is to develop a robust prediction model that can accurately predict COVID-19 severity and understand how predictors impact the risk of severe infection.

Data

The training data in "severity_training.RData" includes data from 800 participants.

The test data in "severity_test.RData" includes data from another set of 200 participants.

Here is a description of each variable:

- ID (`id`): Participant ID
- Age (`age`): Age
- Gender (`gender`): 1 = Male, 0 = Female
- Race/ethnicity (`race`): 1 = White, 2 = Asian, 3 = Black, 4 = Hispanic
- Smoking (`smoking`): Smoking status; 0 = Never smoked, 1 = Former smoker, 2 = Current smoker
- Height (`height`): Height (in centimeters)
- Weight (`weight`): Weight (in kilograms)
- BMI (`bmi`): Body Mass Index; BMI = weight (in kilograms) / height (in meters) squared
- Hypertension (`hypertension`): 0 = No, 1 = Yes
- Diabetes (`diabetes`): 0 = No, 1 = Yes
- Systolic blood pressure (`SBP`): Systolic blood pressure (in mm/Hg)
- LDL cholesterol (`LDL`): LDL (low-density lipoprotein) cholesterol (in mg/dL)
- Vaccination status at the time of infection (`vaccine`): 0 = Not vaccinated, 1 = Vaccinated
- Depression score (`depression`): Higher scores indicate higher risk for depression
- Severity of COVID-19 infection (`severity`): **Response variable**; 0 = Not severe, 1 = Severe

Data Preparation

```r
# loading training data
load("data/severity_training.RData") # is depression discrete?

# making discrete variables factors
training_data = training_data |>
  select(-id) |>
  mutate_at(vars(age, height, weight, bmi, SBP, LDL, depression), as.numeric) |>
 mutate(
    gender = factor(gender,
                    levels = c(0, 1),
                    labels = c("Female", "Male")) |>
      relevel(ref = "Female"),
    race = factor(race,
                  levels = c(1, 2, 3, 4),
                  labels = c("White", "Asian", "Black", "Hispanic")) |>
      relevel(ref = "White"),
    smoking = factor(smoking,
                     levels = c(0, 1, 2),
                     labels = c("Never_smoked", "Former_smoker", "Current_smoker")) |>
      relevel(ref = "Never_smoked"),
    hypertension = factor(hypertension,
                          levels = c(0, 1),
```

```
                          labels = c("No", "Yes")) |>
      relevel(ref = "No"),
    diabetes = factor(diabetes,
                      levels = c(0, 1),
                      labels = c("No", "Yes")) |>
      relevel(ref = "No"),
    vaccine = factor(vaccine,
                     levels = c(0, 1),
                     labels = c("Not_vaccinated", "Vaccinated")) |>
      relevel(ref = "Not_vaccinated"),
    severity = factor(severity,
                      levels = c(0, 1),
                      labels = c("Not_severe", "Severe")) |>
      relevel(ref = "Not_severe")
  ) |>
  janitor::clean_names()

# checking levels
levels(training_data$race)
levels(training_data$smoking)
levels(training_data$hypertension)
levels(training_data$diabetes)
levels(training_data$vaccine)
levels(training_data$severity)

# matrix of predictors & vector of response for data set exploration
x.train = model.matrix(severity ~ ., training_data)[, -1]
y.train = training_data$severity

# loading testing data
load("data/severity_test.RData")

# making discrete variables factors
test_data = test_data |>
  select(-id) |>
  mutate_at(vars(age, height, weight, bmi, SBP, LDL, depression), as.numeric) |>
 mutate(
    gender = factor(gender,
                    levels = c(0, 1),
                    labels = c("Female", "Male")) |>
      relevel(ref = "Female"),
    race = factor(race,
                  levels = c(1, 2, 3, 4),
                  labels = c("White", "Asian", "Black", "Hispanic")) |>
      relevel(ref = "White"),
    smoking = factor(smoking,
                     levels = c(0, 1, 2),
                     labels = c("Never_smoked", "Former_smoker", "Current_smoker")) |>
      relevel(ref = "Never_smoked"),
    hypertension = factor(hypertension,
                          levels = c(0, 1),
                          labels = c("No", "Yes")) |>
      relevel(ref = "No"),
```

```r
    diabetes = factor(diabetes,
                      levels = c(0, 1),
                      labels = c("No", "Yes")) |>
      relevel(ref = "No"),
    vaccine = factor(vaccine,
                     levels = c(0, 1),
                     labels = c("Not_vaccinated", "Vaccinated")) |>
      relevel(ref = "Not_vaccinated"),
    severity = factor(severity,
                      levels = c(0, 1),
                      labels = c("Not_severe", "Severe")) |>
      relevel(ref = "Not_severe")
  ) |>
  janitor::clean_names()

# matrix of predictors and vector of response
x.test = model.matrix(severity ~., test_data)[, -1]
y.test = test_data$severity
```

Exploratory analysis and data visualization

Descriptive Statistics

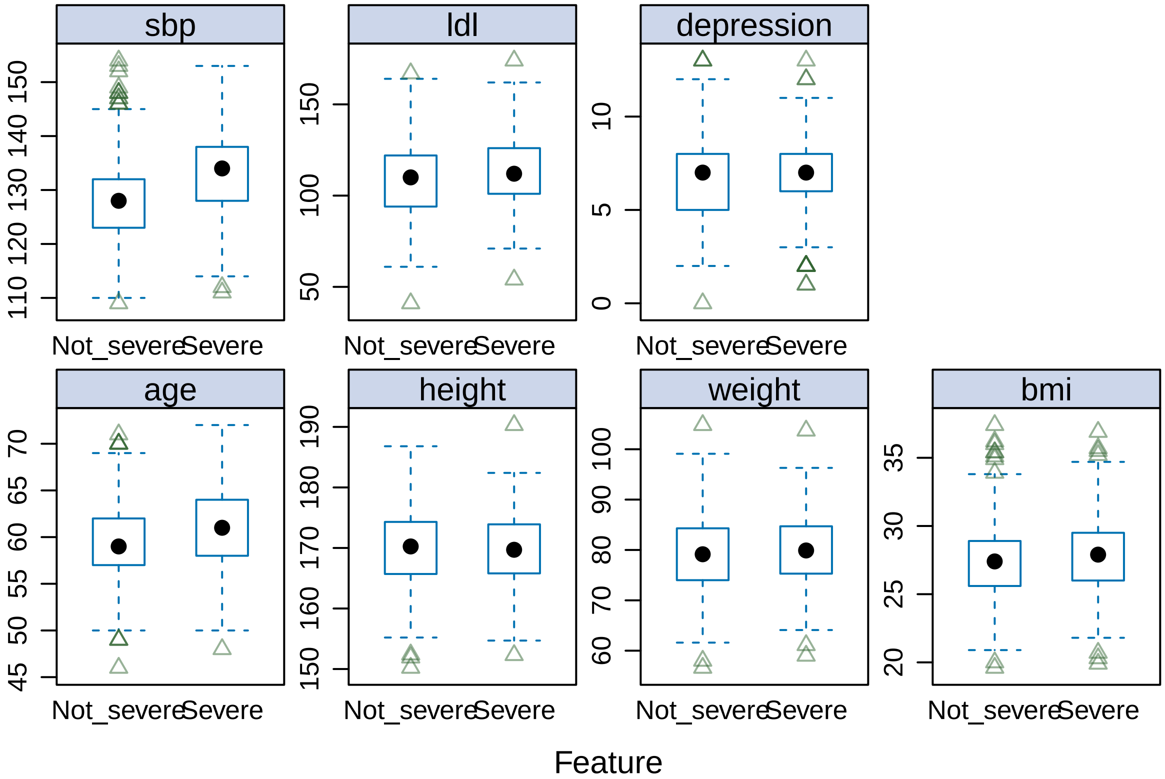
```
# when doing data exploration, should we do this on the entire dataset? do we need to create a random s

descriptive_table = table1(~ age + gender + race + smoking + height + weight + bmi + hypertension + dia
                           data = training_data,
                           overall = "Total",
                           caption = "Descriptive Characteristics of Participants, Stratified by Sever

ds = t1kable(descriptive_table)
ds
```

Continuous Variable Visualization

```
theme1 <- trellis.par.get()
theme1$plot.symbol$col <- rgb(.2, .4, .2, .5)
theme1$plot.symbol$pch <- 2
theme1$plot.line$col <- rgb(.8, .1, .1, 1)
theme1$plot.line$lwd <- 2
theme1$strip.background$col <- rgb(.0, .2, .6, .2)
trellis.par.set(theme1)

featurePlot(
  x.train[, -c(2, 3, 4, 5, 6, 7, 11, 12, 15)],
  y.train,
  scales = list(x = list(relation = "free"),
                y = list(relation = "free")),
  plot = "box")
```

Table 1: Descriptive Characteristics of Participants, Stratified by Severity of COVID-19 Infection

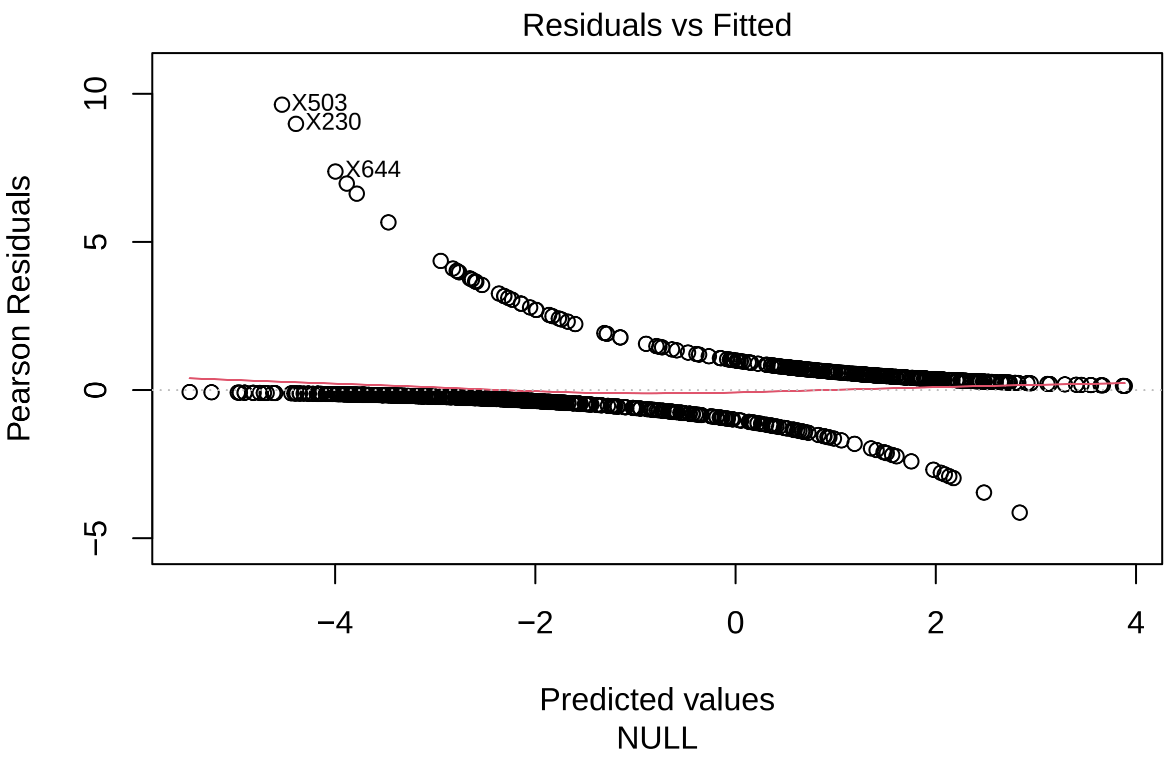
	Not_severe	Severe	Total
	(N=514)	(N=286)	(N=800)
age			
Mean (SD)	59.5 (4.29)	61.0 (4.12)	60.0 (4.30)
Median [Min, Max]	59.0 [46.0, 71.0]	61.0 [48.0, 72.0]	60.0 [46.0, 72.0]
gender			
Female	255 (49.6%)	155 (54.2%)	410 (51.3%)
Male	259 (50.4%)	131 (45.8%)	390 (48.8%)
race			
White	328 (63.8%)	193 (67.5%)	521 (65.1%)
Asian	34 (6.6%)	16 (5.6%)	50 (6.3%)
Black	103 (20.0%)	46 (16.1%)	149 (18.6%)
Hispanic	49 (9.5%)	31 (10.8%)	80 (10.0%)
smoking			
Never_smoked	304 (59.1%)	163 (57.0%)	467 (58.4%)
Former_smoker	157 (30.5%)	91 (31.8%)	248 (31.0%)
Current_smoker	53 (10.3%)	32 (11.2%)	85 (10.6%)
height			
Mean (SD)	170 (6.24)	170 (5.83)	170 (6.09)
Median [Min, Max]	170 [150, 187]	170 [152, 190]	170 [150, 190]
weight			
Mean (SD)	79.0 (7.33)	80.1 (7.09)	79.4 (7.26)
Median [Min, Max]	79.2 [56.6, 105]	79.9 [59.0, 104]	79.3 [56.6, 105]
bmi			
Mean (SD)	27.4 (2.70)	27.9 (2.78)	27.5 (2.74)
Median [Min, Max]	27.4 [19.6, 37.4]	27.9 [19.9, 36.9]	27.6 [19.6, 37.4]
hypertension			
No	332 (64.6%)	100 (35.0%)	432 (54.0%)
Yes	182 (35.4%)	186 (65.0%)	368 (46.0%)
diabetes			
No	437 (85.0%)	242 (84.6%)	679 (84.9%)
Yes	77 (15.0%)	44 (15.4%)	121 (15.1%)
sbp			
Mean (SD)	128 (7.58)	133 (7.62)	130 (7.97)
Median [Min, Max]	128 [109, 154]	134 [111, 153]	130 [109, 154]
ldl			
Mean (SD)	108 (20.5)	113 (18.8)	110 (20.1)
Median [Min, Max]	110 [41.0, 167]	112 [54.0, 174]	111 [41.0, 174]
vaccine			
Not_vaccinated	96 (18.7%)	240 (83.9%)	336 (42.0%)
Vaccinated	418 (81.3%)	46 (16.1%)	464 (58.0%)
depression			
Mean (SD)	6.91 (2.13)	6.90 (2.09)	6.91 (2.12)
Median [Min, Max]	7.00 [0, 13.0]	7.00 [1.00, 13.0]	7.00 [0, 13.0]

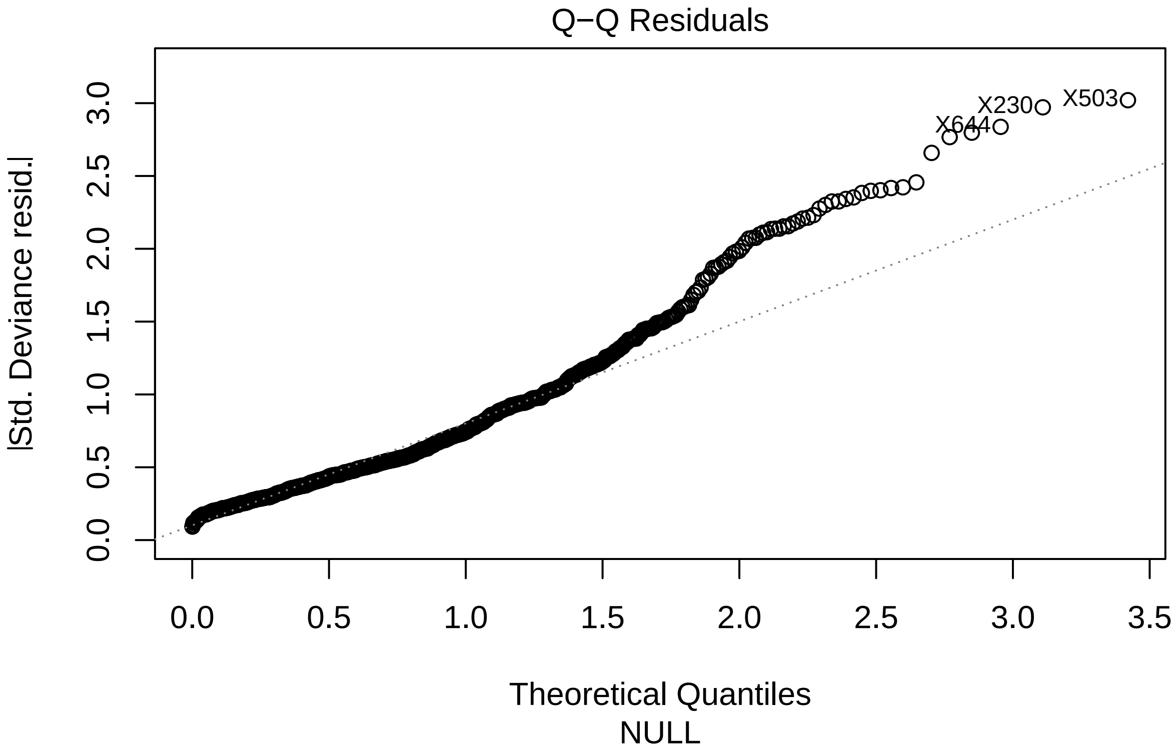

sbp
ldl
depression
age
height
weight
bmi
Not_severe
Severe
Feature

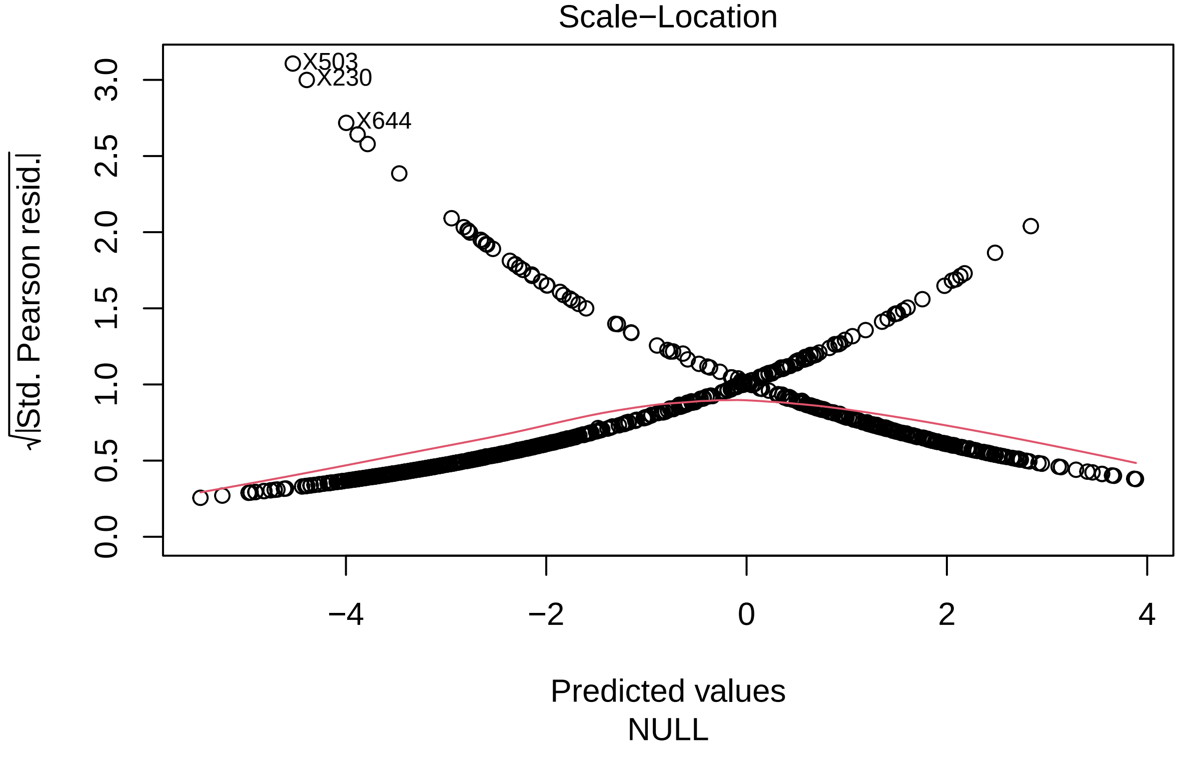
Model training

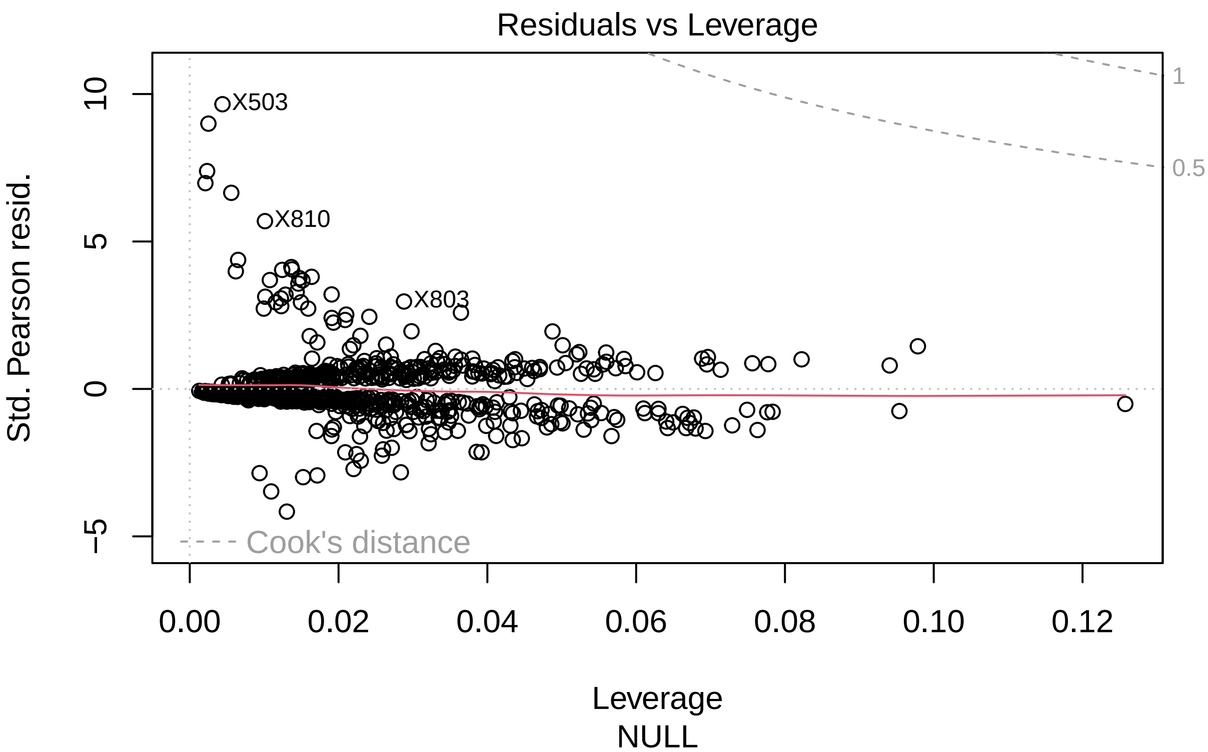
Logistic Regression

```
# setting a 10-fold cross-validation
ctrl = trainControl(method = "cv", number = 10,
                    summaryFunction = twoClassSummary,
                    classProbs = TRUE)
set.seed(2)

# logistic regression
model.glm = train(x = training_data[1:13],
                  y = training_data$severity,
                  method = "glm",
                  metric = "ROC",
                  trControl = ctrl)

plot(model.glm$finalModel)
```




Q−Q Residuals
|Std. Deviance resid.|
Theoretical Quantiles
NULL
X503
X230
X644


Scale−Location
√|Std. Pearson resid.|
Predicted values
NULL
X503
X230
X644




```r
coef(model.glm$finalModel)
```

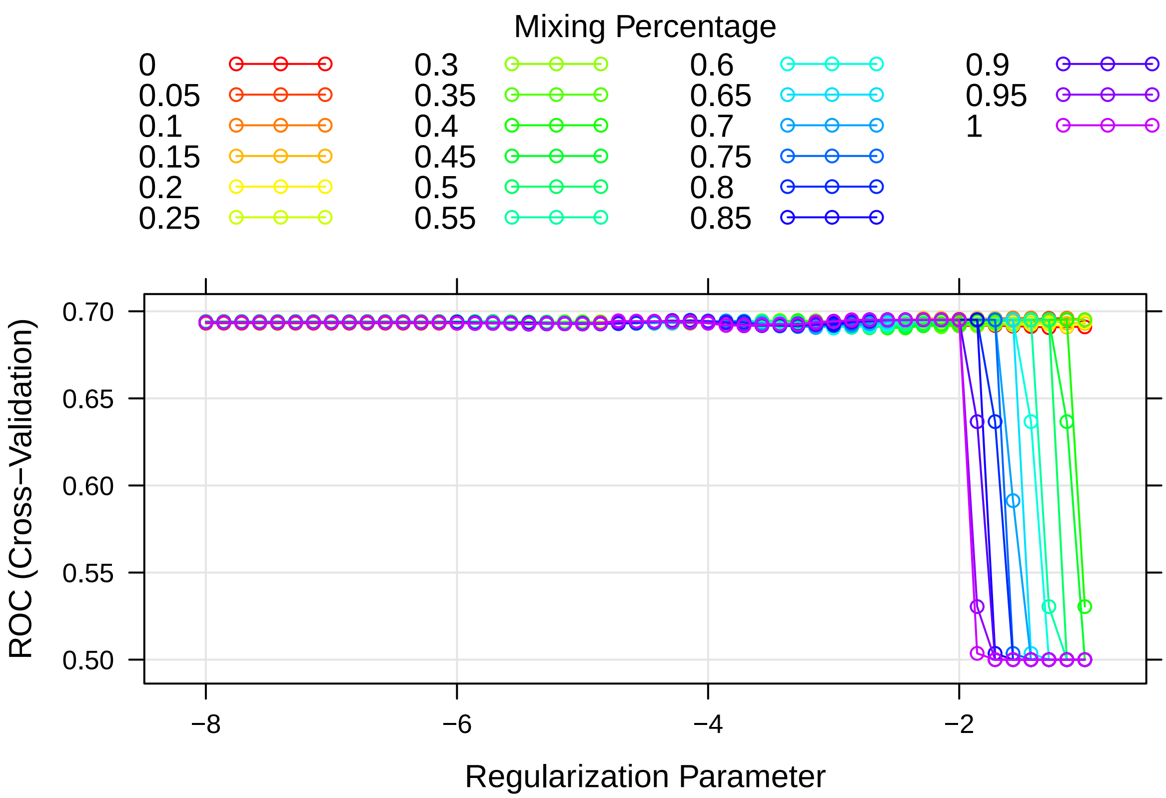
```
##           (Intercept)                   age            genderMale
##          -36.14267644            0.06479499           -0.40913157
##             raceAsian             raceBlack          raceHispanic
##           -0.20261995            0.01737165           -0.17462048
##  smokingFormer_smoker smokingCurrent_smoker                height
##            0.02496598            0.49239971            0.11171808
##                weight                   bmi           diabetesYes
##           -0.13337473            0.53758507            0.25302775
##       hypertensionYes                   sbp                   ldl
##            0.38092720            0.07081051            0.01002248
##     vaccineVaccinated            depression
##           -3.61798671           -0.03796927
```

Penalized Logistic Regression

```
# penalized logistic regression - elastic net (need help)
glmnGrid = expand.grid(.alpha = seq(0, 1, length = 21),
                       .lambda = exp(seq(-8, -1, length = 50)))
set.seed(2)
model.glmn = train(x = training_data[1:13],
                   y = training_data$severity,
                   method = "glmnet",
                   tuneGrid = glmnGrid,
                   metric = "ROC",
                   trControl = ctrl)
model.glmn$bestTune
```

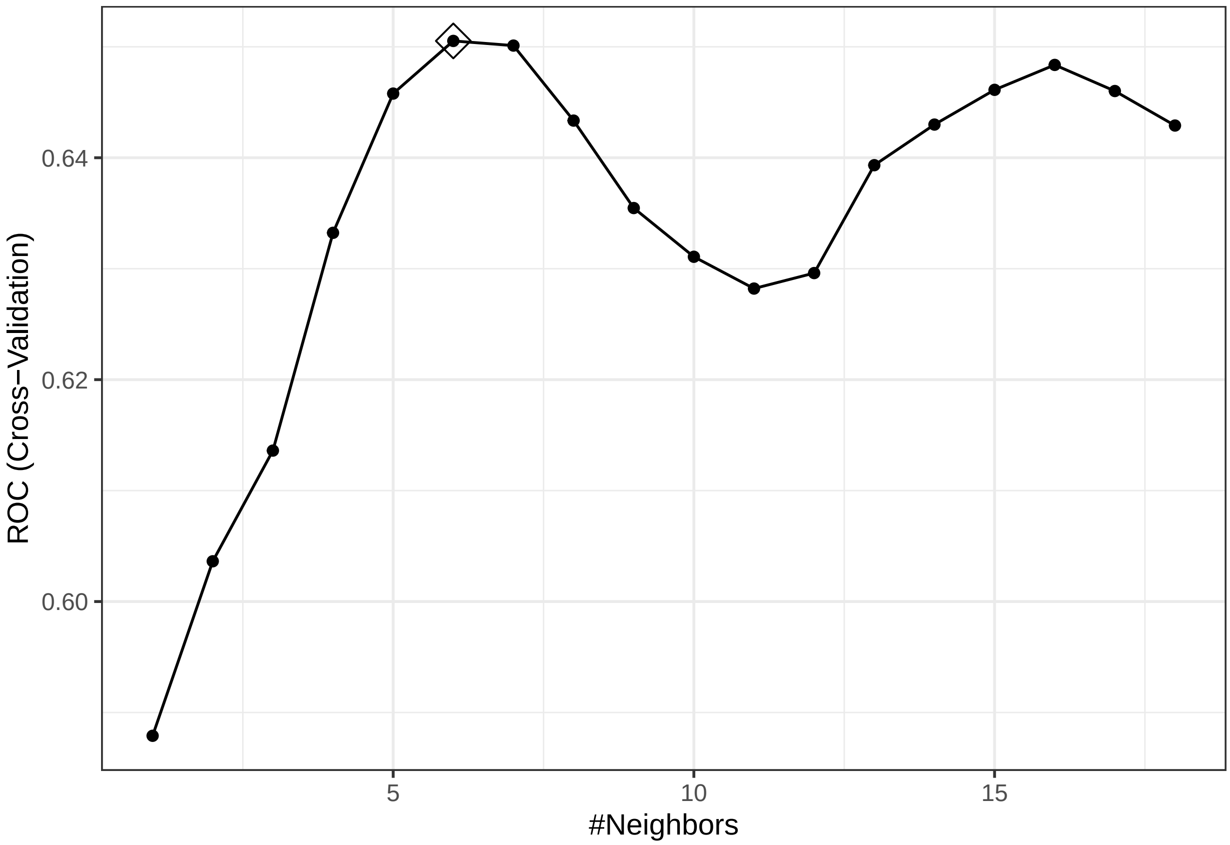
```
##     alpha    lambda
## 146   0.1 0.2077482
```

```
myCol = rainbow(25)
myPar = list(superpose.symbol = list(col = myCol),
superpose.line = list(col = myCol))
plot(model.glmn, par.settings = myPar, xTrans = function(x) log(x))
```



