A statistical approach to colorectal cancer diagnosis based on protein signature

Group 5

Introduction

Colorectal cancer (CRC) is cancer of the last several inches of the colon, the lower part of the large intestine. Colorectal cancer often starts as clumps of cells called polyps. It is the third most common type of cancer in the United States [1]. Cancer cases have decreased with the use of Colonoscopies. The current procedure includes a fecal occult blood test (FOBT) for pre-selection of cases for further colonoscopy evaluation. However, its accuracy is quite low and does not adequately detect subjects with CRC. A non-invasive method for pre-selection of screening for CRC is in need. We have analyzed data collected by Surinova, S. et al. [2] which contains information about protein concentration in CRC and Healthy patients and built a statistical model to predict the possibility of presence of CRC in a subject. This is clearly a classification problem and using Logistic Regression, we were able to identify 6 proteins which correlate more with prevalence of CRC.

Definitions and Abbreviations

1. Training dataset - Dataset used to train the final selected model.
2. Testing dataset - Dataset used to test the final selected model.
3. Model-Fitting dataset - Dataset sampled from the Training dataset used to fit the candidate models.
4. Validation dataset - Dataset sampled from the Training dataset used to select a final model from the candidate models.
5. Explanatory Variables/Features - Normalized log2 values of Protein signatures
6. Class/Labels - Labels determining whether a subject has CRC or not.
7. CRC - Colorectal Cancer
8. VIF - Variance Influence Factors
9. AIC - Akaike Information Criterion
10. SBC/BIC - Schwarz Bayesian Criterion/Bayesian Information Criterion
11. ROC - Receiver Operating Characteristic
12. AUROC - Area under Receiver Operating Characteristic

Methods

*Datasets*

Two independent datasets were used in this study. The first dataset (henceforth referred as training dataset) was used for training and selection of models and the second(referred as testing dataset) was used for final calculation of model metrics. The training dataset comprised of protein concentration of subjects from a prospective screening study (BLiTz) (Hundt et al, 2009; Brenner et. al, 2010) and a case–control study examining the role of colonoscopy in CRC prevention (DACHS+) (Brenner et. al, 2006, 2007). The validation dataset included subjects selected at the University Hospital Olomouc [2]. The training dataset consisted of two groups (CRC and non-CRC) of 100 subjects each comprising of logarithmic values of protein signatures. The testing dataset consisted of 202 subjects with CRC and 67 subjects of non-CRC subjects. To make the intensities comparable for the purpose of predictive analysis, the median normalized log2-relative quantifications of the validation cohort were equalized with the median normalized log2-relative quantifications of the training cohort.

*Preprocessing*

Proteins with more than 25% missing values were removed from both datasets and rest were imputed with minimum value observed in the same dataset, representing the limit of detection of protein signatures [2]. The dataset consisted of large number of highly correlated proteins presenting the problem of multicollinearity among the predictors.

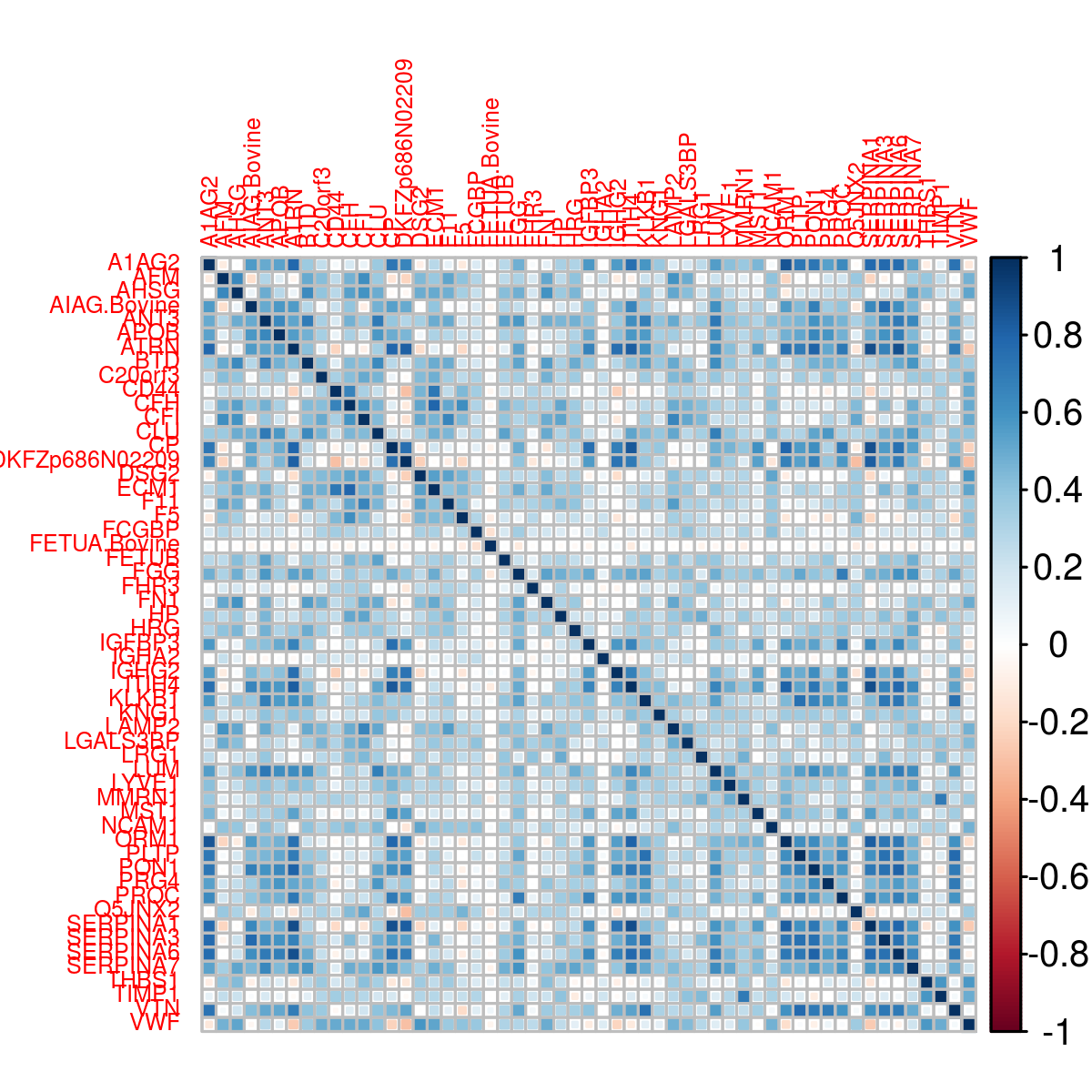


Figure 1 shows the correlation matrix for the training dataset.

Blue represents positive correlation and Red negative. The larger the squares, the larger the correlation. Stepwise Variance Inflation Factors(VIF) was used to eliminate the multicollinearity problem [3]. VIF for an explanatory variable is obtained using the pseudo r-squared value of regression of that variable against all other explanatory variables. A threshold of 5 was used to eliminate a variable.

The training dataset was randomly split in a 80:20 manner into model-fitting and validation datasets.

*Selection of Candidate Models*

For creation of candidate models, the following four methods were used on the model-fitting dataset: "Stepwise Backward using AIC", "Stepwise Forward using AIC", "Stepwise Both Forward and Backward using AIC" and "Stepwise Both Forward and Backward using SBC Criterion". 2 best models from each method were selected as the Candidate models.

*Evaluation of Candidate Models*

Homer-Lemeshow Goodness of Fit Test was applied to each model. We consider the model to be unfit if p-value < 0.05. However, none of the candidate models had p-value < 0.05 and hence, none were eliminated [Appendix].  
We next plot the deviance residuals of the models with predicted probabilities with Lowess Smooth.

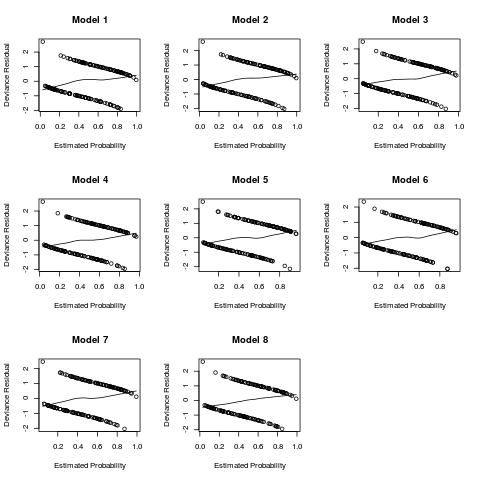
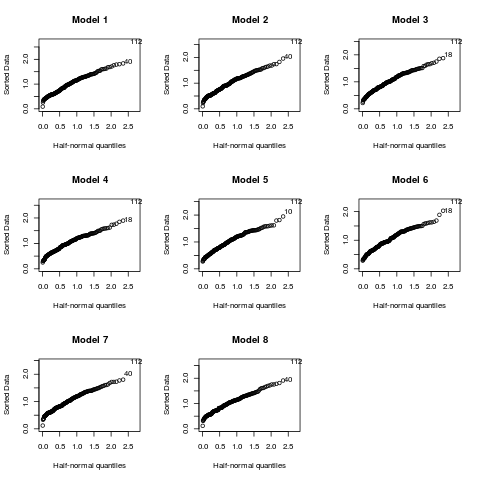


Figure 2 shows the plot of Deviance Residuals Vs Estimated Probability with Lowess Smooth.

If a model is correct, a lowess smooth of the plot of the residuals against the estimated probability should result approximately in a horizontal line with zero intercept. None of the plots depict any significant departure from this and hence, there is no evidence that any model is inadequate.

  
Figure 3 shows the half-normal probability plots for each candidate model.

A Half-normal probability plot helps to highlight outlying deviance residuals even though the residuals are not normally distributed. Outliers appear at the top right of a half-normal probability plot as points separated from the others. From the plots, we observe that observations 18, 40 and 112 might be an outlier. However, more detailed study of these observations is required before we exclude them as outliers. For the purpose of this study, we do not consider them as outliers.  
We next consider overdispersion. Sometimes we can get a deviance that is much larger than expected if the model was correct. It can be due to the presence of outliers, sparse data or clustering of data. The approach to deal with overdispersion is to add a dispersion parameter . It can be estimated with: (p = no. of parameters in model).

We consider overdispersion to exist if >> 1.  
The values of for the 8 candidate models were 1.17, 1.12, 1.07, 1.13, 1.08, 1.04, 1.06 and 1.14 suggesting dispersion not very different than 1 (no dispersion).

We next consider the predictive ability of the models. We observe how each of the model performs by predicting on the validation set. We generate the ROC plot and calculate the AUROC for each of the models. The Area under the ROC provides an unbiased, and non-parametric measure of the discrimination ability of the model. AOC = 0.5 means that predictions are no better than random guessing. An AUROC value >= 0.80 is considered ideal.

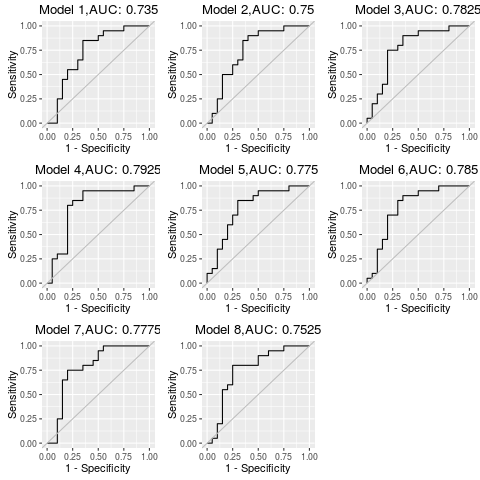


Figure 4 shows the ROC plots for each of the 8 models.

The AUROC is shown in the title of each of the plots. We observe that Model 4 has the maximum AUROC with value 0.7925. We'll consider this as our final model.  
Now that we have finalized our model, we still need to determine the best cut-off value for classification. For the purpose of this study, we would like to have a model with high sensitivity as we wish to minimize incorrect label of a CRC subject as non-CRC.

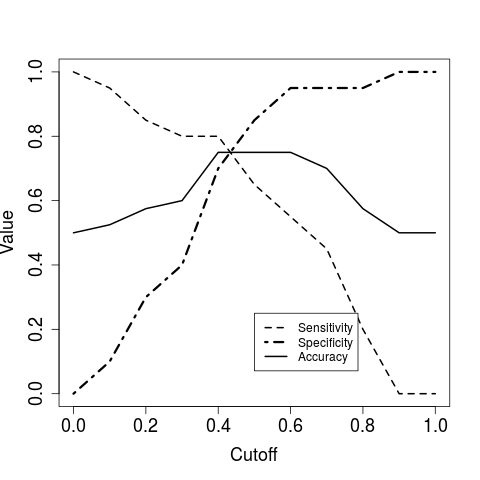


Figure 5 shows a Sensitivity Vs Specificity Vs Accuracy plot.

The sensitivity curve(light-dashed), the specificity curve(darker-dashed) and accuracy curve(solid) all merge at cut-off point 0.45. Since this point also results in a high sensitivity(0.8) for the validation dataset, we use this as our final cut-off point. We now have a final Model and a cut-off point decided. Since the model selection is complete, We merge both the model-fitting and the validation datasets and fit the model with it (while allowing for overdispersion).

Results

Our Final model consists of 6 proteins: TIMP1, LAMP2, HP, LRG1, SERPINA7 and LUM.

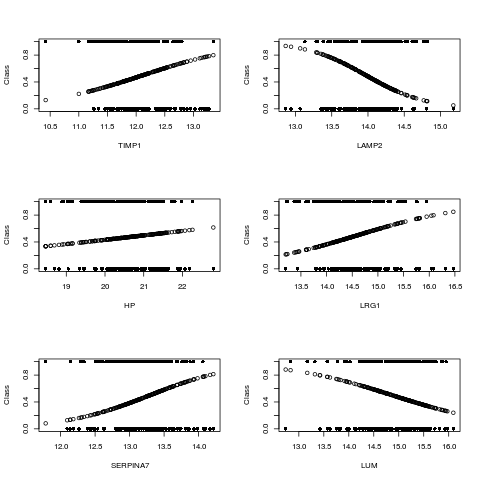


Figure 6 shows the predicted probability lines as function of one predictor, while fixing the remaining predictors at their median values.

Prediction of observations from the training dataset results in 70% balanced Accuracy and 0.74 Sensitivity and 0.66 Specificity. Prediction of new observations from the testing dataset for the selected model results in 65.4% balanced Accuracy with 0.995 Sensitivity and 0.31 Specificity.

Discussion

Since we modeled our experiment to have high Sensitivity values, the results are acceptable to us. Also, the balanced accuracy for both training and testing datasets are almost similar (70 and 65.4 respectively). However, we do realize that the specificity and hence, the balanced accuracy has suffered. There will always be a trade-off between Sensitivity and Specificity and due to the critical nature of incorrect labeling of a CRC subject as non-CRC, we have made the choice of choosing higher Sensitivity.  
The predictive ability might increase with more data in the training set. Also, usage of techniques like K-Nearest Neighbor for imputation of missing values in the training and testing dataset might yield better results. But since we were limiting our techniques to those learnt in class, we ignored this method. Finally, using an ensemble classification method like Random Forest or Gradient Boosted Trees or even regularization techniques might help.

References

[1] "Colorectal Cancer—Patient Version".Retrieved from <https://www.cancer.gov/types/colorectal>[2] "Prediction of colorectal cancer diagnosis based on circulating plasma proteins", Silvia Surinova , Meena Choi, Sha Tao, Peter J Schüffler, Ching-Yun Chang, Timothy Clough, Kamil Vyslouzil, Marta Khoylou, Josef Srovnal, Yansheng Liu, Mariette Matondo, Ruth Hüttenhain, Hendrik Weisser, Joachim M Buhmann, Marián Hajdúch, Hermann Brenner, Olga Vitek & Ruedi Aebersold.  
[3] Marcus."Collinearity and stepwise VIF selection".Retrieved from <https://beckmw.wordpress.com/2013/02/05/collinearity-and-stepwise-vif-selection/>[4] Applied Linear Statistical Methods, Michael Kutner, Christopher Nachtsheim, John Neter, William Li.

Appendix

# Pre-Processing: Cleaning and Formatting Data

## Input

load(file = "Surinova\_training\_abun.Rda")  
cols <- Surinova\_training\_abun[,1]  
input.train.raw <- t(Surinova\_training\_abun[,-1])  
input.train.raw <- data.frame(input.train.raw)  
colnames(input.train.raw) <- cols  
  
load(file = "Surinova\_testing\_abun.Rda")  
cols <- Surinova\_testing\_abun[,1]  
input.test.raw <- t(Surinova\_testing\_abun[,-1])  
input.test.raw <- data.frame(input.test.raw)  
colnames(input.test.raw) <- cols  
  
# check to see the column names match in both the input datasets.  
which(colnames(input.train.raw) != colnames(input.test.raw))

## integer(0)

# Sicne protein abundances are normalized within each dataset and not between training and validation set, we cannot merge these both datasets.  
  
# Formatting Column Names  
colnames(input.train.raw)[colnames(input.train.raw) == 'AIAG-Bovine'] <- 'AIAG.Bovine'  
colnames(input.train.raw)[colnames(input.train.raw) == 'FETUA-Bovine'] <- 'FETUA.Bovine'  
  
colnames(input.test.raw)[colnames(input.test.raw) == 'AIAG-Bovine'] <- 'AIAG.Bovine'  
colnames(input.test.raw)[colnames(input.test.raw) == 'FETUA-Bovine'] <- 'FETUA.Bovine'  
  
# Create Class label: CRC = 1, Healthy = 0  
input.train.raw$Class <- gsub("\_.\*", "\\1",rownames(input.train.raw))  
input.train.raw$Class <- as.factor(input.train.raw$Class)  
table(input.train.raw$Class)

##   
## CRC Healthy   
## 100 100

input.test.raw$Class <- gsub("\_.\*", "\\1",rownames(input.test.raw))  
input.test.raw$Class[input.test.raw$Class == 'Control'] <- 'Healthy'  
input.test.raw$Class <- as.factor(input.test.raw$Class)  
table(input.test.raw$Class)

##   
## CRC Healthy   
## 202 67

head(input.train.raw)

## A1AG2 AFM AHSG AIAG.Bovine ANT3 AOC3  
## CRC\_P1A10 14.23816 16.10302 19.95179 15.25354 17.20794 10.033227  
## CRC\_P1A2 15.02411 16.02071 19.71592 15.15455 17.29790 9.035202  
## CRC\_P1A4 15.63136 16.14380 19.71085 15.59163 17.59625 10.382938  
## CRC\_P1A6 15.40136 16.27642 19.70438 15.11819 17.42250 9.504018  
## CRC\_P1B12 16.00316 16.95821 20.42033 15.58249 17.98820 9.651676  
## CRC\_P1B2 13.93242 16.52772 19.88985 13.37131 16.32493 9.521379  
## APOB ATRN BTD C20orf3 CADM1 CD163  
## CRC\_P1A10 15.54477 14.38339 16.28307 10.660954 9.743511 10.94965  
## CRC\_P1A2 15.13188 13.98172 16.24919 10.702064 9.702175 10.83449  
## CRC\_P1A4 15.95530 14.63535 16.49916 11.188267 10.373824 11.22385  
## CRC\_P1A6 15.71493 14.06070 16.27773 9.966157 10.105507 11.17723  
## CRC\_P1B12 16.24733 14.20360 16.54142 12.574731 9.690320 12.23111  
## CRC\_P1B2 14.51862 13.70165 15.79196 10.578714 9.190440 12.21289  
## CD44 CDH5 CFH CFI CLU CP CTSD  
## CRC\_P1A10 9.943858 8.749720 17.26186 16.52607 19.32642 16.99737 9.275675  
## CRC\_P1A2 10.425750 9.056710 17.26762 16.86256 19.40444 16.22411 10.865768  
## CRC\_P1A4 11.026696 9.477187 17.98868 17.20551 19.53746 17.75640 10.029862  
## CRC\_P1A6 11.103752 9.866905 18.17423 17.52567 19.38313 18.05366 10.203826  
## CRC\_P1B12 11.166600 8.522353 18.82219 18.47344 20.19405 16.23669 10.941220  
## CRC\_P1B2 8.038643 9.225166 16.13991 16.94726 18.90905 16.34736 11.858181  
## DKFZp686N02209 DSG2 ECM1 F11 F5 FCGBP  
## CRC\_P1A10 20.70295 10.22517 13.113391 14.81510 12.23214 12.38189  
## CRC\_P1A2 21.86027 10.04610 12.569733 14.71162 12.14809 11.68763  
## CRC\_P1A4 21.84249 11.11479 13.661017 15.56122 12.80789 12.40291  
## CRC\_P1A6 20.70488 10.95813 13.545199 15.95390 13.18926 13.03992  
## CRC\_P1B12 21.18504 10.87991 13.371014 15.98843 12.54162 13.23842  
## CRC\_P1B2 21.77231 10.23335 9.915183 14.69724 11.62907 12.69986  
## FETUA.Bovine FETUB FGA FGG FHR3 FN1  
## CRC\_P1A10 17.04864 13.29704 8.144845 11.34954 11.52154 12.55169  
## CRC\_P1A2 17.07832 13.50235 9.305395 12.19192 10.73714 13.47176  
## CRC\_P1A4 17.12503 13.55688 9.432872 11.49952 11.56901 12.36536  
## CRC\_P1A6 17.06354 13.12742 9.746036 11.87189 13.40319 12.17770  
## CRC\_P1B12 17.02016 14.95305 10.066428 11.59058 12.56019 14.10296  
## CRC\_P1B2 17.08612 13.19051 NA 10.68147 10.05570 11.81432  
## GOLM1 HP HRG HYOU1 ICAM1 IGFBP3 IGHA2  
## CRC\_P1A10 8.529159 19.74767 17.47524 7.504040 9.090639 10.918418 18.90573  
## CRC\_P1A2 NA 20.12543 17.95990 9.764873 9.253566 10.357056 21.04688  
## CRC\_P1A4 NA 20.78502 17.57534 8.646144 9.369628 11.619532 18.87876  
## CRC\_P1A6 NA 21.87358 17.38916 8.868061 9.760900 11.425023 20.89932  
## CRC\_P1B12 9.749398 22.79789 17.95183 8.115907 9.887392 10.175458 21.26316  
## CRC\_P1B2 9.913008 20.71284 16.76395 8.842497 9.027833 9.527139 21.92661  
## IGHG2 ITIH4 KLKB1 KNG1 LAMP2 LCN2 LGALS3BP  
## CRC\_P1A10 22.10597 15.64604 14.12489 17.65508 13.68160 9.446541 14.82148  
## CRC\_P1A2 22.44804 15.36709 14.19172 16.98601 13.48692 10.623488 15.12812  
## CRC\_P1A4 22.95173 16.40141 14.09215 17.39206 14.12212 10.024225 14.20939  
## CRC\_P1A6 22.93422 16.18817 13.48183 17.82389 14.41111 10.109405 14.87094  
## CRC\_P1B12 21.26145 15.87709 15.19997 17.95218 15.17730 11.052435 16.55743  
## CRC\_P1B2 21.00712 14.94386 13.20866 17.39358 13.94826 9.355121 16.28340  
## LRG1 LUM LYVE1 MMRN1 MPO MRC2 MST1  
## CRC\_P1A10 13.96127 14.99193 11.86759 11.39385 9.729238 10.86842 12.96116  
## CRC\_P1A2 14.08645 15.41582 11.71390 11.15791 10.202602 10.01434 13.09922  
## CRC\_P1A4 15.05310 15.06369 12.19818 11.73116 9.782391 10.56038 14.11266  
## CRC\_P1A6 14.92352 14.60999 11.77828 11.95025 10.761889 10.02103 13.92377  
## CRC\_P1B12 16.46953 15.93393 12.92101 12.33475 11.727629 11.41932 13.10718  
## CRC\_P1B2 14.49637 14.47633 12.45132 11.68845 9.834259 10.91711 13.37761  
## NCAM1 ORM1 PGCP PIGR PLTP PLXDC2  
## CRC\_P1A10 9.905815 16.74179 8.379739 9.744116 11.85560 10.050261  
## CRC\_P1A2 10.496499 17.24994 8.406487 9.422932 11.54273 9.974399  
## CRC\_P1A4 10.521723 18.41524 8.243928 9.306936 12.15338 9.812975  
## CRC\_P1A6 10.385096 18.09024 9.114961 9.417459 11.19101 9.847176  
## CRC\_P1B12 10.517894 18.28100 8.778907 11.389195 12.12600 10.414638  
## CRC\_P1B2 9.854809 17.02723 8.368942 9.466000 11.35824 8.387396  
## PON1 PRG4 PROC PTPRJ Q5JNX2 SERPINA1 SERPINA3  
## CRC\_P1A10 16.87047 11.84463 11.109446 9.758946 19.02813 18.06109 14.21804  
## CRC\_P1A2 16.55428 12.49583 11.111383 9.934520 19.86254 17.61019 14.83233  
## CRC\_P1A4 16.34508 11.70096 11.533164 10.328319 19.50177 18.53997 15.30873  
## CRC\_P1A6 15.46083 11.09706 11.693945 9.741059 19.98466 17.40141 14.25424  
## CRC\_P1B12 16.46015 14.46691 10.699745 10.568064 20.46745 17.44801 16.23191  
## CRC\_P1B2 14.47485 11.85023 9.470798 9.922271 18.14204 17.95217 12.60729  
## SERPINA6 SERPINA7 THBS1 TIMP1 TNC VTN VWF  
## CRC\_P1A10 15.79685 13.58185 13.99569 11.57875 10.275261 12.06684 10.66103  
## CRC\_P1A2 15.81540 13.13844 13.70771 11.96097 10.234434 12.83689 10.77843  
## CRC\_P1A4 16.40177 13.74233 15.63696 12.15584 10.241626 12.31163 11.18527  
## CRC\_P1A6 16.31049 13.93689 15.51727 12.37927 9.269195 10.67764 10.88786  
## CRC\_P1B12 16.48583 14.16713 15.12911 12.16912 10.476927 14.50458 11.25418  
## CRC\_P1B2 15.29659 13.23403 15.39790 12.52729 10.026299 11.52916 11.03501  
## Class  
## CRC\_P1A10 CRC  
## CRC\_P1A2 CRC  
## CRC\_P1A4 CRC  
## CRC\_P1A6 CRC  
## CRC\_P1B12 CRC  
## CRC\_P1B2 CRC

str(input.train.raw)

