Master File

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# User Inputs

output.var = params$output.var   
  
transform.abs = FALSE  
log.pred = params$log.pred  
norm.pred = FALSE  
algo.forward.caret = params$algo.forward.caret  
algo.backward.caret = params$algo.backward.caret  
algo.stepwise.caret = params$algo.stepwise.caret  
algo.LASSO.caret = params$algo.LASSO.caret  
algo.LARS.caret = params$algo.LARS.caret  
message("Parameters used for training/prediction: ")

## Parameters used for training/prediction:

str(params)

## List of 7  
## $ output.var : chr "y3"  
## $ log.pred : logi TRUE  
## $ algo.forward.caret : logi TRUE  
## $ algo.backward.caret: logi TRUE  
## $ algo.stepwise.caret: logi TRUE  
## $ algo.LASSO.caret : logi TRUE  
## $ algo.LARS.caret : logi TRUE

# Setup Labels  
output.var.tr = if (log.pred == TRUE) paste0(output.var,'.log') else output.var.tr = output.var

# Loading Data

feat = read.csv('../../Data/features\_highprec.csv')  
labels = read.csv('../../Data/labels.csv')  
predictors = names(dplyr::select(feat,-JobName))  
data.ori = inner\_join(feat,labels,by='JobName')  
#data.ori = inner\_join(feat,select\_at(labels,c('JobName',output.var)),by='JobName')

# Data validation

cc = complete.cases(data.ori)  
data.notComplete = data.ori[! cc,]  
data = data.ori[cc,] %>% select\_at(c(predictors,output.var,'JobName'))  
message('Original cases: ',nrow(data.ori))

## Original cases: 10000

message('Non-Complete cases: ',nrow(data.notComplete))

## Non-Complete cases: 3020

message('Complete cases: ',nrow(data))

## Complete cases: 6980

summary(dplyr::select\_at(data,c('JobName',output.var)))

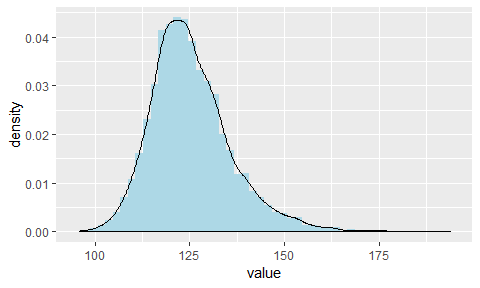
## JobName y3   
## Job\_00001: 1 Min. : 95.91   
## Job\_00002: 1 1st Qu.:118.29   
## Job\_00003: 1 Median :124.03   
## Job\_00004: 1 Mean :125.40   
## Job\_00007: 1 3rd Qu.:131.06   
## Job\_00008: 1 Max. :193.73   
## (Other) :6974

# Output Variable

The Output Variable **y3** shows right skewness, so will proceed with a log transformation

## Histogram

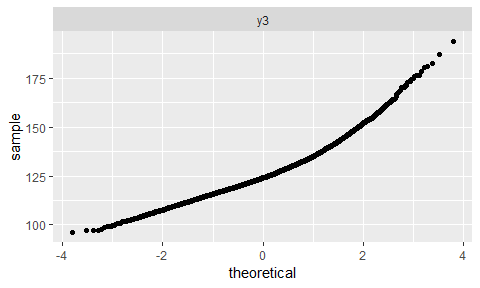
df=gather(select\_at(data,output.var))  
ggplot(df, aes(x=value)) +   
 geom\_histogram(aes(y=..density..),bins = 50,fill='light blue') +   
 geom\_density()



#stat\_function(fun = dnorm, n = 100, args = list(mean = mean(df$value), sd = sd(df$value)))

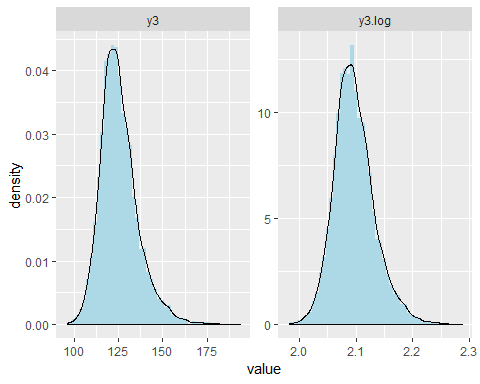
## QQPlot

ggplot(gather(select\_at(data,output.var)), aes(sample=value)) +   
 stat\_qq() +   
 facet\_wrap(~key, scales = 'free',ncol=4)

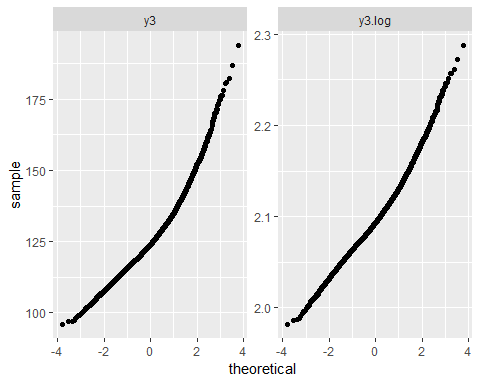


## Trasformation of Output Variable from y3 to y3.log

if(log.pred==TRUE) data[[output.var.tr]] = log(data[[output.var]],10) else  
 data[[output.var.tr]] = data[[output.var]]  
df=gather(select\_at(data,c(output.var,output.var.tr)))  
ggplot(df, aes(value)) +   
 geom\_histogram(aes(y=..density..),bins = 50,fill='light blue') +   
 geom\_density() +   
 # stat\_function(fun = dnorm, n = 100, args = list(mean = mean(df$value), sd = sd(df$value)))   
 facet\_wrap(~key, scales = 'free',ncol=2)



ggplot(gather(select\_at(data,c(output.var,output.var.tr))), aes(sample=value)) +   
 stat\_qq() +   
 facet\_wrap(~key, scales = 'free',ncol=4)



## Best Normalizator y3

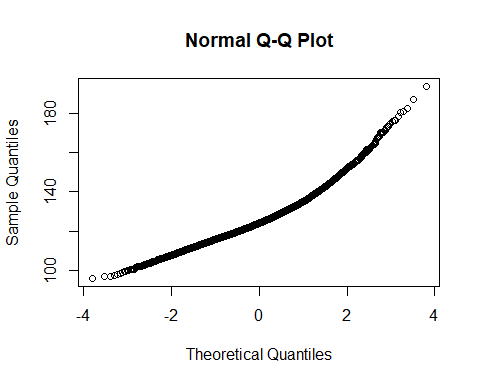
Normalization of **y3** using bestNormalize package. (suggested orderNorm) This is cool, but I think is too far for the objective of the project

t=bestNormalize::bestNormalize(data[[output.var]])

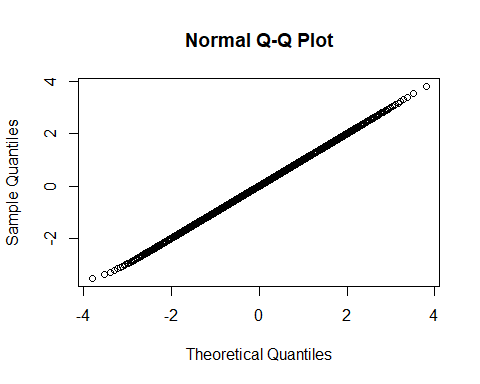
t

## Best Normalizing transformation with 6980 Observations  
## Estimated Normality Statistics (Pearson P / df, lower => more normal):  
## - No transform: 2.9123   
## - Box-Cox: 1.4129   
## - Log\_b(x+a): 2.0491   
## - sqrt(x+a): 2.398   
## - exp(x): 749.0112   
## - arcsinh(x): 2.0491   
## - Yeo-Johnson: 1.139   
## - orderNorm: 1.0911   
## Estimation method: Out-of-sample via CV with 10 folds and 5 repeats  
##   
## Based off these, bestNormalize chose:  
## orderNorm Transformation with 6980 nonmissing obs and no ties   
## - Original quantiles:  
## 0% 25% 50% 75% 100%   
## 95.913 118.289 124.030 131.059 193.726

qqnorm(data[[output.var]])



qqnorm(predict(t))



**orderNorm()** is a rank-based procedure by which the values of a vector are mapped to their percentile, which is then mapped to the same percentile of the normal distribution. Without the presence of ties, this essentially guarantees that the transformation leads to a uniform distribution

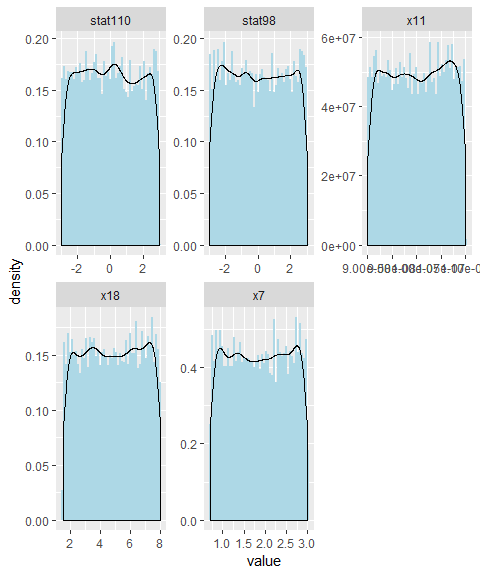
# Predictors

All predictors show a **Fat-Tail** situation, where the two tails are very tall, and a low distribution around the mean. The orderNorm transformation can help (see [Best Normalizator] section)

## Interesting Predictors

Histograms

cols = c('x11','x18','stat98','x7','stat110')  
df=gather(select\_at(data,cols))  
ggplot(df, aes(value)) +   
 geom\_histogram(aes(y=..density..),bins = 50,fill='light blue') +   
 geom\_density() +   
 # stat\_function(fun = dnorm, n = 100, args = list(mean = mean(df$value), sd = sd(df$value)))   
 facet\_wrap(~key, scales = 'free',ncol=3)



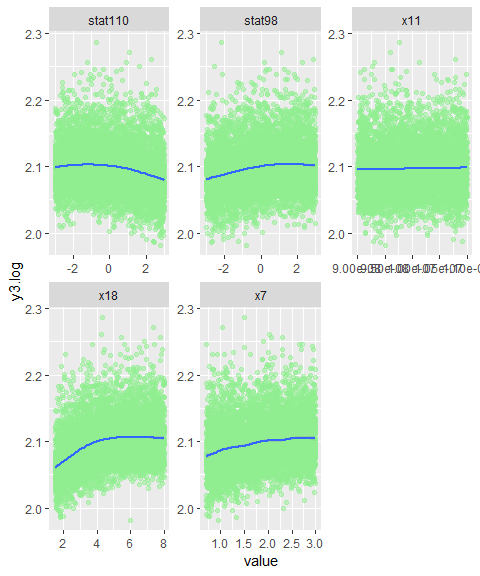
# ggplot(gather(select\_at(data,cols)), aes(sample=value)) +   
# stat\_qq()+  
# facet\_wrap(~key, scales = 'free',ncol=2)  
  
lapply(select\_at(data,cols),summary)

## $x11  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 9.000e-08 9.494e-08 1.001e-07 1.001e-07 1.052e-07 1.100e-07   
##   
## $x18  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 1.500 3.147 4.769 4.772 6.418 7.999   
##   
## $stat98  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## -2.998619 -1.551882 -0.015993 -0.005946 1.528405 2.999499   
##   
## $x7  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 0.700 1.266 1.854 1.852 2.446 3.000   
##   
## $stat110  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## -2.999543 -1.496865 -0.002193 -0.004129 1.504273 2.999563

Scatter plot vs. output variable \*\*y3.log

d = gather(dplyr::select\_at(data,c(cols,output.var.tr)),key=target,value=value,-!!output.var.tr)  
ggplot(data=d, aes\_string(x='value',y=output.var.tr)) +   
 geom\_point(color='light green',alpha=0.5) +   
 geom\_smooth() +   
 facet\_wrap(~target, scales = 'free',ncol=3)

## `geom\_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'

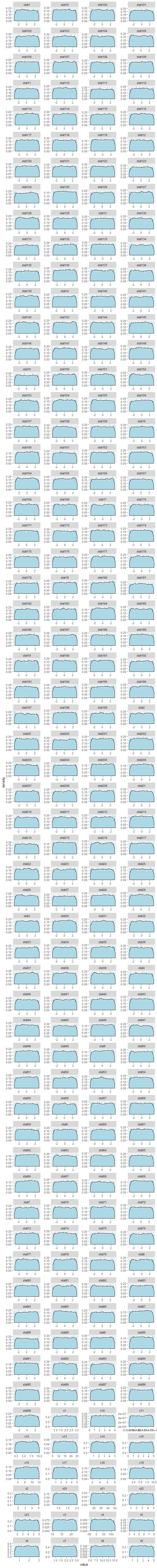


## All Predictors

### Histograms

All indicators have a strong indication of **Fat-Tails**

df=gather(select\_at(data,predictors))  
ggplot(df, aes(value)) +   
 geom\_histogram(aes(y=..density..),bins = 50,fill='light blue') +   
 geom\_density() +   
 # stat\_function(fun = dnorm, n = 100, args = list(mean = mean(df$value), sd = sd(df$value)))   
 facet\_wrap(~key, scales = 'free',ncol=4)



# Correlations

## With Output Variable

#chart.Correlation(select(data,-JobName), pch=21)  
t=as.data.frame(round(cor(dplyr::select(data,-one\_of(output.var.tr,'JobName'))  
 ,select\_at(data,output.var.tr)),4)) %>%  
 rownames\_to\_column(var='variable') %>% filter(variable != !!output.var) %>% arrange(-y3.log)  
#DT::datatable(t)  
message("Top Positive")

## Top Positive

kable(head(arrange(t,desc(y3.log)),20))

|  |  |
| --- | --- |
| variable | y3.log |
| x18 | 0.3120 |
| x7 | 0.2091 |
| stat98 | 0.1784 |
| x9 | 0.1127 |
| x17 | 0.0611 |
| x16 | 0.0489 |
| x10 | 0.0472 |
| x21 | 0.0412 |
| x11 | 0.0322 |
| x8 | 0.0318 |
| stat156 | 0.0287 |
| stat23 | 0.0234 |
| stat100 | 0.0206 |
| stat144 | 0.0203 |
| stat59 | 0.0202 |
| stat60 | 0.0199 |
| stat195 | 0.0199 |
| stat141 | 0.0194 |
| stat73 | 0.0192 |
| stat197 | 0.0185 |

message("Top Negative")

## Top Negative

kable(head(arrange(t,y3.log),20))

|  |  |
| --- | --- |
| variable | y3.log |
| stat110 | -0.1594 |
| x4 | -0.0603 |
| stat13 | -0.0345 |
| stat41 | -0.0345 |
| stat14 | -0.0317 |
| stat149 | -0.0309 |
| stat113 | -0.0279 |
| stat4 | -0.0248 |
| stat106 | -0.0236 |
| stat146 | -0.0236 |
| stat186 | -0.0217 |
| stat91 | -0.0210 |
| stat214 | -0.0209 |
| stat5 | -0.0207 |
| stat22 | -0.0202 |
| stat39 | -0.0202 |
| stat175 | -0.0194 |
| stat187 | -0.0193 |
| stat128 | -0.0192 |
| stat37 | -0.0191 |

## Between All Variables

#chart.Correlation(select(data,-JobName), pch=21)  
t=as.data.frame(round(cor(dplyr::select(data,-one\_of('JobName'))),4))  
#DT::datatable(t,options=list(scrollX=T))  
message("Showing only 10 variables")

## Showing only 10 variables

kable(t[1:10,1:10])

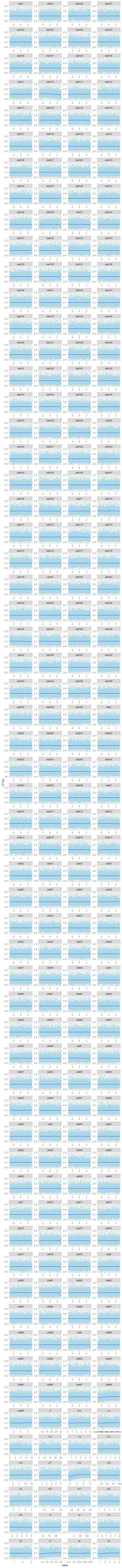
|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 |
| x1 | 1.0000 | 0.0034 | -0.0028 | 0.0085 | 0.0068 | 0.0159 | 0.0264 | -0.0012 | 0.0142 | 0.0013 |
| x2 | 0.0034 | 1.0000 | -0.0057 | 0.0004 | -0.0094 | -0.0101 | 0.0089 | 0.0078 | 0.0049 | -0.0214 |
| x3 | -0.0028 | -0.0057 | 1.0000 | 0.0029 | 0.0046 | 0.0006 | -0.0105 | -0.0002 | 0.0167 | -0.0137 |
| x4 | 0.0085 | 0.0004 | 0.0029 | 1.0000 | -0.0059 | 0.0104 | 0.0098 | 0.0053 | 0.0061 | -0.0023 |
| x5 | 0.0068 | -0.0094 | 0.0046 | -0.0059 | 1.0000 | 0.0016 | -0.0027 | 0.0081 | 0.0259 | -0.0081 |
| x6 | 0.0159 | -0.0101 | 0.0006 | 0.0104 | 0.0016 | 1.0000 | 0.0200 | -0.0157 | 0.0117 | -0.0072 |
| x7 | 0.0264 | 0.0089 | -0.0105 | 0.0098 | -0.0027 | 0.0200 | 1.0000 | -0.0018 | -0.0069 | -0.0221 |
| x8 | -0.0012 | 0.0078 | -0.0002 | 0.0053 | 0.0081 | -0.0157 | -0.0018 | 1.0000 | 0.0142 | -0.0004 |
| x9 | 0.0142 | 0.0049 | 0.0167 | 0.0061 | 0.0259 | 0.0117 | -0.0069 | 0.0142 | 1.0000 | 0.0149 |
| x10 | 0.0013 | -0.0214 | -0.0137 | -0.0023 | -0.0081 | -0.0072 | -0.0221 | -0.0004 | 0.0149 | 1.0000 |

## Scatter Plots with Output Variable

Scatter plots with all predictors and the output variable (y3.log)

d = gather(dplyr::select\_at(data,c(predictors,output.var.tr)),key=target,value=value,-!!output.var.tr)  
ggplot(data=d, aes\_string(x='value',y=output.var.tr)) +   
 geom\_point(color='light blue',alpha=0.5) +   
 geom\_smooth() +   
 facet\_wrap(~target, scales = 'free',ncol=4)

## `geom\_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'



## Multicollinearity - VIF

No Multicollinearity among predictors

Showing Top predictor by VIF Value

vifDF = usdm::vif(select\_at(data,predictors)) %>% arrange(desc(VIF))  
head(vifDF,15)

## Variables VIF  
## 1 stat153 1.061778  
## 2 stat31 1.061637  
## 3 stat159 1.061523  
## 4 stat11 1.060840  
## 5 stat202 1.060508  
## 6 stat119 1.060098  
## 7 stat142 1.060066  
## 8 stat198 1.059876  
## 9 stat138 1.059637  
## 10 stat56 1.059073  
## 11 stat200 1.058856  
## 12 stat127 1.058855  
## 13 stat192 1.058595  
## 14 stat52 1.057795  
## 15 stat113 1.057734

# Feature Eng

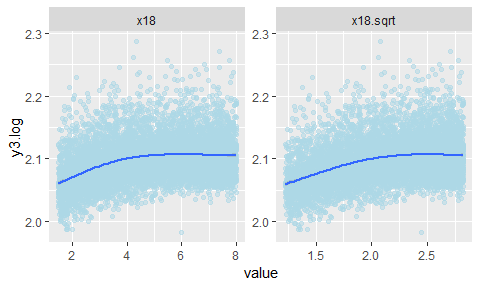
* Square Root transformation for **x18**

data.tr=data %>%  
 mutate(x18.sqrt = sqrt(x18))   
cols=c('x18','x18.sqrt')

## Comparing Pre and Post Transformation Density Plots

# ggplot(gather(select\_at(data.tr,cols)), aes(value)) +   
# geom\_histogram(aes(y=..density..),bins = 50,fill='light blue') +   
# geom\_density() +   
# facet\_wrap(~key, scales = 'free',ncol=4)  
  
d = gather(dplyr::select\_at(data.tr,c(cols,output.var.tr)),key=target,value=value,-!!output.var.tr)  
ggplot(data=d, aes\_string(x='value',y=output.var.tr)) +   
 geom\_point(color='light blue',alpha=0.5) +   
 geom\_smooth() +   
 facet\_wrap(~target, scales = 'free',ncol=4)

## `geom\_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'



#removing unwanted variables  
data.tr=data.tr %>%  
 dplyr::select\_at(names(data.tr)[! names(data.tr) %in% c('x18','y3','JobName')])  
  
data=data.tr  
label.names=output.var.tr

# Modeling

## Train Test Split

data = data[sample(nrow(data)),] # randomly shuffle data  
split = sample.split(data[,label.names], SplitRatio = 0.8)  
  
data.train = subset(data, split == TRUE)  
data.test = subset(data, split == FALSE)

## Common Functions

plot.diagnostics <- function(model, train) {  
 plot(model)  
   
 residuals = resid(model) # Plotted above in plot(lm.out)  
 r.standard = rstandard(model)  
 r.student = rstudent(model)  
   
 df = data.frame(x=predict(model,train),y=r.student)  
 p=ggplot(data=df,aes(x=x,y=y)) +  
 geom\_point(color='blue',alpha=0.5,shape=20,size=2) +  
 geom\_hline(yintercept = 0,size=1)+  
 ylab("Student Residuals") +  
 xlab("Predicted Values")+  
 ggtitle("Student Residual Plot")  
 plot(p)  
   
 df = data.frame(x=predict(model,train),y=r.standard)  
 p=ggplot(data=df,aes(x=x,y=y)) +  
 geom\_point(color='blue',alpha=0.5,shape=20,size=2) +  
 geom\_hline(yintercept = c(-2,0,2),size=1)+  
 ylab("Student Residuals") +  
 xlab("Predicted Values")+  
 ggtitle("Student Residual Plot")  
 plot(p)  
 # Histogram  
 df=data.frame(r.student)  
 p=ggplot(data=df,aes(r.student)) +  
 geom\_histogram(aes(y=..density..),bins = 50,fill='blue',alpha=0.6) +   
 stat\_function(fun = dnorm, n = 100, args = list(mean = 0, sd = 1)) +  
 ylab("Density")+  
 xlab("Studentized Residuals")+  
 ggtitle("Distribution of Studentized Residuals")  
 plot(p)  
 # http://www.stat.columbia.edu/~martin/W2024/R7.pdf  
 # Influential plots  
 inf.meas = influence.measures(model)  
 # print (summary(inf.meas)) # too much data  
   
 # Leverage plot  
 lev = hat(model.matrix(model))  
 df=tibble::rownames\_to\_column(as.data.frame(lev),'id')  
 p=ggplot(data=df,aes(x=as.numeric(id),y=lev)) +  
 geom\_point(color='blue',alpha=0.5,shape=20,size=2) +  
 ylab('Leverage - check') +   
 xlab('Index')  
 plot(p)  
 # Cook's Distance  
 cd = cooks.distance(model)  
 df=tibble::rownames\_to\_column(as.data.frame(cd),'id')  
 p=ggplot(data=df,aes(x=as.numeric(id),y=cd)) +  
 geom\_point(color='blue',alpha=0.5,shape=20,size=2) +  
 geom\_text(data=filter(df,cd>15/nrow(train)),aes(label=id),check\_overlap=T,size=3,vjust=-.5)+  
 ylab('Cooks distances') +   
 geom\_hline(yintercept = c(4/nrow(train),0),size=1)+  
 xlab('Index')  
 plot(p)  
 print (paste("Number of data points that have Cook's D > 4/n: ", length(cd[cd > 4/nrow(train)]), sep = ""))   
 print (paste("Number of data points that have Cook's D > 1: ", length(cd[cd > 1]), sep = ""))   
 return(cd)  
}  
  
# function to set up random seeds  
# Based on http://jaehyeon-kim.github.io/2015/05/Setup-Random-Seeds-on-Caret-Package.html   
setCaretSeeds <- function(method = "cv", numbers = 1, repeats = 1, tunes = NULL, seed = 1701) {  
 #B is the number of resamples and integer vector of M (numbers + tune length if any)  
 B <- if (method == "cv") numbers  
 else if(method == "repeatedcv") numbers \* repeats  
 else NULL  
 if(is.null(length)) {  
 seeds <- NULL  
 } else {  
 set.seed(seed = seed)  
 seeds <- vector(mode = "list", length = B)  
 seeds <- lapply(seeds, function(x) sample.int(n = 1000000  
 , size = numbers + ifelse(is.null(tunes), 0, tunes)))  
 seeds[[length(seeds) + 1]] <- sample.int(n = 1000000, size = 1)  
 }  
 # return seeds  
 seeds  
}  
  
train.caret.glmselect = function(formula, data, method  
 ,subopt = NULL, feature.names  
 , train.control = NULL, tune.grid = NULL, pre.proc = NULL){  
   
 if(is.null(train.control)){  
 train.control <- trainControl(method = "cv"  
 ,number = 10  
 ,seeds = setCaretSeeds(method = "cv"  
 , numbers = 10  
 , seed = 1701)  
 ,search = "grid"  
 ,verboseIter = TRUE  
 ,allowParallel = TRUE  
 )  
 }  
   
 if(is.null(tune.grid)){  
 if (method == 'leapForward' | method == 'leapBackward' | method == 'leapSeq'){  
 tune.grid = data.frame(nvmax = 1:length(feature.names))  
 }  
 if (method == 'glmnet' && subopt == 'LASSO'){  
 # Will only show 1 Lambda value during training, but that is OK  
 # https://stackoverflow.com/questions/47526544/why-need-to-tune-lambda-with-carettrain-method-glmnet-and-cv-glmnet  
 # Another option for LASSO is this: https://github.com/topepo/caret/blob/master/RegressionTests/Code/lasso.R  
 lambda = 10^seq(-2,0, length =100)  
 alpha = c(1)  
 tune.grid = expand.grid(alpha = alpha,lambda = lambda)  
 }  
 if (method == 'lars'){  
 # https://github.com/topepo/caret/blob/master/RegressionTests/Code/lars.R  
 fraction = seq(0, 1, length = 100)  
 tune.grid = expand.grid(fraction = fraction)  
 pre.proc = c("center", "scale")   
 }  
 }  
   
 # http://sshaikh.org/2015/05/06/parallelize-machine-learning-in-r-with-multi-core-cpus/  
 cl <- makeCluster(detectCores()\*0.85) # use 75% of cores only, leave rest for other tasks  
 registerDoParallel(cl)  
  
 set.seed(1)   
 # note that the seed has to actually be set just before this function is called  
 # settign is above just not ensure reproducibility for some reason  
 model.caret <- caret::train(formula  
 , data = data  
 , method = method  
 , tuneGrid = tune.grid  
 , trControl = train.control  
 , preProc = pre.proc  
 )  
   
 stopCluster(cl)  
 registerDoSEQ() # register sequential engine in case you are not using this function anymore  
   
 if (method == 'leapForward' | method == 'leapBackward' | method == 'leapSeq'){  
 print("All models results")  
 print(model.caret$results) # all model results  
 print("Best Model")  
 print(model.caret$bestTune) # best model  
 model = model.caret$finalModel  
  
