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)))

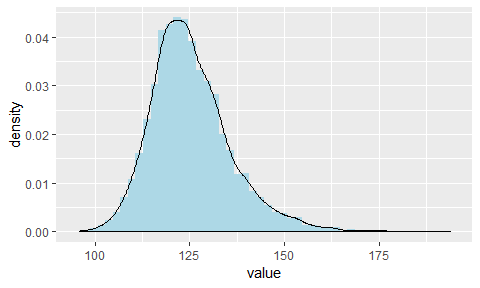
## JobName y3   
## Job\_00001: 1 Min. : 95.91   
## Job\_00002: 1 1st Qu.:118.29   
## Job\_00003: 1 Median :124.03   
## Job\_00004: 1 Mean :125.40   
## Job\_00007: 1 3rd Qu.:131.06   
## Job\_00008: 1 Max. :193.73   
## (Other) :6974

# Output Variable

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

## Histogram

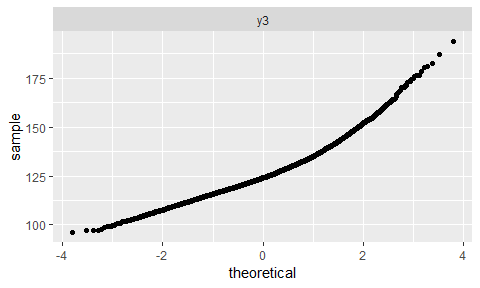
df=gather(select\_at(data,output.var))  
ggplot(df, aes(x=value)) +   
 geom\_histogram(aes(y=..density..),bins = 50,fill='light blue') +   
 geom\_density()



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

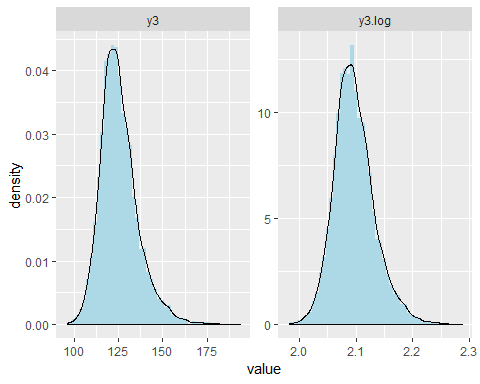
## QQPlot

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

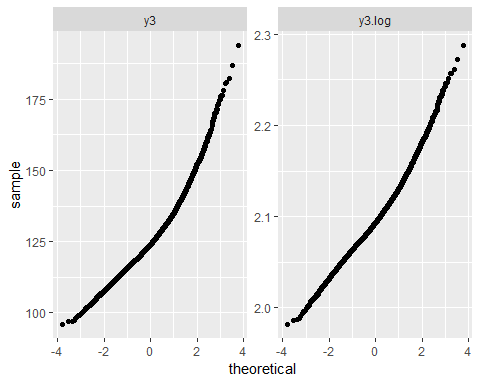


## Trasformation of Output Variable from y3 to y3.log

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

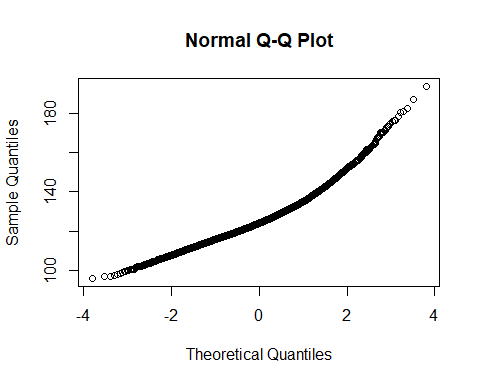
Normalization of **y3** using bestNormalize package. (suggested orderNorm) This is cool, but I think is too far for the objective of the project

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

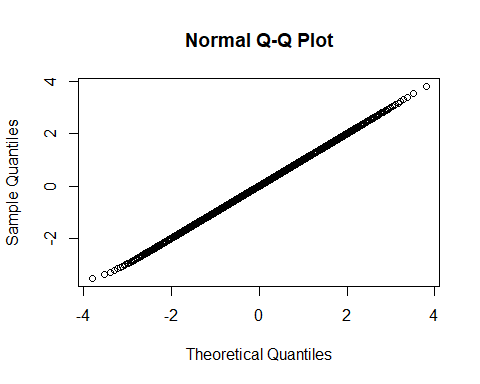
t

## Best Normalizing transformation with 6980 Observations  
## Estimated Normality Statistics (Pearson P / df, lower => more normal):  
## - No transform: 2.8967   
## - Box-Cox: 1.3967   
## - Log\_b(x+a): 1.9638   
## - sqrt(x+a): 2.4058   
## - exp(x): 749.2778   
## - arcsinh(x): 1.9638   
## - Yeo-Johnson: 1.1499   
## - orderNorm: 1.0916   
## 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

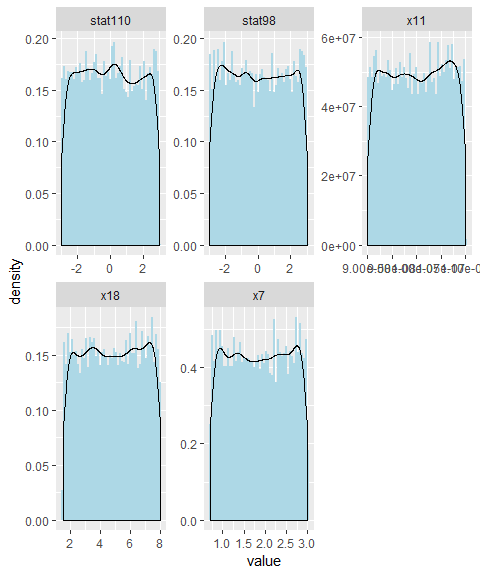
# Predictors

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)



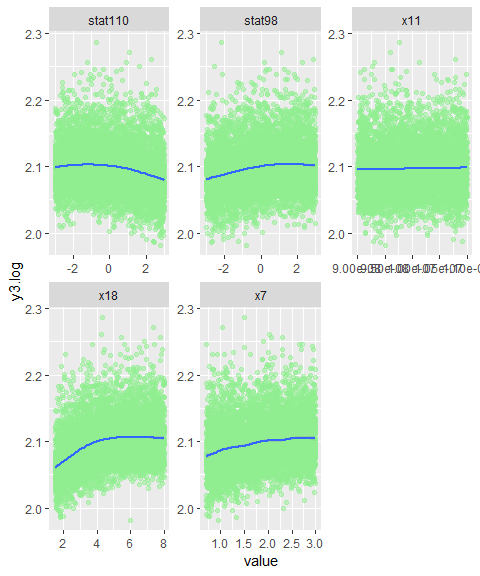
# ggplot(gather(select\_at(data,cols)), aes(sample=value)) +   
# stat\_qq()+  
# facet\_wrap(~key, scales = 'free',ncol=2)  
  
lapply(select\_at(data,cols),summary)

## $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")'

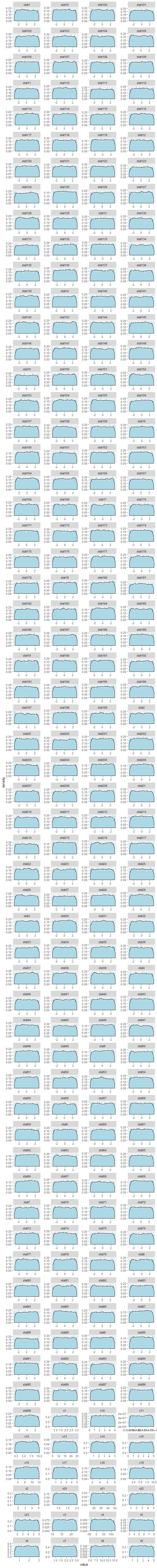


## All Predictors

### 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])

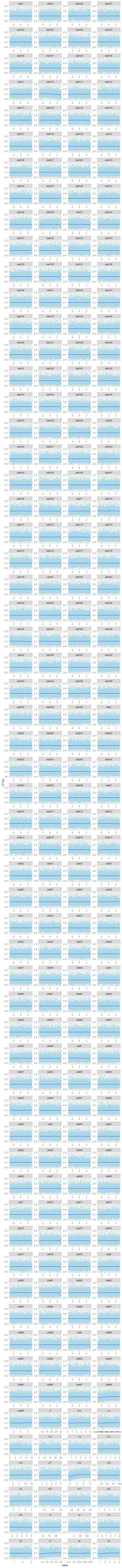
|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | x1 | x2 | x3 | x4 | x5 | x6 | x7 | x8 | x9 | x10 |
| x1 | 1.0000 | 0.0034 | -0.0028 | 0.0085 | 0.0068 | 0.0159 | 0.0264 | -0.0012 | 0.0142 | 0.0013 |
| x2 | 0.0034 | 1.0000 | -0.0057 | 0.0004 | -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 stat202 1.063041  
## 2 stat113 1.061407  
## 3 stat20 1.060739  
## 4 stat150 1.060240  
## 5 stat14 1.059110  
## 6 x22 1.059006  
## 7 stat164 1.058807  
## 8 stat205 1.058631  
## 9 stat178 1.058478  
## 10 stat145 1.058110  
## 11 stat192 1.058072  
## 12 stat200 1.057345  
## 13 stat83 1.057300  
## 14 stat124 1.057025  
## 15 stat72 1.056963

# Feature Eng

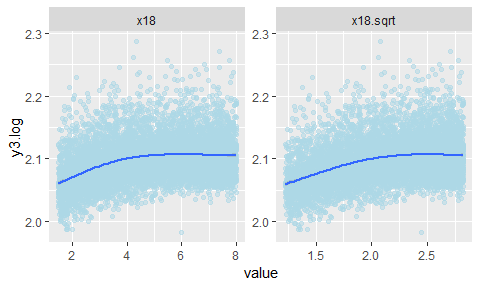
* Square Root transformation for **x18**