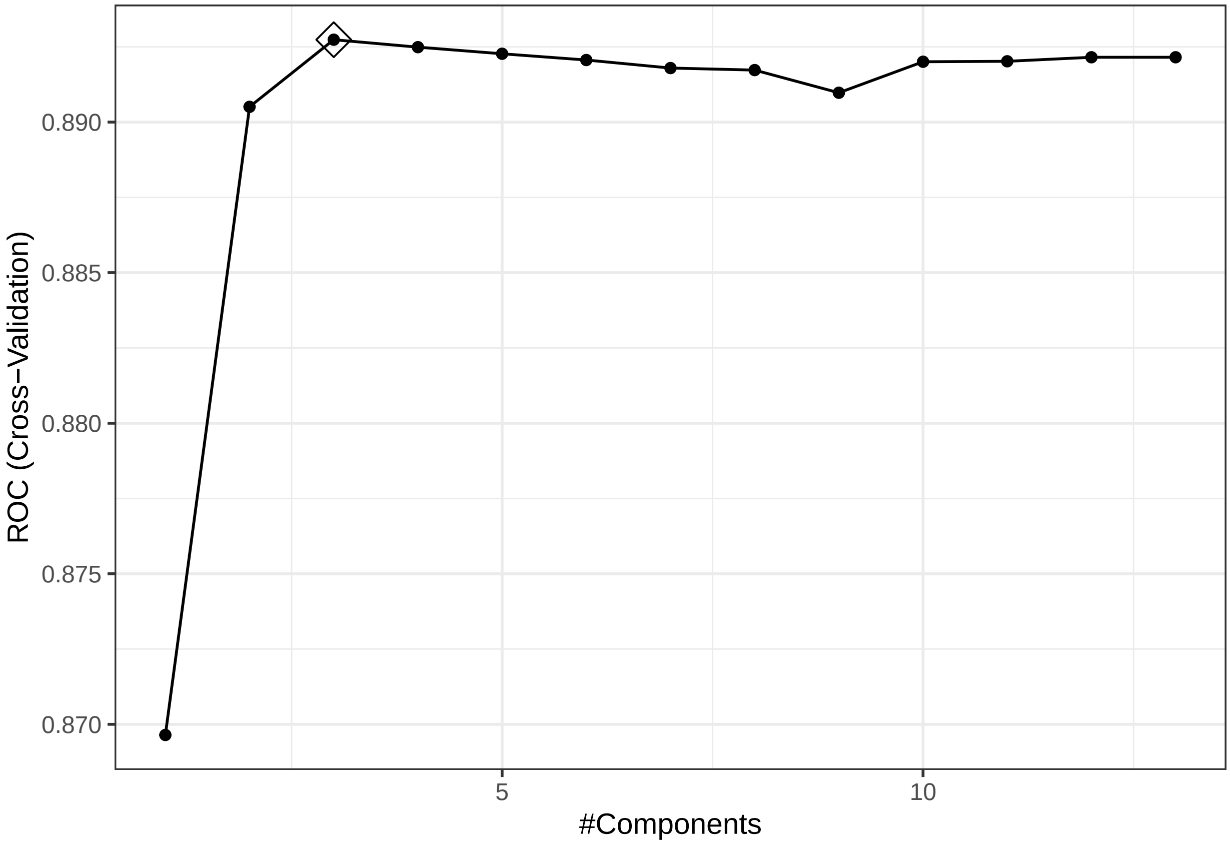
KNN

```r
set.seed(2)

model.knn = train(x.train, y.train,
                  method = "knn",
                  trControl = ctrl,
                  tuneGrid = expand.grid(k = seq(from = 1, to = 18, by = 1)))

ggplot(model.knn, highlight = TRUE) + theme_bw()
```



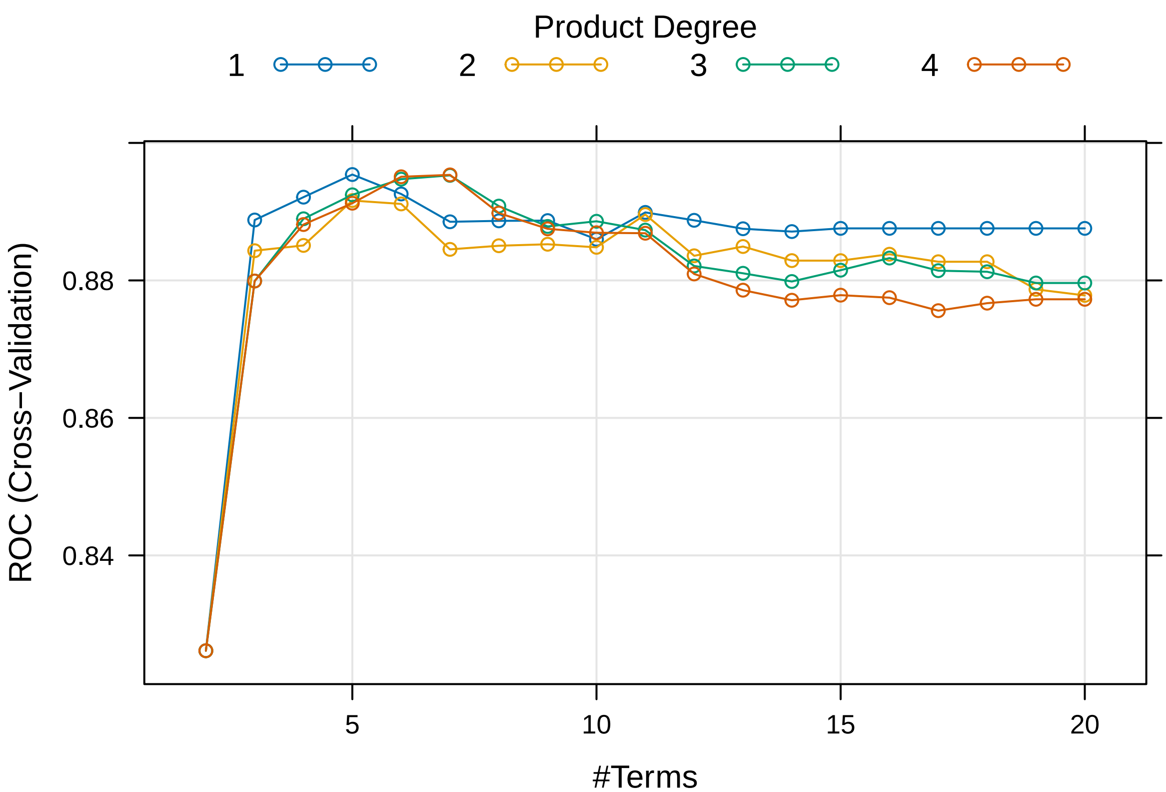
PLS

```
set.seed(2)

# pls using caret
model.pls = train(x.train, y.train,
                  method = "pls",
                  tuneGrid = data.frame(ncomp = 1:13),
                  trControl = ctrl,
                  preProcess = c("center", "scale"))

ggplot(model.pls, highlight = TRUE) + theme_bw()
```



MARS

```
# MARS
set.seed(2)
model.mars = train(x = training_data[1:13],
                   y = training_data$severity,
                   method = "earth",
                   tuneGrid = expand.grid(degree = 1:4,
                                          nprune = 2:20),
                   metric = "ROC",
                   trControl = ctrl)

plot(model.mars)
```




```
model.mars$bestTune
```

```
##   nprune degree
## 4      5      1
```

```
coef(model.mars$finalModel)
```

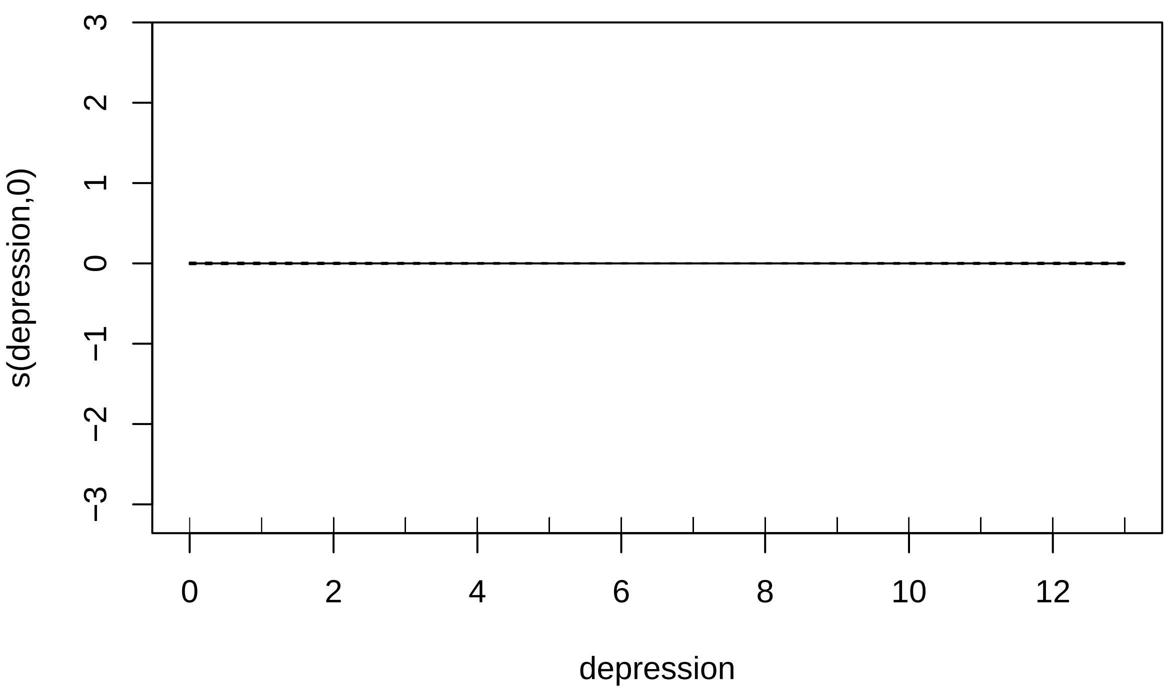
```
##       (Intercept) vaccineVaccinated        h(sbp-139)        h(139-sbp)
##        1.98341761       -3.50798169       -0.01515556       -0.13557595
##         h(bmi-27)
##        0.24293455
```

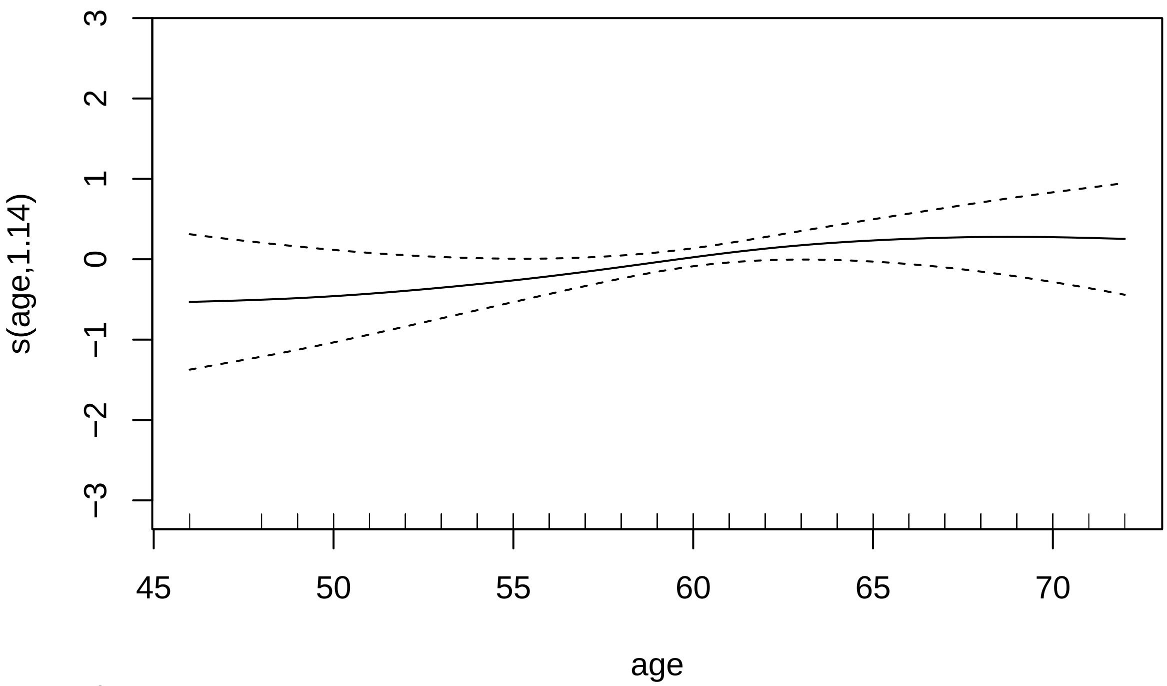
GAM

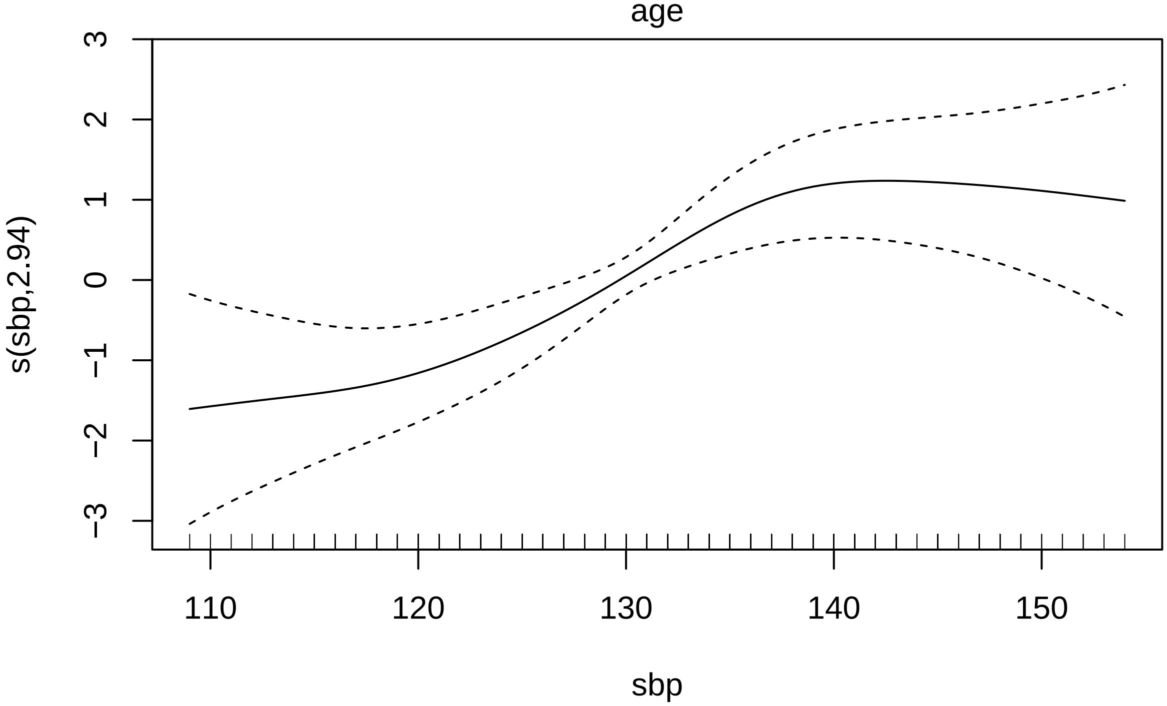
```r
set.seed(2)

model.gam = train(x = x.train,
                  y = y.train,
                  method = "gam",
                  metric = "ROC",
                  trControl = ctrl)

model.gam$finalModel
```

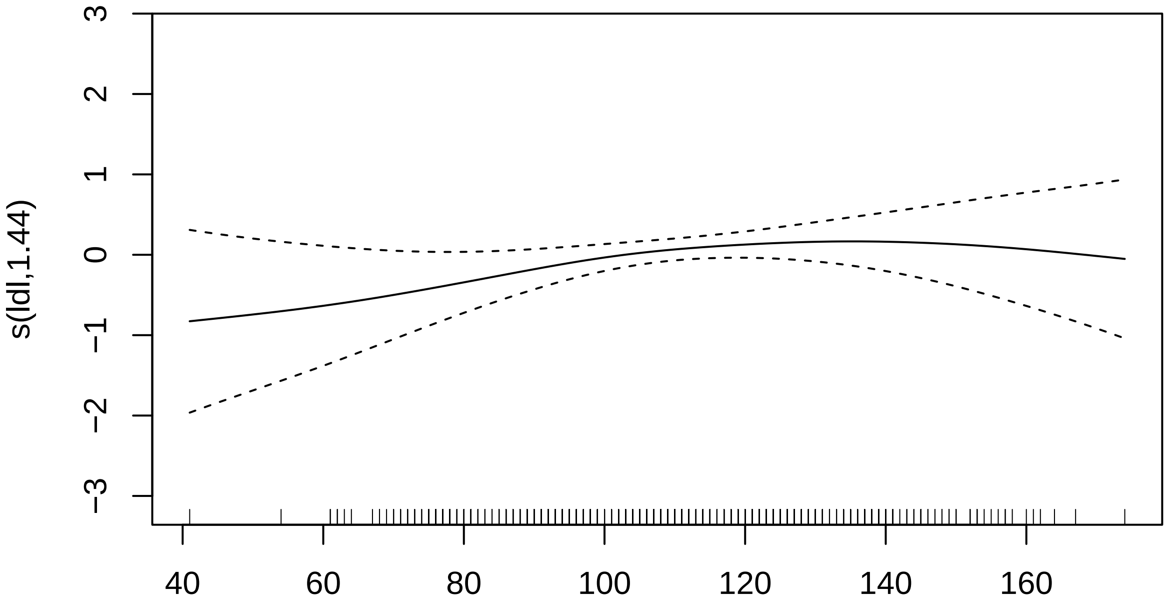
```
##
## Family: binomial
## Link function: logit
##
## Formula:
## .outcome ~ genderMale + raceAsian + raceBlack + raceHispanic +
##     smokingFormer_smoker + smokingCurrent_smoker + diabetesYes +
##     hypertensionYes + vaccineVaccinated + s(depression) + s(age) +
##     s(sbp) + s(ldl) + s(bmi) + s(height) + s(weight)
##
## Estimated degrees of freedom:
## 0.0003 1.1386 2.9397 1.4411 1.6912 2.3301 0.6288
##  total = 20.17
##
## UBRE score: -0.2327168
```

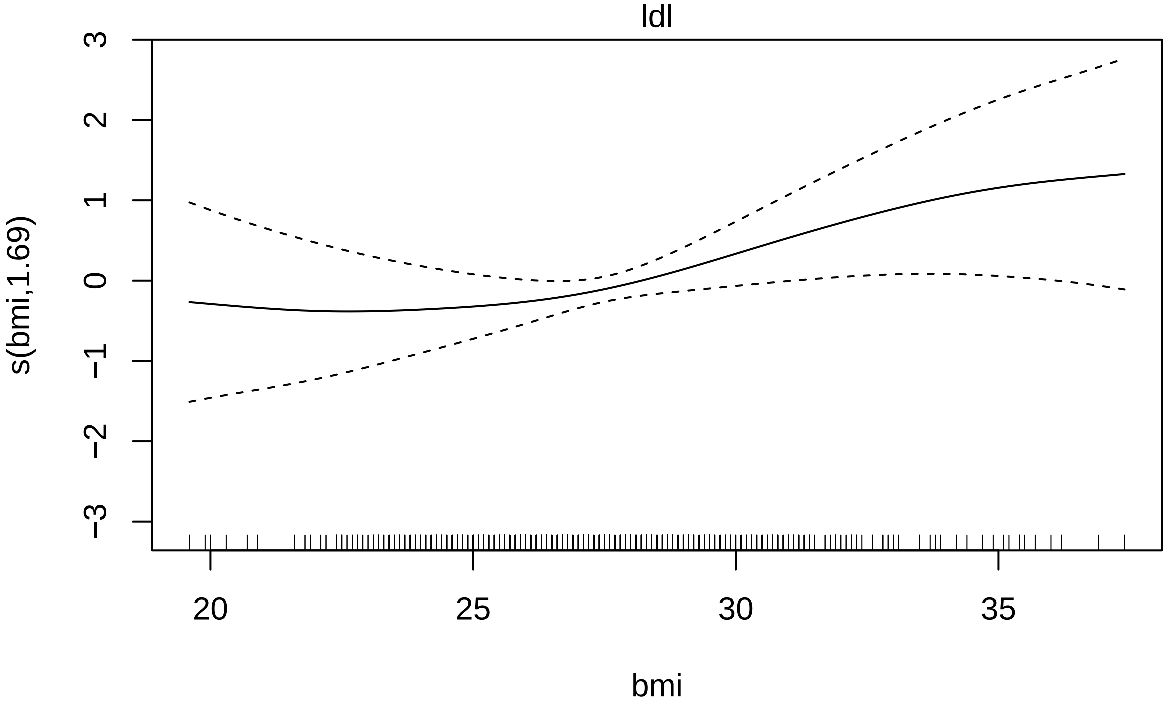
```r
plot(model.gam$finalModel)
```

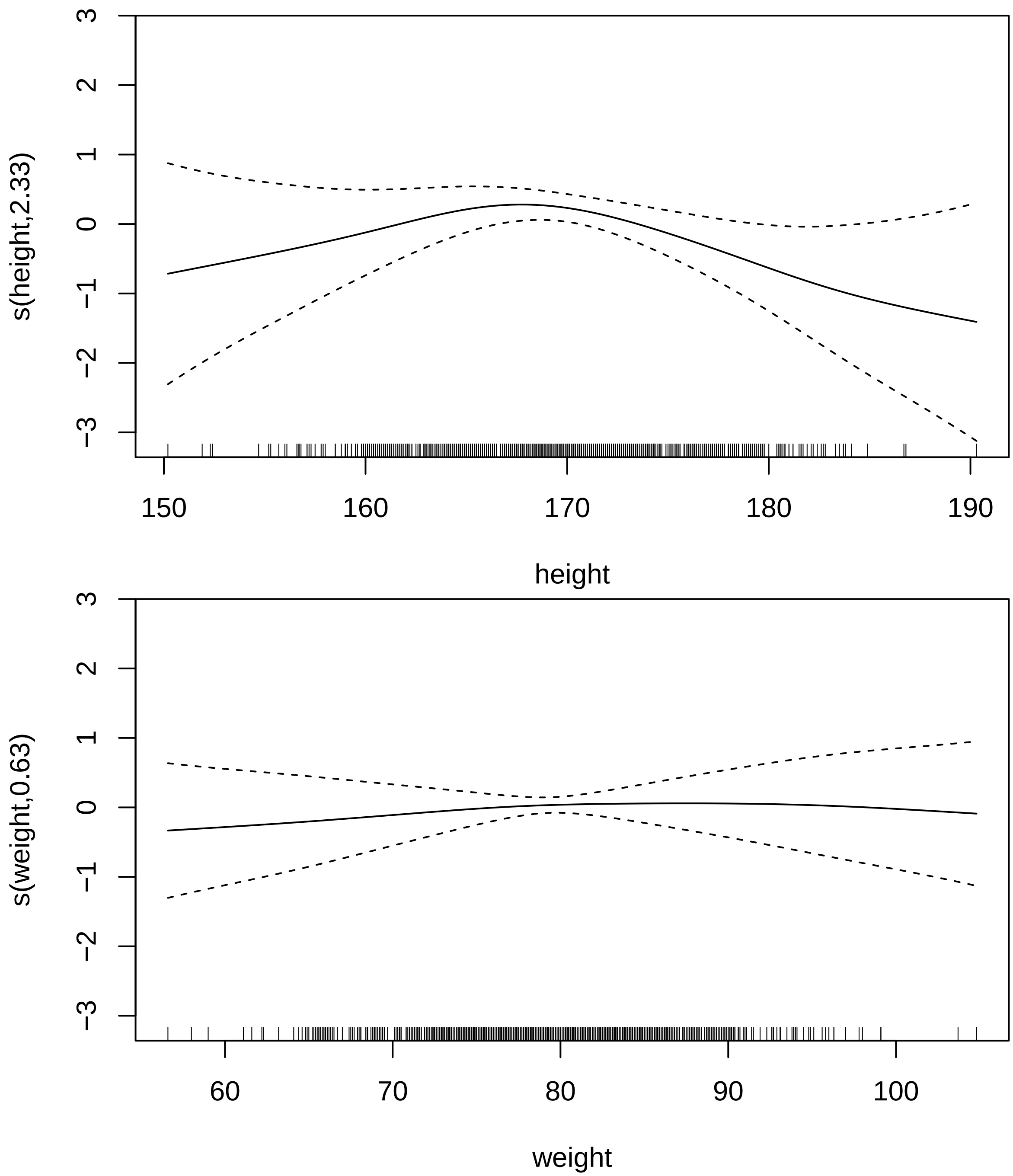



s(age,1.14)
3
2
1
0
−1
−2
−3
45
50
55
60
65
70
age


s(sbp,2.94)
3
2
1
0
−1
−2
−3
110
120
130
140
150
sbp


s(ldl,1.44)
3
2
1
0
−1
−2
−3
40
60
80
100
120
140
160
ldl


s(bmi,1.69)
3
2
1
0
−1
−2
−3
20
25
30
35
bmi



LDA

```
set.seed(2)
model.lda = train(x = x.train,
                  y = y.train,
                  method = "lda",
                  metric = "ROC",
                  trControl = ctrl)

model.lda$finalModel
```

```
## Call:
## lda(x, grouping = y)
##
## Prior probabilities of groups:
## Not_severe     Severe
##     0.6425     0.3575
##
## Group means:
##                 age genderMale  raceAsian raceBlack raceHispanic
## Not_severe 59.46887  0.5038911 0.06614786 0.2003891   0.09533074
## Severe     61.04545  0.4580420 0.05594406 0.1608392   0.10839161
##            smokingFormer_smoker smokingCurrent_smoker   height   weight
## Not_severe            0.3054475             0.1031128 170.1516 79.04125
## Severe                0.3181818             0.1118881 169.7269 80.10245
##                 bmi diabetesYes hypertensionYes      sbp      ldl
## Not_severe 27.35331   0.1498054       0.3540856 128.0272 108.4689
## Severe     27.86993   0.1538462       0.6503497 133.1224 113.4580
##            vaccineVaccinated depression
## Not_severe         0.8132296   6.912451
## Severe             0.1608392   6.902098
##
## Coefficients of linear discriminants:
##                               LD1
## age                   0.034385337
## genderMale           -0.236369596
## raceAsian            -0.126074229
## raceBlack             0.007697045
## raceHispanic         -0.114853112
## smokingFormer_smoker  0.027814955
## smokingCurrent_smoker 0.248324764
## height                0.067561771
## weight               -0.077322293
## bmi                   0.301287096
## diabetesYes           0.144018177
## hypertensionYes       0.215120572
## sbp                   0.036100853
## ldl                   0.004588793
## vaccineVaccinated    -2.478676582
## depression           -0.010600382
```