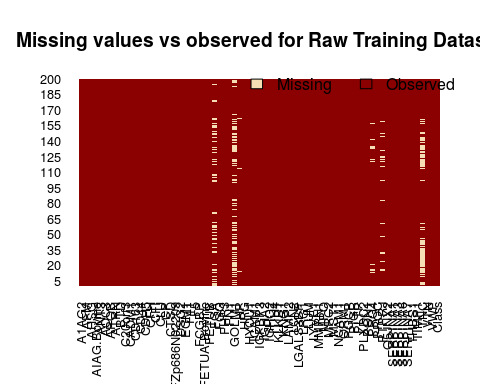
## 'data.frame': 200 obs. of 73 variables:  
## $ A1AG2 : num 14.2 15 15.6 15.4 16 ...  
## $ AFM : num 16.1 16 16.1 16.3 17 ...  
## $ AHSG : num 20 19.7 19.7 19.7 20.4 ...  
## $ AIAG.Bovine : num 15.3 15.2 15.6 15.1 15.6 ...  
## $ ANT3 : num 17.2 17.3 17.6 17.4 18 ...  
## $ AOC3 : num 10.03 9.04 10.38 9.5 9.65 ...  
## $ APOB : num 15.5 15.1 16 15.7 16.2 ...  
## $ ATRN : num 14.4 14 14.6 14.1 14.2 ...  
## $ BTD : num 16.3 16.2 16.5 16.3 16.5 ...  
## $ C20orf3 : num 10.66 10.7 11.19 9.97 12.57 ...  
## $ CADM1 : num 9.74 9.7 10.37 10.11 9.69 ...  
## $ CD163 : num 10.9 10.8 11.2 11.2 12.2 ...  
## $ CD44 : num 9.94 10.43 11.03 11.1 11.17 ...  
## $ CDH5 : num 8.75 9.06 9.48 9.87 8.52 ...  
## $ CFH : num 17.3 17.3 18 18.2 18.8 ...  
## $ CFI : num 16.5 16.9 17.2 17.5 18.5 ...  
## $ CLU : num 19.3 19.4 19.5 19.4 20.2 ...  
## $ CP : num 17 16.2 17.8 18.1 16.2 ...  
## $ CTSD : num 9.28 10.87 10.03 10.2 10.94 ...  
## $ DKFZp686N02209: num 20.7 21.9 21.8 20.7 21.2 ...  
## $ DSG2 : num 10.2 10 11.1 11 10.9 ...  
## $ ECM1 : num 13.1 12.6 13.7 13.5 13.4 ...  
## $ F11 : num 14.8 14.7 15.6 16 16 ...  
## $ F5 : num 12.2 12.1 12.8 13.2 12.5 ...  
## $ FCGBP : num 12.4 11.7 12.4 13 13.2 ...  
## $ FETUA.Bovine : num 17 17.1 17.1 17.1 17 ...  
## $ FETUB : num 13.3 13.5 13.6 13.1 15 ...  
## $ FGA : num 8.14 9.31 9.43 9.75 10.07 ...  
## $ FGG : num 11.3 12.2 11.5 11.9 11.6 ...  
## $ FHR3 : num 11.5 10.7 11.6 13.4 12.6 ...  
## $ FN1 : num 12.6 13.5 12.4 12.2 14.1 ...  
## $ GOLM1 : num 8.53 NA NA NA 9.75 ...  
## $ HP : num 19.7 20.1 20.8 21.9 22.8 ...  
## $ HRG : num 17.5 18 17.6 17.4 18 ...  
## $ HYOU1 : num 7.5 9.76 8.65 8.87 8.12 ...  
## $ ICAM1 : num 9.09 9.25 9.37 9.76 9.89 ...  
## $ IGFBP3 : num 10.9 10.4 11.6 11.4 10.2 ...  
## $ IGHA2 : num 18.9 21 18.9 20.9 21.3 ...  
## $ IGHG2 : num 22.1 22.4 23 22.9 21.3 ...  
## $ ITIH4 : num 15.6 15.4 16.4 16.2 15.9 ...  
## $ KLKB1 : num 14.1 14.2 14.1 13.5 15.2 ...  
## $ KNG1 : num 17.7 17 17.4 17.8 18 ...  
## $ LAMP2 : num 13.7 13.5 14.1 14.4 15.2 ...  
## $ LCN2 : num 9.45 10.62 10.02 10.11 11.05 ...  
## $ LGALS3BP : num 14.8 15.1 14.2 14.9 16.6 ...  
## $ LRG1 : num 14 14.1 15.1 14.9 16.5 ...  
## $ LUM : num 15 15.4 15.1 14.6 15.9 ...  
## $ LYVE1 : num 11.9 11.7 12.2 11.8 12.9 ...  
## $ MMRN1 : num 11.4 11.2 11.7 12 12.3 ...  
## $ MPO : num 9.73 10.2 9.78 10.76 11.73 ...  
## $ MRC2 : num 10.9 10 10.6 10 11.4 ...  
## $ MST1 : num 13 13.1 14.1 13.9 13.1 ...  
## $ NCAM1 : num 9.91 10.5 10.52 10.39 10.52 ...  
## $ ORM1 : num 16.7 17.2 18.4 18.1 18.3 ...  
## $ PGCP : num 8.38 8.41 8.24 9.11 8.78 ...  
## $ PIGR : num 9.74 9.42 9.31 9.42 11.39 ...  
## $ PLTP : num 11.9 11.5 12.2 11.2 12.1 ...  
## $ PLXDC2 : num 10.05 9.97 9.81 9.85 10.41 ...  
## $ PON1 : num 16.9 16.6 16.3 15.5 16.5 ...  
## $ PRG4 : num 11.8 12.5 11.7 11.1 14.5 ...  
## $ PROC : num 11.1 11.1 11.5 11.7 10.7 ...  
## $ PTPRJ : num 9.76 9.93 10.33 9.74 10.57 ...  
## $ Q5JNX2 : num 19 19.9 19.5 20 20.5 ...  
## $ SERPINA1 : num 18.1 17.6 18.5 17.4 17.4 ...  
## $ SERPINA3 : num 14.2 14.8 15.3 14.3 16.2 ...  
## $ SERPINA6 : num 15.8 15.8 16.4 16.3 16.5 ...  
## $ SERPINA7 : num 13.6 13.1 13.7 13.9 14.2 ...  
## $ THBS1 : num 14 13.7 15.6 15.5 15.1 ...  
## $ TIMP1 : num 11.6 12 12.2 12.4 12.2 ...  
## $ TNC : num 10.28 10.23 10.24 9.27 10.48 ...  
## $ VTN : num 12.1 12.8 12.3 10.7 14.5 ...  
## $ VWF : num 10.7 10.8 11.2 10.9 11.3 ...  
## $ Class : Factor w/ 2 levels "CRC","Healthy": 1 1 1 1 1 1 1 1 1 1 ...

There are 200 subjects and 72 proteins in the training dataset out of which 100 subjects are diagnosed with CRC and 100 are healthy.  
There are 269 subjects and 72 proteins in the testing dataset out of which 202 subjects are diagnosed with CRC and 67 are healthy.

# Pre-Processing: Missing Values

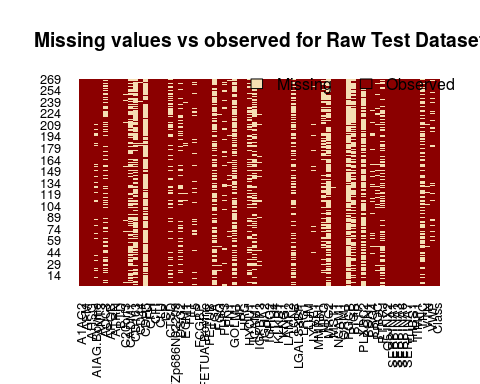
## Visualizing Missing Values in Training dataset

par(mfrow=c(1,1))  
missmap(input.train.raw, main = "Missing values vs observed for Raw Training Dataset", rank.order=FALSE)



## Visualizing Missing Values in Testing dataset

missmap(input.test.raw, main = "Missing values vs observed for Raw Test Dataset", rank.order=FALSE)

 Most of the missing values are related to the second dataset("Surinova\_testing\_abun.Rda")

## Dealing with Missing Values Pt. 1: Drop > 25% Missing

### Training Dataset

# Remove Columns with Missing Values.  
missing.percent.train <- sapply(input.train.raw,function(x) sum(is.na(x)) \* 100/length(x))  
missing.columns.train <- sort(missing.percent.train[missing.percent.train != 0])  
missing.columns.train

## HP PRG4 PTPRJ FGA TNC GOLM1   
## 1.5 5.0 8.0 23.5 33.5 36.0

length(missing.columns.train)

## [1] 6

There are 6 columns with Missing Values in the Training Dataset.

### Testing Dataset

# Remove Columns with Missing Values.  
missing.percent.test <- sapply(input.test.raw, function(x) sum(is.na(x)) \* 100/length(x))  
missing.columns.test <- sort(missing.percent.test[missing.percent.test != 0])  
missing.columns.test

## ATRN MST1 CD44 ECM1 VTN FGG   
## 0.3717472 0.7434944 1.8587361 2.2304833 2.6022305 2.9739777   
## C20orf3 FN1 LYVE1 IGFBP3 PROC PRG4   
## 3.7174721 4.4609665 5.5762082 7.0631970 8.5501859 9.2936803   
## VWF FHR3 F5 AIAG.Bovine DSG2 CTSD   
## 11.8959108 12.6394052 13.0111524 13.3828996 23.4200743 28.2527881   
## HYOU1 AOC3 MPO PTPRJ ICAM1 LCN2   
## 30.4832714 31.5985130 33.8289963 40.5204461 43.8661710 43.8661710   
## CADM1 TNC FGA PIGR CD163 GOLM1   
## 44.6096654 46.4684015 55.0185874 56.5055762 59.8513011 61.3382900   
## PLXDC2 MRC2 PGCP CDH5   
## 70.2602230 72.1189591 83.6431227 84.3866171

length(missing.columns.test)

## [1] 34

There are 34 columns with Missing Values in the Testing Dataset.

As we observe from the above tables, there are large number of columns with more than 25 % missing data.We'll drop these columns from both the datasets.

# we'll combine the dropped column list from both training and testing datasets to keep the remaining columns consistent.  
dropped.columns.train <- names(missing.columns.train[missing.columns.train > 25])  
dropped.columns.test <- names(missing.columns.test[missing.columns.test > 25])  
dropped.columns.final <- union(dropped.columns.train, dropped.columns.test)  
dropped.columns.final

## [1] "TNC" "GOLM1" "CTSD" "HYOU1" "AOC3" "MPO" "PTPRJ"   
## [8] "ICAM1" "LCN2" "CADM1" "FGA" "PIGR" "CD163" "PLXDC2"  
## [15] "MRC2" "PGCP" "CDH5"

input.train.df <- input.train.raw  
input.test.df <- input.test.raw  
input.train.df[, dropped.columns.final] <- NULL  
input.test.df[, dropped.columns.final] <- NULL  
dim(input.train.df)

## [1] 200 56

dim(input.test.df)

## [1] 269 56

In total, We dropped 17 columns.

## Dealing with Missing Values Pt. 2: Replace with Min

For the rest of the columns with missing values, we'll replace the missing values with the mean.

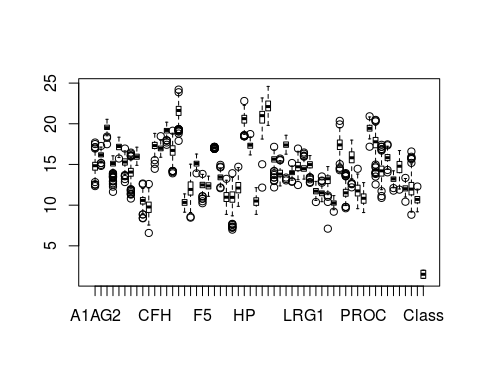
# Replace Missing Values with Min  
replace.min <- function(x) replace(x, is.na(x), min(x, na.rm=TRUE))  
cols <- colnames(subset(input.train.df, select = -Class))  
input.train.df[, cols] <- sapply(input.train.df[, cols], replace.min)  
input.test.df[, cols] <- sapply(input.test.df[, cols], replace.min)

Now, we do not have any missing values in our data.

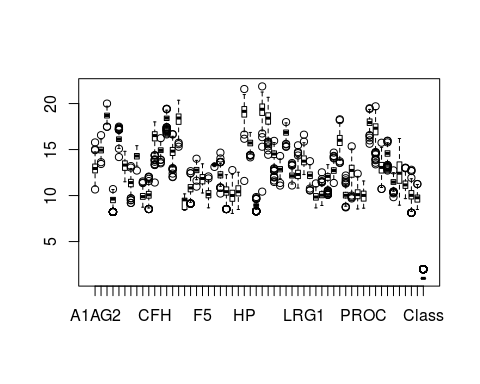
# Data Exploration

## Boxplot

par(mfrow = c(1,1))  
boxplot(input.train.df)



boxplot(input.test.df)

 The boxplots does show some points as outliers but since they are all logarithmic values, scale is small. Also, we confirm that the data has indeed been normalized separately for each dataset.

## Correlation amongst Predictors.

# Correlation between Predictors  
correlations <- cor(subset(input.train.df, select=-Class))  
png('correlations.png', width=4, height=4, units="in", res=300)  
corrplot(correlations, method="square", tl.cex = 0.5)  
#dev.off()  
#dev.off()  
  
cols <- colnames(subset(input.train.df, select = -Class))  
keep.cols <- vif\_func(in\_frame=input.train.df[, cols],thresh=5,trace=F)

## Loading required package: fmsb

keep.cols

## [1] "AFM" "AHSG" "AIAG.Bovine" "APOB"   
## [5] "BTD" "C20orf3" "CD44" "CFI"   
## [9] "CLU" "DKFZp686N02209" "DSG2" "F11"   
## [13] "F5" "FCGBP" "FETUA.Bovine" "FETUB"   
## [17] "FHR3" "FN1" "HP" "HRG"   
## [21] "IGFBP3" "IGHA2" "IGHG2" "KNG1"   
## [25] "LAMP2" "LGALS3BP" "LRG1" "LUM"   
## [29] "LYVE1" "MMRN1" "MST1" "NCAM1"   
## [33] "PLTP" "PRG4" "PROC" "Q5JNX2"   
## [37] "SERPINA7" "THBS1" "TIMP1" "VWF"

input.train.df <- input.train.df[, c(keep.cols, "Class")]  
input.test.df <- input.test.df[, c(keep.cols, "Class")]  
dim(input.train.df)

## [1] 200 41

dim(input.test.df)

## [1] 269 41

Blue represents positive correlation and Red negative. The larger the squares, the larger the correlation.  
We observe that some of the predictors are highly correlated with each other.

# Preprocessing: Shuffling and Splitting the Datasets

The input datasets consisted of all CRC subject data in the to half and Healthy subject data in the bottom half. The datasets are therefore shuffled to prevent bias in the training and testing cohorts. We'll split the training dataset into 2 subsets: training(80%) and validation sets(20%). We'll not split the testing dataset.

set.seed(seed.id)  
training <- input.train.df  
inTrain <- createDataPartition(training$Class, p = 0.8, list=FALSE)  
train <- training[inTrain, ]  
validation <- training[-inTrain, ]  
   
set.seed(seed.id)  
testing <- input.test.df[sample(nrow(input.test.df)), ]

# Model Selection

glm.full <- glm(Class ~ ., data = train, family = binomial)  
glm.null <- glm(Class ~ 1, data = train, family = binomial)

## AIC-based backward selection

model.aic.backward <- step(glm.full, direction = "backward", trace = 1)