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(ceiling(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

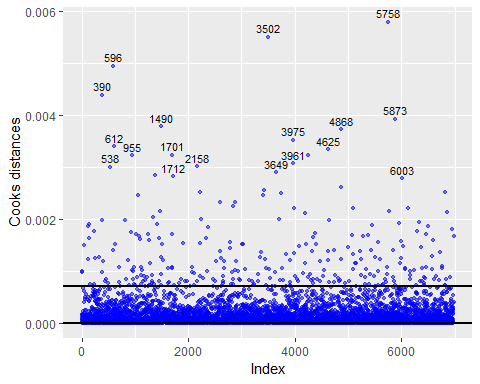
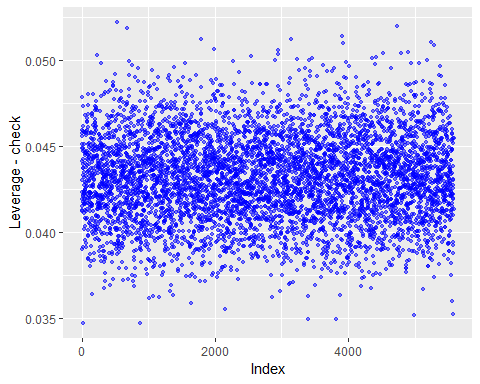
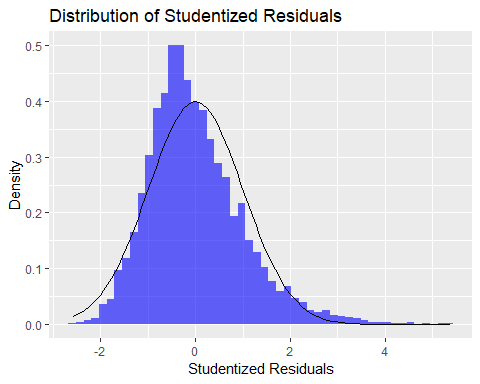
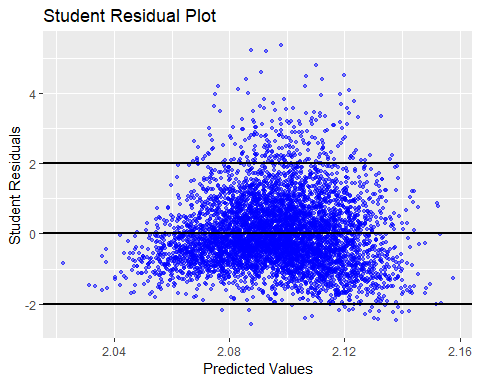
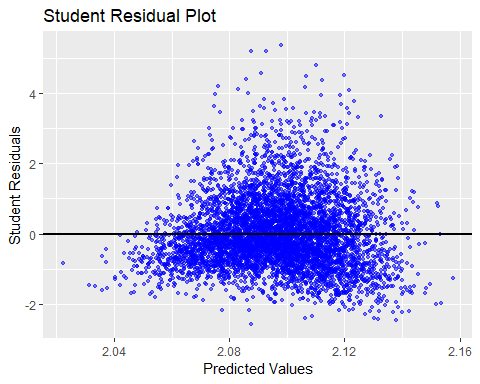
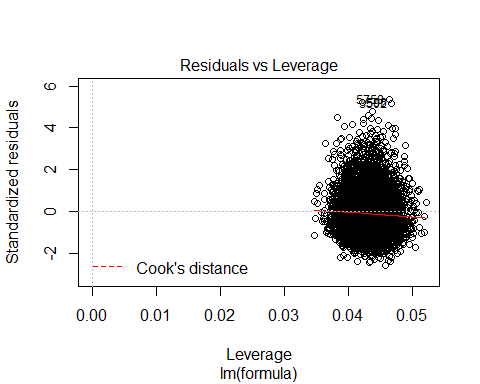
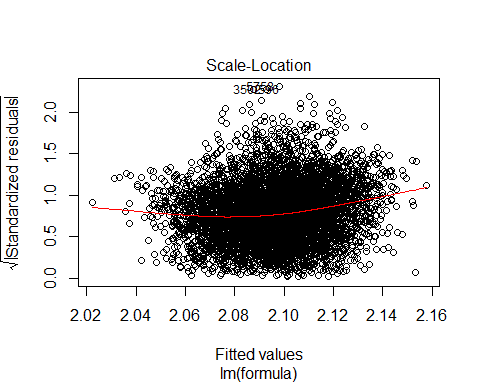
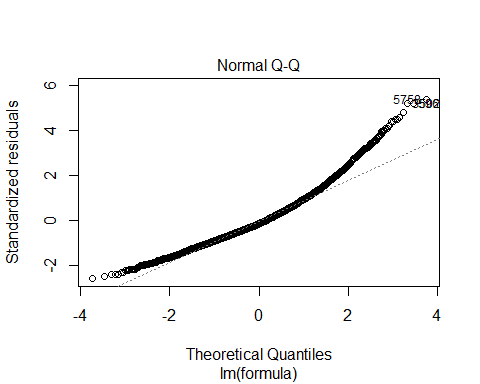
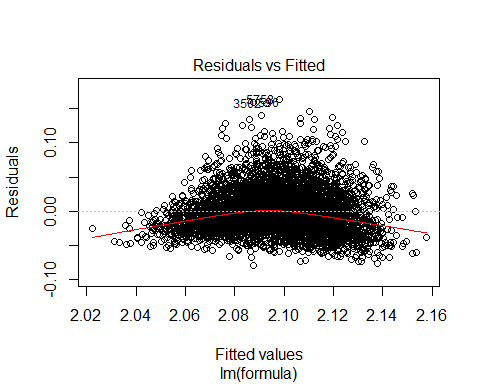
# Update feature.names because we may have transformed some features  
feature.names = n[!n %in% label.names]