 # Metrics Plot   
 dataPlot = model.caret$results %>%  
 gather(key='metric',value='value',-nvmax) %>%  
 dplyr::filter(metric %in% c('MAE','RMSE','Rsquared'))  
 metricsPlot = ggplot(data=dataPlot,aes(x=nvmax,y=value) ) +  
 geom\_line(color='lightblue4') +  
 geom\_point(color='blue',alpha=0.7,size=.9) +  
 facet\_wrap(~metric,ncol=2,scales='free\_y')+  
 theme\_light()  
 plot(metricsPlot)  
   
 # Residuals Plot  
 # leap function does not support studentized residuals  
 dataPlot=data.frame(pred=predict(model.caret,data),res=resid(model.caret))  
 residPlot = ggplot(dataPlot,aes(x=pred,y=res)) +  
 geom\_point(color='light blue',alpha=0.7) +  
 geom\_smooth(method="lm")+  
 theme\_light()  
 plot(residPlot)  
   
 residHistogram = ggplot(dataPlot,aes(x=res)) +  
 geom\_histogram(aes(y=..density..),fill='light blue',alpha=1) +  
 #geom\_density(color='lightblue4') +   
 stat\_function(fun = dnorm, n = 100, args = list(mean = mean(dataPlot$res)  
 , sd = sd(dataPlot$res)),color='lightblue4')   
 theme\_light()  
 plot(residHistogram)  
 id = rownames(model.caret$bestTune)   
 # Provides the coefficients of the best model  
 # regsubsets doens return a full model (see documentation of regsubset), so we need to recalcualte themodel  
 # https://stackoverflow.com/questions/13063762/how-to-obtain-a-lm-object-from-regsubsets  
 print("Coefficients of final model:")  
 coefs <- coef(model, id=id)  
 #calculate the model to the the coef intervals  
 nams <- names(coefs)  
 nams <- nams[!nams %in% "(Intercept)"]  
 response <- as.character(formula[[2]])  
 form <- as.formula(paste(response, paste(nams, collapse = " + "), sep = " ~ "))  
 mod <- lm(form, data = data)  
 #coefs  
 #coef(mod)  
 print(car::Confint(mod))  
 return(list(model = model,id = id, residPlot = residPlot, residHistogram=residHistogram  
 ,modelLM=mod))  
 }  
 if (method == 'glmnet' && subopt == 'LASSO'){  
 print(model.caret)  
 print(plot(model.caret))  
 print(model.caret$bestTune)  
   
 print(model.caret$results)  
 model=model.caret$finalModel  
 # Metrics Plot   
 dataPlot = model.caret$results %>%  
 gather(key='metric',value='value',-lambda) %>%  
 dplyr::filter(metric %in% c('MAE','RMSE','Rsquared'))  
 metricsPlot = ggplot(data=dataPlot,aes(x=lambda,y=value) ) +  
 geom\_line(color='lightblue4') +  
 geom\_point(color='blue',alpha=0.7,size=.9) +  
 facet\_wrap(~metric,ncol=2,scales='free\_y')+  
 theme\_light()  
 plot(metricsPlot)  
   
 # Residuals Plot   
 dataPlot=data.frame(pred=predict(model.caret,data),res=resid(model.caret))  
 residPlot = ggplot(dataPlot,aes(x=pred,y=res)) +  
 geom\_point(color='light blue',alpha=0.7) +  
 geom\_smooth(method="lm")+  
 theme\_light()  
 plot(residPlot)  
  
 residHistogram = ggplot(dataPlot,aes(x=res)) +  
 geom\_histogram(aes(y=..density..),fill='light blue',alpha=1) +  
 #geom\_density(color='lightblue4') +  
 stat\_function(fun = dnorm, n = 100, args = list(mean = mean(dataPlot$res)  
 , sd = sd(dataPlot$res)),color='lightblue4')   
 theme\_light()  
 plot(residHistogram)  
   
 print("Coefficients")   
 #no interval for glmnet: https://stackoverflow.com/questions/39750965/confidence-intervals-for-ridge-regression  
 t=coef(model,s=model.caret$bestTune$lambda)  
 model.coef = t[which(t[,1]!=0),]  
 print(as.data.frame(model.coef))  
 id = NULL # not really needed but added for consistency  
 return(list(model = model.caret,id = id, residPlot = residPlot, metricsPlot=metricsPlot ))  
 }  
 if (method == 'lars'){  
 print(model.caret)  
 print(plot(model.caret))  
 print(model.caret$bestTune)  
   
 # Metrics Plot  
 dataPlot = model.caret$results %>%  
 gather(key='metric',value='value',-fraction) %>%  
 dplyr::filter(metric %in% c('MAE','RMSE','Rsquared'))  
 metricsPlot = ggplot(data=dataPlot,aes(x=fraction,y=value) ) +  
 geom\_line(color='lightblue4') +  
 geom\_point(color='blue',alpha=0.7,size=.9) +  
 facet\_wrap(~metric,ncol=2,scales='free\_y')+  
 theme\_light()  
 plot(metricsPlot)  
   
 # Residuals Plot  
 dataPlot=data.frame(pred=predict(model.caret,data),res=resid(model.caret))  
 residPlot = ggplot(dataPlot,aes(x=pred,y=res)) +  
 geom\_point(color='light blue',alpha=0.7) +  
 geom\_smooth(method="lm")+  
 theme\_light()  
 plot(residPlot)  
  
 residHistogram = ggplot(dataPlot,aes(x=res)) +  
 geom\_histogram(aes(y=..density..),fill='light blue',alpha=1) +  
 #geom\_density(color='lightblue4') +   
 stat\_function(fun = dnorm, n = 100, args = list(mean = mean(dataPlot$res)  
 , sd = sd(dataPlot$res)),color='lightblue4')   
 theme\_light()  
 plot(residHistogram)  
   
 print("Coefficients")   
 t=coef(model.caret$finalModel,s=model.caret$bestTune$fraction,mode='fraction')  
 model.coef = t[which(t!=0)]  
 print(model.coef)  
 id = NULL # not really needed but added for consistency  
 return(list(model = model.caret,id = id, residPlot = residPlot, residHistogram=residHistogram))  
 }  
}  
  
# https://stackoverflow.com/questions/48265743/linear-model-subset-selection-goodness-of-fit-with-k-fold-cross-validation  
# changed slightly since call[[2]] was just returning "formula" without actually returnign the value in formula  
predict.regsubsets <- function(object, newdata, id, formula, ...) {  
 #form <- as.formula(object$call[[2]])  
 mat <- model.matrix(formula, newdata) # adds intercept and expands any interaction terms  
 coefi <- coef(object, id = id)  
 xvars <- names(coefi)  
 return(mat[,xvars]%\*%coefi)  
}  
   
test.model = function(model, test, level=0.95  
 ,draw.limits = FALSE, good = 0.1, ok = 0.15  
 ,method = NULL, subopt = NULL  
 ,id = NULL, formula, feature.names, label.names  
 ,transformation = NULL){  
 ## if using caret for glm select equivalent functionality,   
 ## need to pass formula (full is ok as it will select subset of variables from there)  
 if (is.null(method)){  
 pred = predict(model, newdata=test, interval="confidence", level = level)   
 }  
   
 if (method == 'leapForward' | method == 'leapBackward' | method == 'leapSeq'){  
 pred = predict.regsubsets(model, newdata = test, id = id, formula = formula)  
 }  
   
 if (method == 'glmnet' && subopt == 'LASSO'){  
 xtest = as.matrix(test[,feature.names])   
 pred=as.data.frame(predict(model, xtest))  
 }  
   
 if (method == 'lars'){  
 pred=as.data.frame(predict(model, newdata = test))  
 }  
   
 # Summary of predicted values  
 print ("Summary of predicted values: ")  
 print(summary(pred[,1]))  
  
 test.mse = mean((test[,label.names]-pred[,1])^2)  
 print (paste(method, subopt, "Test MSE:", test.mse, sep=" "))  
   
 if(log.pred == TRUE || norm.pred == TRUE){  
 # plot transformewd comparison first  
 df=data.frame(x=test[,label.names],y=pred[,1])  
 ggplot(df,aes(x=x,y=y)) +  
 geom\_point(color='blue',alpha=0.5,shape=20,size=2) +  
 geom\_abline(slope=1,intercept=0,color='black',size=1) +  
 #scale\_y\_continuous(limits=c(min(df),max(df)))+  
 xlab("Actual (Transformed)")+  
 ylab("Predicted (Transformed)")  
 }  
   
 if (log.pred == FALSE && norm.pred == FALSE){  
 x = test[,label.names]  
 y = pred[,1]  
 }  
 if (log.pred == TRUE){  
 x = 10^test[,label.names]  
 y = 10^pred[,1]   
 }  
 if (norm.pred == TRUE){  
 x = predict(transformation, test[,label.names], inverse = TRUE)  
 y = predict(transformation, pred[,1], inverse = TRUE)  
 }  
  
 df=data.frame(x,y)  
 ggplot(df,aes(x,y)) +  
 geom\_point(color='blue',alpha=0.5,shape=20,size=2) +  
 geom\_abline(slope=c(1+good,1-good,1+ok,1-ok)  
 ,intercept=rep(0,4),color=c('dark green','dark green','dark red','dark red'),size=1,alpha=0.8) +  
 #scale\_y\_continuous(limits=c(min(df),max(df)))+  
 xlab("Actual")+  
 ylab("Predicted")   
   
   
}

## Setup Formulae

n <- names(data.train)  
 formula <- as.formula(paste(paste(n[n %in% label.names], collapse = " + ")  
 ," ~", paste(n[!n %in% label.names], collapse = " + ")))   
  
grand.mean.formula = as.formula(paste(paste(n[n %in% label.names], collapse = " + ")," ~ 1"))  
  
print(formula)

## y3.log ~ x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8 + x9 + x10 + x11 +   
## x12 + x13 + x14 + x15 + x16 + x17 + x19 + x20 + x21 + x22 +   
## x23 + stat1 + stat2 + stat3 + stat4 + stat5 + stat6 + stat7 +   
## stat8 + stat9 + stat10 + stat11 + stat12 + stat13 + stat14 +   
## stat15 + stat16 + stat17 + stat18 + stat19 + stat20 + stat21 +   
## stat22 + stat23 + stat24 + stat25 + stat26 + stat27 + stat28 +   
## stat29 + stat30 + stat31 + stat32 + stat33 + stat34 + stat35 +   
## stat36 + stat37 + stat38 + stat39 + stat40 + stat41 + stat42 +   
## stat43 + stat44 + stat45 + stat46 + stat47 + stat48 + stat49 +   
## stat50 + stat51 + stat52 + stat53 + stat54 + stat55 + stat56 +   
## stat57 + stat58 + stat59 + stat60 + stat61 + stat62 + stat63 +   
## stat64 + stat65 + stat66 + stat67 + stat68 + stat69 + stat70 +   
## stat71 + stat72 + stat73 + stat74 + stat75 + stat76 + stat77 +   
## stat78 + stat79 + stat80 + stat81 + stat82 + stat83 + stat84 +   
## stat85 + stat86 + stat87 + stat88 + stat89 + stat90 + stat91 +   
## stat92 + stat93 + stat94 + stat95 + stat96 + stat97 + stat98 +   
## stat99 + stat100 + stat101 + stat102 + stat103 + stat104 +   
## stat105 + stat106 + stat107 + stat108 + stat109 + stat110 +   
## stat111 + stat112 + stat113 + stat114 + stat115 + stat116 +   
## stat117 + stat118 + stat119 + stat120 + stat121 + stat122 +   
## stat123 + stat124 + stat125 + stat126 + stat127 + stat128 +   
## stat129 + stat130 + stat131 + stat132 + stat133 + stat134 +   
## stat135 + stat136 + stat137 + stat138 + stat139 + stat140 +   
## stat141 + stat142 + stat143 + stat144 + stat145 + stat146 +   
## stat147 + stat148 + stat149 + stat150 + stat151 + stat152 +   
## stat153 + stat154 + stat155 + stat156 + stat157 + stat158 +   
## stat159 + stat160 + stat161 + stat162 + stat163 + stat164 +   
## stat165 + stat166 + stat167 + stat168 + stat169 + stat170 +   
## stat171 + stat172 + stat173 + stat174 + stat175 + stat176 +   
## stat177 + stat178 + stat179 + stat180 + stat181 + stat182 +   
## stat183 + stat184 + stat185 + stat186 + stat187 + stat188 +   
## stat189 + stat190 + stat191 + stat192 + stat193 + stat194 +   
## stat195 + stat196 + stat197 + stat198 + stat199 + stat200 +   
## stat201 + stat202 + stat203 + stat204 + stat205 + stat206 +   
## stat207 + stat208 + stat209 + stat210 + stat211 + stat212 +   
## stat213 + stat214 + stat215 + stat216 + stat217 + x18.sqrt

print(grand.mean.formula)

## y3.log ~ 1

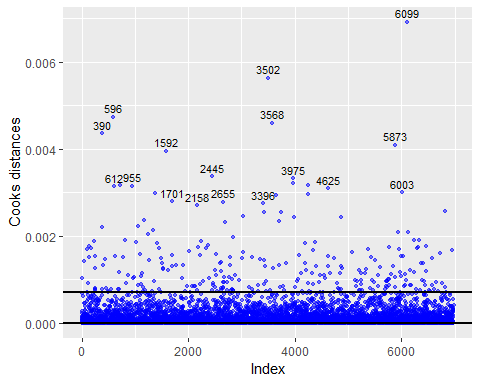
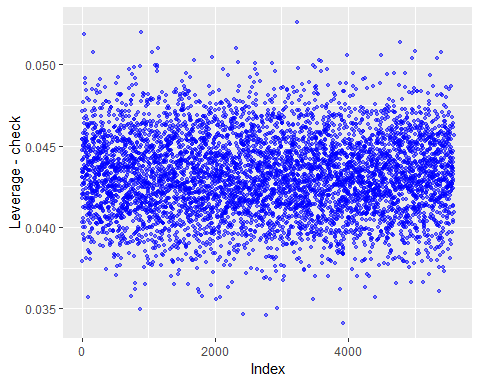
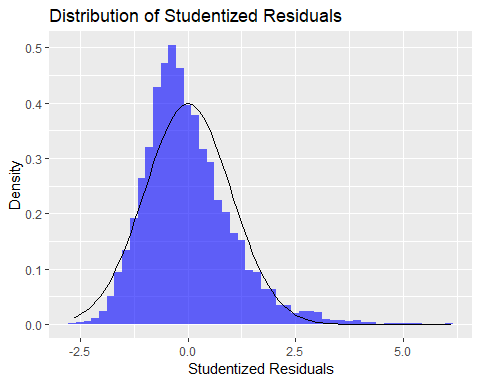
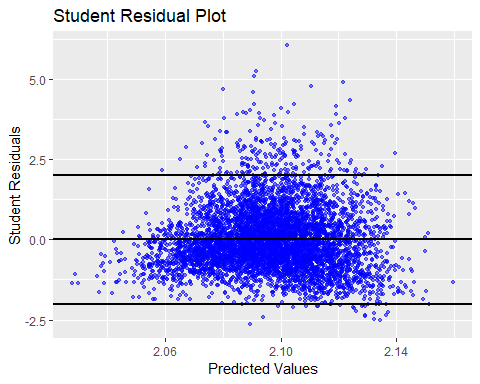
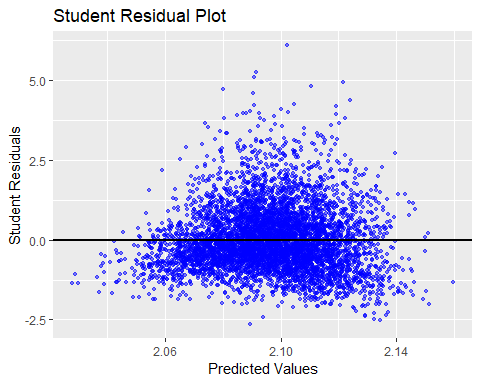
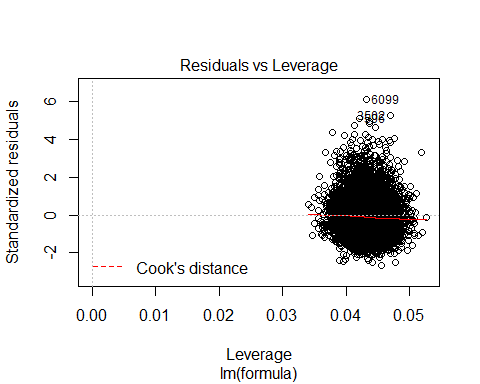
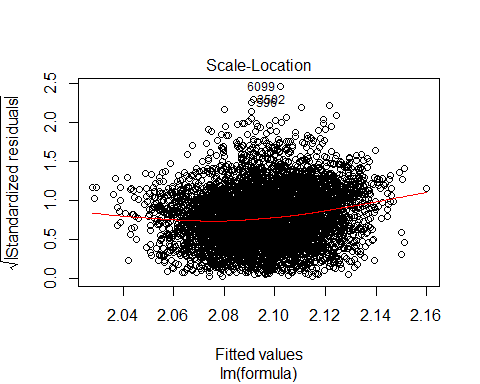
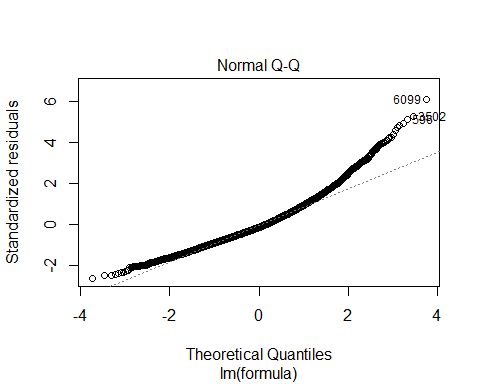
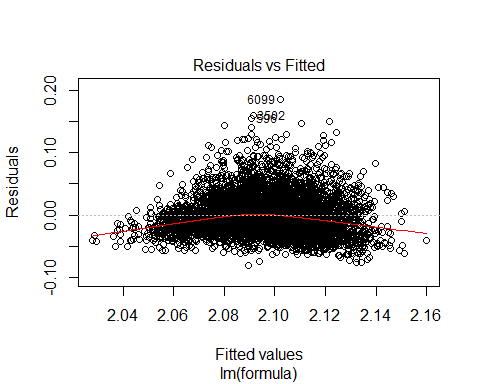
# Update feature.names because we may have transformed some features  
feature.names = n[!n %in% label.names]

## Full Model

model.full = lm(formula , data.train)  
summary(model.full)