## Start: AIC=244.75  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + C20orf3 + CD44 +   
## CFI + CLU + DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + LYVE1 + MMRN1 + MST1 +   
## NCAM1 + PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - C20orf3 1 162.75 242.75  
## - LYVE1 1 162.75 242.75  
## - CFI 1 162.76 242.76  
## - PLTP 1 162.76 242.76  
## - FN1 1 162.76 242.76  
## - Q5JNX2 1 162.77 242.77  
## - AFM 1 162.79 242.79  
## - CD44 1 162.80 242.80  
## - PROC 1 162.80 242.80  
## - DSG2 1 162.85 242.85  
## - BTD 1 162.86 242.86  
## - MST1 1 162.90 242.90  
## - AHSG 1 162.95 242.95  
## - LRG1 1 162.98 242.98  
## - APOB 1 162.98 242.98  
## - F11 1 162.99 242.99  
## - FETUB 1 163.02 243.02  
## - PRG4 1 163.06 243.06  
## - HRG 1 163.08 243.08  
## - AIAG.Bovine 1 163.12 243.12  
## - TIMP1 1 163.16 243.16  
## - IGFBP3 1 163.20 243.20  
## - F5 1 163.23 243.23  
## - THBS1 1 163.44 243.44  
## - VWF 1 163.46 243.46  
## - CLU 1 163.48 243.48  
## - FCGBP 1 163.65 243.65  
## - LGALS3BP 1 163.85 243.85  
## - FHR3 1 163.89 243.89  
## - IGHG2 1 163.94 243.94  
## - KNG1 1 164.13 244.13  
## - IGHA2 1 164.42 244.42  
## - DKFZp686N02209 1 164.43 244.43  
## <none> 162.75 244.75  
## - HP 1 164.85 244.85  
## - NCAM1 1 164.96 244.96  
## - MMRN1 1 164.97 244.97  
## - FETUA.Bovine 1 165.47 245.47  
## - LUM 1 166.60 246.60  
## - SERPINA7 1 171.36 251.36  
## - LAMP2 1 174.73 254.73  
##   
## Step: AIC=242.75  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CFI +   
## CLU + DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + LYVE1 + MMRN1 + MST1 +   
## NCAM1 + PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - LYVE1 1 162.75 240.75  
## - CFI 1 162.76 240.76  
## - PLTP 1 162.76 240.76  
## - FN1 1 162.76 240.76  
## - Q5JNX2 1 162.77 240.77  
## - AFM 1 162.79 240.79  
## - CD44 1 162.80 240.80  
## - PROC 1 162.80 240.80  
## - DSG2 1 162.85 240.85  
## - BTD 1 162.86 240.86  
## - MST1 1 162.90 240.90  
## - AHSG 1 162.95 240.95  
## - LRG1 1 162.98 240.98  
## - APOB 1 162.99 240.99  
## - F11 1 162.99 240.99  
## - FETUB 1 163.02 241.02  
## - PRG4 1 163.07 241.07  
## - HRG 1 163.08 241.08  
## - AIAG.Bovine 1 163.15 241.15  
## - TIMP1 1 163.16 241.16  
## - IGFBP3 1 163.22 241.22  
## - F5 1 163.23 241.23  
## - THBS1 1 163.44 241.44  
## - VWF 1 163.46 241.46  
## - CLU 1 163.49 241.49  
## - FCGBP 1 163.65 241.65  
## - LGALS3BP 1 163.88 241.88  
## - FHR3 1 163.90 241.90  
## - IGHG2 1 163.94 241.94  
## - KNG1 1 164.13 242.13  
## - DKFZp686N02209 1 164.43 242.43  
## - IGHA2 1 164.46 242.46  
## <none> 162.75 242.75  
## - HP 1 164.87 242.87  
## - MMRN1 1 165.00 243.00  
## - NCAM1 1 165.00 243.00  
## - FETUA.Bovine 1 165.51 243.51  
## - LUM 1 166.62 244.62  
## - SERPINA7 1 171.45 249.45  
## - LAMP2 1 174.73 252.73  
##   
## Step: AIC=240.75  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CFI +   
## CLU + DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 +   
## PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 +   
## VWF  
##   
## Df Deviance AIC  
## - CFI 1 162.76 238.76  
## - PLTP 1 162.76 238.76  
## - FN1 1 162.76 238.76  
## - Q5JNX2 1 162.78 238.78  
## - AFM 1 162.79 238.79  
## - CD44 1 162.80 238.80  
## - PROC 1 162.80 238.80  
## - DSG2 1 162.85 238.85  
## - BTD 1 162.86 238.86  
## - MST1 1 162.90 238.90  
## - AHSG 1 162.95 238.95  
## - LRG1 1 162.99 238.99  
## - APOB 1 163.00 239.00  
## - F11 1 163.00 239.00  
## - FETUB 1 163.03 239.03  
## - PRG4 1 163.08 239.08  
## - HRG 1 163.08 239.08  
## - AIAG.Bovine 1 163.15 239.15  
## - TIMP1 1 163.16 239.16  
## - IGFBP3 1 163.23 239.23  
## - F5 1 163.24 239.24  
## - THBS1 1 163.45 239.45  
## - VWF 1 163.46 239.46  
## - CLU 1 163.49 239.49  
## - FCGBP 1 163.65 239.65  
## - FHR3 1 163.90 239.90  
## - LGALS3BP 1 163.90 239.90  
## - IGHG2 1 163.95 239.95  
## - KNG1 1 164.13 240.13  
## - DKFZp686N02209 1 164.43 240.43  
## - IGHA2 1 164.47 240.47  
## <none> 162.75 240.75  
## - HP 1 164.94 240.94  
## - NCAM1 1 165.01 241.01  
## - MMRN1 1 165.08 241.08  
## - FETUA.Bovine 1 165.51 241.51  
## - LUM 1 167.15 243.15  
## - SERPINA7 1 172.02 248.02  
## - LAMP2 1 174.74 250.74  
##   
## Step: AIC=238.76  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU +   
## DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 +   
## PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 +   
## VWF  
##   
## Df Deviance AIC  
## - PLTP 1 162.76 236.76  
## - FN1 1 162.77 236.77  
## - Q5JNX2 1 162.78 236.78  
## - AFM 1 162.79 236.79  
## - PROC 1 162.81 236.81  
## - CD44 1 162.81 236.81  
## - DSG2 1 162.86 236.86  
## - BTD 1 162.86 236.86  
## - MST1 1 162.91 236.91  
## - AHSG 1 162.95 236.95  
## - APOB 1 163.01 237.01  
## - LRG1 1 163.01 237.01  
## - FETUB 1 163.04 237.04  
## - F11 1 163.05 237.05  
## - PRG4 1 163.08 237.08  
## - HRG 1 163.09 237.09  
## - TIMP1 1 163.16 237.16  
## - AIAG.Bovine 1 163.24 237.24  
## - IGFBP3 1 163.27 237.27  
## - F5 1 163.28 237.28  
## - THBS1 1 163.45 237.45  
## - VWF 1 163.46 237.46  
## - CLU 1 163.53 237.53  
## - FCGBP 1 163.65 237.65  
## - FHR3 1 163.90 237.90  
## - IGHG2 1 163.95 237.95  
## - LGALS3BP 1 163.97 237.97  
## - KNG1 1 164.19 238.19  
## - DKFZp686N02209 1 164.47 238.47  
## - IGHA2 1 164.47 238.47  
## <none> 162.76 238.76  
## - NCAM1 1 165.01 239.01  
## - HP 1 165.07 239.07  
## - MMRN1 1 165.08 239.08  
## - FETUA.Bovine 1 165.72 239.72  
## - LUM 1 167.18 241.18  
## - SERPINA7 1 173.05 247.05  
## - LAMP2 1 174.95 248.95  
##   
## Step: AIC=236.76  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU +   
## DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 +   
## PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - FN1 1 162.78 234.78  
## - Q5JNX2 1 162.79 234.79  
## - AFM 1 162.80 234.80  
## - PROC 1 162.81 234.81  
## - CD44 1 162.81 234.81  
## - BTD 1 162.87 234.87  
## - DSG2 1 162.87 234.87  
## - MST1 1 162.92 234.92  
## - AHSG 1 162.96 234.96  
## - LRG1 1 163.01 235.01  
## - APOB 1 163.02 235.02  
## - FETUB 1 163.05 235.05  
## - F11 1 163.06 235.06  
## - PRG4 1 163.09 235.09  
## - HRG 1 163.10 235.10  
## - TIMP1 1 163.17 235.17  
## - AIAG.Bovine 1 163.25 235.25  
## - IGFBP3 1 163.28 235.28  
## - F5 1 163.29 235.29  
## - THBS1 1 163.45 235.45  
## - VWF 1 163.47 235.47  
## - CLU 1 163.60 235.60  
## - FCGBP 1 163.66 235.66  
## - FHR3 1 163.90 235.90  
## - IGHG2 1 163.95 235.95  
## - LGALS3BP 1 163.97 235.97  
## - KNG1 1 164.23 236.23  
## - IGHA2 1 164.47 236.47  
## - DKFZp686N02209 1 164.47 236.47  
## <none> 162.76 236.76  
## - NCAM1 1 165.04 237.04  
## - MMRN1 1 165.08 237.08  
## - HP 1 165.09 237.09  
## - FETUA.Bovine 1 165.74 237.74  
## - LUM 1 167.36 239.36  
## - SERPINA7 1 173.16 245.16  
## - LAMP2 1 175.10 247.10  
##   
## Step: AIC=234.78  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU +   
## DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 +   
## LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 +   
## PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - AFM 1 162.81 232.81  
## - Q5JNX2 1 162.81 232.81  
## - CD44 1 162.81 232.81  
## - PROC 1 162.82 232.82  
## - BTD 1 162.87 232.87  
## - DSG2 1 162.90 232.90  
## - MST1 1 162.93 232.93  
## - AHSG 1 163.00 233.00  
## - APOB 1 163.04 233.04  
## - LRG1 1 163.06 233.06  
## - FETUB 1 163.06 233.06  
## - F11 1 163.10 233.10  
## - HRG 1 163.11 233.11  
## - PRG4 1 163.14 233.14  
## - TIMP1 1 163.17 233.17  
## - AIAG.Bovine 1 163.25 233.25  
## - IGFBP3 1 163.28 233.28  
## - F5 1 163.38 233.38  
## - THBS1 1 163.47 233.47  
## - VWF 1 163.48 233.48  
## - CLU 1 163.60 233.60  
## - FCGBP 1 163.67 233.67  
## - FHR3 1 163.95 233.95  
## - LGALS3BP 1 163.97 233.97  
## - IGHG2 1 164.03 234.03  
## - KNG1 1 164.23 234.23  
## - DKFZp686N02209 1 164.47 234.47  
## - IGHA2 1 164.48 234.48  
## <none> 162.78 234.78  
## - HP 1 165.09 235.09  
## - NCAM1 1 165.10 235.10  
## - MMRN1 1 165.11 235.11  
## - FETUA.Bovine 1 165.74 235.74  
## - LUM 1 167.38 237.38  
## - SERPINA7 1 173.17 243.17  
## - LAMP2 1 175.39 245.39  
##   
## Step: AIC=232.81  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + PROC + Q5JNX2 +   
## SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - Q5JNX2 1 162.83 230.83  
## - PROC 1 162.84 230.84  
## - CD44 1 162.84 230.84  
## - BTD 1 162.89 230.89  
## - DSG2 1 162.93 230.93  
## - MST1 1 162.96 230.96  
## - APOB 1 163.05 231.05  
## - FETUB 1 163.08 231.08  
## - AHSG 1 163.09 231.09  
## - F11 1 163.12 231.12  
## - LRG1 1 163.12 231.12  
## - HRG 1 163.14 231.14  
## - PRG4 1 163.18 231.18  
## - TIMP1 1 163.18 231.18  
## - AIAG.Bovine 1 163.25 231.25  
## - IGFBP3 1 163.34 231.34  
## - F5 1 163.38 231.38  
## - VWF 1 163.49 231.49  
## - THBS1 1 163.51 231.51  
## - CLU 1 163.61 231.61  
## - FCGBP 1 163.68 231.68  
## - LGALS3BP 1 163.97 231.97  
## - FHR3 1 163.98 231.98  
## - IGHG2 1 164.07 232.07  
## - KNG1 1 164.25 232.25  
## - IGHA2 1 164.56 232.56  
## - DKFZp686N02209 1 164.68 232.68  
## <none> 162.81 232.81  
## - HP 1 165.13 233.13  
## - NCAM1 1 165.15 233.15  
## - MMRN1 1 165.28 233.28  
## - FETUA.Bovine 1 165.76 233.76  
## - LUM 1 167.54 235.54  
## - SERPINA7 1 173.18 241.18  
## - LAMP2 1 176.63 244.63  
##   
## Step: AIC=230.83  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + PROC + SERPINA7 +   
## THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - PROC 1 162.86 228.86  
## - CD44 1 162.87 228.87  
## - BTD 1 162.91 228.91  
## - DSG2 1 162.97 228.97  
## - MST1 1 162.98 228.98  
## - APOB 1 163.09 229.09  
## - AHSG 1 163.11 229.11  
## - LRG1 1 163.12 229.12  
## - FETUB 1 163.13 229.13  
## - F11 1 163.18 229.18  
## - TIMP1 1 163.19 229.19  
## - HRG 1 163.19 229.19  
## - PRG4 1 163.23 229.23  
## - AIAG.Bovine 1 163.25 229.25  
## - F5 1 163.38 229.38  
## - IGFBP3 1 163.38 229.38  
## - VWF 1 163.51 229.51  
## - THBS1 1 163.51 229.51  
## - CLU 1 163.61 229.61  
## - FCGBP 1 163.68 229.68  
## - FHR3 1 163.99 229.99  
## - LGALS3BP 1 164.03 230.03  
## - IGHG2 1 164.20 230.20  
## - KNG1 1 164.25 230.25  
## - IGHA2 1 164.56 230.56  
## <none> 162.83 230.83  
## - DKFZp686N02209 1 164.97 230.97  
## - NCAM1 1 165.15 231.15  
## - HP 1 165.16 231.16  
## - MMRN1 1 165.50 231.50  
## - FETUA.Bovine 1 165.95 231.95  
## - LUM 1 167.55 233.55  
## - SERPINA7 1 173.48 239.48  
## - LAMP2 1 177.04 243.04  
##   
## Step: AIC=228.86  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - CD44 1 162.91 226.91  
## - BTD 1 162.94 226.94  
## - DSG2 1 163.00 227.00  
## - MST1 1 163.01 227.01  
## - AHSG 1 163.13 227.13  
## - APOB 1 163.13 227.13  
## - LRG1 1 163.16 227.16  
## - FETUB 1 163.18 227.18  
## - HRG 1 163.20 227.20  
## - TIMP1 1 163.21 227.21  
## - PRG4 1 163.23 227.23  
## - F11 1 163.26 227.26  
## - AIAG.Bovine 1 163.27 227.27  
## - IGFBP3 1 163.38 227.38  
## - F5 1 163.39 227.39  
## - VWF 1 163.51 227.51  
## - THBS1 1 163.53 227.53  
## - CLU 1 163.61 227.61  
## - FCGBP 1 163.71 227.71  
## - FHR3 1 164.00 228.00  
## - LGALS3BP 1 164.09 228.09  
## - IGHG2 1 164.20 228.20  
## - KNG1 1 164.27 228.27  
## - IGHA2 1 164.65 228.65  
## <none> 162.86 228.86  
## - NCAM1 1 165.17 229.17  
## - DKFZp686N02209 1 165.17 229.17  
## - HP 1 165.20 229.20  
## - MMRN1 1 165.60 229.60  
## - FETUA.Bovine 1 165.99 229.99  
## - LUM 1 167.57 231.57  
## - SERPINA7 1 173.65 237.65  
## - LAMP2 1 177.17 241.17  
##   
## Step: AIC=226.91  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - BTD 1 162.95 224.95  
## - DSG2 1 163.02 225.02  
## - MST1 1 163.09 225.09  
## - AHSG 1 163.15 225.15  
## - LRG1 1 163.17 225.17  
## - APOB 1 163.19 225.19  
## - HRG 1 163.24 225.24  
## - TIMP1 1 163.25 225.25  
## - FETUB 1 163.26 225.26  
## - AIAG.Bovine 1 163.28 225.28  
## - PRG4 1 163.29 225.29  
## - F11 1 163.31 225.31  
## - IGFBP3 1 163.39 225.39  
## - F5 1 163.48 225.48  
## - VWF 1 163.52 225.52  
## - THBS1 1 163.62 225.62  
## - CLU 1 163.65 225.65  
## - FCGBP 1 163.74 225.74  
## - FHR3 1 164.09 226.09  
## - LGALS3BP 1 164.22 226.22  
## - IGHG2 1 164.32 226.32  
## - KNG1 1 164.41 226.41  
## - IGHA2 1 164.65 226.65  
## <none> 162.91 226.91  
## - NCAM1 1 165.19 227.19  
## - DKFZp686N02209 1 165.21 227.21  
## - HP 1 165.28 227.28  
## - MMRN1 1 165.95 227.95  
## - FETUA.Bovine 1 166.24 228.24  
## - LUM 1 167.57 229.57  
## - SERPINA7 1 173.81 235.81  
## - LAMP2 1 177.27 239.27  
##   
## Step: AIC=224.95  
## Class ~ AHSG + AIAG.Bovine + APOB + CLU + DKFZp686N02209 + DSG2 +   
## F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG +   
## IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LRG1 +   
## LUM + MMRN1 + MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 +   
## VWF  
##   
## Df Deviance AIC  
## - DSG2 1 163.05 223.05  
## - MST1 1 163.15 223.15  
## - AHSG 1 163.16 223.16  
## - LRG1 1 163.19 223.19  
## - TIMP1 1 163.25 223.25  
## - APOB 1 163.26 223.26  
## - HRG 1 163.28 223.28  
## - PRG4 1 163.31 223.31  
## - FETUB 1 163.32 223.32  
## - AIAG.Bovine 1 163.32 223.32  
## - IGFBP3 1 163.39 223.39  
## - F11 1 163.41 223.41  
## - F5 1 163.52 223.52  
## - VWF 1 163.54 223.54  
## - THBS1 1 163.64 223.64  
## - FCGBP 1 163.76 223.76  
## - CLU 1 163.77 223.77  
## - FHR3 1 164.10 224.10  
## - IGHG2 1 164.33 224.33  
## - LGALS3BP 1 164.34 224.34  
## - KNG1 1 164.43 224.43  
## - IGHA2 1 164.71 224.71  
## <none> 162.95 224.95  
## - DKFZp686N02209 1 165.23 225.23  
## - NCAM1 1 165.27 225.27  
## - HP 1 165.42 225.42  
## - MMRN1 1 166.11 226.11  
## - FETUA.Bovine 1 166.38 226.38  
## - LUM 1 167.65 227.65  
## - SERPINA7 1 173.85 233.85  
## - LAMP2 1 177.28 237.28  
##   
## Step: AIC=223.05  
## Class ~ AHSG + AIAG.Bovine + APOB + CLU + DKFZp686N02209 + F11 +   
## F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG + IGFBP3 +   
## IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 +   
## MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - LRG1 1 163.26 221.26  
## - AHSG 1 163.27 221.27  
## - MST1 1 163.27 221.27  
## - APOB 1 163.30 221.30  
## - PRG4 1 163.38 221.38  
## - TIMP1 1 163.39 221.39  
## - F11 1 163.41 221.41  
## - FETUB 1 163.41 221.41  
## - IGFBP3 1 163.42 221.42  
## - AIAG.Bovine 1 163.44 221.44  
## - HRG 1 163.47 221.47  
## - F5 1 163.56 221.56  
## - VWF 1 163.78 221.78  
## - FCGBP 1 163.80 221.80  
## - THBS1 1 163.82 221.82  
## - CLU 1 163.95 221.95  
## - FHR3 1 164.21 222.21  
## - IGHG2 1 164.36 222.36  
## - LGALS3BP 1 164.47 222.47  
## - KNG1 1 164.55 222.55  
## - IGHA2 1 164.72 222.72  
## <none> 163.05 223.05  
## - DKFZp686N02209 1 165.25 223.25  
## - NCAM1 1 165.28 223.28  
## - HP 1 165.68 223.68  
## - MMRN1 1 166.16 224.16  
## - FETUA.Bovine 1 166.40 224.40  
## - LUM 1 167.81 225.81  
## - SERPINA7 1 173.98 231.98  
## - LAMP2 1 177.29 235.29  
##   
## Step: AIC=221.26  
## Class ~ AHSG + AIAG.Bovine + APOB + CLU + DKFZp686N02209 + F11 +   
## F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG + IGFBP3 +   
## IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + MST1 +   
## NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - APOB 1 163.48 219.48  
## - AHSG 1 163.50 219.50  
## - FETUB 1 163.50 219.50  
## - MST1 1 163.56 219.56  
## - PRG4 1 163.65 219.65  
## - AIAG.Bovine 1 163.66 219.66  
## - F11 1 163.69 219.69  
## - TIMP1 1 163.73 219.73  
## - HRG 1 163.76 219.76  
## - IGFBP3 1 163.85 219.85  
## - F5 1 163.91 219.91  
## - FCGBP 1 164.23 220.23  
## - CLU 1 164.25 220.25  
## - VWF 1 164.26 220.26  
## - THBS1 1 164.29 220.29  
## - LGALS3BP 1 164.58 220.58  
## - IGHG2 1 164.61 220.61  
## - KNG1 1 164.79 220.79  
## - FHR3 1 164.83 220.83  
## - IGHA2 1 165.06 221.06  
## <none> 163.26 221.26  
## - NCAM1 1 165.34 221.34  
## - DKFZp686N02209 1 165.53 221.53  
## - HP 1 166.34 222.34  
## - FETUA.Bovine 1 166.73 222.73  
## - MMRN1 1 167.11 223.11  
## - LUM 1 167.87 223.87  
## - SERPINA7 1 174.37 230.37  
## - LAMP2 1 177.29 233.29  
##   
## Step: AIC=219.48  
## Class ~ AHSG + AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 +   
## FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG + IGFBP3 +   
## IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + MST1 +   
## NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - FETUB 1 163.72 217.72  
## - AHSG 1 163.73 217.73  
## - MST1 1 163.79 217.79  
## - HRG 1 163.90 217.90  
## - F11 1 163.91 217.91  
## - F5 1 163.96 217.96  
## - TIMP1 1 164.02 218.02  
## - AIAG.Bovine 1 164.05 218.05  
## - PRG4 1 164.08 218.08  
## - IGFBP3 1 164.20 218.20  
## - CLU 1 164.39 218.39  
## - VWF 1 164.45 218.45  
## - FCGBP 1 164.52 218.52  
## - THBS1 1 164.59 218.59  
## - LGALS3BP 1 164.72 218.72  
## - IGHG2 1 164.86 218.86  
## - KNG1 1 164.96 218.96  
## - FHR3 1 165.16 219.16  
## - IGHA2 1 165.19 219.19  
## <none> 163.48 219.48  
## - NCAM1 1 165.49 219.49  
## - DKFZp686N02209 1 165.63 219.63  
## - HP 1 166.56 220.56  
## - FETUA.Bovine 1 166.90 220.90  
## - MMRN1 1 167.13 221.13  
## - LUM 1 168.67 222.67  
## - SERPINA7 1 174.87 228.87  
## - LAMP2 1 177.58 231.58  
##   
## Step: AIC=217.72  
## Class ~ AHSG + AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 +   
## FCGBP + FETUA.Bovine + FHR3 + HP + HRG + IGFBP3 + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + MST1 + NCAM1 +   
## PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - MST1 1 164.01 216.01  
## - AHSG 1 164.02 216.02  
## - F11 1 164.10 216.10  
## - HRG 1 164.10 216.10  
## - F5 1 164.19 216.19  
## - TIMP1 1 164.27 216.27  
## - PRG4 1 164.40 216.40  
## - AIAG.Bovine 1 164.44 216.44  
## - IGFBP3 1 164.46 216.46  
## - CLU 1 164.50 216.50  
## - VWF 1 164.69 216.69  
## - THBS1 1 164.78 216.78  
## - FCGBP 1 164.79 216.79  
## - LGALS3BP 1 164.97 216.97  
## - IGHG2 1 165.00 217.00  
## - KNG1 1 165.11 217.11  
## - FHR3 1 165.31 217.31  
## - IGHA2 1 165.47 217.47  
## - NCAM1 1 165.69 217.69  
## <none> 163.72 217.72  
## - DKFZp686N02209 1 166.12 218.12  
## - HP 1 166.83 218.83  
## - FETUA.Bovine 1 167.10 219.10  
## - MMRN1 1 167.19 219.19  
## - LUM 1 168.74 220.74  
## - SERPINA7 1 174.94 226.94  
## - LAMP2 1 178.45 230.45  
##   
## Step: AIC=216.01  
## Class ~ AHSG + AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 +   
## FCGBP + FETUA.Bovine + FHR3 + HP + HRG + IGFBP3 + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 +   
## SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - AHSG 1 164.26 214.26  
## - F11 1 164.33 214.33  
## - TIMP1 1 164.44 214.44  
## - F5 1 164.48 214.48  
## - HRG 1 164.57 214.57  
## - PRG4 1 164.65 214.65  
## - AIAG.Bovine 1 164.72 214.72  
## - CLU 1 164.82 214.82  
## - IGFBP3 1 164.88 214.88  
## - VWF 1 164.93 214.93  
## - FCGBP 1 165.05 215.05  
## - THBS1 1 165.10 215.10  
## - LGALS3BP 1 165.20 215.20  
## - KNG1 1 165.38 215.38  
## - IGHG2 1 165.53 215.53  
## - IGHA2 1 165.62 215.62  
## - FHR3 1 165.89 215.89  
## - NCAM1 1 165.89 215.89  
## <none> 164.01 216.01  
## - DKFZp686N02209 1 166.22 216.22  
## - HP 1 167.13 217.13  
## - MMRN1 1 167.41 217.41  
## - FETUA.Bovine 1 167.48 217.48  
## - LUM 1 169.14 219.14  
## - SERPINA7 1 175.25 225.25  
## - LAMP2 1 178.64 228.64  
##   
## Step: AIC=214.26  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 + FCGBP +   
## FETUA.Bovine + FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 +   
## THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - F11 1 164.55 212.55  
## - TIMP1 1 164.71 212.71  
## - F5 1 164.73 212.73  
## - PRG4 1 164.81 212.81  
## - AIAG.Bovine 1 164.90 212.90  
## - HRG 1 164.97 212.97  
## - CLU 1 165.01 213.01  
## - IGFBP3 1 165.11 213.11  
## - LGALS3BP 1 165.35 213.35  
## - FCGBP 1 165.36 213.36  
## - VWF 1 165.41 213.41  
## - THBS1 1 165.51 213.51  
## - KNG1 1 165.62 213.62  
## - IGHG2 1 165.87 213.87  
## - IGHA2 1 165.98 213.98  
## - NCAM1 1 166.09 214.09  
## - FHR3 1 166.13 214.13  
## <none> 164.26 214.26  
## - DKFZp686N02209 1 166.56 214.56  
## - HP 1 167.22 215.22  
## - FETUA.Bovine 1 167.69 215.69  
## - MMRN1 1 167.97 215.97  
## - LUM 1 169.83 217.83  
## - SERPINA7 1 175.33 223.33  
## - LAMP2 1 179.01 227.01  
##   
## Step: AIC=212.55  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + F5 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 +   
## LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - TIMP1 1 164.94 210.94  
## - PRG4 1 165.06 211.06  
## - HRG 1 165.15 211.15  
## - F5 1 165.18 211.18  
## - IGFBP3 1 165.26 211.26  
## - AIAG.Bovine 1 165.35 211.35  
## - CLU 1 165.45 211.45  
## - LGALS3BP 1 165.47 211.47  
## - FCGBP 1 165.51 211.51  
## - THBS1 1 165.61 211.61  
## - VWF 1 165.75 211.75  
## - KNG1 1 165.84 211.84  
## - IGHA2 1 166.16 212.16  
## - IGHG2 1 166.24 212.24  
## - NCAM1 1 166.54 212.54  
## <none> 164.55 212.55  
## - DKFZp686N02209 1 166.72 212.72  
## - FHR3 1 167.05 213.05  
## - FETUA.Bovine 1 167.97 213.97  
## - HP 1 168.09 214.09  
## - MMRN1 1 168.39 214.39  
## - LUM 1 170.14 216.14  
## - SERPINA7 1 175.74 221.74  
## - LAMP2 1 179.10 225.10  
##   
## Step: AIC=210.94  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + F5 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 +   
## LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## VWF  
##   
## Df Deviance AIC  
## - F5 1 165.48 209.48  
## - IGFBP3 1 165.55 209.55  
## - THBS1 1 165.66 209.66  
## - CLU 1 165.70 209.70  
## - PRG4 1 165.71 209.71  
## - HRG 1 165.72 209.72  
## - FCGBP 1 165.90 209.90  
## - LGALS3BP 1 165.92 209.92  
## - AIAG.Bovine 1 165.93 209.93  
## - VWF 1 165.93 209.93  
## - KNG1 1 166.28 210.28  
## - IGHA2 1 166.37 210.37  
## - IGHG2 1 166.70 210.70  
## <none> 164.94 210.94  
## - NCAM1 1 166.99 210.99  
## - DKFZp686N02209 1 167.30 211.30  
## - FHR3 1 167.51 211.51  
## - FETUA.Bovine 1 168.75 212.75  
## - HP 1 169.23 213.23  
## - LUM 1 170.30 214.30  
## - MMRN1 1 172.70 216.70  
## - SERPINA7 1 176.42 220.42  
## - LAMP2 1 180.21 224.21  
##   
## Step: AIC=209.48  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 +   
## LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## VWF  
##   
## Df Deviance AIC  
## - IGFBP3 1 165.85 207.85  
## - HRG 1 166.02 208.02  
## - THBS1 1 166.08 208.08  
## - AIAG.Bovine 1 166.24 208.24  
## - CLU 1 166.29 208.29  
## - VWF 1 166.35 208.35  
## - FCGBP 1 166.50 208.50  
## - LGALS3BP 1 166.63 208.63  
## - IGHA2 1 166.69 208.69  
## - KNG1 1 166.81 208.81  
## - PRG4 1 166.83 208.83  
## <none> 165.48 209.48  
## - IGHG2 1 167.58 209.58  
## - DKFZp686N02209 1 167.68 209.68  
## - NCAM1 1 167.98 209.98  
## - FHR3 1 168.42 210.42  
## - FETUA.Bovine 1 169.17 211.17  
## - HP 1 169.68 211.68  
## - LUM 1 171.48 213.48  
## - MMRN1 1 172.93 214.93  
## - SERPINA7 1 176.89 218.89  
## - LAMP2 1 180.37 222.37  
##   
## Step: AIC=207.85  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 + VWF  
##   
## Df Deviance AIC  
## - THBS1 1 166.45 206.45  
## - HRG 1 166.47 206.47  
## - VWF 1 166.56 206.56  
## - AIAG.Bovine 1 166.66 206.66  
## - CLU 1 166.67 206.67  
## - FCGBP 1 166.79 206.79  
## - IGHA2 1 166.97 206.97  
## - LGALS3BP 1 166.98 206.98  
## - PRG4 1 167.32 207.32  
## - KNG1 1 167.62 207.62  
## - DKFZp686N02209 1 167.72 207.72  
## <none> 165.85 207.85  
## - NCAM1 1 168.13 208.13  
## - IGHG2 1 168.34 208.34  
## - FHR3 1 168.59 208.59  
## - FETUA.Bovine 1 169.81 209.81  
## - HP 1 169.94 209.94  
## - LUM 1 171.51 211.51  
## - MMRN1 1 173.24 213.24  
## - SERPINA7 1 177.06 217.06  
## - LAMP2 1 180.96 220.96  
##   
## Step: AIC=206.45  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - HRG 1 166.95 204.95  
## - AIAG.Bovine 1 167.07 205.07  
## - CLU 1 167.10 205.10  
## - LGALS3BP 1 167.52 205.52  
## - FCGBP 1 167.61 205.61  
## - IGHA2 1 167.70 205.70  
## - PRG4 1 167.91 205.91  
## - VWF 1 167.96 205.96  
## - KNG1 1 168.05 206.05  
## - DKFZp686N02209 1 168.07 206.07  
## <none> 166.45 206.45  
## - NCAM1 1 168.63 206.63  
## - IGHG2 1 168.76 206.76  
## - FHR3 1 169.50 207.50  
## - FETUA.Bovine 1 169.93 207.93  
## - HP 1 170.16 208.16  
## - LUM 1 171.87 209.87  
## - MMRN1 1 173.25 211.25  
## - SERPINA7 1 177.73 215.73  
## - LAMP2 1 181.77 219.77  
##   
## Step: AIC=204.95  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM +   
## MMRN1 + NCAM1 + PRG4 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - AIAG.Bovine 1 167.38 203.38  
## - CLU 1 167.67 203.67  
## - LGALS3BP 1 167.81 203.81  
## - IGHA2 1 168.09 204.09  
## - FCGBP 1 168.32 204.32  
## - PRG4 1 168.38 204.38  
## - VWF 1 168.42 204.42  
## - KNG1 1 168.75 204.75  
## - DKFZp686N02209 1 168.80 204.80  
## - NCAM1 1 168.95 204.95  
## <none> 166.95 204.95  
## - IGHG2 1 169.53 205.53  
## - FHR3 1 169.76 205.76  
## - FETUA.Bovine 1 170.46 206.46  
## - HP 1 170.78 206.78  
## - LUM 1 173.86 209.86  
## - MMRN1 1 175.43 211.43  
## - SERPINA7 1 178.16 214.16  
## - LAMP2 1 182.56 218.56  
##   
## Step: AIC=203.38  
## Class ~ CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 +   
## HP + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 +   
## NCAM1 + PRG4 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - CLU 1 167.84 201.84  
## - LGALS3BP 1 168.28 202.28  
## - IGHA2 1 168.53 202.53  
## - FCGBP 1 168.62 202.62  
## - PRG4 1 168.67 202.67  
## - VWF 1 168.68 202.68  
## - DKFZp686N02209 1 168.98 202.98  
## - KNG1 1 169.11 203.11  
## <none> 167.38 203.38  
## - NCAM1 1 169.40 203.40  
## - FHR3 1 169.91 203.91  
## - IGHG2 1 170.04 204.04  
## - FETUA.Bovine 1 170.81 204.81  
## - HP 1 171.16 205.16  
## - LUM 1 175.29 209.29  
## - MMRN1 1 175.55 209.55  
## - SERPINA7 1 178.17 212.17  
## - LAMP2 1 182.74 216.74  
##   
## Step: AIC=201.84  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 +   
## SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - LGALS3BP 1 168.59 200.59  
## - PRG4 1 168.75 200.75  
## - VWF 1 168.79 200.79  
## - FCGBP 1 169.00 201.00  
## - IGHA2 1 169.18 201.18  
## - KNG1 1 169.25 201.25  
## - DKFZp686N02209 1 169.42 201.42  
## <none> 167.84 201.84  
## - FHR3 1 170.12 202.12  
## - NCAM1 1 170.51 202.51  
## - IGHG2 1 170.83 202.83  
## - FETUA.Bovine 1 171.21 203.21  
## - HP 1 171.56 203.56  
## - LUM 1 175.50 207.50  
## - MMRN1 1 175.86 207.86  
## - SERPINA7 1 179.39 211.39  
## - LAMP2 1 182.96 214.96  
##   
## Step: AIC=200.59  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 +   
## VWF  
##   
## Df Deviance AIC  
## - PRG4 1 169.20 199.20  
## - VWF 1 169.29 199.29  
## - IGHA2 1 169.52 199.52  
## - DKFZp686N02209 1 170.10 200.10  
## - KNG1 1 170.11 200.11  
## - FCGBP 1 170.44 200.44  
## <none> 168.59 200.59  
## - NCAM1 1 170.79 200.79  
## - IGHG2 1 171.56 201.56  
## - FHR3 1 171.57 201.57  
## - FETUA.Bovine 1 171.95 201.95  
## - HP 1 172.75 202.75  
## - LUM 1 176.34 206.34  
## - MMRN1 1 177.59 207.59  
## - SERPINA7 1 179.98 209.98  
## - LAMP2 1 182.97 212.97  
##   
## Step: AIC=199.2  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - VWF 1 169.83 197.83  
## - IGHA2 1 170.08 198.08  
## - DKFZp686N02209 1 170.49 198.49  
## - KNG1 1 170.83 198.83  
## <none> 169.20 199.20  
## - NCAM1 1 171.28 199.28  
## - FCGBP 1 171.36 199.36  
## - IGHG2 1 172.06 200.06  
## - FETUA.Bovine 1 172.16 200.16  
## - FHR3 1 172.25 200.25  
## - HP 1 173.15 201.15  
## - MMRN1 1 178.13 206.13  
## - LUM 1 178.78 206.78  
## - SERPINA7 1 180.12 208.12  
## - LAMP2 1 185.62 213.62  
##   
## Step: AIC=197.83  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + SERPINA7  
##   
## Df Deviance AIC  
## - IGHA2 1 170.75 196.75  
## - KNG1 1 171.25 197.25  
## - DKFZp686N02209 1 171.44 197.44  
## - NCAM1 1 171.49 197.49  
## - FCGBP 1 171.56 197.56  
## <none> 169.83 197.83  
## - IGHG2 1 172.32 198.32  
## - FHR3 1 172.50 198.50  
## - FETUA.Bovine 1 172.51 198.51  
## - HP 1 173.86 199.86  
## - MMRN1 1 178.13 204.13  
## - LUM 1 179.27 205.27  
## - SERPINA7 1 180.14 206.14  
## - LAMP2 1 187.37 213.37  
##   
## Step: AIC=196.75  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 +   
## KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + SERPINA7  
##   
## Df Deviance AIC  
## - NCAM1 1 172.03 196.03  
## - FCGBP 1 172.03 196.03  
## - DKFZp686N02209 1 172.18 196.18  
## - KNG1 1 172.75 196.75  
## <none> 170.75 196.75  
## - IGHG2 1 173.04 197.04  
## - FETUA.Bovine 1 173.25 197.25  
## - FHR3 1 174.10 198.10  
## - HP 1 174.31 198.31  
## - MMRN1 1 179.33 203.33  
## - LUM 1 179.49 203.49  
## - SERPINA7 1 181.11 205.11  
## - LAMP2 1 188.15 212.15  
##   
## Step: AIC=196.03  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 +   
## KNG1 + LAMP2 + LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - DKFZp686N02209 1 172.97 194.97  
## - KNG1 1 173.88 195.88  
## <none> 172.03 196.03  
## - IGHG2 1 174.07 196.07  
## - FCGBP 1 174.61 196.61  
## - FETUA.Bovine 1 174.72 196.72  
## - FHR3 1 175.05 197.05  
## - HP 1 175.70 197.70  
## - LUM 1 179.92 201.92  
## - MMRN1 1 181.53 203.53  
## - SERPINA7 1 181.94 203.94  
## - LAMP2 1 188.15 210.15  
##   
## Step: AIC=194.97  
## Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 + KNG1 + LAMP2 +   
## LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - IGHG2 1 174.09 194.09  
## - KNG1 1 174.52 194.52  
## <none> 172.97 194.97  
## - FCGBP 1 175.38 195.38  
## - FETUA.Bovine 1 175.40 195.40  
## - FHR3 1 175.49 195.49  
## - HP 1 176.24 196.24  
## - LUM 1 180.40 200.40  
## - MMRN1 1 182.74 202.74  
## - SERPINA7 1 184.85 204.85  
## - LAMP2 1 191.38 211.38  
##   
## Step: AIC=194.09  
## Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + KNG1 + LAMP2 + LUM +   
## MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## <none> 174.09 194.09  
## - KNG1 1 176.13 194.13  
## - FETUA.Bovine 1 176.27 194.27  
## - FCGBP 1 176.56 194.56  
## - FHR3 1 176.71 194.71  
## - HP 1 177.90 195.90  
## - MMRN1 1 183.67 201.67  
## - LUM 1 184.52 202.52  
## - SERPINA7 1 184.99 202.99  
## - LAMP2 1 191.38 209.38

summary(model.aic.backward)

##   
## Call:  
## glm(formula = Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + KNG1 +   
## LAMP2 + LUM + MMRN1 + SERPINA7, family = binomial, data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -1.8946 -0.8822 -0.1143 0.9205 2.7140   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 122.1951 83.8466 1.457 0.145016   
## FCGBP -0.5803 0.3745 -1.550 0.121184   
## FETUA.Bovine -7.0967 4.8653 -1.459 0.144665   
## FHR3 -0.2556 0.1604 -1.594 0.110989   
## HP -0.5438 0.2848 -1.910 0.056190 .   
## KNG1 0.4819 0.3768 1.279 0.200999   
## LAMP2 2.5943 0.6818 3.805 0.000142 \*\*\*  
## LUM 1.3460 0.4363 3.085 0.002037 \*\*   
## MMRN1 -1.4466 0.4904 -2.950 0.003180 \*\*   
## SERPINA7 -2.1277 0.6782 -3.137 0.001705 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 174.09 on 150 degrees of freedom  
## AIC: 194.09  
##   
## Number of Fisher Scoring iterations: 4

This results in 9 columns in the best model with AIC = 194.09

## AIC-based forward selection

model.aic.forward <- step(glm.null, direction = "forward", trace = 1, scope = list(lower=glm.null, upper=glm.full))