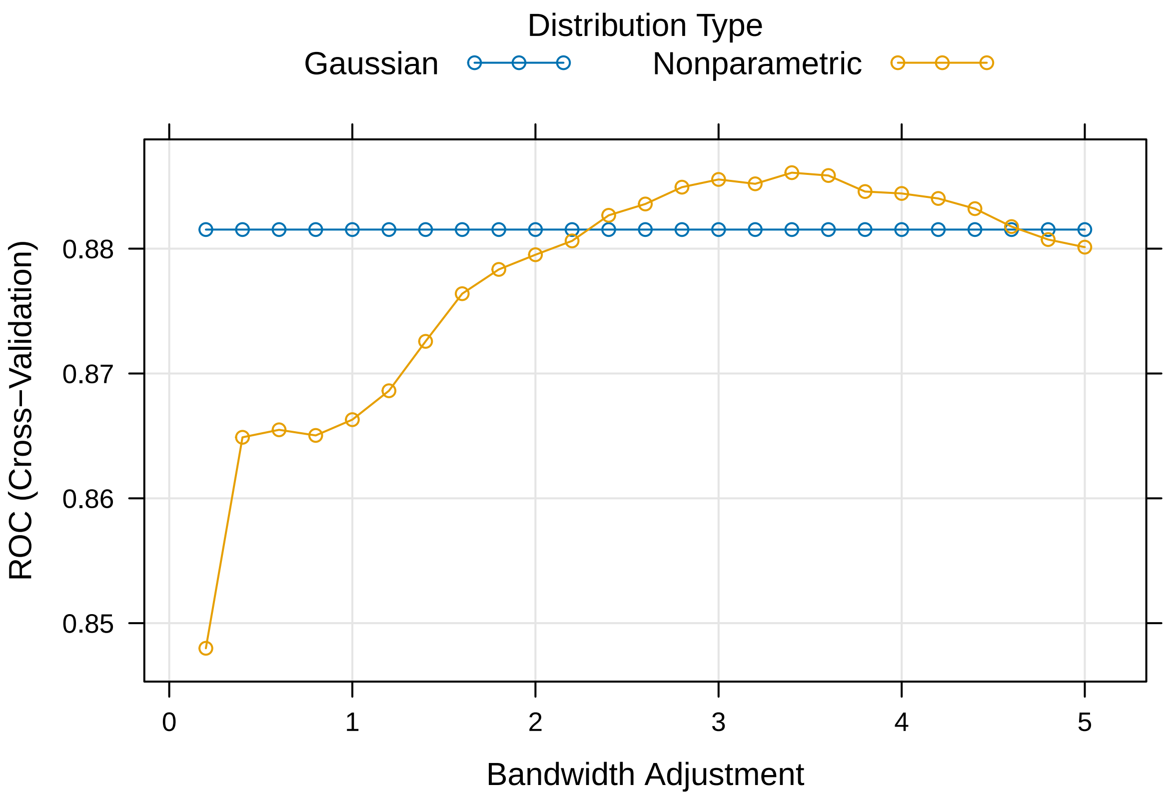
QDA

```r
set.seed(2)
model.qda = train(x = x.train,
                  y = y.train,
                  method = "qda",
                  metric = "ROC",
                  trControl = ctrl)
model.qda$finalModel
```

```
## Call:
## qda(x, grouping = y)
##
## Prior probabilities of groups:
## Not_severe     Severe
##     0.6425     0.3575
##
## Group means:
##                 age genderMale  raceAsian raceBlack raceHispanic
## Not_severe 59.46887  0.5038911 0.06614786 0.2003891   0.09533074
## Severe     61.04545  0.4580420 0.05594406 0.1608392   0.10839161
##            smokingFormer_smoker smokingCurrent_smoker   height   weight
## Not_severe            0.3054475             0.1031128 170.1516 79.04125
## Severe                0.3181818             0.1118881 169.7269 80.10245
##                 bmi diabetesYes hypertensionYes      sbp      ldl
## Not_severe 27.35331   0.1498054       0.3540856 128.0272 108.4689
## Severe     27.86993   0.1538462       0.6503497 133.1224 113.4580
##            vaccineVaccinated depression
## Not_severe         0.8132296   6.912451
## Severe             0.1608392   6.902098
```