## Full Model

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

##   
## Call:  
## lm(formula = formula, data = data.train)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.078499 -0.020718 -0.004436 0.016706 0.163057   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.961e+00 9.407e-03 208.501 < 2e-16 \*\*\*  
## x1 1.482e-04 6.523e-04 0.227 0.820313   
## x2 2.118e-04 4.152e-04 0.510 0.610049   
## x3 6.317e-05 1.131e-04 0.558 0.576572   
## x4 -5.193e-05 8.989e-06 -5.777 8.02e-09 \*\*\*  
## x5 2.874e-04 2.929e-04 0.981 0.326499   
## x6 2.583e-04 5.932e-04 0.435 0.663253   
## x7 1.153e-02 6.331e-04 18.218 < 2e-16 \*\*\*  
## x8 3.793e-04 1.465e-04 2.589 0.009656 \*\*   
## x9 3.185e-03 3.280e-04 9.710 < 2e-16 \*\*\*  
## x10 1.002e-03 3.061e-04 3.273 0.001071 \*\*   
## x11 2.581e+05 7.291e+04 3.541 0.000403 \*\*\*  
## x12 -1.521e-04 1.860e-04 -0.818 0.413502   
## x13 9.163e-05 7.410e-05 1.237 0.216252   
## x14 -5.969e-04 3.197e-04 -1.867 0.062004 .   
## x15 -1.037e-04 3.057e-04 -0.339 0.734528   
## x16 1.082e-03 2.131e-04 5.076 3.98e-07 \*\*\*  
## x17 1.509e-03 3.237e-04 4.662 3.20e-06 \*\*\*  
## x19 2.415e-04 1.640e-04 1.473 0.140904   
## x20 -1.390e-03 1.142e-03 -1.218 0.223459   
## x21 1.515e-04 4.165e-05 3.637 0.000278 \*\*\*  
## x22 -2.747e-04 3.432e-04 -0.800 0.423527   
## x23 -9.063e-05 3.257e-04 -0.278 0.780829   
## stat1 -1.630e-04 2.473e-04 -0.659 0.509816   
## stat2 -4.459e-05 2.455e-04 -0.182 0.855882   
## stat3 2.045e-04 2.474e-04 0.826 0.408579   
## stat4 -3.228e-04 2.477e-04 -1.303 0.192514   
## stat5 -1.920e-04 2.475e-04 -0.776 0.437810   
## stat6 -2.322e-04 2.484e-04 -0.935 0.350024   
## stat7 3.800e-05 2.468e-04 0.154 0.877646   
## stat8 2.536e-04 2.461e-04 1.030 0.302847   
## stat9 5.464e-05 2.450e-04 0.223 0.823512   
## stat10 -3.056e-04 2.464e-04 -1.240 0.214949   
## stat11 -2.179e-04 2.480e-04 -0.879 0.379617   
## stat12 1.037e-05 2.452e-04 0.042 0.966252   
## stat13 -2.103e-04 2.459e-04 -0.855 0.392318   
## stat14 -7.853e-04 2.444e-04 -3.213 0.001323 \*\*   
## stat15 -2.119e-04 2.437e-04 -0.870 0.384489   
## stat16 2.550e-05 2.462e-04 0.104 0.917488   
## stat17 5.554e-05 2.434e-04 0.228 0.819526   
## stat18 -2.299e-04 2.446e-04 -0.940 0.347354   
## stat19 -9.580e-05 2.451e-04 -0.391 0.695961   
## stat20 -3.012e-04 2.449e-04 -1.230 0.218811   
## stat21 -1.362e-04 2.466e-04 -0.552 0.580924   
## stat22 -2.299e-04 2.466e-04 -0.932 0.351340   
## stat23 5.531e-04 2.452e-04 2.256 0.024124 \*   
## stat24 -2.836e-04 2.467e-04 -1.150 0.250263   
## stat25 -6.542e-04 2.445e-04 -2.676 0.007468 \*\*   
## stat26 -3.946e-04 2.445e-04 -1.614 0.106679   
## stat27 -4.883e-06 2.467e-04 -0.020 0.984210   
## stat28 -3.942e-05 2.472e-04 -0.159 0.873327   
## stat29 4.452e-04 2.486e-04 1.791 0.073327 .   
## stat30 2.563e-04 2.484e-04 1.032 0.302317   
## stat31 -8.217e-06 2.473e-04 -0.033 0.973493   
## stat32 6.769e-06 2.482e-04 0.027 0.978244   
## stat33 -2.657e-04 2.444e-04 -1.087 0.276946   
## stat34 2.905e-04 2.453e-04 1.184 0.236508   
## stat35 -2.768e-04 2.478e-04 -1.117 0.264034   
## stat36 -8.188e-05 2.440e-04 -0.336 0.737206   
## stat37 -3.275e-04 2.486e-04 -1.317 0.187855   
## stat38 2.428e-04 2.465e-04 0.985 0.324575   
## stat39 -2.396e-04 2.455e-04 -0.976 0.329130   
## stat40 -9.009e-05 2.461e-04 -0.366 0.714346   
## stat41 -4.370e-04 2.432e-04 -1.797 0.072414 .   
## stat42 -1.854e-04 2.464e-04 -0.752 0.452003   
## stat43 -2.128e-04 2.464e-04 -0.863 0.387928   
## stat44 2.245e-04 2.474e-04 0.908 0.364111   
## stat45 -1.475e-04 2.466e-04 -0.598 0.549754   
## stat46 3.216e-04 2.456e-04 1.309 0.190490   
## stat47 1.284e-05 2.474e-04 0.052 0.958607   
## stat48 2.704e-04 2.459e-04 1.100 0.271474   
## stat49 -4.091e-05 2.444e-04 -0.167 0.867093   
## stat50 4.127e-04 2.446e-04 1.687 0.091591 .   
## stat51 3.520e-04 2.457e-04 1.432 0.152125   
## stat52 -1.391e-05 2.462e-04 -0.057 0.954929   
## stat53 -5.207e-04 2.468e-04 -2.110 0.034919 \*   
## stat54 -3.974e-04 2.471e-04 -1.608 0.107887   
## stat55 1.576e-04 2.432e-04 0.648 0.516954   
## stat56 -2.229e-04 2.468e-04 -0.903 0.366381   
## stat57 -5.867e-05 2.430e-04 -0.242 0.809175   
## stat58 -2.922e-04 2.449e-04 -1.193 0.232803   
## stat59 2.646e-04 2.459e-04 1.076 0.281888   
## stat60 3.735e-04 2.468e-04 1.514 0.130202   
## stat61 -3.656e-04 2.472e-04 -1.479 0.139286   
## stat62 -2.621e-04 2.469e-04 -1.062 0.288493   
## stat63 1.455e-04 2.466e-04 0.590 0.555132   
## stat64 -2.544e-04 2.452e-04 -1.038 0.299376   
## stat65 -3.160e-04 2.476e-04 -1.276 0.201902   
## stat66 1.109e-04 2.493e-04 0.445 0.656505   
## stat67 -2.901e-05 2.482e-04 -0.117 0.906966   
## stat68 2.441e-05 2.478e-04 0.099 0.921527   
## stat69 1.108e-04 2.451e-04 0.452 0.651310   
## stat70 1.604e-04 2.450e-04 0.655 0.512539   
## stat71 -6.468e-05 2.446e-04 -0.264 0.791440   
## stat72 1.670e-05 2.476e-04 0.067 0.946227   
## stat73 2.642e-04 2.461e-04 1.074 0.283041   
## stat74 -2.246e-04 2.452e-04 -0.916 0.359793   
## stat75 -3.204e-04 2.487e-04 -1.288 0.197755   
## stat76 2.373e-04 2.482e-04 0.956 0.339043   
## stat77 -2.429e-04 2.457e-04 -0.989 0.322928   
## stat78 -3.131e-04 2.459e-04 -1.273 0.202914   
## stat79 1.132e-04 2.477e-04 0.457 0.647648   
## stat80 1.395e-04 2.469e-04 0.565 0.572047   
## stat81 2.077e-04 2.471e-04 0.841 0.400524   
## stat82 4.724e-05 2.455e-04 0.192 0.847429   
## stat83 -4.736e-04 2.456e-04 -1.929 0.053821 .   
## stat84 -2.167e-04 2.462e-04 -0.881 0.378625   
## stat85 5.829e-05 2.469e-04 0.236 0.813405   
## stat86 1.933e-04 2.456e-04 0.787 0.431208   
## stat87 -4.094e-04 2.470e-04 -1.657 0.097489 .   
## stat88 -1.730e-04 2.439e-04 -0.709 0.478164   
## stat89 -2.041e-04 2.452e-04 -0.832 0.405278   
## stat90 1.029e-05 2.462e-04 0.042 0.966669   
## stat91 -6.647e-04 2.453e-04 -2.710 0.006756 \*\*   
## stat92 -3.563e-04 2.475e-04 -1.440 0.150037   
## stat93 -2.428e-04 2.490e-04 -0.975 0.329481   
## stat94 -2.497e-04 2.458e-04 -1.016 0.309787   
## stat95 6.893e-05 2.465e-04 0.280 0.779782   
## stat96 -4.955e-05 2.460e-04 -0.201 0.840404   
## stat97 3.940e-05 2.437e-04 0.162 0.871571   
## stat98 3.679e-03 2.439e-04 15.083 < 2e-16 \*\*\*  
## stat99 2.265e-04 2.469e-04 0.917 0.359065   
## stat100 5.315e-04 2.446e-04 2.173 0.029850 \*   
## stat101 -2.293e-04 2.471e-04 -0.928 0.353370   
## stat102 2.793e-04 2.471e-04 1.130 0.258409   
## stat103 -2.508e-04 2.477e-04 -1.013 0.311339   
## stat104 -3.085e-04 2.475e-04 -1.246 0.212636   
## stat105 1.028e-04 2.446e-04 0.420 0.674254   
## stat106 -2.559e-04 2.455e-04 -1.043 0.297224   
## stat107 -2.014e-04 2.457e-04 -0.820 0.412388   
## stat108 -2.612e-04 2.464e-04 -1.060 0.289254   
## stat109 2.464e-06 2.458e-04 0.010 0.992002   
## stat110 -3.434e-03 2.453e-04 -13.999 < 2e-16 \*\*\*  
## stat111 -3.267e-05 2.449e-04 -0.133 0.893861   
## stat112 8.614e-05 2.480e-04 0.347 0.728395   
## stat113 -1.779e-04 2.481e-04 -0.717 0.473472   
## stat114 3.571e-04 2.460e-04 1.452 0.146698   
## stat115 1.883e-04 2.454e-04 0.767 0.442873   
## stat116 2.271e-04 2.464e-04 0.922 0.356642   
## stat117 4.530e-05 2.473e-04 0.183 0.854631   
## stat118 -1.955e-05 2.437e-04 -0.080 0.936067   
## stat119 3.696e-05 2.456e-04 0.150 0.880383   
## stat120 2.088e-04 2.439e-04 0.856 0.392124   
## stat121 -2.576e-04 2.457e-04 -1.049 0.294456   
## stat122 -1.426e-04 2.448e-04 -0.582 0.560336   
## stat123 1.436e-04 2.483e-04 0.578 0.563115   
## stat124 -2.112e-04 2.465e-04 -0.857 0.391558   
## stat125 2.339e-04 2.465e-04 0.949 0.342559   
## stat126 1.722e-04 2.445e-04 0.704 0.481328   
## stat127 2.321e-04 2.459e-04 0.944 0.345158   
## stat128 -1.629e-04 2.464e-04 -0.661 0.508575   
## stat129 2.552e-04 2.444e-04 1.044 0.296447   
## stat130 1.306e-04 2.469e-04 0.529 0.596940   
## stat131 1.620e-04 2.460e-04 0.659 0.510226   
## stat132 1.103e-05 2.450e-04 0.045 0.964076   
## stat133 2.166e-04 2.478e-04 0.874 0.382085   
## stat134 -1.833e-04 2.431e-04 -0.754 0.450783   
## stat135 -2.925e-04 2.449e-04 -1.194 0.232371   
## stat136 -1.406e-05 2.464e-04 -0.057 0.954504   
## stat137 1.153e-04 2.445e-04 0.471 0.637400   
## stat138 4.018e-05 2.447e-04 0.164 0.869571   
## stat139 1.411e-04 2.469e-04 0.572 0.567600   
## stat140 5.750e-05 2.449e-04 0.235 0.814386   
## stat141 -3.798e-05 2.446e-04 -0.155 0.876613   
## stat142 -1.603e-04 2.474e-04 -0.648 0.516905   
## stat143 2.027e-04 2.448e-04 0.828 0.407569   
## stat144 5.087e-04 2.434e-04 2.090 0.036649 \*   
## stat145 4.293e-05 2.507e-04 0.171 0.864021   
## stat146 -4.762e-04 2.476e-04 -1.923 0.054524 .   
## stat147 -5.071e-04 2.478e-04 -2.046 0.040812 \*   
## stat148 -4.815e-04 2.437e-04 -1.975 0.048265 \*   
## stat149 -6.308e-04 2.470e-04 -2.554 0.010680 \*   
## stat150 -1.077e-04 2.472e-04 -0.436 0.663073   
## stat151 -1.050e-04 2.481e-04 -0.423 0.672200   
## stat152 -1.769e-04 2.455e-04 -0.721 0.471200   
## stat153 6.854e-05 2.510e-04 0.273 0.784820   
## stat154 -3.066e-05 2.485e-04 -0.123 0.901827   
## stat155 -2.506e-06 2.446e-04 -0.010 0.991825   
## stat156 4.437e-04 2.477e-04 1.791 0.073288 .   
## stat157 -2.127e-04 2.453e-04 -0.867 0.385791   
## stat158 -6.431e-05 2.495e-04 -0.258 0.796632   
## stat159 1.582e-04 2.447e-04 0.647 0.517974   
## stat160 1.156e-04 2.463e-04 0.469 0.639006   
## stat161 9.552e-05 2.465e-04 0.388 0.698371   
## stat162 -5.674e-05 2.445e-04 -0.232 0.816466   
## stat163 -7.687e-05 2.509e-04 -0.306 0.759328   
## stat164 2.749e-04 2.473e-04 1.112 0.266223   
## stat165 -1.984e-04 2.436e-04 -0.814 0.415453   
## stat166 -3.661e-04 2.446e-04 -1.497 0.134476   
## stat167 -3.234e-04 2.467e-04 -1.311 0.189877   
## stat168 -1.559e-04 2.458e-04 -0.634 0.525985   
## stat169 1.285e-04 2.475e-04 0.519 0.603716   
## stat170 -9.028e-05 2.472e-04 -0.365 0.715003   
## stat171 1.941e-04 2.497e-04 0.778 0.436855   
## stat172 3.056e-04 2.463e-04 1.241 0.214833   
## stat173 -2.606e-04 2.478e-04 -1.052 0.293002   
## stat174 -8.778e-05 2.468e-04 -0.356 0.722065   
## stat175 -3.979e-04 2.482e-04 -1.603 0.109024   
## stat176 1.892e-04 2.461e-04 0.768 0.442233   
## stat177 -1.296e-04 2.480e-04 -0.523 0.601235   
## stat178 1.316e-04 2.507e-04 0.525 0.599670   
## stat179 4.614e-05 2.457e-04 0.188 0.851068   
## stat180 -3.373e-04 2.449e-04 -1.377 0.168504   
## stat181 3.824e-04 2.477e-04 1.544 0.122714   
## stat182 9.516e-05 2.479e-04 0.384 0.701066   
## stat183 4.685e-05 2.457e-04 0.191 0.848801   
## stat184 2.585e-04 2.472e-04 1.046 0.295661   
## stat185 -1.086e-05 2.425e-04 -0.045 0.964278   
## stat186 -2.059e-04 2.487e-04 -0.828 0.407871   
## stat187 -2.865e-04 2.454e-04 -1.168 0.242956   
## stat188 1.192e-04 2.470e-04 0.483 0.629289   
## stat189 3.212e-05 2.459e-04 0.131 0.896100   
## stat190 6.937e-05 2.448e-04 0.283 0.776903   
## stat191 -1.209e-04 2.461e-04 -0.491 0.623356   
## stat192 -1.174e-04 2.487e-04 -0.472 0.636978   
## stat193 -1.485e-04 2.497e-04 -0.594 0.552219   
## stat194 1.437e-04 2.451e-04 0.586 0.557746   
## stat195 2.343e-04 2.461e-04 0.952 0.341093   
## stat196 -1.986e-04 2.480e-04 -0.801 0.423242   
## stat197 8.025e-05 2.428e-04 0.330 0.741058   
## stat198 -3.874e-04 2.467e-04 -1.570 0.116361   
## stat199 2.628e-04 2.446e-04 1.074 0.282690   
## stat200 -3.600e-04 2.442e-04 -1.474 0.140416   
## stat201 4.068e-05 2.462e-04 0.165 0.868770   
## stat202 -5.720e-05 2.500e-04 -0.229 0.819071   
## stat203 2.379e-05 2.447e-04 0.097 0.922568   
## stat204 -3.167e-04 2.447e-04 -1.294 0.195601   
## stat205 -1.841e-04 2.447e-04 -0.752 0.451914   
## stat206 -2.349e-05 2.478e-04 -0.095 0.924494   
## stat207 5.063e-04 2.465e-04 2.054 0.039990 \*   
## stat208 -1.867e-05 2.462e-04 -0.076 0.939553   
## stat209 -1.284e-04 2.452e-04 -0.524 0.600437   
## stat210 -1.713e-04 2.472e-04 -0.693 0.488398   
## stat211 -2.938e-04 2.457e-04 -1.196 0.231873   
## stat212 -2.361e-04 2.459e-04 -0.960 0.336934   
## stat213 -2.827e-04 2.474e-04 -1.142 0.253353   
## stat214 -3.670e-04 2.461e-04 -1.492 0.135885   
## stat215 -3.338e-04 2.471e-04 -1.351 0.176865   
## stat216 -1.946e-05 2.458e-04 -0.079 0.936908   
## stat217 2.733e-04 2.456e-04 1.112 0.266012   
## x18.sqrt 2.615e-02 9.389e-04 27.846 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.03117 on 5343 degrees of freedom  
## Multiple R-squared: 0.2804, Adjusted R-squared: 0.2481   
## F-statistic: 8.674 on 240 and 5343 DF, p-value: < 2.2e-16