## Start: AIC=223.81  
## Class ~ 1  
##   
## Df Deviance AIC  
## + TIMP1 1 209.97 213.97  
## + MMRN1 1 211.66 215.66  
## + HP 1 212.07 216.07  
## + LRG1 1 213.06 217.06  
## + FHR3 1 216.41 220.41  
## + SERPINA7 1 217.81 221.81  
## + LGALS3BP 1 218.56 222.56  
## + CD44 1 218.72 222.72  
## + LAMP2 1 218.96 222.96  
## + FCGBP 1 219.20 223.20  
## <none> 221.81 223.81  
## + DSG2 1 219.81 223.81  
## + F5 1 220.07 224.07  
## + LYVE1 1 220.11 224.11  
## + CFI 1 220.48 224.48  
## + HRG 1 220.92 224.92  
## + PRG4 1 220.94 224.94  
## + NCAM1 1 221.06 225.06  
## + VWF 1 221.13 225.13  
## + BTD 1 221.22 225.22  
## + FETUB 1 221.26 225.26  
## + THBS1 1 221.28 225.28  
## + PROC 1 221.35 225.35  
## + F11 1 221.40 225.40  
## + LUM 1 221.41 225.41  
## + IGHG2 1 221.46 225.46  
## + C20orf3 1 221.47 225.47  
## + AIAG.Bovine 1 221.48 225.48  
## + AFM 1 221.52 225.52  
## + FN1 1 221.54 225.54  
## + FETUA.Bovine 1 221.58 225.58  
## + APOB 1 221.58 225.58  
## + MST1 1 221.62 225.62  
## + PLTP 1 221.63 225.63  
## + DKFZp686N02209 1 221.69 225.69  
## + Q5JNX2 1 221.71 225.71  
## + IGHA2 1 221.74 225.74  
## + KNG1 1 221.78 225.78  
## + CLU 1 221.78 225.78  
## + IGFBP3 1 221.80 225.80  
## + AHSG 1 221.81 225.81  
##   
## Step: AIC=213.97  
## Class ~ TIMP1  
##   
## Df Deviance AIC  
## + LAMP2 1 202.29 208.29  
## + HP 1 206.23 212.23  
## + THBS1 1 206.98 212.98  
## + LRG1 1 207.12 213.12  
## + FHR3 1 207.18 213.18  
## + AFM 1 207.72 213.72  
## <none> 209.97 213.97  
## + SERPINA7 1 208.30 214.30  
## + FN1 1 208.36 214.36  
## + LUM 1 208.38 214.38  
## + IGHA2 1 208.43 214.43  
## + BTD 1 208.90 214.90  
## + MMRN1 1 208.92 214.92  
## + VWF 1 209.00 215.00  
## + AHSG 1 209.13 215.13  
## + PRG4 1 209.17 215.17  
## + KNG1 1 209.19 215.19  
## + APOB 1 209.23 215.23  
## + CLU 1 209.34 215.34  
## + CD44 1 209.38 215.38  
## + C20orf3 1 209.59 215.59  
## + HRG 1 209.60 215.60  
## + F5 1 209.60 215.60  
## + AIAG.Bovine 1 209.65 215.65  
## + FCGBP 1 209.69 215.69  
## + IGHG2 1 209.76 215.76  
## + DSG2 1 209.78 215.78  
## + MST1 1 209.78 215.78  
## + FETUA.Bovine 1 209.83 215.83  
## + LGALS3BP 1 209.84 215.84  
## + DKFZp686N02209 1 209.84 215.84  
## + Q5JNX2 1 209.90 215.90  
## + F11 1 209.92 215.92  
## + NCAM1 1 209.92 215.92  
## + LYVE1 1 209.93 215.93  
## + PROC 1 209.94 215.94  
## + PLTP 1 209.95 215.95  
## + CFI 1 209.95 215.95  
## + IGFBP3 1 209.96 215.96  
## + FETUB 1 209.96 215.96  
##   
## Step: AIC=208.29  
## Class ~ TIMP1 + LAMP2  
##   
## Df Deviance AIC  
## + HP 1 194.96 202.96  
## + SERPINA7 1 195.46 203.46  
## + LRG1 1 196.14 204.14  
## + CFI 1 196.86 204.86  
## + FHR3 1 198.25 206.25  
## + MMRN1 1 199.49 207.49  
## + LGALS3BP 1 199.91 207.91  
## + F11 1 200.19 208.19  
## + DSG2 1 200.21 208.21  
## <none> 202.29 208.29  
## + CD44 1 200.41 208.41  
## + F5 1 200.55 208.55  
## + FETUB 1 200.68 208.68  
## + FCGBP 1 200.81 208.81  
## + THBS1 1 201.34 209.34  
## + NCAM1 1 201.48 209.48  
## + IGHA2 1 201.51 209.51  
## + PROC 1 201.73 209.73  
## + Q5JNX2 1 201.74 209.74  
## + LYVE1 1 201.80 209.80  
## + AIAG.Bovine 1 201.92 209.92  
## + C20orf3 1 201.93 209.93  
## + CLU 1 202.00 210.00  
## + LUM 1 202.06 210.06  
## + IGHG2 1 202.07 210.07  
## + PLTP 1 202.08 210.08  
## + HRG 1 202.09 210.09  
## + AHSG 1 202.10 210.10  
## + BTD 1 202.10 210.10  
## + IGFBP3 1 202.19 210.19  
## + FETUA.Bovine 1 202.19 210.19  
## + MST1 1 202.24 210.24  
## + DKFZp686N02209 1 202.24 210.24  
## + PRG4 1 202.27 210.27  
## + AFM 1 202.28 210.28  
## + VWF 1 202.28 210.28  
## + KNG1 1 202.29 210.29  
## + APOB 1 202.29 210.29  
## + FN1 1 202.29 210.29  
##   
## Step: AIC=202.96  
## Class ~ TIMP1 + LAMP2 + HP  
##   
## Df Deviance AIC  
## + LRG1 1 191.82 201.82  
## + SERPINA7 1 191.88 201.88  
## + CFI 1 192.65 202.65  
## + FHR3 1 192.70 202.70  
## + MMRN1 1 192.82 202.82  
## <none> 194.96 202.96  
## + DSG2 1 193.23 203.23  
## + FCGBP 1 193.23 203.23  
## + F5 1 193.47 203.47  
## + CD44 1 193.59 203.59  
## + LUM 1 193.75 203.75  
## + LGALS3BP 1 193.78 203.78  
## + IGHA2 1 194.15 204.15  
## + NCAM1 1 194.23 204.23  
## + THBS1 1 194.24 204.24  
## + IGHG2 1 194.34 204.34  
## + FETUB 1 194.52 204.52  
## + F11 1 194.61 204.61  
## + LYVE1 1 194.64 204.64  
## + KNG1 1 194.71 204.71  
## + MST1 1 194.71 204.71  
## + PRG4 1 194.73 204.73  
## + FETUA.Bovine 1 194.74 204.74  
## + C20orf3 1 194.75 204.75  
## + FN1 1 194.79 204.79  
## + VWF 1 194.86 204.86  
## + Q5JNX2 1 194.86 204.86  
## + BTD 1 194.87 204.87  
## + APOB 1 194.87 204.87  
## + AHSG 1 194.92 204.92  
## + HRG 1 194.94 204.94  
## + PROC 1 194.95 204.95  
## + AFM 1 194.95 204.95  
## + CLU 1 194.95 204.95  
## + IGFBP3 1 194.95 204.95  
## + PLTP 1 194.95 204.95  
## + AIAG.Bovine 1 194.95 204.95  
## + DKFZp686N02209 1 194.96 204.96  
##   
## Step: AIC=201.82  
## Class ~ TIMP1 + LAMP2 + HP + LRG1  
##   
## Df Deviance AIC  
## + SERPINA7 1 189.22 201.22  
## + LUM 1 189.76 201.76  
## <none> 191.82 201.82  
## + CFI 1 190.34 202.34  
## + FCGBP 1 190.61 202.61  
## + LGALS3BP 1 190.64 202.64  
## + F5 1 190.65 202.65  
## + DSG2 1 190.65 202.65  
## + CD44 1 190.69 202.69  
## + MMRN1 1 190.70 202.70  
## + FHR3 1 190.78 202.78  
## + NCAM1 1 190.93 202.93  
## + IGHG2 1 191.24 203.24  
## + IGHA2 1 191.36 203.36  
## + FETUA.Bovine 1 191.46 203.46  
## + THBS1 1 191.52 203.52  
## + APOB 1 191.52 203.52  
## + KNG1 1 191.52 203.52  
## + PRG4 1 191.54 203.54  
## + F11 1 191.66 203.66  
## + AFM 1 191.69 203.69  
## + C20orf3 1 191.69 203.69  
## + AIAG.Bovine 1 191.69 203.69  
## + VWF 1 191.70 203.70  
## + PROC 1 191.76 203.76  
## + MST1 1 191.76 203.76  
## + LYVE1 1 191.77 203.77  
## + CLU 1 191.78 203.78  
## + IGFBP3 1 191.81 203.81  
## + AHSG 1 191.81 203.81  
## + Q5JNX2 1 191.81 203.81  
## + PLTP 1 191.81 203.81  
## + BTD 1 191.82 203.82  
## + FETUB 1 191.82 203.82  
## + DKFZp686N02209 1 191.82 203.82  
## + FN1 1 191.82 203.82  
## + HRG 1 191.82 203.82  
##   
## Step: AIC=201.23  
## Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7  
##   
## Df Deviance AIC  
## + LUM 1 180.75 194.75  
## + IGHG2 1 186.45 200.45  
## <none> 189.22 201.22  
## + AIAG.Bovine 1 187.32 201.32  
## + APOB 1 187.59 201.59  
## + PRG4 1 187.69 201.69  
## + FHR3 1 187.84 201.84  
## + KNG1 1 187.87 201.87  
## + F5 1 187.97 201.97  
## + CLU 1 188.08 202.08  
## + CD44 1 188.11 202.11  
## + CFI 1 188.16 202.16  
## + NCAM1 1 188.24 202.24  
## + MST1 1 188.24 202.24  
## + LGALS3BP 1 188.24 202.24  
## + DKFZp686N02209 1 188.31 202.31  
## + HRG 1 188.38 202.38  
## + FCGBP 1 188.39 202.39  
## + BTD 1 188.42 202.42  
## + DSG2 1 188.43 202.43  
## + FETUA.Bovine 1 188.53 202.53  
## + MMRN1 1 188.68 202.68  
## + PLTP 1 188.71 202.71  
## + LYVE1 1 188.72 202.72  
## + AHSG 1 188.75 202.75  
## + IGHA2 1 188.80 202.80  
## + PROC 1 188.83 202.83  
## + IGFBP3 1 188.86 202.86  
## + THBS1 1 189.03 203.03  
## + FETUB 1 189.04 203.04  
## + VWF 1 189.09 203.09  
## + FN1 1 189.10 203.10  
## + F11 1 189.10 203.10  
## + Q5JNX2 1 189.11 203.11  
## + AFM 1 189.19 203.19  
## + C20orf3 1 189.22 203.22  
##   
## Step: AIC=194.75  
## Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7 + LUM  
##   
## Df Deviance AIC  
## + NCAM1 1 178.47 194.47  
## + MMRN1 1 178.72 194.72  
## <none> 180.75 194.75  
## + FHR3 1 179.01 195.01  
## + FCGBP 1 179.15 195.15  
## + LGALS3BP 1 179.46 195.46  
## + CD44 1 179.81 195.81  
## + IGHA2 1 179.98 195.98  
## + FETUA.Bovine 1 179.98 195.98  
## + DSG2 1 180.10 196.10  
## + KNG1 1 180.21 196.21  
## + CFI 1 180.23 196.23  
## + F5 1 180.28 196.28  
## + FETUB 1 180.40 196.40  
## + IGHG2 1 180.41 196.41  
## + C20orf3 1 180.42 196.42  
## + THBS1 1 180.52 196.52  
## + AHSG 1 180.61 196.61  
## + BTD 1 180.63 196.63  
## + VWF 1 180.64 196.64  
## + CLU 1 180.65 196.65  
## + PRG4 1 180.66 196.66  
## + LYVE1 1 180.66 196.66  
## + F11 1 180.66 196.66  
## + HRG 1 180.66 196.66  
## + MST1 1 180.68 196.68  
## + Q5JNX2 1 180.69 196.69  
## + IGFBP3 1 180.72 196.72  
## + AFM 1 180.72 196.72  
## + PLTP 1 180.73 196.73  
## + AIAG.Bovine 1 180.73 196.73  
## + FN1 1 180.74 196.74  
## + APOB 1 180.75 196.75  
## + PROC 1 180.75 196.75  
## + DKFZp686N02209 1 180.75 196.75  
##   
## Step: AIC=194.47  
## Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7 + LUM + NCAM1  
##   
## Df Deviance AIC  
## <none> 178.47 194.47  
## + MMRN1 1 176.70 194.70  
## + FHR3 1 176.86 194.86  
## + LGALS3BP 1 177.08 195.08  
## + IGHA2 1 177.10 195.10  
## + FETUA.Bovine 1 177.71 195.71  
## + FETUB 1 177.75 195.75  
## + FCGBP 1 177.78 195.78  
## + KNG1 1 177.82 195.82  
## + AHSG 1 178.07 196.07  
## + THBS1 1 178.08 196.08  
## + CD44 1 178.09 196.09  
## + CFI 1 178.12 196.12  
## + IGHG2 1 178.24 196.24  
## + C20orf3 1 178.25 196.25  
## + HRG 1 178.32 196.32  
## + LYVE1 1 178.36 196.36  
## + PLTP 1 178.37 196.37  
## + DKFZp686N02209 1 178.37 196.37  
## + APOB 1 178.40 196.40  
## + Q5JNX2 1 178.40 196.40  
## + AIAG.Bovine 1 178.40 196.40  
## + DSG2 1 178.41 196.41  
## + PRG4 1 178.42 196.42  
## + F5 1 178.42 196.42  
## + MST1 1 178.42 196.42  
## + IGFBP3 1 178.43 196.43  
## + PROC 1 178.44 196.44  
## + VWF 1 178.46 196.46  
## + CLU 1 178.46 196.46  
## + BTD 1 178.46 196.46  
## + AFM 1 178.47 196.47  
## + FN1 1 178.47 196.47  
## + F11 1 178.47 196.47

summary(model.aic.forward)

##   
## Call:  
## glm(formula = Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7 +   
## LUM + NCAM1, family = binomial, data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.02726 -0.94320 -0.05077 0.93724 2.48858   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 7.3902 8.2991 0.890 0.37320   
## TIMP1 -0.9190 0.4498 -2.043 0.04102 \*   
## LAMP2 2.7202 0.6946 3.916 8.99e-05 \*\*\*  
## HP -0.3650 0.2814 -1.297 0.19463   
## LRG1 -0.7993 0.3743 -2.135 0.03273 \*   
## SERPINA7 -1.9639 0.6460 -3.040 0.00237 \*\*   
## LUM 1.2721 0.4218 3.016 0.00256 \*\*   
## NCAM1 -0.8055 0.5401 -1.491 0.13585   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 178.47 on 152 degrees of freedom  
## AIC: 194.47  
##   
## Number of Fisher Scoring iterations: 4

This results in 7 columns in the best model with AIC = 194.47

## AIC-based forward-backward selection

model.aic.both <- step(glm.null, direction = "both", trace = 1, scope=list(lower=glm.null, upper=glm.full))

## Start: AIC=223.81  
## Class ~ 1  
##   
## Df Deviance AIC  
## + TIMP1 1 209.97 213.97  
## + MMRN1 1 211.66 215.66  
## + HP 1 212.07 216.07  
## + LRG1 1 213.06 217.06  
## + FHR3 1 216.41 220.41  
## + SERPINA7 1 217.81 221.81  
## + LGALS3BP 1 218.56 222.56  
## + CD44 1 218.72 222.72  
## + LAMP2 1 218.96 222.96  
## + FCGBP 1 219.20 223.20  
## <none> 221.81 223.81  
## + DSG2 1 219.81 223.81  
## + F5 1 220.07 224.07  
## + LYVE1 1 220.11 224.11  
## + CFI 1 220.48 224.48  
## + HRG 1 220.92 224.92  
## + PRG4 1 220.94 224.94  
## + NCAM1 1 221.06 225.06  
## + VWF 1 221.13 225.13  
## + BTD 1 221.22 225.22  
## + FETUB 1 221.26 225.26  
## + THBS1 1 221.28 225.28  
## + PROC 1 221.35 225.35  
## + F11 1 221.40 225.40  
## + LUM 1 221.41 225.41  
## + IGHG2 1 221.46 225.46  
## + C20orf3 1 221.47 225.47  
## + AIAG.Bovine 1 221.48 225.48  
## + AFM 1 221.52 225.52  
## + FN1 1 221.54 225.54  
## + FETUA.Bovine 1 221.58 225.58  
## + APOB 1 221.58 225.58  
## + MST1 1 221.62 225.62  
## + PLTP 1 221.63 225.63  
## + DKFZp686N02209 1 221.69 225.69  
## + Q5JNX2 1 221.71 225.71  
## + IGHA2 1 221.74 225.74  
## + KNG1 1 221.78 225.78  
## + CLU 1 221.78 225.78  
## + IGFBP3 1 221.80 225.80  
## + AHSG 1 221.81 225.81  
##   
## Step: AIC=213.97  
## Class ~ TIMP1  
##   
## Df Deviance AIC  
## + LAMP2 1 202.29 208.29  
## + HP 1 206.23 212.23  
## + THBS1 1 206.98 212.98  
## + LRG1 1 207.12 213.12  
## + FHR3 1 207.18 213.18  
## + AFM 1 207.72 213.72  
## <none> 209.97 213.97  
## + SERPINA7 1 208.30 214.30  
## + FN1 1 208.36 214.36  
## + LUM 1 208.38 214.38  
## + IGHA2 1 208.43 214.43  
## + BTD 1 208.90 214.90  
## + MMRN1 1 208.92 214.92  
## + VWF 1 209.00 215.00  
## + AHSG 1 209.13 215.13  
## + PRG4 1 209.17 215.17  
## + KNG1 1 209.19 215.19  
## + APOB 1 209.23 215.23  
## + CLU 1 209.34 215.34  
## + CD44 1 209.38 215.38  
## + C20orf3 1 209.59 215.59  
## + HRG 1 209.60 215.60  
## + F5 1 209.60 215.60  
## + AIAG.Bovine 1 209.65 215.65  
## + FCGBP 1 209.69 215.69  
## + IGHG2 1 209.76 215.76  
## + DSG2 1 209.78 215.78  
## + MST1 1 209.78 215.78  
## + FETUA.Bovine 1 209.83 215.83  
## + LGALS3BP 1 209.84 215.84  
## + DKFZp686N02209 1 209.84 215.84  
## + Q5JNX2 1 209.90 215.90  
## + F11 1 209.92 215.92  
## + NCAM1 1 209.92 215.92  
## + LYVE1 1 209.93 215.93  
## + PROC 1 209.94 215.94  
## + PLTP 1 209.95 215.95  
## + CFI 1 209.95 215.95  
## + IGFBP3 1 209.96 215.96  
## + FETUB 1 209.96 215.96  
## - TIMP1 1 221.81 223.81  
##   
## Step: AIC=208.29  
## Class ~ TIMP1 + LAMP2  
##   
## Df Deviance AIC  
## + HP 1 194.96 202.96  
## + SERPINA7 1 195.46 203.46  
## + LRG1 1 196.14 204.14  
## + CFI 1 196.86 204.86  
## + FHR3 1 198.25 206.25  
## + MMRN1 1 199.49 207.49  
## + LGALS3BP 1 199.91 207.91  
## + F11 1 200.19 208.19  
## + DSG2 1 200.21 208.21  
## <none> 202.29 208.29  
## + CD44 1 200.41 208.41  
## + F5 1 200.55 208.55  
## + FETUB 1 200.68 208.68  
## + FCGBP 1 200.81 208.81  
## + THBS1 1 201.34 209.34  
## + NCAM1 1 201.48 209.48  
## + IGHA2 1 201.51 209.51  
## + PROC 1 201.73 209.73  
## + Q5JNX2 1 201.74 209.74  
## + LYVE1 1 201.80 209.80  
## + AIAG.Bovine 1 201.92 209.92  
## + C20orf3 1 201.93 209.93  
## + CLU 1 202.00 210.00  
## + LUM 1 202.06 210.06  
## + IGHG2 1 202.07 210.07  
## + PLTP 1 202.08 210.08  
## + HRG 1 202.09 210.09  
## + AHSG 1 202.10 210.10  
## + BTD 1 202.10 210.10  
## + IGFBP3 1 202.19 210.19  
## + FETUA.Bovine 1 202.19 210.19  
## + MST1 1 202.24 210.24  
## + DKFZp686N02209 1 202.24 210.24  
## + PRG4 1 202.27 210.27  
## + AFM 1 202.28 210.28  
## + VWF 1 202.28 210.28  
## + KNG1 1 202.29 210.29  
## + APOB 1 202.29 210.29  
## + FN1 1 202.29 210.29  
## - LAMP2 1 209.97 213.97  
## - TIMP1 1 218.96 222.96  
##   
## Step: AIC=202.96  
## Class ~ TIMP1 + LAMP2 + HP  
##   
## Df Deviance AIC  
## + LRG1 1 191.82 201.82  
## + SERPINA7 1 191.88 201.88  
## + CFI 1 192.65 202.65  
## + FHR3 1 192.70 202.70  
## + MMRN1 1 192.82 202.82  
## <none> 194.96 202.96  
## + DSG2 1 193.23 203.23  
## + FCGBP 1 193.23 203.23  
## + F5 1 193.47 203.47  
## + CD44 1 193.59 203.59  
## + LUM 1 193.75 203.75  
## + LGALS3BP 1 193.78 203.78  
## + IGHA2 1 194.15 204.15  
## + NCAM1 1 194.23 204.23  
## + THBS1 1 194.24 204.24  
## + IGHG2 1 194.34 204.34  
## + FETUB 1 194.52 204.52  
## + F11 1 194.61 204.61  
## + LYVE1 1 194.64 204.64  
## + KNG1 1 194.71 204.71  
## + MST1 1 194.71 204.71  
## + PRG4 1 194.73 204.73  
## + FETUA.Bovine 1 194.74 204.74  
## + C20orf3 1 194.75 204.75  
## + FN1 1 194.79 204.79  
## + VWF 1 194.86 204.86  
## + Q5JNX2 1 194.86 204.86  
## + BTD 1 194.87 204.87  
## + APOB 1 194.87 204.87  
## + AHSG 1 194.92 204.92  
## + HRG 1 194.94 204.94  
## + PROC 1 194.95 204.95  
## + AFM 1 194.95 204.95  
## + CLU 1 194.95 204.95  
## + IGFBP3 1 194.95 204.95  
## + PLTP 1 194.95 204.95  
## + AIAG.Bovine 1 194.95 204.95  
## + DKFZp686N02209 1 194.96 204.96  
## - HP 1 202.29 208.29  
## - TIMP1 1 203.53 209.53  
## - LAMP2 1 206.23 212.23  
##   
## Step: AIC=201.82  
## Class ~ TIMP1 + LAMP2 + HP + LRG1  
##   
## Df Deviance AIC  
## + SERPINA7 1 189.22 201.22  
## + LUM 1 189.76 201.76  
## <none> 191.82 201.82  
## + CFI 1 190.34 202.34  
## + FCGBP 1 190.61 202.61  
## + LGALS3BP 1 190.64 202.64  
## + F5 1 190.65 202.65  
## + DSG2 1 190.65 202.65  
## + CD44 1 190.69 202.69  
## + MMRN1 1 190.70 202.70  
## + FHR3 1 190.78 202.78  
## + NCAM1 1 190.93 202.93  
## - LRG1 1 194.96 202.96  
## + IGHG2 1 191.24 203.24  
## + IGHA2 1 191.36 203.36  
## + FETUA.Bovine 1 191.46 203.46  
## + THBS1 1 191.52 203.52  
## + APOB 1 191.52 203.52  
## + KNG1 1 191.52 203.52  
## + PRG4 1 191.54 203.54  
## + F11 1 191.66 203.66  
## + AFM 1 191.69 203.69  
## + C20orf3 1 191.69 203.69  
## + AIAG.Bovine 1 191.69 203.69  
## + VWF 1 191.70 203.70  
## + PROC 1 191.76 203.76  
## + MST1 1 191.76 203.76  
## + LYVE1 1 191.77 203.77  
## + CLU 1 191.78 203.78  
## + IGFBP3 1 191.81 203.81  
## + AHSG 1 191.81 203.81  
## + Q5JNX2 1 191.81 203.81  
## + PLTP 1 191.81 203.81  
## + BTD 1 191.82 203.82  
## + FETUB 1 191.82 203.82  
## + DKFZp686N02209 1 191.82 203.82  
## + FN1 1 191.82 203.82  
## + HRG 1 191.82 203.82  
## - HP 1 196.14 204.14  
## - TIMP1 1 197.71 205.71  
## - LAMP2 1 205.03 213.03  
##   
## Step: AIC=201.23  
## Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7  
##   
## Df Deviance AIC  
## + LUM 1 180.75 194.75  
## + IGHG2 1 186.45 200.45  
## <none> 189.22 201.22  
## - HP 1 191.30 201.30  
## + AIAG.Bovine 1 187.32 201.32  
## + APOB 1 187.59 201.59  
## + PRG4 1 187.69 201.69  
## - SERPINA7 1 191.82 201.82  
## + FHR3 1 187.84 201.84  
## + KNG1 1 187.87 201.87  
## - LRG1 1 191.88 201.88  
## + F5 1 187.97 201.97  
## + CLU 1 188.08 202.08  
## + CD44 1 188.11 202.11  
## + CFI 1 188.16 202.16  
## + NCAM1 1 188.24 202.24  
## + MST1 1 188.24 202.24  
## + LGALS3BP 1 188.24 202.24  
## + DKFZp686N02209 1 188.31 202.31  
## + HRG 1 188.38 202.38  
## + FCGBP 1 188.39 202.39  
## + BTD 1 188.42 202.42  
## + DSG2 1 188.43 202.43  
## + FETUA.Bovine 1 188.53 202.53  
## + MMRN1 1 188.68 202.68  
## + PLTP 1 188.71 202.71  
## + LYVE1 1 188.72 202.72  
## + AHSG 1 188.75 202.75  
## + IGHA2 1 188.80 202.80  
## + PROC 1 188.83 202.83  
## + IGFBP3 1 188.86 202.86  
## + THBS1 1 189.03 203.03  
## + FETUB 1 189.04 203.04  
## + VWF 1 189.09 203.09  
## + FN1 1 189.10 203.10  
## + F11 1 189.10 203.10  
## + Q5JNX2 1 189.11 203.11  
## + AFM 1 189.19 203.19  
## + C20orf3 1 189.22 203.22  
## - TIMP1 1 195.38 205.38  
## - LAMP2 1 204.91 214.91  
##   
## Step: AIC=194.75  
## Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7 + LUM  
##   
## Df Deviance AIC  
## + NCAM1 1 178.47 194.47  
## - HP 1 182.59 194.59  
## + MMRN1 1 178.72 194.72  
## <none> 180.75 194.75  
## + FHR3 1 179.01 195.01  
## + FCGBP 1 179.15 195.15  
## + LGALS3BP 1 179.46 195.46  
## + CD44 1 179.81 195.81  
## + IGHA2 1 179.98 195.98  
## + FETUA.Bovine 1 179.98 195.98  
## + DSG2 1 180.10 196.10  
## + KNG1 1 180.21 196.21  
## + CFI 1 180.23 196.23  
## + F5 1 180.28 196.28  
## + FETUB 1 180.40 196.40  
## + IGHG2 1 180.41 196.41  
## + C20orf3 1 180.42 196.42  
## + THBS1 1 180.52 196.52  
## + AHSG 1 180.61 196.61  
## + BTD 1 180.63 196.63  
## + VWF 1 180.64 196.64  
## + CLU 1 180.65 196.65  
## + PRG4 1 180.66 196.66  
## + LYVE1 1 180.66 196.66  
## + F11 1 180.66 196.66  
## + HRG 1 180.66 196.66  
## + MST1 1 180.68 196.68  
## + Q5JNX2 1 180.69 196.69  
## + IGFBP3 1 180.72 196.72  
## + AFM 1 180.72 196.72  
## + PLTP 1 180.73 196.73  
## + AIAG.Bovine 1 180.73 196.73  
## + FN1 1 180.74 196.74  
## + APOB 1 180.75 196.75  
## + PROC 1 180.75 196.75  
## + DKFZp686N02209 1 180.75 196.75  
## - LRG1 1 185.13 197.13  
## - TIMP1 1 187.04 199.04  
## - LUM 1 189.22 201.22  
## - SERPINA7 1 189.76 201.76  
## - LAMP2 1 196.66 208.66  
##   
## Step: AIC=194.47  
## Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7 + LUM + NCAM1  
##   
## Df Deviance AIC  
## - HP 1 180.19 194.19  
## <none> 178.47 194.47  
## + MMRN1 1 176.70 194.70  
## - NCAM1 1 180.75 194.75  
## + FHR3 1 176.86 194.86  
## + LGALS3BP 1 177.08 195.08  
## + IGHA2 1 177.10 195.10  
## + FETUA.Bovine 1 177.71 195.71  
## + FETUB 1 177.75 195.75  
## + FCGBP 1 177.78 195.78  
## + KNG1 1 177.82 195.82  
## + AHSG 1 178.07 196.07  
## + THBS1 1 178.08 196.08  
## + CD44 1 178.09 196.09  
## + CFI 1 178.12 196.12  
## + IGHG2 1 178.24 196.24  
## + C20orf3 1 178.25 196.25  
## + HRG 1 178.32 196.32  
## + LYVE1 1 178.36 196.36  
## + PLTP 1 178.37 196.37  
## + DKFZp686N02209 1 178.37 196.37  
## + APOB 1 178.40 196.40  
## + Q5JNX2 1 178.40 196.40  
## + AIAG.Bovine 1 178.40 196.40  
## + DSG2 1 178.41 196.41  
## + PRG4 1 178.42 196.42  
## + F5 1 178.42 196.42  
## + MST1 1 178.42 196.42  
## + IGFBP3 1 178.43 196.43  
## + PROC 1 178.44 196.44  
## + VWF 1 178.46 196.46  
## + CLU 1 178.46 196.46  
## + BTD 1 178.46 196.46  
## + AFM 1 178.47 196.47  
## + FN1 1 178.47 196.47  
## + F11 1 178.47 196.47  
## - TIMP1 1 182.78 196.78  
## - LRG1 1 183.20 197.20  
## - LUM 1 188.24 202.24  
## - SERPINA7 1 188.50 202.50  
## - LAMP2 1 196.66 210.66  
##   
## Step: AIC=194.19  
## Class ~ TIMP1 + LAMP2 + LRG1 + SERPINA7 + LUM + NCAM1  
##   
## Df Deviance AIC  
## + FHR3 1 178.19 194.19  
## <none> 180.19 194.19  
## + LGALS3BP 1 178.45 194.45  
## + HP 1 178.47 194.47  
## - NCAM1 1 182.59 194.59  
## + MMRN1 1 178.73 194.73  
## + IGHA2 1 178.99 194.99  
## + CFI 1 179.41 195.41  
## + FETUB 1 179.50 195.50  
## + FETUA.Bovine 1 179.50 195.50  
## + KNG1 1 179.54 195.54  
## + CD44 1 179.74 195.74  
## + FCGBP 1 179.76 195.76  
## + THBS1 1 179.86 195.86  
## + IGHG2 1 179.88 195.88  
## + C20orf3 1 179.92 195.92  
## + AHSG 1 179.99 195.99  
## + APOB 1 180.08 196.08  
## + F11 1 180.09 196.09  
## + BTD 1 180.10 196.10  
## + PLTP 1 180.10 196.10  
## + AIAG.Bovine 1 180.10 196.10  
## + PROC 1 180.11 196.11  
## + HRG 1 180.13 196.13  
## + MST1 1 180.14 196.14  
## + FN1 1 180.14 196.14  
## + F5 1 180.14 196.14  
## + VWF 1 180.15 196.15  
## + IGFBP3 1 180.15 196.15  
## + DSG2 1 180.16 196.16  
## + DKFZp686N02209 1 180.16 196.16  
## + CLU 1 180.17 196.17  
## + AFM 1 180.18 196.18  
## + LYVE1 1 180.18 196.18  
## + PRG4 1 180.18 196.18  
## + Q5JNX2 1 180.19 196.19  
## - TIMP1 1 186.01 198.01  
## - LRG1 1 186.75 198.75  
## - LUM 1 190.23 202.23  
## - SERPINA7 1 193.65 205.65  
## - LAMP2 1 197.74 209.74  
##   
## Step: AIC=194.19  
## Class ~ TIMP1 + LAMP2 + LRG1 + SERPINA7 + LUM + NCAM1 + FHR3  
##   
## Df Deviance AIC  
## <none> 178.19 194.19  
## - FHR3 1 180.19 194.19  
## - NCAM1 1 180.38 194.38  
## + MMRN1 1 176.77 194.77  
## + HP 1 176.86 194.86  
## + LGALS3BP 1 177.17 195.17  
## + IGHA2 1 177.33 195.33  
## + KNG1 1 177.40 195.40  
## + FETUA.Bovine 1 177.49 195.49  
## + FETUB 1 177.50 195.50  
## + CFI 1 177.73 195.73  
## + AHSG 1 177.77 195.77  
## + IGHG2 1 177.81 195.81  
## + HRG 1 177.89 195.89  
## - LRG1 1 181.89 195.89  
## + FCGBP 1 177.89 195.89  
## + THBS1 1 177.97 195.97  
## + VWF 1 177.98 195.98  
## + IGFBP3 1 178.04 196.04  
## + C20orf3 1 178.04 196.04  
## + CD44 1 178.08 196.08  
## + AIAG.Bovine 1 178.10 196.10  
## + DKFZp686N02209 1 178.10 196.10  
## + Q5JNX2 1 178.12 196.12  
## + FN1 1 178.12 196.12  
## + BTD 1 178.12 196.12  
## + APOB 1 178.13 196.13  
## + PLTP 1 178.15 196.15  
## + MST1 1 178.16 196.16  
## + LYVE1 1 178.17 196.17  
## + PROC 1 178.18 196.18  
## + AFM 1 178.18 196.18  
## + CLU 1 178.18 196.18  
## + DSG2 1 178.18 196.18  
## + PRG4 1 178.19 196.19  
## + F5 1 178.19 196.19  
## + F11 1 178.19 196.19  
## - TIMP1 1 183.87 197.87  
## - LUM 1 188.58 202.58  
## - SERPINA7 1 192.29 206.29  
## - LAMP2 1 196.03 210.03