Naive Bayes (NB)

```
# how to tune NB?
nbGrid = expand.grid(usekernel = c(FALSE, TRUE),
                     fL = 1,
                     adjust = seq(.2, 5, by = .2))
set.seed(2)
model.nb = train(x = x.train,
                 y = y.train,
                 method = "nb",
                 tuneGrid = nbGrid,
                 metric = "ROC",
                 trControl = ctrl)
plot(model.nb)
```




```
model.nb$bestTune
```

```
##    fL usekernel adjust
## 42  1      TRUE    3.4
```

```
model.nb$finalModel
```

```
## $apriori
## grouping
## Not_severe     Severe
##     0.6425     0.3575
##
## $tables
## $tables$age
## $tables$age$Not_severe
```

```
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 3.276
##
##        x               y
##  Min.   :36.17   Min.   :3.240e-06
##  1st Qu.:47.34   1st Qu.:5.095e-04
##  Median :58.50   Median :8.818e-03
##  Mean   :58.50   Mean   :2.237e-02
##  3rd Qu.:69.66   3rd Qu.:4.340e-02
##  Max.   :80.83   Max.   :7.341e-02
##
## $tables$age$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 4.071
##
##        x               y
##  Min.   :35.79   Min.   :6.120e-06
##  1st Qu.:47.89   1st Qu.:4.830e-04
##  Median :60.00   Median :7.734e-03
##  Mean   :60.00   Mean   :2.063e-02
##  3rd Qu.:72.11   3rd Qu.:3.977e-02
##  Max.   :84.21   Max.   :6.887e-02
##
##
## $tables$genderMale
## $tables$genderMale$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.4394
##
##        x                 y
##  Min.   :-1.3183   Min.   :0.005056
##  1st Qu.:-0.4092   1st Qu.:0.065590
##  Median : 0.5000   Median :0.296017
##  Mean   : 0.5000   Mean   :0.274341
##  3rd Qu.: 1.4092   3rd Qu.:0.478500
##  Max.   : 2.3183   Max.   :0.501583
##
## $tables$genderMale$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.4928
##
##        x                 y
```

```
##  Min.   :-1.4783   Min.   :0.004163
##  1st Qu.:-0.4892   1st Qu.:0.054802
##  Median : 0.5000   Median :0.249263
##  Mean   : 0.5000   Mean   :0.252157
##  3rd Qu.: 1.4892   3rd Qu.:0.451335
##  Max.   : 2.4783   Max.   :0.503657
##
##
## $tables$raceAsian
## $tables$raceAsian$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.2184
##
##        x                  y
##  Min.   :-0.65534   Min.   :0.001356
##  1st Qu.:-0.07767   1st Qu.:0.058789
##  Median : 0.50000   Median :0.115559
##  Mean   : 0.50000   Mean   :0.431777
##  3rd Qu.: 1.07767   3rd Qu.:0.710201
##  Max.   : 1.65534   Max.   :1.704901
##
## $tables$raceAsian$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.2273
##
##        x                  y
##  Min.   :-0.68188   Min.   :0.001102
##  1st Qu.:-0.09094   1st Qu.:0.056832
##  Median : 0.50000   Median :0.096677
##  Mean   : 0.50000   Mean   :0.422084
##  3rd Qu.: 1.09094   3rd Qu.:0.707112
##  Max.   : 1.68188   Max.   :1.656538
##
##
## $tables$raceBlack
## $tables$raceBlack$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.3518
##
##        x                 y
##  Min.   :-1.0555   Min.   :0.002552
##  1st Qu.:-0.2777   1st Qu.:0.070360
##  Median : 0.5000   Median :0.244896
##  Mean   : 0.5000   Mean   :0.320704
##  3rd Qu.: 1.2777   3rd Qu.:0.517906
```

```
##  Max.   : 2.0555   Max.   :0.910590
##
## $tables$raceBlack$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.3634
##
##        x                y
##  Min.   :-1.090   Min.   :0.001981
##  1st Qu.:-0.295   1st Qu.:0.059468
##  Median : 0.500   Median :0.203735
##  Mean   : 0.500   Mean   :0.313730
##  3rd Qu.: 1.295   3rd Qu.:0.529073
##  Max.   : 2.090   Max.   :0.925319
##
##
## $tables$raceHispanic
## $tables$raceHispanic$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.2581
##
##        x                 y
##  Min.   :-0.7743   Min.   :0.001654
##  1st Qu.:-0.1372   1st Qu.:0.077879
##  Median : 0.5000   Median :0.143643
##  Mean   : 0.5000   Mean   :0.391457
##  3rd Qu.: 1.1372   3rd Qu.:0.651065
##  Max.   : 1.7743   Max.   :1.398214
##
## $tables$raceHispanic$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.3075
##
##        x                 y
##  Min.   :-0.9224   Min.   :0.001579
##  1st Qu.:-0.2112   1st Qu.:0.062210
##  Median : 0.5000   Median :0.152821
##  Mean   : 0.5000   Mean   :0.350712
##  3rd Qu.: 1.2112   3rd Qu.:0.597910
##  Max.   : 1.9224   Max.   :1.157318
##
##
## $tables$smokingFormer_smoker
## $tables$smokingFormer_smoker$Not_severe
##
## Call:
```

```
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.4048
##
##        x                 y
##  Min.   :-1.2145   Min.   :0.003377
##  1st Qu.:-0.3572   1st Qu.:0.067287
##  Median : 0.5000   Median :0.283394
##  Mean   : 0.5000   Mean   :0.290960
##  3rd Qu.: 1.3572   3rd Qu.:0.460554
##  Max.   : 2.2145   Max.   :0.699683
##
## $tables$smokingFormer_smoker$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.4607
##
##        x                y
##  Min.   :-1.382   Min.   :0.003094
##  1st Qu.:-0.441   1st Qu.:0.056076
##  Median : 0.500   Median :0.244153
##  Mean   : 0.500   Mean   :0.265065
##  3rd Qu.: 1.441   3rd Qu.:0.445425
##  Max.   : 2.382   Max.   :0.619975
##
##
## $tables$smokingCurrent_smoker
## $tables$smokingCurrent_smoker$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.2673
##
##        x                 y
##  Min.   :-0.8019   Min.   :0.001728
##  1st Qu.:-0.1509   1st Qu.:0.077124
##  Median : 0.5000   Median :0.151115
##  Mean   : 0.5000   Mean   :0.383183
##  3rd Qu.: 1.1509   3rd Qu.:0.637338
##  Max.   : 1.8019   Max.   :1.338499
##
## $tables$smokingCurrent_smoker$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.3118
##
##        x                 y
##  Min.   :-0.9353   Min.   :0.001607
##  1st Qu.:-0.2177   1st Qu.:0.062239
```

```
##  Median : 0.5000   Median :0.157377
##  Mean   : 0.5000   Mean   :0.347555
##  3rd Qu.: 1.2177   3rd Qu.:0.592791
##  Max.   : 1.9353   Max.   :1.137104
##
##
## $tables$height
## $tables$height$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 5.478
##
##        x               y
##  Min.   :133.8   Min.   :2.960e-06
##  1st Qu.:151.1   1st Qu.:3.115e-04
##  Median :168.5   Median :5.361e-03
##  Mean   :168.5   Mean   :1.438e-02
##  3rd Qu.:185.9   3rd Qu.:2.806e-02
##  Max.   :203.2   Max.   :4.753e-02
##
## $tables$height$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 5.753
##
##        x               y
##  Min.   :135.0   Min.   :0.0000028
##  1st Qu.:153.2   1st Qu.:0.0002160
##  Median :171.3   Median :0.0041101
##  Mean   :171.3   Mean   :0.0137756
##  3rd Qu.:189.4   3rd Qu.:0.0262831
##  Max.   :207.6   Max.   :0.0488791
##
##
## $tables$weight
## $tables$weight$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 6.437
##
##        x                y
##  Min.   : 37.29   Min.   :1.610e-06
##  1st Qu.: 58.99   1st Qu.:1.611e-04
##  Median : 80.70   Median :3.327e-03
##  Mean   : 80.70   Mean   :1.151e-02
##  3rd Qu.:102.41   3rd Qu.:2.221e-02
##  Max.   :124.11   Max.   :4.050e-02
##
```

```
## $tables$weight$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 6.926
##
##        x                y
##  Min.   : 38.22   Min.   :2.520e-06
##  1st Qu.: 59.79   1st Qu.:2.040e-04
##  Median : 81.35   Median :3.727e-03
##  Mean   : 81.35   Mean   :1.158e-02
##  3rd Qu.:102.91   3rd Qu.:2.215e-02
##  Max.   :124.48   Max.   :4.044e-02
##
##
## $tables$bmi
## $tables$bmi$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 2.162
##
##        x               y
##  Min.   :13.11   Min.   :5.670e-06
##  1st Qu.:20.81   1st Qu.:6.282e-04
##  Median :28.50   Median :9.248e-03
##  Mean   :28.50   Mean   :3.246e-02
##  3rd Qu.:36.19   3rd Qu.:6.107e-02
##  Max.   :43.89   Max.   :1.176e-01
##
## $tables$bmi$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 2.579
##
##        x               y
##  Min.   :12.16   Min.   :1.011e-05
##  1st Qu.:20.28   1st Qu.:7.340e-04
##  Median :28.40   Median :1.048e-02
##  Mean   :28.40   Mean   :3.076e-02
##  3rd Qu.:36.52   3rd Qu.:5.791e-02
##  Max.   :44.64   Max.   :1.075e-01
##
##
## $tables$diabetesYes
## $tables$diabetesYes$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
```

```
## Data: xx (514 obs.); Bandwidth 'bw' = 0.3137
##
##        x                 y
##  Min.   :-0.9410   Min.   :0.002137
##  1st Qu.:-0.2205   1st Qu.:0.073069
##  Median : 0.5000   Median :0.198557
##  Mean   : 0.5000   Mean   :0.346180
##  3rd Qu.: 1.2205   3rd Qu.:0.570623
##  Max.   : 1.9410   Max.   :1.082367
##
## $tables$diabetesYes$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.3568
##
##        x                 y
##  Min.   :-1.0705   Min.   :0.00193
##  1st Qu.:-0.2853   1st Qu.:0.06001
##  Median : 0.5000   Median :0.19888
##  Mean   : 0.5000   Mean   :0.31763
##  3rd Qu.: 1.2853   3rd Qu.:0.53567
##  Max.   : 2.0705   Max.   :0.94928
##
##
## $tables$hypertensionYes
## $tables$hypertensionYes$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.4203
##
##        x                 y
##  Min.   :-1.2610   Min.   :0.003773
##  1st Qu.:-0.3805   1st Qu.:0.066342
##  Median : 0.5000   Median :0.289537
##  Mean   : 0.5000   Mean   :0.283276
##  3rd Qu.: 1.3805   3rd Qu.:0.450622
##  Max.   : 2.2610   Max.   :0.635073
##
## $tables$hypertensionYes$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.4716
##
##        x                 y
##  Min.   :-1.4149   Min.   :0.003319
##  1st Qu.:-0.4574   1st Qu.:0.055554
##  Median : 0.5000   Median :0.246724
##  Mean   : 0.5000   Mean   :0.260511
```

```
##  3rd Qu.: 1.4574   3rd Qu.:0.441410
##  Max.   : 2.4149   Max.   :0.586568
##
##
## $tables$sbp
## $tables$sbp$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 5.897
##
##        x                y
##  Min.   : 91.31   Min.   :3.180e-06
##  1st Qu.:111.40   1st Qu.:3.285e-04
##  Median :131.50   Median :4.558e-03
##  Mean   :131.50   Mean   :1.243e-02
##  3rd Qu.:151.60   3rd Qu.:2.358e-02
##  Max.   :171.69   Max.   :4.231e-02
##
## $tables$sbp$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 7.184
##
##        x                y
##  Min.   : 89.45   Min.   :5.770e-06
##  1st Qu.:110.72   1st Qu.:3.990e-04
##  Median :132.00   Median :4.851e-03
##  Mean   :132.00   Mean   :1.174e-02
##  3rd Qu.:153.28   3rd Qu.:2.218e-02
##  Max.   :174.55   Max.   :3.895e-02
##
##
## $tables$ldl
## $tables$ldl$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 18.04
##
##        x                y
##  Min.   :-13.13   Min.   :5.520e-07
##  1st Qu.: 45.44   1st Qu.:7.124e-05
##  Median :104.00   Median :1.469e-03
##  Mean   :104.00   Mean   :4.265e-03
##  3rd Qu.:162.56   3rd Qu.:8.267e-03
##  Max.   :221.13   Max.   :1.447e-02
##
## $tables$ldl$Severe
##
```

```
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 18.42
##
##        x                 y
##  Min.   : -1.259   Min.   :1.024e-06
##  1st Qu.: 56.370   1st Qu.:7.066e-05
##  Median :114.000   Median :1.353e-03
##  Mean   :114.000   Mean   :4.334e-03
##  3rd Qu.:171.630   3rd Qu.:8.271e-03
##  Max.   :229.259   Max.   :1.523e-02
##
##
## $tables$vaccineVaccinated
## $tables$vaccineVaccinated$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 0.3425
##
##        x                 y
##  Min.   :-1.0276   Min.   :0.002442
##  1st Qu.:-0.2638   1st Qu.:0.070760
##  Median : 0.5000   Median :0.234795
##  Mean   : 0.5000   Mean   :0.326552
##  3rd Qu.: 1.2638   3rd Qu.:0.530281
##  Max.   : 2.0276   Max.   :0.950099
##
## $tables$vaccineVaccinated$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 0.3634
##
##        x                y
##  Min.   :-1.090   Min.   :0.001981
##  1st Qu.:-0.295   1st Qu.:0.059468
##  Median : 0.500   Median :0.203735
##  Mean   : 0.500   Mean   :0.313730
##  3rd Qu.: 1.295   3rd Qu.:0.529073
##  Max.   : 2.090   Max.   :0.925319
##
##
## $tables$depression
## $tables$depression$Not_severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (514 obs.); Bandwidth 'bw' = 1.874
##
```

```
##        x                 y
##  Min.   :-5.6225   Min.   :5.960e-06
##  1st Qu.: 0.4388   1st Qu.:8.031e-04
##  Median : 6.5000   Median :1.431e-02
##  Mean   : 6.5000   Mean   :4.120e-02
##  3rd Qu.:12.5612   3rd Qu.:7.939e-02
##  Max.   :18.6225   Max.   :1.401e-01
##
## $tables$depression$Severe
##
## Call:
##  density.default(x = xx, adjust = ..1)
##
## Data: xx (286 obs.); Bandwidth 'bw' = 1.474
##
##        x                y
##  Min.   :-3.421   Min.   :1.343e-05
##  1st Qu.: 1.790   1st Qu.:1.617e-03
##  Median : 7.000   Median :1.976e-02
##  Mean   : 7.000   Mean   :4.793e-02
##  3rd Qu.:12.210   3rd Qu.:8.962e-02
##  Max.   :17.421   Max.   :1.615e-01
##
##
##
## $levels
## [1] "Not_severe" "Severe"
##
## $call
## NaiveBayes.default(x = x, grouping = y, usekernel = TRUE, fL = param$fL,
##     adjust = param$adjust)
##
## $x
##      age genderMale raceAsian raceBlack raceHispanic smokingFormer_smoker
## X1    59          0         0         0            0                    1
## X2    54          1         0         0            0                    1
## X3    55          1         0         1            0                    1
## X4    59          0         0         0            0                    0
## X6    64          1         0         0            0                    0
## X9    67          0         0         0            0                    0
## X10   66          1         0         0            0                    0
## X11   50          1         0         0            1                    1
## X12   67          0         0         0            0                    0
## X13   64          1         0         0            0                    0
## X14   63          0         0         0            0                    0
## X15   53          0         0         0            1                    0
## X17   61          1         0         0            0                    0
## X18   62          0         0         0            0                    0
## X19   58          0         0         0            1                    1
## X21   58          1         0         0            0                    0
## X22   63          0         0         1            0                    0
## X24   55          0         0         0            0                    0
## X25   61          0         0         0            0                    1
## X26   64          0         0         1            0                    0
```

```
## X27   63         0        1        0          0                    1
## X28   59         0        0        0          0                    0
## X29   57         1        0        0          0                    1
## X30   61         0        0        1          0                    0
## X31   66         0        0        1          0                    0
## X33   61         1        1        0          0                    0
## X36   56         1        0        1          0                    0
## X39   63         1        0        1          0                    0
## X40   64         0        0        0          0                    0
## X41   65         1        0        0          0                    0
## X42   55         0        0        1          0                    1
## X45   60         1        0        1          0                    0
## X46   62         1        0        0          0                    1
## X47   55         1        0        0          0                    0
## X49   66         0        0        0          0                    0
## X54   60         1        0        1          0                    0
## X56   61         1        0        0          0                    0
## X57   62         1        1        0          0                    1
## X59   62         1        0        0          0                    1
## X60   55         1        0        0          0                    0
## X61   46         1        0        0          0                    0
## X62   63         1        0        0          0                    1
## X64   66         0        0        0          0                    0
## X65   60         1        1        0          0                    0
## X67   58         0        0        0          1                    1
## X69   65         0        0        0          0                    1
## X70   61         0        0        0          0                    1
## X72   57         0        1        0          0                    0
## X73   58         0        0        0          1                    0
## X74   55         0        0        0          0                    0
## X75   59         0        0        0          0                    1
## X77   65         0        0        0          1                    1
## X78   66         1        0        0          0                    1
## X79   64         0        0        1          0                    0
## X82   59         1        0        0          0                    0
## X85   61         0        0        0          0                    0
## X87   56         1        1        0          0                    0
## X88   49         0        0        0          0                    0
## X89   55         1        0        0          0                    0
## X90   57         0        0        0          0                    0
## X91   65         1        0        1          0                    0
## X92   60         0        0        0          0                    0
## X93   64         0        0        0          0                    0
## X94   60         1        1        0          0                    0
## X95   57         0        0        0          0                    0
## X96   51         0        0        0          0                    0
## X97   60         0        0        0          0                    1
## X98   66         0        0        0          0                    1
## X99   64         0        1        0          0                    1
## X100  64         0        0        0          0                    1
## X101  57         0        0        0          0                    0
## X102  59         0        0        0          0                    1
## X103  61         1        0        1          0                    0
## X104  51         1        0        0          0                    0
```

```
## X105  62          0         0         1            0                    0
## X106  57          1         0         0            0                    0
## X108  60          0         1         0            0                    0
## X109  51          0         0         0            0                    0
## X110  58          0         0         0            0                    1
## X112  62          1         0         1            0                    1
## X113  53          0         0         0            0                    0
## X114  57          1         0         0            0                    0
## X115  56          1         1         0            0                    0
## X116  62          1         0         0            0                    1
## X117  64          1         0         0            1                    0
## X119  62          1         0         0            0                    0
## X120  60          1         0         1            0                    0
## X121  59          0         0         1            0                    0
## X122  58          0         0         0            0                    1
## X123  54          1         0         0            0                    0
## X126  63          1         0         0            0                    0
## X127  54          1         0         0            0                    0
## X128  61          0         0         0            0                    1
## X129  70          1         0         0            0                    0
## X130  60          0         0         0            0                    0
## X131  56          0         0         0            1                    1
## X132  66          1         0         0            1                    0
## X133  57          0         1         0            0                    1
## X135  66          0         0         0            1                    1
## X136  64          1         1         0            0                    0
## X137  54          1         0         0            1                    0
## X138  67          1         0         0            0                    0
## X139  62          0         0         0            0                    1
## X142  57          0         0         0            1                    0
## X144  67          0         1         0            0                    0
## X145  59          0         0         0            0                    1
## X146  53          1         0         1            0                    0
## X147  64          1         0         0            0                    1
## X148  61          0         0         0            1                    0
## X149  61          0         0         0            1                    0
## X150  58          0         0         1            0                    0
## X152  55          0         0         0            0                    0
## X154  58          0         0         0            0                    1
## X155  63          1         0         0            0                    0
## X156  71          0         0         0            0                    0
## X157  67          1         0         1            0                    0
## X159  60          0         0         0            1                    0
## X160  57          0         0         0            1                    0
## X161  59          1         0         0            0                    0
## X162  57          1         0         0            0                    0
## X163  61          0         0         1            0                    0
## X164  64          1         0         0            1                    0
## X165  62          0         0         0            0                    0
## X166  63          1         0         0            0                    1
## X167  54          0         0         1            0                    1
## X168  59          1         0         0            0                    1
## X169  56          0         0         0            0                    0
## X170  62          1         0         0            0                    0
```

```
## X171   56          1        0        0        0             0
## X172   62          0        0        1        0             0
## X173   57          0        0        0        0             0
## X174   58          1        0        1        0             0
## X175   64          0        0        0        0             0
## X177   58          0        0        0        0             0
## X179   57          1        0        0        1             1
## X180   63          1        0        0        0             1
## X181   63          1        0        0        0             0
## X182   53          1        0        0        0             1
## X183   59          1        0        1        0             0
## X184   61          1        0        0        0             0
## X185   62          0        0        0        0             0
## X186   54          1        0        1        0             0
## X187   65          0        0        0        0             0
## X188   49          1        0        1        0             1
## X189   61          0        0        0        0             0
## X190   64          0        1        0        0             0
## X191   63          0        0        0        0             0
## X192   65          0        0        0        0             1
## X193   50          1        0        1        0             0
## X194   72          0        0        0        0             0
## X195   56          0        0        0        0             0
## X196   57          0        0        0        0             1
## X198   62          0        0        0        0             0
## X200   60          0        0        0        0             0
## X201   59          1        0        0        0             1
## X202   52          1        0        0        0             0
## X204   59          1        0        0        0             0
## X205   59          0        0        0        0             0
## X206   57          1        0        0        0             0
## X207   69          0        0        0        0             0
## X209   65          0        0        0        1             0
## X211   59          1        0        1        0             0
## X212   67          1        1        0        0             1
## X213   64          1        0        0        0             1
## X214   60          1        0        1        0             0
## X215   57          1        0        0        1             0
## X216   60          0        0        1        0             0
## X217   59          0        0        1        0             1
## X218   64          0        0        0        0             0
## X219   61          0        0        0        0             0
## X220   60          0        0        0        0             0
## X221   63          0        0        0        0             0
## X222   59          1        0        0        1             1
## X223   60          0        0        0        0             0
## X224   67          0        0        0        1             1
## X226   67          1        0        1        0             0
## X227   66          1        0        1        0             0
## X228   59          0        0        1        0             0
## X229   58          1        0        0        0             0
## X230   60          1        0        0        0             1
## X231   58          1        0        0        0             0
## X233   62          1        0        1        0             1
```

```
## X234   55             1           0           0             0                       0
## X235   58             1           0           0             0                       0
## X236   62             0           1           0             0                       0
## X237   60             1           0           0             0                       0
## X238   67             0           0           0             0                       0
## X239   61             0           0           0             0                       0
## X240   56             0           0           0             0                       0
## X241   52             1           0           0             0                       0
## X244   65             1           0           0             0                       0
## X245   63             1           0           0             0                       0
## X246   56             1           0           0             1                       1
## X247   53             0           0           0             0                       0
## X248   67             0           0           0             0                       0
## X249   61             0           0           0             1                       0
## X251   59             1           0           0             0                       0
## X252   60             0           0           0             1                       0
## X254   56             0           0           0             0                       0
## X255   55             1           0           0             0                       0
## X256   54             0           0           1             0                       0
## X257   63             0           0           0             1                       1
## X258   61             0           0           1             0                       1
## X259   61             0           0           0             0                       0
## X260   56             1           0           0             1                       0
## X261   63             1           0           0             0                       1
## X262   63             0           0           0             1                       0
## X264   58             0           0           0             0                       0
## X265   66             1           0           0             0                       0
## X266   62             1           1           0             0                       0
## X267   64             0           0           0             1                       0
## X268   55             1           0           0             0                       0
## X269   60             1           0           0             0                       1
## X270   52             1           0           1             0                       1
## X273   61             1           1           0             0                       0
## X274   64             0           0           0             0                       0
## X275   53             1           0           0             0                       0
## X276   63             0           0           1             0                       0
## X277   51             1           0           0             0                       0
## X278   56             0           0           0             0                       0
## X279   58             0           0           1             0                       1
## X280   61             0           0           1             0                       0
## X282   59             1           0           0             0                       0
## X283   54             1           0           0             0                       1
## X284   64             1           0           0             0                       0
## X286   61             1           0           0             0                       0
## X289   60             1           0           0             0                       0
## X290   56             0           0           0             0                       1
## X292   66             0           0           1             0                       0
## X293   61             1           0           0             0                       1
## X295   58             1           0           0             0                       1
## X296   56             0           0           0             1                       0
## X298   60             0           0           0             0                       0
## X299   59             0           0           0             0                       0
## X300   61             0           0           1             0                       0
## X301   62             1           0           0             1                       0
```

```
## X302   58          0          0          0            0                      0
## X303   64          0          1          0            0                      0
## X305   59          1          0          1            0                      1
## X306   61          0          0          0            1                      0
## X307   66          0          0          0            0                      0
## X311   70          0          0          0            0                      0
## X312   59          0          0          0            0                      0
## X313   69          1          0          0            0                      0
## X314   60          0          0          1            0                      0
## X315   65          1          0          0            0                      0
## X316   61          0          0          0            1                      1
## X317   64          1          0          0            0                      0
## X318   55          0          0          0            0                      0
## X319   54          1          0          0            0                      1
## X321   55          1          0          0            0                      0
## X322   60          0          0          1            0                      0
## X326   59          0          0          1            0                      0
## X327   64          1          0          0            0                      0
## X328   57          0          0          0            0                      1
## X329   61          0          0          0            1                      0
## X330   55          0          0          0            0                      0
## X331   57          0          0          0            0                      1
## X332   61          1          1          0            0                      1
## X333   60          1          0          1            0                      0
## X334   62          0          0          0            0                      0
## X335   61          0          0          0            0                      1
## X336   60          0          0          0            0                      1
## X339   60          1          0          0            1                      0
## X340   57          1          0          0            0                      0
## X341   59          1          0          0            0                      0
## X342   56          1          0          0            0                      0
## X345   61          1          0          0            0                      0
## X347   65          1          1          0            0                      0
## X349   60          0          0          0            0                      0
## X351   57          0          0          0            0                      1
## X353   69          0          0          0            0                      0
## X354   56          1          0          0            0                      1
## X355   60          0          0          0            0                      1
## X356   62          1          0          0            0                      0
## X359   60          0          0          0            0                      0
## X360   68          1          0          0            0                      1
## X361   64          0          0          0            0                      0
## X363   57          0          0          0            0                      0
## X365   53          1          0          0            0                      0
## X366   57          0          0          0            0                      0
## X367   60          0          0          0            0                      1
## X369   56          1          0          0            0                      1
## X371   66          1          0          1            0                      0
## X372   59          0          0          0            0                      1
## X373   65          0          0          0            0                      0
## X374   58          1          0          0            0                      1
## X376   59          1          0          0            0                      0
## X377   54          0          0          0            0                      0
## X378   66          1          0          0            0                      0
```

```
## X379  52         1         0         0          0               1
## X380  59         0         0         0          0               1
## X382  57         0         0         0          0               0
## X383  56         0         0         0          0               1
## X385  60         0         0         1          0               0
## X386  48         1         1         0          0               0
## X387  60         0         0         0          0               0
## X388  66         1         0         0          0               0
## X389  59         1         0         0          0               0
## X391  52         1         0         0          0               0
## X392  62         1         0         0          0               1
## X393  57         0         0         0          0               1
## X394  65         0         0         0          0               0
## X395  62         0         0         0          0               0
## X396  57         0         0         0          1               0
## X397  59         0         0         1          0               1
## X398  63         1         0         0          0               0
## X399  61         0         0         1          0               1
## X401  62         1         0         0          1               1
## X402  57         1         0         0          0               0
## X405  61         1         0         0          0               0
## X406  62         1         0         0          1               0
## X407  56         1         0         0          1               1
## X408  55         0         0         0          0               1
## X410  67         1         0         0          0               1
## X411  62         1         0         0          1               0
## X412  64         1         0         1          0               0
## X413  61         0         0         0          0               0
## X414  58         0         0         0          1               0
## X415  64         0         0         0          0               0
## X416  61         1         0         0          0               1
## X417  64         1         0         0          0               0
## X418  59         0         0         0          0               0
## X419  60         1         0         0          0               1
## X420  52         1         0         0          0               0
## X421  66         1         0         0          0               0
## X422  59         0         1         0          0               0
## X423  60         0         0         0          1               0
## X424  63         1         0         1          0               0
## X425  55         1         0         1          0               0
## X426  70         0         0         1          0               0
## X427  60         0         0         1          0               1
## X431  60         1         0         1          0               0
## X432  56         1         0         0          0               0
## X434  55         0         0         0          0               1
## X435  58         0         0         0          0               0
## X437  69         0         1         0          0               0
## X438  55         1         0         0          0               0
## X439  69         1         0         0          1               0
## X440  60         0         0         0          0               1
## X441  57         1         0         0          0               1
## X442  67         0         0         0          0               1
## X443  57         1         0         0          0               0
## X444  65         1         0         0          1               0
```

```
## X445  57          0         0         0            1                   1
## X448  66          1         0         0            0                   1
## X450  63          0         0         0            1                   0
## X451  61          1         0         1            0                   0
## X453  56          0         0         0            0                   1
## X454  62          0         0         1            0                   1
## X455  60          1         0         0            1                   0
## X456  60          1         0         0            0                   1
## X457  61          0         0         0            0                   1
## X458  56          1         0         0            0                   0
## X459  66          1         0         0            0                   1
## X460  69          1         1         0            0                   0
## X461  57          1         0         1            0                   1
## X464  64          0         0         0            0                   0
## X465  68          0         0         0            1                   0
## X466  59          1         0         0            0                   0
## X468  66          1         0         1            0                   1
## X469  59          0         0         0            1                   0
## X470  61          0         0         0            0                   1
## X472  61          0         0         1            0                   1
## X473  62          0         0         0            0                   0
## X474  63          0         0         0            0                   0
## X475  62          1         0         0            0                   0
## X476  53          1         0         0            1                   0
## X478  62          0         0         0            0                   0
## X480  67          1         0         0            0                   1
## X481  64          0         0         0            0                   0
## X482  58          1         0         0            0                   1
## X483  64          1         1         0            0                   0
## X484  58          1         0         1            0                   0
## X486  70          0         0         0            0                   0
## X487  66          1         0         1            0                   1
## X488  56          0         0         0            0                   1
## X489  70          1         0         0            0                   0
## X490  63          1         0         0            0                   0
## X491  65          0         0         0            0                   0
## X492  57          1         0         0            0                   1
## X493  62          1         0         0            0                   0
## X494  66          1         0         0            0                   1
## X495  62          1         1         0            0                   1
## X496  63          0         0         0            0                   0
## X497  62          0         0         1            0                   0
## X498  57          1         0         0            0                   0
## X499  57          0         0         0            0                   0
## X500  60          1         0         1            0                   0
## X501  62          1         0         1            0                   0
## X502  66          1         0         0            0                   0
## X503  59          0         0         0            0                   0
## X504  61          0         0         0            0                   0
## X507  59          0         0         0            0                   0
## X509  56          1         0         0            0                   1
## X511  58          1         0         0            0                   0
## X512  68          0         0         0            0                   0
## X513  60          0         0         0            0                   0
```

```
## X514  57    0    0    0    0    0
## X515  57    0    0    0    0    0
## X516  60    1    0    0    0    0
## X518  58    1    0    0    0    0
## X520  62    1    0    0    0    0
## X521  58    1    0    0    0    1
## X522  61    0    0    0    0    1
## X523  59    0    0    0    0    1
## X524  68    1    0    0    0    0
## X525  59    0    0    0    0    0
## X527  58    0    0    0    0    0
## X528  62    1    0    1    0    0
## X529  62    0    1    0    0    1
## X530  62    1    0    0    0    0
## X533  64    1    0    0    0    1
## X535  61    1    0    0    0    1
## X536  59    1    0    0    0    1
## X539  58    0    0    0    0    1
## X540  63    1    0    1    0    0
## X541  69    0    0    0    1    0
## X542  65    1    0    0    0    1
## X543  64    0    0    0    0    0
## X545  63    0    0    0    0    0
## X546  63    0    1    0    0    0
## X547  67    0    0    0    0    0
## X548  66    1    0    0    0    1
## X549  54    1    0    0    0    0
## X550  54    1    0    1    0    1
## X551  54    1    0    1    0    1
## X552  62    0    0    0    0    1
## X553  66    0    0    0    0    0
## X554  62    1    0    0    1    0
## X556  61    0    0    0    0    1
## X557  58    0    0    0    0    1
## X558  57    1    0    0    0    0
## X559  65    1    0    0    0    0
## X560  57    1    0    0    1    1
## X561  62    1    0    0    0    1
## X562  63    0    0    0    0    1
## X563  58    1    0    0    0    0
## X564  58    0    0    1    0    0
## X565  62    1    0    0    0    0
## X566  53    0    0    0    0    0
## X567  54    0    0    0    0    0
## X568  68    1    0    0    0    0
## X569  62    1    0    1    0    1
## X571  63    1    0    0    0    1
## X573  65    1    0    0    1    0
## X574  59    1    0    0    1    0
## X575  52    0    0    1    0    0
## X576  59    1    0    0    0    0
## X577  61    1    0    0    0    0
## X579  60    0    0    1    0    1
## X580  54    0    0    0    1    1
```

```
## X582  62           0          0          0            0                    1
## X584  64           1          0          0            0                    0
## X587  57           0          0          0            0                    0
## X588  63           0          0          0            0                    1
## X589  56           1          0          0            0                    0
## X591  54           0          0          0            0                    0
## X592  60           0          0          1            0                    1
## X593  56           1          0          0            0                    0
## X594  65           0          0          0            0                    0
## X597  56           0          0          0            1                    0
## X598  56           0          0          0            0                    0
## X600  61           0          0          0            1                    1
## X601  65           0          0          0            0                    0
## X602  58           0          0          0            0                    1
## X603  63           0          0          0            0                    1
## X604  52           0          1          0            0                    1
## X605  64           1          0          0            0                    1
## X606  62           0          0          0            1                    1
## X609  63           1          0          0            0                    0
## X610  58           1          0          0            0                    0
## X611  52           1          0          0            0                    1
## X613  63           1          0          1            0                    0
## X614  58           0          0          0            0                    1
## X615  53           1          1          0            0                    0
## X617  57           1          0          0            1                    1
## X618  59           1          1          0            0                    0
## X619  57           0          0          0            0                    1
## X620  55           1          0          0            0                    0
## X623  59           0          0          0            0                    0
## X624  61           0          0          0            0                    0
## X625  56           0          0          0            0                    0
## X626  58           0          0          0            0                    0
## X628  70           1          0          1            0                    0
## X629  59           0          0          0            0                    0
## X630  61           0          0          0            0                    0
## X631  64           1          0          0            0                    1
## X632  59           0          0          0            0                    1
## X633  58           1          0          0            0                    0
## X634  64           1          0          0            0                    0
## X635  55           1          0          0            0                    0
## X636  57           1          0          1            0                    1
## X637  61           1          0          0            0                    1
## X638  56           0          0          1            0                    0
## X640  60           0          0          0            0                    0
## X641  58           0          0          0            0                    0
## X642  60           1          0          1            0                    0
## X643  50           1          0          0            1                    1
## X644  55           0          0          0            0                    0
## X645  54           1          0          0            1                    1
## X646  58           1          0          0            0                    0
## X648  55           1          0          0            0                    0
## X649  57           1          0          0            0                    1
## X650  63           0          0          1            0                    0
## X652  58           0          0          0            0                    0
```

```
## X654  64       0       0       0       0         1
## X655  68       1       0       0       0         1
## X656  60       0       0       0       0         0
## X657  56       1       0       0       0         0
## X658  61       1       0       1       0         1
## X659  59       0       1       0       0         0
## X660  66       0       0       1       0         0
## X661  64       1       0       0       0         1
## X663  58       0       1       0       0         0
## X664  61       1       0       0       0         0
## X665  61       0       0       0       0         1
## X666  60       0       0       0       0         1
## X667  69       1       0       1       0         0
## X668  65       0       0       0       0         1
## X669  65       1       0       1       0         0
## X670  61       0       0       0       0         0
## X673  65       1       0       0       1         0
## X674  62       0       0       0       0         0
## X675  52       0       0       0       0         0
## X676  60       1       0       0       0         0
## X677  62       1       0       1       0         0
## X678  59       1       0       0       1         1
## X679  63       1       0       1       0         0
## X680  60       0       0       0       0         0
## X681  64       1       1       0       0         1
## X682  57       0       0       1       0         1
## X683  55       1       0       1       0         0
## X684  64       0       1       0       0         0
## X685  57       0       0       1       0         0
## X686  58       0       0       1       0         0
## X687  62       1       0       0       0         0
## X688  64       0       0       0       0         1
## X690  62       1       0       0       0         0
## X691  52       0       0       0       0         0
## X692  52       0       0       0       0         0
## X693  60       0       0       0       0         0
## X694  62       0       1       0       0         1
## X697  57       1       0       0       0         0
## X698  65       1       0       0       0         0
## X699  56       1       0       0       0         0
## X700  57       1       0       0       0         0
## X701  61       1       0       0       0         0
## X702  58       1       1       0       0         0
## X703  63       1       0       0       0         0
## X705  58       0       0       1       0         0
## X706  63       0       0       0       0         0
## X707  57       1       0       0       0         0
## X708  58       0       0       0       1         0
## X709  63       1       0       1       0         1
## X710  65       0       0       0       0         1
## X711  61       1       0       0       0         0
## X712  58       0       0       0       0         0
## X713  51       0       1       0       0         0
## X714  55       0       1       0       0         1
```

```
## X715   56          1          0          0          0              0
## X716   57          0          0          0          0              0
## X717   62          1          0          0          0              0
## X718   59          1          0          0          1              0
## X719   59          1          0          1          0              0
## X720   62          0          0          0          0              0
## X721   57          1          0          1          0              0
## X722   62          1          0          0          0              0
## X724   50          0          0          0          0              0
## X725   56          0          0          1          0              0
## X726   63          1          0          0          0              0
## X730   67          0          0          1          0              0
## X731   61          0          0          0          1              0
## X732   65          1          0          0          0              0
## X734   57          1          0          0          0              0
## X735   52          1          0          0          0              0
## X737   62          0          0          0          0              0
## X738   56          0          0          1          0              0
## X739   59          0          0          0          0              1
## X740   56          0          0          0          0              1
## X744   55          1          0          0          0              0
## X745   62          0          0          0          0              0
## X746   62          0          0          0          0              0
## X747   61          1          0          1          0              1
## X748   54          1          0          0          0              0
## X749   63          0          0          0          0              0
## X751   58          0          0          0          0              0
## X752   66          0          0          0          0              0
## X753   65          0          0          0          0              1
## X754   58          1          1          0          0              0
## X757   64          1          0          0          0              0
## X758   59          0          0          0          0              0
## X759   58          1          0          1          0              0
## X761   65          0          0          1          0              0
## X762   62          0          0          0          0              0
## X763   62          0          1          0          0              0
## X764   67          1          0          0          0              0
## X765   64          1          0          1          0              0
## X766   58          1          0          1          0              1
## X767   62          0          0          0          0              0
## X768   58          0          0          0          0              1
## X769   61          1          0          0          0              0
## X770   65          1          0          0          0              0
## X772   60          0          0          0          0              1
## X773   64          0          0          0          0              0
## X774   68          0          0          0          0              0
## X775   61          0          0          1          0              0
## X776   59          0          0          0          0              0
## X777   61          1          1          0          0              1
## X778   66          1          0          0          0              0
## X779   63          1          0          0          0              1
## X780   61          0          0          0          0              1
## X781   69          1          0          0          0              0
## X784   57          1          0          0          0              0
```

```
## X786  63         0        0        1         0           0
## X787  66         1        0        0         0           0
## X788  64         0        0        1         0           0
## X789  56         0        0        1         0           0
## X790  58         0        0        0         0           0
## X791  63         1        0        0         0           1
## X792  67         1        0        0         0           0
## X794  68         0        0        0         0           0
## X795  55         1        0        1         0           0
## X796  61         0        0        0         0           0
## X797  60         1        0        0         0           1
## X798  58         1        0        0         0           0
## X799  58         1        0        0         0           0
## X800  64         1        0        1         0           0
## X801  62         0        0        0         0           1
## X802  50         1        0        0         0           0
## X803  53         0        0        0         1           0
## X804  55         0        0        0         0           1
## X805  55         0        0        0         0           0
## X807  68         0        0        0         0           0
## X808  64         1        0        0         0           0
## X809  58         1        0        0         0           1
## X810  57         0        0        0         0           1
## X812  57         0        0        0         0           1
## X813  64         0        0        1         0           0
## X814  62         1        0        0         0           0
## X815  55         0        0        0         0           0
## X816  63         0        0        1         0           0
## X817  60         1        0        0         0           0
## X818  61         1        0        0         0           1
## X820  61         1        0        0         0           0
## X821  59         1        1        0         0           0
## X822  62         0        0        0         0           0
## X823  67         0        0        0         0           1
## X824  61         0        0        0         1           1
## X825  55         1        0        0         1           0
## X826  64         0        0        1         0           1
## X830  63         1        0        0         0           0
## X831  58         0        1        0         0           1
## X832  55         0        0        0         0           0
## X833  52         1        0        0         0           0
## X834  69         1        0        0         0           1
## X836  56         0        0        1         0           0
## X837  55         1        0        1         0           1
## X838  62         1        0        1         0           1
## X839  53         1        0        0         0           0
## X840  60         1        0        0         0           0
## X841  61         1        0        1         0           0
## X842  56         1        0        0         0           0
## X843  60         0        0        1         0           1
## X844  57         0        0        0         0           0
## X847  70         1        0        0         0           0
## X848  62         0        1        0         0           0
## X849  59         1        0        0         0           0
```

```
## X850   58         0         0         0          1                0
## X851   64         1         0         0          0                1
## X852   58         0         0         1          0                0
## X853   54         1         0         0          0                0
## X854   68         0         0         0          0                0
## X855   57         1         0         0          0                1
## X856   49         0         0         1          0                0
## X857   61         0         0         0          0                0
## X858   59         1         0         1          0                0
## X859   61         1         0         1          0                0
## X860   61         0         0         0          0                0
## X861   56         0         0         0          0                0
## X862   53         0         0         0          0                1
## X864   61         1         0         0          0                0
## X865   53         0         0         0          0                1
## X866   64         1         0         1          0                1
## X867   60         1         0         0          0                0
## X868   59         1         0         0          0                1
## X869   60         0         0         0          1                1
## X870   56         0         0         0          0                0
## X871   63         0         0         0          0                0
## X872   54         0         0         0          0                0
## X873   56         0         0         1          0                0
## X874   58         1         0         0          0                0
## X875   57         1         0         1          0                0
## X877   64         0         0         0          0                0
## X878   54         0         0         0          0                1
## X879   59         0         0         0          0                0
## X880   62         1         0         1          0                0
## X881   57         0         0         0          0                1
## X882   60         0         1         0          0                1
## X883   57         0         0         0          0                1
## X884   66         0         0         0          0                0
## X885   59         0         0         1          0                0
## X886   61         0         0         0          0                0
## X887   65         1         0         0          0                0
## X888   65         1         0         0          0                0
## X889   65         1         0         0          1                0
## X890   58         1         0         0          0                0
## X891   58         0         0         0          0                1
## X892   59         1         0         1          0                1
## X894   60         0         0         0          1                0
## X895   64         1         0         1          0                0
## X897   58         0         0         0          0                1
## X899   58         1         0         0          0                0
## X900   57         0         0         1          0                1
## X901   68         0         0         0          0                1
## X902   66         0         0         1          0                0
## X903   61         0         0         0          0                0
## X904   57         0         0         0          0                1
## X905   61         0         0         0          0                1
## X906   52         1         0         0          0                1
## X907   61         0         1         0          0                0
## X908   57         1         0         0          0                1
```

```
## X909   58          1          0          0            0                   1
## X910   64          0          0          0            0                   1
## X911   54          0          0          1            0                   0
## X913   59          0          0          0            0                   1
## X916   61          1          0          0            1                   0
## X917   66          1          0          0            0                   0
## X918   55          0          0          0            0                   0
## X919   58          1          0          0            0                   0
## X920   54          1          0          0            0                   1
## X921   70          0          0          0            0                   0
## X922   63          1          0          0            0                   0
## X924   57          1          0          0            0                   0
## X925   55          0          0          0            0                   0
## X926   56          0          0          1            0                   1
## X927   64          0          0          0            0                   0
## X929   61          1          0          0            0                   0
## X932   66          1          0          1            0                   0
## X933   57          1          0          0            0                   1
## X935   65          0          0          0            0                   0
## X936   63          1          0          0            0                   0
## X937   57          1          1          0            0                   0
## X939   64          0          0          0            1                   1
## X940   63          1          0          1            0                   1
## X941   64          1          0          0            1                   0
## X942   59          0          0          1            0                   0
## X943   58          1          0          0            0                   0
## X945   65          1          0          0            0                   0
## X946   63          1          0          1            0                   0
## X948   58          0          0          0            0                   1
## X949   58          1          0          0            0                   0
## X950   50          0          0          0            0                   0
## X951   51          0          0          0            0                   0
## X953   69          0          0          0            0                   0
## X954   69          1          0          0            0                   0
## X955   59          0          0          0            0                   1
## X956   62          1          0          0            0                   0
## X957   55          0          0          0            0                   0
## X958   61          0          0          0            0                   0
## X959   54          0          0          0            0                   0
## X960   51          0          0          0            0                   0
## X961   56          0          0          1            0                   0
## X962   63          1          0          0            1                   1
## X963   63          1          0          0            0                   1
## X964   65          1          0          0            0                   0
## X965   59          0          0          0            0                   0
## X966   56          1          0          1            0                   1
## X968   60          1          0          0            1                   0
## X969   60          1          0          0            0                   1
## X970   57          0          0          0            0                   0
## X971   53          0          0          0            0                   0
## X972   60          1          0          1            0                   1
## X973   55          0          0          0            0                   1
## X974   66          1          0          0            0                   1
## X975   56          1          0          0            0                   1
```

```
## X976  58           1         0         0            0                    0
## X977  57           0         0         0            0                    0
## X978  59           1         0         0            0                    0
## X979  67           0         0         0            0                    0
## X980  58           1         0         0            0                    1
## X981  61           1         0         0            0                    1
## X982  56           0         0         1            0                    1
## X983  66           1         0         1            0                    1
## X984  53           0         0         0            0                    0
## X985  59           1         0         1            0                    1
## X986  55           0         0         0            0                    1
## X987  61           0         1         0            0                    0
## X988  51           1         0         1            0                    0
## X989  56           1         0         0            0                    0
## X990  56           0         0         0            1                    1
## X991  55           0         0         1            0                    0
## X992  57           1         0         1            0                    0
## X993  59           0         0         0            0                    0
## X994  63           0         0         0            0                    0
## X995  54           0         0         0            0                    0
## X996  55           0         0         1            0                    1
## X997  57           0         0         0            0                    0
## X998  62           1         0         0            0                    1
## X999  61           1         0         0            0                    1
##       smokingCurrent_smoker height weight  bmi diabetesYes hypertensionYes sbp
## X1                        0  170.3   74.7 25.8           0               0 120
## X2                        0  170.8   75.7 26.0           1               1 133
## X3                        0  172.7   89.5 30.0           0               0 123
## X4                        0  171.7   74.6 25.3           0               0 121
## X6                        0  168.8   87.9 30.8           0               1 132
## X9                        0  168.5   76.5 27.0           0               1 138
## X10                       0  170.3   73.0 25.2           0               1 135
## X11                       0  172.7   93.9 31.5           0               0 128
## X12                       0  169.9   73.9 25.6           0               1 143
## X13                       0  181.2   89.6 27.3           1               1 139
## X14                       1  183.5   78.8 23.4           0               0 129
## X15                       0  168.6   90.3 31.8           0               1 131
## X17                       0  160.1   73.3 28.6           0               1 138
## X18                       0  172.5   83.8 28.1           0               0 128
## X19                       0  161.6   92.3 35.4           0               1 133
## X21                       0  173.0   85.8 28.7           0               0 130
## X22                       0  172.2   77.6 26.2           0               1 134
## X24                       0  160.6   75.9 29.4           0               0 124
## X25                       0  170.7   85.6 29.4           0               1 134
## X26                       0  166.2   79.1 28.7           0               1 131
## X27                       0  169.7   68.9 23.9           0               1 140
## X28                       0  156.6   73.4 29.9           0               1 136
## X29                       0  175.9   78.0 25.2           0               1 136
## X30                       0  166.7   88.7 31.9           0               1 134
## X31                       0  165.9   74.9 27.2           0               1 131
## X33                       0  175.5   80.9 26.3           0               0 130
## X36                       0  173.1   74.1 24.7           0               1 140
## X39                       0  163.0   64.6 24.3           0               1 134
## X40                       0  160.4   69.2 26.9           0               1 133
```

```
## X41                        0  172.2   79.0 26.6           0                0 124
## X42                        0  165.3   84.6 31.0           0                0 122
## X45                        0  179.3   82.9 25.8           0                1 135
## X46                        0  172.7   85.5 28.7           0                0 128
## X47                        0  162.7   85.8 32.4           0                1 131
## X49                        0  166.2   85.6 31.0           1                1 134
## X54                        0  178.2   73.5 23.2           0                0 127
## X56                        0  176.9  104.8 33.5           0                1 133
## X57                        0  174.6   84.6 27.8           0                1 137
## X59                        0  170.5   82.7 28.5           0                1 131
## X60                        1  172.1   65.9 22.2           0                0 121
## X61                        0  173.5   77.9 25.9           0                0 125
## X62                        0  176.2   83.3 26.8           0                0 124
## X64                        0  167.9   73.6 26.1           1                1 153
## X65                        1  169.6   70.3 24.4           0                1 136
## X67                        0  170.4   85.9 29.6           0                1 133
## X69                        0  170.0   81.3 28.1           1                0 125
## X70                        0  181.2   77.0 23.5           0                0 121
## X72                        0  164.6   80.7 29.8           1                0 119
## X73                        0  164.4   78.6 29.1           0                1 132
## X74                        0  163.3   67.5 25.3           0                0 124
## X75                        0  170.6   67.9 23.3           0                0 116
## X77                        0  172.1   71.2 24.0           0                1 133
## X78                        0  178.7   91.0 28.5           0                1 135
## X79                        1  173.9   81.1 26.8           0                1 150
## X82                        0  163.3   78.3 29.4           0                0 114
## X85                        0  164.2   82.6 30.6           0                0 124
## X87                        0  174.0   80.5 26.6           0                0 117
## X88                        0  180.8   88.8 27.2           0                0 117
## X89                        0  169.3   81.0 28.3           0                0 120
## X90                        0  168.0   76.6 27.1           0                1 131
## X91                        0  170.6   78.0 26.8           0                0 128
## X92                        0  163.0   76.0 28.6           0                1 133
## X93                        0  172.0   77.0 26.0           0                1 148
## X94                        0  168.0   76.5 27.1           0                1 136
## X95                        0  176.4   85.3 27.4           0                0 130
## X96                        1  172.3   77.4 26.1           0                0 121
## X97                        0  174.1   78.1 25.8           1                1 136
## X98                        0  174.1   83.1 27.4           0                1 140
## X99                        0  172.2   85.4 28.8           1                0 119
## X100                       0  167.4   72.4 25.9           0                1 132
## X101                       0  175.3   84.5 27.5           0                0 126
## X102                       0  174.2   84.9 28.0           0                1 138
## X103                       0  171.5   82.5 28.1           0                1 141
## X104                       0  176.8   87.9 28.1           0                1 135
## X105                       0  164.5   72.8 26.9           0                1 132
## X106                       0  165.5   87.3 31.9           0                0 122
## X108                       0  172.3   81.3 27.4           0                0 122
## X109                       0  163.2   79.0 29.7           0                1 135
## X110                       0  171.7   80.3 27.3           0                0 128
## X112                       0  161.4   75.1 28.9           1                0 128
## X113                       0  160.5   74.8 29.0           0                0 122
## X114                       0  173.3   75.6 25.2           0                0 114
## X115                       0  169.6   83.0 28.9           1                0 126
```

```
## X116                    0  172.9   84.4 28.2            1                1 134
## X117                    0  176.0   89.0 28.7            0                1 143
## X119                    0  165.3   75.7 27.7            0                0 128
## X120                    0  181.6   98.0 29.7            0                0 128
## X121                    0  181.5   77.4 23.5            0                1 146
## X122                    0  183.3   88.4 26.3            0                0 127
## X123                    0  173.9   67.6 22.4            0                0 116
## X126                    0  176.1   94.9 30.6            0                0 128
## X127                    0  181.0   83.7 25.6            0                0 124
## X128                    0  176.8   89.2 28.5            0                1 151
## X129                    0  167.2   77.6 27.7            0                1 145
## X130                    0  156.7   67.7 27.6            0                1 131
## X131                    0  171.0   84.3 28.8            1                0 122
## X132                    0  176.6   88.6 28.4            1                0 118
## X133                    0  167.7   70.3 25.0            0                0 124
## X135                    0  166.5   80.4 29.0            1                0 126
## X136                    0  173.3   83.8 27.9            0                0 126
## X137                    0  156.0   76.3 31.4            0                0 126
## X138                    0  169.1   76.7 26.8            0                1 154
## X139                    0  170.1   86.0 29.7            0                1 131
## X142                    0  176.9   81.3 26.0            0                1 141
## X144                    0  172.8   88.3 29.6            1                1 134
## X145                    0  165.5   92.7 33.8            0                1 134
## X146                    0  167.3   83.4 29.8            0                0 125
## X147                    0  171.6   70.4 23.9            0                1 131
## X148                    0  174.6   88.1 28.9            0                0 120
## X149                    0  179.3   89.6 27.9            0                1 143
## X150                    0  160.4   72.4 28.1            0                1 133
## X152                    0  175.0   84.3 27.5            1                0 130
## X154                    0  178.5   71.6 22.5            0                1 131
## X155                    0  173.3   77.7 25.9            1                1 132
## X156                    0  171.6   82.0 27.9            0                1 131
## X157                    1  177.5   72.5 23.0            0                1 143
## X159                    0  171.5   84.8 28.8            1                0 128
## X160                    0  165.6   83.3 30.4            0                1 132
## X161                    1  161.1   80.6 31.0            0                1 131
## X162                    0  170.2   83.3 28.8            0                0 117
## X163                    1  165.7   75.2 27.4            0                0 126
## X164                    0  164.7   79.2 29.2            0                0 126
## X165                    1  180.4   86.4 26.6            0                0 125
## X166                    0  176.4   84.1 27.0            0                0 128
## X167                    0  161.4   85.6 32.8            0                1 135
## X168                    0  173.8   83.4 27.6            1                1 131
## X169                    0  168.5   74.4 26.2            1                0 118
## X170                    0  174.0   78.8 26.0            0                0 124
## X171                    0  163.9   75.4 28.1            0                0 125
## X172                    0  162.7   82.6 31.2            0                0 130
## X173                    0  173.0   89.0 29.7            0                0 120
## X174                    0  174.5   78.1 25.7            0                1 131
## X175                    0  160.3   72.3 28.1            0                1 132
## X177                    0  179.1   80.4 25.0            0                1 134
## X179                    0  165.3   96.0 35.1            0                0 127
## X180                    0  173.3   83.3 27.7            0                1 149
## X181                    0  175.0   82.4 26.9            0                1 143
```

```