##   
## Call:  
## lm(formula = formula, data = data.train)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.080336 -0.020457 -0.004459 0.016152 0.184991   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.974e+00 9.469e-03 208.465 < 2e-16 \*\*\*  
## x1 -3.185e-04 6.522e-04 -0.488 0.625378   
## x2 3.238e-04 4.144e-04 0.781 0.434671   
## x3 6.835e-05 1.136e-04 0.602 0.547428   
## x4 -4.480e-05 8.947e-06 -5.007 5.70e-07 \*\*\*  
## x5 6.242e-04 2.931e-04 2.130 0.033238 \*   
## x6 1.898e-04 5.919e-04 0.321 0.748525   
## x7 1.114e-02 6.337e-04 17.580 < 2e-16 \*\*\*  
## x8 3.536e-04 1.472e-04 2.402 0.016334 \*   
## x9 3.375e-03 3.296e-04 10.241 < 2e-16 \*\*\*  
## x10 1.319e-03 3.070e-04 4.295 1.78e-05 \*\*\*  
## x11 1.373e+05 7.330e+04 1.873 0.061186 .   
## x12 -2.650e-04 1.868e-04 -1.419 0.155998   
## x13 7.068e-05 7.465e-05 0.947 0.343777   
## x14 -4.886e-04 3.203e-04 -1.525 0.127213   
## x15 1.375e-04 3.040e-04 0.452 0.651068   
## x16 7.918e-04 2.127e-04 3.723 0.000199 \*\*\*  
## x17 1.810e-03 3.221e-04 5.618 2.03e-08 \*\*\*  
## x19 3.116e-04 1.643e-04 1.896 0.058003 .   
## x20 -6.698e-04 1.138e-03 -0.588 0.556227   
## x21 1.456e-04 4.177e-05 3.486 0.000494 \*\*\*  
## x22 -2.643e-04 3.408e-04 -0.776 0.438071   
## x23 -7.521e-05 3.264e-04 -0.230 0.817765   
## stat1 -9.232e-05 2.453e-04 -0.376 0.706712   
## stat2 2.136e-04 2.451e-04 0.871 0.383605   
## stat3 3.992e-04 2.456e-04 1.625 0.104130   
## stat4 -8.145e-04 2.479e-04 -3.286 0.001024 \*\*   
## stat5 -1.796e-04 2.457e-04 -0.731 0.464850   
## stat6 -5.408e-05 2.460e-04 -0.220 0.825977   
## stat7 -7.224e-05 2.463e-04 -0.293 0.769320   
## stat8 3.741e-04 2.460e-04 1.521 0.128346   
## stat9 2.485e-04 2.455e-04 1.012 0.311455   
## stat10 -2.874e-04 2.465e-04 -1.166 0.243685   
## stat11 -1.535e-04 2.482e-04 -0.619 0.536093   
## stat12 1.021e-04 2.448e-04 0.417 0.676685   
## stat13 -4.354e-04 2.429e-04 -1.793 0.073105 .   
## stat14 -9.426e-04 2.446e-04 -3.854 0.000118 \*\*\*  
## stat15 -3.648e-04 2.445e-04 -1.492 0.135775   
## stat16 1.005e-04 2.461e-04 0.408 0.682933   
## stat17 -1.258e-04 2.435e-04 -0.517 0.605425   
## stat18 -3.348e-04 2.463e-04 -1.359 0.174240   
## stat19 8.904e-05 2.451e-04 0.363 0.716387   
## stat20 -3.600e-04 2.458e-04 -1.465 0.143055   
## stat21 2.667e-05 2.460e-04 0.108 0.913663   
## stat22 -5.127e-04 2.455e-04 -2.089 0.036784 \*   
## stat23 5.237e-04 2.444e-04 2.143 0.032182 \*   
## stat24 -2.505e-04 2.443e-04 -1.025 0.305228   
## stat25 -2.530e-04 2.452e-04 -1.032 0.302153   
## stat26 -3.166e-04 2.462e-04 -1.286 0.198420   
## stat27 2.525e-04 2.467e-04 1.023 0.306181   
## stat28 1.352e-04 2.460e-04 0.549 0.582707   
## stat29 2.992e-04 2.476e-04 1.209 0.226856   
## stat30 4.986e-04 2.487e-04 2.005 0.045055 \*   
## stat31 9.875e-06 2.480e-04 0.040 0.968240   
## stat32 -5.269e-05 2.470e-04 -0.213 0.831087   
## stat33 -1.331e-04 2.451e-04 -0.543 0.587059   
## stat34 -7.155e-05 2.455e-04 -0.291 0.770762   
## stat35 -3.001e-04 2.467e-04 -1.217 0.223833   
## stat36 -2.146e-04 2.445e-04 -0.878 0.380210   
## stat37 -3.062e-04 2.471e-04 -1.239 0.215351   
## stat38 2.503e-04 2.463e-04 1.016 0.309623   
## stat39 -1.973e-04 2.440e-04 -0.809 0.418801   
## stat40 -4.419e-05 2.450e-04 -0.180 0.856873   
## stat41 -5.557e-04 2.443e-04 -2.275 0.022934 \*   
## stat42 2.118e-04 2.450e-04 0.864 0.387385   
## stat43 -2.047e-04 2.469e-04 -0.829 0.407066   
## stat44 1.435e-04 2.470e-04 0.581 0.561130   
## stat45 -3.315e-04 2.455e-04 -1.350 0.176970   
## stat46 2.424e-04 2.465e-04 0.983 0.325653   
## stat47 8.230e-05 2.465e-04 0.334 0.738453   
## stat48 1.835e-04 2.470e-04 0.743 0.457700   
## stat49 9.642e-05 2.442e-04 0.395 0.692959   
## stat50 2.780e-04 2.436e-04 1.141 0.253899   
## stat51 2.543e-04 2.462e-04 1.033 0.301573   
## stat52 -4.836e-05 2.471e-04 -0.196 0.844819   
## stat53 -3.258e-04 2.487e-04 -1.310 0.190291   
## stat54 -3.353e-04 2.479e-04 -1.353 0.176259   
## stat55 2.005e-04 2.439e-04 0.822 0.411261   
## stat56 -1.355e-04 2.464e-04 -0.550 0.582507   
## stat57 -1.474e-04 2.421e-04 -0.609 0.542706   
## stat58 2.526e-04 2.439e-04 1.036 0.300433   
## stat59 3.672e-04 2.457e-04 1.495 0.135054   
## stat60 6.467e-04 2.463e-04 2.626 0.008662 \*\*   
## stat61 -1.135e-04 2.467e-04 -0.460 0.645374   
## stat62 -1.446e-04 2.447e-04 -0.591 0.554642   
## stat63 2.713e-04 2.470e-04 1.098 0.272130   
## stat64 -1.905e-05 2.436e-04 -0.078 0.937664   
## stat65 -1.390e-04 2.473e-04 -0.562 0.574002   
## stat66 1.966e-04 2.507e-04 0.784 0.433053   
## stat67 2.042e-05 2.465e-04 0.083 0.933986   
## stat68 -4.640e-05 2.481e-04 -0.187 0.851678   
## stat69 -1.300e-04 2.456e-04 -0.529 0.596510   
## stat70 2.416e-04 2.448e-04 0.987 0.323545   
## stat71 -1.432e-05 2.458e-04 -0.058 0.953555   
## stat72 1.720e-04 2.469e-04 0.697 0.486030   
## stat73 1.944e-04 2.465e-04 0.789 0.430333   
## stat74 2.077e-05 2.460e-04 0.084 0.932721   
## stat75 -1.866e-04 2.461e-04 -0.758 0.448266   
## stat76 3.025e-04 2.459e-04 1.230 0.218702   
## stat77 -4.682e-05 2.462e-04 -0.190 0.849172   
## stat78 -3.761e-04 2.454e-04 -1.533 0.125413   
## stat79 -1.211e-04 2.485e-04 -0.487 0.626038   
## stat80 3.572e-04 2.465e-04 1.449 0.147363   
## stat81 1.816e-04 2.469e-04 0.736 0.461896   
## stat82 2.831e-04 2.451e-04 1.155 0.248086   
## stat83 -1.787e-04 2.458e-04 -0.727 0.467256   
## stat84 -3.084e-04 2.456e-04 -1.256 0.209172   
## stat85 1.528e-05 2.468e-04 0.062 0.950653   
## stat86 2.519e-04 2.466e-04 1.021 0.307154   
## stat87 -2.992e-04 2.472e-04 -1.210 0.226207   
## stat88 -6.875e-05 2.436e-04 -0.282 0.777751   
## stat89 -5.098e-04 2.440e-04 -2.089 0.036721 \*   
## stat90 -1.376e-04 2.470e-04 -0.557 0.577613   
## stat91 -4.410e-04 2.446e-04 -1.803 0.071444 .   
## stat92 -4.308e-04 2.455e-04 -1.755 0.079351 .   
## stat93 -5.957e-05 2.487e-04 -0.240 0.810695   
## stat94 -2.841e-04 2.458e-04 -1.155 0.247969   
## stat95 -1.655e-04 2.468e-04 -0.671 0.502414   
## stat96 -2.308e-04 2.455e-04 -0.940 0.347393   
## stat97 2.817e-04 2.444e-04 1.152 0.249199   
## stat98 3.535e-03 2.421e-04 14.601 < 2e-16 \*\*\*  
## stat99 4.486e-04 2.463e-04 1.821 0.068588 .   
## stat100 5.824e-04 2.466e-04 2.362 0.018207 \*   
## stat101 -3.202e-04 2.470e-04 -1.296 0.194965   
## stat102 -7.971e-05 2.477e-04 -0.322 0.747569   
## stat103 -4.221e-04 2.494e-04 -1.693 0.090552 .   
## stat104 -8.865e-05 2.450e-04 -0.362 0.717537   
## stat105 2.528e-04 2.439e-04 1.036 0.300132   
## stat106 -3.938e-04 2.457e-04 -1.603 0.109063   
## stat107 -2.280e-04 2.446e-04 -0.932 0.351264   
## stat108 -1.384e-04 2.460e-04 -0.563 0.573661   
## stat109 -3.598e-05 2.444e-04 -0.147 0.882955   
## stat110 -3.438e-03 2.452e-04 -14.018 < 2e-16 \*\*\*  
## stat111 -5.165e-05 2.454e-04 -0.210 0.833313   
## stat112 -1.671e-04 2.473e-04 -0.676 0.499219   
## stat113 -1.342e-04 2.478e-04 -0.541 0.588200   
## stat114 1.012e-04 2.458e-04 0.412 0.680604   
## stat115 5.137e-05 2.460e-04 0.209 0.834573   
## stat116 6.293e-05 2.454e-04 0.256 0.797630   
## stat117 1.392e-05 2.469e-04 0.056 0.955039   
## stat118 -3.117e-04 2.443e-04 -1.276 0.202060   
## stat119 2.988e-04 2.446e-04 1.222 0.221809   
## stat120 8.412e-05 2.443e-04 0.344 0.730624   
## stat121 -2.327e-04 2.456e-04 -0.947 0.343491   
## stat122 -3.794e-05 2.453e-04 -0.155 0.877107   
## stat123 6.105e-05 2.502e-04 0.244 0.807207   
## stat124 -1.573e-04 2.468e-04 -0.637 0.523868   
## stat125 1.714e-04 2.469e-04 0.694 0.487584   
## stat126 1.906e-04 2.442e-04 0.780 0.435134   
## stat127 1.934e-05 2.455e-04 0.079 0.937205   
## stat128 -2.001e-04 2.456e-04 -0.815 0.415361   
## stat129 2.365e-04 2.446e-04 0.967 0.333742   
## stat130 2.827e-04 2.462e-04 1.148 0.250960   
## stat131 1.344e-04 2.457e-04 0.547 0.584571   
## stat132 4.063e-05 2.447e-04 0.166 0.868146   
## stat133 -5.834e-05 2.472e-04 -0.236 0.813447   
## stat134 -1.587e-04 2.454e-04 -0.647 0.517818   
## stat135 1.544e-04 2.436e-04 0.634 0.526212   
## stat136 -1.090e-04 2.460e-04 -0.443 0.657799   
## stat137 1.892e-04 2.431e-04 0.778 0.436336   
## stat138 9.798e-05 2.454e-04 0.399 0.689759   
## stat139 -9.275e-05 2.457e-04 -0.377 0.705865   
## stat140 -7.587e-05 2.446e-04 -0.310 0.756483   
## stat141 1.155e-04 2.439e-04 0.474 0.635768   
## stat142 -4.508e-05 2.483e-04 -0.182 0.855939   
## stat143 1.471e-04 2.446e-04 0.602 0.547455   
## stat144 4.551e-04 2.445e-04 1.861 0.062785 .   
## stat145 -6.444e-05 2.492e-04 -0.259 0.795990   
## stat146 -5.349e-04 2.479e-04 -2.158 0.030982 \*   
## stat147 -4.260e-04 2.481e-04 -1.717 0.085992 .   
## stat148 -5.459e-04 2.425e-04 -2.251 0.024445 \*   
## stat149 -6.268e-04 2.477e-04 -2.530 0.011429 \*   
## stat150 -1.371e-04 2.472e-04 -0.555 0.579022   
## stat151 -1.178e-04 2.487e-04 -0.474 0.635804   
## stat152 -1.309e-04 2.451e-04 -0.534 0.593363   
## stat153 -2.188e-05 2.509e-04 -0.087 0.930532   
## stat154 1.746e-04 2.486e-04 0.703 0.482377   
## stat155 -1.834e-04 2.441e-04 -0.751 0.452396   
## stat156 3.840e-04 2.489e-04 1.543 0.122869   
## stat157 -2.920e-04 2.455e-04 -1.189 0.234374   
## stat158 -1.301e-04 2.486e-04 -0.523 0.600830   
## stat159 -2.937e-05 2.455e-04 -0.120 0.904777   
## stat160 8.784e-05 2.478e-04 0.354 0.723033   
## stat161 5.711e-04 2.473e-04 2.309 0.020960 \*   
## stat162 8.817e-05 2.426e-04 0.363 0.716341   
## stat163 2.067e-04 2.494e-04 0.829 0.407304   
## stat164 2.004e-04 2.486e-04 0.806 0.420174   
## stat165 -2.125e-05 2.434e-04 -0.087 0.930425   
## stat166 -3.294e-04 2.433e-04 -1.354 0.175773   
## stat167 -1.290e-04 2.450e-04 -0.526 0.598643   
## stat168 -2.351e-04 2.452e-04 -0.959 0.337693   
## stat169 1.391e-04 2.448e-04 0.568 0.570000   
## stat170 -1.057e-04 2.460e-04 -0.430 0.667443   
## stat171 -6.656e-05 2.478e-04 -0.269 0.788209   
## stat172 5.186e-04 2.442e-04 2.123 0.033782 \*   
## stat173 -2.520e-05 2.475e-04 -0.102 0.918910   
## stat174 -1.978e-05 2.459e-04 -0.080 0.935893   
## stat175 -4.430e-04 2.463e-04 -1.799 0.072113 .   
## stat176 -1.488e-04 2.463e-04 -0.604 0.545856   
## stat177 1.750e-04 2.473e-04 0.708 0.479173   
## stat178 -1.376e-04 2.475e-04 -0.556 0.578235   
## stat179 2.789e-04 2.452e-04 1.137 0.255404   
## stat180 -2.361e-04 2.450e-04 -0.964 0.335154   
## stat181 2.941e-04 2.460e-04 1.195 0.231974   
## stat182 8.303e-05 2.473e-04 0.336 0.737107   
## stat183 2.490e-04 2.459e-04 1.013 0.311169   
## stat184 1.484e-05 2.481e-04 0.060 0.952305   
## stat185 -3.034e-05 2.424e-04 -0.125 0.900399   
## stat186 -1.590e-04 2.476e-04 -0.642 0.520977   
## stat187 -4.336e-04 2.445e-04 -1.773 0.076240 .   
## stat188 6.069e-05 2.465e-04 0.246 0.805507   
## stat189 8.145e-05 2.473e-04 0.329 0.741847   
## stat190 -1.939e-04 2.456e-04 -0.790 0.429686   
## stat191 -2.181e-04 2.468e-04 -0.884 0.376889   
## stat192 9.585e-05 2.477e-04 0.387 0.698816   
## stat193 7.872e-05 2.496e-04 0.315 0.752497   
## stat194 -1.107e-04 2.460e-04 -0.450 0.652909   
## stat195 3.336e-04 2.459e-04 1.357 0.174983   
## stat196 -1.133e-04 2.491e-04 -0.455 0.649326   
## stat197 4.347e-04 2.442e-04 1.780 0.075125 .   
## stat198 -1.926e-04 2.478e-04 -0.777 0.437126   
## stat199 1.849e-04 2.432e-04 0.760 0.447293   
## stat200 -2.944e-04 2.429e-04 -1.212 0.225597   
## stat201 -5.360e-05 2.451e-04 -0.219 0.826858   
## stat202 -1.431e-04 2.497e-04 -0.573 0.566617   
## stat203 6.727e-05 2.454e-04 0.274 0.783979   
## stat204 -4.187e-04 2.435e-04 -1.719 0.085617 .   
## stat205 -9.352e-05 2.441e-04 -0.383 0.701674   
## stat206 -2.586e-05 2.489e-04 -0.104 0.917269   
## stat207 3.660e-04 2.459e-04 1.489 0.136659   
## stat208 3.139e-04 2.457e-04 1.278 0.201445   
## stat209 -2.194e-04 2.440e-04 -0.899 0.368548   
## stat210 -1.497e-04 2.475e-04 -0.605 0.545290   
## stat211 -1.765e-04 2.449e-04 -0.721 0.471135   
## stat212 -2.356e-04 2.458e-04 -0.959 0.337762   
## stat213 -9.691e-05 2.470e-04 -0.392 0.694804   
## stat214 -3.935e-04 2.450e-04 -1.606 0.108364   
## stat215 -3.510e-04 2.470e-04 -1.421 0.155385   
## stat216 -6.337e-05 2.453e-04 -0.258 0.796151   
## stat217 1.541e-04 2.460e-04 0.626 0.531032   
## x18.sqrt 2.512e-02 9.385e-04 26.769 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.03114 on 5343 degrees of freedom  
## Multiple R-squared: 0.273, Adjusted R-squared: 0.2403   
## F-statistic: 8.358 on 240 and 5343 DF, p-value: < 2.2e-16

cd.full = plot.diagnostics(model=model.full, train=data.train)



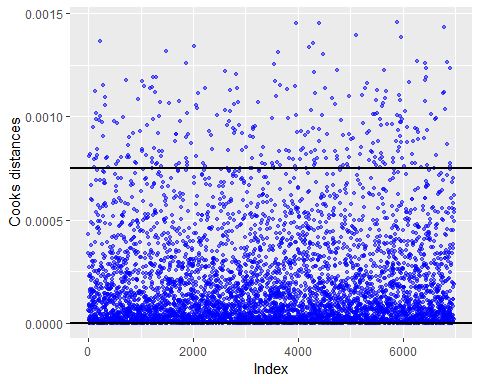
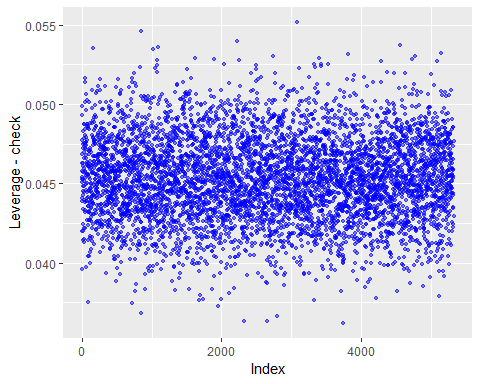
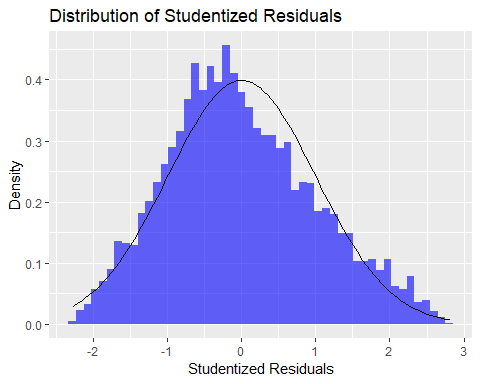
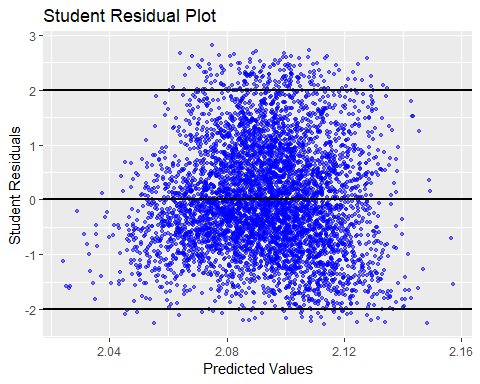
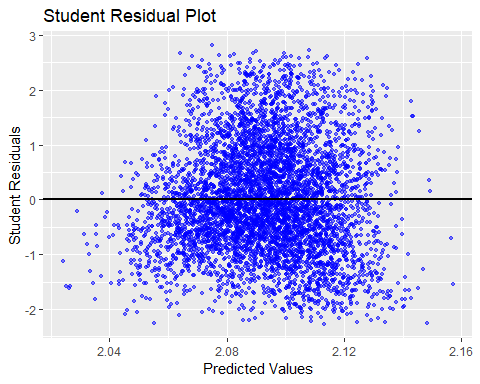
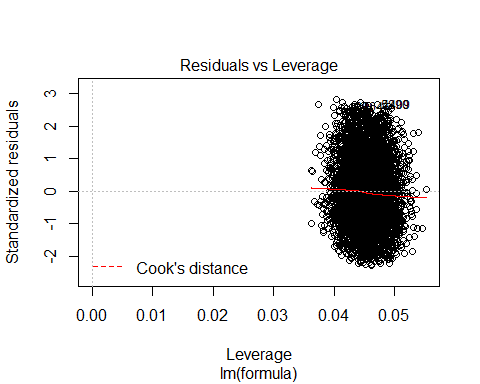
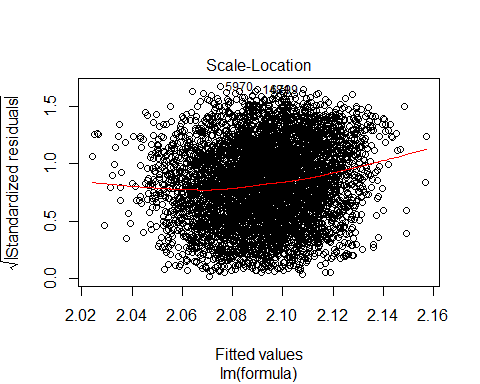
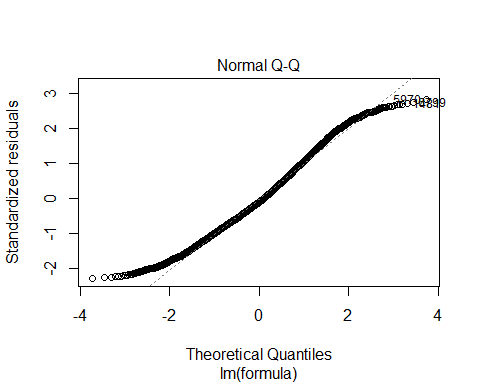
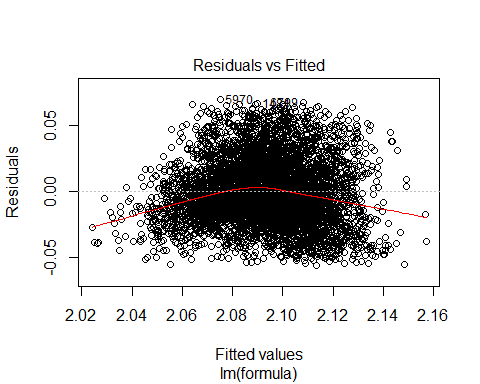
## [1] "Number of data points that have Cook's D > 4/n: 266"  
## [1] "Number of data points that have Cook's D > 1: 0"

## Checking with removal of high influence points

high.cd = names(cd.full[cd.full > 4/nrow(data.train)])  
data.train2 = data.train[!(rownames(data.train)) %in% high.cd,]  
model.full2 = lm(formula , data.train2)  
summary(model.full2)

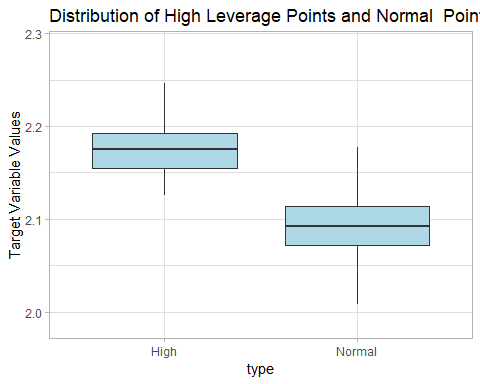
##   
## Call:  
## lm(formula = formula, data = data.train2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.055768 -0.017301 -0.002526 0.016107 0.069241   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.962e+00 7.865e-03 249.423 < 2e-16 \*\*\*  
## x1 -3.150e-04 5.406e-04 -0.583 0.560106   
## x2 1.857e-04 3.428e-04 0.542 0.588008   
## x3 6.951e-05 9.379e-05 0.741 0.458632   
## x4 -5.156e-05 7.411e-06 -6.958 3.90e-12 \*\*\*  
## x5 6.462e-04 2.423e-04 2.667 0.007687 \*\*   
## x6 -2.081e-04 4.895e-04 -0.425 0.670713   
## x7 1.188e-02 5.244e-04 22.657 < 2e-16 \*\*\*  
## x8 4.544e-04 1.220e-04 3.726 0.000197 \*\*\*  
## x9 3.330e-03 2.718e-04 12.253 < 2e-16 \*\*\*  
## x10 1.528e-03 2.537e-04 6.022 1.85e-09 \*\*\*  
## x11 1.572e+05 6.076e+04 2.587 0.009708 \*\*   
## x12 -1.463e-04 1.542e-04 -0.949 0.342576   
## x13 1.203e-04 6.179e-05 1.947 0.051588 .   
## x14 -2.001e-04 2.651e-04 -0.755 0.450405   
## x15 6.385e-05 2.515e-04 0.254 0.799587   
## x16 9.736e-04 1.759e-04 5.536 3.25e-08 \*\*\*  
## x17 1.699e-03 2.671e-04 6.362 2.17e-10 \*\*\*  
## x19 2.820e-04 1.359e-04 2.075 0.038069 \*   
## x20 -4.107e-04 9.432e-04 -0.435 0.663290   
## x21 1.508e-04 3.458e-05 4.361 1.32e-05 \*\*\*  
## x22 -3.368e-04 2.815e-04 -1.196 0.231621   
## x23 1.846e-04 2.705e-04 0.683 0.494820   
## stat1 -2.156e-04 2.028e-04 -1.063 0.287777   
## stat2 2.293e-04 2.026e-04 1.132 0.257737   
## stat3 5.054e-04 2.035e-04 2.484 0.013035 \*   
## stat4 -7.884e-04 2.056e-04 -3.835 0.000127 \*\*\*  
## stat5 -4.537e-04 2.032e-04 -2.233 0.025623 \*   
## stat6 -8.734e-05 2.031e-04 -0.430 0.667184   
## stat7 -1.440e-04 2.038e-04 -0.707 0.479719   
## stat8 2.729e-04 2.031e-04 1.343 0.179220   
## stat9 1.356e-04 2.033e-04 0.667 0.504790   
## stat10 -2.771e-04 2.035e-04 -1.362 0.173277   
## stat11 -3.099e-04 2.055e-04 -1.508 0.131634   
## stat12 1.252e-04 2.023e-04 0.619 0.536151   
## stat13 -4.610e-04 2.009e-04 -2.295 0.021779 \*   
## stat14 -1.111e-03 2.023e-04 -5.494 4.13e-08 \*\*\*  
## stat15 -5.496e-04 2.025e-04 -2.714 0.006673 \*\*   
## stat16 -1.260e-04 2.034e-04 -0.619 0.535684   
## stat17 -3.076e-04 2.018e-04 -1.524 0.127492   
## stat18 -2.348e-04 2.034e-04 -1.154 0.248454   
## stat19 -5.053e-05 2.033e-04 -0.248 0.803760   
## stat20 -8.984e-05 2.035e-04 -0.442 0.658798   
## stat21 -4.884e-05 2.034e-04 -0.240 0.810259   
## stat22 -4.020e-04 2.026e-04 -1.984 0.047285 \*   
## stat23 3.780e-04 2.026e-04 1.865 0.062172 .   
## stat24 -3.008e-04 2.021e-04 -1.489 0.136556   
## stat25 -1.692e-04 2.028e-04 -0.834 0.404367   
## stat26 -3.166e-04 2.036e-04 -1.555 0.120019   
## stat27 1.536e-04 2.046e-04 0.751 0.452839   
## stat28 1.239e-04 2.033e-04 0.609 0.542434   
## stat29 1.446e-04 2.050e-04 0.705 0.480666   
## stat30 4.329e-04 2.055e-04 2.107 0.035170 \*   
## stat31 7.996e-05 2.050e-04 0.390 0.696541   
## stat32 -1.629e-04 2.042e-04 -0.798 0.425170   
## stat33 -8.903e-05 2.025e-04 -0.440 0.660214   
## stat34 1.154e-04 2.029e-04 0.569 0.569603   
## stat35 -4.170e-04 2.040e-04 -2.045 0.040933 \*   
## stat36 -7.025e-05 2.028e-04 -0.346 0.729020   
## stat37 -1.827e-04 2.043e-04 -0.894 0.371120   
## stat38 3.498e-04 2.031e-04 1.722 0.085092 .   
## stat39 -3.776e-04 2.019e-04 -1.871 0.061463 .   
## stat40 -1.409e-04 2.032e-04 -0.693 0.488325   
## stat41 -5.134e-04 2.020e-04 -2.542 0.011066 \*   
## stat42 3.185e-04 2.032e-04 1.567 0.117078   
## stat43 -2.351e-04 2.040e-04 -1.152 0.249202   
## stat44 1.878e-04 2.044e-04 0.919 0.358215   
## stat45 -2.305e-04 2.028e-04 -1.136 0.255808   
## stat46 1.376e-04 2.041e-04 0.674 0.500102   
## stat47 1.855e-04 2.039e-04 0.910 0.362866   
## stat48 2.255e-04 2.042e-04 1.104 0.269598   
## stat49 -9.084e-05 2.022e-04 -0.449 0.653255   
## stat50 2.816e-04 2.014e-04 1.398 0.162073   
## stat51 8.890e-05 2.039e-04 0.436 0.662783   
## stat52 3.897e-05 2.044e-04 0.191 0.848810   
## stat53 -3.590e-04 2.058e-04 -1.745 0.081125 .   
## stat54 -3.860e-04 2.052e-04 -1.881 0.059996 .   
## stat55 1.901e-04 2.018e-04 0.942 0.346076   
## stat56 -3.969e-05 2.040e-04 -0.195 0.845763   
## stat57 -6.013e-05 2.007e-04 -0.300 0.764521   
## stat58 2.037e-04 2.018e-04 1.010 0.312614   
## stat59 3.443e-04 2.034e-04 1.693 0.090565 .   
## stat60 7.108e-04 2.039e-04 3.487 0.000493 \*\*\*  
## stat61 -9.851e-05 2.036e-04 -0.484 0.628546   
## stat62 -2.628e-04 2.025e-04 -1.298 0.194325   
## stat63 2.336e-04 2.045e-04 1.142 0.253362   
## stat64 1.323e-04 2.012e-04 0.658 0.510654   
## stat65 9.539e-06 2.049e-04 0.047 0.962871   
## stat66 1.621e-04 2.076e-04 0.780 0.435161   
## stat67 5.605e-05 2.041e-04 0.275 0.783621   
## stat68 -6.427e-05 2.053e-04 -0.313 0.754284   
## stat69 -1.223e-04 2.034e-04 -0.601 0.547805   
## stat70 2.531e-04 2.023e-04 1.251 0.210942   
## stat71 5.624e-05 2.040e-04 0.276 0.782768   
## stat72 1.611e-05 2.043e-04 0.079 0.937146   
## stat73 2.800e-04 2.038e-04 1.374 0.169438   
## stat74 8.621e-05 2.037e-04 0.423 0.672095   
## stat75 1.760e-04 2.039e-04 0.863 0.388031   
## stat76 2.541e-04 2.033e-04 1.250 0.211286   
## stat77 1.516e-04 2.040e-04 0.743 0.457387   
## stat78 -5.490e-04 2.027e-04 -2.709 0.006774 \*\*   
## stat79 9.978e-05 2.052e-04 0.486 0.626862   
## stat80 3.828e-04 2.035e-04 1.882 0.059943 .   
## stat81 8.594e-05 2.048e-04 0.420 0.674722   
## stat82 -1.148e-04 2.030e-04 -0.565 0.571849   
## stat83 -1.940e-04 2.032e-04 -0.955 0.339816   
## stat84 -1.896e-04 2.033e-04 -0.933 0.350945   
## stat85 -2.452e-04 2.044e-04 -1.200 0.230275   
## stat86 2.378e-04 2.040e-04 1.166 0.243864   
## stat87 -3.966e-04 2.044e-04 -1.940 0.052453 .   
## stat88 5.757e-05 2.016e-04 0.286 0.775186   
## stat89 -2.374e-04 2.024e-04 -1.173 0.240685   
## stat90 -1.675e-04 2.045e-04 -0.819 0.412993   
## stat91 -3.954e-04 2.019e-04 -1.958 0.050229 .   
## stat92 -2.435e-04 2.031e-04 -1.199 0.230648   
## stat93 1.656e-04 2.067e-04 0.801 0.423075   
## stat94 -1.767e-04 2.031e-04 -0.870 0.384480   
## stat95 5.937e-05 2.044e-04 0.290 0.771518   
## stat96 -2.200e-04 2.033e-04 -1.082 0.279427   
## stat97 1.363e-04 2.020e-04 0.675 0.499816   
## stat98 3.430e-03 2.002e-04 17.129 < 2e-16 \*\*\*  
## stat99 4.909e-04 2.041e-04 2.405 0.016200 \*   
## stat100 5.683e-04 2.040e-04 2.786 0.005354 \*\*   
## stat101 -2.659e-04 2.045e-04 -1.300 0.193731   
## stat102 1.868e-05 2.050e-04 0.091 0.927388   
## stat103 -4.851e-04 2.061e-04 -2.354 0.018633 \*   
## stat104 1.363e-05 2.033e-04 0.067 0.946523   
## stat105 2.049e-04 2.020e-04 1.015 0.310349   
## stat106 -3.630e-04 2.031e-04 -1.787 0.073969 .   
## stat107 -1.287e-04 2.021e-04 -0.637 0.524100   
## stat108 -3.395e-05 2.036e-04 -0.167 0.867579   
## stat109 -1.524e-04 2.024e-04 -0.753 0.451632   
## stat110 -3.379e-03 2.026e-04 -16.680 < 2e-16 \*\*\*  
## stat111 2.978e-05 2.026e-04 0.147 0.883163   
## stat112 -1.121e-04 2.046e-04 -0.548 0.583834   
## stat113 -2.616e-04 2.051e-04 -1.276 0.202067   
## stat114 1.873e-04 2.033e-04 0.921 0.357030   
## stat115 2.389e-04 2.035e-04 1.174 0.240568   
## stat116 1.063e-04 2.031e-04 0.523 0.600739   
## stat117 -5.765e-05 2.039e-04 -0.283 0.777335   
## stat118 -3.630e-05 2.021e-04 -0.180 0.857436   
## stat119 4.352e-04 2.021e-04 2.153 0.031333 \*   
## stat120 -1.191e-04 2.019e-04 -0.590 0.555301   
## stat121 -3.684e-04 2.031e-04 -1.813 0.069840 .   
## stat122 -2.251e-04 2.036e-04 -1.106 0.268948   
## stat123 1.172e-04 2.068e-04 0.566 0.571093   
## stat124 -1.520e-04 2.039e-04 -0.745 0.456209   
## stat125 9.350e-05 2.041e-04 0.458 0.646964   
## stat126 1.356e-04 2.022e-04 0.670 0.502721   
## stat127 2.312e-05 2.029e-04 0.114 0.909298   
## stat128 -4.128e-04 2.027e-04 -2.037 0.041732 \*   
## stat129 1.188e-04 2.021e-04 0.588 0.556615   
## stat130 1.377e-04 2.034e-04 0.677 0.498371   
## stat131 9.950e-05 2.030e-04 0.490 0.624041   
## stat132 5.634e-06 2.024e-04 0.028 0.977791   
## stat133 7.790e-05 2.049e-04 0.380 0.703838   
## stat134 5.145e-05 2.030e-04 0.253 0.799896   
## stat135 9.106e-05 2.014e-04 0.452 0.651197   
## stat136 -1.331e-04 2.035e-04 -0.654 0.513093   
## stat137 3.142e-04 2.012e-04 1.562 0.118385   
## stat138 -1.451e-05 2.035e-04 -0.071 0.943146   
## stat139 -1.759e-04 2.035e-04 -0.865 0.387334   
## stat140 6.695e-05 2.017e-04 0.332 0.739945   
## stat141 2.383e-04 2.016e-04 1.182 0.237105   
## stat142 -6.702e-05 2.055e-04 -0.326 0.744360   
## stat143 7.245e-05 2.027e-04 0.358 0.720720   
## stat144 5.573e-04 2.025e-04 2.752 0.005947 \*\*   
## stat145 -3.966e-05 2.063e-04 -0.192 0.847557   
## stat146 -5.560e-04 2.051e-04 -2.711 0.006732 \*\*   
## stat147 -4.745e-04 2.051e-04 -2.313 0.020739 \*   
## stat148 -3.151e-04 2.009e-04 -1.568 0.116856   
## stat149 -6.066e-04 2.053e-04 -2.955 0.003144 \*\*   
## stat150 -2.353e-04 2.047e-04 -1.149 0.250500   
## stat151 2.361e-04 2.064e-04 1.144 0.252729   
## stat152 -6.667e-05 2.025e-04 -0.329 0.741997   
## stat153 1.397e-04 2.072e-04 0.675 0.499999   
## stat154 3.340e-04 2.062e-04 1.620 0.105366   
## stat155 6.028e-05 2.023e-04 0.298 0.765698   
## stat156 2.504e-04 2.056e-04 1.218 0.223248   
## stat157 -1.521e-04 2.030e-04 -0.749 0.453851   
## stat158 -2.710e-06 2.057e-04 -0.013 0.989488   
## stat159 1.070e-04 2.031e-04 0.527 0.598167   
## stat160 2.792e-04 2.053e-04 1.360 0.173797   
## stat161 2.937e-04 2.045e-04 1.436 0.151046   
## stat162 -3.426e-06 2.005e-04 -0.017 0.986371   
## stat163 3.119e-04 2.069e-04 1.507 0.131838   
## stat164 2.940e-05 2.062e-04 0.143 0.886628   
## stat165 7.165e-06 2.013e-04 0.036 0.971603   
## stat166 -3.196e-04 2.010e-04 -1.590 0.111877   
## stat167 -2.169e-04 2.032e-04 -1.068 0.285771   
## stat168 -1.168e-04 2.029e-04 -0.576 0.564821   
## stat169 1.313e-04 2.028e-04 0.647 0.517437   
## stat170 6.116e-05 2.035e-04 0.300 0.763826   
## stat171 -2.808e-04 2.051e-04 -1.369 0.171017   
## stat172 6.992e-04 2.017e-04 3.467 0.000530 \*\*\*  
## stat173 7.833e-05 2.047e-04 0.383 0.702043   
## stat174 6.917e-05 2.036e-04 0.340 0.734095   
## stat175 -4.325e-04 2.035e-04 -2.125 0.033637 \*   
## stat176 -3.799e-04 2.038e-04 -1.864 0.062368 .   
## stat177 -5.584e-05 2.045e-04 -0.273 0.784810   
## stat178 2.893e-05 2.047e-04 0.141 0.887600   
## stat179 2.526e-04 2.032e-04 1.243 0.213809   
## stat180 -1.268e-04 2.029e-04 -0.625 0.531962   
## stat181 3.703e-04 2.033e-04 1.821 0.068665 .   
## stat182 1.254e-04 2.051e-04 0.612 0.540751   
## stat183 3.247e-04 2.038e-04 1.593 0.111183   
## stat184 1.904e-04 2.050e-04 0.929 0.353152   
## stat185 9.087e-05 2.008e-04 0.453 0.650859   
## stat186 9.763e-05 2.047e-04 0.477 0.633390   
## stat187 -2.983e-04 2.021e-04 -1.476 0.139904   
## stat188 1.523e-04 2.036e-04 0.748 0.454499   
## stat189 -3.271e-05 2.046e-04 -0.160 0.873003   
## stat190 -3.465e-04 2.032e-04 -1.705 0.088191 .   
## stat191 -2.558e-04 2.039e-04 -1.255 0.209679   
## stat192 1.603e-04 2.054e-04 0.781 0.435104   
## stat193 1.892e-04 2.071e-04 0.914 0.360919   
## stat194 -3.673e-04 2.039e-04 -1.802 0.071625 .   
## stat195 7.340e-05 2.037e-04 0.360 0.718601   
## stat196 -1.415e-04 2.059e-04 -0.687 0.492090   
## stat197 2.195e-04 2.022e-04 1.086 0.277678   
## stat198 -1.274e-04 2.049e-04 -0.622 0.534232   
## stat199 2.851e-04 2.011e-04 1.417 0.156407   
## stat200 -1.822e-04 2.017e-04 -0.904 0.366289   
## stat201 -4.769e-05 2.030e-04 -0.235 0.814229   
## stat202 9.855e-05 2.065e-04 0.477 0.633257   
## stat203 7.156e-06 2.033e-04 0.035 0.971918   
## stat204 -3.057e-04 2.012e-04 -1.519 0.128831   
## stat205 1.627e-04 2.016e-04 0.807 0.419541   
## stat206 6.582e-06 2.059e-04 0.032 0.974500   
## stat207 5.089e-04 2.034e-04 2.503 0.012358 \*   
## stat208 3.271e-04 2.037e-04 1.606 0.108361   
## stat209 -7.186e-05 2.017e-04 -0.356 0.721600   
## stat210 -4.268e-04 2.047e-04 -2.085 0.037104 \*   
## stat211 -1.417e-04 2.023e-04 -0.700 0.483848   
## stat212 -1.431e-04 2.035e-04 -0.703 0.481894   
## stat213 -6.104e-05 2.043e-04 -0.299 0.765113   
## stat214 -8.772e-05 2.029e-04 -0.432 0.665557   
## stat215 -2.799e-04 2.047e-04 -1.367 0.171557   
## stat216 -2.043e-04 2.026e-04 -1.008 0.313395   
## stat217 8.400e-05 2.032e-04 0.413 0.679282   
## x18.sqrt 2.569e-02 7.739e-04 33.197 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.02511 on 5077 degrees of freedom  
## Multiple R-squared: 0.3778, Adjusted R-squared: 0.3483   
## F-statistic: 12.84 on 240 and 5077 DF, p-value: < 2.2e-16