summary(model.aic.both)

##   
## Call:  
## glm(formula = Class ~ TIMP1 + LAMP2 + LRG1 + SERPINA7 + LUM +   
## NCAM1 + FHR3, family = binomial, data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.14878 -0.93004 -0.02417 0.93892 2.49909   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 6.1312 8.3810 0.732 0.464434   
## TIMP1 -1.0291 0.4422 -2.328 0.019938 \*   
## LAMP2 2.6904 0.6946 3.873 0.000107 \*\*\*  
## LRG1 -0.7291 0.3851 -1.893 0.058322 .   
## SERPINA7 -2.2482 0.6394 -3.516 0.000438 \*\*\*  
## LUM 1.3098 0.4240 3.089 0.002006 \*\*   
## NCAM1 -0.7839 0.5356 -1.463 0.143332   
## FHR3 -0.2323 0.1666 -1.395 0.163052   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 178.19 on 152 degrees of freedom  
## AIC: 194.19  
##   
## Number of Fisher Scoring iterations: 4

This results in 7 columns in the model with AIC = 194.19

## BIC-based forward-backward selection

model.sbc.both <- step(glm.full, direction = "both", trace = 1, scope=list(lower=glm.null, upper=glm.full),  
 k=log(nrow(train)))

## Start: AIC=370.83  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + C20orf3 + CD44 +   
## CFI + CLU + DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + LYVE1 + MMRN1 + MST1 +   
## NCAM1 + PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - C20orf3 1 162.75 365.76  
## - LYVE1 1 162.75 365.76  
## - CFI 1 162.76 365.76  
## - PLTP 1 162.76 365.76  
## - FN1 1 162.76 365.77  
## - Q5JNX2 1 162.77 365.78  
## - AFM 1 162.79 365.80  
## - CD44 1 162.80 365.81  
## - PROC 1 162.80 365.81  
## - DSG2 1 162.85 365.85  
## - BTD 1 162.86 365.87  
## - MST1 1 162.90 365.91  
## - AHSG 1 162.95 365.96  
## - LRG1 1 162.98 365.98  
## - APOB 1 162.98 365.99  
## - F11 1 162.99 366.00  
## - FETUB 1 163.02 366.03  
## - PRG4 1 163.06 366.07  
## - HRG 1 163.08 366.09  
## - AIAG.Bovine 1 163.12 366.12  
## - TIMP1 1 163.16 366.16  
## - IGFBP3 1 163.20 366.21  
## - F5 1 163.23 366.23  
## - THBS1 1 163.44 366.45  
## - VWF 1 163.46 366.46  
## - CLU 1 163.48 366.49  
## - FCGBP 1 163.65 366.65  
## - LGALS3BP 1 163.85 366.86  
## - FHR3 1 163.89 366.90  
## - IGHG2 1 163.94 366.95  
## - KNG1 1 164.13 367.13  
## - IGHA2 1 164.42 367.43  
## - DKFZp686N02209 1 164.43 367.44  
## - HP 1 164.85 367.86  
## - NCAM1 1 164.96 367.97  
## - MMRN1 1 164.97 367.97  
## - FETUA.Bovine 1 165.47 368.48  
## - LUM 1 166.60 369.61  
## <none> 162.75 370.83  
## - SERPINA7 1 171.36 374.37  
## - LAMP2 1 174.73 377.73  
##   
## Step: AIC=365.76  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CFI +   
## CLU + DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + LYVE1 + MMRN1 + MST1 +   
## NCAM1 + PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - LYVE1 1 162.75 360.68  
## - CFI 1 162.76 360.69  
## - PLTP 1 162.76 360.69  
## - FN1 1 162.76 360.69  
## - Q5JNX2 1 162.77 360.71  
## - AFM 1 162.79 360.72  
## - CD44 1 162.80 360.73  
## - PROC 1 162.80 360.73  
## - DSG2 1 162.85 360.78  
## - BTD 1 162.86 360.79  
## - MST1 1 162.90 360.83  
## - AHSG 1 162.95 360.88  
## - LRG1 1 162.98 360.91  
## - APOB 1 162.99 360.92  
## - F11 1 162.99 360.92  
## - FETUB 1 163.02 360.95  
## - PRG4 1 163.07 361.00  
## - HRG 1 163.08 361.01  
## - AIAG.Bovine 1 163.15 361.08  
## - TIMP1 1 163.16 361.09  
## - IGFBP3 1 163.22 361.15  
## - F5 1 163.23 361.16  
## - THBS1 1 163.44 361.37  
## - VWF 1 163.46 361.39  
## - CLU 1 163.49 361.42  
## - FCGBP 1 163.65 361.58  
## - LGALS3BP 1 163.88 361.81  
## - FHR3 1 163.90 361.83  
## - IGHG2 1 163.94 361.87  
## - KNG1 1 164.13 362.06  
## - DKFZp686N02209 1 164.43 362.36  
## - IGHA2 1 164.46 362.39  
## - HP 1 164.87 362.80  
## - MMRN1 1 165.00 362.93  
## - NCAM1 1 165.00 362.93  
## - FETUA.Bovine 1 165.51 363.44  
## - LUM 1 166.62 364.55  
## <none> 162.75 365.76  
## - SERPINA7 1 171.45 369.38  
## + C20orf3 1 162.75 370.83  
## - LAMP2 1 174.73 372.66  
##   
## Step: AIC=360.68  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CFI +   
## CLU + DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 +   
## PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 +   
## VWF  
##   
## Df Deviance AIC  
## - CFI 1 162.76 355.61  
## - PLTP 1 162.76 355.61  
## - FN1 1 162.76 355.62  
## - Q5JNX2 1 162.78 355.63  
## - AFM 1 162.79 355.65  
## - CD44 1 162.80 355.66  
## - PROC 1 162.80 355.66  
## - DSG2 1 162.85 355.71  
## - BTD 1 162.86 355.72  
## - MST1 1 162.90 355.76  
## - AHSG 1 162.95 355.81  
## - LRG1 1 162.99 355.84  
## - APOB 1 163.00 355.85  
## - F11 1 163.00 355.86  
## - FETUB 1 163.03 355.88  
## - PRG4 1 163.08 355.93  
## - HRG 1 163.08 355.94  
## - AIAG.Bovine 1 163.15 356.01  
## - TIMP1 1 163.16 356.02  
## - IGFBP3 1 163.23 356.08  
## - F5 1 163.24 356.10  
## - THBS1 1 163.45 356.30  
## - VWF 1 163.46 356.32  
## - CLU 1 163.49 356.35  
## - FCGBP 1 163.65 356.51  
## - FHR3 1 163.90 356.75  
## - LGALS3BP 1 163.90 356.76  
## - IGHG2 1 163.95 356.80  
## - KNG1 1 164.13 356.98  
## - DKFZp686N02209 1 164.43 357.29  
## - IGHA2 1 164.47 357.32  
## - HP 1 164.94 357.80  
## - NCAM1 1 165.01 357.87  
## - MMRN1 1 165.08 357.94  
## - FETUA.Bovine 1 165.51 358.37  
## - LUM 1 167.15 360.01  
## <none> 162.75 360.68  
## - SERPINA7 1 172.02 364.88  
## + LYVE1 1 162.75 365.76  
## + C20orf3 1 162.75 365.76  
## - LAMP2 1 174.74 367.60  
##   
## Step: AIC=355.61  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU +   
## DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 +   
## PLTP + PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 +   
## VWF  
##   
## Df Deviance AIC  
## - PLTP 1 162.76 350.54  
## - FN1 1 162.77 350.55  
## - Q5JNX2 1 162.78 350.56  
## - AFM 1 162.79 350.58  
## - PROC 1 162.81 350.59  
## - CD44 1 162.81 350.59  
## - DSG2 1 162.86 350.64  
## - BTD 1 162.86 350.64  
## - MST1 1 162.91 350.70  
## - AHSG 1 162.95 350.73  
## - APOB 1 163.01 350.79  
## - LRG1 1 163.01 350.79  
## - FETUB 1 163.04 350.82  
## - F11 1 163.05 350.83  
## - PRG4 1 163.08 350.86  
## - HRG 1 163.09 350.87  
## - TIMP1 1 163.16 350.94  
## - AIAG.Bovine 1 163.24 351.02  
## - IGFBP3 1 163.27 351.05  
## - F5 1 163.28 351.07  
## - THBS1 1 163.45 351.23  
## - VWF 1 163.46 351.24  
## - CLU 1 163.53 351.31  
## - FCGBP 1 163.65 351.44  
## - FHR3 1 163.90 351.68  
## - IGHG2 1 163.95 351.73  
## - LGALS3BP 1 163.97 351.75  
## - KNG1 1 164.19 351.97  
## - DKFZp686N02209 1 164.47 352.25  
## - IGHA2 1 164.47 352.25  
## - NCAM1 1 165.01 352.79  
## - HP 1 165.07 352.85  
## - MMRN1 1 165.08 352.87  
## - FETUA.Bovine 1 165.72 353.50  
## - LUM 1 167.18 354.96  
## <none> 162.76 355.61  
## + CFI 1 162.75 360.68  
## + LYVE1 1 162.76 360.69  
## + C20orf3 1 162.76 360.69  
## - SERPINA7 1 173.05 360.83  
## - LAMP2 1 174.95 362.73  
##   
## Step: AIC=350.54  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU +   
## DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + FN1 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 +   
## PRG4 + PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - FN1 1 162.78 345.48  
## - Q5JNX2 1 162.79 345.49  
## - AFM 1 162.80 345.50  
## - PROC 1 162.81 345.51  
## - CD44 1 162.81 345.52  
## - BTD 1 162.87 345.57  
## - DSG2 1 162.87 345.57  
## - MST1 1 162.92 345.62  
## - AHSG 1 162.96 345.66  
## - LRG1 1 163.01 345.72  
## - APOB 1 163.02 345.73  
## - FETUB 1 163.05 345.76  
## - F11 1 163.06 345.77  
## - PRG4 1 163.09 345.80  
## - HRG 1 163.10 345.81  
## - TIMP1 1 163.17 345.87  
## - AIAG.Bovine 1 163.25 345.95  
## - IGFBP3 1 163.28 345.98  
## - F5 1 163.29 345.99  
## - THBS1 1 163.45 346.16  
## - VWF 1 163.47 346.17  
## - CLU 1 163.60 346.31  
## - FCGBP 1 163.66 346.37  
## - FHR3 1 163.90 346.61  
## - IGHG2 1 163.95 346.66  
## - LGALS3BP 1 163.97 346.67  
## - KNG1 1 164.23 346.93  
## - IGHA2 1 164.47 347.18  
## - DKFZp686N02209 1 164.47 347.18  
## - NCAM1 1 165.04 347.75  
## - MMRN1 1 165.08 347.79  
## - HP 1 165.09 347.79  
## - FETUA.Bovine 1 165.74 348.44  
## - LUM 1 167.36 350.07  
## <none> 162.76 350.54  
## + PLTP 1 162.76 355.61  
## + CFI 1 162.76 355.61  
## + LYVE1 1 162.76 355.62  
## + C20orf3 1 162.76 355.62  
## - SERPINA7 1 173.16 355.86  
## - LAMP2 1 175.10 357.80  
##   
## Step: AIC=345.48  
## Class ~ AFM + AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU +   
## DKFZp686N02209 + DSG2 + F11 + F5 + FCGBP + FETUA.Bovine +   
## FETUB + FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 +   
## LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 +   
## PROC + Q5JNX2 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - AFM 1 162.81 340.44  
## - Q5JNX2 1 162.81 340.44  
## - CD44 1 162.81 340.45  
## - PROC 1 162.82 340.45  
## - BTD 1 162.87 340.50  
## - DSG2 1 162.90 340.53  
## - MST1 1 162.93 340.56  
## - AHSG 1 163.00 340.63  
## - APOB 1 163.04 340.67  
## - LRG1 1 163.06 340.69  
## - FETUB 1 163.06 340.69  
## - F11 1 163.10 340.73  
## - HRG 1 163.11 340.74  
## - PRG4 1 163.14 340.77  
## - TIMP1 1 163.17 340.80  
## - AIAG.Bovine 1 163.25 340.88  
## - IGFBP3 1 163.28 340.91  
## - F5 1 163.38 341.01  
## - THBS1 1 163.47 341.10  
## - VWF 1 163.48 341.11  
## - CLU 1 163.60 341.23  
## - FCGBP 1 163.67 341.30  
## - FHR3 1 163.95 341.58  
## - LGALS3BP 1 163.97 341.60  
## - IGHG2 1 164.03 341.66  
## - KNG1 1 164.23 341.86  
## - DKFZp686N02209 1 164.47 342.11  
## - IGHA2 1 164.48 342.11  
## - HP 1 165.09 342.72  
## - NCAM1 1 165.10 342.73  
## - MMRN1 1 165.11 342.75  
## - FETUA.Bovine 1 165.74 343.37  
## - LUM 1 167.38 345.01  
## <none> 162.78 345.48  
## + FN1 1 162.76 350.54  
## + PLTP 1 162.77 350.55  
## + CFI 1 162.77 350.55  
## + LYVE1 1 162.78 350.56  
## + C20orf3 1 162.78 350.56  
## - SERPINA7 1 173.17 350.80  
## - LAMP2 1 175.39 353.02  
##   
## Step: AIC=340.44  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + PROC + Q5JNX2 +   
## SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - Q5JNX2 1 162.83 335.39  
## - PROC 1 162.84 335.40  
## - CD44 1 162.84 335.40  
## - BTD 1 162.89 335.44  
## - DSG2 1 162.93 335.49  
## - MST1 1 162.96 335.52  
## - APOB 1 163.05 335.60  
## - FETUB 1 163.08 335.64  
## - AHSG 1 163.09 335.64  
## - F11 1 163.12 335.67  
## - LRG1 1 163.12 335.67  
## - HRG 1 163.14 335.69  
## - PRG4 1 163.18 335.73  
## - TIMP1 1 163.18 335.74  
## - AIAG.Bovine 1 163.25 335.81  
## - IGFBP3 1 163.34 335.90  
## - F5 1 163.38 335.93  
## - VWF 1 163.49 336.05  
## - THBS1 1 163.51 336.06  
## - CLU 1 163.61 336.17  
## - FCGBP 1 163.68 336.23  
## - LGALS3BP 1 163.97 336.53  
## - FHR3 1 163.98 336.53  
## - IGHG2 1 164.07 336.63  
## - KNG1 1 164.25 336.80  
## - IGHA2 1 164.56 337.12  
## - DKFZp686N02209 1 164.68 337.24  
## - HP 1 165.13 337.69  
## - NCAM1 1 165.15 337.71  
## - MMRN1 1 165.28 337.84  
## - FETUA.Bovine 1 165.76 338.32  
## - LUM 1 167.54 340.10  
## <none> 162.81 340.44  
## + AFM 1 162.78 345.48  
## + FN1 1 162.80 345.50  
## + PLTP 1 162.81 345.51  
## + CFI 1 162.81 345.51  
## + LYVE1 1 162.81 345.51  
## + C20orf3 1 162.81 345.51  
## - SERPINA7 1 173.18 345.74  
## - LAMP2 1 176.63 349.19  
##   
## Step: AIC=335.39  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + PROC + SERPINA7 +   
## THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - PROC 1 162.86 330.34  
## - CD44 1 162.87 330.35  
## - BTD 1 162.91 330.39  
## - DSG2 1 162.97 330.45  
## - MST1 1 162.98 330.46  
## - APOB 1 163.09 330.57  
## - AHSG 1 163.11 330.59  
## - LRG1 1 163.12 330.61  
## - FETUB 1 163.13 330.61  
## - F11 1 163.18 330.66  
## - TIMP1 1 163.19 330.67  
## - HRG 1 163.19 330.67  
## - PRG4 1 163.23 330.71  
## - AIAG.Bovine 1 163.25 330.73  
## - F5 1 163.38 330.86  
## - IGFBP3 1 163.38 330.87  
## - VWF 1 163.51 330.99  
## - THBS1 1 163.51 330.99  
## - CLU 1 163.61 331.09  
## - FCGBP 1 163.68 331.16  
## - FHR3 1 163.99 331.47  
## - LGALS3BP 1 164.03 331.51  
## - IGHG2 1 164.20 331.68  
## - KNG1 1 164.25 331.74  
## - IGHA2 1 164.56 332.04  
## - DKFZp686N02209 1 164.97 332.45  
## - NCAM1 1 165.15 332.63  
## - HP 1 165.16 332.64  
## - MMRN1 1 165.50 332.98  
## - FETUA.Bovine 1 165.95 333.43  
## - LUM 1 167.55 335.03  
## <none> 162.83 335.39  
## + Q5JNX2 1 162.81 340.44  
## + AFM 1 162.81 340.44  
## + FN1 1 162.82 340.45  
## + PLTP 1 162.83 340.46  
## + LYVE1 1 162.83 340.46  
## + CFI 1 162.83 340.46  
## + C20orf3 1 162.83 340.47  
## - SERPINA7 1 173.48 340.96  
## - LAMP2 1 177.04 344.52  
##   
## Step: AIC=330.34  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CD44 + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - CD44 1 162.91 325.31  
## - BTD 1 162.94 325.34  
## - DSG2 1 163.00 325.40  
## - MST1 1 163.01 325.42  
## - AHSG 1 163.13 325.53  
## - APOB 1 163.13 325.54  
## - LRG1 1 163.16 325.56  
## - FETUB 1 163.18 325.59  
## - HRG 1 163.20 325.60  
## - TIMP1 1 163.21 325.62  
## - PRG4 1 163.23 325.64  
## - F11 1 163.26 325.67  
## - AIAG.Bovine 1 163.27 325.68  
## - IGFBP3 1 163.38 325.79  
## - F5 1 163.39 325.79  
## - VWF 1 163.51 325.92  
## - THBS1 1 163.53 325.93  
## - CLU 1 163.61 326.02  
## - FCGBP 1 163.71 326.11  
## - FHR3 1 164.00 326.41  
## - LGALS3BP 1 164.09 326.50  
## - IGHG2 1 164.20 326.60  
## - KNG1 1 164.27 326.68  
## - IGHA2 1 164.65 327.05  
## - NCAM1 1 165.17 327.57  
## - DKFZp686N02209 1 165.17 327.58  
## - HP 1 165.20 327.61  
## - MMRN1 1 165.60 328.01  
## - FETUA.Bovine 1 165.99 328.40  
## - LUM 1 167.57 329.98  
## <none> 162.86 330.34  
## + PROC 1 162.83 335.39  
## + Q5JNX2 1 162.84 335.40  
## + AFM 1 162.84 335.40  
## + FN1 1 162.85 335.41  
## + LYVE1 1 162.86 335.42  
## + CFI 1 162.86 335.42  
## + PLTP 1 162.86 335.42  
## + C20orf3 1 162.86 335.42  
## - SERPINA7 1 173.65 336.05  
## - LAMP2 1 177.17 339.57  
##   
## Step: AIC=325.31  
## Class ~ AHSG + AIAG.Bovine + APOB + BTD + CLU + DKFZp686N02209 +   
## DSG2 + F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP +   
## HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LRG1 + LUM + MMRN1 + MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - BTD 1 162.95 320.28  
## - DSG2 1 163.02 320.35  
## - MST1 1 163.09 320.42  
## - AHSG 1 163.15 320.48  
## - LRG1 1 163.17 320.50  
## - APOB 1 163.19 320.52  
## - HRG 1 163.24 320.57  
## - TIMP1 1 163.25 320.58  
## - FETUB 1 163.26 320.59  
## - AIAG.Bovine 1 163.28 320.61  
## - PRG4 1 163.29 320.62  
## - F11 1 163.31 320.64  
## - IGFBP3 1 163.39 320.72  
## - F5 1 163.48 320.81  
## - VWF 1 163.52 320.85  
## - THBS1 1 163.62 320.95  
## - CLU 1 163.65 320.98  
## - FCGBP 1 163.74 321.07  
## - FHR3 1 164.09 321.42  
## - LGALS3BP 1 164.22 321.55  
## - IGHG2 1 164.32 321.65  
## - KNG1 1 164.41 321.74  
## - IGHA2 1 164.65 321.98  
## - NCAM1 1 165.19 322.53  
## - DKFZp686N02209 1 165.21 322.53  
## - HP 1 165.28 322.61  
## - MMRN1 1 165.95 323.28  
## - FETUA.Bovine 1 166.24 323.57  
## - LUM 1 167.57 324.90  
## <none> 162.91 325.31  
## + CD44 1 162.86 330.34  
## + PROC 1 162.87 330.35  
## + Q5JNX2 1 162.88 330.36  
## + AFM 1 162.89 330.37  
## + CFI 1 162.90 330.38  
## + FN1 1 162.91 330.39  
## + LYVE1 1 162.91 330.39  
## + C20orf3 1 162.91 330.39  
## + PLTP 1 162.91 330.39  
## - SERPINA7 1 173.81 331.14  
## - LAMP2 1 177.27 334.60  
##   
## Step: AIC=320.28  
## Class ~ AHSG + AIAG.Bovine + APOB + CLU + DKFZp686N02209 + DSG2 +   
## F11 + F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG +   
## IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LRG1 +   
## LUM + MMRN1 + MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 +   
## VWF  
##   
## Df Deviance AIC  
## - DSG2 1 163.05 315.31  
## - MST1 1 163.15 315.40  
## - AHSG 1 163.16 315.41  
## - LRG1 1 163.19 315.44  
## - TIMP1 1 163.25 315.51  
## - APOB 1 163.26 315.51  
## - HRG 1 163.28 315.54  
## - PRG4 1 163.31 315.56  
## - FETUB 1 163.32 315.57  
## - AIAG.Bovine 1 163.32 315.58  
## - IGFBP3 1 163.39 315.65  
## - F11 1 163.41 315.66  
## - F5 1 163.52 315.78  
## - VWF 1 163.54 315.80  
## - THBS1 1 163.64 315.90  
## - FCGBP 1 163.76 316.02  
## - CLU 1 163.77 316.02  
## - FHR3 1 164.10 316.35  
## - IGHG2 1 164.33 316.59  
## - LGALS3BP 1 164.34 316.59  
## - KNG1 1 164.43 316.68  
## - IGHA2 1 164.71 316.97  
## - DKFZp686N02209 1 165.23 317.49  
## - NCAM1 1 165.27 317.52  
## - HP 1 165.42 317.68  
## - MMRN1 1 166.11 318.37  
## - FETUA.Bovine 1 166.38 318.63  
## - LUM 1 167.65 319.90  
## <none> 162.95 320.28  
## + BTD 1 162.91 325.31  
## + PROC 1 162.92 325.33  
## + Q5JNX2 1 162.94 325.34  
## + CD44 1 162.94 325.34  
## + AFM 1 162.94 325.35  
## + LYVE1 1 162.95 325.36  
## + CFI 1 162.95 325.36  
## + PLTP 1 162.95 325.36  
## + C20orf3 1 162.95 325.36  
## + FN1 1 162.95 325.36  
## - SERPINA7 1 173.85 326.11  
## - LAMP2 1 177.28 329.53  
##   
## Step: AIC=315.31  
## Class ~ AHSG + AIAG.Bovine + APOB + CLU + DKFZp686N02209 + F11 +   
## F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG + IGFBP3 +   
## IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LRG1 + LUM + MMRN1 +   
## MST1 + NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - LRG1 1 163.26 310.44  
## - AHSG 1 163.27 310.45  
## - MST1 1 163.27 310.45  
## - APOB 1 163.30 310.48  
## - PRG4 1 163.38 310.56  
## - TIMP1 1 163.39 310.57  
## - F11 1 163.41 310.59  
## - FETUB 1 163.41 310.59  
## - IGFBP3 1 163.42 310.60  
## - AIAG.Bovine 1 163.44 310.63  
## - HRG 1 163.47 310.65  
## - F5 1 163.56 310.74  
## - VWF 1 163.78 310.96  
## - FCGBP 1 163.80 310.98  
## - THBS1 1 163.82 311.00  
## - CLU 1 163.95 311.13  
## - FHR3 1 164.21 311.39  
## - IGHG2 1 164.36 311.54  
## - LGALS3BP 1 164.47 311.65  
## - KNG1 1 164.55 311.73  
## - IGHA2 1 164.72 311.90  
## - DKFZp686N02209 1 165.25 312.43  
## - NCAM1 1 165.28 312.45  
## - HP 1 165.68 312.86  
## - MMRN1 1 166.16 313.34  
## - FETUA.Bovine 1 166.40 313.58  
## - LUM 1 167.81 314.99  
## <none> 163.05 315.31  
## + DSG2 1 162.95 320.28  
## + PROC 1 163.02 320.35  
## + BTD 1 163.02 320.35  
## + Q5JNX2 1 163.03 320.36  
## + AFM 1 163.04 320.37  
## + CD44 1 163.05 320.38  
## + FN1 1 163.05 320.38  
## + C20orf3 1 163.05 320.38  
## + LYVE1 1 163.05 320.38  
## + CFI 1 163.05 320.38  
## + PLTP 1 163.05 320.38  
## - SERPINA7 1 173.98 321.16  
## - LAMP2 1 177.29 324.47  
##   
## Step: AIC=310.44  
## Class ~ AHSG + AIAG.Bovine + APOB + CLU + DKFZp686N02209 + F11 +   
## F5 + FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG + IGFBP3 +   
## IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + MST1 +   
## NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - APOB 1 163.48 305.59  
## - AHSG 1 163.50 305.60  
## - FETUB 1 163.50 305.61  
## - MST1 1 163.56 305.67  
## - PRG4 1 163.65 305.76  
## - AIAG.Bovine 1 163.66 305.76  
## - F11 1 163.69 305.80  
## - TIMP1 1 163.73 305.83  
## - HRG 1 163.76 305.87  
## - IGFBP3 1 163.85 305.95  
## - F5 1 163.91 306.02  
## - FCGBP 1 164.23 306.33  
## - CLU 1 164.25 306.36  
## - VWF 1 164.26 306.37  
## - THBS1 1 164.29 306.39  
## - LGALS3BP 1 164.58 306.69  
## - IGHG2 1 164.61 306.72  
## - KNG1 1 164.79 306.90  
## - FHR3 1 164.83 306.94  
## - IGHA2 1 165.06 307.17  
## - NCAM1 1 165.34 307.44  
## - DKFZp686N02209 1 165.53 307.64  
## - HP 1 166.34 308.44  
## - FETUA.Bovine 1 166.73 308.84  
## - MMRN1 1 167.11 309.21  
## - LUM 1 167.87 309.97  
## <none> 163.26 310.44  
## + LRG1 1 163.05 315.31  
## + DSG2 1 163.19 315.44  
## + PROC 1 163.23 315.48  
## + AFM 1 163.23 315.49  
## + FN1 1 163.24 315.49  
## + CFI 1 163.25 315.50  
## + BTD 1 163.25 315.51  
## + LYVE1 1 163.25 315.51  
## + C20orf3 1 163.25 315.51  
## + Q5JNX2 1 163.25 315.51  
## + CD44 1 163.26 315.52  
## + PLTP 1 163.26 315.52  
## - SERPINA7 1 174.37 316.47  
## - LAMP2 1 177.29 319.40  
##   
## Step: AIC=305.59  
## Class ~ AHSG + AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 +   
## FCGBP + FETUA.Bovine + FETUB + FHR3 + HP + HRG + IGFBP3 +   
## IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + MST1 +   
## NCAM1 + PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - FETUB 1 163.72 300.75  
## - AHSG 1 163.73 300.75  
## - MST1 1 163.79 300.82  
## - HRG 1 163.90 300.93  
## - F11 1 163.91 300.94  
## - F5 1 163.96 300.99  
## - TIMP1 1 164.02 301.05  
## - AIAG.Bovine 1 164.05 301.08  
## - PRG4 1 164.08 301.11  
## - IGFBP3 1 164.20 301.23  
## - CLU 1 164.39 301.42  
## - VWF 1 164.45 301.48  
## - FCGBP 1 164.52 301.55  
## - THBS1 1 164.59 301.62  
## - LGALS3BP 1 164.72 301.75  
## - IGHG2 1 164.86 301.89  
## - KNG1 1 164.96 301.99  
## - FHR3 1 165.16 302.19  
## - IGHA2 1 165.19 302.22  
## - NCAM1 1 165.49 302.52  
## - DKFZp686N02209 1 165.63 302.66  
## - HP 1 166.56 303.59  
## - FETUA.Bovine 1 166.90 303.93  
## - MMRN1 1 167.13 304.16  
## <none> 163.48 305.59  
## - LUM 1 168.67 305.70  
## + APOB 1 163.26 310.44  
## + LRG1 1 163.30 310.48  
## + PROC 1 163.44 310.62  
## + DSG2 1 163.45 310.63  
## + C20orf3 1 163.46 310.64  
## + BTD 1 163.46 310.64  
## + LYVE1 1 163.46 310.64  
## + CFI 1 163.46 310.64  
## + FN1 1 163.47 310.64  
## + Q5JNX2 1 163.47 310.64  
## + AFM 1 163.47 310.65  
## + CD44 1 163.48 310.66  
## + PLTP 1 163.48 310.66  
## - SERPINA7 1 174.87 311.90  
## - LAMP2 1 177.58 314.61  
##   
## Step: AIC=300.75  
## Class ~ AHSG + AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 +   
## FCGBP + FETUA.Bovine + FHR3 + HP + HRG + IGFBP3 + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + MST1 + NCAM1 +   
## PRG4 + SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - MST1 1 164.01 295.96  
## - AHSG 1 164.02 295.97  
## - F11 1 164.10 296.05  
## - HRG 1 164.10 296.06  
## - F5 1 164.19 296.15  
## - TIMP1 1 164.27 296.23  
## - PRG4 1 164.40 296.36  
## - AIAG.Bovine 1 164.44 296.39  
## - IGFBP3 1 164.46 296.42  
## - CLU 1 164.50 296.45  
## - VWF 1 164.69 296.64  
## - THBS1 1 164.78 296.73  
## - FCGBP 1 164.79 296.75  
## - LGALS3BP 1 164.97 296.92  
## - IGHG2 1 165.00 296.96  
## - KNG1 1 165.11 297.07  
## - FHR3 1 165.31 297.27  
## - IGHA2 1 165.47 297.42  
## - NCAM1 1 165.69 297.64  
## - DKFZp686N02209 1 166.12 298.08  
## - HP 1 166.83 298.78  
## - FETUA.Bovine 1 167.10 299.05  
## - MMRN1 1 167.19 299.14  
## - LUM 1 168.74 300.69  
## <none> 163.72 300.75  
## + FETUB 1 163.48 305.59  
## + APOB 1 163.50 305.61  
## + PROC 1 163.64 305.75  
## + LRG1 1 163.65 305.76  
## + BTD 1 163.68 305.79  
## + Q5JNX2 1 163.69 305.79  
## + DSG2 1 163.69 305.80  
## + LYVE1 1 163.69 305.80  
## + CD44 1 163.70 305.81  
## + C20orf3 1 163.71 305.81  
## + CFI 1 163.71 305.81  
## + PLTP 1 163.72 305.82  
## + FN1 1 163.72 305.82  
## + AFM 1 163.72 305.83  
## - SERPINA7 1 174.94 306.90  
## - LAMP2 1 178.45 310.40  
##   
## Step: AIC=295.96  
## Class ~ AHSG + AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 +   
## FCGBP + FETUA.Bovine + FHR3 + HP + HRG + IGFBP3 + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 +   
## SERPINA7 + THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - AHSG 1 164.26 291.14  
## - F11 1 164.33 291.21  
## - TIMP1 1 164.44 291.32  
## - F5 1 164.48 291.36  
## - HRG 1 164.57 291.45  
## - PRG4 1 164.65 291.53  
## - AIAG.Bovine 1 164.72 291.60  
## - CLU 1 164.82 291.70  
## - IGFBP3 1 164.88 291.76  
## - VWF 1 164.93 291.81  
## - FCGBP 1 165.05 291.93  
## - THBS1 1 165.10 291.98  
## - LGALS3BP 1 165.20 292.08  
## - KNG1 1 165.38 292.26  
## - IGHG2 1 165.53 292.40  
## - IGHA2 1 165.62 292.49  
## - FHR3 1 165.89 292.77  
## - NCAM1 1 165.89 292.77  
## - DKFZp686N02209 1 166.22 293.10  
## - HP 1 167.13 294.01  
## - MMRN1 1 167.41 294.29  
## - FETUA.Bovine 1 167.48 294.36  
## <none> 164.01 295.96  
## - LUM 1 169.14 296.02  
## + MST1 1 163.72 300.75  
## + APOB 1 163.78 300.81  
## + FETUB 1 163.79 300.82  
## + LRG1 1 163.88 300.91  
## + PROC 1 163.91 300.94  
## + BTD 1 163.96 300.99  
## + DSG2 1 163.96 300.99  
## + CFI 1 163.97 301.00  
## + LYVE1 1 163.97 301.00  
## + CD44 1 163.98 301.01  
## + Q5JNX2 1 163.99 301.02  
## + C20orf3 1 164.00 301.03  
## + AFM 1 164.01 301.04  
## + PLTP 1 164.01 301.04  
## + FN1 1 164.01 301.04  
## - SERPINA7 1 175.25 302.12  
## - LAMP2 1 178.64 305.52  
##   
## Step: AIC=291.14  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + F11 + F5 + FCGBP +   
## FETUA.Bovine + FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 +   
## KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 +   
## THBS1 + TIMP1 + VWF  
##   
## Df Deviance AIC  
## - F11 1 164.55 286.36  
## - TIMP1 1 164.71 286.52  
## - F5 1 164.73 286.53  
## - PRG4 1 164.81 286.61  
## - AIAG.Bovine 1 164.90 286.70  
## - HRG 1 164.97 286.77  
## - CLU 1 165.01 286.81  
## - IGFBP3 1 165.11 286.92  
## - LGALS3BP 1 165.35 287.15  
## - FCGBP 1 165.36 287.17  
## - VWF 1 165.41 287.22  
## - THBS1 1 165.51 287.31  
## - KNG1 1 165.62 287.43  
## - IGHG2 1 165.87 287.67  
## - IGHA2 1 165.98 287.78  
## - NCAM1 1 166.09 287.89  
## - FHR3 1 166.13 287.93  
## - DKFZp686N02209 1 166.56 288.37  
## - HP 1 167.22 289.03  
## - FETUA.Bovine 1 167.69 289.50  
## - MMRN1 1 167.97 289.77  
## <none> 164.26 291.14  
## - LUM 1 169.83 291.63  
## + FETUB 1 164.00 295.96  
## + AHSG 1 164.01 295.96  
## + MST1 1 164.02 295.97  
## + APOB 1 164.03 295.98  
## + LRG1 1 164.14 296.09  
## + PROC 1 164.19 296.15  
## + DSG2 1 164.21 296.16  
## + LYVE1 1 164.22 296.18  
## + CD44 1 164.23 296.19  
## + FN1 1 164.24 296.19  
## + Q5JNX2 1 164.24 296.19  
## + AFM 1 164.24 296.19  
## + CFI 1 164.25 296.20  
## + BTD 1 164.26 296.21  
## + C20orf3 1 164.26 296.22  
## + PLTP 1 164.26 296.22  
## - SERPINA7 1 175.33 297.13  
## - LAMP2 1 179.01 300.82  
##   
## Step: AIC=286.36  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + F5 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 +   
## LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## TIMP1 + VWF  
##   
## Df Deviance AIC  
## - TIMP1 1 164.94 281.67  
## - PRG4 1 165.06 281.79  
## - HRG 1 165.15 281.88  
## - F5 1 165.18 281.91  
## - IGFBP3 1 165.26 281.99  
## - AIAG.Bovine 1 165.35 282.08  
## - CLU 1 165.45 282.18  
## - LGALS3BP 1 165.47 282.19  
## - FCGBP 1 165.51 282.24  
## - THBS1 1 165.61 282.33  
## - VWF 1 165.75 282.48  
## - KNG1 1 165.84 282.57  
## - IGHA2 1 166.16 282.89  
## - IGHG2 1 166.24 282.97  
## - NCAM1 1 166.54 283.27  
## - DKFZp686N02209 1 166.72 283.44  
## - FHR3 1 167.05 283.78  
## - FETUA.Bovine 1 167.97 284.70  
## - HP 1 168.09 284.82  
## - MMRN1 1 168.39 285.12  
## <none> 164.55 286.36  
## - LUM 1 170.14 286.87  
## + F11 1 164.26 291.14  
## + APOB 1 164.32 291.20  
## + AHSG 1 164.33 291.21  
## + FETUB 1 164.34 291.22  
## + MST1 1 164.35 291.23  
## + LRG1 1 164.38 291.26  
## + PROC 1 164.43 291.30  
## + CFI 1 164.48 291.36  
## + LYVE1 1 164.48 291.36  
## + Q5JNX2 1 164.50 291.38  
## + CD44 1 164.52 291.40  
## + FN1 1 164.52 291.40  
## + BTD 1 164.54 291.42  
## + AFM 1 164.54 291.43  
## + C20orf3 1 164.55 291.43  
## + PLTP 1 164.55 291.43  
## + DSG2 1 164.55 291.43  
## - SERPINA7 1 175.74 292.46  
## - LAMP2 1 179.10 295.83  
##   
## Step: AIC=281.67  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + F5 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 +   
## LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## VWF  
##   
## Df Deviance AIC  
## - F5 1 165.48 277.14  
## - IGFBP3 1 165.55 277.20  
## - THBS1 1 165.66 277.31  
## - CLU 1 165.70 277.35  
## - PRG4 1 165.71 277.36  
## - HRG 1 165.72 277.38  
## - FCGBP 1 165.90 277.55  
## - LGALS3BP 1 165.92 277.58  
## - AIAG.Bovine 1 165.93 277.58  
## - VWF 1 165.93 277.58  
## - KNG1 1 166.28 277.93  
## - IGHA2 1 166.37 278.02  
## - IGHG2 1 166.70 278.35  
## - NCAM1 1 166.99 278.65  
## - DKFZp686N02209 1 167.30 278.95  
## - FHR3 1 167.51 279.17  
## - FETUA.Bovine 1 168.75 280.40  
## - HP 1 169.23 280.88  
## <none> 164.94 281.67  
## - LUM 1 170.30 281.96  
## - MMRN1 1 172.70 284.35  
## + TIMP1 1 164.55 286.36  
## + APOB 1 164.65 286.45  
## + AHSG 1 164.69 286.49  
## + FETUB 1 164.70 286.50  
## + LRG1 1 164.70 286.50  
## + F11 1 164.71 286.52  
## + PROC 1 164.82 286.62  
## + MST1 1 164.83 286.63  
## + LYVE1 1 164.85 286.66  
## + CFI 1 164.89 286.69  
## + FN1 1 164.89 286.70  
## + CD44 1 164.90 286.70  
## + Q5JNX2 1 164.92 286.72  
## + C20orf3 1 164.93 286.73  
## + DSG2 1 164.93 286.74  
## + BTD 1 164.93 286.74  
## + AFM 1 164.93 286.74  
## + PLTP 1 164.94 286.74  
## - SERPINA7 1 176.42 288.07  
## - LAMP2 1 180.21 291.86  
##   
## Step: AIC=277.14  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGFBP3 + IGHA2 + IGHG2 + KNG1 + LAMP2 +   
## LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 +   
## VWF  
##   
## Df Deviance AIC  
## - IGFBP3 1 165.85 272.43  
## - HRG 1 166.02 272.60  
## - THBS1 1 166.08 272.66  
## - AIAG.Bovine 1 166.24 272.82  
## - CLU 1 166.29 272.87  
## - VWF 1 166.35 272.92  
## - FCGBP 1 166.50 273.07  
## - LGALS3BP 1 166.63 273.21  
## - IGHA2 1 166.69 273.27  
## - KNG1 1 166.81 273.39  
## - PRG4 1 166.83 273.41  
## - IGHG2 1 167.58 274.16  
## - DKFZp686N02209 1 167.68 274.26  
## - NCAM1 1 167.98 274.56  
## - FHR3 1 168.42 275.00  
## - FETUA.Bovine 1 169.17 275.75  
## - HP 1 169.68 276.26  
## <none> 165.48 277.14  
## - LUM 1 171.48 278.06  
## - MMRN1 1 172.93 279.50  
## + F5 1 164.94 281.67  
## + LRG1 1 165.09 281.81  
## + F11 1 165.12 281.85  
## + TIMP1 1 165.18 281.91  
## + AHSG 1 165.25 281.98  
## + CFI 1 165.25 281.98  
## + FETUB 1 165.26 281.99  
## + LYVE1 1 165.36 282.09  
## + FN1 1 165.37 282.10  
## + MST1 1 165.37 282.10  
## + CD44 1 165.40 282.13  
## + PROC 1 165.40 282.13  
## + APOB 1 165.42 282.15  
## + Q5JNX2 1 165.47 282.20  
## + DSG2 1 165.48 282.21  
## + BTD 1 165.48 282.21  
## + AFM 1 165.48 282.21  
## + C20orf3 1 165.48 282.21  
## + PLTP 1 165.48 282.21  
## - SERPINA7 1 176.89 283.47  
## - LAMP2 1 180.37 286.95  
##   
## Step: AIC=272.42  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + THBS1 + VWF  
##   
## Df Deviance AIC  
## - THBS1 1 166.45 267.95  
## - HRG 1 166.47 267.98  
## - VWF 1 166.56 268.07  
## - AIAG.Bovine 1 166.66 268.16  
## - CLU 1 166.67 268.17  
## - FCGBP 1 166.79 268.29  
## - IGHA2 1 166.97 268.47  
## - LGALS3BP 1 166.98 268.49  
## - PRG4 1 167.32 268.82  
## - KNG1 1 167.62 269.13  
## - DKFZp686N02209 1 167.72 269.23  
## - NCAM1 1 168.13 269.63  
## - IGHG2 1 168.34 269.84  
## - FHR3 1 168.59 270.09  
## - FETUA.Bovine 1 169.81 271.31  
## - HP 1 169.94 271.45  
## <none> 165.85 272.43  
## - LUM 1 171.51 273.02  
## - MMRN1 1 173.24 274.74  
## + LRG1 1 165.30 276.95  
## + IGFBP3 1 165.48 277.14  
## + F5 1 165.55 277.20  
## + CFI 1 165.57 277.22  
## + TIMP1 1 165.59 277.25  
## + FETUB 1 165.60 277.25  
## + AHSG 1 165.62 277.27  
## + F11 1 165.63 277.28  
## + MST1 1 165.66 277.32  
## + APOB 1 165.69 277.34  
## + LYVE1 1 165.76 277.42  
## + CD44 1 165.80 277.45  
## + BTD 1 165.81 277.46  
## + FN1 1 165.81 277.46  
## + DSG2 1 165.82 277.47  
## + AFM 1 165.83 277.49  
## + C20orf3 1 165.84 277.49  
## + PROC 1 165.84 277.49  
## + PLTP 1 165.84 277.50  
## + Q5JNX2 1 165.85 277.50  
## - SERPINA7 1 177.06 278.56  
## - LAMP2 1 180.96 282.46  
##   
## Step: AIC=267.95  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + HRG + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP +   
## LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - HRG 1 166.95 263.38  
## - AIAG.Bovine 1 167.07 263.50  
## - CLU 1 167.10 263.52  
## - LGALS3BP 1 167.52 263.95  
## - FCGBP 1 167.61 264.04  
## - IGHA2 1 167.70 264.13  
## - PRG4 1 167.91 264.34  
## - VWF 1 167.96 264.39  
## - KNG1 1 168.05 264.48  
## - DKFZp686N02209 1 168.07 264.50  
## - NCAM1 1 168.63 265.06  
## - IGHG2 1 168.76 265.19  
## - FHR3 1 169.50 265.93  
## - FETUA.Bovine 1 169.93 266.36  
## - HP 1 170.16 266.58  
## <none> 166.45 267.95  
## - LUM 1 171.87 268.30  
## - MMRN1 1 173.25 269.68  
## + LRG1 1 165.72 272.30  
## + THBS1 1 165.85 272.43  
## + IGFBP3 1 166.08 272.66  
## + AHSG 1 166.10 272.68  
## + MST1 1 166.17 272.75  
## + CFI 1 166.23 272.81  
## + APOB 1 166.24 272.81  
## + F5 1 166.24 272.82  
## + FETUB 1 166.25 272.83  
## + LYVE1 1 166.36 272.94  
## + F11 1 166.36 272.94  
## + CD44 1 166.37 272.95  
## + AFM 1 166.38 272.96  
## + BTD 1 166.39 272.97  
## + FN1 1 166.41 272.99  
## + TIMP1 1 166.42 273.00  
## + C20orf3 1 166.45 273.02  
## + PLTP 1 166.45 273.02  
## + DSG2 1 166.45 273.03  
## + Q5JNX2 1 166.45 273.03  
## + PROC 1 166.45 273.03  
## - SERPINA7 1 177.73 274.16  
## - LAMP2 1 181.77 278.20  
##   
## Step: AIC=263.38  
## Class ~ AIAG.Bovine + CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine +   
## FHR3 + HP + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM +   
## MMRN1 + NCAM1 + PRG4 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - AIAG.Bovine 1 167.38 258.73  
## - CLU 1 167.67 259.02  
## - LGALS3BP 1 167.81 259.16  
## - IGHA2 1 168.09 259.44  
## - FCGBP 1 168.32 259.68  
## - PRG4 1 168.38 259.73  
## - VWF 1 168.42 259.77  
## - KNG1 1 168.75 260.10  
## - DKFZp686N02209 1 168.80 260.15  
## - NCAM1 1 168.95 260.30  
## - IGHG2 1 169.53 260.89  
## - FHR3 1 169.76 261.12  
## - FETUA.Bovine 1 170.46 261.82  
## - HP 1 170.78 262.13  
## <none> 166.95 263.38  
## - LUM 1 173.86 265.21  
## - MMRN1 1 175.43 266.78  
## + LRG1 1 166.07 267.57  
## + HRG 1 166.45 267.95  
## + AHSG 1 166.46 267.96  
## + THBS1 1 166.47 267.98  
## + IGFBP3 1 166.50 268.00  
## + MST1 1 166.51 268.02  
## + APOB 1 166.76 268.27  
## + FETUB 1 166.77 268.27  
## + CFI 1 166.80 268.31  
## + AFM 1 166.83 268.33  
## + BTD 1 166.84 268.34  
## + TIMP1 1 166.86 268.36  
## + LYVE1 1 166.86 268.37  
## + F5 1 166.88 268.38  
## + FN1 1 166.90 268.40  
## + CD44 1 166.92 268.42  
## + DSG2 1 166.93 268.43  
## + PLTP 1 166.93 268.43  
## + F11 1 166.93 268.43  
## + PROC 1 166.94 268.44  
## + Q5JNX2 1 166.95 268.45  
## + C20orf3 1 166.95 268.46  
## - SERPINA7 1 178.16 269.51  
## - LAMP2 1 182.56 273.91  
##   
## Step: AIC=258.73  
## Class ~ CLU + DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 +   
## HP + IGHA2 + IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 +   
## NCAM1 + PRG4 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - CLU 1 167.84 254.12  
## - LGALS3BP 1 168.28 254.56  
## - IGHA2 1 168.53 254.81  
## - FCGBP 1 168.62 254.90  
## - PRG4 1 168.67 254.94  
## - VWF 1 168.68 254.96  
## - DKFZp686N02209 1 168.98 255.26  
## - KNG1 1 169.11 255.39  
## - NCAM1 1 169.40 255.67  
## - FHR3 1 169.91 256.19  
## - IGHG2 1 170.04 256.32  
## - FETUA.Bovine 1 170.81 257.09  
## - HP 1 171.16 257.44  
## <none> 167.38 258.73  
## - LUM 1 175.29 261.57  
## - MMRN1 1 175.55 261.83  
## + LRG1 1 166.62 263.05  
## + IGFBP3 1 166.90 263.33  
## + AIAG.Bovine 1 166.95 263.38  
## + APOB 1 167.01 263.44  
## + MST1 1 167.02 263.45  
## + CFI 1 167.02 263.45  
## + THBS1 1 167.03 263.46  
## + AHSG 1 167.03 263.46  
## + HRG 1 167.07 263.50  
## + FETUB 1 167.09 263.52  
## + TIMP1 1 167.20 263.63  
## + LYVE1 1 167.26 263.69  
## + BTD 1 167.29 263.72  
## + F11 1 167.31 263.74  
## + PLTP 1 167.32 263.75  
## + F5 1 167.35 263.77  
## + PROC 1 167.36 263.79  
## + CD44 1 167.36 263.79  
## + AFM 1 167.37 263.80  
## + C20orf3 1 167.37 263.80  
## + DSG2 1 167.37 263.80  
## + Q5JNX2 1 167.37 263.80  
## + FN1 1 167.38 263.81  
## - SERPINA7 1 178.17 264.45  
## - LAMP2 1 182.74 269.02  
##   
## Step: AIC=254.12  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LGALS3BP + LUM + MMRN1 + NCAM1 + PRG4 +   
## SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - LGALS3BP 1 168.59 249.79  
## - PRG4 1 168.75 249.95  
## - VWF 1 168.79 250.00  
## - FCGBP 1 169.00 250.20  
## - IGHA2 1 169.18 250.38  
## - KNG1 1 169.25 250.46  
## - DKFZp686N02209 1 169.42 250.62  
## - FHR3 1 170.12 251.33  
## - NCAM1 1 170.51 251.71  
## - IGHG2 1 170.83 252.03  
## - FETUA.Bovine 1 171.21 252.41  
## - HP 1 171.56 252.76  
## <none> 167.84 254.12  
## - LUM 1 175.50 256.70  
## - MMRN1 1 175.86 257.07  
## + LRG1 1 166.87 258.22  
## + IGFBP3 1 167.36 258.71  
## + CLU 1 167.38 258.73  
## + MST1 1 167.41 258.77  
## + HRG 1 167.43 258.79  
## + CFI 1 167.46 258.81  
## + AHSG 1 167.52 258.87  
## + THBS1 1 167.58 258.93  
## + APOB 1 167.65 259.00  
## + AIAG.Bovine 1 167.67 259.02  
## + PLTP 1 167.68 259.04  
## + TIMP1 1 167.72 259.07  
## + LYVE1 1 167.72 259.07  
## + F11 1 167.72 259.07  
## + FETUB 1 167.72 259.07  
## + PROC 1 167.77 259.12  
## + F5 1 167.78 259.13  
## + BTD 1 167.80 259.15  
## + AFM 1 167.81 259.17  
## + Q5JNX2 1 167.82 259.17  
## + DSG2 1 167.82 259.17  
## + CD44 1 167.83 259.18  
## + C20orf3 1 167.84 259.19  
## + FN1 1 167.84 259.19  
## - SERPINA7 1 179.39 260.59  
## - LAMP2 1 182.96 264.17  
##   
## Step: AIC=249.79  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + PRG4 + SERPINA7 +   
## VWF  
##   
## Df Deviance AIC  
## - PRG4 1 169.20 245.33  
## - VWF 1 169.29 245.42  
## - IGHA2 1 169.52 245.64  
## - DKFZp686N02209 1 170.10 246.22  
## - KNG1 1 170.11 246.24  
## - FCGBP 1 170.44 246.57  
## - NCAM1 1 170.79 246.91  
## - IGHG2 1 171.56 247.69  
## - FHR3 1 171.57 247.70  
## - FETUA.Bovine 1 171.95 248.08  
## - HP 1 172.75 248.87  
## <none> 168.59 249.79  
## - LUM 1 176.34 252.47  
## - MMRN1 1 177.59 253.71  
## + LGALS3BP 1 167.84 254.12  
## + LRG1 1 167.86 254.14  
## + CFI 1 168.05 254.33  
## + IGFBP3 1 168.13 254.41  
## + MST1 1 168.27 254.54  
## + CLU 1 168.28 254.56  
## + THBS1 1 168.34 254.62  
## + AIAG.Bovine 1 168.35 254.63  
## + HRG 1 168.38 254.66  
## + AHSG 1 168.39 254.67  
## + FETUB 1 168.42 254.70  
## + LYVE1 1 168.42 254.70  
## + TIMP1 1 168.44 254.71  
## + APOB 1 168.45 254.72  
## + F5 1 168.46 254.74  
## + PLTP 1 168.51 254.79  
## + C20orf3 1 168.53 254.81  
## + F11 1 168.53 254.81  
## + PROC 1 168.55 254.83  
## + DSG2 1 168.56 254.84  
## + Q5JNX2 1 168.56 254.84  
## + BTD 1 168.57 254.85  
## + FN1 1 168.58 254.86  
## + AFM 1 168.58 254.86  
## + CD44 1 168.59 254.86  
## - SERPINA7 1 179.98 256.11  
## - LAMP2 1 182.97 259.09  
##   
## Step: AIC=245.33  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + SERPINA7 + VWF  
##   
## Df Deviance AIC  
## - VWF 1 169.83 240.88  
## - IGHA2 1 170.08 241.14  
## - DKFZp686N02209 1 170.49 241.54  
## - KNG1 1 170.83 241.88  
## - NCAM1 1 171.28 242.34  
## - FCGBP 1 171.36 242.41  
## - IGHG2 1 172.06 243.11  
## - FETUA.Bovine 1 172.16 243.22  
## - FHR3 1 172.25 243.30  
## - HP 1 173.15 244.20  
## <none> 169.20 245.33  
## - MMRN1 1 178.13 249.18  
## + LRG1 1 168.30 249.51  
## + PRG4 1 168.59 249.79  
## - LUM 1 178.78 249.84  
## + IGFBP3 1 168.65 249.85  
## + LGALS3BP 1 168.75 249.95  
## + CFI 1 168.76 249.97  
## + APOB 1 168.86 250.07  
## + LYVE1 1 168.88 250.08  
## + F5 1 168.90 250.10  
## + TIMP1 1 168.90 250.10  
## + THBS1 1 168.91 250.11  
## + FETUB 1 168.91 250.12  
## + MST1 1 168.94 250.14  
## + AIAG.Bovine 1 168.96 250.16  
## + HRG 1 169.00 250.20  
## + AHSG 1 169.07 250.27  
## + PLTP 1 169.07 250.27  
## + PROC 1 169.11 250.32  
## + BTD 1 169.13 250.34  
## + CLU 1 169.14 250.34  
## + F11 1 169.17 250.37  
## + Q5JNX2 1 169.19 250.39  
## + FN1 1 169.19 250.39  
## + CD44 1 169.19 250.40  
## + AFM 1 169.20 250.40  
## + C20orf3 1 169.20 250.40  
## + DSG2 1 169.20 250.40  
## - SERPINA7 1 180.12 251.18  
## - LAMP2 1 185.62 256.67  
##   
## Step: AIC=240.88  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHA2 +   
## IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + SERPINA7  
##   
## Df Deviance AIC  
## - IGHA2 1 170.75 236.73  
## - KNG1 1 171.25 237.22  
## - DKFZp686N02209 1 171.44 237.42  
## - NCAM1 1 171.49 237.47  
## - FCGBP 1 171.56 237.54  
## - IGHG2 1 172.32 238.30  
## - FHR3 1 172.50 238.48  
## - FETUA.Bovine 1 172.51 238.48  
## - HP 1 173.86 239.84  
## <none> 169.83 240.88  
## - MMRN1 1 178.13 244.11  
## + LRG1 1 168.68 244.80  
## - LUM 1 179.27 245.24  
## + THBS1 1 169.13 245.26  
## + VWF 1 169.20 245.33  
## + PRG4 1 169.29 245.42  
## + LYVE1 1 169.44 245.57  
## + APOB 1 169.47 245.60  
## + AHSG 1 169.47 245.60  
## + CFI 1 169.50 245.62  
## + IGFBP3 1 169.50 245.63  
## + FETUB 1 169.50 245.63  
## + LGALS3BP 1 169.53 245.66  
## + MST1 1 169.58 245.71  
## + AIAG.Bovine 1 169.59 245.72  
## + HRG 1 169.63 245.75  
## + F5 1 169.64 245.76  
## + BTD 1 169.68 245.81  
## + PLTP 1 169.70 245.82  
## + FN1 1 169.71 245.84  
## + PROC 1 169.71 245.84  
## + TIMP1 1 169.76 245.88  
## + DSG2 1 169.80 245.93  
## + F11 1 169.80 245.93  
## + C20orf3 1 169.81 245.94  
## + Q5JNX2 1 169.81 245.94  
## + CD44 1 169.82 245.95  
## + AFM 1 169.82 245.95  
## + CLU 1 169.83 245.95  
## - SERPINA7 1 180.14 246.12  
## - LAMP2 1 187.37 253.35  
##   
## Step: AIC=236.73  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 +   
## KNG1 + LAMP2 + LUM + MMRN1 + NCAM1 + SERPINA7  
##   
## Df Deviance AIC  
## - NCAM1 1 172.03 232.93  
## - FCGBP 1 172.03 232.94  
## - DKFZp686N02209 1 172.18 233.08  
## - KNG1 1 172.75 233.65  
## - IGHG2 1 173.04 233.94  
## - FETUA.Bovine 1 173.25 234.15  
## - FHR3 1 174.10 235.00  
## - HP 1 174.31 235.21  
## <none> 170.75 236.73  
## - MMRN1 1 179.33 240.23  
## - LUM 1 179.49 240.39  
## + LRG1 1 169.53 240.58  
## + IGHA2 1 169.83 240.88  
## + THBS1 1 169.97 241.02  
## + VWF 1 170.08 241.14  
## + AHSG 1 170.27 241.32  
## + PRG4 1 170.27 241.32  
## + FETUB 1 170.43 241.48  
## + APOB 1 170.47 241.52  
## + LYVE1 1 170.52 241.57  
## + IGFBP3 1 170.53 241.58  
## + CFI 1 170.54 241.59  
## + HRG 1 170.54 241.60  
## + AIAG.Bovine 1 170.56 241.61  
## + MST1 1 170.58 241.63  
## + FN1 1 170.62 241.68  
## + PLTP 1 170.63 241.69  
## + BTD 1 170.64 241.69  
## + PROC 1 170.66 241.71  
## + C20orf3 1 170.66 241.72  
## + LGALS3BP 1 170.68 241.73  
## + F5 1 170.68 241.73  
## + CD44 1 170.69 241.75  
## + AFM 1 170.69 241.75  
## + Q5JNX2 1 170.72 241.77  
## + CLU 1 170.73 241.78  
## + F11 1 170.74 241.79  
## + TIMP1 1 170.74 241.79  
## + DSG2 1 170.75 241.80  
## - SERPINA7 1 181.11 242.01  
## - LAMP2 1 188.15 249.05  
##   
## Step: AIC=232.93  
## Class ~ DKFZp686N02209 + FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 +   
## KNG1 + LAMP2 + LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - DKFZp686N02209 1 172.97 228.80  
## - KNG1 1 173.88 229.71  
## - IGHG2 1 174.07 229.90  
## - FCGBP 1 174.61 230.44  
## - FETUA.Bovine 1 174.72 230.54  
## - FHR3 1 175.05 230.88  
## - HP 1 175.70 231.53  
## <none> 172.03 232.93  
## - LUM 1 179.92 235.75  
## + NCAM1 1 170.75 236.73  
## + LRG1 1 171.06 237.04  
## - MMRN1 1 181.53 237.36  
## + IGHA2 1 171.49 237.47  
## + THBS1 1 171.59 237.57  
## + PRG4 1 171.59 237.57  
## + F5 1 171.69 237.67  
## + AHSG 1 171.75 237.72  
## + CFI 1 171.76 237.74  
## + LYVE1 1 171.77 237.74  
## + VWF 1 171.77 237.75  
## + CLU 1 171.78 237.75  
## - SERPINA7 1 181.94 237.77  
## + PLTP 1 171.81 237.79  
## + F11 1 171.85 237.83  
## + HRG 1 171.85 237.83  
## + Q5JNX2 1 171.87 237.84  
## + FETUB 1 171.87 237.85  
## + IGFBP3 1 171.89 237.87  
## + AIAG.Bovine 1 171.90 237.88  
## + PROC 1 171.90 237.88  
## + MST1 1 171.91 237.89  
## + FN1 1 171.93 237.91  
## + APOB 1 171.94 237.91  
## + C20orf3 1 171.94 237.91  
## + DSG2 1 171.95 237.92  
## + TIMP1 1 171.97 237.95  
## + LGALS3BP 1 172.00 237.97  
## + BTD 1 172.01 237.99  
## + AFM 1 172.01 237.99  
## + CD44 1 172.02 237.99  
## - LAMP2 1 188.15 243.98  
##   
## Step: AIC=228.8  
## Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 + KNG1 + LAMP2 +   
## LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - IGHG2 1 174.09 224.84  
## - KNG1 1 174.52 225.27  
## - FCGBP 1 175.38 226.13  
## - FETUA.Bovine 1 175.40 226.15  
## - FHR3 1 175.49 226.24  
## - HP 1 176.24 226.99  
## <none> 172.97 228.80  
## - LUM 1 180.40 231.16  
## + DKFZp686N02209 1 172.03 232.93  
## + LRG1 1 172.03 232.94  
## + NCAM1 1 172.18 233.08  
## + IGHA2 1 172.47 233.37  
## + AHSG 1 172.48 233.38  
## + VWF 1 172.49 233.39  
## + THBS1 1 172.59 233.49  
## - MMRN1 1 182.74 233.50  
## + HRG 1 172.64 233.54  
## + FETUB 1 172.69 233.59  
## + LYVE1 1 172.70 233.60  
## + PRG4 1 172.70 233.60  
## + F5 1 172.74 233.65  
## + FN1 1 172.76 233.67  
## + CLU 1 172.79 233.69  
## + C20orf3 1 172.82 233.72  
## + CFI 1 172.83 233.74  
## + AFM 1 172.87 233.77  
## + TIMP1 1 172.88 233.78  
## + F11 1 172.89 233.79  
## + CD44 1 172.90 233.80  
## + PLTP 1 172.91 233.81  
## + BTD 1 172.92 233.82  
## + AIAG.Bovine 1 172.93 233.83  
## + LGALS3BP 1 172.93 233.84  
## + MST1 1 172.94 233.84  
## + PROC 1 172.95 233.86  
## + APOB 1 172.96 233.86  
## + DSG2 1 172.96 233.86  
## + IGFBP3 1 172.96 233.87  
## + Q5JNX2 1 172.97 233.87  
## - SERPINA7 1 184.85 235.60  
## - LAMP2 1 191.38 242.13  
##   
## Step: AIC=224.84  
## Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + KNG1 + LAMP2 + LUM +   
## MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - KNG1 1 176.13 221.80  
## - FETUA.Bovine 1 176.27 221.94  
## - FCGBP 1 176.56 222.23  
## - FHR3 1 176.71 222.38  
## - HP 1 177.90 223.57  
## <none> 174.09 224.84  
## + LRG1 1 172.81 228.63  
## + IGHG2 1 172.97 228.80  
## + NCAM1 1 173.16 228.99  
## - MMRN1 1 183.67 229.35  
## + CFI 1 173.65 229.48  
## + IGHA2 1 173.66 229.49  
## + CLU 1 173.67 229.49  
## + F5 1 173.70 229.52  
## + HRG 1 173.71 229.54  
## + PRG4 1 173.74 229.57  
## + IGFBP3 1 173.76 229.59  
## + AHSG 1 173.79 229.61  
## + MST1 1 173.79 229.62  
## + PROC 1 173.80 229.62  
## + LYVE1 1 173.81 229.63  
## + PLTP 1 173.84 229.67  
## + F11 1 173.87 229.69  
## + DSG2 1 173.88 229.71  
## + TIMP1 1 173.92 229.75  
## + THBS1 1 173.93 229.75  
## + FN1 1 173.96 229.78  
## + AIAG.Bovine 1 173.97 229.80  
## + VWF 1 173.98 229.81  
## + APOB 1 174.02 229.84  
## + BTD 1 174.02 229.85  
## + LGALS3BP 1 174.02 229.85  
## + FETUB 1 174.03 229.85  
## + AFM 1 174.07 229.89  
## + Q5JNX2 1 174.07 229.90  
## + DKFZp686N02209 1 174.07 229.90  
## + C20orf3 1 174.08 229.90  
## + CD44 1 174.08 229.91  
## - LUM 1 184.52 230.20  
## - SERPINA7 1 184.99 230.67  
## - LAMP2 1 191.38 237.06  
##   
## Step: AIC=221.8  
## Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + LAMP2 + LUM + MMRN1 +   
## SERPINA7  
##   
## Df Deviance AIC  
## - FETUA.Bovine 1 178.02 218.62  
## - FCGBP 1 178.21 218.81  
## - FHR3 1 178.54 219.14  
## - HP 1 179.98 220.59  
## <none> 176.13 221.80  
## + KNG1 1 174.09 224.84  
## + IGHG2 1 174.52 225.27  
## - MMRN1 1 184.67 225.27  
## + LRG1 1 174.62 225.37  
## + IGFBP3 1 175.13 225.88  
## + NCAM1 1 175.19 225.94  
## + IGHA2 1 175.26 226.01  
## + CFI 1 175.31 226.07  
## - SERPINA7 1 185.67 226.27  
## + PROC 1 175.54 226.29  
## + PRG4 1 175.63 226.38  
## + HRG 1 175.69 226.44  
## + MST1 1 175.71 226.46  
## + PLTP 1 175.71 226.46  
## + DSG2 1 175.75 226.51  
## + F5 1 175.81 226.56  
## + TIMP1 1 175.83 226.58  
## + BTD 1 175.90 226.65  
## + AIAG.Bovine 1 175.91 226.66  
## + AHSG 1 175.92 226.68  
## + CLU 1 175.92 226.68  
## + APOB 1 175.94 226.70  
## + LYVE1 1 175.96 226.71  
## + F11 1 176.04 226.79  
## + LGALS3BP 1 176.04 226.80  
## + CD44 1 176.06 226.81  
## + THBS1 1 176.07 226.82  
## + Q5JNX2 1 176.07 226.83  
## + FETUB 1 176.09 226.85  
## + DKFZp686N02209 1 176.10 226.85  
## + AFM 1 176.11 226.86  
## + FN1 1 176.11 226.86  
## + VWF 1 176.12 226.87  
## + C20orf3 1 176.12 226.87  
## - LUM 1 188.00 228.61  
## - LAMP2 1 194.42 235.02  
##   
## Step: AIC=218.62  
## Class ~ FCGBP + FHR3 + HP + LAMP2 + LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - FCGBP 1 179.68 215.21  
## - FHR3 1 180.49 216.02  
## - HP 1 181.82 217.35  
## <none> 178.02 218.62  
## - MMRN1 1 186.12 221.65  
## + FETUA.Bovine 1 176.13 221.80  
## + KNG1 1 176.27 221.94  
## + LRG1 1 176.50 222.18  
## - SERPINA7 1 186.69 222.21  
## + IGHG2 1 176.72 222.40  
## + CFI 1 176.79 222.47  
## + IGFBP3 1 176.87 222.55  
## + NCAM1 1 176.89 222.56  
## + IGHA2 1 177.31 222.99  
## + TIMP1 1 177.39 223.07  
## + DSG2 1 177.50 223.18  
## + PROC 1 177.51 223.19  
## + HRG 1 177.56 223.24  
## + MST1 1 177.58 223.26  
## + CLU 1 177.73 223.41  
## + F5 1 177.79 223.47  
## + PRG4 1 177.80 223.48  
## + AIAG.Bovine 1 177.81 223.49  
## + PLTP 1 177.83 223.51  
## + APOB 1 177.88 223.56  
## + AHSG 1 177.88 223.56  
## + LGALS3BP 1 177.88 223.56  
## + LYVE1 1 177.89 223.56  
## + CD44 1 177.91 223.58  
## + F11 1 177.93 223.60  
## + BTD 1 177.93 223.60  
## + C20orf3 1 177.98 223.65  
## + DKFZp686N02209 1 177.98 223.66  
## + FETUB 1 178.00 223.67  
## + FN1 1 178.01 223.69  
## + Q5JNX2 1 178.01 223.69  
## + AFM 1 178.01 223.69  
## + THBS1 1 178.01 223.69  
## + VWF 1 178.01 223.69  
## - LUM 1 189.59 225.12  
## - LAMP2 1 195.13 230.65  
##   
## Step: AIC=215.21  
## Class ~ FHR3 + HP + LAMP2 + LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## - FHR3 1 182.66 213.11  
## - HP 1 183.18 213.63  
## <none> 179.68 215.21  
## + NCAM1 1 177.60 218.20  
## + LRG1 1 177.99 218.59  
## + FCGBP 1 178.02 218.62  
## + FETUA.Bovine 1 178.21 218.81  
## + KNG1 1 178.23 218.83  
## + IGHG2 1 178.32 218.93  
## + CFI 1 178.44 219.04  
## - SERPINA7 1 188.62 219.07  
## + IGFBP3 1 178.67 219.27  
## + TIMP1 1 178.73 219.33  
## + DSG2 1 178.74 219.34  
## + F5 1 179.06 219.66  
## + PROC 1 179.08 219.68  
## + HRG 1 179.11 219.71  
## + LGALS3BP 1 179.14 219.75  
## + PRG4 1 179.22 219.82  
## + CD44 1 179.31 219.92  
## + MST1 1 179.33 219.93  
## + CLU 1 179.35 219.95  
## + IGHA2 1 179.47 220.07  
## + VWF 1 179.51 220.11  
## + C20orf3 1 179.51 220.11  
## + Q5JNX2 1 179.51 220.11  
## + APOB 1 179.53 220.13  
## + AIAG.Bovine 1 179.54 220.14  
## + BTD 1 179.57 220.17  
## + PLTP 1 179.61 220.21  
## + AHSG 1 179.61 220.21  
## + LYVE1 1 179.62 220.22  
## + DKFZp686N02209 1 179.63 220.23  
## + AFM 1 179.64 220.24  
## + FETUB 1 179.64 220.24  
## + F11 1 179.66 220.26  
## + FN1 1 179.67 220.27  
## + THBS1 1 179.68 220.28  
## - MMRN1 1 190.04 220.49  
## - LUM 1 190.56 221.01  
## - LAMP2 1 195.60 226.05  
##   
## Step: AIC=213.11  
## Class ~ HP + LAMP2 + LUM + MMRN1 + SERPINA7  
##   
## Df Deviance AIC  
## <none> 182.66 213.11  
## - HP 1 187.93 213.31  
## + LRG1 1 179.58 215.11  
## + FHR3 1 179.68 215.21  
## - SERPINA7 1 190.60 215.97  
## + FCGBP 1 180.49 216.02  
## + NCAM1 1 180.54 216.07  
## + CFI 1 180.68 216.21  
## + DSG2 1 180.99 216.51  
## + FETUA.Bovine 1 181.19 216.71  
## + IGHG2 1 181.23 216.75  
## + F5 1 181.37 216.89  
## + KNG1 1 181.43 216.96  
## + LGALS3BP 1 181.55 217.07  
## + CD44 1 181.57 217.09  
## + TIMP1 1 181.75 217.27  
## + IGFBP3 1 181.85 217.38  
## + PRG4 1 181.91 217.44  
## + MST1 1 182.04 217.56  
## + Q5JNX2 1 182.14 217.67  
## + PROC 1 182.15 217.68  
## + VWF 1 182.16 217.69  
## + IGHA2 1 182.17 217.70  
## + C20orf3 1 182.34 217.86  
## + F11 1 182.37 217.89  
## + HRG 1 182.43 217.96  
## + DKFZp686N02209 1 182.43 217.96  
## + APOB 1 182.46 217.98  
## + BTD 1 182.46 217.99  
## + CLU 1 182.50 218.03  
## + AFM 1 182.55 218.08  
## + LYVE1 1 182.58 218.10  
## + AIAG.Bovine 1 182.59 218.12  
## - LUM 1 192.75 218.13  
## + THBS1 1 182.64 218.17  
## + PLTP 1 182.64 218.17  
## + AHSG 1 182.65 218.18  
## + FN1 1 182.66 218.18  
## + FETUB 1 182.66 218.18  
## - MMRN1 1 194.63 220.01  
## - LAMP2 1 197.82 223.19