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



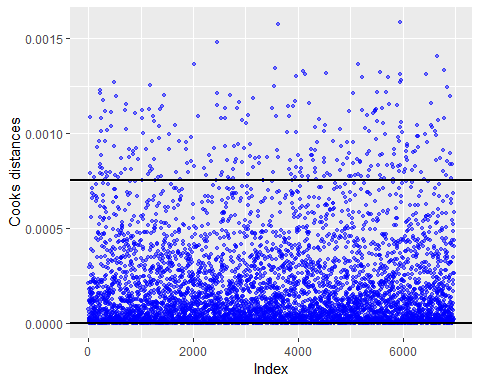
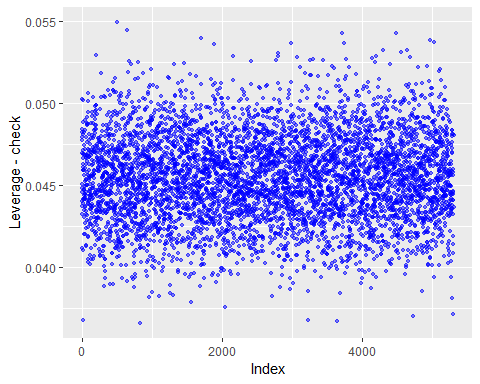
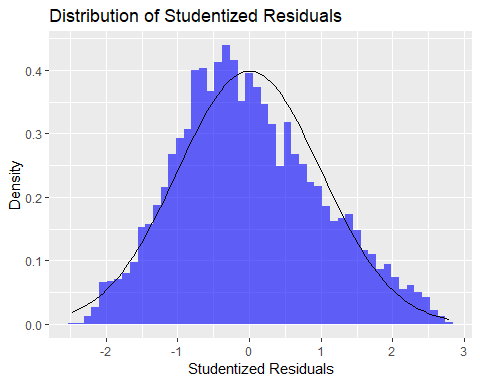
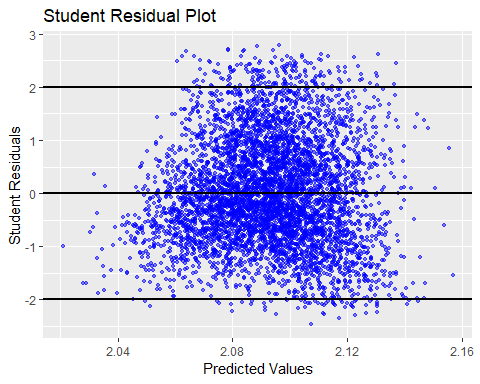
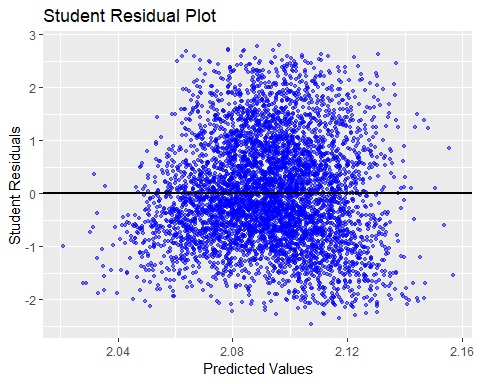
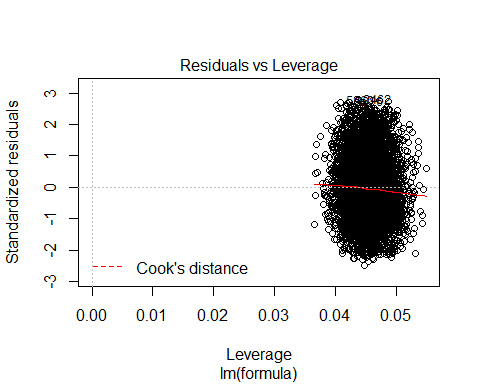
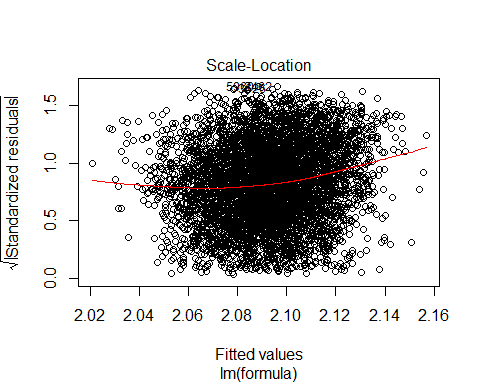
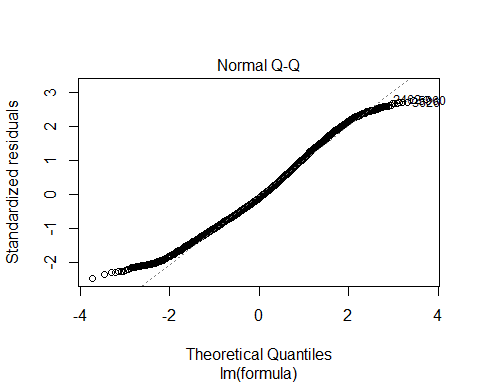
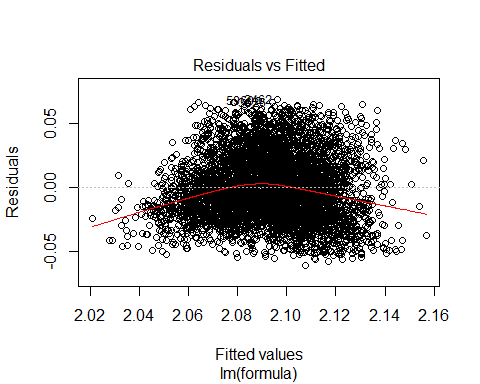
## [1] "Number of data points that have Cook's D > 4/n: 279"  
## [1] "Number of data points that have Cook's D > 1: 0"