cd.full2 = plot.diagnostics(model.full2, data.train2)



## [1] "Number of data points that have Cook's D > 4/n: 280"  
## [1] "Number of data points that have Cook's D > 1: 0"

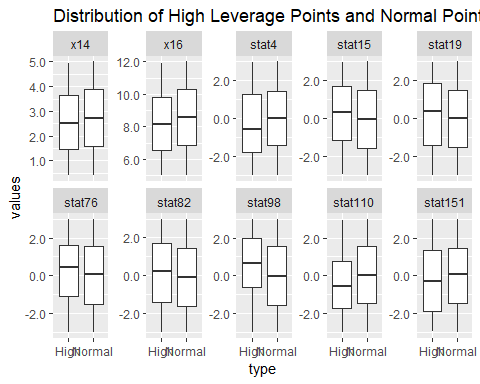
# much more normal residuals than before.   
# Checking to see if distributions are different and if so whcih variables  
# High Leverage Plot   
plotData = data.train %>%   
 rownames\_to\_column() %>%  
 mutate(type=ifelse(rowname %in% high.cd,'High','Normal')) %>%  
 dplyr::select(type,target=one\_of(label.names))  
  
ggplot(data=plotData, aes(x=type,y=target)) +  
 geom\_boxplot(fill='light blue',outlier.shape=NA) +  
 scale\_y\_continuous(name="Target Variable Values",label=scales::comma\_format(accuracy=.1)) +  
 theme\_light() +  
 ggtitle('Distribution of High Leverage Points and Normal Points')



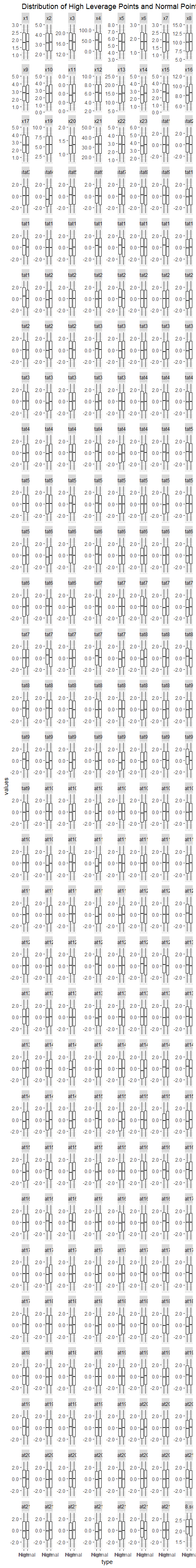
# 2 sample t-tests  
  
plotData = data.train %>%   
 rownames\_to\_column() %>%  
 mutate(type=ifelse(rowname %in% high.cd,'High','Normal')) %>%  
 dplyr::select(type,one\_of(feature.names))  
  
comp.test = lapply(dplyr::select(plotData, one\_of(feature.names))  
 , function(x) t.test(x ~ plotData$type, var.equal = TRUE))   
  
sig.comp = list.filter(comp.test, p.value < 0.05)  
sapply(sig.comp, function(x) x[['p.value']])

## x14 x16 stat4 stat15 stat19 stat76 stat82 stat98 stat110   
## 2.746369e-02 9.799075e-03 7.926082e-03 3.299495e-02 1.916061e-02 2.028787e-02 1.982310e-02 1.101298e-06 1.076994e-04   
## stat151   
## 4.462420e-02

mm = melt(plotData, id=c('type')) %>% filter(variable %in% names(sig.comp))  
  
ggplot(mm,aes(x=type, y=value)) +  
 geom\_boxplot()+  
 facet\_wrap(~variable, ncol=5, scales = 'free\_y') +  
 scale\_y\_continuous(name="values",label=scales::comma\_format(accuracy=.1)) +  
 ggtitle('Distribution of High Leverage Points and Normal Points')



# Distribution (box) Plots  
mm = melt(plotData, id=c('type'))  
  
ggplot(mm,aes(x=type, y=value)) +  
 geom\_boxplot()+  
 facet\_wrap(~variable, ncol=8, scales = 'free\_y') +  
 scale\_y\_continuous(name="values",label=scales::comma\_format(accuracy=.1)) +  
 ggtitle('Distribution of High Leverage Points and Normal Points')



## Grand Means Model

model.null = lm(grand.mean.formula, data.train)  
summary(model.null)

##   
## Call:  
## lm(formula = grand.mean.formula, data = data.train)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.109802 -0.023733 -0.002874 0.020733 0.190807   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.0963815 0.0004781 4385 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.03573 on 5583 degrees of freedom

## Variable Selection

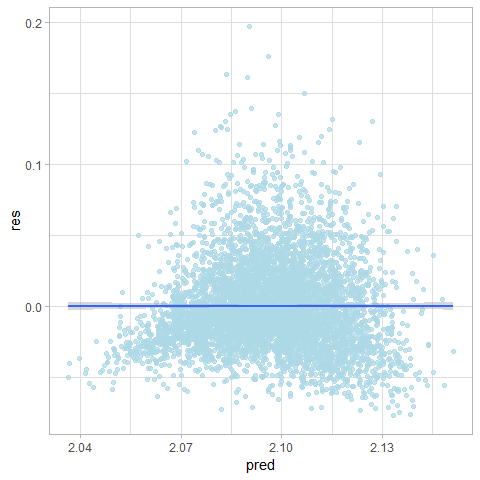
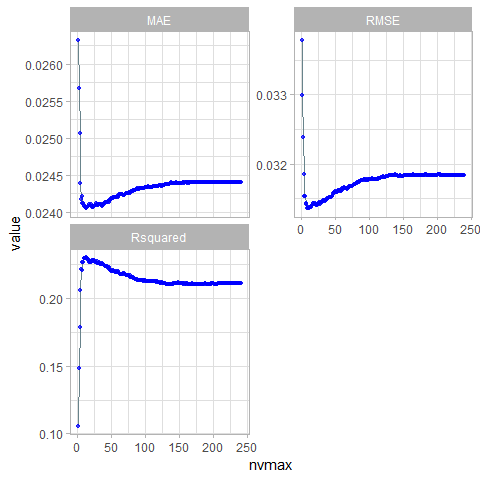
Basic: <http://www.stat.columbia.edu/~martin/W2024/R10.pdf> Cross Validation + Other Metrics: <http://www.sthda.com/english/articles/37-model-selection-essentials-in-r/154-stepwise-regression-essentials-in-r/>

### Forward Selection with CV

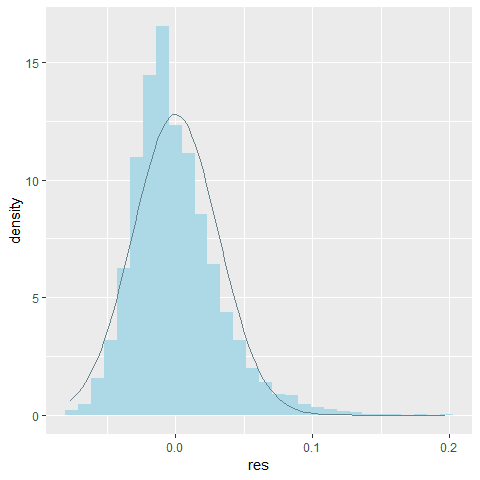
#### Train

if (algo.forward.caret == TRUE){  
 set.seed(1)  
 returned = train.caret.glmselect(formula = formula  
 , data = data.train  
 , method = "leapForward"  
 , feature.names = feature.names)  
 model.forward = returned$model  
 id = returned$id  
}

## Aggregating results  
## Selecting tuning parameters  
## Fitting nvmax = 12 on full training set  
## [1] "All models results"  
## nvmax RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.03378306 0.1058427 0.02632363 0.001445430 0.02324686 0.0009129561  
## 2 2 0.03298202 0.1480269 0.02566677 0.001381916 0.02786171 0.0008394827  
## 3 3 0.03238356 0.1785508 0.02506527 0.001333185 0.03172184 0.0008337556  
## 4 4 0.03184761 0.2054452 0.02438376 0.001296625 0.02805134 0.0007643137  
## 5 5 0.03153039 0.2210558 0.02417792 0.001235732 0.03004692 0.0007523258  
## 6 6 0.03153955 0.2206742 0.02421102 0.001212023 0.02951659 0.0007175730  
## 7 7 0.03142815 0.2262083 0.02412177 0.001203939 0.03212790 0.0007114201  
## 8 8 0.03142380 0.2262731 0.02412492 0.001235578 0.03041218 0.0007394213  
## 9 9 0.03135847 0.2294938 0.02409113 0.001264442 0.03094750 0.0007654157  
## 10 10 0.03137010 0.2290962 0.02407976 0.001321272 0.03198457 0.0007971954  
## 11 11 0.03136297 0.2295083 0.02406788 0.001297139 0.03219363 0.0007695563  
## 12 12 0.03135599 0.2298537 0.02404779 0.001280496 0.03174877 0.0007224132  
## 13 13 0.03137072 0.2291394 0.02404637 0.001270598 0.03024679 0.0007276347  
## 14 14 0.03136885 0.2291867 0.02406354 0.001291404 0.02925539 0.0007448656  
## 15 15 0.03139006 0.2282679 0.02407826 0.001289834 0.03031212 0.0007442875  
## 16 16 0.03140329 0.2276346 0.02407718 0.001285931 0.02985744 0.0007480732  
## 17 17 0.03143089 0.2263647 0.02410061 0.001262333 0.02942596 0.0007377310  
## 18 18 0.03142597 0.2265590 0.02409775 0.001264961 0.02885455 0.0007524056  
## 19 19 0.03141680 0.2270474 0.02409001 0.001276779 0.02908986 0.0007714958  
## 20 20 0.03143181 0.2264121 0.02410377 0.001277565 0.02927432 0.0007631304  
## 21 21 0.03142082 0.2269857 0.02407560 0.001276639 0.02946019 0.0007658795  
## 22 22 0.03140045 0.2280111 0.02406278 0.001271494 0.02959707 0.0007641192  
## 23 23 0.03140176 0.2279841 0.02406872 0.001266043 0.02903883 0.0007596651  
## 24 24 0.03141159 0.2275737 0.02407443 0.001240772 0.02900799 0.0007411205  
## 25 25 0.03141943 0.2272546 0.02408420 0.001266567 0.02818469 0.0007678249  
## 26 26 0.03143565 0.2264953 0.02409457 0.001269206 0.02767010 0.0007561123  
## 27 27 0.03144104 0.2262552 0.02411393 0.001273899 0.02680592 0.0007712771  
## 28 28 0.03142281 0.2271739 0.02409365 0.001283094 0.02745960 0.0007993907  
## 29 29 0.03145232 0.2257794 0.02410140 0.001282757 0.02722457 0.0008101964  
## 30 30 0.03145373 0.2257616 0.02409762 0.001285794 0.02712707 0.0007959050  
## 31 31 0.03145057 0.2259336 0.02410184 0.001289520 0.02796365 0.0007945183  
## 32 32 0.03146330 0.2253287 0.02410090 0.001308269 0.02779164 0.0008006730  
## 33 33 0.03147347 0.2248661 0.02410511 0.001301804 0.02786828 0.0007846637  
## 34 34 0.03148001 0.2245865 0.02410235 0.001304001 0.02768345 0.0007957741  
## 35 35 0.03146860 0.2251570 0.02409298 0.001299687 0.02805261 0.0007980090  
## 36 36 0.03145900 0.2256599 0.02408327 0.001291333 0.02853451 0.0007908090  
## 37 37 0.03147795 0.2248434 0.02409361 0.001313515 0.02895717 0.0008064706  
## 38 38 0.03148435 0.2245879 0.02410123 0.001309461 0.02898943 0.0008047483  
## 39 39 0.03149791 0.2239598 0.02411675 0.001306535 0.02879029 0.0007974463  
## 40 40 0.03150797 0.2235111 0.02411951 0.001299443 0.02805695 0.0007853544  
## 41 41 0.03152049 0.2230233 0.02413718 0.001296287 0.02806709 0.0007920201  
## 42 42 0.03151955 0.2230950 0.02413206 0.001292292 0.02748965 0.0007847160  
## 43 43 0.03151981 0.2230834 0.02413031 0.001285105 0.02699986 0.0007817327  
## 44 44 0.03152491 0.2228762 0.02413557 0.001277483 0.02667189 0.0007567369  
## 45 45 0.03153702 0.2223592 0.02413859 0.001287254 0.02707177 0.0007578532  
## 46 46 0.03153943 0.2222586 0.02413433 0.001276058 0.02682009 0.0007505538  
## 47 47 0.03157102 0.2208848 0.02415728 0.001287321 0.02767754 0.0007714968  
## 48 48 0.03158263 0.2203439 0.02416173 0.001279985 0.02727496 0.0007656089  
## 49 49 0.03158962 0.2200793 0.02416787 0.001269584 0.02690088 0.0007667075  
## 50 50 0.03160046 0.2196221 0.02418761 0.001259270 0.02657580 0.0007617480  
## 51 51 0.03159809 0.2197487 0.02418880 0.001260096 0.02653410 0.0007677067  
## 52 52 0.03159164 0.2200946 0.02419531 0.001273291 0.02766066 0.0007787377  
## 53 53 0.03159502 0.2199442 0.02418974 0.001271994 0.02772595 0.0007716531  
## 54 54 0.03160350 0.2196035 0.02419590 0.001284347 0.02828234 0.0007789598  
## 55 55 0.03161327 0.2191749 0.02419828 0.001284879 0.02820856 0.0007798837  
## 56 56 0.03162018 0.2188464 0.02420564 0.001297794 0.02832100 0.0007821886  
## 57 57 0.03160528 0.2195636 0.02420446 0.001310936 0.02809934 0.0007898357  
## 58 58 0.03161380 0.2191803 0.02420871 0.001307851 0.02797561 0.0007982203  
## 59 59 0.03161095 0.2193460 0.02420396 0.001303799 0.02819966 0.0007970075  
## 60 60 0.03162036 0.2189360 0.02421357 0.001305435 0.02800649 0.0007955544  
## 61 61 0.03164481 0.2178567 0.02423328 0.001315877 0.02841530 0.0008039545  
## 62 62 0.03165007 0.2176332 0.02423911 0.001304956 0.02830644 0.0007927464  
## 63 63 0.03165500 0.2174125 0.02423582 0.001308565 0.02777424 0.0007968352  
## 64 64 0.03166038 0.2171610 0.02424368 0.001294776 0.02794576 0.0007817263  
## 65 65 0.03164946 0.2176776 0.02423738 0.001284558 0.02776907 0.0007750591  
## 66 66 0.03164710 0.2177760 0.02423378 0.001269755 0.02729687 0.0007636916  
## 67 67 0.03164133 0.2180870 0.02423197 0.001257920 0.02671679 0.0007520417  
## 68 68 0.03164335 0.2180620 0.02422840 0.001259846 0.02687852 0.0007508521  
## 69 69 0.03165339 0.2175981 0.02423225 0.001260742 0.02697618 0.0007453041  
## 70 70 0.03166084 0.2172690 0.02424311 0.001263089 0.02647702 0.0007533942  
## 71 71 0.03167959 0.2164670 0.02425278 0.001262510 0.02662651 0.0007488328  
## 72 72 0.03167499 0.2167011 0.02424793 0.001274020 0.02685472 0.0007491783  
## 73 73 0.03168107 0.2164618 0.02425314 0.001278675 0.02707855 0.0007527849  
## 74 74 0.03167880 0.2165466 0.02425368 0.001287439 0.02713986 0.0007544370  
## 75 75 0.03168450 0.2163744 0.02425837 0.001286400 0.02771580 0.0007589528  
## 76 76 0.03168988 0.2161986 0.02426397 0.001286857 0.02764505 0.0007662621  
## 77 77 0.03168515 0.2163891 0.02425684 0.001288322 0.02757688 0.0007699613  
## 78 78 0.03170313 0.2155990 0.02427154 0.001290694 0.02706897 0.0007768320  
## 79 79 0.03170797 0.2154046 0.02428011 0.001294443 0.02700969 0.0007729743  
## 80 80 0.03171006 0.2153339 0.02427837 0.001293888 0.02702646 0.0007775687  
## 81 81 0.03171494 0.2150632 0.02428543 0.001293701 0.02690858 0.0007793757  
## 82 82 0.03172511 0.2146154 0.02428995 0.001284144 0.02653496 0.0007640182  
## 83 83 0.03173154 0.2143276 0.02428972 0.001279489 0.02644692 0.0007560490  
## 84 84 0.03173735 0.2141016 0.02429541 0.001273033 0.02655683 0.0007497910  
## 85 85 0.03173841 0.2141123 0.02429812 0.001276406 0.02736694 0.0007600667  
## 86 86 0.03174683 0.2137853 0.02430167 0.001274385 0.02774292 0.0007508619  
## 87 87 0.03175370 0.2134864 0.02431252 0.001272022 0.02758354 0.0007552864  
## 88 88 0.03175908 0.2132480 0.02431566 0.001266263 0.02729910 0.0007530346  
## 89 89 0.03175838 0.2133276 0.02431167 0.001259175 0.02734816 0.0007505063  
## 90 90 0.03176224 0.2131670 0.02431726 0.001247948 0.02703526 0.0007442174  
## 91 91 0.03176525 0.2130610 0.02431366 0.001247911 0.02669906 0.0007418737  
## 92 92 0.03177152 0.2128304 0.02431673 0.001246131 0.02632820 0.0007408410  
## 93 93 0.03177176 0.2128366 0.02432651 0.001244485 0.02711901 0.0007414686  
## 94 94 0.03176778 0.2129556 0.02431855 0.001242457 0.02666431 0.0007438610  
## 95 95 0.03176735 0.2129454 0.02431909 0.001247514 0.02678113 0.0007441168  
## 96 96 0.03177725 0.2125265 0.02432684 0.001251691 0.02712456 0.0007465395  
## 97 97 0.03176940 0.2128544 0.02431970 0.001240743 0.02701773 0.0007387990  
## 98 98 0.03176825 0.2129287 0.02431956 0.001233221 0.02697097 0.0007230819  
## 99 99 0.03177269 0.2127178 0.02433268 0.001236831 0.02711266 0.0007208761  
## 100 100 0.03178169 0.2123370 0.02434092 0.001226018 0.02694099 0.0007079596  
## 101 101 0.03178101 0.2123495 0.02433271 0.001221869 0.02671347 0.0007110858  
## 102 102 0.03178221 0.2123286 0.02433113 0.001230787 0.02696311 0.0007169744  
## 103 103 0.03178417 0.2122803 0.02433803 0.001233446 0.02734139 0.0007167405  
## 104 104 0.03178574 0.2122520 0.02434303 0.001233757 0.02748284 0.0007133546  
## 105 105 0.03178131 0.2124471 0.02433916 0.001232801 0.02745627 0.0007095581  
## 106 106 0.03177944 0.2125700 0.02433665 0.001227620 0.02753225 0.0007073834  
## 107 107 0.03177694 0.2126569 0.02433159 0.001224699 0.02766605 0.0007078159  
## 108 108 0.03177881 0.2125355 0.02433770 0.001220016 0.02743650 0.0006995887  
## 109 109 0.03178071 0.2124855 0.02433737 0.001218416 0.02742052 0.0007042914  
## 110 110 0.03178070 0.2125215 0.02433585 0.001215096 0.02768352 0.0007024547  
## 111 111 0.03177881 0.2126385 0.02434171 0.001214473 0.02795430 0.0007031486  
## 112 112 0.03178528 0.2123448 0.02434631 0.001207776 0.02789450 0.0006915779  
## 113 113 0.03178497 0.2123690 0.02434203 0.001206918 0.02782534 0.0006862160  
## 114 114 0.03179440 0.2119850 0.02434871 0.001216780 0.02769284 0.0006883593  
## 115 115 0.03179474 0.2119872 0.02434734 0.001217413 0.02813999 0.0006921328  
## 116 116 0.03179954 0.2117594 0.02434996 0.001222824 0.02831903 0.0006982535  
## 117 117 0.03179447 0.2120202 0.02434226 0.001223550 0.02857609 0.0006978725  
## 118 118 0.03180041 0.2118256 0.02434942 0.001229501 0.02874763 0.0006975551  
## 119 119 0.03180223 0.2117571 0.02435022 0.001229820 0.02843853 0.0006975760  
## 120 120 0.03180956 0.2114324 0.02435546 0.001226028 0.02816822 0.0006933845  
## 121 121 0.03181867 0.2110157 0.02436447 0.001229138 0.02800465 0.0006871930  
## 122 122 0.03181419 0.2111788 0.02435770 0.001232873 0.02759794 0.0006912432  
## 123 123 0.03180920 0.2113945 0.02435404 0.001236039 0.02757312 0.0006909751  
## 124 124 0.03181273 0.2112177 0.02435295 0.001238546 0.02772544 0.0006906860  
## 125 125 0.03181886 0.2109665 0.02436001 0.001239612 0.02779754 0.0006903576  
## 126 126 0.03181532 0.2111202 0.02436160 0.001244437 0.02779043 0.0006967157  
## 127 127 0.03182515 0.2107071 0.02436674 0.001244256 0.02771679 0.0006949327  
## 128 128 0.03182639 0.2106568 0.02436626 0.001244718 0.02800630 0.0006945931  
## 129 129 0.03183204 0.2104574 0.02436960 0.001240116 0.02826092 0.0006958620  
## 130 130 0.03183722 0.2102402 0.02437518 0.001237189 0.02842956 0.0006915960  
## 131 131 0.03183668 0.2102844 0.02437175 0.001240728 0.02854371 0.0006925862  
## 132 132 0.03183781 0.2102601 0.02437334 0.001240538 0.02841002 0.0006998787  
## 133 133 0.03183797 0.2102285 0.02437423 0.001249102 0.02833846 0.0007051827  
## 134 134 0.03183906 0.2102195 0.02437975 0.001257087 0.02822394 0.0007092663  
## 135 135 0.03183844 0.2102459 0.02438104 0.001261194 0.02826553 0.0007135534  
## 136 136 0.03183664 0.2103013 0.02438329 0.001260578 0.02827519 0.0007170505  
## 137 137 0.03184270 0.2100628 0.02438872 0.001255234 0.02812962 0.0007153826  
## 138 138 0.03184882 0.2097849 0.02439561 0.001255395 0.02827677 0.0007161014  
## 139 139 0.03184103 0.2101110 0.02439250 0.001253371 0.02818567 0.0007167953  
## 140 140 0.03183509 0.2103751 0.02438762 0.001254487 0.02834210 0.0007135163  
## 141 141 0.03183355 0.2104743 0.02439050 0.001261218 0.02857358 0.0007205926  
## 142 142 0.03182979 0.2106358 0.02438917 0.001258109 0.02842636 0.0007193668  
## 143 143 0.03182494 0.2108623 0.02438797 0.001257732 0.02836542 0.0007201094  
## 144 144 0.03182883 0.2106953 0.02439292 0.001254740 0.02826605 0.0007188267  
## 145 145 0.03183089 0.2106133 0.02439698 0.001255207 0.02843411 0.0007206850  
## 146 146 0.03183006 0.2106618 0.02439292 0.001261381 0.02838357 0.0007227259  
## 147 147 0.03182407 0.2109516 0.02438887 0.001261583 0.02855693 0.0007232161  
## 148 148 0.03181888 0.2111969 0.02438471 0.001263312 0.02842684 0.0007239488  
## 149 149 0.03182490 0.2109378 0.02438908 0.001264936 0.02846773 0.0007209870  
## 150 150 0.03182817 0.2108102 0.02439214 0.001263630 0.02844910 0.0007197910  
## 151 151 0.03183038 0.2107207 0.02439321 0.001261923 0.02818766 0.0007202108  
## 152 152 0.03183401 0.2105741 0.02439526 0.001266699 0.02827815 0.0007229234  
## 153 153 0.03183124 0.2107006 0.02438955 0.001267498 0.02814285 0.0007216402  
## 154 154 0.03183115 0.2107046 0.02438992 0.001267610 0.02819671 0.0007262832  
## 155 155 0.03183941 0.2103498 0.02439793 0.001273742 0.02821250 0.0007295537  
## 156 156 0.03183549 0.2105279 0.02439846 0.001277143 0.02844271 0.0007314140  
## 157 157 0.03183312 0.2106358 0.02439523 0.001275835 0.02848871 0.0007298647  
## 158 158 0.03183870 0.2104028 0.02439889 0.001286963 0.02854462 0.0007349922  
## 159 159 0.03183904 0.2104071 0.02439770 0.001284300 0.02861905 0.0007369121  
## 160 160 0.03183826 0.2104702 0.02439561 0.001287454 0.02885420 0.0007424869  
## 161 161 0.03183608 0.2105518 0.02439490 0.001292242 0.02900496 0.0007461351  
## 162 162 0.03184132 0.2103346 0.02440014 0.001291962 0.02906814 0.0007498750  
## 163 163 0.03184095 0.2103508 0.02439606 0.001295987 0.02904188 0.0007527636  
## 164 164 0.03184179 0.2102845 0.02439537 0.001298205 0.02892448 0.0007558892  
## 165 165 0.03184427 0.2101677 0.02439705 0.001299541 0.02891979 0.0007551743  
## 166 166 0.03184192 0.2102723 0.02439669 0.001299075 0.02894964 0.0007554859  
## 167 167 0.03184089 0.2103054 0.02439834 0.001304328 0.02895231 0.0007636826  
## 168 168 0.03183789 0.2104735 0.02439585 0.001310976 0.02922440 0.0007668708  
## 169 169 0.03183835 0.2104282 0.02439939 0.001309865 0.02921760 0.0007667045  
## 170 170 0.03183972 0.2103842 0.02439981 0.001310326 0.02920154 0.0007688354  
## 171 171 0.03183914 0.2103977 0.02439923 0.001311623 0.02915299 0.0007661572  
## 172 172 0.03184142 0.2103007 0.02439978 0.001320725 0.02933212 0.0007718162  
## 173 173 0.03184124 0.2103181 0.02439585 0.001318579 0.02920717 0.0007715068  
## 174 174 0.03184121 0.2103279 0.02439751 0.001317812 0.02920550 0.0007743991  
## 175 175 0.03183900 0.2104225 0.02439702 0.001314096 0.02909563 0.0007700225  
## 176 176 0.03184143 0.2103255 0.02439938 0.001312536 0.02918463 0.0007721761  
## 177 177 0.03184115 0.2103563 0.02439842 0.001315888 0.02931570 0.0007736747  
## 178 178 0.03183929 0.2104359 0.02439792 0.001314413 0.02916285 0.0007724581  
## 179 179 0.03184009 0.2103940 0.02440160 0.001313051 0.02905678 0.0007708584  
## 180 180 0.03184053 0.2103724 0.02440060 0.001318546 0.02907090 0.0007731406  
## 181 181 0.03184110 0.2103426 0.02440058 0.001317920 0.02897918 0.0007758682  
## 182 182 0.03184396 0.2102139 0.02440184 0.001318081 0.02894153 0.0007765386  
## 183 183 0.03184329 0.2102692 0.02439936 0.001321651 0.02893997 0.0007772036  
## 184 184 0.03184354 0.2102627 0.02440016 0.001323416 0.02910307 0.0007790238  
## 185 185 0.03184274 0.2102893 0.02440035 0.001322127 0.02901975 0.0007784217  
## 186 186 0.03184086 0.2103833 0.02439932 0.001325250 0.02915412 0.0007827550  
## 187 187 0.03183897 0.2104652 0.02439820 0.001327938 0.02917914 0.0007873400  
## 188 188 0.03183939 0.2104498 0.02439894 0.001328516 0.02923190 0.0007863676  
## 189 189 0.03184121 0.2103747 0.02439835 0.001332730 0.02921315 0.0007901659  
## 190 190 0.03184136 0.2103723 0.02439673 0.001331620 0.02914454 0.0007890484  
## 191 191 0.03184226 0.2103454 0.02439735 0.001332765 0.02915970 0.0007910192  
## 192 192 0.03184283 0.2103267 0.02439730 0.001331118 0.02919002 0.0007904136  
## 193 193 0.03184238 0.2103492 0.02439681 0.001331445 0.02909350 0.0007870101  
## 194 194 0.03184141 0.2104043 0.02439763 0.001329424 0.02892051 0.0007858165  
## 195 195 0.03184090 0.2104245 0.02439982 0.001329041 0.02888815 0.0007873130  
## 196 196 0.03184055 0.2104502 0.02439715 0.001329438 0.02895480 0.0007877131  
## 197 197 0.03184096 0.2104404 0.02439802 0.001331282 0.02890244 0.0007889976  
## 198 198 0.03183928 0.2105162 0.02439643 0.001328758 0.02891454 0.0007877112  
## 199 199 0.03183912 0.2105303 0.02439845 0.001331307 0.02897714 0.0007896055  
## 200 200 0.03184067 0.2104723 0.02439975 0.001332914 0.02910093 0.0007923824  
## 201 201 0.03184374 0.2103505 0.02440165 0.001335323 0.02925047 0.0007937888  
## 202 202 0.03184561 0.2102726 0.02440189 0.001338345 0.02938165 0.0007957981  
## 203 203 0.03184410 0.2103340 0.02440058 0.001336377 0.02932407 0.0007936603  
## 204 204 0.03184335 0.2103594 0.02440068 0.001335304 0.02922204 0.0007926315  
## 205 205 0.03184242 0.2103976 0.02440098 0.001333687 0.02917211 0.0007916241  
## 206 206 0.03184206 0.2104105 0.02440020 0.001335764 0.02928735 0.0007938728  
## 207 207 0.03184033 0.2104918 0.02439919 0.001335024 0.02928027 0.0007926535  
## 208 208 0.03183965 0.2105235 0.02439940 0.001336854 0.02928678 0.0007932637  
## 209 209 0.03184025 0.2105063 0.02440027 0.001335790 0.02925635 0.0007931812  
## 210 210 0.03183943 0.2105477 0.02440027 0.001335253 0.02930079 0.0007927331  
## 211 211 0.03183852 0.2105827 0.02440001 0.001336481 0.02924856 0.0007925577  
## 212 212 0.03183785 0.2106217 0.02439972 0.001337912 0.02932884 0.0007946135  
## 213 213 0.03183851 0.2105875 0.02440206 0.001336862 0.02930310 0.0007954517  
## 214 214 0.03183758 0.2106258 0.02440177 0.001337027 0.02929790 0.0007958365  
## 215 215 0.03183867 0.2105735 0.02440283 0.001337997 0.02925860 0.0007952394  
## 216 216 0.03183856 0.2105727 0.02440349 0.001337264 0.02921846 0.0007964778  
## 217 217 0.03183721 0.2106275 0.02440234 0.001337122 0.02925631 0.0007965668  
## 218 218 0.03183600 0.2106796 0.02440064 0.001336818 0.02923217 0.0007942518  
## 219 219 0.03183584 0.2106887 0.02440094 0.001336779 0.02922719 0.0007954410  
## 220 220 0.03183594 0.2106891 0.02440154 0.001336702 0.02929583 0.0007949577  
## 221 221 0.03183465 0.2107378 0.02439987 0.001335510 0.02932521 0.0007947993  
## 222 222 0.03183401 0.2107597 0.02439968 0.001337904 0.02933324 0.0007974601  
## 223 223 0.03183408 0.2107581 0.02439978 0.001338525 0.02933883 0.0007972573  
## 224 224 0.03183339 0.2107800 0.02439918 0.001337639 0.02929462 0.0007961265  
## 225 225 0.03183410 0.2107518 0.02439964 0.001339077 0.02930655 0.0007971099  
## 226 226 0.03183427 0.2107465 0.02440026 0.001338954 0.02930459 0.0007971379  
## 227 227 0.03183360 0.2107780 0.02439973 0.001337596 0.02928906 0.0007958173  
## 228 228 0.03183315 0.2107966 0.02439897 0.001339690 0.02931409 0.0007975018  
## 229 229 0.03183273 0.2108142 0.02439867 0.001339922 0.02933661 0.0007978075  
## 230 230 0.03183351 0.2107810 0.02439875 0.001338704 0.02932294 0.0007967590  
## 231 231 0.03183364 0.2107752 0.02439902 0.001337931 0.02931439 0.0007954286  
## 232 232 0.03183401 0.2107606 0.02439922 0.001337823 0.02930870 0.0007949646  
## 233 233 0.03183402 0.2107641 0.02439904 0.001338087 0.02931253 0.0007949976  
## 234 234 0.03183424 0.2107542 0.02439907 0.001338405 0.02930240 0.0007950382  
## 235 235 0.03183421 0.2107532 0.02439901 0.001337893 0.02930516 0.0007948011  
## 236 236 0.03183425 0.2107512 0.02439899 0.001337232 0.02930668 0.0007939406  
## 237 237 0.03183398 0.2107624 0.02439869 0.001337539 0.02930594 0.0007940875  
## 238 238 0.03183393 0.2107653 0.02439855 0.001337446 0.02931865 0.0007937922  
## 239 239 0.03183404 0.2107600 0.02439860 0.001337350 0.02931949 0.0007937274  
## 240 240 0.03183405 0.2107598 0.02439861 0.001337411 0.02932076 0.0007938112  
## [1] "Best Model"  
## nvmax  
## 12 12