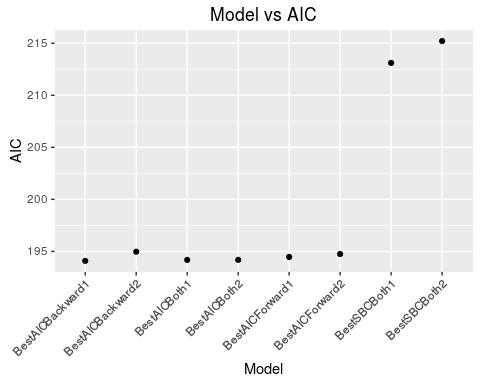
summary(model.sbc.both)

##   
## Call:  
## glm(formula = Class ~ HP + LAMP2 + LUM + MMRN1 + SERPINA7, family = binomial,   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.0343 -0.9466 -0.1179 0.9503 2.4615   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 0.9173 7.7240 0.119 0.905464   
## HP -0.6052 0.2700 -2.242 0.024978 \*   
## LAMP2 2.2758 0.6206 3.667 0.000245 \*\*\*  
## LUM 1.2678 0.4145 3.058 0.002225 \*\*   
## MMRN1 -1.4659 0.4496 -3.260 0.001112 \*\*   
## SERPINA7 -1.6917 0.6187 -2.734 0.006250 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 182.66 on 154 degrees of freedom  
## AIC: 194.66  
##   
## Number of Fisher Scoring iterations: 4

As expected, the BIC selection results in a parsimonious model with 5 columns with SBC = 213.11

We select the top 2 models in each of the above selections as our candidate models.

formula.BestAICBackward1 <- model.aic.backward$formula  
formula.BestAICBackward2 <- as.formula(Class ~ FCGBP + FETUA.Bovine + FHR3 + HP + IGHG2 + KNG1 + LAMP2 + LUM + MMRN1 + SERPINA7)  
  
formula.BestAICForward1 <- model.aic.forward$formula  
formula.BestAICForward2 <- as.formula(Class ~ TIMP1 + LAMP2 + HP + LRG1 + SERPINA7 + LUM)  
  
formula.BestAICBoth1 <- model.aic.both$formula  
formula.BestAICBoth2 <- as.formula(Class ~ TIMP1 + LAMP2 + LRG1 + SERPINA7 + LUM + NCAM1)  
  
formula.BestSBCBoth1 <- model.sbc.both$formula  
formula.BestSBCBoth2 <- as.formula(Class ~ FHR3 + HP + LAMP2 + LUM + MMRN1 + SERPINA7)  
  
# Plot the Candidate Models' AIC Values  
candidateModels.aic <- data.frame(model <- c("BestAICBackward1", "BestAICBackward2", "BestAICForward1", "BestAICForward2", "BestAICBoth1", "BestAICBoth2", "BestSBCBoth1", "BestSBCBoth2"), AIC <- c(model.aic.backward$aic, 194.97, model.aic.forward$aic, 194.75, model.aic.both$aic, 194.19, 213.11, 215.21))  
colnames(candidateModels.aic) <- c("Model", "AIC")  
ggplot(candidateModels.aic, aes(x=Model, y=AIC)) + geom\_point() + theme(axis.text.x = element\_text(angle = 45, hjust = 1)) + ggtitle("Model vs AIC")

 We can ignore the AIC values for BestSBCBoth1 and BestSBCBoth2 in the above plot as it considers the SBC criterion instead.