## 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)

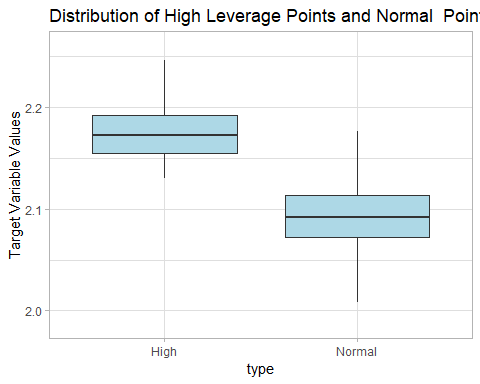
##   
## Call:  
## lm(formula = formula, data = data.train2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.060320 -0.017557 -0.002295 0.016130 0.068254   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.952e+00 7.774e-03 251.111 < 2e-16 \*\*\*  
## x1 1.636e-04 5.391e-04 0.303 0.761584   
## x2 1.924e-04 3.424e-04 0.562 0.574257   
## x3 4.962e-07 9.306e-05 0.005 0.995745   
## x4 -5.973e-05 7.415e-06 -8.055 9.85e-16 \*\*\*  
## x5 6.273e-04 2.413e-04 2.600 0.009351 \*\*   
## x6 -5.262e-04 4.891e-04 -1.076 0.282109   
## x7 1.230e-02 5.223e-04 23.554 < 2e-16 \*\*\*  
## x8 4.824e-04 1.209e-04 3.989 6.72e-05 \*\*\*  
## x9 3.228e-03 2.700e-04 11.956 < 2e-16 \*\*\*  
## x10 1.465e-03 2.526e-04 5.799 7.09e-09 \*\*\*  
## x11 2.582e+05 6.035e+04 4.279 1.91e-05 \*\*\*  
## x12 1.051e-04 1.530e-04 0.687 0.492292   
## x13 1.651e-04 6.111e-05 2.702 0.006913 \*\*   
## x14 -2.565e-04 2.637e-04 -0.973 0.330706   
## x15 -8.644e-05 2.523e-04 -0.343 0.731917   
## x16 1.056e-03 1.758e-04 6.008 2.01e-09 \*\*\*  
## x17 1.525e-03 2.671e-04 5.709 1.20e-08 \*\*\*  
## x19 1.153e-04 1.352e-04 0.853 0.393794   
## x20 -8.489e-04 9.440e-04 -0.899 0.368578   
## x21 1.275e-04 3.427e-05 3.720 0.000201 \*\*\*  
## x22 -4.206e-04 2.821e-04 -1.491 0.136052   
## x23 2.373e-05 2.686e-04 0.088 0.929591   
## stat1 -4.161e-04 2.036e-04 -2.043 0.041056 \*   
## stat2 -1.342e-04 2.023e-04 -0.664 0.506940   
## stat3 3.014e-04 2.041e-04 1.477 0.139799   
## stat4 -4.766e-04 2.045e-04 -2.330 0.019830 \*   
## stat5 -1.147e-05 2.047e-04 -0.056 0.955322   
## stat6 -2.525e-04 2.047e-04 -1.233 0.217480   
## stat7 2.638e-05 2.032e-04 0.130 0.896723   
## stat8 2.208e-04 2.030e-04 1.088 0.276626   
## stat9 -9.592e-05 2.023e-04 -0.474 0.635479   
## stat10 -2.468e-04 2.028e-04 -1.217 0.223543   
## stat11 -3.701e-04 2.046e-04 -1.809 0.070520 .   
## stat12 9.297e-05 2.022e-04 0.460 0.645764   
## stat13 -3.369e-04 2.027e-04 -1.662 0.096564 .   
## stat14 -9.929e-04 2.014e-04 -4.931 8.43e-07 \*\*\*  
## stat15 -3.780e-04 2.014e-04 -1.877 0.060611 .   
## stat16 -1.232e-04 2.029e-04 -0.607 0.543897   
## stat17 -6.353e-05 2.009e-04 -0.316 0.751801   
## stat18 -2.436e-04 2.015e-04 -1.209 0.226761   
## stat19 -9.224e-05 2.028e-04 -0.455 0.649231   
## stat20 -2.770e-05 2.021e-04 -0.137 0.890993   
## stat21 -8.701e-05 2.035e-04 -0.428 0.668959   
## stat22 -2.329e-04 2.031e-04 -1.147 0.251600   
## stat23 5.339e-04 2.028e-04 2.632 0.008517 \*\*   
## stat24 -4.587e-04 2.040e-04 -2.249 0.024585 \*   
## stat25 -5.166e-04 2.016e-04 -2.563 0.010405 \*   
## stat26 -3.287e-04 2.022e-04 -1.625 0.104144   
## stat27 6.226e-05 2.041e-04 0.305 0.760325   
## stat28 -4.621e-05 2.040e-04 -0.227 0.820764   
## stat29 2.807e-04 2.052e-04 1.368 0.171464   
## stat30 1.042e-04 2.046e-04 0.509 0.610726   
## stat31 1.967e-04 2.039e-04 0.965 0.334668   
## stat32 1.050e-04 2.050e-04 0.512 0.608481   
## stat33 -9.281e-05 2.018e-04 -0.460 0.645541   
## stat34 4.085e-04 2.022e-04 2.021 0.043368 \*   
## stat35 -3.746e-04 2.043e-04 -1.834 0.066736 .   
## stat36 3.721e-06 2.013e-04 0.018 0.985258   
## stat37 -2.609e-04 2.054e-04 -1.270 0.204088   
## stat38 3.774e-04 2.030e-04 1.859 0.063050 .   
## stat39 -3.072e-04 2.019e-04 -1.521 0.128256   
## stat40 -5.553e-05 2.032e-04 -0.273 0.784704   
## stat41 -3.081e-04 2.006e-04 -1.536 0.124534   
## stat42 -8.353e-05 2.036e-04 -0.410 0.681702   
## stat43 -2.190e-04 2.032e-04 -1.078 0.281026   
## stat44 6.621e-05 2.043e-04 0.324 0.745938   
## stat45 -1.799e-04 2.037e-04 -0.883 0.377318   
## stat46 1.007e-04 2.029e-04 0.496 0.619582   
## stat47 -4.754e-06 2.042e-04 -0.023 0.981424   
## stat48 2.728e-04 2.027e-04 1.345 0.178566   
## stat49 -1.223e-04 2.016e-04 -0.607 0.544190   
## stat50 3.534e-04 2.018e-04 1.752 0.079866 .   
## stat51 2.754e-04 2.025e-04 1.360 0.173956   
## stat52 7.165e-05 2.031e-04 0.353 0.724211   
## stat53 -5.410e-04 2.035e-04 -2.658 0.007886 \*\*   
## stat54 -4.119e-04 2.045e-04 -2.014 0.044025 \*   
## stat55 -1.787e-05 2.010e-04 -0.089 0.929139   
## stat56 -2.300e-04 2.035e-04 -1.130 0.258551   
## stat57 -1.719e-04 2.008e-04 -0.856 0.392037   
## stat58 -3.320e-04 2.019e-04 -1.644 0.100152   
## stat59 2.584e-04 2.027e-04 1.274 0.202590   
## stat60 4.706e-04 2.034e-04 2.313 0.020754 \*   
## stat61 -3.348e-04 2.036e-04 -1.644 0.100216   
## stat62 -3.957e-04 2.034e-04 -1.945 0.051831 .   
## stat63 1.112e-04 2.033e-04 0.547 0.584620   
## stat64 -1.066e-04 2.023e-04 -0.527 0.598220   
## stat65 -2.008e-04 2.040e-04 -0.984 0.324978   
## stat66 1.294e-04 2.053e-04 0.630 0.528426   
## stat67 1.618e-04 2.048e-04 0.790 0.429519   
## stat68 6.542e-05 2.044e-04 0.320 0.748988   
## stat69 -7.923e-05 2.023e-04 -0.392 0.695318   
## stat70 1.368e-04 2.022e-04 0.676 0.498816   
## stat71 -3.230e-05 2.022e-04 -0.160 0.873103   
## stat72 -5.330e-05 2.041e-04 -0.261 0.794004   
## stat73 2.320e-04 2.032e-04 1.142 0.253696   
## stat74 1.162e-06 2.021e-04 0.006 0.995412   
## stat75 -8.051e-05 2.049e-04 -0.393 0.694348   
## stat76 1.705e-04 2.049e-04 0.832 0.405402   
## stat77 -9.709e-05 2.030e-04 -0.478 0.632504   
## stat78 -3.489e-04 2.024e-04 -1.724 0.084780 .   
## stat79 2.775e-04 2.037e-04 1.362 0.173271   
## stat80 2.266e-04 2.033e-04 1.115 0.265088   
## stat81 1.659e-04 2.039e-04 0.814 0.415915   
## stat82 4.661e-05 2.026e-04 0.230 0.818027   
## stat83 -4.910e-04 2.020e-04 -2.430 0.015127 \*   
## stat84 -2.187e-04 2.029e-04 -1.078 0.281122   
## stat85 -1.567e-04 2.036e-04 -0.770 0.441594   
## stat86 2.597e-04 2.027e-04 1.281 0.200196   
## stat87 -2.419e-04 2.035e-04 -1.189 0.234645   
## stat88 -5.333e-05 2.013e-04 -0.265 0.791068   
## stat89 7.216e-05 2.027e-04 0.356 0.721898   
## stat90 -9.242e-05 2.032e-04 -0.455 0.649264   
## stat91 -6.631e-04 2.022e-04 -3.279 0.001050 \*\*   
## stat92 -1.600e-04 2.040e-04 -0.784 0.432995   
## stat93 7.149e-07 2.061e-04 0.003 0.997232   
## stat94 3.768e-05 2.022e-04 0.186 0.852155   
## stat95 2.669e-04 2.033e-04 1.313 0.189285   
## stat96 -8.902e-05 2.029e-04 -0.439 0.660822   
## stat97 1.043e-04 2.006e-04 0.520 0.603197   
## stat98 3.552e-03 2.009e-04 17.675 < 2e-16 \*\*\*  
## stat99 3.134e-04 2.036e-04 1.539 0.123825   
## stat100 6.010e-04 2.018e-04 2.978 0.002916 \*\*   
## stat101 -1.969e-04 2.039e-04 -0.966 0.334179   
## stat102 3.062e-04 2.038e-04 1.503 0.133010   
## stat103 -2.943e-04 2.043e-04 -1.440 0.149815   
## stat104 -3.146e-04 2.043e-04 -1.540 0.123643   
## stat105 1.836e-04 2.018e-04 0.910 0.362779   
## stat106 -3.426e-04 2.022e-04 -1.694 0.090323 .   