## X182                  0  170.0   83.7 29.0          0              0 116
## X183                  0  167.0   68.0 24.4          0              1 131
## X184                  0  179.7   79.5 24.6          1              1 145
## X185                  0  176.4   75.2 24.2          0              1 137
## X186                  0  174.3   89.7 29.5          0              0 125
## X187                  0  169.0   67.6 23.7          0              1 140
## X188                  0  157.5   79.2 31.9          0              0 115
## X189                  1  172.3   82.0 27.6          0              1 132
## X190                  0  174.3   79.4 26.1          1              1 142
## X191                  0  161.3   78.4 30.1          0              0 130
## X192                  0  165.3   77.3 28.3          0              1 148
## X193                  0  167.3   84.2 30.1          1              0 124
## X194                  1  166.3   81.2 29.4          0              1 149
## X195                  0  162.6   93.9 35.5          0              0 117
## X196                  0  165.7   64.8 23.6          1              0 123
## X198                  0  173.9   95.1 31.4          0              1 134
## X200                  1  174.0   81.9 27.0          1              0 122
## X201                  0  175.6   86.4 28.0          0              0 129
## X202                  0  166.0   85.7 31.1          0              0 130
## X204                  0  167.4   76.3 27.2          0              1 132
## X205                  0  178.1   89.3 28.2          0              0 119
## X206                  0  166.9   78.5 28.2          0              1 134
## X207                  0  165.6   85.0 31.0          1              1 138
## X209                  0  161.7   76.4 29.2          0              0 121
## X211                  1  173.9   72.5 24.0          0              1 134
## X212                  0  171.3   86.5 29.5          0              0 128
## X213                  0  173.9   83.1 27.5          0              1 147
## X214                  0  168.9   71.5 25.1          0              0 116
## X215                  0  165.2   79.3 29.1          0              0 125
## X216                  0  176.8   80.1 25.6          0              1 135
## X217                  0  171.5   85.3 29.0          1              0 124
## X218                  0  162.0   72.6 27.6          0              1 138
## X219                  1  170.2   74.2 25.6          0              1 134
## X220                  0  172.9   74.6 25.0          0              0 122
## X221                  0  168.4   84.5 29.8          0              0 122
## X222                  0  169.3   87.3 30.5          0              0 125
## X223                  0  168.8   71.9 25.2          1              0 121
## X224                  0  167.6   79.6 28.3          0              1 137
## X226                  0  168.7   74.1 26.0          1              1 141
## X227                  0  167.4   87.0 31.0          1              1 142
## X228                  0  166.2   78.2 28.3          0              1 132
## X229                  0  166.4   80.5 29.1          1              0 126
## X230                  0  174.1   71.7 23.7          0              0 121
## X231                  0  169.4   85.6 29.8          0              0 129
## X233                  0  172.3   75.4 25.4          0              0 124
## X234                  0  162.9   82.8 31.2          0              1 139
## X235                  0  168.3   82.3 29.1          0              1 133
## X236                  0  154.7   85.4 35.7          0              0 127
## X237                  0  161.2   71.7 27.6          0              0 129
## X238                  1  172.5   75.5 25.4          0              1 140
## X239                  0  164.2   71.3 26.4          0              0 122
## X240                  0  160.9   79.2 30.6          0              1 131
## X241                  0  171.1   79.0 27.0          0              0 120
## X244                  0  171.1   80.5 27.5          0              0 128
```

```
## X245                    1  172.4   77.3 26.0           0            0 130
## X246                    0  164.8   85.3 31.4           0            0 130
## X247                    0  165.2   79.2 29.0           0            1 132
## X248                    0  178.3   73.7 23.2           0            0 115
## X249                    0  168.4   65.7 23.2           0            1 138
## X251                    0  156.8   88.4 36.0           0            1 133
## X252                    0  175.8   87.1 28.2           0            1 142
## X254                    0  171.1   79.3 27.1           0            0 128
## X255                    0  159.6   72.7 28.6           0            1 134
## X256                    0  167.3   87.3 31.2           0            0 115
## X257                    0  164.1   82.9 30.8           0            1 141
## X258                    0  167.1   81.5 29.2           0            0 129
## X259                    1  178.7   71.6 22.4           0            0 127
## X260                    0  161.6   72.0 27.6           0            0 128
## X261                    0  169.2   79.1 27.6           0            0 126
## X262                    1  157.2   68.7 27.8           0            0 126
## X264                    0  169.0   74.3 26.0           0            1 132
## X265                    0  174.2   75.4 24.8           0            0 123
## X266                    0  174.3   85.2 28.1           0            0 125
## X267                    0  169.0   80.5 28.2           0            1 138
## X268                    0  177.4   90.7 28.8           0            1 133
## X269                    0  177.6   88.0 27.9           0            0 128
## X270                    0  166.1   87.4 31.7           1            0 114
## X273                    0  169.3   79.2 27.6           0            0 123
## X274                    1  164.2   69.7 25.9           0            1 134
## X275                    0  163.7   65.0 24.3           0            0 125
## X276                    0  164.5   88.9 32.9           0            0 127
## X277                    0  162.7   75.1 28.4           1            0 123
## X278                    0  162.1   64.4 24.5           0            0 122
## X279                    0  162.9   66.3 25.0           1            1 133
## X280                    0  177.4   84.9 27.0           0            0 126
## X282                    1  179.2   76.7 23.9           0            0 122
## X283                    0  167.9   66.0 23.4           0            0 121
## X284                    0  172.6   79.5 26.7           0            0 123
## X286                    0  170.4   91.0 31.3           0            0 120
## X289                    1  175.8   88.0 28.5           0            0 122
## X290                    0  167.5   81.9 29.2           0            0 120
## X292                    1  150.2   58.0 25.7           1            0 122
## X293                    0  179.3   85.5 26.6           0            0 126
## X295                    0  167.5   68.5 24.4           0            1 135
## X296                    0  173.4   78.8 26.2           0            0 125
## X298                    0  165.1   71.5 26.2           0            1 131
## X299                    0  166.0   74.0 26.9           0            0 129
## X300                    0  172.2   86.5 29.2           0            1 134
## X301                    0  165.8   76.9 28.0           1            0 129
## X302                    0  172.7   85.2 28.6           0            0 125
## X303                    0  166.3   74.5 26.9           0            0 126
## X305                    0  159.0   82.5 32.6           0            1 131
## X306                    0  170.3   81.4 28.1           0            1 131
## X307                    0  164.5   82.1 30.3           0            0 119
## X311                    0  179.4   82.9 25.8           1            1 141
## X312                    0  165.3   78.0 28.6           0            0 130
## X313                    1  173.0   91.9 30.7           0            1 141
## X314                    0  184.9   82.5 24.1           0            0 126
```

```
## X315                     0  159.0   78.2 30.9            0               1 138
## X316                     0  168.9   72.9 25.6            0               0 129
## X317                     0  168.1   64.8 22.9            0               0 125
## X318                     0  158.8   72.9 28.9            0               0 119
## X319                     0  169.1   74.1 25.9            0               0 128
## X321                     1  180.6   84.1 25.8            0               1 133
## X322                     0  171.6   89.8 30.5            0               0 121
## X326                     0  179.0   91.1 28.4            0               0 119
## X327                     0  172.6   96.3 32.3            0               1 135
## X328                     0  169.4   86.9 30.3            0               0 113
## X329                     0  174.6   81.7 26.8            1               0 120
## X330                     0  174.9   83.5 27.3            0               0 116
## X331                     0  161.0   72.8 28.1            0               0 119
## X332                     0  161.2   74.1 28.5            0               1 138
## X333                     0  160.9   69.0 26.6            1               1 133
## X334                     0  170.9   77.0 26.4            0               1 139
## X335                     0  167.5   73.4 26.1            0               0 127
## X336                     0  163.2   74.2 27.9            0               1 136
## X339                     0  173.0   87.8 29.3            0               1 139
## X340                     1  165.1   76.2 28.0            0               0 129
## X341                     0  159.0   80.6 31.9            1               1 135
## X342                     0  165.9   68.1 24.7            0               0 130
## X345                     0  176.5   72.9 23.4            0               1 133
## X347                     0  168.8   66.2 23.2            0               0 126
## X349                     0  172.3   86.6 29.2            0               1 146
## X351                     0  168.4   81.6 28.8            1               1 140
## X353                     0  172.1   81.2 27.4            0               1 134
## X354                     0  169.7   82.6 28.7            0               0 128
## X355                     0  164.4   65.7 24.3            0               0 125
## X356                     1  166.1   70.5 25.6            0               1 133
## X359                     0  164.7   56.6 20.9            1               1 132
## X360                     0  167.2   80.2 28.7            1               1 148
## X361                     0  167.1   80.5 28.8            0               0 123
## X363                     0  169.7   80.8 28.1            0               1 138
## X365                     0  168.8   91.4 32.1            0               0 128
## X366                     0  172.0   72.8 24.6            0               1 135
## X367                     0  173.9   91.9 30.4            0               0 121
## X369                     0  173.8   87.3 28.9            0               1 138
## X371                     0  166.0   73.5 26.7            0               1 133
## X372                     0  167.7  103.7 36.9            0               1 139
## X373                     0  178.0   84.8 26.8            0               1 135
## X374                     0  172.7   70.3 23.6            0               0 123
## X376                     0  178.0   75.4 23.8            0               0 121
## X377                     1  152.3   65.2 28.1            0               1 134
## X378                     0  169.8   68.5 23.8            0               1 137
## X379                     0  170.1   78.3 27.1            0               0 119
## X380                     0  171.9   92.6 31.4            0               1 146
## X382                     1  164.5   74.2 27.4            0               1 131
## X383                     0  164.9   85.0 31.2            0               0 121
## X385                     0  170.5   66.4 22.8            0               1 131
## X386                     1  165.0   77.7 28.5            0               0 114
## X387                     0  170.7   81.3 27.9            0               1 135
## X388                     0  168.4   77.4 27.3            0               0 117
## X389                     0  174.7   70.4 23.1            1               0 120
```

```
## X391                    0  163.9   74.9 27.9              0               0 118
## X392                    0  167.7   79.4 28.2              0               1 135
## X393                    0  175.1   80.2 26.2              0               0 121
## X394                    0  175.6   82.8 26.9              0               1 137
## X395                    0  178.2   78.2 24.6              0               0 124
## X396                    1  179.6   89.8 27.8              1               1 133
## X397                    0  166.3   78.3 28.3              0               0 125
## X398                    0  169.0   74.3 26.0              0               1 131
## X399                    0  174.4   75.6 24.8              0               0 129
## X401                    0  176.7   68.4 21.9              1               1 141
## X402                    0  165.5   67.7 24.7              0               0 122
## X405                    0  173.0   79.0 26.4              0               0 129
## X406                    0  174.7   79.6 26.1              0               1 136
## X407                    0  177.4   86.1 27.4              0               0 119
## X408                    0  173.4   75.5 25.1              0               0 122
## X410                    0  166.7   73.6 26.5              0               0 128
## X411                    0  160.7   84.1 32.6              0               1 134
## X412                    0  173.2   76.9 25.7              0               0 125
## X413                    1  171.5   76.6 26.1              0               1 134
## X414                    0  170.6   75.2 25.9              0               0 126
## X415                    0  172.7   83.6 28.0              0               0 130
## X416                    0  164.3   65.4 24.2              0               1 140
## X417                    0  164.7   77.8 28.7              1               1 132
## X418                    0  177.5   86.4 27.4              0               0 129
## X419                    0  178.1   90.1 28.4              0               1 131
## X420                    0  171.9   78.0 26.4              0               1 132
## X421                    0  172.4   78.8 26.5              1               0 128
## X422                    0  168.6   72.4 25.5              0               0 123
## X423                    0  167.8   85.3 30.3              0               0 129
## X424                    0  164.2   79.6 29.5              0               1 133
## X425                    0  173.2   77.8 25.9              0               0 115
## X426                    0  183.8   85.3 25.3              0               1 134
## X427                    0  173.5   65.9 21.9              0               0 130
## X431                    0  166.0   77.8 28.2              0               1 135
## X432                    0  171.4   73.6 25.1              0               1 136
## X434                    0  168.2   73.3 25.9              0               0 122
## X435                    0  175.4   75.5 24.5              0               0 118
## X437                    0  175.2   61.1 19.9              0               1 144
## X438                    0  167.8   87.8 31.2              0               0 130
## X439                    0  172.2   82.0 27.7              1               1 144
## X440                    0  171.4   83.2 28.3              0               0 123
## X441                    0  175.4   81.5 26.5              0               0 121
## X442                    0  165.9   69.4 25.2              0               0 130
## X443                    0  166.2   72.9 26.4              0               0 119
## X444                    1  163.9   61.6 22.9              1               0 130
## X445                    0  169.3   85.6 29.9              0               0 127
## X448                    0  175.6   77.7 25.2              0               1 140
## X450                    0  171.8   87.7 29.7              0               1 133
## X451                    0  163.9   76.5 28.5              0               0 125
## X453                    0  168.4   73.5 25.9              1               0 122
## X454                    0  168.7   83.0 29.1              0               1 134
## X455                    0  166.8   77.8 28.0              1               0 127
## X456                    0  161.6   74.5 28.5              0               0 124
## X457                    0  169.6   78.5 27.3              0               1 131
```

```
## X458                          0  160.8   83.3 32.2             0                1 131
## X459                          0  179.0   77.4 24.2             0                1 135
## X460                          0  176.4   79.0 25.4             1                1 137
## X461                          0  178.9   80.9 25.3             1                0 126
## X464                          0  179.0   79.3 24.7             0                1 147
## X465                          0  165.0   83.9 30.8             0                1 152
## X466                          0  175.3   72.9 23.7             1                0 127
## X468                          0  177.4   78.4 24.9             0                0 124
## X469                          0  166.2   80.8 29.2             0                1 132
## X470                          0  165.5   74.9 27.4             0                0 123
## X472                          0  167.0   82.3 29.5             0                0 128
## X473                          0  177.0   75.9 24.2             0                1 131
## X474                          1  175.6   94.0 30.5             0                0 128
## X475                          1  177.3   84.4 26.8             0                1 134
## X476                          1  178.0   83.9 26.5             0                0 120
## X478                          0  168.8   78.1 27.4             0                1 137
## X480                          0  171.3   88.8 30.2             0                0 130
## X481                          0  167.7   80.0 28.4             0                0 129
## X482                          0  173.2   99.1 33.0             0                1 132
## X483                          0  169.7   71.2 24.7             0                1 132
## X484                          0  161.8   72.8 27.8             0                0 125
## X486                          0  177.2   84.4 26.9             0                1 138
## X487                          0  175.0   83.5 27.3             0                1 137
## X488                          0  172.4   69.5 23.4             1                0 127
## X489                          0  174.0   80.6 26.6             0                1 138
## X490                          0  172.6   70.1 23.5             0                1 146
## X491                          0  177.7   78.8 25.0             0                1 136
## X492                          0  173.9   81.1 26.8             1                1 138
## X493                          0  172.7   79.9 26.8             0                1 140
## X494                          0  158.0   71.7 28.7             0                1 142
## X495                          0  163.2   68.9 25.9             0                0 129
## X496                          1  175.5   76.3 24.8             0                1 133
## X497                          1  172.4   84.4 28.4             0                0 127
## X498                          0  177.7   90.3 28.6             0                1 131
## X499                          0  178.2   81.4 25.6             0                0 123
## X500                          0  168.5   75.0 26.4             0                0 123
## X501                          0  175.5   86.0 27.9             0                1 133
## X502                          0  181.6   76.3 23.1             0                1 138
## X503                          0  190.3   83.8 23.1             0                0 118
## X504                          0  171.5   75.0 25.5             0                0 120
## X507                          1  179.6   76.2 23.6             0                0 126
## X509                          0  157.9   75.0 30.1             0                0 130
## X511                          0  163.4   85.9 32.2             0                0 121
## X512                          1  165.6   69.2 25.2             0                1 134
## X513                          0  168.0   82.7 29.3             0                1 133
## X514                          0  171.6   72.5 24.6             0                0 125
## X515                          0  179.0   83.5 26.0             1                0 130
## X516                          0  164.9   74.6 27.5             1                1 131
## X518                          0  170.5   78.7 27.1             0                0 123
## X520                          0  168.7   80.3 28.2             0                1 147
## X521                          0  178.1   83.6 26.4             1                0 121
## X522                          0  170.0   80.6 27.9             0                1 133
## X523                          0  165.9   82.9 30.1             0                0 125
## X524                          1  163.6   83.0 31.0             0                1 136
```

```
## X525                         0  172.4   72.8 24.5          0                0 115
## X527                         1  167.4   76.2 27.2          0                0 124
## X528                         0  168.8   59.0 20.7          0                1 136
## X529                         0  166.1   77.6 28.1          0                0 126
## X530                         0  172.7   76.1 25.5          0                1 131
## X533                         0  167.8   76.7 27.2          0                0 126
## X535                         0  175.0   89.9 29.3          1                0 123
## X536                         0  176.2   84.9 27.3          0                1 131
## X539                         0  156.7   71.7 29.2          0                1 135
## X540                         0  176.1   69.5 22.4          0                0 121
## X541                         0  164.3   84.0 31.1          1                0 128
## X542                         0  167.0   82.9 29.7          0                1 151
## X543                         0  162.2   77.8 29.6          0                1 135
## X545                         0  178.8   70.8 22.2          0                1 138
## X546                         0  169.6   86.2 30.0          0                0 129
## X547                         0  163.3   76.0 28.5          0                1 139
## X548                         0  162.3   75.9 28.8          0                0 130
## X549                         1  174.3   87.6 28.8          0                0 122
## X550                         0  167.7   63.2 22.5          0                0 123
## X551                         0  157.8   66.3 26.6          0                1 131
## X552                         0  157.1   73.0 29.6          0                1 137
## X553                         0  170.7   86.8 29.8          0                1 137
## X554                         0  165.6   76.7 28.0          0                1 138
## X556                         0  169.1   71.9 25.1          1                0 124
## X557                         0  182.1   74.7 22.5          1                0 130
## X558                         0  167.0   86.0 30.8          0                1 131
## X559                         0  173.8   75.5 25.0          0                1 136
## X560                         0  171.8   71.1 24.1          0                1 132
## X561                         0  166.2   93.1 33.7          0                1 137
## X562                         0  168.8   78.2 27.5          0                0 127
## X563                         0  165.7   75.8 27.6          0                0 129
## X564                         0  179.1   87.0 27.1          0                0 124
## X565                         1  167.8   85.8 30.5          0                0 128
## X566                         0  182.6   85.6 25.7          0                1 136
## X567                         0  180.5   90.6 27.8          0                0 125
## X568                         0  167.4   77.0 27.5          0                1 143
## X569                         0  171.9   78.6 26.6          0                1 134
## X571                         0  168.1   72.2 25.5          0                0 119
## X573                         0  166.5   86.8 31.3          0                1 142
## X574                         1  168.5   74.3 26.2          0                0 117
## X575                         0  151.9   69.2 30.0          0                0 110
## X576                         0  164.0   86.0 32.0          0                1 142
## X577                         0  173.3   75.3 25.0          0                0 127
## X579                         0  168.5   86.6 30.5          0                0 126
## X580                         0  163.6   82.3 30.7          0                0 125
## X582                         0  180.8   74.4 22.7          0                0 122
## X584                         1  171.1   69.2 23.6          0                1 137
## X587                         0  163.2   68.5 25.7          0                1 136
## X588                         0  168.5   83.7 29.5          0                1 136
## X589                         0  165.3   90.4 33.1          0                1 139
## X591                         0  178.9   72.9 22.8          0                0 118
## X592                         0  162.1   79.6 30.3          0                0 122
## X593                         1  182.2   82.0 24.7          0                0 117
## X594                         0  171.4   68.4 23.3          0                1 141
```

```
## X597                     0  165.1   87.8 32.2           1               0 125
## X598                     1  178.0   87.9 27.8           1               0 124
## X600                     0  172.9   83.7 28.0           0               0 128
## X601                     0  176.1   69.3 22.4           1               0 127
## X602                     0  173.7   86.5 28.7           0               0 124
## X603                     0  158.5   65.8 26.2           0               0 130
## X604                     0  167.1   83.5 29.9           0               0 122
## X605                     0  161.7   74.1 28.4           0               1 136
## X606                     0  161.3   78.6 30.2           0               1 131
## X609                     0  170.4   70.4 24.2           0               1 145
## X610                     0  177.1   86.5 27.6           0               1 135
## X611                     0  155.3   83.7 34.7           0               0 115
## X613                     0  173.8   81.5 27.0           1               1 137
## X614                     0  178.9   93.5 29.2           1               1 135
## X615                     0  166.4   69.1 24.9           0               0 120
## X617                     0  172.0   97.0 32.8           0               1 132
## X618                     0  174.3   70.1 23.1           0               0 119
## X619                     0  159.1   68.5 27.1           1               1 132
## X620                     1  169.2   80.9 28.3           0               0 113
## X623                     1  173.2   73.5 24.5           0               1 134
## X624                     0  177.5   83.6 26.5           0               0 129
## X625                     0  168.5   80.2 28.2           1               0 130
## X626                     0  176.3   83.4 26.8           0               1 139
## X628                     0  162.1   81.0 30.8           1               1 134
## X629                     0  164.7   74.3 27.4           1               0 118
## X630                     0  163.1   82.6 31.0           1               0 130
## X631                     0  174.0   66.1 21.8           0               1 131
## X632                     0  163.6   66.5 24.8           1               0 129
## X633                     0  182.4   86.1 25.9           1               0 130
## X634                     1  169.6   76.1 26.4           0               0 130
## X635                     1  176.2   79.0 25.5           0               0 130
## X636                     0  164.3   73.5 27.2           0               0 128
## X637                     0  180.5   90.4 27.7           0               0 128
## X638                     0  165.9   85.9 31.2           0               0 116
## X640                     1  162.7   77.9 29.4           0               1 132
## X641                     0  168.3   79.5 28.1           0               0 126
## X642                     0  162.0   82.4 31.4           0               0 129
## X643                     0  165.1   78.4 28.8           0               0 115
## X644                     0  167.1   77.4 27.7           0               0 118
## X645                     0  163.8   75.7 28.2           0               1 137
## X646                     0  161.6   81.6 31.3           0               0 125
## X648                     0  167.1   80.0 28.6           0               0 127
## X649                     0  169.0   83.1 29.1           0               0 123
## X650                     0  172.5   77.8 26.1           0               0 123
## X652                     0  165.8   83.4 30.4           0               1 132
## X654                     0  178.3   90.9 28.6           0               1 135
## X655                     0  164.5   72.7 26.9           0               1 151
## X656                     1  169.5   76.8 26.7           0               1 133
## X657                     0  175.0   66.0 21.6           0               0 120
## X658                     0  162.3   82.0 31.1           0               1 134
## X659                     0  171.0   72.1 24.7           0               0 127
## X660                     1  162.2   92.6 35.2           0               1 138
## X661                     0  181.0   72.5 22.1           0               1 143
## X663                     0  177.2   82.4 26.2           0               0 129
```

```
## X664                      0  179.5   80.4 25.0            1                1 135
## X665                      0  168.7   79.8 28.1            0                1 134
## X666                      0  170.8   94.1 32.2            0                0 130
## X667                      0  161.1   94.0 36.2            0                1 142
## X668                      0  157.1   71.0 28.7            0                0 127
## X669                      0  163.1   76.7 28.9            0                1 134
## X670                      0  186.7   80.9 23.2            0                1 135
## X673                      0  171.9   90.1 30.5            0                1 142
## X674                      0  178.5   90.4 28.4            0                0 127
## X675                      0  176.1   80.7 26.0            0                0 130
## X676                      0  167.8   73.8 26.2            1                1 139
## X677                      0  166.2   78.1 28.3            0                0 127
## X678                      0  166.7   79.7 28.7            0                1 131
## X679                      0  178.4   86.3 27.1            0                1 136
## X680                      0  168.7   87.3 30.7            0                1 137
## X681                      0  168.0   86.5 30.7            1                1 147
## X682                      0  170.5   84.7 29.1            0                1 134
## X683                      0  171.7   84.2 28.6            0                0 127
## X684                      0  178.5   85.0 26.7            0                1 136
## X685                      0  166.9   83.8 30.1            0                0 123
## X686                      0  169.2   74.8 26.1            0                0 119
## X687                      0  170.1   85.0 29.4            0                1 132
## X688                      0  171.4   86.1 29.3            1                1 136
## X690                      0  161.9   71.2 27.2            0                0 130
## X691                      0  161.1   83.9 32.3            0                0 130
## X692                      0  172.4   81.5 27.4            0                1 136
## X693                      0  180.0   81.7 25.2            0                1 140
## X694                      0  169.8   80.9 28.1            0                0 127
## X697                      1  175.4   80.0 26.0            0                0 127
## X698                      0  167.5   68.1 24.3            0                1 138
## X699                      0  168.1   78.8 27.9            0                0 118
## X700                      1  176.4   95.8 30.8            0                0 129
## X701                      0  170.3   74.8 25.8            0                1 139
## X702                      0  166.1   76.9 27.9            0                0 126
## X703                      0  175.0   84.4 27.6            0                0 130
## X705                      1  184.1   73.9 21.8            0                0 123
## X706                      0  170.4   80.5 27.7            1                0 123
## X707                      0  169.9   74.1 25.7            1                1 139
## X708                      0  169.5   65.3 22.7            0                0 126
## X709                      0  156.6   70.8 28.9            0                0 129
## X710                      0  178.3   82.7 26.0            1                1 143
## X711                      0  169.5   86.5 30.1            0                1 144
## X712                      1  157.3   78.8 31.9            0                0 120
## X713                      0  170.4   77.2 26.6            1                0 121
## X714                      0  176.3   75.6 24.3            0                0 123
## X715                      0  159.5   69.2 27.2            1                0 127
## X716                      0  169.5   75.7 26.3            0                0 116
## X717                      0  171.5   83.8 28.5            0                1 132
## X718                      1  182.7   85.4 25.6            0                0 123
## X719                      0  170.5   65.6 22.6            1                0 125
## X720                      1  172.2   72.1 24.3            0                1 136
## X721                      0  168.5   82.7 29.1            0                0 125
## X722                      0  170.7   80.0 27.5            1                1 133
## X724                      0  168.7   71.0 25.0            0                0 124
```

```
## X725                    1  178.2   83.1 26.2              0               0 128
## X726                    0  174.1   78.0 25.7              0               1 143
## X730                    1  174.6   79.2 26.0              0               0 127
## X731                    0  177.0   88.9 28.4              1               1 133
## X732                    0  172.8   85.8 28.7              0               1 135
## X734                    0  174.3   89.4 29.4              0               1 138
## X735                    0  178.3   77.6 24.4              1               0 130
## X737                    0  178.5   81.3 25.5              0               0 117
## X738                    0  165.6   74.0 27.0              0               0 130
## X739                    0  182.8   66.7 20.0              0               0 120
## X740                    0  165.4   90.1 33.0              0               1 147
## X744                    0  178.9   87.1 27.2              0               1 132
## X745                    0  171.6   75.6 25.7              0               1 134
## X746                    0  179.6   85.2 26.4              1               1 139
## X747                    0  173.2   84.0 28.0              0               0 123
## X748                    0  165.7   79.6 29.0              0               1 134
## X749                    0  175.2   70.9 23.1              1               1 135
## X751                    0  171.3   70.4 24.0              0               0 121
## X752                    1  163.5   85.7 32.1              0               1 141
## X753                    0  173.9   74.4 24.6              0               1 136
## X754                    1  169.1   95.6 33.5              0               0 126
## X757                    0  170.2   76.4 26.4              0               0 124
## X758                    0  179.2   83.3 25.9              0               0 128
## X759                    0  177.2   88.0 28.0              0               0 109
## X761                    1  171.7   88.0 29.8              0               0 115
## X762                    0  168.7   73.0 25.6              0               0 124
## X763                    0  171.6   87.8 29.8              0               1 132
## X764                    0  170.0   80.5 27.9              0               1 138
## X765                    0  179.8   86.3 26.7              1               1 136
## X766                    0  177.2   72.4 23.0              0               0 113
## X767                    0  167.0   91.5 32.8              0               1 138
## X768                    0  163.1   78.2 29.4              0               0 129
## X769                    0  170.2   73.3 25.3              0               0 129
## X770                    1  162.1   80.7 30.7              0               0 125
## X772                    0  167.7   64.1 22.8              0               1 133
## X773                    0  163.9   78.2 29.1              1               1 131
## X774                    0  168.4   71.5 25.2              0               1 137
## X775                    0  164.7   75.5 27.9              0               0 125
## X776                    0  170.3   78.6 27.1              0               0 122
## X777                    0  161.6   75.9 29.1              1               1 132
## X778                    0  165.5   74.6 27.2              1               0 125
## X779                    0  180.6   83.3 25.5              0               1 134
## X780                    0  155.2   71.3 29.6              0               0 128
## X781                    0  164.0   74.3 27.6              0               1 132
## X784                    0  171.8   83.2 28.2              0               0 121
## X786                    1  173.7   74.2 24.6              1               0 127
## X787                    1  169.7   97.8 33.9              0               0 124
## X788                    0  161.5   68.9 26.4              0               0 119
## X789                    0  166.5   94.8 34.2              1               0 124
## X790                    0  174.6   88.2 28.9              0               0 129
## X791                    0  169.4   64.8 22.6              0               1 136
## X792                    0  178.7   64.9 20.3              0               1 143
## X794                    0  176.8   75.3 24.1              0               0 119
## X795                    1  168.5   78.6 27.7              0               0 129
```

```
## X796                     0  172.0   79.0 26.7             0                1 146
## X797                     0  168.5   77.1 27.2             0                1 131
## X798                     1  174.0   86.1 28.4             0                0 124
## X799                     0  162.0   79.2 30.2             0                0 118
## X800                     0  163.0   74.6 28.1             1                1 148
## X801                     0  175.8   73.3 23.7             0                1 152
## X802                     0  176.3   77.6 25.0             0                0 124
## X803                     1  168.6   91.9 32.3             0                0 127
## X804                     0  171.3   74.0 25.2             0                0 125
## X805                     0  171.2   80.8 27.6             0                1 134
## X807                     0  161.8   65.6 25.1             0                1 132
## X808                     0  164.1   75.2 27.9             1                1 134
## X809                     0  170.2   82.4 28.4             0                0 127
## X810                     0  171.2   86.1 29.4             1                0 111
## X812                     0  165.0   96.3 35.4             1                0 125
## X813                     1  168.2   78.9 27.9             0                1 131
## X814                     0  170.9   84.6 29.0             0                0 130
## X815                     0  170.5   65.5 22.5             0                0 121
## X816                     0  171.1   76.7 26.2             0                0 122
## X817                     0  163.9   78.5 29.2             0                1 140
## X818                     0  175.6   89.1 28.9             0                1 144
## X820                     0  178.1   62.2 19.6             1                0 117
## X821                     0  182.4   79.5 23.9             0                1 138
## X822                     1  173.1   81.9 27.3             0                1 131
## X823                     0  178.1   81.2 25.6             0                1 136
## X824                     0  171.3   85.4 29.1             0                0 122
## X825                     0  181.7   85.1 25.8             0                1 133
## X826                     0  167.2   76.8 27.5             1                1 132
## X830                     0  169.8   81.5 28.2             0                1 133
## X831                     0  174.3   86.7 28.5             0                0 128
## X832                     0  152.4   86.8 37.4             0                0 122
## X833                     0  164.5   71.2 26.3             0                0 122
## X834                     0  159.8   81.5 31.9             0                1 142
## X836                     0  178.9   84.7 26.5             0                1 133
## X837                     0  172.0   70.4 23.8             0                0 130
## X838                     0  160.0   70.5 27.5             0                0 128
## X839                     1  165.7   80.4 29.3             0                0 128
## X840                     1  172.4   82.0 27.6             0                1 132
## X841                     0  176.3   86.3 27.8             0                1 136
## X842                     0  164.2   83.8 31.1             0                0 120
## X843                     0  163.9   73.1 27.2             0                0 117
## X844                     0  172.6   62.3 20.9             0                0 126
## X847                     0  163.0   71.3 26.8             0                1 141
## X848                     0  172.5   90.6 30.4             1                0 122
## X849                     0  164.8   72.2 26.6             0                1 140
## X850                     1  169.7   84.4 29.3             0                0 112
## X851                     0  169.9   74.6 25.8             0                1 134
## X852                     0  168.7   73.4 25.8             0                0 130
## X853                     0  171.5   82.6 28.1             1                0 126
## X854                     0  156.1   69.7 28.6             0                1 146
## X855                     0  160.7   90.2 34.9             0                0 124
## X856                     0  169.1   69.4 24.3             0                0 121
## X857                     0  169.1   76.4 26.7             0                0 130
## X858                     0  161.0   80.4 31.0             0                0 130
```

```
## X859                       0  178.7   75.5 23.6              0                1 132
## X860                       0  172.4   81.7 27.5              0                1 131
## X861                       0  165.3   74.8 27.4              0                0 130
## X862                       0  174.2   86.3 28.4              0                0 118
## X864                       0  160.2   71.9 28.0              0                0 123
## X865                       0  168.6   76.5 26.9              0                0 128
## X866                       0  167.5   73.4 26.1              0                0 127
## X867                       0  173.4   80.7 26.8              0                1 138
## X868                       0  167.0   81.2 29.1              0                0 119
## X869                       0  180.4   79.7 24.5              0                1 136
## X870                       0  165.0   67.0 24.6              0                0 118
## X871                       0  166.0   77.1 28.0              0                1 135
## X872                       1  163.7   71.6 26.7              0                0 130
## X873                       0  166.8   77.5 27.9              1                1 136
## X874                       1  165.9   67.6 24.6              0                0 128
## X875                       0  167.8   79.3 28.2              0                0 120
## X877                       1  170.7   83.9 28.8              0                0 125
## X878                       0  172.2   70.2 23.7              0                0 127
## X879                       0  177.8   90.0 28.5              0                0 125
## X880                       0  178.0   82.9 26.2              0                0 128
## X881                       0  171.1   86.2 29.5              0                1 132
## X882                       0  173.3   70.3 23.4              0                0 120
## X883                       0  158.5   86.5 34.4              0                0 130
## X884                       0  166.4   89.1 32.2              0                1 135
## X885                       0  180.6   93.1 28.5              1                1 133
## X886                       0  163.5   73.5 27.5              1                1 145
## X887                       0  181.9   79.2 23.9              0                1 132
## X888                       0  166.2   78.3 28.3              0                0 130
## X889                       0  165.0   78.5 28.9              0                0 126
## X890                       0  171.4   71.1 24.2              1                0 116
## X891                       0  165.9   68.8 25.0              1                1 137
## X892                       0  177.5   87.5 27.8              0                1 137
## X894                       0  175.6   81.7 26.5              0                0 129
## X895                       0  169.8   80.2 27.8              0                0 121
## X897                       0  175.1   74.1 24.2              0                0 130
## X899                       0  175.6   74.8 24.3              0                0 127
## X900                       0  155.7   74.6 30.8              0                0 122
## X901                       0  169.9   80.7 28.0              0                1 150
## X902                       0  169.6   90.2 31.3              0                0 128
## X903                       0  165.7   82.7 30.1              0                0 129
## X904                       0  172.3   76.2 25.7              0                1 132
## X905                       0  186.8   83.2 23.8              0                1 138
## X906                       0  170.7   83.3 28.6              0                0 122
## X907                       0  169.9   84.5 29.3              0                0 127
## X908                       0  175.8   80.3 26.0              0                1 133
## X909                       0  174.3   93.8 30.9              0                0 127
## X910                       0  165.9   84.9 30.9              0                1 145
## X911                       0  171.6   82.8 28.1              0                0 124
## X913                       0  173.3   73.4 24.4              0                1 134
## X916                       0  162.5   82.8 31.4              0                0 125
## X917                       0  163.6   88.2 32.9              0                1 145
## X918                       0  164.6   79.9 29.5              0                0 119
## X919                       0  172.0   94.5 31.9              0                1 139
## X920                       0  164.8   82.2 30.3              0                0 123
```

```
## X921                      0  162.9   75.4 28.4           0                1 149
## X922                      0  167.3   79.4 28.3           1                1 140
## X924                      0  179.0   99.1 30.9           1                0 118
## X925                      0  177.2   93.1 29.7           0                0 126
## X926                      0  165.8   75.6 27.5           0                0 110
## X927                      0  163.4   78.5 29.4           1                0 129
## X929                      0  173.6   77.7 25.8           1                1 143
## X932                      0  170.7   81.3 27.9           1                1 139
## X933                      0  173.2   74.7 24.9           0                0 130
## X935                      0  175.0   73.1 23.8           0                1 139
## X936                      0  175.6   89.3 29.0           0                1 145
## X937                      0  174.2   84.5 27.8           0                1 140
## X939                      0  170.1   86.4 29.9           0                1 153
## X940                      0  168.3   77.8 27.5           0                0 128
## X941                      0  159.3   73.0 28.8           0                1 138
## X942                      0  171.9   83.2 28.2           0                0 130
## X943                      0  171.6   84.7 28.8           0                1 139
## X945                      0  180.7   80.8 24.7           0                0 130
## X946                      0  165.5   80.0 29.2           0                1 137
## X948                      0  162.9   74.7 28.2           0                1 135
## X949                      0  172.5   76.9 25.9           0                0 122
## X950                      0  173.6   74.7 24.8           0                0 112
## X951                      1  176.2   84.5 27.2           0                0 119
## X953                      0  164.5   84.3 31.1           0                0 125
## X954                      1  171.7   74.9 25.4           0                1 137
## X955                      0  183.7   89.5 26.5           0                0 124
## X956                      0  169.2   64.4 22.5           1                0 128
## X957                      0  173.1   71.4 23.8           0                1 135
## X958                      0  162.9   70.2 26.5           0                1 142
## X959                      0  164.1   67.4 25.0           0                0 128
## X960                      1  176.8   78.3 25.0           0                0 113
## X961                      0  168.8   86.1 30.2           1                1 133
## X962                      0  174.5   90.4 29.7           0                1 134
## X963                      0  160.1   78.6 30.7           0                0 123
## X964                      0  169.3   83.2 29.0           0                0 122
## X965                      0  168.7   81.8 28.8           0                1 131
## X966                      0  172.4   83.5 28.1           0                0 125
## X968                      0  168.9   91.4 32.0           1                1 132
## X969                      0  168.9   76.9 27.0           0                1 138
## X970                      0  176.0   85.3 27.6           0                1 135
## X971                      0  171.4   68.5 23.3           0                0 122
## X972                      0  174.0   76.2 25.2           0                0 127
## X973                      0  163.7   73.2 27.3           0                0 120
## X974                      0  170.2   67.7 23.4           0                1 148
## X975                      0  171.8   90.2 30.6           0                1 131
## X976                      0  168.3   79.3 28.0           0                0 125
## X977                      0  179.7   92.9 28.8           0                0 123
## X978                      0  169.7   82.4 28.6           0                0 122
## X979                      0  162.5   83.7 31.7           0                1 149
## X980                      0  170.7   76.5 26.3           0                1 132
## X981                      0  167.7   83.2 29.6           0                0 123
## X982                      0  156.7   74.8 30.5           0                1 136
## X983                      0  164.9   74.8 27.5           0                1 140
## X984                      1  168.5   76.5 26.9           0                0 120
```

```
## X985                        0  165.9   84.8 30.8           0                1 132
## X986                        0  170.1   74.2 25.6           0                0 117
## X987                        0  159.9   73.3 28.7           0                0 121
## X988                        0  176.0   81.7 26.4           0                0 112
## X989                        0  172.5   84.4 28.4           0                0 125
## X990                        0  159.9   78.0 30.5           0                0 128
## X991                        0  170.2   89.0 30.7           1                0 129
## X992                        1  172.2   85.6 28.9           0                0 117
## X993                        0  164.7   83.5 30.8           0                0 129
## X994                        0  174.4   73.1 24.1           0                0 130
## X995                        0  167.5   75.3 26.9           1                1 132
## X996                        0  174.7   80.9 26.5           1                1 131
## X997                        1  169.7   73.3 25.4           0                1 135
## X998                        0  164.7   72.5 26.7           0                1 133
## X999                        0  174.3   82.5 27.2           0                1 137
##       ldl vaccineVaccinated depression
## X1     95                 1          5
## X2     87                 0          2
## X3    139                 1          5
## X4    126                 1          4
## X6     99                 1          9
## X9     97                 0          8
## X10   111                 0          8
## X11   132                 0          5
## X12   103                 0          4
## X13   122                 0          8
## X14    97                 0          6
## X15    86                 0          5
## X17   117                 0         10
## X18   108                 1          7
## X19   133                 1          8
## X21    86                 1         10
## X22   127                 1          5
## X24    91                 0         10
## X25   119                 0          7
## X26    98                 1          6
## X27   115                 0          6
## X28   116                 0          4
## X29    95                 0          7
## X30   111                 0          8
## X31    67                 1          7
## X33   142                 1         13
## X36    84                 1         10
## X39   133                 1         10
## X40   118                 1          9
## X41   129                 1          6
## X42   114                 1          7
## X45   100                 1          7
## X46    98                 1          8
## X47   111                 1          9
## X49   117                 1          7
## X54   115                 0          7
## X56   139                 1          6
## X57   111                 0          6
```

```
## X59   89                1           4
## X60  117                0           6
## X61  113                0           9
## X62  109                0           7
## X64  138                1           4
## X65  118                0           8
## X67  119                0           9
## X69  127                0           4
## X70  116                1           2
## X72  107                0           6
## X73   82                0           8
## X74   76                1           4
## X75  123                0           6
## X77   86                0           9
## X78  131                0           7
## X79  149                0          10
## X82   84                0           7
## X85   89                1           7
## X87   81                0           4
## X88   76                0           4
## X89  116                0           4
## X90  141                0           6
## X91  125                0           6
## X92  150                1           7
## X93  126                1          11
## X94  108                0           8
## X95  150                1           9
## X96   85                1           7
## X97  121                1           9
## X98  105                0           2
## X99  106                1          11
## X100 108                1           6
## X101 131                1           7
## X102 115                1           9
## X103 121                0          11
## X104 117                1           6
## X105 118                1          12
## X106 112                0           5
## X108  87                1           8
## X109 110                1           9
## X110  91                0           7
## X112 148                1           7
## X113  78                1           8
## X114  85                0           3
## X115 126                0           6
## X116 114                0           2
## X117 109                0           5
## X119  96                1           7
## X120 102                1           6
## X121 137                0           8
## X122 110                0           9
## X123 140                1           8
## X126 114                1           7
## X127  94                0           3
```

```
## X128 128                    0           6
## X129  93                    1           5
## X130 127                    1           6
## X131 107                    1           5
## X132 103                    1           6
## X133 118                    1          12
## X135 122                    1           8
## X136  80                    1           8
## X137 101                    0           7
## X138  98                    1           6
## X139 125                    0           9
## X142 174                    0           6
## X144 148                    1           5
## X145  75                    1           3
## X146  92                    1           6
## X147  94                    1           2
## X148 136                    0           8
## X149 135                    0           5
## X150 118                    1           4
## X152 120                    1           8
## X154 131                    1           8
## X155 135                    0           9
## X156 104                    1           7
## X157 126                    0           8
## X159 119                    1           6
## X160 121                    1           8
## X161  72                    1           6
## X162  82                    1           5
## X163 107                    1           5
## X164  93                    1          10
## X165  63                    0           5
## X166 118                    1           6
## X167 127                    0           5
## X168 109                    0           6
## X169  77                    1           5
## X170 112                    1           9
## X171 111                    1           8
## X172 132                    1           5
## X173 106                    0           6
## X174 135                    0           5
## X175 104                    1           4
## X177 153                    1           7
## X179  72                    1          10
## X180 111                    1           2
## X181 110                    0           5
## X182  99                    0           5
## X183 120                    1           5
## X184 120                    1           8
## X185 102                    1           5
## X186  81                    1           7
## X187 121                    1           7
## X188  74                    0           5
## X189 126                    0           7
## X190 108                    0           2
```

```
## X191 127                1           8
## X192 134                0           7
## X193  87                0           6
## X194  71                0           9
## X195 109                0           8
## X196  73                1          10
## X198  98                0           9
## X200 101                0           5
## X201  98                0           8
## X202  80                1          10
## X204 105                1           9
## X205  84                1           5
## X206 127                0           4
## X207 136                1          12
## X209 100                1           8
## X211 137                1           9
## X212 152                0           7
## X213 110                0           4
## X214 147                1          10
## X215  81                1           7
## X216 129                0          11
## X217  90                1           8
## X218 125                1           4
## X219 119                1           8
## X220 107                0          11
## X221 131                1           8
## X222  91                1           5
## X223 101                0           9
## X224  80                0           7
## X226 120                0           8
## X227 120                1           4
## X228 108                1           7
## X229 119                1           9
## X230  82                1           4
## X231 101                0           7
## X233  98                1           8
## X234 135                0           8
## X235 143                1           9
## X236 138                0          11
## X237 121                1           8
## X238 156                1           4
## X239  92                0           7
## X240  77                0           6
## X241  93                0           4
## X244 111                0           8
## X245 104                0           2
## X246  98                1           5
## X247  70                1           5
## X248 133                1           4
## X249 130                1           7
## X251 106                1           7
## X252 118                1           6
## X254  81                1           7
## X255 135                1           3
```

```
## X256 105                 1          4
## X257 126                 0          8
## X258 122                 1         10
## X259 117                 1          5
## X260 118                 0          7
## X261 114                 1          3
## X262  90                 1          7
## X264 122                 0          8
## X265 118                 0          9
## X266 104                 0         12
## X267 146                 0          7
## X268 106                 1         10
## X269 104                 1          8
## X270 102                 1         10
## X273 104                 1          8
## X274 106                 0         11
## X275 110                 0          5
## X276 110                 1          5
## X277  76                 1          3
## X278  82                 1          5
## X279 102                 0          7
## X280  82                 1          5
## X282  98                 0         10
## X283  91                 1          5
## X284 116                 1          9
## X286 103                 1          6
## X289 103                 0          7
## X290  69                 1          6
## X292  81                 1          5
## X293  96                 0          7
## X295 137                 1          7
## X296 139                 1          5
## X298  97                 0         10
## X299 110                 1          8
## X300 126                 1          9
## X301 112                 0          7
## X302  68                 1          7
## X303  93                 1         13
## X305  99                 0          9
## X306  88                 0          7
## X307  94                 1          6
## X311 116                 0          8
## X312  90                 0          6
## X313 114                 1          7
## X314  94                 1          4
## X315 108                 1          6
## X316 123                 1          4
## X317 123                 1          8
## X318 123                 1          3
## X319  77                 0          9
## X321 104                 1          5
## X322  75                 1          6
## X326  62                 1          7
## X327 123                 0          7
```

```
## X328 117                 1           4
## X329 121                 0           5
## X330  93                 1           9
## X331  76                 0           8
## X332 130                 1           9
## X333 122                 1           7
## X334 147                 0           8
## X335 123                 1           9
## X336  62                 1           8
## X339  91                 0           5
## X340 110                 1           6
## X341 145                 0           9
## X342 112                 0           5
## X345 145                 1           6
## X347  78                 1           7
## X349 123                 1           7
## X351 118                 1           9
## X353 123                 1           4
## X354 114                 1           7
## X355 105                 0           5
## X356 140                 0           7
## X359  76                 0           6
## X360 117                 1          11
## X361  95                 1           6
## X363  99                 1          10
## X365 100                 0           6
## X366 123                 1           8
## X367 121                 0           8
## X369 153                 0           9
## X371 132                 1           7
## X372  99                 0           3
## X373  90                 0           7
## X374 110                 1           2
## X376  95                 0           6
## X377  93                 0           8
## X378 118                 1           9
## X379  77                 1           8
## X380 125                 1           9
## X382 129                 0           6
## X383 111                 0           8
## X385  84                 1           6
## X386 124                 0           5
## X387 152                 0           2
## X388  94                 1           9
## X389 115                 0           8
## X391 101                 0           7
## X392 141                 0           7
## X393 103                 0           4
## X394  81                 0           5
## X395  92                 0          10
## X396 112                 0           7
## X397  99                 0           6
## X398 167                 1           7
## X399  99                 1           7
```

```
## X401  86                    1            9
## X402 126                    1            9
## X405 112                    0            3
## X406 113                    0            7
## X407 116                    0            6
## X408 122                    1            8
## X410 111                    0            6
## X411 124                    0            8
## X412 139                    0            2
## X413  81                    1            5
## X414 118                    0            9
## X415 102                    0            5
## X416  85                    0            5
## X417 121                    1            6
## X418 105                    0            2
## X419 145                    1            6
## X420 105                    1            8
## X421 114                    1            8
## X422  70                    1            8
## X423 120                    1            4
## X424 108                    0            8
## X425 127                    1            9
## X426 120                    0            5
## X427 125                    1            7
## X431 105                    0            8
## X432 122                    0           11
## X434  95                    1            7
## X435 145                    0            7
## X437 162                    0            6
## X438  77                    1            8
## X439 105                    1            4
## X440 109                    0            8
## X441 113                    1            7
## X442  92                    0            6
## X443 107                    0            5
## X444 131                    1            5
## X445 127                    1            4
## X448 123                    1            7
## X450 138                    1            9
## X451 121                    0            8
## X453  87                    0            6
## X454 108                    1            6
## X455 110                    1            6
## X456 122                    0            2
## X457  90                    0            7
## X458  92                    1            8
## X459 149                    1           10
## X460 118                    1            8
## X461 120                    0            8
## X464 110                    1            5
## X465 127                    1            5
## X466  41                    1            7
## X468 128                    1           10
## X469 111                    1            5
```

```
## X470  72                 0          3
## X472 116                 1          4
## X473  97                 0          6
## X474  95                 0          6
## X475  95                 1          3
## X476  98                 1          7
## X478 123                 0          8
## X480 105                 0          8
## X481 106                 0          7
## X482 114                 1          4
## X483  99                 1          6
## X484  99                 0         12
## X486 127                 1          6
## X487 123                 1          8
## X488 128                 1          4
## X489 138                 0          8
## X490  83                 1         10
## X491 122                 0          6
## X492 127                 0         13
## X493 116                 1          7
## X494 104                 0          8
## X495 119                 1          7
## X496 123                 0          6
## X497 127                 1          9
## X498 158                 0          2
## X499 131                 1          7
## X500 161                 1          7
## X501  92                 1          6
## X502 115                 1          6
## X503  89                 1          9
## X504 115                 0         10
## X507 100                 1          5
## X509  86                 0          2
## X511  79                 1          5
## X512 130                 1          6
## X513 101                 0          9
## X514 133                 1          8
## X515 108                 0          7
## X516 115                 0          7
## X518 100                 1          8
## X520 103                 0          5
## X521 103                 1         10
## X522  88                 0          4
## X523 132                 1          5
## X524  91                 0          8
## X525 120                 1          8
## X527 123                 1          5
## X528 133                 0          8
## X529 117                 1          6
## X530  87                 1          5
## X533  89                 1          4
## X535 105                 1          9
## X536 105                 0         10
## X539 121                 0          8
```

```
## X540 124                    1            7
## X541 124                    1            8
## X542 119                    0            6
## X543 110                    0            7
## X545 130                    0            7
## X546 152                    1            8
## X547 101                    0            9
## X548 103                    1            3
## X549 103                    0            6
## X550 103                    1            3
## X551 132                    0           11
## X552  82                    0            7
## X553 122                    1            6
## X554 121                    1            5
## X556 100                    1            6
## X557  88                    0           10
## X558  54                    0            8
## X559 126                    0            6
## X560 144                    1           12
## X561 130                    0            6
## X562 134                    1            8
## X563 130                    1           10
## X564 131                    1            9
## X565  96                    0            7
## X566 135                    0            7
## X567 140                    1            8
## X568 112                    1            8
## X569 107                    0            7
## X571  81                    1            5
## X573 153                    0            5
## X574  93                    0            7
## X575 104                    0            9
## X576 137                    1            4
## X577 118                    1            4
## X579  78                    1            7
## X580  94                    0            1
## X582 126                    1            6
## X584 111                    1            7
## X587 133                    0            8
## X588 116                    1            5
## X589  93                    0            5
## X591  64                    1            6
## X592 110                    1           11
## X593 111                    1            6
## X594  94                    1            4
## X597  89                    0            8
## X598 105                    1            5
## X600 134                    0            5
## X601 137                    1            4
## X602 105                    0           10
## X603  89                    0            5
## X604 105                    1            7
## X605  96                    0            6
## X606  99                    0            8
```

```
## X609  99                 0          7
## X610 154                 0          7
## X611  99                 0          7
## X613 108                 0          9
## X614 130                 0          7
## X615 108                 1          8
## X617  93                 1          7
## X618  95                 0          5
## X619 101                 1         11
## X620  74                 1          9
## X623 131                 0          8
## X624 121                 1         10
## X625 101                 1          6
## X626 140                 1          6
## X628 116                 1          7
## X629 115                 1          5
## X630  80                 1          6
## X631 134                 0          8
## X632  99                 1          7
## X633 117                 0          7
## X634  71                 0          7
## X635 100                 1          7
## X636 149                 1          6
## X637 131                 0          7
## X638 138                 1          5
## X640 109                 1          9
## X641 119                 0          9
## X642 117                 1          9
## X643  61                 1         10
## X644  91                 1          8
## X645  83                 1          5
## X646 103                 1          7
## X648 101                 1          4
## X649  76                 1          9
## X650 104                 1          7
## X652 103                 0          7
## X654 146                 0          8
## X655 103                 0          8
## X656  68                 1          9
## X657  71                 0          9
## X658 106                 0          4
## X659 114                 0          9
## X660 136                 1          8
## X661 122                 0          8
## X663  92                 0          6
## X664 123                 1          9
## X665 104                 0          4
## X666 123                 0          5
## X667 121                 1          8
## X668 120                 1          6
## X669 141                 0          9
## X670 102                 1          6
## X673 116                 0          8
## X674 130                 1          5
```

```
## X675  86                 1           9
## X676 111                 0           7
## X677 101                 1           6
## X678 121                 1           8
## X679 139                 1           4
## X680 136                 0           9
## X681 117                 1           9
## X682 102                 1           8
## X683 134                 1           9
## X684 114                 1           9
## X685 102                 0          10
## X686 122                 1           9
## X687 130                 1           3
## X688 127                 0          11
## X690  89                 0           5
## X691 118                 1           5
## X692 122                 0           7
## X693  98                 1           4
## X694 130                 1           9
## X697 119                 1           8
## X698 138                 1           9
## X699  99                 1           9
## X700 107                 1           8
## X701 124                 1           8
## X702 130                 0           8
## X703 108                 0           9
## X705  93                 1           9
## X706 104                 1           8
## X707 130                 1           8
## X708 129                 1          10
## X709  97                 1           8
## X710 116                 1           7
## X711 118                 0           9
## X712 128                 1           3
## X713 133                 1           7
## X714  75                 0           6
## X715  75                 1           8
## X716 118                 0           7
## X717 129                 1           9
## X718 111                 0           8
## X719 133                 1           8
## X720 112                 1           5
## X721  86                 0           9
## X722 114                 1           9
## X724  80                 0           6
## X725  84                 0          12
## X726 124                 0           4
## X730 134                 0           8
## X731 110                 1           9
## X732 124                 1           6
## X734  92                 1           5
## X735  85                 1           9
## X737 119                 1           4
## X738 111                 1          11
```

```
## X739 131                    1           9
## X740 115                    1           8
## X744 116                    0           6
## X745 116                    0           7
## X746 103                    0          10
## X747  81                    1           7
## X748 111                    1           7
## X749  96                    0          10
## X751 124                    0           7
## X752 114                    1           8
## X753  78                    0           9
## X754 107                    0           9
## X757 137                    1           2
## X758  78                    1           7
## X759 118                    0           3
## X761 106                    1           7
## X762 119                    0           9
## X763 157                    0          10
## X764  81                    1           3
## X765 118                    1           4
## X766 103                    0           6
## X767 118                    1           7
## X768 109                    0           8
## X769 104                    1           6
## X770  97                    1           0
## X772 132                    0           6
## X773 112                    1           8
## X774 118                    0           5
## X775 128                    0          11
## X776 118                    1           3
## X777  78                    1           6
## X778 116                    1           6
## X779 119                    1           7
## X780  98                    1           5
## X781  78                    1           5
## X784 112                    1           5
## X786  77                    1           3
## X787 100                    1           5
## X788  98                    1           6
## X789  99                    0           3
## X790 115                    1           7
## X791 113                    1           6
## X792 106                    0           5
## X794 111                    0           4
## X795 130                    1           6
## X796 117                    1           6
## X797 100                    0           7
## X798 103                    1           2
## X799  93                    0           8
## X800  98                    1           9
## X801 134                    0           9
## X802  91                    0           9
## X803 123                    1           8
## X804 113                    1           6
```

```
## X805  96                  0          5
## X807 112                  1          8
## X808  84                  1          5
## X809 112                  0          6
## X810 105                  1          1
## X812  98                  1          6
## X813 112                  1          8
## X814 116                  1         10
## X815  61                  1          9
## X816 106                  1          7
## X817  85                  1          6
## X818 137                  1          8
## X820  98                  1          4
## X821  96                  0         10
## X822 132                  0          8
## X823 131                  0          9
## X824 104                  1          5
## X825  79                  0         10
## X826 113                  1          7
## X830 107                  1          8
## X831  98                  1          6
## X832  86                  1          9
## X833  98                  0          5
## X834  83                  1          4
## X836 110                  0         10
## X837  99                  0          8
## X838 114                  0          5
## X839 102                  1          8
## X840 111                  0          7
## X841 109                  1          7
## X842  68                  1          5
## X843 124                  1          8
## X844 110                  1          6
## X847 160                  1          6
## X848 114                  1          9
## X849 141                  1          8
## X850  96                  0          7
## X851 121                  0          7
## X852 107                  1          7
## X853  97                  1          8
## X854 143                  0          7
## X855  90                  1          6
## X856  73                  1          3
## X857 137                  0          6
## X858 111                  1          5
## X859 112                  0          5
## X860 123                  0         13
## X861 104                  1          7
## X862  96                  1          7
## X864 130                  0          4
## X865 121                  1          6
## X866 109                  1          8
## X867  77                  0          8
## X868 102                  1          8
```