## `stat\_bin()` using `bins = 30`. Pick better value with `binwidth`.

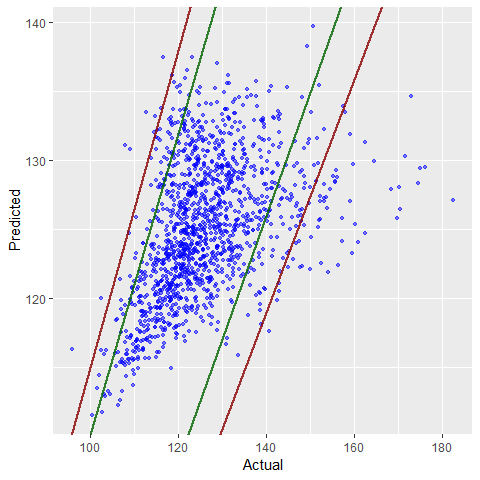


## [1] "Coefficients of final model:"  
## Estimate 2.5 % 97.5 %  
## (Intercept) 1.995577e+00 1.988618e+00 2.002536e+00  
## x4 -4.597873e-05 -6.320899e-05 -2.874848e-05  
## x7 1.104944e-02 9.831013e-03 1.226787e-02  
## x9 3.478685e-03 2.843103e-03 4.114268e-03  
## x10 1.256518e-03 6.653112e-04 1.847725e-03  
## x16 8.369850e-04 4.274152e-04 1.246555e-03  
## x17 1.750061e-03 1.129045e-03 2.371078e-03  
## x21 1.261389e-04 4.555657e-05 2.067213e-04  
## stat4 -7.996807e-04 -1.277735e-03 -3.216262e-04  
## stat14 -8.695003e-04 -1.338717e-03 -4.002840e-04  
## stat98 3.534448e-03 3.068557e-03 4.000339e-03  
## stat110 -3.407628e-03 -3.880579e-03 -2.934678e-03  
## x18.sqrt 2.506995e-02 2.326706e-02 2.687283e-02

#### Test

if (algo.forward.caret == TRUE){  
 test.model(model=model.forward, test=data.test  
 ,method = 'leapForward',subopt = NULL  
 ,formula = formula, feature.names = feature.names, label.names = label.names  
 ,id = id  
 ,draw.limits = TRUE, transformation = t)  
}

## [1] "Summary of predicted values: "  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.047 2.085 2.097 2.097 2.109 2.145   
## [1] "leapForward Test MSE: 0.00108731707436327"

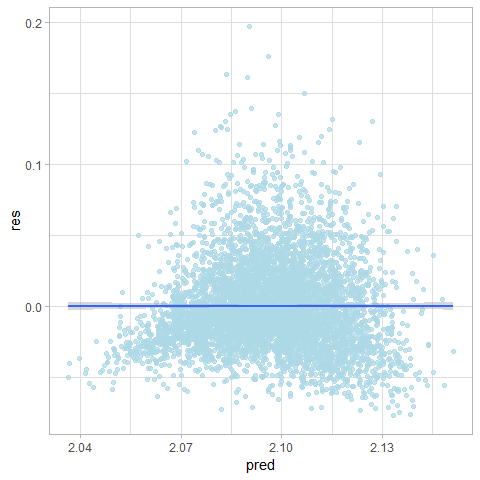
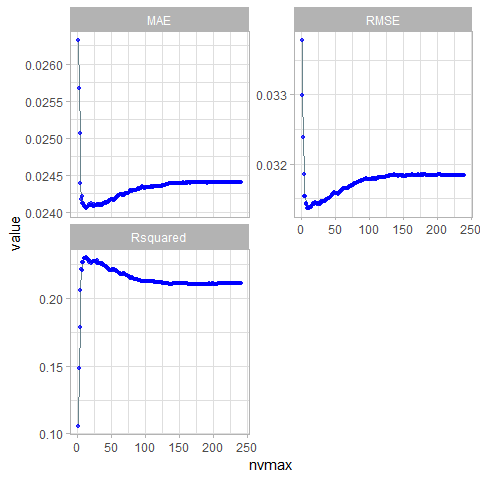


### Backward Elimination with CV

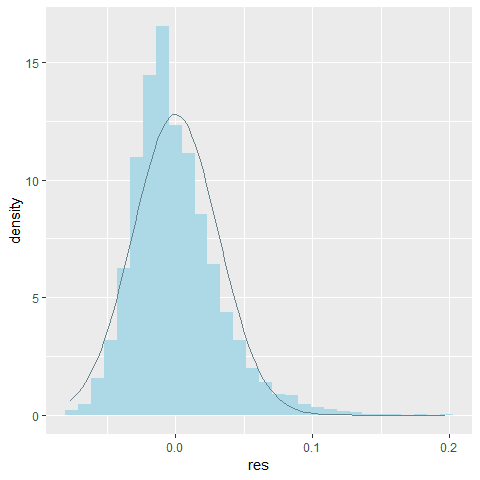
#### Train

if (algo.backward.caret == TRUE){  
 set.seed(1)  
 returned = train.caret.glmselect(formula = formula  
 ,data = data.train  
 ,method = "leapBackward"  
 ,feature.names = feature.names)  
 model.backward = returned$model  
 id = returned$id  
}

## Aggregating results  
## Selecting tuning parameters  
## Fitting nvmax = 12 on full training set  
## [1] "All models results"  
## nvmax RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.03378306 0.1058427 0.02632363 0.001445430 0.02324686 0.0009129561  
## 2 2 0.03298202 0.1480269 0.02566677 0.001381916 0.02786171 0.0008394827  
## 3 3 0.03238356 0.1785508 0.02506527 0.001333185 0.03172184 0.0008337556  
## 4 4 0.03184761 0.2054452 0.02438376 0.001296625 0.02805134 0.0007643137  
## 5 5 0.03153039 0.2210558 0.02417792 0.001235732 0.03004692 0.0007523258  
## 6 6 0.03153955 0.2206742 0.02421102 0.001212023 0.02951659 0.0007175730  
## 7 7 0.03142815 0.2262083 0.02412177 0.001203939 0.03212790 0.0007114201  
## 8 8 0.03142380 0.2262731 0.02412492 0.001235578 0.03041218 0.0007394213  
## 9 9 0.03135847 0.2294938 0.02409113 0.001264442 0.03094750 0.0007654157  
## 10 10 0.03137010 0.2290962 0.02407976 0.001321272 0.03198457 0.0007971954  
## 11 11 0.03136297 0.2295083 0.02406788 0.001297139 0.03219363 0.0007695563  
## 12 12 0.03135599 0.2298537 0.02404779 0.001280496 0.03174877 0.0007224132  
## 13 13 0.03137072 0.2291394 0.02404637 0.001270598 0.03024679 0.0007276347  
## 14 14 0.03136885 0.2291867 0.02406354 0.001291404 0.02925539 0.0007448656  
## 15 15 0.03139006 0.2282679 0.02407826 0.001289834 0.03031212 0.0007442875  
## 16 16 0.03140329 0.2276346 0.02407718 0.001285931 0.02985744 0.0007480732  
## 17 17 0.03143233 0.2262982 0.02410158 0.001261527 0.02937934 0.0007367824  
## 18 18 0.03142032 0.2268416 0.02409102 0.001267895 0.02907934 0.0007587634  
## 19 19 0.03141833 0.2270082 0.02409411 0.001276142 0.02919409 0.0007681325  
## 20 20 0.03144412 0.2258506 0.02411399 0.001269203 0.02878211 0.0007578581  
## 21 21 0.03143709 0.2262872 0.02409290 0.001266016 0.02924380 0.0007595887  
## 22 22 0.03143069 0.2265854 0.02409454 0.001251127 0.02864825 0.0007568067  
## 23 23 0.03142771 0.2267999 0.02408163 0.001250242 0.02864695 0.0007577162  
## 24 24 0.03142063 0.2271428 0.02408348 0.001234339 0.02860402 0.0007401582  
## 25 25 0.03142575 0.2269609 0.02410031 0.001258364 0.02928929 0.0007620661  
## 26 26 0.03142864 0.2268461 0.02409661 0.001269920 0.02901690 0.0007582775  
## 27 27 0.03142385 0.2271006 0.02409583 0.001280359 0.02789061 0.0007840820  
## 28 28 0.03141630 0.2274390 0.02408706 0.001287071 0.02727146 0.0008016818  
## 29 29 0.03144887 0.2259045 0.02410361 0.001285727 0.02719433 0.0008088091  
## 30 30 0.03146058 0.2254217 0.02410594 0.001280595 0.02717292 0.0007903503  
## 31 31 0.03145130 0.2259105 0.02410244 0.001294827 0.02782617 0.0008059300  
## 32 32 0.03145742 0.2256613 0.02409768 0.001293149 0.02763891 0.0007893347  
## 33 33 0.03146111 0.2254986 0.02409564 0.001278494 0.02733764 0.0007741531  
## 34 34 0.03146247 0.2254608 0.02409249 0.001291545 0.02728916 0.0007829625  
## 35 35 0.03147102 0.2250937 0.02410345 0.001298651 0.02769841 0.0007914303  
## 36 36 0.03146496 0.2254014 0.02409373 0.001284691 0.02811267 0.0007833284  
## 37 37 0.03148457 0.2245230 0.02410454 0.001301526 0.02825119 0.0007982825  
## 38 38 0.03148952 0.2243379 0.02411868 0.001303053 0.02838544 0.0007939917  
## 39 39 0.03149185 0.2242403 0.02412088 0.001305732 0.02809026 0.0007907665  
## 40 40 0.03150745 0.2235800 0.02412571 0.001296087 0.02746499 0.0007772373  
## 41 41 0.03150840 0.2235726 0.02412743 0.001285277 0.02717178 0.0007760445  
## 42 42 0.03152096 0.2230200 0.02412449 0.001281669 0.02693509 0.0007590107  
## 43 43 0.03152569 0.2228183 0.02412762 0.001282144 0.02672275 0.0007652701  
## 44 44 0.03153938 0.2222035 0.02413534 0.001281475 0.02635278 0.0007629312  
## 45 45 0.03155147 0.2216472 0.02413792 0.001276532 0.02662973 0.0007556169  
## 46 46 0.03155884 0.2213531 0.02414294 0.001261041 0.02635959 0.0007411914  
## 47 47 0.03158123 0.2203925 0.02416131 0.001276835 0.02695083 0.0007575141  
## 48 48 0.03158778 0.2200759 0.02416380 0.001275590 0.02665467 0.0007573662  
## 49 49 0.03158966 0.2200562 0.02417353 0.001268893 0.02696134 0.0007669540  
## 50 50 0.03158225 0.2204614 0.02417711 0.001271837 0.02784051 0.0007662576  
## 51 51 0.03157514 0.2208149 0.02417398 0.001274714 0.02815896 0.0007715110  
## 52 52 0.03158236 0.2205249 0.02417823 0.001272648 0.02822683 0.0007663296  
## 53 53 0.03157372 0.2209425 0.02416548 0.001271691 0.02781522 0.0007572315  
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## 56 56 0.03158777 0.2203404 0.02418393 0.001293660 0.02867487 0.0007789377  
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## 58 58 0.03161122 0.2193859 0.02421040 0.001308262 0.02948473 0.0007938274  
## 59 59 0.03162026 0.2190114 0.02421963 0.001309500 0.02901721 0.0007934549  
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## 70 70 0.03165894 0.2172847 0.02424771 0.001271527 0.02661429 0.0007648076  
## 71 71 0.03167535 0.2166168 0.02425544 0.001272545 0.02697337 0.0007625016  
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## 75 75 0.03169156 0.2160327 0.02425732 0.001280351 0.02780817 0.0007621846  
## 76 76 0.03169550 0.2158543 0.02426379 0.001281785 0.02779121 0.0007693247  
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## 80 80 0.03171913 0.2149202 0.02428665 0.001279211 0.02774643 0.0007593325  
## 81 81 0.03172377 0.2146933 0.02428782 0.001270016 0.02742809 0.0007441324  
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## 85 85 0.03174385 0.2139050 0.02430013 0.001259084 0.02709156 0.0007522389  
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## 88 88 0.03175596 0.2134022 0.02430771 0.001242929 0.02651685 0.0007427055  
## 89 89 0.03176434 0.2130531 0.02431645 0.001241086 0.02653030 0.0007465278  
## 90 90 0.03176293 0.2131422 0.02431416 0.001236247 0.02694500 0.0007414339  
## 91 91 0.03176424 0.2131037 0.02431262 0.001244603 0.02693746 0.0007485112  
## 92 92 0.03177155 0.2127923 0.02432551 0.001235595 0.02658965 0.0007423842  
## 93 93 0.03177630 0.2126070 0.02432645 0.001236047 0.02718841 0.0007401391  
## 94 94 0.03178265 0.2123133 0.02433465 0.001232254 0.02689876 0.0007388380  
## 95 95 0.03179033 0.2120069 0.02434273 0.001230208 0.02738931 0.0007345993  
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## 98 98 0.03177588 0.2126558 0.02432460 0.001212784 0.02744658 0.0007107595  
## 99 99 0.03178199 0.2124130 0.02432766 0.001213963 0.02734670 0.0007112566  
## 100 100 0.03178122 0.2124336 0.02433149 0.001209479 0.02680801 0.0007010662  
## 101 101 0.03177772 0.2126024 0.02433162 0.001207815 0.02718029 0.0007001173  
## 102 102 0.03177889 0.2125970 0.02433143 0.001212292 0.02745454 0.0007041085  
## 103 103 0.03178269 0.2124307 0.02433540 0.001216673 0.02743231 0.0007029028  
## 104 104 0.03178680 0.2122501 0.02433653 0.001224541 0.02748034 0.0007106591  
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## 106 106 0.03178754 0.2122312 0.02434035 0.001217287 0.02758343 0.0007033590  
## 107 107 0.03178498 0.2123425 0.02433740 0.001210611 0.02756914 0.0006996299  
## 108 108 0.03178951 0.2121583 0.02434442 0.001205856 0.02742970 0.0006977011  
## 109 109 0.03178829 0.2122264 0.02434197 0.001209873 0.02747435 0.0006977653  
## 110 110 0.03178304 0.2124445 0.02433775 0.001208513 0.02740874 0.0006927753  
## 111 111 0.03177902 0.2126035 0.02433681 0.001206663 0.02733501 0.0006934858  
## 112 112 0.03178882 0.2121911 0.02434554 0.001201826 0.02731583 0.0006830695  
## 113 113 0.03180161 0.2116426 0.02435248 0.001207424 0.02706619 0.0006839527  
## 114 114 0.03179892 0.2117899 0.02434939 0.001214677 0.02687580 0.0006905346  
## 115 115 0.03180740 0.2114377 0.02435170 0.001210310 0.02729041 0.0006918226  
## 116 116 0.03180569 0.2115305 0.02434634 0.001214513 0.02800035 0.0006966503  
## 117 117 0.03180751 0.2115013 0.02434753 0.001217726 0.02827313 0.0006962680  
## 118 118 0.03181074 0.2113760 0.02435287 0.001224310 0.02842391 0.0006939978  
## 119 119 0.03180812 0.2114609 0.02435105 0.001225515 0.02806781 0.0006874453  
## 120 120 0.03181062 0.2113378 0.02435006 0.001232362 0.02776984 0.0006933126  
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## 138 138 0.03184232 0.2101073 0.02439198 0.001263912 0.02884291 0.0007229470  
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## 142 142 0.03182963 0.2106200 0.02439015 0.001257915 0.02842729 0.0007205731  
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## 151 151 0.03182590 0.2109083 0.02438618 0.001271871 0.02852152 0.0007227738  
## 152 152 0.03182585 0.2109073 0.02438789 0.001270146 0.02842658 0.0007238834  
## 153 153 0.03182651 0.2108945 0.02438858 0.001271430 0.02844934 0.0007241219  
## 154 154 0.03182548 0.2109750 0.02438765 0.001269702 0.02839435 0.0007251462  
## 155 155 0.03183118 0.2107133 0.02439196 0.001272000 0.02850822 0.0007280423  
## 156 156 0.03183575 0.2105423 0.02439590 0.001278938 0.02859704 0.0007345982  
## 157 157 0.03183276 0.2106652 0.02439273 0.001278341 0.02860632 0.0007326307  
## 158 158 0.03183416 0.2106260 0.02439042 0.001285214 0.02883817 0.0007350796  
## 159 159 0.03183393 0.2106283 0.02439223 0.001283199 0.02880074 0.0007368583  
## 160 160 0.03183723 0.2105111 0.02439671 0.001286326 0.02894977 0.0007413463  
## 161 161 0.03183672 0.2105322 0.02439508 0.001291415 0.02909850 0.0007462207  
## 162 162 0.03184099 0.2103599 0.02439852 0.001291455 0.02923463 0.0007513355  
## 163 163 0.03184466 0.2101914 0.02439942 0.001298669 0.02906679 0.0007558974  
## 164 164 0.03184413 0.2102000 0.02439738 0.001301916 0.02892587 0.0007585782  
## 165 165 0.03184231 0.2102731 0.02439502 0.001302355 0.02885253 0.0007580289  
## 166 166 0.03184029 0.2103479 0.02439568 0.001301783 0.02893411 0.0007554039  
## 167 167 0.03184087 0.2103072 0.02439745 0.001304295 0.02897873 0.0007614015  
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## 171 171 0.03184166 0.2102843 0.02440104 0.001309460 0.02897577 0.0007658792  
## 172 172 0.03184555 0.2101266 0.02439991 0.001317317 0.02911421 0.0007699890  
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## 174 174 0.03184198 0.2102941 0.02439926 0.001317699 0.02910729 0.0007717884  
## 175 175 0.03184150 0.2103013 0.02439944 0.001314514 0.02914666 0.0007700317  
## 176 176 0.03184384 0.2102189 0.02440124 0.001312929 0.02921810 0.0007723960  
## 177 177 0.03184209 0.2103103 0.02439878 0.001314566 0.02933322 0.0007712308  
## 178 178 0.03184285 0.2102827 0.02440076 0.001314178 0.02920650 0.0007703080  
## 179 179 0.03184303 0.2102607 0.02440239 0.001313266 0.02909989 0.0007711412  
## 180 180 0.03184535 0.2101636 0.02440360 0.001315086 0.02897387 0.0007719874  
## 181 181 0.03184506 0.2101731 0.02440301 0.001313907 0.02886078 0.0007733430  
## 182 182 0.03184567 0.2101462 0.02440246 0.001318161 0.02896782 0.0007753590  
## 183 183 0.03184435 0.2102042 0.02440067 0.001320864 0.02896057 0.0007775010  
## 184 184 0.03184174 0.2103281 0.02439890 0.001323095 0.02908750 0.0007789463  
## 185 185 0.03184212 0.2103164 0.02440026 0.001321405 0.02901677 0.0007783231  
## 186 186 0.03184086 0.2103833 0.02439932 0.001325250 0.02915412 0.0007827550  
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## 192 192 0.03184108 0.2104005 0.02439579 0.001331793 0.02921865 0.0007897545  
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## 207 207 0.03184018 0.2105003 0.02439970 0.001334636 0.02927298 0.0007938840  
## 208 208 0.03183971 0.2105214 0.02440000 0.001337020 0.02928859 0.0007947071  
## 209 209 0.03184025 0.2105063 0.02440027 0.001335790 0.02925635 0.0007931812  
## 210 210 0.03183943 0.2105477 0.02440027 0.001335253 0.02930079 0.0007927331  
## 211 211 0.03183917 0.2105559 0.02440045 0.001337223 0.02925089 0.0007930896  
## 212 212 0.03183848 0.2105953 0.02440012 0.001338640 0.02933107 0.0007950844  
## 213 213 0.03183851 0.2105875 0.02440206 0.001336862 0.02930310 0.0007954517  
## 214 214 0.03183758 0.2106258 0.02440177 0.001337027 0.02929790 0.0007958365  
## 215 215 0.03183796 0.2106051 0.02440329 0.001336111 0.02922803 0.0007965419  
## 216 216 0.03183724 0.2106337 0.02440217 0.001335364 0.02920250 0.0007938569  
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## 218 218 0.03183600 0.2106796 0.02440064 0.001336818 0.02923217 0.0007942518  
## 219 219 0.03183518 0.2107103 0.02440002 0.001335009 0.02920766 0.0007930352  
## 220 220 0.03183555 0.2106954 0.02440043 0.001335150 0.02928488 0.0007925677  
## 221 221 0.03183493 0.2107238 0.02440016 0.001336033 0.02932995 0.0007951731  
## 222 222 0.03183391 0.2107631 0.02439943 0.001337977 0.02933685 0.0007974540  
## 223 223 0.03183408 0.2107581 0.02439978 0.001338525 0.02933883 0.0007972573  
## 224 224 0.03183339 0.2107800 0.02439918 0.001337639 0.02929462 0.0007961265  
## 225 225 0.03183410 0.2107518 0.02439964 0.001339077 0.02930655 0.0007971099  
## 226 226 0.03183427 0.2107465 0.02440026 0.001338954 0.02930459 0.0007971379  
## 227 227 0.03183360 0.2107780 0.02439973 0.001337596 0.02928906 0.0007958173  
## 228 228 0.03183315 0.2107966 0.02439897 0.001339690 0.02931409 0.0007975018  
## 229 229 0.03183291 0.2108067 0.02439882 0.001339854 0.02933865 0.0007978092  
## 230 230 0.03183369 0.2107733 0.02439890 0.001338636 0.02932501 0.0007967606  
## 231 231 0.03183364 0.2107752 0.02439902 0.001337931 0.02931439 0.0007954286  
## 232 232 0.03183401 0.2107606 0.02439922 0.001337823 0.02930870 0.0007949646  
## 233 233 0.03183402 0.2107641 0.02439904 0.001338087 0.02931253 0.0007949976  
## 234 234 0.03183424 0.2107542 0.02439907 0.001338405 0.02930240 0.0007950382  
## 235 235 0.03183421 0.2107532 0.02439901 0.001337893 0.02930516 0.0007948011  
## 236 236 0.03183425 0.2107512 0.02439899 0.001337232 0.02930668 0.0007939406  
## 237 237 0.03183398 0.2107624 0.02439869 0.001337539 0.02930594 0.0007940875  
## 238 238 0.03183393 0.2107653 0.02439855 0.001337446 0.02931865 0.0007937922  
## 239 239 0.03183404 0.2107600 0.02439860 0.001337350 0.02931949 0.0007937274  
## 240 240 0.03183405 0.2107598 0.02439861 0.001337411 0.02932076 0.0007938112  
## [1] "Best Model"  
## nvmax  
## 12 12