## stat107 -3.013e-05 2.024e-04 -0.149 0.881687   
## stat108 -4.134e-05 2.037e-04 -0.203 0.839204   
## stat109 -1.220e-04 2.031e-04 -0.601 0.547936   
## stat110 -3.329e-03 2.021e-04 -16.472 < 2e-16 \*\*\*  
## stat111 2.051e-05 2.016e-04 0.102 0.918977   
## stat112 7.254e-05 2.048e-04 0.354 0.723202   
## stat113 -1.632e-04 2.042e-04 -0.799 0.424357   
## stat114 4.892e-04 2.030e-04 2.409 0.016026 \*   
## stat115 2.355e-04 2.027e-04 1.162 0.245345   
## stat116 2.435e-04 2.034e-04 1.197 0.231405   
## stat117 1.373e-04 2.036e-04 0.674 0.500100   
## stat118 2.485e-04 2.009e-04 1.237 0.216200   
## stat119 9.058e-05 2.022e-04 0.448 0.654228   
## stat120 5.851e-05 2.012e-04 0.291 0.771178   
## stat121 -3.576e-04 2.026e-04 -1.765 0.077544 .   
## stat122 -1.403e-04 2.026e-04 -0.693 0.488624   
## stat123 2.919e-04 2.045e-04 1.427 0.153578   
## stat124 -1.635e-04 2.031e-04 -0.805 0.420863   
## stat125 1.882e-04 2.035e-04 0.925 0.355083   
## stat126 1.969e-04 2.013e-04 0.978 0.328168   
## stat127 2.372e-04 2.026e-04 1.171 0.241721   
## stat128 -3.185e-04 2.028e-04 -1.570 0.116399   
## stat129 3.652e-04 2.013e-04 1.814 0.069693 .   
## stat130 1.064e-04 2.036e-04 0.523 0.601280   
## stat131 4.544e-05 2.027e-04 0.224 0.822637   
## stat132 2.011e-05 2.018e-04 0.100 0.920649   
## stat133 1.993e-04 2.047e-04 0.974 0.330207   
## stat134 -1.586e-04 2.004e-04 -0.791 0.428707   
## stat135 -3.179e-04 2.020e-04 -1.574 0.115510   
## stat136 -1.668e-04 2.027e-04 -0.823 0.410682   
## stat137 9.387e-05 2.014e-04 0.466 0.641105   
## stat138 -6.809e-05 2.020e-04 -0.337 0.736064   
## stat139 -1.019e-04 2.035e-04 -0.501 0.616642   
## stat140 1.811e-04 2.015e-04 0.899 0.368809   
## stat141 1.639e-04 2.016e-04 0.813 0.416406   
## stat142 -6.029e-05 2.039e-04 -0.296 0.767502   
## stat143 -4.021e-05 2.020e-04 -0.199 0.842214   
## stat144 3.513e-04 2.003e-04 1.754 0.079566 .   
## stat145 -9.331e-05 2.066e-04 -0.452 0.651574   
## stat146 -6.496e-04 2.041e-04 -3.183 0.001466 \*\*   
## stat147 -4.580e-04 2.049e-04 -2.236 0.025424 \*   
## stat148 -3.210e-04 2.015e-04 -1.593 0.111254   
## stat149 -6.196e-04 2.043e-04 -3.033 0.002431 \*\*   
## stat150 -2.147e-04 2.045e-04 -1.050 0.293770   
## stat151 2.435e-04 2.052e-04 1.187 0.235274   
## stat152 -1.343e-04 2.023e-04 -0.664 0.506789   
## stat153 2.232e-04 2.067e-04 1.080 0.280138   
## stat154 9.726e-05 2.053e-04 0.474 0.635639   
## stat155 1.634e-04 2.017e-04 0.810 0.418040   
## stat156 2.126e-04 2.039e-04 1.042 0.297241   
## stat157 -1.086e-04 2.021e-04 -0.537 0.591013   
## stat158 9.915e-05 2.056e-04 0.482 0.629726   
## stat159 2.171e-04 2.018e-04 1.076 0.282063   
## stat160 4.004e-05 2.037e-04 0.197 0.844200   
## stat161 1.853e-04 2.031e-04 0.912 0.361602   
## stat162 -1.005e-04 2.012e-04 -0.500 0.617271   
## stat163 1.785e-05 2.074e-04 0.086 0.931434   
## stat164 1.683e-04 2.042e-04 0.824 0.409754   
## stat165 -1.716e-05 2.015e-04 -0.085 0.932156   
## stat166 -2.800e-04 2.013e-04 -1.391 0.164351   
## stat167 -3.185e-04 2.032e-04 -1.567 0.117083   
## stat168 -1.770e-04 2.025e-04 -0.874 0.382152   
## stat169 2.425e-05 2.048e-04 0.118 0.905728   
## stat170 -1.149e-05 2.040e-04 -0.056 0.955081   
## stat171 1.114e-04 2.059e-04 0.541 0.588432   
## stat172 4.559e-04 2.027e-04 2.249 0.024533 \*   
## stat173 -3.767e-05 2.042e-04 -0.184 0.853640   
## stat174 3.791e-05 2.038e-04 0.186 0.852415   
## stat175 -4.729e-04 2.040e-04 -2.319 0.020455 \*   
## stat176 -1.221e-04 2.031e-04 -0.601 0.547860   
## stat177 -4.949e-04 2.047e-04 -2.418 0.015659 \*   
## stat178 1.483e-04 2.067e-04 0.718 0.472971   
## stat179 1.106e-05 2.030e-04 0.054 0.956548   
## stat180 -3.238e-04 2.028e-04 -1.597 0.110405   
## stat181 4.594e-04 2.039e-04 2.252 0.024340 \*   
## stat182 2.890e-04 2.044e-04 1.414 0.157457   
## stat183 4.927e-05 2.031e-04 0.243 0.808363   
## stat184 3.001e-04 2.034e-04 1.476 0.140130   
## stat185 6.436e-05 1.998e-04 0.322 0.747377   
## stat186 7.721e-05 2.051e-04 0.377 0.706526   
## stat187 -2.121e-04 2.019e-04 -1.051 0.293423   
## stat188 2.368e-04 2.036e-04 1.163 0.244780   
## stat189 -1.462e-04 2.035e-04 -0.719 0.472356   
## stat190 -6.896e-05 2.021e-04 -0.341 0.733002   
## stat191 -7.859e-06 2.026e-04 -0.039 0.969058   
## stat192 -1.309e-04 2.050e-04 -0.639 0.523151   
## stat193 -8.233e-05 2.061e-04 -0.400 0.689504   
## stat194 -1.250e-04 2.026e-04 -0.617 0.537045   
## stat195 -5.887e-06 2.032e-04 -0.029 0.976891   
## stat196 -2.450e-04 2.042e-04 -1.200 0.230330   
## stat197 -8.158e-05 2.002e-04 -0.407 0.683727   
## stat198 -2.826e-04 2.035e-04 -1.388 0.165051   
## stat199 2.615e-04 2.015e-04 1.298 0.194485   
## stat200 -2.778e-04 2.023e-04 -1.373 0.169787   
## stat201 1.632e-04 2.034e-04 0.802 0.422328   
## stat202 3.882e-05 2.062e-04 0.188 0.850662   
## stat203 -9.717e-07 2.020e-04 -0.005 0.996163   
## stat204 1.834e-05 2.020e-04 0.091 0.927672   
## stat205 2.546e-05 2.011e-04 0.127 0.899266   
## stat206 -9.557e-07 2.043e-04 -0.005 0.996268   
## stat207 6.305e-04 2.033e-04 3.102 0.001934 \*\*   
## stat208 1.171e-04 2.032e-04 0.576 0.564616   
## stat209 2.868e-05 2.019e-04 0.142 0.887063   
## stat210 -3.365e-04 2.037e-04 -1.652 0.098653 .   
## stat211 -3.820e-04 2.026e-04 -1.885 0.059487 .   
## stat212 -1.392e-04 2.030e-04 -0.686 0.492826   
## stat213 -3.258e-04 2.040e-04 -1.597 0.110279   
## stat214 -1.866e-04 2.031e-04 -0.919 0.358149   
## stat215 -1.909e-04 2.040e-04 -0.936 0.349479   
## stat216 -6.682e-05 2.022e-04 -0.330 0.741112   
## stat217 1.999e-04 2.022e-04 0.988 0.323069   
## x18.sqrt 2.626e-02 7.718e-04 34.023 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.02502 on 5064 degrees of freedom  
## Multiple R-squared: 0.3873, Adjusted R-squared: 0.3582   
## F-statistic: 13.34 on 240 and 5064 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: 282"  
## [1] "Number of data points that have Cook's D > 1: 0"