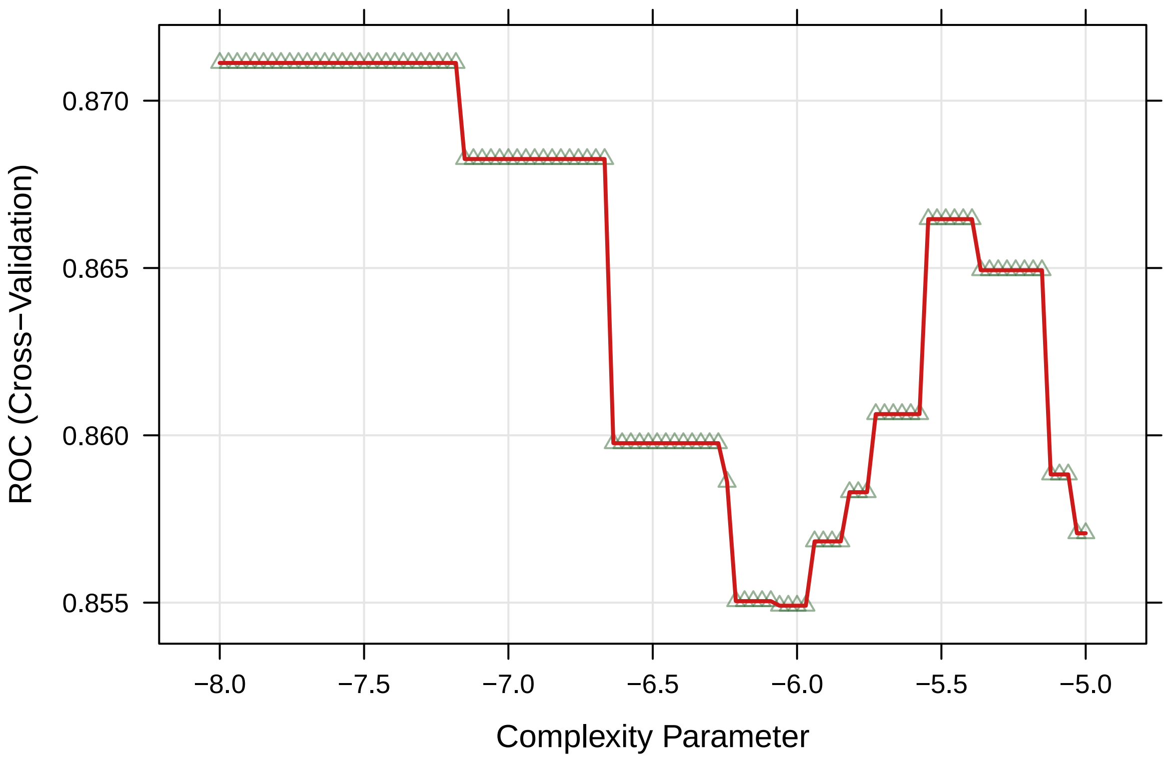
```
## X869 108                 1          11
## X870 114                 0           6
## X871  76                 0           7
## X872 101                 1           6
## X873 108                 0           2
## X874  86                 1           8
## X875  98                 1           7
## X877  85                 0           5
## X878  91                 1           2
## X879  73                 1           9
## X880 116                 0           8
## X881 106                 1           4
## X882  94                 1           8
## X883 100                 1           3
## X884 149                 1           5
## X885 115                 1           8
## X886 106                 0           6
## X887 150                 1           7
## X888 109                 0           6
## X889 108                 1           7
## X890 121                 1           9
## X891 149                 1           6
## X892 119                 1           9
## X894 100                 0           7
## X895  98                 1           5
## X897 114                 0           8
## X899  98                 0          11
## X900 110                 1           7
## X901 129                 0           8
## X902  92                 0           3
## X903 128                 1           7
## X904 129                 1           8
## X905 123                 1           7
## X906 128                 1           9
## X907 111                 1           9
## X908 100                 0           9
## X909 135                 1           6
## X910 136                 1           9
## X911  70                 1           9
## X913 127                 1           6
## X916 111                 1           6
## X917 164                 1           9
## X918 126                 0           7
## X919 122                 0           4
## X920  87                 1           7
## X921 134                 0           5
## X922  97                 0           6
## X924  96                 1           5
## X925  99                 1           7
## X926 103                 1           6
## X927 117                 0           8
## X929 106                 0           7
## X932 155                 0           8
## X933  75                 1           7
```

```
## X935  96                   1           3
## X936 115                   0          10
## X937 102                   1           9
## X939 117                   0           9
## X940 108                   0           8
## X941 150                   1           9
## X942 139                   1           9
## X943 127                   0          10
## X945 124                   1           6
## X946 117                   1           7
## X948 121                   0           6
## X949  93                   1           5
## X950  79                   1          11
## X951 145                   1           6
## X953 114                   0           7
## X954 123                   0           4
## X955 128                   1          10
## X956 114                   0           8
## X957  94                   0           7
## X958 140                   1           7
## X959 105                   1           7
## X960 104                   1           7
## X961  97                   0           6
## X962 144                   0           8
## X963 134                   1           9
## X964 102                   1           8
## X965 100                   1          11
## X966  78                   0           6
## X968 130                   1           7
## X969 119                   1           9
## X970 107                   0           6
## X971 112                   1          10
## X972  99                   1          11
## X973  88                   1           8
## X974 133                   0           9
## X975 115                   1           5
## X976  89                   0           7
## X977 111                   1           9
## X978  93                   1           7
## X979 122                   1           7
## X980  89                   1          10
## X981 117                   0           7
## X982 112                   0           4
## X983 157                   0           7
## X984  76                   1          10
## X985 125                   1           8
## X986  83                   0           7
## X987  83                   0           8
## X988 137                   1           6
## X989 114                   1           7
## X990 129                   1          10
## X991 106                   1           6
## X992  95                   1           9
## X993  99                   1           5
```

```
## X994  98                 0          7
## X995 121                 0          7
## X996 120                 0          7
## X997 122                 1          5
## X998 125                 1          5
## X999  98                 0          5
##
## $usekernel
## [1] TRUE
##
## $varnames
##  [1] "age"                   "genderMale"            "raceAsian"
##  [4] "raceBlack"             "raceHispanic"          "smokingFormer_smoker"
##  [7] "smokingCurrent_smoker" "height"                "weight"
## [10] "bmi"                   "diabetesYes"           "hypertensionYes"
## [13] "sbp"                   "ldl"                   "vaccineVaccinated"
## [16] "depression"
##
## $xNames
##  [1] "age"                   "genderMale"            "raceAsian"
##  [4] "raceBlack"             "raceHispanic"          "smokingFormer_smoker"
##  [7] "smokingCurrent_smoker" "height"                "weight"
## [10] "bmi"                   "diabetesYes"           "hypertensionYes"
## [13] "sbp"                   "ldl"                   "vaccineVaccinated"
## [16] "depression"
##
## $problemType
## [1] "Classification"
##
## $tuneValue
##    fL usekernel adjust
## 42  1      TRUE    3.4
##
## $obsLevels
## [1] "Not_severe" "Severe"
## attr(,"ordered")
## [1] FALSE
##
## $param
## list()
##
## attr(,"class")
## [1] "NaiveBayes"
```