## `stat\_bin()` using `bins = 30`. Pick better value with `binwidth`.

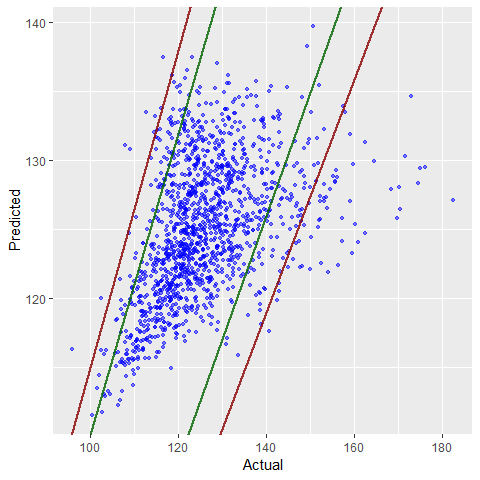


## [1] "Coefficients of final model:"  
## Estimate 2.5 % 97.5 %  
## (Intercept) 1.995577e+00 1.988618e+00 2.002536e+00  
## x4 -4.597873e-05 -6.320899e-05 -2.874848e-05  
## x7 1.104944e-02 9.831013e-03 1.226787e-02  
## x9 3.478685e-03 2.843103e-03 4.114268e-03  
## x10 1.256518e-03 6.653112e-04 1.847725e-03  
## x16 8.369850e-04 4.274152e-04 1.246555e-03  
## x17 1.750061e-03 1.129045e-03 2.371078e-03  
## x21 1.261389e-04 4.555657e-05 2.067213e-04  
## stat4 -7.996807e-04 -1.277735e-03 -3.216262e-04  
## stat14 -8.695003e-04 -1.338717e-03 -4.002840e-04  
## stat98 3.534448e-03 3.068557e-03 4.000339e-03  
## stat110 -3.407628e-03 -3.880579e-03 -2.934678e-03  
## x18.sqrt 2.506995e-02 2.326706e-02 2.687283e-02

#### Test

if (algo.backward.caret == TRUE){  
 test.model(model.backward, data.test  
 ,method = 'leapBackward',subopt = NULL  
 ,formula = formula, feature.names = feature.names, label.names = label.names  
 ,id = id  
 ,draw.limits = TRUE, transformation = t)  
}

## [1] "Summary of predicted values: "  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.047 2.085 2.097 2.097 2.109 2.145   
## [1] "leapBackward Test MSE: 0.00108731707436328"

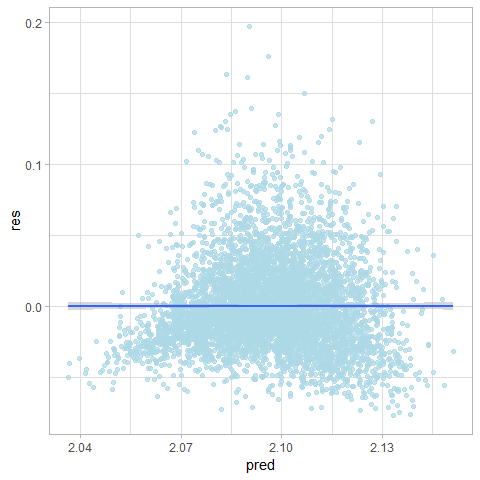
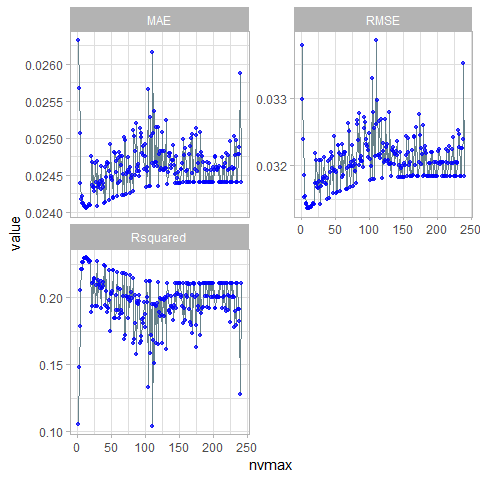


### Stepwise Selection with CV

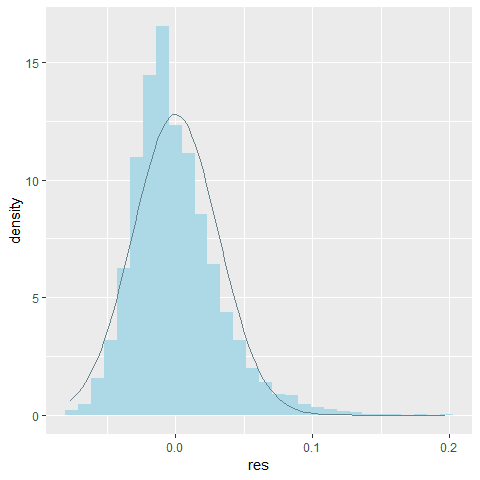
#### Train

if (algo.stepwise.caret == TRUE){  
 set.seed(1)  
 returned = train.caret.glmselect(formula = formula  
 ,data = data.train  
 ,method = "leapSeq"  
 ,feature.names = feature.names)  
 model.stepwise = returned$model  
 id = returned$id  
}

## Aggregating results  
## Selecting tuning parameters  
## Fitting nvmax = 12 on full training set  
## [1] "All models results"  
## nvmax RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.03378306 0.1058427 0.02632363 0.001445430 0.02324686 0.0009129561  
## 2 2 0.03298202 0.1480269 0.02566677 0.001381916 0.02786171 0.0008394827  
## 3 3 0.03238356 0.1785508 0.02506527 0.001333185 0.03172184 0.0008337556  
## 4 4 0.03184761 0.2054452 0.02438376 0.001296625 0.02805134 0.0007643137  
## 5 5 0.03153039 0.2210558 0.02417792 0.001235732 0.03004692 0.0007523258  
## 6 6 0.03153955 0.2206742 0.02421102 0.001212023 0.02951659 0.0007175730  
## 7 7 0.03142815 0.2262083 0.02412177 0.001203939 0.03212790 0.0007114201  
## 8 8 0.03142380 0.2262731 0.02412492 0.001235578 0.03041218 0.0007394213  
## 9 9 0.03135847 0.2294938 0.02409113 0.001264442 0.03094750 0.0007654157  
## 10 10 0.03137010 0.2290962 0.02407976 0.001321272 0.03198457 0.0007971954  
## 11 11 0.03136297 0.2295083 0.02406788 0.001297139 0.03219363 0.0007695563  
## 12 12 0.03135599 0.2298537 0.02404779 0.001280496 0.03174877 0.0007224132  
## 13 13 0.03137072 0.2291394 0.02404637 0.001270598 0.03024679 0.0007276347  
## 14 14 0.03136885 0.2291867 0.02406354 0.001291404 0.02925539 0.0007448656  
## 15 15 0.03139006 0.2282679 0.02407826 0.001289834 0.03031212 0.0007442875  
## 16 16 0.03140329 0.2276346 0.02407718 0.001285931 0.02985744 0.0007480732  
## 17 17 0.03142923 0.2264448 0.02410247 0.001262958 0.02959687 0.0007359754  
## 18 18 0.03141967 0.2268718 0.02409644 0.001268017 0.02919622 0.0007538960  
## 19 19 0.03141328 0.2272267 0.02409023 0.001279024 0.02913328 0.0007713691  
## 20 20 0.03217565 0.1886795 0.02474950 0.001753774 0.07022155 0.0013005008  
## 21 21 0.03173502 0.2109291 0.02435721 0.001451398 0.05162007 0.0009627426  
## 22 22 0.03207758 0.1930659 0.02466934 0.001615897 0.07407000 0.0012873987  
## 23 23 0.03173508 0.2110036 0.02433877 0.001424966 0.05116695 0.0010773936  
## 24 24 0.03166742 0.2134629 0.02433172 0.001350395 0.05705644 0.0010405516  
## 25 25 0.03165559 0.2142967 0.02428347 0.001514238 0.05970027 0.0009583941  
## 26 26 0.03208095 0.1933681 0.02465652 0.001511554 0.06086910 0.0011463926  
## 27 27 0.03176855 0.2091704 0.02440046 0.001458537 0.06349965 0.0010741579  
## 28 28 0.03141958 0.2273245 0.02408429 0.001284670 0.02733409 0.0008034233  
## 29 29 0.03207561 0.1933321 0.02468158 0.001709381 0.06306245 0.0013020653  
## 30 30 0.03168802 0.2128553 0.02433504 0.001292782 0.04940253 0.0009245754  
## 31 31 0.03176395 0.2098717 0.02436756 0.001443972 0.04991842 0.0010969059  
## 32 32 0.03178737 0.2087829 0.02437179 0.001447774 0.04921310 0.0011007732  
## 33 33 0.03182429 0.2066374 0.02442073 0.001525685 0.06355038 0.0012314656  
## 34 34 0.03212461 0.1918587 0.02461892 0.002019613 0.08101727 0.0014711896  
## 35 35 0.03174066 0.2124023 0.02430424 0.002026704 0.05165892 0.0013501917  
## 36 36 0.03183921 0.2068330 0.02442703 0.001673421 0.04670124 0.0011601667  
## 37 37 0.03172381 0.2112358 0.02434048 0.001385213 0.05446983 0.0010660614  
## 38 38 0.03180488 0.2080460 0.02438553 0.001481178 0.05167558 0.0009947027  
## 39 39 0.03149474 0.2241101 0.02411671 0.001309254 0.02877909 0.0007974763  
## 40 40 0.03205539 0.1940237 0.02460641 0.001688594 0.07800411 0.0012923421  
## 41 41 0.03151272 0.2233984 0.02413556 0.001299044 0.02779602 0.0007926193  
## 42 42 0.03189679 0.2044214 0.02447463 0.001663949 0.04573589 0.0011276228  
## 43 43 0.03208768 0.1927837 0.02464627 0.001422089 0.06301827 0.0010221527  
## 44 44 0.03219934 0.1889176 0.02467616 0.002010861 0.07940710 0.0014505082  
## 45 45 0.03214022 0.1920010 0.02465456 0.002110032 0.07172687 0.0015650049  
## 46 46 0.03196277 0.1982078 0.02454626 0.001512785 0.06917216 0.0010872085  
## 47 47 0.03158243 0.2203139 0.02415806 0.001274252 0.02671410 0.0007574827  
## 48 48 0.03243029 0.1751378 0.02491715 0.001663486 0.08013633 0.0012852942  
## 49 49 0.03191762 0.2031869 0.02445553 0.001422056 0.04927062 0.0009487118  
## 50 50 0.03193402 0.2023708 0.02447694 0.001443044 0.06266982 0.0010806091  
## 51 51 0.03189134 0.2044573 0.02443530 0.001411673 0.04862579 0.0010963284  
## 52 52 0.03159164 0.2200946 0.02419531 0.001273291 0.02766066 0.0007787377  
## 53 53 0.03159567 0.2199087 0.02419069 0.001271727 0.02767919 0.0007713094  
## 54 54 0.03230010 0.1844337 0.02481390 0.001693540 0.06690817 0.0012553026  
## 55 55 0.03229508 0.1848441 0.02479923 0.001677983 0.05473585 0.0011450574  
## 56 56 0.03217985 0.1905659 0.02468745 0.002107440 0.07258051 0.0015768756  
## 57 57 0.03197313 0.2014829 0.02453802 0.001646023 0.04431050 0.0010930249  
## 58 58 0.03161631 0.2190658 0.02420660 0.001305932 0.02806011 0.0007970460  
## 59 59 0.03215293 0.1901007 0.02472268 0.001530551 0.07266044 0.0012893479  
## 60 60 0.03182738 0.2071459 0.02439473 0.001527618 0.05819899 0.0009723221  
## 61 61 0.03230843 0.1842747 0.02480377 0.001681469 0.05410398 0.0012666278  
## 62 62 0.03185197 0.2060704 0.02441425 0.001537105 0.05856507 0.0009784455  
## 63 63 0.03220180 0.1877487 0.02475946 0.001533271 0.07318172 0.0012950314  
## 64 64 0.03216643 0.1905705 0.02463131 0.002020760 0.07357460 0.0013208285  
## 65 65 0.03219987 0.1879165 0.02475853 0.001515372 0.07289318 0.0012780328  
## 66 66 0.03164574 0.2178280 0.02423143 0.001272635 0.02749236 0.0007633384  
## 67 67 0.03196333 0.2011693 0.02451173 0.001498376 0.06088765 0.0011793792  
## 68 68 0.03164811 0.2178157 0.02422066 0.001257260 0.02661762 0.0007496974  
## 69 69 0.03262499 0.1686546 0.02501204 0.002052129 0.06558672 0.0014869943  
## 70 70 0.03251164 0.1721860 0.02496421 0.001574924 0.07151817 0.0011794963  
## 71 71 0.03197985 0.2006734 0.02451456 0.001437183 0.06096395 0.0010708091  
## 72 72 0.03166798 0.2169907 0.02424172 0.001278559 0.02699325 0.0007558675  
## 73 73 0.03198769 0.2002186 0.02453415 0.001512111 0.06103247 0.0011856463  
## 74 74 0.03204130 0.1985817 0.02456937 0.001637165 0.04498112 0.0010865700  
## 75 75 0.03230487 0.1848153 0.02474690 0.001959619 0.07572949 0.0014042263  
## 76 76 0.03198379 0.2004090 0.02453390 0.001514710 0.06055591 0.0011830856  
## 77 77 0.03168743 0.2161970 0.02425950 0.001284610 0.02695628 0.0007697838  
## 78 78 0.03207477 0.1971579 0.02460704 0.001624200 0.04452955 0.0010841021  
## 79 79 0.03191378 0.2036827 0.02445201 0.001490886 0.05555255 0.0009259650  
## 80 80 0.03202375 0.1997355 0.02449364 0.001887292 0.05677536 0.0012231372  
## 81 81 0.03172800 0.2144231 0.02428683 0.001271227 0.02685018 0.0007535185  
## 82 82 0.03266656 0.1655298 0.02509895 0.001518673 0.07092168 0.0013202808  
## 83 83 0.03261005 0.1689972 0.02502700 0.002022154 0.06924939 0.0013697861  
## 84 84 0.03237456 0.1810941 0.02482570 0.001450278 0.05759174 0.0011224594  
## 85 85 0.03199517 0.2018235 0.02449189 0.001980818 0.05202286 0.0013211497  
## 86 86 0.03277681 0.1579867 0.02519615 0.001513023 0.08425467 0.0013001491  
## 87 87 0.03209399 0.1960416 0.02460564 0.001400927 0.04872257 0.0009361843  
## 88 88 0.03206156 0.1974490 0.02455409 0.001399826 0.04849359 0.0010687527  
## 89 89 0.03213191 0.1948623 0.02464456 0.001608204 0.04541280 0.0010914185  
## 90 90 0.03206254 0.1974366 0.02454901 0.001377632 0.04794908 0.0010627092  
## 91 91 0.03196834 0.2015115 0.02447799 0.001454508 0.05536123 0.0009079348  
## 92 92 0.03271884 0.1656099 0.02513877 0.002159911 0.06345787 0.0014638076  
## 93 93 0.03255374 0.1709394 0.02501298 0.001847982 0.07668047 0.0013480779  
## 94 94 0.03263742 0.1676066 0.02506537 0.001714544 0.06699718 0.0012629346  
## 95 95 0.03232026 0.1836991 0.02479888 0.001512365 0.06497938 0.0009899338  
## 96 96 0.03238498 0.1805943 0.02488383 0.001560911 0.07753432 0.0013196029  
## 97 97 0.03228246 0.1847221 0.02476980 0.001344704 0.06079854 0.0010871060  
## 98 98 0.03212039 0.1960464 0.02458313 0.001890017 0.05816737 0.0012269958  
## 99 99 0.03222727 0.1874231 0.02475404 0.001476160 0.07038275 0.0010620687  
## 100 100 0.03247154 0.1775139 0.02491864 0.001629999 0.05648660 0.0012458039  
## 101 101 0.03178152 0.2123929 0.02433752 0.001214758 0.02668959 0.0007055507  
## 102 102 0.03209253 0.1962418 0.02460490 0.001400732 0.06068140 0.0010287389  
## 103 103 0.03199387 0.2001420 0.02455018 0.001250285 0.05007699 0.0008412131  
## 104 104 0.03330148 0.1332784 0.02565442 0.001592936 0.07340737 0.0012798046  
## 105 105 0.03178957 0.2121455 0.02434394 0.001222109 0.02731501 0.0007110558  
## 106 106 0.03279640 0.1583576 0.02527528 0.001947645 0.08456274 0.0014595930  
## 107 107 0.03178680 0.2122277 0.02434696 0.001217012 0.02708525 0.0006987845  
## 108 108 0.03255829 0.1716523 0.02503004 0.002023727 0.07959379 0.0014578560  
## 109 109 0.03214107 0.1946035 0.02466157 0.001587656 0.04606379 0.0010578828  
## 110 110 0.03386563 0.1043214 0.02616663 0.001732445 0.07784052 0.0012258798  
## 111 111 0.03261384 0.1677943 0.02506616 0.001394720 0.07671734 0.0012273373  
## 112 112 0.03297428 0.1510799 0.02536144 0.002060587 0.08748458 0.0014991318  
## 113 113 0.03214844 0.1951243 0.02462054 0.001923028 0.05949954 0.0012756436  
## 114 114 0.03215511 0.1940905 0.02466796 0.001569101 0.04490650 0.0010279296  
## 115 115 0.03266076 0.1658831 0.02513929 0.001372194 0.07595405 0.0010816235  
## 116 116 0.03216964 0.1934390 0.02467467 0.001569918 0.04534960 0.0010403526  
## 117 117 0.03209838 0.1958725 0.02462448 0.001463167 0.06058794 0.0011564234  
## 118 118 0.03268953 0.1650918 0.02514560 0.001604938 0.07448693 0.0012116116  
## 119 119 0.03181517 0.2111849 0.02435475 0.001225659 0.02796484 0.0006920534  
## 120 120 0.03220984 0.1891596 0.02478655 0.001276066 0.06038263 0.0009988860  
## 121 121 0.03233356 0.1858119 0.02481545 0.001822462 0.04896430 0.0012348776  
## 122 122 0.03204261 0.1994766 0.02456602 0.001230963 0.03537730 0.0007156896  
## 123 123 0.03206884 0.1986222 0.02458740 0.001432508 0.03416751 0.0008910834  
## 124 124 0.03269044 0.1658979 0.02507859 0.001925249 0.07241443 0.0013921567  
## 125 125 0.03226755 0.1867915 0.02482192 0.001372428 0.06282442 0.0011267974  
## 126 126 0.03206457 0.1983857 0.02455984 0.001292013 0.03981345 0.0009255657  
## 127 127 0.03230714 0.1860153 0.02482674 0.001429797 0.04983899 0.0009846269  
## 128 128 0.03207397 0.1980023 0.02455855 0.001285780 0.03956161 0.0009200441  
## 129 129 0.03202079 0.1998264 0.02459030 0.001254457 0.04661509 0.0008651436  
## 130 130 0.03279382 0.1612932 0.02524217 0.001538244 0.05706096 0.0011954188  
## 131 131 0.03202269 0.1997468 0.02459316 0.001255665 0.04709937 0.0008643833  
## 132 132 0.03183196 0.2104944 0.02437116 0.001249135 0.02834487 0.0007004666  
## 133 133 0.03202720 0.2013195 0.02453524 0.001787319 0.04353891 0.0011441604  
## 134 134 0.03221980 0.1900022 0.02480006 0.001332373 0.05552782 0.0010672720  
## 135 135 0.03220780 0.1905363 0.02475883 0.001363125 0.05626604 0.0010889763  
## 136 136 0.03226883 0.1882827 0.02479678 0.001303366 0.04794025 0.0009626131  
## 137 137 0.03200905 0.2010471 0.02458725 0.001237393 0.04157521 0.0008208866  
## 138 138 0.03215882 0.1933888 0.02462906 0.001434103 0.04259186 0.0008243377  
## 139 139 0.03216871 0.1926672 0.02469942 0.001201157 0.04272462 0.0008884911  
## 140 140 0.03220548 0.1918679 0.02470068 0.001315392 0.02913354 0.0008653371  
## 141 141 0.03235534 0.1826859 0.02490924 0.001157968 0.05003684 0.0007652884  
## 142 142 0.03214611 0.1939938 0.02462567 0.001440881 0.04306017 0.0008276517  
## 143 143 0.03182846 0.2107186 0.02438888 0.001255197 0.02841800 0.0007195126  
## 144 144 0.03199749 0.2019794 0.02451492 0.001244721 0.03228592 0.0008217606  
## 145 145 0.03219811 0.1918622 0.02475499 0.001573797 0.05063140 0.0011030601  
## 146 146 0.03182805 0.2107477 0.02439137 0.001260233 0.02844595 0.0007212351  
## 147 147 0.03195790 0.2033448 0.02445180 0.001391785 0.04634097 0.0007658764  
## 148 148 0.03198124 0.2022931 0.02454098 0.001282292 0.04355177 0.0008312108  
## 149 149 0.03182971 0.2107204 0.02439399 0.001262065 0.02858049 0.0007186891  
## 150 150 0.03182756 0.2108146 0.02439189 0.001264069 0.02844942 0.0007199937  
## 151 151 0.03182844 0.2108040 0.02438995 0.001262410 0.02833911 0.0007219306  
## 152 152 0.03203388 0.2004568 0.02457145 0.001226729 0.03098046 0.0006605957  
## 153 153 0.03199556 0.2017542 0.02457667 0.001258825 0.04232039 0.0008334003  
## 154 154 0.03215690 0.1933373 0.02466348 0.001254164 0.04484968 0.0008904568  
## 155 155 0.03242990 0.1804590 0.02498103 0.001829418 0.06309570 0.0013782579  
## 156 156 0.03183414 0.2105998 0.02439678 0.001278049 0.02852218 0.0007310822  
## 157 157 0.03220264 0.1916785 0.02476196 0.001344351 0.04012083 0.0008801300  
## 158 158 0.03240101 0.1828843 0.02485746 0.002018618 0.05184126 0.0014113403  
## 159 159 0.03200567 0.2013608 0.02455020 0.001302582 0.04425366 0.0008421791  
## 160 160 0.03183818 0.2104746 0.02439680 0.001286353 0.02879685 0.0007409899  
## 161 161 0.03204360 0.2005000 0.02456855 0.001643667 0.04303479 0.0010786865  
## 162 162 0.03184164 0.2103129 0.02440055 0.001291718 0.02907538 0.0007496308  
## 163 163 0.03184429 0.2101956 0.02439985 0.001294463 0.02889652 0.0007501085  
## 164 164 0.03222068 0.1910411 0.02477480 0.001359831 0.04058778 0.0009018919  
## 165 165 0.03184594 0.2100936 0.02440036 0.001298363 0.02893910 0.0007529354  
## 166 166 0.03241452 0.1814781 0.02488968 0.001259666 0.02485715 0.0007842137  
## 167 167 0.03242734 0.1794753 0.02499427 0.001366210 0.06407909 0.0011344732  
## 168 168 0.03200765 0.2016856 0.02452756 0.001303342 0.03355017 0.0008706933  
## 169 169 0.03256830 0.1734187 0.02504490 0.001707174 0.05658506 0.0011517041  
## 170 170 0.03184039 0.2103362 0.02440196 0.001308407 0.02904863 0.0007688999  
## 171 171 0.03183840 0.2104298 0.02439832 0.001312053 0.02914826 0.0007663482  
## 172 172 0.03184464 0.2101607 0.02440106 0.001317995 0.02916501 0.0007700650  
## 173 173 0.03204592 0.2000004 0.02458402 0.001268951 0.03077157 0.0007035636  
## 174 174 0.03275948 0.1631544 0.02513687 0.001527643 0.05501049 0.0010705770  
## 175 175 0.03245412 0.1790600 0.02503181 0.001284476 0.05384013 0.0010113513  
## 176 176 0.03202062 0.2018759 0.02455284 0.001805574 0.04418855 0.0011808875  
## 177 177 0.03224921 0.1901001 0.02477321 0.001338971 0.02698634 0.0007574230  
## 178 178 0.03215904 0.1934123 0.02466312 0.001429171 0.05644190 0.0009118029  
## 179 179 0.03184110 0.2103413 0.02440131 0.001314591 0.02912432 0.0007716622  
## 180 180 0.03259728 0.1715720 0.02507496 0.001523010 0.05713090 0.0011777299  
## 181 181 0.03184528 0.2101546 0.02440302 0.001314878 0.02887339 0.0007751663  
## 182 182 0.03229161 0.1878633 0.02480769 0.001425937 0.05199869 0.0011831706  
## 183 183 0.03221787 0.1917113 0.02475632 0.001812203 0.05454886 0.0012318061  
## 184 184 0.03217656 0.1925586 0.02467380 0.001450011 0.05747758 0.0009208650  
## 185 185 0.03184044 0.2103879 0.02439871 0.001319465 0.02901013 0.0007764275  
## 186 186 0.03184086 0.2103833 0.02439932 0.001325250 0.02915412 0.0007827550  
## 187 187 0.03183897 0.2104652 0.02439820 0.001327938 0.02917914 0.0007873400  
## 188 188 0.03203320 0.2010862 0.02457127 0.001653808 0.04234819 0.0011161631  
## 189 189 0.03184154 0.2103733 0.02439780 0.001334259 0.02937326 0.0007927421  
## 190 190 0.03203339 0.2010913 0.02456947 0.001655161 0.04224964 0.0011202423  
## 191 191 0.03219388 0.1924068 0.02466593 0.001548931 0.04681941 0.0009232141  
## 192 192 0.03184235 0.2103429 0.02439722 0.001330863 0.02915756 0.0007897697  
## 193 193 0.03219250 0.1921947 0.02466238 0.001398559 0.04692734 0.0007483836  
## 194 194 0.03184002 0.2104640 0.02439620 0.001330438 0.02898420 0.0007858027  
## 195 195 0.03184022 0.2104543 0.02439870 0.001329536 0.02892005 0.0007873113  
## 196 196 0.03205123 0.1998992 0.02456763 0.001343734 0.03612339 0.0009559250  
## 197 197 0.03184096 0.2104404 0.02439802 0.001331282 0.02890244 0.0007889976  
## 198 198 0.03184024 0.2104749 0.02439747 0.001328119 0.02892708 0.0007869655  
## 199 199 0.03204042 0.2002204 0.02461051 0.001349722 0.04561396 0.0009127207  
## 200 200 0.03184140 0.2104401 0.02440021 0.001333243 0.02916006 0.0007924733  
## 201 201 0.03203547 0.2010426 0.02456769 0.001657119 0.04223158 0.0011090101  
## 202 202 0.03221718 0.1920941 0.02475623 0.001831574 0.05461961 0.0012585256  
## 203 203 0.03223399 0.1916601 0.02474598 0.001903437 0.04369581 0.0012388412  
## 204 204 0.03205252 0.1998250 0.02459842 0.001284154 0.03076495 0.0007217823  
## 205 205 0.03201916 0.2009850 0.02457299 0.001358937 0.04534064 0.0009210978  
## 206 206 0.03205092 0.2000113 0.02456555 0.001346256 0.03592492 0.0009520507  
## 207 207 0.03204976 0.1999463 0.02459749 0.001284366 0.03086484 0.0007227794  
## 208 208 0.03183971 0.2105214 0.02440000 0.001337020 0.02928859 0.0007947071  
## 209 209 0.03204489 0.2001118 0.02461408 0.001356560 0.04597678 0.0009186779  
## 210 210 0.03183943 0.2105477 0.02440027 0.001335253 0.02930079 0.0007927331  
## 211 211 0.03183852 0.2105827 0.02440001 0.001336481 0.02924856 0.0007925577  
## 212 212 0.03183848 0.2105953 0.02440012 0.001338640 0.02933107 0.0007950844  
## 213 213 0.03223936 0.1917713 0.02474485 0.002114497 0.05425860 0.0014521499  
## 214 214 0.03204878 0.1999881 0.02460406 0.001286190 0.03092525 0.0007261031  
## 215 215 0.03183867 0.2105735 0.02440283 0.001337997 0.02925860 0.0007952394  
## 216 216 0.03203079 0.2007878 0.02460652 0.001348625 0.04522421 0.0009259110  
## 217 217 0.03221161 0.1916759 0.02465977 0.001475132 0.05160434 0.0010035456  
## 218 218 0.03228520 0.1893505 0.02479730 0.001944151 0.06012677 0.0014020880  
## 219 219 0.03183584 0.2106887 0.02440094 0.001336779 0.02922719 0.0007954410  
## 220 220 0.03183525 0.2107125 0.02440056 0.001334896 0.02927510 0.0007925994  
## 221 221 0.03202647 0.2019163 0.02455839 0.001865634 0.04574981 0.0012202754  
## 222 222 0.03223805 0.1907842 0.02477125 0.001691162 0.05511314 0.0012246799  
## 223 223 0.03203764 0.2010613 0.02457760 0.001679389 0.04285463 0.0011329185  
## 224 224 0.03242010 0.1818670 0.02495388 0.001849554 0.06393261 0.0013393985  
## 225 225 0.03183410 0.2107518 0.02439964 0.001339077 0.02930655 0.0007971099  
## 226 226 0.03183427 0.2107465 0.02440026 0.001338954 0.02930459 0.0007971379  
## 227 227 0.03204223 0.2002670 0.02460150 0.001286610 0.03079792 0.0007266567  
## 228 228 0.03183315 0.2107966 0.02439897 0.001339690 0.02931409 0.0007975018  
## 229 229 0.03203798 0.2010532 0.02457805 0.001684395 0.04302652 0.0011373780  
## 230 230 0.03204059 0.2003520 0.02459597 0.001286383 0.03063137 0.0007221704  
## 231 231 0.03252342 0.1775186 0.02502793 0.001766476 0.06642639 0.0013922413  
## 232 232 0.03226467 0.1893624 0.02476609 0.001378543 0.05089706 0.0010743065  
## 233 233 0.03246296 0.1792612 0.02497275 0.001209507 0.04374166 0.0008756961  
## 234 234 0.03183424 0.2107542 0.02439907 0.001338405 0.02930240 0.0007950382  
## 235 235 0.03183421 0.2107532 0.02439901 0.001337893 0.02930516 0.0007948011  
## 236 236 0.03224758 0.1909911 0.02478128 0.001901500 0.05718432 0.0012929064  
## 237 237 0.03224969 0.1909487 0.02478129 0.001898043 0.05727996 0.0012907472  
## 238 238 0.03239291 0.1823186 0.02487104 0.001402533 0.05687911 0.0008684909  
## 239 239 0.03352755 0.1279666 0.02587917 0.001498301 0.04848967 0.0010256802  
## 240 240 0.03183405 0.2107598 0.02439861 0.001337411 0.02932076 0.0007938112  
## [1] "Best Model"  
## nvmax  
## 12 12