# Candidate Model Fitting

## Train Logistic Regression on the candidate Models

model.BestAICBackward1 <- glm(formula.BestAICBackward1, family=binomial(link='logit'), data=train)  
summary(model.BestAICBackward1)

##   
## Call:  
## glm(formula = formula.BestAICBackward1, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -1.8946 -0.8822 -0.1143 0.9205 2.7140   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 122.1951 83.8466 1.457 0.145016   
## FCGBP -0.5803 0.3745 -1.550 0.121184   
## FETUA.Bovine -7.0967 4.8653 -1.459 0.144665   
## FHR3 -0.2556 0.1604 -1.594 0.110989   
## HP -0.5438 0.2848 -1.910 0.056190 .   
## KNG1 0.4819 0.3768 1.279 0.200999   
## LAMP2 2.5943 0.6818 3.805 0.000142 \*\*\*  
## LUM 1.3460 0.4363 3.085 0.002037 \*\*   
## MMRN1 -1.4466 0.4904 -2.950 0.003180 \*\*   
## SERPINA7 -2.1277 0.6782 -3.137 0.001705 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 174.09 on 150 degrees of freedom  
## AIC: 194.09  
##   
## Number of Fisher Scoring iterations: 4

model.BestAICBackward2 <- glm(formula.BestAICBackward2, family=binomial(link='logit'), data=train)  
summary(model.BestAICBackward2)

##   
## Call:  
## glm(formula = formula.BestAICBackward2, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.02513 -0.89869 -0.08684 0.90207 2.61653   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 127.2303 84.9235 1.498 0.134088   
## FCGBP -0.5753 0.3757 -1.531 0.125724   
## FETUA.Bovine -7.6121 4.9520 -1.537 0.124247   
## FHR3 -0.2513 0.1604 -1.567 0.117129   
## HP -0.5046 0.2849 -1.771 0.076537 .   
## IGHG2 0.2867 0.2720 1.054 0.291882   
## KNG1 0.4076 0.3541 1.151 0.249671   
## LAMP2 2.7823 0.7174 3.878 0.000105 \*\*\*  
## LUM 1.2016 0.4560 2.635 0.008419 \*\*   
## MMRN1 -1.4901 0.5015 -2.971 0.002966 \*\*   
## SERPINA7 -2.2947 0.7078 -3.242 0.001186 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 172.97 on 149 degrees of freedom  
## AIC: 194.97  
##   
## Number of Fisher Scoring iterations: 4

model.BestAICForward1 <- glm(formula.BestAICForward1, family=binomial(link='logit'), data=train)  
summary(model.BestAICForward1)

##   
## Call:  
## glm(formula = formula.BestAICForward1, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.02726 -0.94320 -0.05077 0.93724 2.48858   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 7.3902 8.2991 0.890 0.37320   
## TIMP1 -0.9190 0.4498 -2.043 0.04102 \*   
## LAMP2 2.7202 0.6946 3.916 8.99e-05 \*\*\*  
## HP -0.3650 0.2814 -1.297 0.19463   
## LRG1 -0.7993 0.3743 -2.135 0.03273 \*   
## SERPINA7 -1.9639 0.6460 -3.040 0.00237 \*\*   
## LUM 1.2721 0.4218 3.016 0.00256 \*\*   
## NCAM1 -0.8055 0.5401 -1.491 0.13585   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 178.47 on 152 degrees of freedom  
## AIC: 194.47  
##   
## Number of Fisher Scoring iterations: 4

model.BestAICForward2 <- glm(formula.BestAICForward2, family=binomial(link='logit'), data=train)  
summary(model.BestAICForward2)

##   
## Call:  
## glm(formula = formula.BestAICForward2, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -1.95503 -0.94785 -0.02557 0.95793 2.64048   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 5.5052 8.1360 0.677 0.498625   
## TIMP1 -1.0630 0.4350 -2.444 0.014529 \*   
## LAMP2 2.3504 0.6358 3.697 0.000218 \*\*\*  
## HP -0.3738 0.2792 -1.339 0.180665   
## LRG1 -0.7607 0.3698 -2.057 0.039709 \*   
## SERPINA7 -1.8355 0.6346 -2.893 0.003821 \*\*   
## LUM 1.1676 0.4145 2.817 0.004847 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 180.75 on 153 degrees of freedom  
## AIC: 194.75  
##   
## Number of Fisher Scoring iterations: 4

model.BestAICBoth1 <- glm(formula.BestAICBoth1, family=binomial(link='logit'), data=train)  
summary(model.BestAICBoth1)

##   
## Call:  
## glm(formula = formula.BestAICBoth1, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.14878 -0.93004 -0.02417 0.93892 2.49909   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 6.1312 8.3810 0.732 0.464434   
## TIMP1 -1.0291 0.4422 -2.328 0.019938 \*   
## LAMP2 2.6904 0.6946 3.873 0.000107 \*\*\*  
## LRG1 -0.7291 0.3851 -1.893 0.058322 .   
## SERPINA7 -2.2482 0.6394 -3.516 0.000438 \*\*\*  
## LUM 1.3098 0.4240 3.089 0.002006 \*\*   
## NCAM1 -0.7839 0.5356 -1.463 0.143332   
## FHR3 -0.2323 0.1666 -1.395 0.163052   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 178.19 on 152 degrees of freedom  
## AIC: 194.19  
##   
## Number of Fisher Scoring iterations: 4

model.BestAICBoth2 <- glm(formula.BestAICBoth2, family=binomial(link='logit'), data=train)  
summary(model.BestAICBoth2)

##   
## Call:  
## glm(formula = formula.BestAICBoth2, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.03763 -0.92744 -0.02168 0.94090 2.34990   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 6.7812 8.2821 0.819 0.412917   
## TIMP1 -1.0332 0.4385 -2.356 0.018462 \*   
## LAMP2 2.6182 0.6768 3.869 0.000109 \*\*\*  
## LRG1 -0.9055 0.3639 -2.488 0.012832 \*   
## SERPINA7 -2.1591 0.6246 -3.457 0.000547 \*\*\*  
## LUM 1.2807 0.4197 3.051 0.002278 \*\*   
## NCAM1 -0.8137 0.5327 -1.527 0.126643   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 180.19 on 153 degrees of freedom  
## AIC: 194.19  
##   
## Number of Fisher Scoring iterations: 4

model.BestSBCBoth1 <- glm(formula.BestSBCBoth1, family=binomial(link='logit'), data=train)  
summary(model.BestSBCBoth1)

##   
## Call:  
## glm(formula = formula.BestSBCBoth1, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.0343 -0.9466 -0.1179 0.9503 2.4615   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 0.9173 7.7240 0.119 0.905464   
## HP -0.6052 0.2700 -2.242 0.024978 \*   
## LAMP2 2.2758 0.6206 3.667 0.000245 \*\*\*  
## LUM 1.2678 0.4145 3.058 0.002225 \*\*   
## MMRN1 -1.4659 0.4496 -3.260 0.001112 \*\*   
## SERPINA7 -1.6917 0.6187 -2.734 0.006250 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 182.66 on 154 degrees of freedom  
## AIC: 194.66  
##   
## Number of Fisher Scoring iterations: 4

model.BestSBCBoth2 <- glm(formula.BestSBCBoth2, family=binomial(link='logit'), data=train)  
summary(model.BestSBCBoth2)

##   
## Call:  
## glm(formula = formula.BestSBCBoth2, family = binomial(link = "logit"),   
## data = train)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -1.9395 -0.9310 -0.0993 0.9551 2.6557   
##   
## Coefficients:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 0.8137 7.8806 0.103 0.917760   
## FHR3 -0.2700 0.1593 -1.695 0.090084 .   
## HP -0.5108 0.2774 -1.842 0.065548 .   
## LAMP2 2.3735 0.6380 3.720 0.000199 \*\*\*  
## LUM 1.3395 0.4262 3.143 0.001671 \*\*   
## MMRN1 -1.4132 0.4630 -3.052 0.002271 \*\*   
## SERPINA7 -1.8385 0.6389 -2.878 0.004006 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for binomial family taken to be 1)  
##   
## Null deviance: 221.81 on 159 degrees of freedom  
## Residual deviance: 179.68 on 153 degrees of freedom  
## AIC: 193.68  
##   
## Number of Fisher Scoring iterations: 4

# Model Evaluation

## Goodness of Fit: Homer Lemeshow Test

We consider the model to be unfit if p < 0.05.

# Converting Factor label to Numeric, "CRC" -> 1, "Healthy" -> 0  
train.numeric <- train  
train.numeric$Class <- as.numeric(train$Class)  
train.numeric$Class[train.numeric$Class == 1] <- 0  
train.numeric$Class[train.numeric$Class == 2] <- 1  
  
res <- hoslem.test(train.numeric$Class, fitted(model.BestAICBackward1), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestAICBackward1)  
## X-squared = 7.1724, df = 8, p-value = 0.5182

The p-value is 0.5181539 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestAICBackward2), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestAICBackward2)  
## X-squared = 7.192, df = 8, p-value = 0.5161

The p-value is 0.5160649 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestAICForward1), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestAICForward1)  
## X-squared = 3.4505, df = 8, p-value = 0.903

The p-value is 0.9029999 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestAICForward2), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestAICForward2)  
## X-squared = 6.5541, df = 8, p-value = 0.5854

The p-value is 0.5854153 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestAICBoth1), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestAICBoth1)  
## X-squared = 10.933, df = 8, p-value = 0.2055

The p-value is 0.2055332 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestAICBoth2), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestAICBoth2)  
## X-squared = 12.739, df = 8, p-value = 0.1211

The p-value is 0.1211393 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestSBCBoth1), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestSBCBoth1)  
## X-squared = 4.3334, df = 8, p-value = 0.8259

The p-value is 0.8258648 so there's no evidence the model in incorrect.

res <- hoslem.test(train.numeric$Class, fitted(model.BestSBCBoth2), g=10)  
res

##   
## Hosmer and Lemeshow goodness of fit (GOF) test  
##   
## data: train.numeric$Class, fitted(model.BestSBCBoth2)  
## X-squared = 4.7616, df = 8, p-value = 0.7827

The p-value is 0.7827256 so there's no evidence the model in incorrect.

From the above tests, we do not eliminate any Model from the candidate models.

# Diagnostic Residual Plots

## Residuals with Predicted Probabilities with Lowess Smooth

If the model is correct, a lowess smooth of the plot of the residuals against the estimated probability should result approximately in a horizontal line with zero intercept.

png('residuals\_lowess.png')  
par(mfrow=c(3,3))  
scatter.smooth(predict(model.BestAICBackward1, type = "response"),   
 residuals(model.BestAICBackward1), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 1")  
  
scatter.smooth(predict(model.BestAICBackward2, type = "response"),   
 residuals(model.BestAICBackward2), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 2")  
  
scatter.smooth(predict(model.BestAICForward1, type = "response"),   
 residuals(model.BestAICForward1), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 3")  
  
scatter.smooth(predict(model.BestAICForward2, type = "response"),   
 residuals(model.BestAICForward2), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 4")  
  
scatter.smooth(predict(model.BestAICBoth1, type = "response"),   
 residuals(model.BestAICBoth1), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 5")  
  
scatter.smooth(predict(model.BestAICBoth2, type = "response"),   
 residuals(model.BestAICBoth2), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 6")  
  
scatter.smooth(predict(model.BestSBCBoth1, type = "response"),   
 residuals(model.BestSBCBoth1), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 7")  
  
scatter.smooth(predict(model.BestSBCBoth2, type = "response"),   
 residuals(model.BestSBCBoth2), xlab = "Estimated Probability", ylab = "Deviance Residual", main="Model 8")  
#dev.off()

All the Plots look good.

# Half-Normal Probability Plot

A half-normal probability plot helps to highlight outlying deviance residuals even though the residuals are not normally distributed. Outliers will appear at the top right of a half-normal probability plot as points separated from the others.

png('half\_normal.png')  
par(mfrow=c(3,3))  
halfnorm(residuals(model.BestAICBackward1), main="Model 1")  
halfnorm(residuals(model.BestAICBackward2), main="Model 2")  
halfnorm(residuals(model.BestAICForward1), main="Model 3")  
halfnorm(residuals(model.BestAICForward2), main="Model 4")  
halfnorm(residuals(model.BestAICBoth1), main="Model 5")  
halfnorm(residuals(model.BestAICBoth2), main="Model 6")  
halfnorm(residuals(model.BestSBCBoth1), main="Model 7")  
halfnorm(residuals(model.BestSBCBoth2), main="Model 8")  
#dev.off()

We observe from the above plots that observation 18, 40 and 112 might be an outlier.

# Overdispersion

Sometimes we can get a deviance that is much larger than expected if the model was correct. It can be due to the presence of outliers, sparse data or clustering of data. The approach to deal with overdispersion is to add a dispersion parameter . It can be estimated with: (p = no. of parameters in model).  
 We consider overdispersion to exist if >> 1.

par(mfrow=c(1,1))  
# No. of observations in the training dataset.  
n <- nrow(train)  
# No. of parameters in the model.  
p <- length(model.BestAICBackward1$coefficients)  
phi <- sum(residuals(model.BestAICBackward1, type = "pearson")^2) / (n - p)  
phi

## [1] 1.16855

The dispersion parameter is not very different than one (no dispersion).

p <- length(model.BestAICBackward2$coefficients)  
phi <- sum(residuals(model.BestAICBackward2, type = "pearson")^2) / (n - p)  
phi

## [1] 1.124246

The dispersion parameter is not very different than one (no dispersion).

p <- length(model.BestAICForward1$coefficients)  
phi <- sum(residuals(model.BestAICForward1, type = "pearson")^2) / (n - p)  
phi

## [1] 1.068189

The dispersion parameter is not very different than one (no dispersion).

p <- length(model.BestAICForward2$coefficients)  
phi <- sum(residuals(model.BestAICForward2, type = "pearson")^2) / (n - p)  
phi

## [1] 1.129269

The dispersion parameter is not very different than one (no dispersion).

p <- length(model.BestAICBoth1$coefficients)  
phi <- sum(residuals(model.BestAICBoth1, type = "pearson")^2) / (n - p)  
phi

## [1] 1.078921

The dispersion parameter is not very different than one (no dispersion).

p <- length(model.BestAICBoth2$coefficients)  
phi <- sum(residuals(model.BestAICBoth2, type = "pearson")^2) / (n - p)  
phi

## [1] 1.038809

The dispersion parameter is not very different than one (no dispersion).

p <- length(model.BestSBCBoth1$coefficients)  
phi <- sum(residuals(model.BestSBCBoth1, type = "pearson")^2) / (n - p)  
phi

## [1] 1.061533

The dispersion parameter is not very different than one (no dispersion).

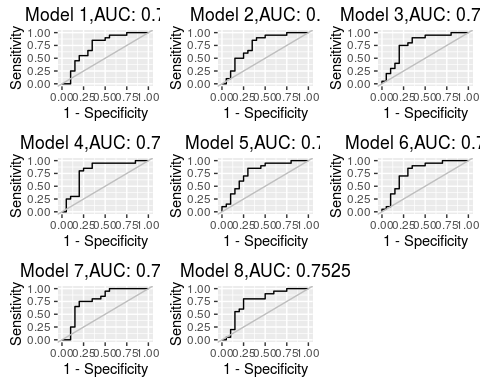
p <- length(model.BestSBCBoth2$coefficients)  
phi <- sum(residuals(model.BestSBCBoth2, type = "pearson")^2) / (n - p)  
phi

## [1] 1.142676

The dispersion parameter is not very different than one (no dispersion).

# Predictive Ability of the Model

# Divide training into 10 equal parts, keep one part as validation set and rest as training.  
model.list <- list()  
model.list[["BestAICBackward1"]] <- formula.BestAICBackward1  
model.list[["BestAICBackward2"]] <- formula.BestAICBackward2  
model.list[["BestAICForward1"]] <- formula.BestAICForward1  
model.list[["BestAICForward2"]] <- formula.BestAICForward2  
model.list[["BestAICBoth1"]] <- formula.BestAICBoth1  
model.list[["BestAICBoth2"]] <- formula.BestAICBoth2  
model.list[["BestSBCBoth1"]] <- formula.BestSBCBoth1  
model.list[["BestSBCBoth2"]] <- formula.BestSBCBoth2  
  
k = 1  
roc.mat <- matrix(list(), nrow=length(model.list), ncol=k)  
fpr.mat <- matrix(list(), nrow=length(model.list), ncol=k)  
tpr.mat <- matrix(list(), nrow=length(model.list), ncol=k)  
auc.mat <- matrix(numeric(), nrow=length(model.list), ncol=k)  
roc.plots.mat <- matrix(list(), nrow=length(model.list), ncol=k)  
#png("ROC\_plots.png")  
par(mfrow=c(3,3))  
for (model.id in 1:length(model.list)){  
 cv.id <- 1  
 fit <- glm(model.list[[model.id]], data=train, family=binomial(link='logit'))  
 predicted <- predict(fit, newdata=subset(validation, select=-Class))  
 prob <- prediction(predicted, validation$Class)  
 tprfpr <- performance(prob, "tpr", "fpr")  
 tpr <- unlist(slot(tprfpr, "y.values"))  
 fpr <- unlist(slot(tprfpr, "x.values"))  
 roc <- data.frame(tpr, fpr)  
 auc <- performance(prob, measure = "auc")  
 auc <- auc@y.values[[1]]  
 roc.mat[[model.id, cv.id]] <- roc  
 fpr.mat[[model.id, cv.id]] <- fpr  
 tpr.mat[[model.id, cv.id]] <- tpr  
 auc.mat[[model.id, cv.id]] <- auc  
 roc.plots.mat[[model.id, cv.id]] <- ggplot(roc) + geom\_line(aes(x = fpr, y = tpr)) + geom\_abline(intercept = 0, slope = 1, colour = "gray") + ylab("Sensitivity") + xlab("1 - Specificity") + ggtitle(paste0("Model ",model.id, ",AUC: " ,round(auc, 4)))  
}  
do.call(grid.arrange, roc.plots.mat[, 1])



#dev.off()  
mean.auc <- apply(auc.mat, 1, mean)  
names(mean.auc) <- names(model.list)  
mean.auc

## BestAICBackward1 BestAICBackward2 BestAICForward1 BestAICForward2   
## 0.7350 0.7500 0.7825 0.7925   
## BestAICBoth1 BestAICBoth2 BestSBCBoth1 BestSBCBoth2   
## 0.7750 0.7850 0.7775 0.7525

#best.model.id <- 7  
best.model.id <- which.max(mean.auc)  
names(model.list)[best.model.id]

## [1] "BestAICForward2"

The area under the function provides an unbiased, and non-parametric measure of the discrimination ability of the model. AOC = 0.5 means that predictions are no better than random guessing. An AUROC value >= 0.80 is considered ideal.  
The Candidate model with best AUROC value is "BestAICForward2" with value 0.7925. We consider this as our final model.

## Selecting the best Cutoff

par(mfrow=c(1,1))  
set.seed(seed.id)  
fit <- train(model.list[[best.model.id]], data = train, method = "glm", family="binomial")  
predicted <- predict(fit, newdata=subset(validation, select=-Class), type="prob", dispersion = 1.129278)[,1]  
  
cutoffs <- seq(0, 1, 0.1)  
sens <- c()  
spec <- c()  
acc <- c()  
for (cutoff in cutoffs){  
 pred <- ifelse(predicted >= cutoff, "CRC","Healthy")  
 cm <- confusionMatrix(pred, validation$Class)  
 sens <- c(sens, cm$byClass[["Sensitivity"]])  
 spec <- c(spec, cm$byClass[["Specificity"]])  
 acc <- c(acc, cm$byClass[["Balanced Accuracy"]])  
}

## Warning in confusionMatrix.default(pred, validation$Class): Levels are not  
## in the same order for reference and data. Refactoring data to match.  
  
## Warning in confusionMatrix.default(pred, validation$Class): Levels are not  
## in the same order for reference and data. Refactoring data to match.  
  
## Warning in confusionMatrix.default(pred, validation$Class): Levels are not  
## in the same order for reference and data. Refactoring data to match.

df <- data.frame(cutoffs <- cutoffs, sens <- sens, spec <- spec, acc <- acc)  
names(df) <- c("cutoffs", "sens", "spec", "acc")  
df

## cutoffs sens spec acc  
## 1 0.0 1.00 0.00 0.500  
## 2 0.1 0.95 0.10 0.525  
## 3 0.2 0.85 0.30 0.575  
## 4 0.3 0.80 0.40 0.600  
## 5 0.4 0.80 0.70 0.750  
## 6 0.5 0.65 0.85 0.750  
## 7 0.6 0.55 0.95 0.750  
## 8 0.7 0.45 0.95 0.700  
## 9 0.8 0.20 0.95 0.575  
## 10 0.9 0.00 1.00 0.500  
## 11 1.0 0.00 1.00 0.500

png("sens\_spec\_acc.png")  
plot(round(df$cutoffs, 4),df$sens, xlab="Cutoff", ylab="Value",cex.lab=1.5,cex.axis=1.5,ylim=c(0,1),type="l",lty=2,lwd=2,axes=TRUE)  
lines(round(df$cutoffs, 4), df$spec,lty=4,lwd=3)  
lines(round(df$cutoffs, 4), df$acc,lwd=2, type="l")  
legend(0.5,.25,lty=c(2,4,1),lwd=c(2,3,2),c("Sensitivity","Specificity","Accuracy"))  
#dev.off()  
  
pred <- ifelse(predicted >= 0.45, "CRC","Healthy")  
confusionMatrix(pred, validation$Class)

## $positive  
## [1] "CRC"  
##   
## $table  
## Reference  
## Prediction CRC Healthy  
## CRC 16 5  
## Healthy 4 15  
##   
## $overall  
## Accuracy Kappa AccuracyLower AccuracyUpper AccuracyNull   
## 0.7750000000 0.5500000000 0.6154883227 0.8916033610 0.5000000000   
## AccuracyPValue McnemarPValue   
## 0.0003397741 1.0000000000   
##   
## $byClass  
## Sensitivity Specificity Pos Pred Value   
## 0.8000000 0.7500000 0.7619048   
## Neg Pred Value Precision Recall   
## 0.7894737 0.7619048 0.8000000   
## F1 Prevalence Detection Rate   
## 0.7804878 0.5000000 0.4000000   
## Detection Prevalence Balanced Accuracy   
## 0.5250000 0.7750000   
##   
## $mode  
## [1] "sens\_spec"  
##   
## $dots  
## list()  
##   
## attr(,"class")  
## [1] "confusionMatrix"

## Fitting the Best Model

We now fit the Best Model with the full training dataset.

set.seed(seed.id)  
best.fit <- train(model.list[[best.model.id]], data = training, method = "glm", family="quasibinomial")  
summary(best.fit)

##   
## Call:  
## NULL  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -2.13751 -0.92826 0.00625 0.95266 2.65247   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 5.5676 7.5642 0.736 0.46259   
## TIMP1 -1.1197 0.4158 -2.693 0.00771 \*\*   
## LAMP2 2.4252 0.6025 4.025 8.18e-05 \*\*\*  
## HP -0.2658 0.2683 -0.991 0.32299   
## LRG1 -0.9263 0.3614 -2.563 0.01113 \*   
## SERPINA7 -1.6046 0.5877 -2.730 0.00692 \*\*   
## LUM 0.9440 0.3746 2.520 0.01254 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for quasibinomial family taken to be 1.116235)  
##   
## Null deviance: 277.26 on 199 degrees of freedom  
## Residual deviance: 225.63 on 193 degrees of freedom  
## AIC: NA  
##   
## Number of Fisher Scoring iterations: 4

# Coefficients  
exp(coef(best.fit$finalModel))

## (Intercept) TIMP1 LAMP2 HP LRG1 SERPINA7   
## 261.8171797 0.3263650 11.3041203 0.7665708 0.3960063 0.2009796   
## LUM   
## 2.5702634

# Confidence Interval of Coefficients  
confint(best.fit$finalModel)

## Waiting for profiling to be done...

## 2.5 % 97.5 %  
## (Intercept) -9.1325157 20.7092327  
## TIMP1 -1.9668537 -0.3259097  
## LAMP2 1.2929658 3.6649085  
## HP -0.8031997 0.2565162  
## LRG1 -1.6594531 -0.2340107  
## SERPINA7 -2.7960502 -0.4790962  
## LUM 0.2244853 1.7049338

## Plotting Predicted Probability Lines

### CP

training.numeric <- training  
training.numeric$Class <- as.numeric(training$Class)  
training.numeric$Class[training.numeric$Class == 1] <- 0  
training.numeric$Class[training.numeric$Class == 2] <- 1  
  
png("predicted\_prob.png")  
par(mfrow=c(3,2))  
test <- with(training, data.frame(TIMP1=TIMP1, LAMP2=median(LAMP2), HP=median(HP), LRG1=median(LRG1), SERPINA7= median(SERPINA7), LUM=median(LUM)))  
test$P <- predict(best.fit, newdata=test, type='prob')[, 1]  
plot(training$TIMP1, training.numeric$Class, pch=16, xlab="TIMP1", ylab="Class")  
points(training$TIMP1, test$P)  
  
test <- with(training, data.frame(TIMP1=median(TIMP1), LAMP2=LAMP2, HP=median(HP), LRG1=median(LRG1), SERPINA7= median(SERPINA7), LUM=median(LUM)))  
test$P <- predict(best.fit, newdata=test, type='prob')[, 1]  
plot(training$LAMP2, training.numeric$Class, pch=16, xlab="LAMP2", ylab="Class")  
points(training$LAMP2, test$P)  
  
test <- with(training, data.frame(TIMP1=median(TIMP1), LAMP2=median(LAMP2), HP=HP, LRG1=median(LRG1), SERPINA7= median(SERPINA7), LUM=median(LUM)))  
test$P <- predict(best.fit, newdata=test, type='prob')[, 1]  
plot(training$HP, training.numeric$Class, pch=16, xlab="HP", ylab="Class")  
points(training$HP, test$P)  
  
test <- with(training, data.frame(TIMP1=median(TIMP1), LAMP2=median(LAMP2), HP=median(HP), LRG1=LRG1, SERPINA7= median(SERPINA7), LUM=median(LUM)))  
test$P <- predict(best.fit, newdata=test, type='prob')[, 1]  
plot(training$LRG1, training.numeric$Class, pch=16, xlab="LRG1", ylab="Class")  
points(training$LRG1, test$P)  
  
test <- with(training, data.frame(TIMP1=median(TIMP1), LAMP2=median(LAMP2), HP=median(HP), LRG1=median(LRG1), SERPINA7=SERPINA7, LUM=median(LUM)))  
test$P <- predict(best.fit, newdata=test, type='prob')[, 1]  
plot(training$SERPINA7, training.numeric$Class, pch=16, xlab="SERPINA7", ylab="Class")  
points(training$SERPINA7, test$P)  
  
test <- with(training, data.frame(TIMP1=median(TIMP1), LAMP2=median(LAMP2), HP=median(HP), LRG1=median(LRG1), SERPINA7=median(SERPINA7), LUM=LUM))  
test$P <- predict(best.fit, newdata=test, type='prob')[, 1]  
plot(training$LUM, training.numeric$Class, pch=16, xlab="LUM", ylab="Class")  
points(training$LUM, test$P)  
#dev.off()  
par(mfrow=c(1,1))

## Test the Final Model

We now introduce the test dataset for final results.

# Confusion Matrix for Training dataset  
predicted <- predict(best.fit, newdata=subset(training, select=-Class), type="prob", dispersion = 1.129278)[,1]  
pred <- ifelse(predicted >= 0.45, "CRC", "Healthy")  
confusionMatrix(data=pred, training$Class)

## $positive  
## [1] "CRC"  
##   
## $table  
## Reference  
## Prediction CRC Healthy  
## CRC 74 34  
## Healthy 26 66  
##   
## $overall  
## Accuracy Kappa AccuracyLower AccuracyUpper AccuracyNull   
## 7.000000e-01 4.000000e-01 6.313501e-01 7.626104e-01 5.000000e-01   
## AccuracyPValue McnemarPValue   
## 7.535308e-09 3.661566e-01   
##   
## $byClass  
## Sensitivity Specificity Pos Pred Value   
## 0.7400000 0.6600000 0.6851852   
## Neg Pred Value Precision Recall   
## 0.7173913 0.6851852 0.7400000   
## F1 Prevalence Detection Rate   
## 0.7115385 0.5000000 0.3700000   
## Detection Prevalence Balanced Accuracy   
## 0.5400000 0.7000000   
##   
## $mode  
## [1] "sens\_spec"  
##   
## $dots  
## list()  
##   
## attr(,"class")  
## [1] "confusionMatrix"

# Confusion Matrix for Testing dataset  
predicted <- predict(fit, newdata=subset(testing, select=-Class), type="prob", dispersion = 1.129278)[,1]  
pred <- ifelse(predicted >= 0.45, "CRC","Healthy")  
confusionMatrix(data=pred, testing$Class)

## $positive  
## [1] "CRC"  
##   
## $table  
## Reference  
## Prediction CRC Healthy  
## CRC 201 46  
## Healthy 1 21  
##   
## $overall  
## Accuracy Kappa AccuracyLower AccuracyUpper AccuracyNull   
## 8.252788e-01 3.977516e-01 7.745208e-01 8.687063e-01 7.509294e-01   
## AccuracyPValue McnemarPValue   
## 2.246670e-03 1.380222e-10   
##   
## $byClass  
## Sensitivity Specificity Pos Pred Value   
## 0.9950495 0.3134328 0.8137652   
## Neg Pred Value Precision Recall   
## 0.9545455 0.8137652 0.9950495   
## F1 Prevalence Detection Rate   
## 0.8953229 0.7509294 0.7472119   
## Detection Prevalence Balanced Accuracy   
## 0.9182156 0.6542412   
##   
## $mode  
## [1] "sens\_spec"  
##   
## $dots  
## list()  
##   
## attr(,"class")  
## [1] "confusionMatrix"

The Balanced Accuracy is almost similar for both training and testing datasets.

## 

## Statement of Contributions

A.S - Abhijeet Sharma  
P.T - Pankaj Tripathi  
A.S did selection and evaluation of models and paper write-up.  
P.T. did pre-processing and plots.