CART

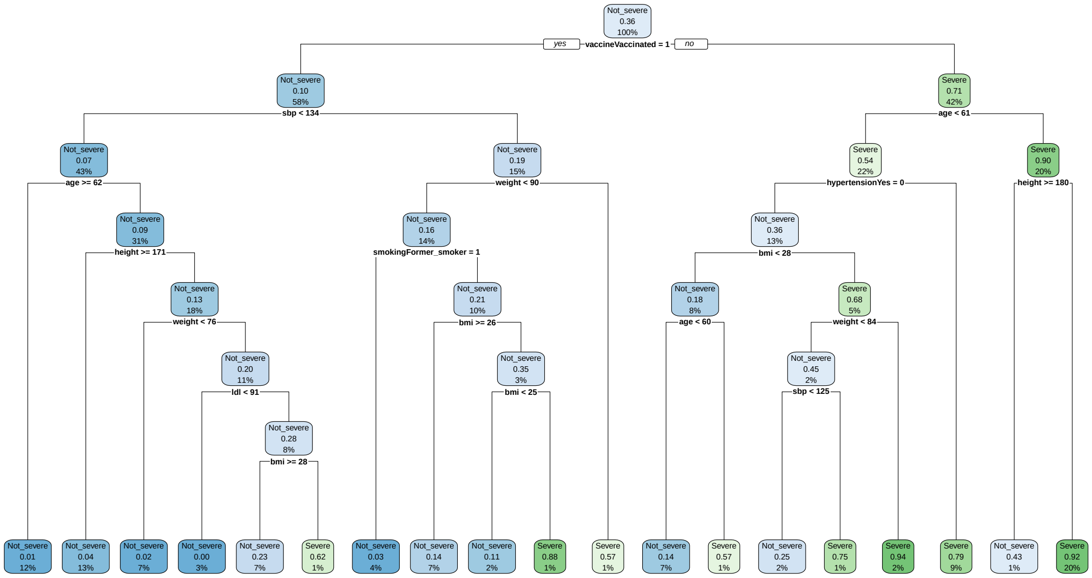
```r
# CART
set.seed(2)
model.cart = train(severity ~ . ,
                   training_data,
                   method = "rpart",
                   tuneGrid = data.frame(cp = exp(seq(-8,-5, len = 100))),
                   trControl = ctrl,
                   metric = "ROC")

plot(model.cart, xTrans = log)
```




```r
model.cart$bestTune
```

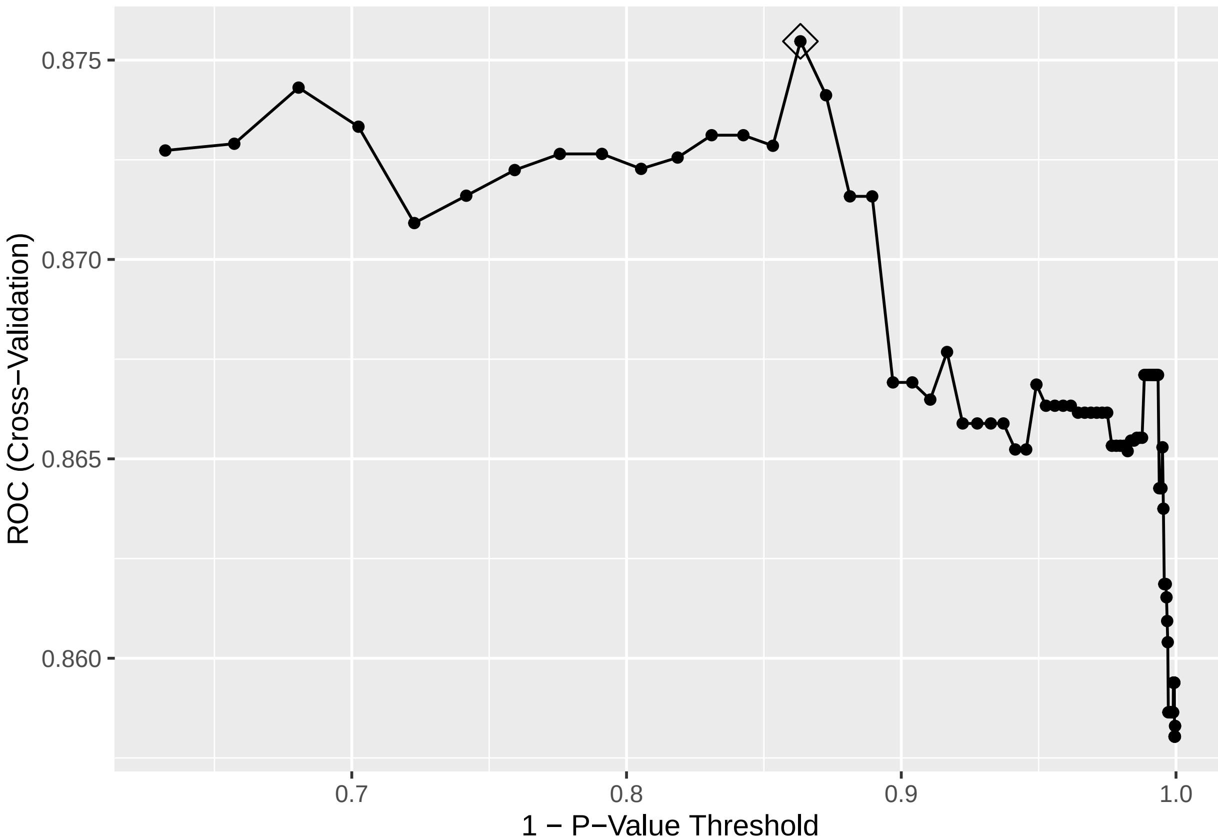
```
##              cp
## 28 0.0007602842
```

```r
rpart.plot(model.cart$finalModel)
```


Not_severe 0.36 100%
yes
vaccineVaccinated = 1
no
Not_severe 0.10 58%
sbp < 134
Severe 0.71 42%
age < 61
Not_severe 0.07 43%
age >= 62
Not_severe 0.19 15%
weight < 90
Severe 0.54 22%
hypertensionYes = 0
Severe 0.90 20%
height >= 180
Not_severe 0.09 31%
height >= 171
Not_severe 0.16 14%
smokingFormer_smoker = 1
Not_severe 0.36 13%
bmi < 28
Not_severe 0.13 18%
weight < 76
Not_severe 0.21 10%
bmi >= 26
Not_severe 0.18 8%
age < 60
Severe 0.68 5%
weight < 84
Not_severe 0.20 11%
ldl < 91
Not_severe 0.35 3%
bmi < 25
Not_severe 0.45 2%
sbp < 125
Not_severe 0.28 8%
bmi >= 28
Not_severe 0.01 12%
Not_severe 0.04 13%
Not_severe 0.02 7%
Not_severe 0.00 3%
Not_severe 0.23 7%
Severe 0.62 1%
Not_severe 0.03 4%
Not_severe 0.14 7%
Not_severe 0.11 2%
Severe 0.88 1%
Severe 0.57 1%
Not_severe 0.14 7%
Severe 0.57 1%
Not_severe 0.25 2%
Severe 0.75 1%
Severe 0.94 2%
Severe 0.79 9%
Not_severe 0.43 1%
Severe 0.92 20%

Conditional Inference Trees (CIT)

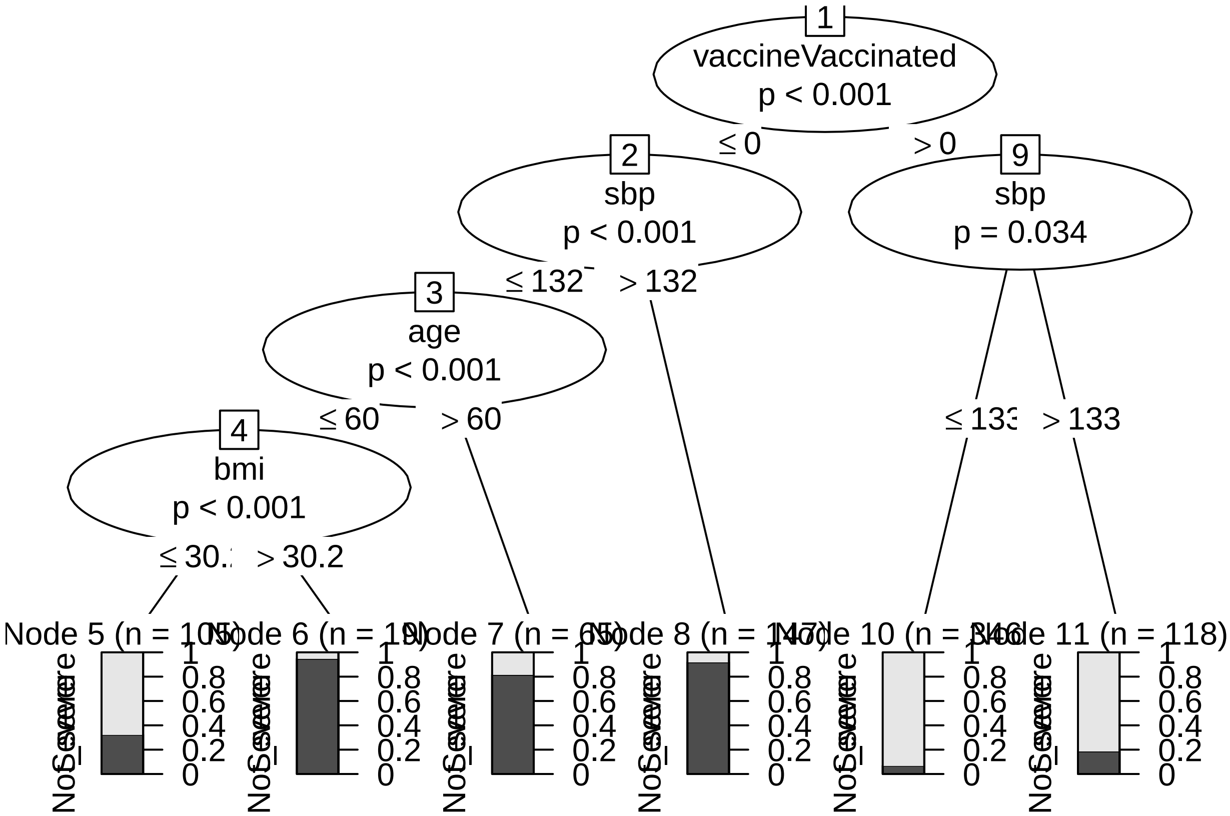
```
set.seed(2)

model.cit = train(severity ~ . ,
                  training_data,
                  method = "ctree",
                  tuneGrid = data.frame(mincriterion = 1-exp(seq(-8, -1, length = 100))),
                  trControl = ctrl)

ggplot(model.cit, highlight = TRUE)
```




```
model.cit$bestTune
```

```
##    mincriterion
## 15    0.8632908
```

```
plot(model.cit$finalModel)
```

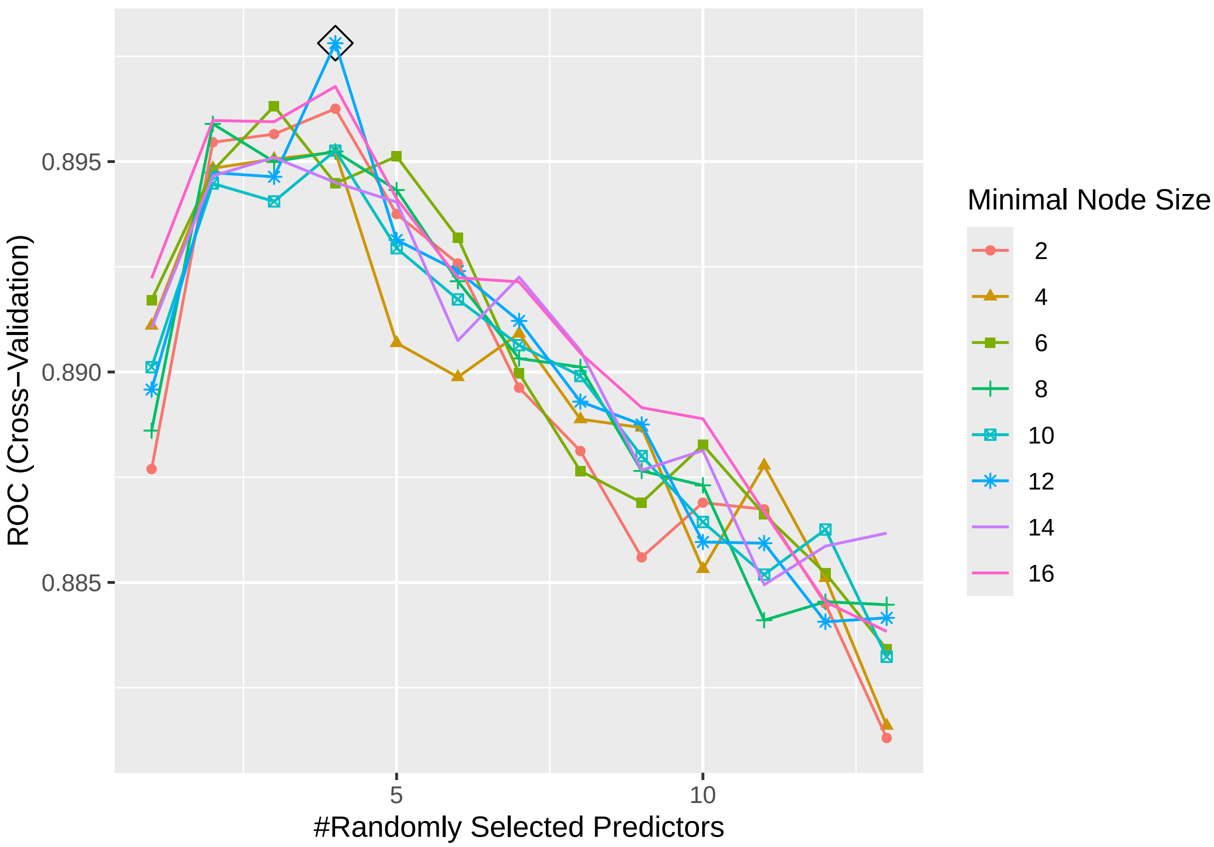

1
vaccineVaccinated
p < 0.001
≤ 0
> 0
2
sbp
p < 0.001
9
sbp
p = 0.034
≤ 132
> 132
3
age
p < 0.001
≤ 60
> 60
> 133
4
bmi
p < 0.001
> 30.2
Node 11 (n = 118)
1
0.8
0.6
0.4
0.2
0

Random Forest

```r
# Try more if possible
rf.grid = expand.grid(mtry = 1:13,
                      splitrule = "gini",
                      min.node.size = seq(from = 2, to = 16, by = 2))
set.seed(2)
model.rf = train(severity ~ . ,
                 data = training_data,
                 method = "ranger",
                 tuneGrid = rf.grid,
                 trControl = ctrl)
model.rf$bestTune
```

```
##    mtry splitrule min.node.size
## 30    4      gini            12
```

```r
ggplot(model.rf, highlight = TRUE)
```

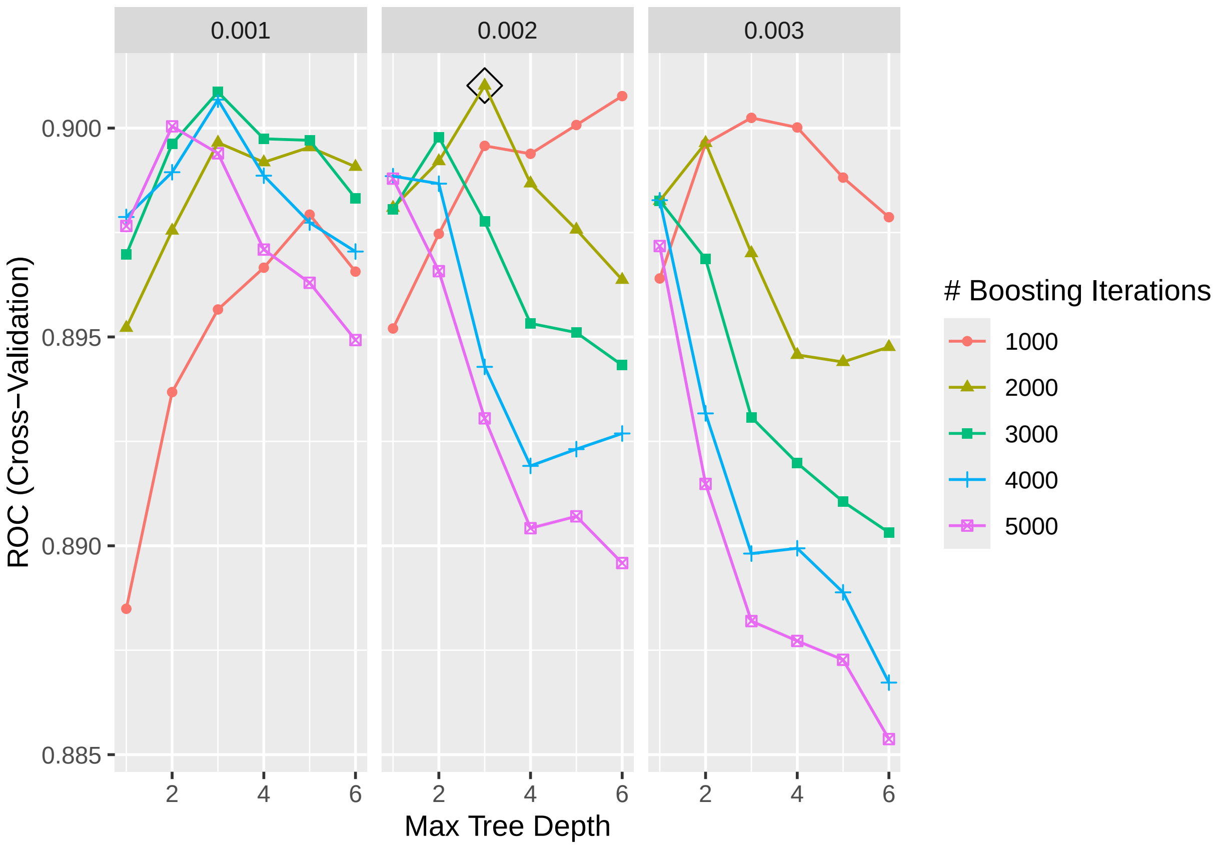


AdaBoost

```
#Try more
gbmA.grid = expand.grid(n.trees = c(1000,2000,3000,4000,5000),
                        interaction.depth = 1:6,
                        shrinkage = c(0.001, 0.002, 0.003),
                        n.minobsinnode = 1)

set.seed(2)

model.gbmA = train(severity ~ . ,
                   training_data,
                   tuneGrid = gbmA.grid,
                   trControl = ctrl,
                   method = "gbm",
                   distribution = "adaboost",
                   metric = "ROC",
                   verbose = FALSE)
model.gbmA$bestTune
```

```
##    n.trees interaction.depth shrinkage n.minobsinnode
## 42    2000                 3     0.002              1
```

```
ggplot(model.gbmA, highlight = TRUE)
```

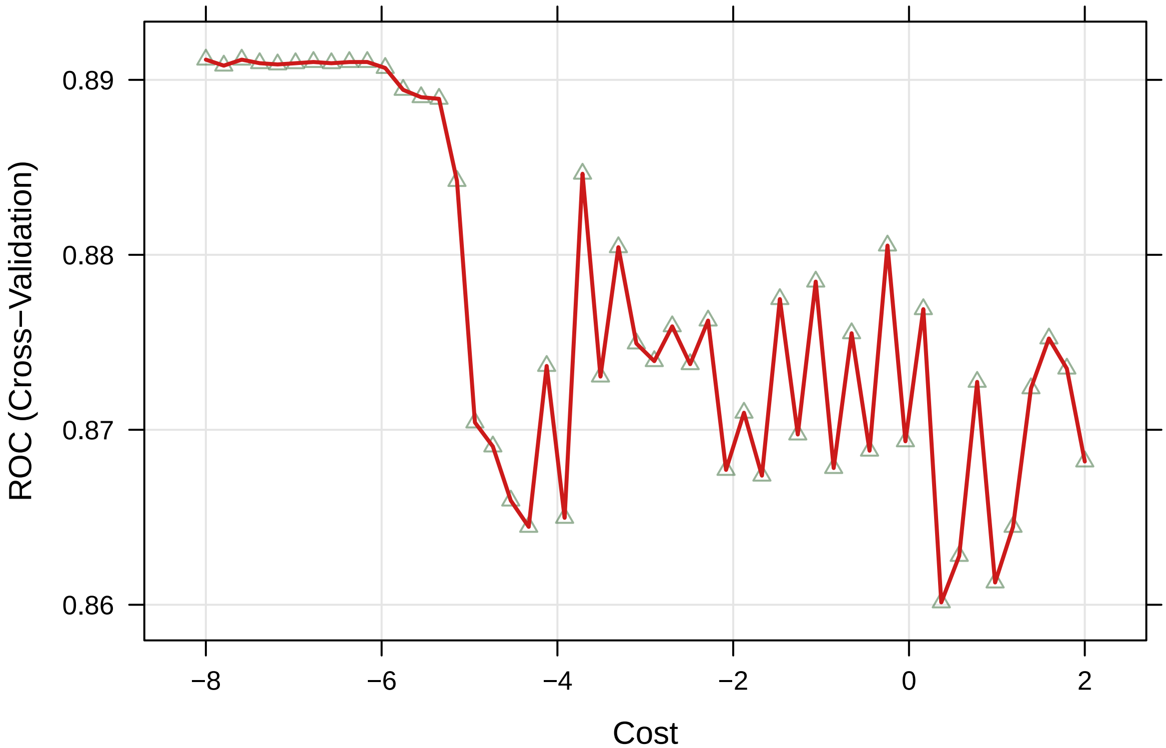


Support Vector Machine: linear

```
set.seed(2)

model.svml = train(severity ~ . ,
                   data = training_data,
                   method = "svmLinear",
                   tuneGrid = data.frame(C = exp(seq(-8, 2, len = 50))),
                   trControl = ctrl)

model.svml$bestTune
```

```
##              C
## 1 0.0003354626
```

```
plot(model.svml, highlight = TRUE, xTrans = log)
```

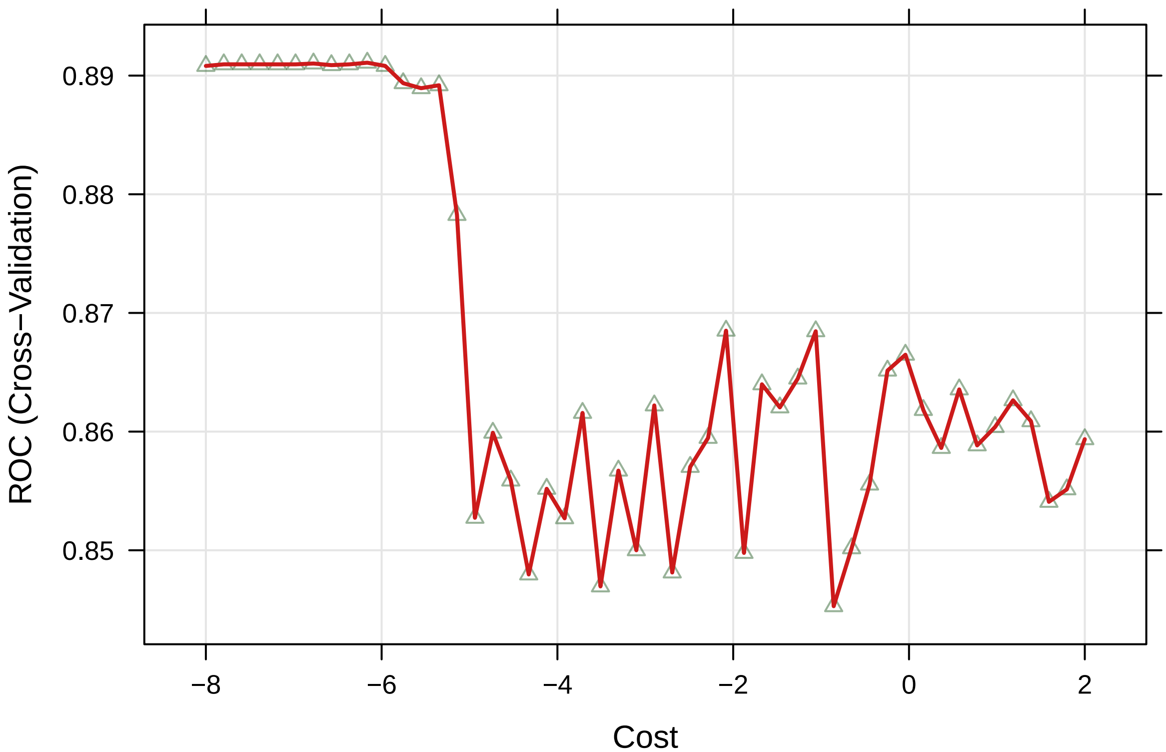


SVML: e1071

```
set.seed(2)

model.svml2 = train(severity ~ . ,
                    data = training_data,
                    method = "svmLinear2",
                    tuneGrid = data.frame(cost = exp(seq(-8, 2, len = 50))),
                    trControl = ctrl)

model.svml2$bestTune
```

```
##            cost
## 10 0.002105367
```

```
plot(model.svml2, highlight = TRUE, xTrans = log)
```