## `stat\_bin()` using `bins = 30`. Pick better value with `binwidth`.

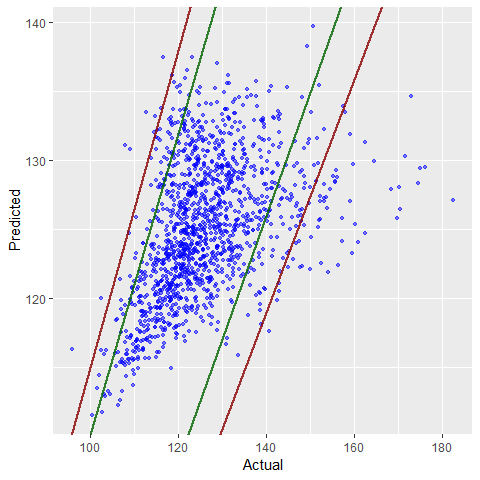


## [1] "Coefficients of final model:"  
## Estimate 2.5 % 97.5 %  
## (Intercept) 1.995577e+00 1.988618e+00 2.002536e+00  
## x4 -4.597873e-05 -6.320899e-05 -2.874848e-05  
## x7 1.104944e-02 9.831013e-03 1.226787e-02  
## x9 3.478685e-03 2.843103e-03 4.114268e-03  
## x10 1.256518e-03 6.653112e-04 1.847725e-03  
## x16 8.369850e-04 4.274152e-04 1.246555e-03  
## x17 1.750061e-03 1.129045e-03 2.371078e-03  
## x21 1.261389e-04 4.555657e-05 2.067213e-04  
## stat4 -7.996807e-04 -1.277735e-03 -3.216262e-04  
## stat14 -8.695003e-04 -1.338717e-03 -4.002840e-04  
## stat98 3.534448e-03 3.068557e-03 4.000339e-03  
## stat110 -3.407628e-03 -3.880579e-03 -2.934678e-03  
## x18.sqrt 2.506995e-02 2.326706e-02 2.687283e-02

#### Test

if (algo.stepwise.caret == TRUE){  
 test.model(model.stepwise, data.test  
 ,method = 'leapSeq',subopt = NULL  
 ,formula = formula, feature.names = feature.names, label.names = label.names  
 ,id = id  
 ,draw.limits = TRUE, transformation = t)  
   
}

## [1] "Summary of predicted values: "  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.047 2.085 2.097 2.097 2.109 2.145   
## [1] "leapSeq Test MSE: 0.00108731707436327"



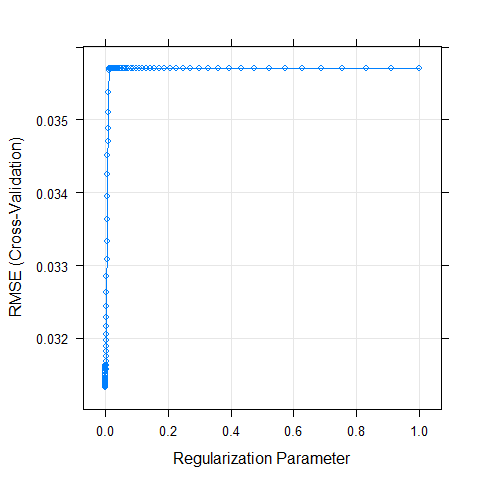
### LASSO with CV

#### Train

if (algo.LASSO.caret == TRUE){  
 set.seed(1)  
 tune.grid= expand.grid(alpha = 1,lambda = 10^seq(from=-4,to=0,length=100))  
 returned = train.caret.glmselect(formula = formula  
 ,data = data.train  
 ,method = "glmnet"  
 ,subopt = 'LASSO'  
 ,tune.grid = tune.grid  
 ,feature.names = feature.names)  
 model.LASSO.caret = returned$model  
}

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

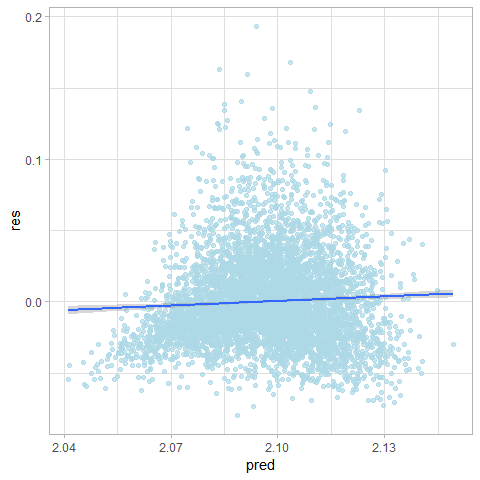
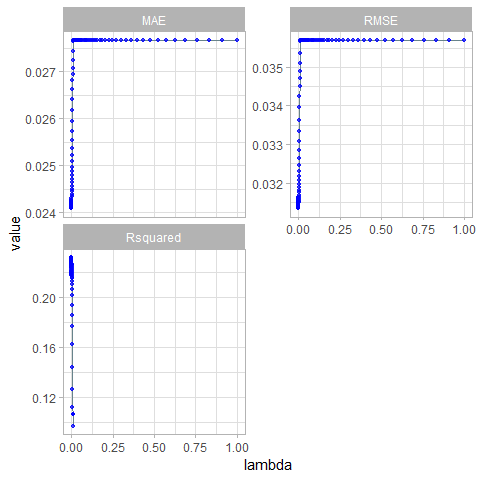
## Aggregating results  
## Selecting tuning parameters  
## Fitting alpha = 1, lambda = 0.000534 on full training set  
## glmnet   
##   
## 5584 samples  
## 240 predictor  
##   
## No pre-processing  
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 5026, 5026, 5026, 5025, 5025, 5026, ...   
## Resampling results across tuning parameters:  
##   
## lambda RMSE Rsquared MAE   
## 0.0001000000 0.03163438 0.2176233 0.02424920  
## 0.0001097499 0.03161872 0.2182038 0.02423862  
## 0.0001204504 0.03160226 0.2188221 0.02422781  
## 0.0001321941 0.03158527 0.2194679 0.02421691  
## 0.0001450829 0.03156721 0.2201679 0.02420558  
## 0.0001592283 0.03154794 0.2209325 0.02419356  
## 0.0001747528 0.03152774 0.2217519 0.02418076  
## 0.0001917910 0.03150725 0.2225986 0.02416757  
## 0.0002104904 0.03148639 0.2234814 0.02415403  
## 0.0002310130 0.03146570 0.2243752 0.02414055  
## 0.0002535364 0.03144428 0.2253290 0.02412635  
## 0.0002782559 0.03142252 0.2263347 0.02411257  
## 0.0003053856 0.03140139 0.2273508 0.02410152  
## 0.0003351603 0.03138108 0.2283714 0.02409302  
## 0.0003678380 0.03136211 0.2293684 0.02408560  
## 0.0004037017 0.03134739 0.2301989 0.02408141  
## 0.0004430621 0.03133607 0.2309159 0.02408112  
## 0.0004862602 0.03133159 0.2313366 0.02408723  
## 0.0005336699 0.03133145 0.2315901 0.02409687  
## 0.0005857021 0.03133548 0.2316823 0.02410935  
## 0.0006428073 0.03134616 0.2314832 0.02412714  
## 0.0007054802 0.03136097 0.2311222 0.02414742  
## 0.0007742637 0.03137909 0.2306437 0.02416996  
## 0.0008497534 0.03140228 0.2299703 0.02419855  
## 0.0009326033 0.03142915 0.2291784 0.02423188  
## 0.0010235310 0.03145700 0.2284544 0.02426510  
## 0.0011233240 0.03149028 0.2275564 0.02430271  
## 0.0012328467 0.03152945 0.2264817 0.02434607  
## 0.0013530478 0.03157465 0.2252190 0.02439349  
## 0.0014849683 0.03162672 0.2237471 0.02444534  
## 0.0016297508 0.03168304 0.2222513 0.02450144  
## 0.0017886495 0.03174446 0.2207238 0.02456371  
## 0.0019630407 0.03181320 0.2190640 0.02463447  
## 0.0021544347 0.03188700 0.2174965 0.02470840  
## 0.0023644894 0.03196540 0.2161252 0.02478525  
## 0.0025950242 0.03205523 0.2146073 0.02487118  
## 0.0028480359 0.03216193 0.2126746 0.02496862  
## 0.0031257158 0.03228997 0.2100299 0.02508080  
## 0.0034304693 0.03244358 0.2063434 0.02521242  
## 0.0037649358 0.03262768 0.2011086 0.02536535  
## 0.0041320124 0.03284748 0.1935917 0.02554368  
## 0.0045348785 0.03308079 0.1854991 0.02573111  
## 0.0049770236 0.03333143 0.1763413 0.02593268  
## 0.0054622772 0.03362733 0.1624154 0.02616414  
## 0.0059948425 0.03395388 0.1434603 0.02641325  
## 0.0065793322 0.03424659 0.1263545 0.02662804  
## 0.0072208090 0.03450569 0.1119194 0.02681119  
## 0.0079248290 0.03470028 0.1061067 0.02694635  
## 0.0086974900 0.03488658 0.1058427 0.02707807  
## 0.0095454846 0.03510782 0.1058427 0.02723595  
## 0.0104761575 0.03537244 0.1058427 0.02742770  
## 0.0114975700 0.03567652 0.0968637 0.02764904  
## 0.0126185688 0.03570122 NaN 0.02766696  
## 0.0138488637 0.03570122 NaN 0.02766696  
## 0.0151991108 0.03570122 NaN 0.02766696  
## 0.0166810054 0.03570122 NaN 0.02766696  
## 0.0183073828 0.03570122 NaN 0.02766696  
## 0.0200923300 0.03570122 NaN 0.02766696  
## 0.0220513074 0.03570122 NaN 0.02766696  
## 0.0242012826 0.03570122 NaN 0.02766696  
## 0.0265608778 0.03570122 NaN 0.02766696  
## 0.0291505306 0.03570122 NaN 0.02766696  
## 0.0319926714 0.03570122 NaN 0.02766696  
## 0.0351119173 0.03570122 NaN 0.02766696  
## 0.0385352859 0.03570122 NaN 0.02766696  
## 0.0422924287 0.03570122 NaN 0.02766696  
## 0.0464158883 0.03570122 NaN 0.02766696  
## 0.0509413801 0.03570122 NaN 0.02766696  
## 0.0559081018 0.03570122 NaN 0.02766696  
## 0.0613590727 0.03570122 NaN 0.02766696  
## 0.0673415066 0.03570122 NaN 0.02766696  
## 0.0739072203 0.03570122 NaN 0.02766696  
## 0.0811130831 0.03570122 NaN 0.02766696  
## 0.0890215085 0.03570122 NaN 0.02766696  
## 0.0977009957 0.03570122 NaN 0.02766696  
## 0.1072267222 0.03570122 NaN 0.02766696  
## 0.1176811952 0.03570122 NaN 0.02766696  
## 0.1291549665 0.03570122 NaN 0.02766696  
## 0.1417474163 0.03570122 NaN 0.02766696  
## 0.1555676144 0.03570122 NaN 0.02766696  
## 0.1707352647 0.03570122 NaN 0.02766696  
## 0.1873817423 0.03570122 NaN 0.02766696  
## 0.2056512308 0.03570122 NaN 0.02766696  
## 0.2257019720 0.03570122 NaN 0.02766696  
## 0.2477076356 0.03570122 NaN 0.02766696  
## 0.2718588243 0.03570122 NaN 0.02766696  
## 0.2983647240 0.03570122 NaN 0.02766696  
## 0.3274549163 0.03570122 NaN 0.02766696  
## 0.3593813664 0.03570122 NaN 0.02766696  
## 0.3944206059 0.03570122 NaN 0.02766696  
## 0.4328761281 0.03570122 NaN 0.02766696  
## 0.4750810162 0.03570122 NaN 0.02766696  
## 0.5214008288 0.03570122 NaN 0.02766696  
## 0.5722367659 0.03570122 NaN 0.02766696  
## 0.6280291442 0.03570122 NaN 0.02766696  
## 0.6892612104 0.03570122 NaN 0.02766696  
## 0.7564633276 0.03570122 NaN 0.02766696  
## 0.8302175681 0.03570122 NaN 0.02766696  
## 0.9111627561 0.03570122 NaN 0.02766696  
## 1.0000000000 0.03570122 NaN 0.02766696  
##   
## Tuning parameter 'alpha' was held constant at a value of 1  
## RMSE was used to select the optimal model using the smallest value.  
## The final values used for the model were alpha = 1 and lambda = 0.0005336699.