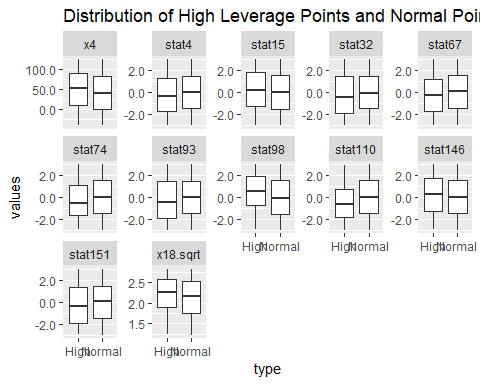
# much more normal residuals than before.   
# Checking to see if distributions are different and if so whcih variables  
# High Leverage Plot   
plotData = data.train %>%   
 rownames\_to\_column() %>%  
 mutate(type=ifelse(rowname %in% high.cd,'High','Normal')) %>%  
 dplyr::select(type,target=one\_of(label.names))  
  
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')



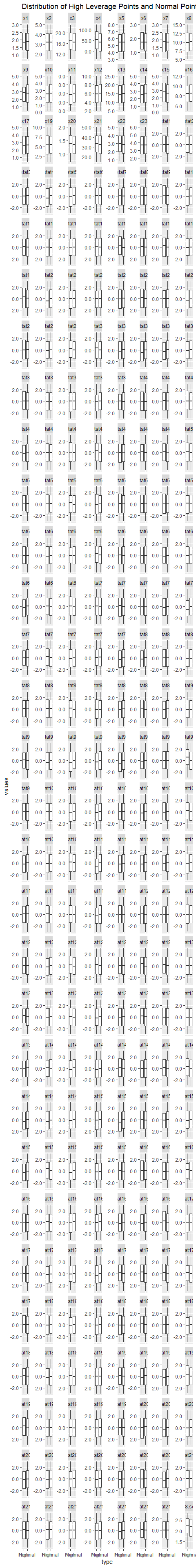
# 2 sample t-tests  
  
plotData = data.train %>%   
 rownames\_to\_column() %>%  
 mutate(type=ifelse(rowname %in% high.cd,'High','Normal')) %>%  
 dplyr::select(type,one\_of(feature.names))  
  
comp.test = lapply(dplyr::select(plotData, one\_of(feature.names))  
 , function(x) t.test(x ~ plotData$type,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

## x4 stat4 stat15 stat32 stat67 stat74 stat93 stat98 stat110   
## 3.081942e-03 4.708858e-02 4.093315e-02 3.959642e-02 3.733217e-02 1.067337e-02 4.883267e-02 7.254503e-07 7.223517e-06   
## stat146 stat151 x18.sqrt   
## 2.740927e-02 2.283891e-02 3.744045e-03

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   
## -0.109816 -0.023710 -0.002983 0.021043 0.164713   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.096396 0.000481 4359 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.03594 on 5583 degrees of freedom

## Variable Selection

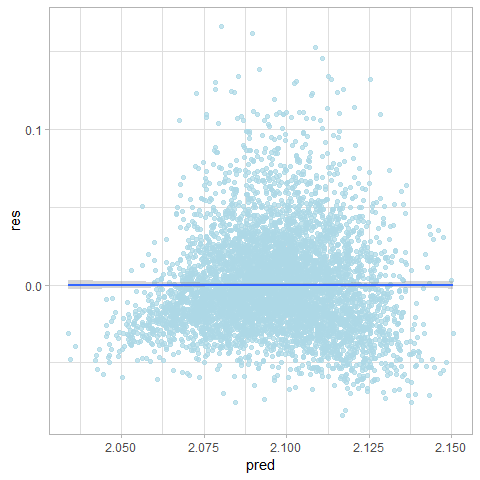
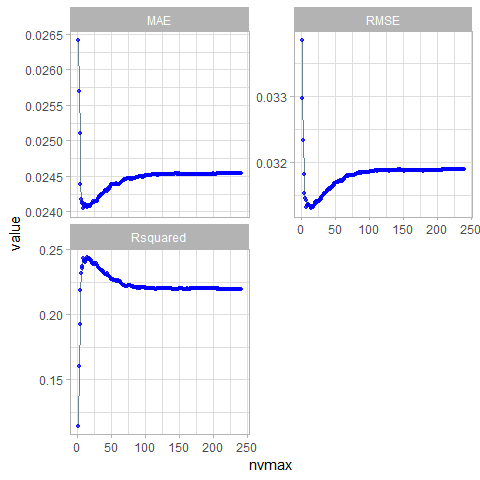
Basic: <http://www.stat.columbia.edu/~martin/W2024/R10.pdf> Cross Validation + Other Metrics: <http://www.sthda.com/english/articles/37-model-selection-essentials-in-r/154-stepwise-regression-essentials-in-r/>