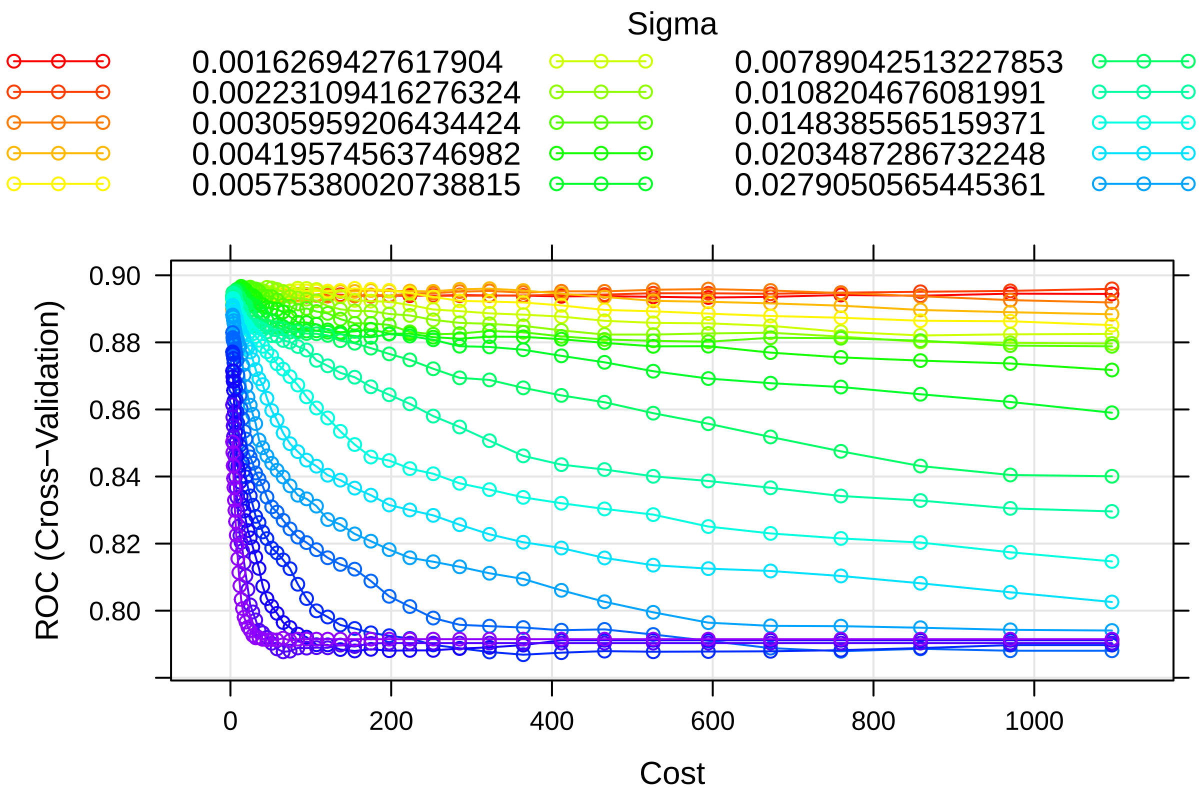


SVML: Radial Sigma

```
svmr.grid = expand.grid(C = exp(seq(1, 7, len = 50)),
                        sigma = exp(seq(-8, -2, len = 20)))

# tunes over both cost and sigma
set.seed(2)
model.svmr = train(severity ~ . ,
                   data = training_data,
                   method = "svmRadialSigma",
                   tuneGrid = svmr.grid,
                   trControl = ctrl)

myCol = rainbow(25)
myPar = list(superpose.symbol = list(col = myCol),
superpose.line = list(col = myCol))

model.svmr$bestTune
```

```
##           sigma        C
## 269 0.004195746 13.35428
```

```
plot(model.svmr, highlight = TRUE, par.settings = myPar)
```



SVML: radial cost

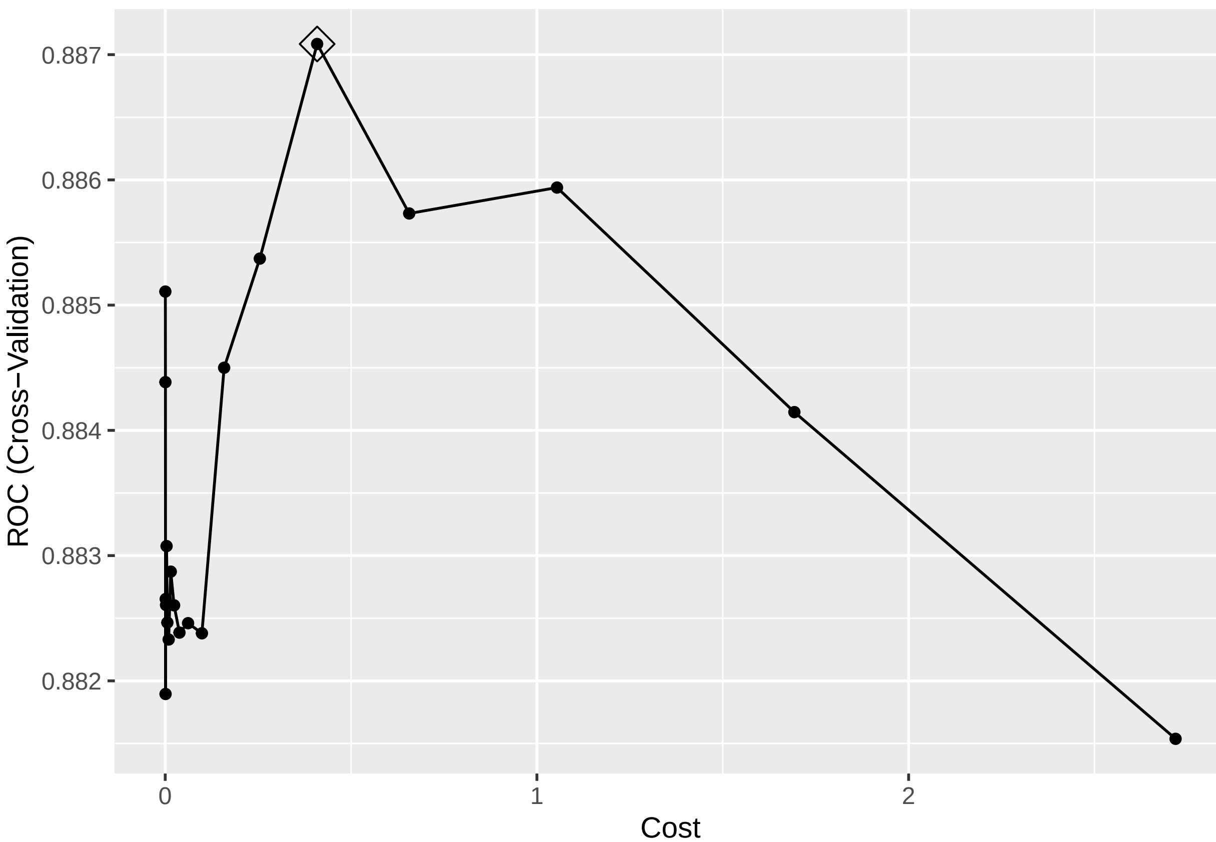
```
set.seed(2)

model.svmr2 = train(severity ~ . ,
                  data = training_data,
                  method = "svmRadialCost",
                  tuneGrid = data.frame(C = exp(seq(-8, 1, len = 20))),
                  trControl = ctrl)
```

```
## maximum number of iterations reached 1.184536e-05 1.182684e-05maximum number of iterations reached 1
```

```
model.svmr2$bestTune
```

```
##            C
## 16 0.4087151
```

```
ggplot(model.svmr2, highlight = TRUE, par.settings = myPar)
```



Results

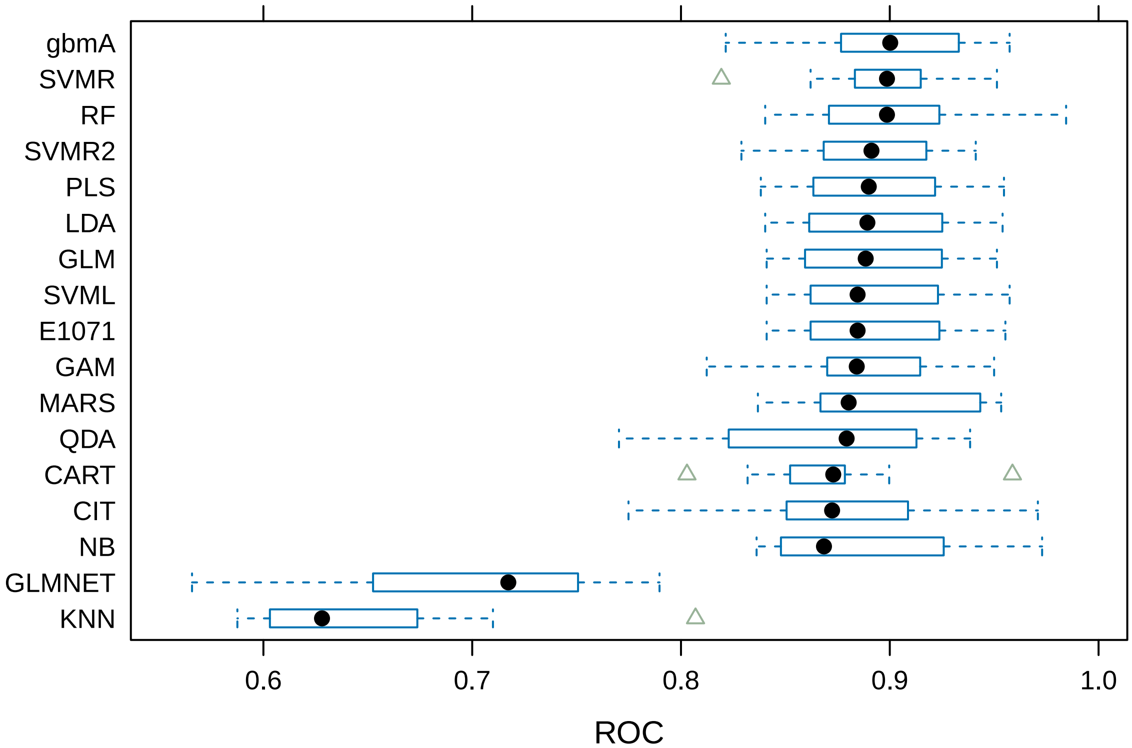
Model Comparison: Cross Validation Performance

```
res = resamples(list(GLM = model.glm,
                     GLMNET = model.glmn,
                     KNN = model.knn,
                     PLS = model.pls,
                     GAM = model.gam,
                     MARS = model.mars,
                     LDA = model.lda,
                     QDA = model.qda,
                     NB = model.nb,
                     CART = model.cart,
                     CIT = model.cit,
                     RF = model.rf,
                     SVML = model.svml,
                     E1071 = model.svml2,
                     SVMR = model.svmr,
                     SVMR2 = model.svmr2,
                     gbmA = model.gbmA
                     ))
summary(res)
```

```
##
## Call:
## summary.resamples(object = res)
##
## Models: GLM, GLMNET, KNN, PLS, GAM, MARS, LDA, QDA, NB, CART, CIT, RF, SVML, E1071, SVMR, SVMR2, gbmA
## Number of resamples: 10
##
## ROC
##             Min.   1st Qu.    Median      Mean   3rd Qu.      Max. NA's
## GLM    0.8410364 0.8594164 0.8884762 0.8902533 0.9211279 0.9513185    0
## GLMNET 0.5658263 0.6652141 0.7172967 0.6961763 0.7462571 0.7897228    0
## KNN    0.5875350 0.6045609 0.6280788 0.6505299 0.6711704 0.8069642    0
## PLS    0.8382353 0.8653846 0.8899325 0.8927358 0.9192186 0.9546991    0
## GAM    0.8123249 0.8700265 0.8841817 0.8878412 0.9122597 0.9499662    0
## MARS   0.8368347 0.8678010 0.8803050 0.8954023 0.9367124 0.9533469    0
## LDA    0.8403361 0.8637268 0.8892694 0.8921525 0.9221443 0.9540230    0
## QDA    0.7703081 0.8323010 0.8793382 0.8685147 0.9055691 0.9384719    0
## NB     0.8362069 0.8484358 0.8684867 0.8860873 0.9237099 0.9729547    0
## CART   0.8028711 0.8556278 0.8729261 0.8711284 0.8778011 0.9587559    0
## CIT    0.7748599 0.8540285 0.8723739 0.8754698 0.9021152 0.9709263    0
## RF     0.8403361 0.8709822 0.8986526 0.8978131 0.9219717 0.9844490    0
## SVML   0.8410364 0.8627321 0.8845903 0.8911562 0.9204239 0.9574037    0
## E1071  0.8410364 0.8627321 0.8845903 0.8910873 0.9207640 0.9553753    0
## SVMR   0.8193277 0.8849469 0.8986646 0.8967070 0.9147678 0.9513185    0
## SVMR2  0.8289385 0.8689329 0.8912244 0.8870851 0.9168427 0.9411765    0
## gbmA   0.8214286 0.8774867 0.9002110 0.9010174 0.9329702 0.9574037    0
##
## Sens
##             Min.   1st Qu.    Median      Mean   3rd Qu.      Max. NA's
## GLM    0.8269231 0.8676471 0.8930995 0.8852187 0.9038462 0.9215686    0
```

```
## GLMNET 0.9230769 0.9607843 0.9611614 0.9611614 0.9615385 1.0000000    0
## KNN    0.7115385 0.7364253 0.7843137 0.7921569 0.8195701 0.9411765    0
## PLS    0.7647059 0.7901584 0.8640649 0.8461161 0.8970588 0.9038462    0
## GAM    0.8235294 0.8529412 0.8942308 0.8891026 0.9215686 0.9423077    0
## MARS   0.8235294 0.8486991 0.8738688 0.8773379 0.9171380 0.9230769    0
## LDA    0.7843137 0.7901584 0.8640649 0.8480769 0.8970588 0.9038462    0
## QDA    0.8039216 0.8438914 0.8725490 0.8715686 0.9033748 0.9230769    0
## NB     0.9038462 0.9411765 0.9607843 0.9572021 0.9615385 1.0000000    0
## CART   0.8076923 0.8627451 0.8834842 0.8872172 0.9278846 0.9607843    0
## CIT    0.8431373 0.8461538 0.9117647 0.8969080 0.9371229 0.9607843    0
## RF     0.8461538 0.9215686 0.9321267 0.9261312 0.9420249 0.9803922    0
## SVML   0.7058824 0.7730015 0.8039216 0.7974736 0.8260747 0.8461538    0
## E1071  0.8461538 0.8872549 0.9313725 0.9162519 0.9420249 0.9807692    0
## SVMR   0.8269231 0.8823529 0.8921569 0.8852187 0.9033748 0.9038462    0
## SVMR2  0.8269231 0.8725490 0.9019608 0.8891026 0.9033748 0.9230769    0
## gbmA   0.8461538 0.8829186 0.9215686 0.9144419 0.9371229 0.9803922    0
##
## Spec
##             Min.    1st Qu.     Median       Mean    3rd Qu.      Max. NA's
## GLM    0.6206897 0.69827586 0.75431034 0.79064039 0.89562808 0.9642857    0
## GLMNET 0.0000000 0.06896552 0.07019704 0.07684729 0.09544335 0.1724138    0
## KNN    0.2142857 0.38269704 0.42118227 0.40443350 0.44827586 0.6206897    0
## PLS    0.6785714 0.76724138 0.82512315 0.82894089 0.89562808 0.9642857    0
## GAM    0.5862069 0.71674877 0.74137931 0.76243842 0.85190887 0.8928571    0
## MARS   0.6206897 0.69827586 0.73706897 0.76613300 0.84975369 0.9285714    0
## LDA    0.6785714 0.76724138 0.82512315 0.82894089 0.89562808 0.9642857    0
## QDA    0.5862069 0.69581281 0.72413793 0.76268473 0.86206897 0.9285714    0
## NB     0.3928571 0.49599754 0.56157635 0.56194581 0.61206897 0.7586207    0
## CART   0.6071429 0.66102217 0.71982759 0.72376847 0.75862069 0.8620690    0
## CIT    0.6071429 0.72413793 0.75431034 0.76588670 0.82758621 0.8928571    0
## RF     0.5862069 0.68996305 0.73706897 0.74802956 0.83620690 0.8965517    0
## SVML   0.6785714 0.80172414 0.86022167 0.84285714 0.89562808 0.9642857    0
## E1071  0.5172414 0.61607143 0.70689655 0.70997537 0.81711823 0.8620690    0
## SVMR   0.6428571 0.71674877 0.79310345 0.80073892 0.89562808 0.9642857    0
## SVMR2  0.6071429 0.70474138 0.77586207 0.78325123 0.89285714 0.8965517    0
## gbmA   0.5517241 0.69581281 0.73706897 0.74137931 0.81034483 0.9285714    0
```

```r
bwplot(res, metric = "ROC") # gbMA has highest median and mean ROC
```




```r
# Cross-validation error
glm.predict = predict(model.glm, newdata = training_data)
# glmnet.predict = predict(model.glmn, newdata = x.train) # getting error?
knn.predict = predict(model.knn, newdata = x.train)
pls.predict = predict(model.pls, newdata = x.train)
gam.predict = predict(model.gam, newdata = x.train)
mars.predict = predict(model.mars, newdata = training_data)
lda.predict = predict(model.lda, newdata = x.train)
qda.predict = predict(model.qda, newdata = x.train)
nb.predict = predict(model.nb, newdata = x.train)
cart.predict = predict(model.cart, newdata = training_data)
cit.predict = predict(model.cit, newdata = training_data)
rf.predict = predict(model.rf, newdata = training_data)
svml.predict = predict(model.svml, newdata = training_data)
e1071.predict = predict(model.svml2, newdata = training_data)
svmr.predict = predict(model.svmr, newdata = training_data)
svmr2.predict = predict(model.svmr2, newdata = training_data)
gbmA.predict = predict(model.gbmA, newdata = training_data)

confusionMatrix(data = glm.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        457     55
##   Severe             57    231
##
##                Accuracy : 0.86
##                  95% CI : (0.834, 0.8833)
```

```
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.6957
##
##  Mcnemar's Test P-Value : 0.9247
##
##             Sensitivity : 0.8891
##             Specificity : 0.8077
##          Pos Pred Value : 0.8926
##          Neg Pred Value : 0.8021
##              Prevalence : 0.6425
##          Detection Rate : 0.5713
##    Detection Prevalence : 0.6400
##       Balanced Accuracy : 0.8484
##
##        'Positive' Class : Not_severe
##
```

```
# confusionMatrix(data = glmnet.predict, reference = y.train)
confusionMatrix(data = knn.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        438    130
##   Severe             76    156
##
##                Accuracy : 0.7425
##                  95% CI : (0.7107, 0.7725)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : 9.156e-10
##
##                   Kappa : 0.415
##
##  Mcnemar's Test P-Value : 0.0002219
##
##             Sensitivity : 0.8521
##             Specificity : 0.5455
##          Pos Pred Value : 0.7711
##          Neg Pred Value : 0.6724
##              Prevalence : 0.6425
##          Detection Rate : 0.5475
##    Detection Prevalence : 0.7100
##       Balanced Accuracy : 0.6988
##
##        'Positive' Class : Not_severe
##
```

```
confusionMatrix(data = pls.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
```

```
## Prediction   Not_severe Severe
##   Not_severe        440     47
##   Severe             74    239
##
##                Accuracy : 0.8488
##                  95% CI : (0.822, 0.8729)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.6775
##
##  Mcnemar's Test P-Value : 0.0181
##
##             Sensitivity : 0.8560
##             Specificity : 0.8357
##          Pos Pred Value : 0.9035
##          Neg Pred Value : 0.7636
##              Prevalence : 0.6425
##          Detection Rate : 0.5500
##    Detection Prevalence : 0.6088
##       Balanced Accuracy : 0.8458
##
##        'Positive' Class : Not_severe
##
```

```
confusionMatrix(data = gam.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        463     54
##   Severe             51    232
##
##                Accuracy : 0.8688
##                  95% CI : (0.8434, 0.8914)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.7136
##
##  Mcnemar's Test P-Value : 0.8453
##
##             Sensitivity : 0.9008
##             Specificity : 0.8112
##          Pos Pred Value : 0.8956
##          Neg Pred Value : 0.8198
##              Prevalence : 0.6425
##          Detection Rate : 0.5787
##    Detection Prevalence : 0.6462
##       Balanced Accuracy : 0.8560
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = mars.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        457     60
##   Severe             57    226
##
##                Accuracy : 0.8538
##                  95% CI : (0.8273, 0.8775)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.6809
##
##  Mcnemar's Test P-Value : 0.8533
##
##             Sensitivity : 0.8891
##             Specificity : 0.7902
##          Pos Pred Value : 0.8839
##          Neg Pred Value : 0.7986
##              Prevalence : 0.6425
##          Detection Rate : 0.5713
##    Detection Prevalence : 0.6462
##       Balanced Accuracy : 0.8397
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = lda.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        437     47
##   Severe             77    239
##
##                Accuracy : 0.845
##                  95% CI : (0.818, 0.8694)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.6703
##
##  Mcnemar's Test P-Value : 0.009207
##
##             Sensitivity : 0.8502
##             Specificity : 0.8357
##          Pos Pred Value : 0.9029
##          Neg Pred Value : 0.7563
##              Prevalence : 0.6425
##          Detection Rate : 0.5463
```

```
##    Detection Prevalence : 0.6050
##       Balanced Accuracy : 0.8429
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = qda.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        456     49
##   Severe             58    237
##
##                Accuracy : 0.8662
##                  95% CI : (0.8407, 0.8891)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.7109
##
##  Mcnemar's Test P-Value : 0.4393
##
##             Sensitivity : 0.8872
##             Specificity : 0.8287
##          Pos Pred Value : 0.9030
##          Neg Pred Value : 0.8034
##              Prevalence : 0.6425
##          Detection Rate : 0.5700
##    Detection Prevalence : 0.6312
##       Balanced Accuracy : 0.8579
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = nb.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        492    126
##   Severe             22    160
##
##                Accuracy : 0.815
##                  95% CI : (0.7863, 0.8413)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.562
##
##  Mcnemar's Test P-Value : < 2.2e-16
##
##             Sensitivity : 0.9572
```

```
##             Specificity : 0.5594
##          Pos Pred Value : 0.7961
##          Neg Pred Value : 0.8791
##              Prevalence : 0.6425
##          Detection Rate : 0.6150
##    Detection Prevalence : 0.7725
##       Balanced Accuracy : 0.7583
##
##        'Positive' Class : Not_severe
##
```

```
confusionMatrix(data = cart.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        474     44
##   Severe             40    242
##
##                Accuracy : 0.895
##                  95% CI : (0.8717, 0.9154)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.7707
##
##  Mcnemar's Test P-Value : 0.7434
##
##             Sensitivity : 0.9222
##             Specificity : 0.8462
##          Pos Pred Value : 0.9151
##          Neg Pred Value : 0.8582
##              Prevalence : 0.6425
##          Detection Rate : 0.5925
##    Detection Prevalence : 0.6475
##       Balanced Accuracy : 0.8842
##
##        'Positive' Class : Not_severe
##
```

```
confusionMatrix(data = cit.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        489     80
##   Severe             25    206
##
##                Accuracy : 0.8688
##                  95% CI : (0.8434, 0.8914)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : < 2.2e-16
##
```

```
##                   Kappa : 0.7016
##
##  Mcnemar's Test P-Value : 1.365e-07
##
##             Sensitivity : 0.9514
##             Specificity : 0.7203
##          Pos Pred Value : 0.8594
##          Neg Pred Value : 0.8918
##              Prevalence : 0.6425
##          Detection Rate : 0.6112
##    Detection Prevalence : 0.7113
##       Balanced Accuracy : 0.8358
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = rf.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        503     37
##   Severe             11    249
##
##                Accuracy : 0.94
##                  95% CI : (0.9212, 0.9554)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.8667
##
##  Mcnemar's Test P-Value : 0.000308
##
##             Sensitivity : 0.9786
##             Specificity : 0.8706
##          Pos Pred Value : 0.9315
##          Neg Pred Value : 0.9577
##              Prevalence : 0.6425
##          Detection Rate : 0.6288
##    Detection Prevalence : 0.6750
##       Balanced Accuracy : 0.9246
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = svml.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        416     44
##   Severe             98    242
##
```

```
##                Accuracy : 0.8225
##                  95% CI : (0.7942, 0.8484)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.6291
##
##  Mcnemar's Test P-Value : 8.681e-06
##
##             Sensitivity : 0.8093
##             Specificity : 0.8462
##          Pos Pred Value : 0.9043
##          Neg Pred Value : 0.7118
##              Prevalence : 0.6425
##          Detection Rate : 0.5200
##    Detection Prevalence : 0.5750
##       Balanced Accuracy : 0.8277
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = e1071.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        454     51
##   Severe             60    235
##
##                Accuracy : 0.8612
##                  95% CI : (0.8353, 0.8845)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.7001
##
##  Mcnemar's Test P-Value : 0.4477
##
##             Sensitivity : 0.8833
##             Specificity : 0.8217
##          Pos Pred Value : 0.8990
##          Neg Pred Value : 0.7966
##              Prevalence : 0.6425
##          Detection Rate : 0.5675
##    Detection Prevalence : 0.6312
##       Balanced Accuracy : 0.8525
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = svmr.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
```

```
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        464     54
##   Severe             50    232
##
##                Accuracy : 0.87
##                  95% CI : (0.8447, 0.8925)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.7161
##
##  Mcnemar's Test P-Value : 0.7686
##
##             Sensitivity : 0.9027
##             Specificity : 0.8112
##          Pos Pred Value : 0.8958
##          Neg Pred Value : 0.8227
##              Prevalence : 0.6425
##          Detection Rate : 0.5800
##    Detection Prevalence : 0.6475
##       Balanced Accuracy : 0.8570
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = svmr2.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        467     54
##   Severe             47    232
##
##                Accuracy : 0.8738
##                  95% CI : (0.8487, 0.896)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.7237
##
##  Mcnemar's Test P-Value : 0.5505
##
##             Sensitivity : 0.9086
##             Specificity : 0.8112
##          Pos Pred Value : 0.8964
##          Neg Pred Value : 0.8315
##              Prevalence : 0.6425
##          Detection Rate : 0.5837
##    Detection Prevalence : 0.6512
##       Balanced Accuracy : 0.8599
##
##        'Positive' Class : Not_severe
##
```

```r
confusionMatrix(data = gbmA.predict, reference = y.train)
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        488     63
##   Severe             26    223
##
##                Accuracy : 0.8888
##                  95% CI : (0.8649, 0.9097)
##     No Information Rate : 0.6425
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.7507
##
##  Mcnemar's Test P-Value : 0.0001356
##
##             Sensitivity : 0.9494
##             Specificity : 0.7797
##          Pos Pred Value : 0.8857
##          Neg Pred Value : 0.8956
##              Prevalence : 0.6425
##          Detection Rate : 0.6100
##    Detection Prevalence : 0.6887
##       Balanced Accuracy : 0.8646
##
##        'Positive' Class : Not_severe
##
```

```r
# 1 - accuracy
gbm_CV_error = 1 - 0.86
# glmnet_CV_error = 1 - 0.645
knn_CV_error = 1 - 0.7575
pls_CV_error = 1 - 0.8488
gam_CV_error = 1 - 0.8688
mars_CV_error = 1 - 0.8538
lda_CV_error = 1 - 0.845
qda_CV_error = 1 - 0.8662
nb_CV_error = 1 - 0.815
cart_CV_error = 1 - 0.895
cit_CV_error = 1 - 0.8688
rf_CV_error = 1 - 0.94
svml_CV_error = 1 - 0.8225
e1071_CV_error = 1 - 0.8612
svmr_CV_error = 1 - 0.87
svmr2_CV_error = 1 - 0.8712
gbMA_CV_error = 1 - 0.8888

# CV error
gbm_CV_error
```

```
## [1] 0.14
```

```r
# glmnet_CV_error
knn_CV_error
```

```
## [1] 0.2425
```

```r
pls_CV_error
```

```
## [1] 0.1512
```

```r
gam_CV_error
```

```
## [1] 0.1312
```

```r
mars_CV_error
```

```
## [1] 0.1462
```

```r
lda_CV_error
```

```
## [1] 0.155
```

```r
qda_CV_error
```

```
## [1] 0.1338
```

```r
nb_CV_error
```

```
## [1] 0.185
```

```r
cart_CV_error
```

```
## [1] 0.105
```

```r
cit_CV_error
```

```
## [1] 0.1312
```

```r
rf_CV_error
```

```
## [1] 0.06
```

```r
svml_CV_error
```

```
## [1] 0.1775
```

```r
e1071_CV_error
```

```
## [1] 0.1388
```

```r
svmr_CV_error
```

```
## [1] 0.13
```

```r
svmr2_CV_error
```

```
## [1] 0.1288
```

```r
gbMA_CV_error
```

```
## [1] 0.1112
```

The gbmA boosted model has the highest mean and median ROC value, based on the resampling summary. The random forest model, however, has the lowest cross-validation error, therefore is the model I choose.

Test Data Performance

```
# test error: gbmA
gbMA.test = predict(model.gbmA, newdata = test_data)

confusionMatrix(data = gbMA.test,
                reference = y.test,
                )
```

```
## Confusion Matrix and Statistics
##
##             Reference
## Prediction   Not_severe Severe
##   Not_severe        125     17
##   Severe             10     48
##
##                Accuracy : 0.865
##                  95% CI : (0.8097, 0.9091)
##     No Information Rate : 0.675
##     P-Value [Acc > NIR] : 5.597e-10
##
##                   Kappa : 0.6835
##
##  Mcnemar's Test P-Value : 0.2482
##
##             Sensitivity : 0.9259
##             Specificity : 0.7385
##          Pos Pred Value : 0.8803
##          Neg Pred Value : 0.8276
##              Prevalence : 0.6750
##          Detection Rate : 0.6250
##    Detection Prevalence : 0.7100
##       Balanced Accuracy : 0.8322
##
##        'Positive' Class : Not_severe
##
```

```
# 1 - accuracy
gbmA_test_error = 1 - 0.865
gbmA_test_error
```

```
## [1] 0.135
```

```
# test error: random forest
rf.test = predict(model.rf, newdata = test_data)

confusionMatrix(data = rf.test,
                reference = y.test,
                )
```

```
## Confusion Matrix and Statistics
##
##             Reference
```

```
## Prediction   Not_severe Severe
##   Not_severe        124     18
##   Severe             11     47
##
##                Accuracy : 0.855
##                  95% CI : (0.7984, 0.9007)
##     No Information Rate : 0.675
##     P-Value [Acc > NIR] : 4.95e-09
##
##                   Kappa : 0.66
##
##  Mcnemar's Test P-Value : 0.2652
##
##             Sensitivity : 0.9185
##             Specificity : 0.7231
##          Pos Pred Value : 0.8732
##          Neg Pred Value : 0.8103
##              Prevalence : 0.6750
##          Detection Rate : 0.6200
##    Detection Prevalence : 0.7100
##       Balanced Accuracy : 0.8208
##
##        'Positive' Class : Not_severe
##
```

```r
# 1 - accuracy
rf_test_error = 1 - 0.855
rf_test_error
```

```
## [1] 0.145
```