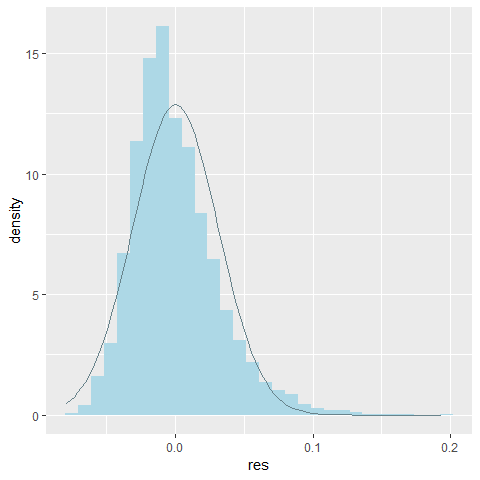
## alpha lambda  
## 19 1 0.0005336699  
## alpha lambda RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.0001000000 0.03163438 0.2176233 0.02424920 0.001295751 0.02892061 0.0007535401  
## 2 1 0.0001097499 0.03161872 0.2182038 0.02423862 0.001291711 0.02888196 0.0007507921  
## 3 1 0.0001204504 0.03160226 0.2188221 0.02422781 0.001287466 0.02884341 0.0007474022  
## 4 1 0.0001321941 0.03158527 0.2194679 0.02421691 0.001283153 0.02880295 0.0007434703  
## 5 1 0.0001450829 0.03156721 0.2201679 0.02420558 0.001278739 0.02875954 0.0007397243  
## 6 1 0.0001592283 0.03154794 0.2209325 0.02419356 0.001273794 0.02870986 0.0007355972  
## 7 1 0.0001747528 0.03152774 0.2217519 0.02418076 0.001269025 0.02866657 0.0007318901  
## 8 1 0.0001917910 0.03150725 0.2225986 0.02416757 0.001264756 0.02861545 0.0007284034  
## 9 1 0.0002104904 0.03148639 0.2234814 0.02415403 0.001261703 0.02854167 0.0007257375  
## 10 1 0.0002310130 0.03146570 0.2243752 0.02414055 0.001260642 0.02845211 0.0007255799  
## 11 1 0.0002535364 0.03144428 0.2253290 0.02412635 0.001260968 0.02841751 0.0007279233  
## 12 1 0.0002782559 0.03142252 0.2263347 0.02411257 0.001261931 0.02844939 0.0007322005  
## 13 1 0.0003053856 0.03140139 0.2273508 0.02410152 0.001264361 0.02849827 0.0007378189  
## 14 1 0.0003351603 0.03138108 0.2283714 0.02409302 0.001267870 0.02862600 0.0007430946  
## 15 1 0.0003678380 0.03136211 0.2293684 0.02408560 0.001270978 0.02874128 0.0007475729  
## 16 1 0.0004037017 0.03134739 0.2301989 0.02408141 0.001273554 0.02884078 0.0007521371  
## 17 1 0.0004430621 0.03133607 0.2309159 0.02408112 0.001275834 0.02897998 0.0007565451  
## 18 1 0.0004862602 0.03133159 0.2313366 0.02408723 0.001276943 0.02901457 0.0007576261  
## 19 1 0.0005336699 0.03133145 0.2315901 0.02409687 0.001276114 0.02911647 0.0007560928  
## 20 1 0.0005857021 0.03133548 0.2316823 0.02410935 0.001276107 0.02928380 0.0007548503  
## 21 1 0.0006428073 0.03134616 0.2314832 0.02412714 0.001276804 0.02944919 0.0007545732  
## 22 1 0.0007054802 0.03136097 0.2311222 0.02414742 0.001275976 0.02956971 0.0007500850  
## 23 1 0.0007742637 0.03137909 0.2306437 0.02416996 0.001277265 0.02970040 0.0007471460  
## 24 1 0.0008497534 0.03140228 0.2299703 0.02419855 0.001277120 0.02984539 0.0007461453  
## 25 1 0.0009326033 0.03142915 0.2291784 0.02423188 0.001277494 0.02986237 0.0007451443  
## 26 1 0.0010235310 0.03145700 0.2284544 0.02426510 0.001278549 0.03001672 0.0007451581  
## 27 1 0.0011233240 0.03149028 0.2275564 0.02430271 0.001279499 0.03015622 0.0007451171  
## 28 1 0.0012328467 0.03152945 0.2264817 0.02434607 0.001280354 0.03021874 0.0007454791  
## 29 1 0.0013530478 0.03157465 0.2252190 0.02439349 0.001280477 0.02999156 0.0007447130  
## 30 1 0.0014849683 0.03162672 0.2237471 0.02444534 0.001281353 0.02977323 0.0007443060  
## 31 1 0.0016297508 0.03168304 0.2222513 0.02450144 0.001284392 0.02958915 0.0007457048  
## 32 1 0.0017886495 0.03174446 0.2207238 0.02456371 0.001293489 0.02945504 0.0007515484  
## 33 1 0.0019630407 0.03181320 0.2190640 0.02463447 0.001305558 0.02929631 0.0007592191  
## 34 1 0.0021544347 0.03188700 0.2174965 0.02470840 0.001314783 0.02918831 0.0007622934  
## 35 1 0.0023644894 0.03196540 0.2161252 0.02478525 0.001320204 0.02909200 0.0007609288  
## 36 1 0.0025950242 0.03205523 0.2146073 0.02487118 0.001328590 0.02893521 0.0007609747  
## 37 1 0.0028480359 0.03216193 0.2126746 0.02496862 0.001338371 0.02883331 0.0007611822  
## 38 1 0.0031257158 0.03228997 0.2100299 0.02508080 0.001349194 0.02873527 0.0007614051  
## 39 1 0.0034304693 0.03244358 0.2063434 0.02521242 0.001361156 0.02866198 0.0007652039  
## 40 1 0.0037649358 0.03262768 0.2011086 0.02536535 0.001374363 0.02864410 0.0007716005  
## 41 1 0.0041320124 0.03284748 0.1935917 0.02554368 0.001388666 0.02880588 0.0007812366  
## 42 1 0.0045348785 0.03308079 0.1854991 0.02573111 0.001392120 0.02895387 0.0007869190  
## 43 1 0.0049770236 0.03333143 0.1763413 0.02593268 0.001398410 0.02898120 0.0007951673  
## 44 1 0.0054622772 0.03362733 0.1624154 0.02616414 0.001406284 0.02898211 0.0008006844  
## 45 1 0.0059948425 0.03395388 0.1434603 0.02641325 0.001414763 0.02762904 0.0008074284  
## 46 1 0.0065793322 0.03424659 0.1263545 0.02662804 0.001415245 0.02544064 0.0008046527  
## 47 1 0.0072208090 0.03450569 0.1119194 0.02681119 0.001413814 0.02547736 0.0007956160  
## 48 1 0.0079248290 0.03470028 0.1061067 0.02694635 0.001399947 0.02313910 0.0007772842  
## 49 1 0.0086974900 0.03488658 0.1058427 0.02707807 0.001395356 0.02324686 0.0007665229  
## 50 1 0.0095454846 0.03510782 0.1058427 0.02723595 0.001390812 0.02324686 0.0007561019  
## 51 1 0.0104761575 0.03537244 0.1058427 0.02742770 0.001386000 0.02324686 0.0007449406  
## 52 1 0.0114975700 0.03567652 0.0968637 0.02764904 0.001382799 0.01269648 0.0007308551  
## 53 1 0.0126185688 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 54 1 0.0138488637 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 55 1 0.0151991108 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 56 1 0.0166810054 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 57 1 0.0183073828 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 58 1 0.0200923300 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 59 1 0.0220513074 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 60 1 0.0242012826 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 61 1 0.0265608778 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 62 1 0.0291505306 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 63 1 0.0319926714 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 64 1 0.0351119173 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 65 1 0.0385352859 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 66 1 0.0422924287 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 67 1 0.0464158883 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 68 1 0.0509413801 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 69 1 0.0559081018 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 70 1 0.0613590727 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 71 1 0.0673415066 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 72 1 0.0739072203 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 73 1 0.0811130831 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 74 1 0.0890215085 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 75 1 0.0977009957 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 76 1 0.1072267222 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 77 1 0.1176811952 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 78 1 0.1291549665 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 79 1 0.1417474163 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 80 1 0.1555676144 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 81 1 0.1707352647 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 82 1 0.1873817423 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 83 1 0.2056512308 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 84 1 0.2257019720 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 85 1 0.2477076356 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 86 1 0.2718588243 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 87 1 0.2983647240 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 88 1 0.3274549163 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 89 1 0.3593813664 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 90 1 0.3944206059 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 91 1 0.4328761281 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 92 1 0.4750810162 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 93 1 0.5214008288 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 94 1 0.5722367659 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 95 1 0.6280291442 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 96 1 0.6892612104 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 97 1 0.7564633276 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 98 1 0.8302175681 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 99 1 0.9111627561 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522  
## 100 1 1.0000000000 0.03570122 NaN 0.02766696 0.001374911 NA 0.0007226522

## Warning: Removed 48 rows containing missing values (geom\_path).

## Warning: Removed 48 rows containing missing values (geom\_point).



## `stat\_bin()` using `bins = 30`. Pick better value with `binwidth`.

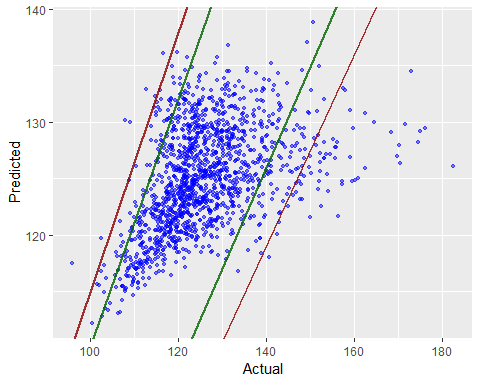


## [1] "Coefficients"  
## model.coef  
## (Intercept) 1.998495e+00  
## x4 -3.411868e-05  
## x5 2.332025e-04  
## x7 1.022185e-02  
## x8 1.887939e-04  
## x9 3.048113e-03  
## x10 8.789627e-04  
## x11 4.578478e+04  
## x12 -2.485595e-05  
## x14 -1.144417e-04  
## x16 5.561430e-04  
## x17 1.342243e-03  
## x19 6.485240e-05  
## x21 8.042284e-05  
## stat3 7.336365e-05  
## stat4 -4.844087e-04  
## stat5 -8.861845e-07  
## stat8 7.746199e-05  
## stat9 2.656000e-08  
## stat10 -6.092299e-07  
## stat13 -1.554969e-04  
## stat14 -5.825829e-04  
## stat15 -1.608401e-05  
## stat20 -4.068940e-05  
## stat22 -1.203024e-04  
## stat23 2.411034e-04  
## stat30 2.783713e-04  
## stat37 -3.189842e-07  
## stat38 7.036301e-07  
## stat41 -2.962570e-04  
## stat45 -1.960994e-05  
## stat53 -8.159734e-07  
## stat54 -7.944626e-07  
## stat59 1.747744e-04  
## stat60 2.422107e-04  
## stat78 -7.833137e-05  
## stat80 1.166860e-04  
## stat84 -2.855316e-05  
## stat89 -2.372371e-04  
## stat91 -1.871581e-04  
## stat92 -1.851294e-04  
## stat97 7.701314e-08  
## stat98 3.252585e-03  
## stat99 7.705167e-05  
## stat100 2.474459e-04  
## stat101 -8.560887e-07  
## stat103 -8.325686e-05  
## stat106 -1.359339e-04  
## stat110 -3.109558e-03  
## stat128 -1.260491e-07  
## stat129 1.935598e-05  
## stat130 8.231208e-05  
## stat144 2.059229e-04  
## stat146 -2.917541e-04  
## stat147 -8.764839e-05  
## stat148 -1.794681e-04  
## stat149 -3.043864e-04  
## stat156 7.576678e-05  
## stat157 -1.414937e-07  
## stat161 2.098303e-04  
## stat164 1.371789e-06  
## stat172 1.803478e-04  
## stat175 -6.934094e-05  
## stat179 2.214117e-05  
## stat181 4.238378e-07  
## stat187 -8.256205e-05  
## stat195 8.625869e-05  
## stat197 1.664128e-04  
## stat204 -5.487311e-05  
## stat207 3.975571e-05  
## stat214 -8.876836e-05  
## stat215 -5.029617e-05  
## x18.sqrt 2.395367e-02

#### Test

if (algo.LASSO.caret == TRUE){  
 test.model(model.LASSO.caret, data.test  
 ,method = 'glmnet',subopt = "LASSO"  
 ,formula = formula, feature.names = feature.names, label.names = label.names  
 ,draw.limits = TRUE, transformation = t)  
}

## [1] "Summary of predicted values: "  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.050 2.085 2.097 2.097 2.109 2.142   
## [1] "glmnet LASSO Test MSE: 0.00109040200655884"



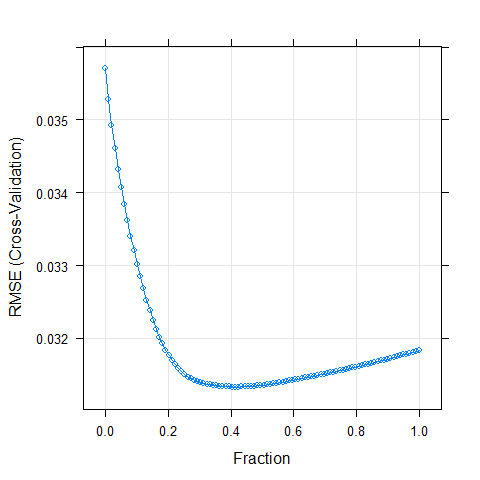
### LARS with CV

#### Train

if (algo.LARS.caret == TRUE){  
 set.seed(1)  
 returned = train.caret.glmselect(formula = formula  
 ,data = data.train  
 ,method = "lars"  
 ,subopt = 'NULL'  
 ,feature.names = feature.names)  
 model.LARS.caret = returned$model  
}

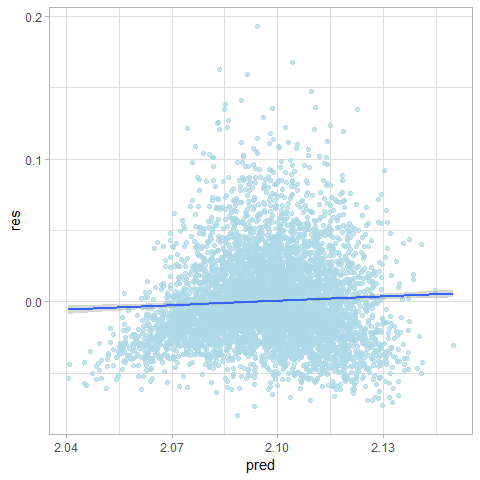
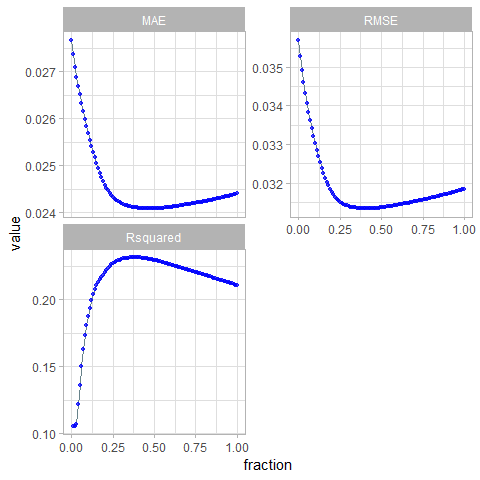
## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info = trainInfo, : There were missing values in resampled  
## performance measures.

## Aggregating results  
## Selecting tuning parameters  
## Fitting fraction = 0.414 on full training set  
## Least Angle Regression   
##   
## 5584 samples  
## 240 predictor  
##   
## Pre-processing: centered (240), scaled (240)   
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 5026, 5026, 5026, 5025, 5025, 5026, ...   
## Resampling results across tuning parameters:  
##   
## fraction RMSE Rsquared MAE   
## 0.00000000 0.03570122 NaN 0.02766696  
## 0.01010101 0.03528615 0.1058427 0.02736457  
## 0.02020202 0.03491858 0.1058427 0.02710064  
## 0.03030303 0.03460275 0.1070459 0.02687863  
## 0.04040404 0.03432631 0.1222055 0.02668587  
## 0.05050505 0.03407582 0.1362394 0.02650476  
## 0.06060606 0.03384171 0.1500216 0.02633066  
## 0.07070707 0.03361733 0.1629764 0.02615748  
## 0.08080808 0.03340422 0.1732539 0.02599104  
## 0.09090909 0.03320385 0.1811423 0.02583153  
## 0.10101010 0.03301881 0.1873978 0.02568084  
## 0.11111111 0.03284570 0.1936247 0.02554310  
## 0.12121212 0.03268070 0.1993992 0.02541072  
## 0.13131313 0.03252616 0.2040668 0.02528376  
## 0.14141414 0.03238224 0.2078260 0.02516343  
## 0.15151515 0.03224907 0.2108435 0.02504917  
## 0.16161616 0.03212679 0.2132567 0.02494087  
## 0.17171717 0.03201722 0.2151685 0.02483970  
## 0.18181818 0.03192311 0.2167569 0.02474814  
## 0.19191919 0.03183932 0.2185015 0.02466345  
## 0.20202020 0.03176381 0.2202557 0.02458627  
## 0.21212121 0.03169622 0.2219178 0.02451851  
## 0.22222222 0.03163691 0.2235195 0.02446019  
## 0.23232323 0.03158413 0.2250218 0.02440708  
## 0.24242424 0.03153846 0.2262804 0.02435981  
## 0.25252525 0.03150019 0.2272910 0.02431759  
## 0.26262626 0.03146901 0.2280782 0.02428190  
## 0.27272727 0.03144362 0.2287704 0.02425173  
## 0.28282828 0.03142387 0.2293040 0.02422717  
## 0.29292929 0.03140641 0.2298051 0.02420476  
## 0.30303030 0.03139112 0.2302545 0.02418495  
## 0.31313131 0.03137793 0.2306407 0.02416905  
## 0.32323232 0.03136766 0.2309161 0.02415685  
## 0.33333333 0.03135984 0.2310988 0.02414643  
## 0.34343434 0.03135256 0.2312822 0.02413622  
## 0.35353535 0.03134571 0.2314595 0.02412642  
## 0.36363636 0.03134052 0.2315661 0.02411836  
## 0.37373737 0.03133647 0.2316271 0.02411120  
## 0.38383838 0.03133367 0.2316327 0.02410486  
## 0.39393939 0.03133225 0.2315775 0.02410000  
## 0.40404040 0.03133158 0.2314973 0.02409570  
## 0.41414141 0.03133102 0.2314234 0.02409123  
## 0.42424242 0.03133140 0.2313111 0.02408739  
## 0.43434343 0.03133184 0.2312040 0.02408401  
## 0.44444444 0.03133332 0.2310538 0.02408159  
## 0.45454545 0.03133612 0.2308425 0.02408035  
## 0.46464646 0.03133982 0.2305955 0.02407986  
## 0.47474747 0.03134425 0.2303216 0.02408047  
## 0.48484848 0.03134878 0.2300503 0.02408136  
## 0.49494949 0.03135363 0.2297721 0.02408240  
## 0.50505051 0.03135880 0.2294864 0.02408391  
## 0.51515152 0.03136479 0.2291637 0.02408607  
## 0.52525253 0.03137141 0.2288152 0.02408855  
## 0.53535354 0.03137847 0.2284515 0.02409124  
## 0.54545455 0.03138569 0.2280853 0.02409408  
## 0.55555556 0.03139283 0.2277284 0.02409696  
## 0.56565657 0.03139994 0.2273778 0.02409982  
## 0.57575758 0.03140751 0.2270109 0.02410337  
## 0.58585859 0.03141519 0.2266442 0.02410748  
## 0.59595960 0.03142320 0.2262678 0.02411225  
## 0.60606061 0.03143146 0.2258850 0.02411745  
## 0.61616162 0.03143968 0.2255101 0.02412263  
## 0.62626263 0.03144776 0.2251464 0.02412797  
## 0.63636364 0.03145596 0.2247818 0.02413351  
## 0.64646465 0.03146420 0.2244202 0.02413888  
## 0.65656566 0.03147265 0.2240540 0.02414436  
## 0.66666667 0.03148121 0.2236863 0.02414997  
## 0.67676768 0.03149000 0.2233114 0.02415577  
## 0.68686869 0.03149899 0.2229312 0.02416182  
## 0.69696970 0.03150811 0.2225495 0.02416769  
## 0.70707071 0.03151739 0.2221648 0.02417371  
## 0.71717172 0.03152671 0.2217833 0.02417973  
## 0.72727273 0.03153610 0.2214014 0.02418566  
## 0.73737374 0.03154578 0.2210107 0.02419185  
## 0.74747475 0.03155548 0.2206239 0.02419798  
## 0.75757576 0.03156517 0.2202427 0.02420403  
## 0.76767677 0.03157486 0.2198658 0.02421001  
## 0.77777778 0.03158440 0.2194998 0.02421593  
## 0.78787879 0.03159413 0.2191288 0.02422212  
## 0.79797980 0.03160405 0.2187539 0.02422859  
## 0.80808081 0.03161410 0.2183767 0.02423529  
## 0.81818182 0.03162442 0.2179924 0.02424223  
## 0.82828283 0.03163497 0.2176019 0.02424956  
## 0.83838384 0.03164573 0.2172061 0.02425736  
## 0.84848485 0.03165672 0.2168055 0.02426551  
## 0.85858586 0.03166793 0.2163984 0.02427386  
## 0.86868687 0.03167936 0.2159869 0.02428229  
## 0.87878788 0.03169073 0.2155833 0.02429060  
## 0.88888889 0.03170227 0.2151767 0.02429908  
## 0.89898990 0.03171383 0.2147738 0.02430771  
## 0.90909091 0.03172542 0.2143736 0.02431637  
## 0.91919192 0.03173705 0.2139748 0.02432516  
## 0.92929293 0.03174869 0.2135800 0.02433404  
## 0.93939394 0.03176035 0.2131882 0.02434293  
## 0.94949495 0.03177206 0.2127973 0.02435184  
## 0.95959596 0.03178410 0.2123965 0.02436099  
## 0.96969697 0.03179629 0.2119938 0.02437025  
## 0.97979798 0.03180874 0.2115833 0.02437970  
## 0.98989899 0.03182126 0.2111750 0.02438906  
## 1.00000000 0.03183405 0.2107598 0.02439861  
##   
## RMSE was used to select the optimal model using the smallest value.  
## The final value used for the model was fraction = 0.4141414.

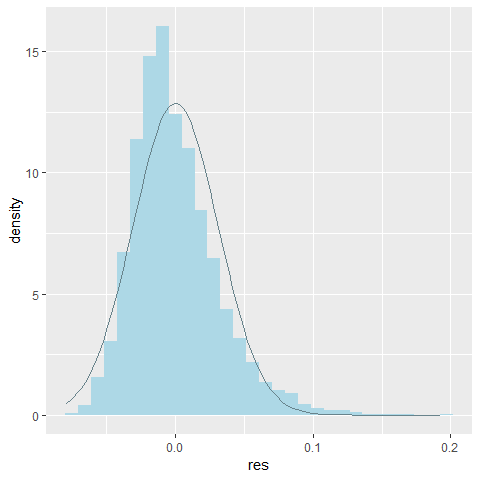


## fraction  
## 42 0.4141414

## Warning: Removed 1 rows containing missing values (geom\_point).



## `stat\_bin()` using `bins = 30`. Pick better value with `binwidth`.

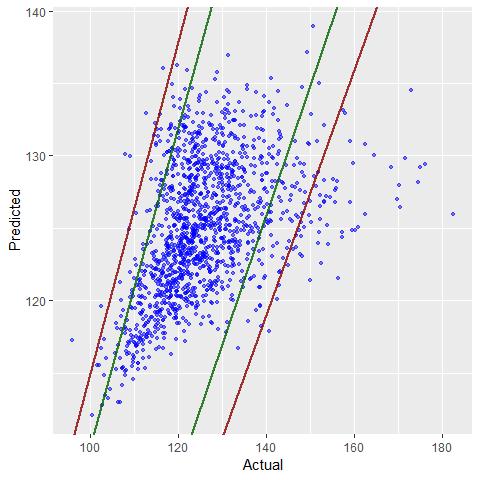


## [1] "Coefficients"  
## x4 x5 x7 x8 x9 x10 x11 x12   
## -1.649984e-03 3.710555e-04 6.907804e-03 5.733062e-04 3.956905e-03 1.252213e-03 2.949050e-04 -8.511963e-05   
## x14 x16 x17 x19 x21 stat3 stat4 stat5   
## -1.798116e-04 1.139045e-03 1.805958e-03 2.077363e-04 8.558053e-04 1.599001e-04 -8.627866e-04 -1.870285e-05   
## stat8 stat10 stat13 stat14 stat15 stat20 stat22 stat23   
## 1.645497e-04 -8.076072e-06 -3.016624e-04 -1.052448e-03 -5.756870e-05 -1.029341e-04 -2.415285e-04 4.485134e-04   
## stat30 stat38 stat41 stat45 stat53 stat54 stat59 stat60   
## 5.015756e-04 9.851910e-06 -5.482059e-04 -6.239178e-05 -1.300113e-05 -1.321213e-05 3.279134e-04 4.594484e-04   
## stat78 stat80 stat84 stat89 stat91 stat92 stat98 stat99   
## -1.620749e-04 2.285997e-04 -8.094196e-05 -4.435615e-04 -3.522484e-04 -3.489658e-04 5.747576e-03 1.678282e-04   
## stat100 stat101 stat103 stat106 stat110 stat129 stat130 stat144   
## 4.615195e-04 -1.509810e-05 -1.736672e-04 -2.652525e-04 -5.419530e-03 6.102363e-05 1.708651e-04 3.883681e-04   
## stat146 stat147 stat148 stat149 stat156 stat161 stat164 stat172   
## -5.312051e-04 -1.837025e-04 -3.485128e-04 -5.519043e-04 1.611700e-04 3.912462e-04 2.904031e-05 3.463529e-04   
## stat175 stat179 stat187 stat195 stat197 stat204 stat207 stat214   
## -1.558508e-04 6.468593e-05 -1.767116e-04 1.803113e-04 3.194976e-04 -1.314823e-04 1.015420e-04 -1.814091e-04   
## stat215 x18.sqrt   
## -1.166878e-04 1.092621e-02

#### Test

if (algo.LARS.caret == TRUE){  
 test.model(model.LARS.caret, data.test  
 ,method = 'lars',subopt = NULL  
 ,formula = formula, feature.names = feature.names, label.names = label.names  
 ,draw.limits = TRUE, transformation = t)  
}

## [1] "Summary of predicted values: "  
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.050 2.085 2.097 2.097 2.109 2.143   
## [1] "lars Test MSE: 0.00109075587762168"



# Session Info

sessionInfo()

## R version 3.5.2 (2018-12-20)  
## Platform: x86\_64-w64-mingw32/x64 (64-bit)  
## Running under: Windows 10 x64 (build 17763)  
##   
## Matrix products: default  
##   
## locale:  
## [1] LC\_COLLATE=English\_United States.1252 LC\_CTYPE=English\_United States.1252 LC\_MONETARY=English\_United States.1252  
## [4] LC\_NUMERIC=C LC\_TIME=English\_United States.1252   
##   
## attached base packages:  
## [1] parallel stats graphics grDevices utils datasets methods base   
##   
## other attached packages:  
## [1] knitr\_1.21 htmltools\_0.3.6 reshape2\_1.4.3 lars\_1.2   
## [5] doParallel\_1.0.14 iterators\_1.0.10 caret\_6.0-81 leaps\_3.0   
## [9] ggforce\_0.1.3 rlist\_0.4.6.1 car\_3.0-2 carData\_3.0-2   
## [13] bestNormalize\_1.3.0 scales\_1.0.0 onewaytests\_2.0 caTools\_1.17.1.1   
## [17] mosaic\_1.5.0 mosaicData\_0.17.0 ggformula\_0.9.1 ggstance\_0.3.1   
## [21] lattice\_0.20-38 DT\_0.5 ggiraphExtra\_0.2.9 ggiraph\_0.6.0   
## [25] investr\_1.4.0 glmnet\_2.0-16 foreach\_1.4.4 Matrix\_1.2-15   
## [29] MASS\_7.3-51.1 PerformanceAnalytics\_1.5.2 xts\_0.11-2 zoo\_1.8-4   
## [33] forcats\_0.3.0 stringr\_1.4.0 dplyr\_0.8.0 purrr\_0.3.0   
## [37] readr\_1.3.1 tidyr\_0.8.2 tibble\_2.0.1 ggplot2\_3.1.0   
## [41] tidyverse\_1.2.1 usdm\_1.1-18 raster\_2.8-19 sp\_1.3-1   
## [45] pacman\_0.5.0   
##   
## loaded via a namespace (and not attached):  
## [1] readxl\_1.2.0 backports\_1.1.3 plyr\_1.8.4 lazyeval\_0.2.1 splines\_3.5.2 mycor\_0.1.1   
## [7] crosstalk\_1.0.0 leaflet\_2.0.2 digest\_0.6.18 magrittr\_1.5 mosaicCore\_0.6.0 openxlsx\_4.1.0   
## [13] recipes\_0.1.4 modelr\_0.1.3 gower\_0.1.2 colorspace\_1.4-0 rvest\_0.3.2 ggrepel\_0.8.0   
## [19] haven\_2.0.0 xfun\_0.4 crayon\_1.3.4 jsonlite\_1.6 survival\_2.43-3 glue\_1.3.0   
## [25] registry\_0.5 gtable\_0.2.0 ppcor\_1.1 ipred\_0.9-8 sjmisc\_2.7.7 abind\_1.4-5   
## [31] rngtools\_1.3.1 bibtex\_0.4.2 Rcpp\_1.0.0 xtable\_1.8-3 units\_0.6-2 foreign\_0.8-71   
## [37] stats4\_3.5.2 lava\_1.6.5 prodlim\_2018.04.18 prediction\_0.3.6.2 htmlwidgets\_1.3 httr\_1.4.0   
## [43] RColorBrewer\_1.1-2 pkgconfig\_2.0.2 farver\_1.1.0 nnet\_7.3-12 labeling\_0.3 tidyselect\_0.2.5   
## [49] rlang\_0.3.1 later\_0.8.0 munsell\_0.5.0 cellranger\_1.1.0 tools\_3.5.2 cli\_1.0.1   
## [55] generics\_0.0.2 moments\_0.14 sjlabelled\_1.0.16 broom\_0.5.1 evaluate\_0.13 ggdendro\_0.1-20   
## [61] yaml\_2.2.0 ModelMetrics\_1.2.2 zip\_1.0.0 nlme\_3.1-137 doRNG\_1.7.1 mime\_0.6   
## [67] xml2\_1.2.0 compiler\_3.5.2 rstudioapi\_0.9.0 curl\_3.3 tweenr\_1.0.1 stringi\_1.3.1   
## [73] highr\_0.7 gdtools\_0.1.7 stringdist\_0.9.5.1 pillar\_1.3.1 data.table\_1.12.0 bitops\_1.0-6   
## [79] httpuv\_1.4.5.1 R6\_2.4.0 promises\_1.0.1 gridExtra\_2.3 rio\_0.5.16 codetools\_0.2-15   
## [85] assertthat\_0.2.0 pkgmaker\_0.27 withr\_2.1.2 nortest\_1.0-4 mgcv\_1.8-26 hms\_0.4.2   
## [91] quadprog\_1.5-5 grid\_3.5.2 rpart\_4.1-13 timeDate\_3043.102 class\_7.3-14 rmarkdown\_1.11   
## [97] snakecase\_0.9.2 shiny\_1.2.0 lubridate\_1.7.4