### Forward Selection with CV

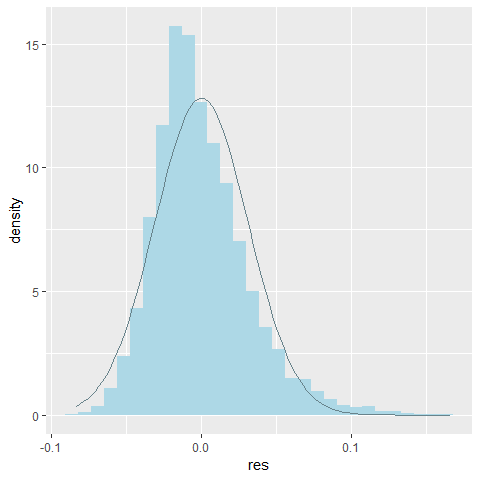
#### Train

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 = 14 on full training set  
## [1] "All models results"  
## nvmax RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.03385738 0.1145667 0.02641424 0.001048112 0.03299944 0.0007434463  
## 2 2 0.03297361 0.1603424 0.02569743 0.001177738 0.03607511 0.0007544725  
## 3 3 0.03232978 0.1926969 0.02510337 0.001223090 0.03748480 0.0007340332  
## 4 4 0.03181266 0.2182469 0.02438175 0.001237239 0.03839796 0.0007718950  
## 5 5 0.03153184 0.2316689 0.02418025 0.001196210 0.03517492 0.0007588363  
## 6 6 0.03145849 0.2354803 0.02413032 0.001234892 0.03753905 0.0007938523  
## 7 7 0.03142398 0.2373029 0.02412418 0.001235519 0.03610509 0.0007735359  
## 8 8 0.03130907 0.2430035 0.02404288 0.001227910 0.03726057 0.0007947536  
## 9 9 0.03134312 0.2413826 0.02408047 0.001249813 0.03770531 0.0007987967  
## 10 10 0.03135267 0.2409749 0.02408432 0.001271804 0.03856028 0.0008117108  
## 11 11 0.03136761 0.2403983 0.02410930 0.001308675 0.03934990 0.0008297917  
## 12 12 0.03134064 0.2416496 0.02408083 0.001315377 0.03924251 0.0008421081  
## 13 13 0.03133591 0.2418348 0.02408769 0.001313317 0.03825367 0.0008238656  
## 14 14 0.03129518 0.2437469 0.02405453 0.001300089 0.03793790 0.0008043731  
## 15 15 0.03131672 0.2427656 0.02408464 0.001320581 0.03817120 0.0008099671  
## 16 16 0.03132297 0.2425894 0.02408072 0.001321350 0.03922834 0.0008193356  
## 17 17 0.03132127 0.2427721 0.02407480 0.001323454 0.04014439 0.0008225935  
## 18 18 0.03132994 0.2423440 0.02407423 0.001294359 0.03951161 0.0008081252  
## 19 19 0.03134959 0.2414151 0.02409620 0.001287711 0.03840347 0.0007757009  
## 20 20 0.03135660 0.2411850 0.02409971 0.001300666 0.03914569 0.0007860304  
## 21 21 0.03139294 0.2395506 0.02412231 0.001293819 0.03915998 0.0007864983  
## 22 22 0.03140180 0.2392025 0.02411647 0.001293086 0.03897861 0.0007798479  
## 23 23 0.03141147 0.2387097 0.02413997 0.001297217 0.03864771 0.0007935866  
## 24 24 0.03139442 0.2394807 0.02412617 0.001278395 0.03842222 0.0007871754  
## 25 25 0.03140554 0.2391034 0.02413459 0.001285206 0.03922006 0.0008022194  
## 26 26 0.03142108 0.2385533 0.02414269 0.001297315 0.03982681 0.0008051963  
## 27 27 0.03141092 0.2391091 0.02414049 0.001293910 0.03997267 0.0008062863  
## 28 28 0.03143466 0.2380493 0.02415208 0.001310652 0.04059138 0.0008212005  
## 29 29 0.03143944 0.2377957 0.02415732 0.001304576 0.04078500 0.0008143863  
## 30 30 0.03147444 0.2362133 0.02418905 0.001310727 0.04129644 0.0008323210  
## 31 31 0.03148354 0.2357924 0.02420756 0.001316376 0.04028789 0.0008247817  
## 32 32 0.03149669 0.2352179 0.02421716 0.001322835 0.04027965 0.0008244305  
## 33 33 0.03150420 0.2349047 0.02422197 0.001325849 0.04051767 0.0008375359  
## 34 34 0.03152896 0.2338334 0.02424223 0.001324523 0.04019087 0.0008396044  
## 35 35 0.03153008 0.2338230 0.02424345 0.001305655 0.03952768 0.0008147721  
## 36 36 0.03152102 0.2342711 0.02423749 0.001298579 0.03946933 0.0008165827  
## 37 37 0.03154795 0.2330481 0.02425753 0.001296252 0.03909595 0.0008168650  
## 38 38 0.03155737 0.2325536 0.02426013 0.001296356 0.03802711 0.0008111606  
## 39 39 0.03157971 0.2316001 0.02427740 0.001294218 0.03725278 0.0008026901  
## 40 40 0.03159307 0.2310419 0.02429438 0.001292305 0.03700757 0.0007978291  
## 41 41 0.03160013 0.2307612 0.02430043 0.001301601 0.03735233 0.0007988512  
## 42 42 0.03159349 0.2310326 0.02430066 0.001302751 0.03724657 0.0007982488  
## 43 43 0.03158574 0.2314062 0.02428490 0.001289003 0.03665118 0.0007819599  
## 44 44 0.03161384 0.2301863 0.02430908 0.001288501 0.03673347 0.0007812789  
## 45 45 0.03161999 0.2299456 0.02430941 0.001271118 0.03591325 0.0007640406  
## 46 46 0.03162966 0.2295070 0.02431915 0.001271765 0.03587394 0.0007640810  
## 47 47 0.03163710 0.2291946 0.02433703 0.001261271 0.03581727 0.0007637532  
## 48 48 0.03165064 0.2285666 0.02434892 0.001269163 0.03582436 0.0007715477  
## 49 49 0.03168130 0.2272102 0.02437673 0.001256963 0.03553697 0.0007616457  
## 50 50 0.03168300 0.2271760 0.02438325 0.001260480 0.03597571 0.0007739595  
## 51 51 0.03169348 0.2266788 0.02438413 0.001267237 0.03585170 0.0007799165  
## 52 52 0.03169286 0.2267579 0.02438389 0.001265710 0.03588899 0.0007765058  
## 53 53 0.03169958 0.2265206 0.02438708 0.001272878 0.03584720 0.0007826016  
## 54 54 0.03170489 0.2263422 0.02438804 0.001281980 0.03615822 0.0007921468  
## 55 55 0.03170276 0.2264762 0.02438980 0.001290749 0.03635165 0.0007980015  
## 56 56 0.03171049 0.2261104 0.02439134 0.001295603 0.03657627 0.0007971017  
## 57 57 0.03171640 0.2258196 0.02439293 0.001291712 0.03624014 0.0007860943  
## 58 58 0.03171887 0.2256696 0.02438493 0.001295552 0.03607346 0.0007852433  
## 59 59 0.03171454 0.2258413 0.02438234 0.001298370 0.03610537 0.0007773793  
## 60 60 0.03171920 0.2256646 0.02438529 0.001295906 0.03624178 0.0007887054  
## 61 61 0.03171788 0.2256842 0.02438476 0.001285744 0.03583310 0.0007776295  
## 62 62 0.03172577 0.2252371 0.02439257 0.001278582 0.03537525 0.0007660654  
## 63 63 0.03173904 0.2246658 0.02440327 0.001265813 0.03486096 0.0007608003  
## 64 64 0.03175325 0.2240709 0.02441673 0.001268301 0.03457480 0.0007614809  
## 65 65 0.03176772 0.2234537 0.02442898 0.001265675 0.03448879 0.0007556465  
## 66 66 0.03178015 0.2228700 0.02443345 0.001242958 0.03379649 0.0007414787  
## 67 67 0.03178357 0.2227129 0.02443824 0.001238588 0.03396202 0.0007477436  
## 68 68 0.03179588 0.2221724 0.02445044 0.001235356 0.03371712 0.0007415067  
## 69 69 0.03178893 0.2224647 0.02443882 0.001225879 0.03338810 0.0007251704  
## 70 70 0.03180367 0.2218967 0.02445524 0.001240819 0.03375682 0.0007328219  
## 71 71 0.03180665 0.2217647 0.02446097 0.001239302 0.03384001 0.0007395080  
## 72 72 0.03180626 0.2218462 0.02446186 0.001241565 0.03413160 0.0007503921  
## 73 73 0.03180833 0.2218324 0.02447027 0.001246511 0.03419323 0.0007521029  
## 74 74 0.03180367 0.2220598 0.02446283 0.001237358 0.03405985 0.0007488203  
## 75 75 0.03180684 0.2220007 0.02447063 0.001248466 0.03441434 0.0007563203  
## 76 76 0.03180683 0.2220542 0.02446652 0.001256533 0.03474979 0.0007673848  
## 77 77 0.03180133 0.2223833 0.02446054 0.001266135 0.03515622 0.0007851598  
## 78 78 0.03180792 0.2220873 0.02446519 0.001266307 0.03502229 0.0007748906  
## 79 79 0.03181351 0.2218493 0.02446421 0.001255398 0.03480915 0.0007700319  
## 80 80 0.03181250 0.2218920 0.02446137 0.001243389 0.03455225 0.0007716946  
## 81 81 0.03181740 0.2217248 0.02446295 0.001250643 0.03468552 0.0007777161  
## 82 82 0.03183194 0.2210912 0.02446511 0.001256550 0.03495844 0.0007912118  
## 83 83 0.03183578 0.2209014 0.02446925 0.001257236 0.03488913 0.0007890988  
## 84 84 0.03183543 0.2209335 0.02447070 0.001253624 0.03498182 0.0007909788  
## 85 85 0.03183715 0.2208732 0.02447554 0.001255658 0.03506025 0.0007891871  
## 86 86 0.03184293 0.2206497 0.02448112 0.001256797 0.03519472 0.0007956242  
## 87 87 0.03184837 0.2204312 0.02448450 0.001262727 0.03526005 0.0007988523  
## 88 88 0.03184358 0.2206376 0.02448317 0.001262572 0.03511020 0.0007906951  
## 89 89 0.03183573 0.2209717 0.02448227 0.001253543 0.03479898 0.0007838103  
## 90 90 0.03184330 0.2206525 0.02449375 0.001257617 0.03469665 0.0007902159  
## 91 91 0.03185071 0.2203163 0.02449532 0.001254351 0.03438302 0.0007891690  
## 92 92 0.03185150 0.2203302 0.02449453 0.001252982 0.03454150 0.0007889153  
## 93 93 0.03184854 0.2205266 0.02449797 0.001261550 0.03487960 0.0007988814  
## 94 94 0.03184918 0.2205001 0.02449181 0.001264934 0.03472969 0.0007991958  
## 95 95 0.03184567 0.2206690 0.02448651 0.001266283 0.03463927 0.0008018467  
## 96 96 0.03184201 0.2208552 0.02448603 0.001269568 0.03481696 0.0008086352  
## 97 97 0.03184936 0.2205838 0.02449532 0.001273178 0.03490522 0.0008120494  
## 98 98 0.03185167 0.2205062 0.02450399 0.001277238 0.03514729 0.0008224958  
## 99 99 0.03184898 0.2206173 0.02450349 0.001273973 0.03492041 0.0008212123  
## 100 100 0.03185375 0.2204203 0.02450614 0.001276840 0.03471982 0.0008133765  
## 101 101 0.03185722 0.2202862 0.02451349 0.001276973 0.03472605 0.0008084929  
## 102 102 0.03186334 0.2200039 0.02451454 0.001272393 0.03444876 0.0008023357  
## 103 103 0.03186379 0.2200639 0.02451881 0.001273440 0.03451859 0.0007979636  
## 104 104 0.03186206 0.2201499 0.02451454 0.001262854 0.03432678 0.0007880920  
## 105 105 0.03186675 0.2200164 0.02451482 0.001259834 0.03416096 0.0007809026  
## 106 106 0.03187043 0.2198762 0.02451134 0.001263072 0.03426180 0.0007829787  
## 107 107 0.03186520 0.2201043 0.02451236 0.001253387 0.03408691 0.0007770300  
## 108 108 0.03186933 0.2199653 0.02451658 0.001256708 0.03425805 0.0007742449  
## 109 109 0.03187151 0.2198752 0.02452144 0.001252609 0.03420558 0.0007755884  
## 110 110 0.03187305 0.2198115 0.02452325 0.001250050 0.03391310 0.0007677650  
## 111 111 0.03187118 0.2199280 0.02452431 0.001249966 0.03372901 0.0007638861  
## 112 112 0.03186804 0.2201077 0.02452116 0.001256042 0.03386342 0.0007605537  
## 113 113 0.03187589 0.2197717 0.02452492 0.001263066 0.03403940 0.0007674240  
## 114 114 0.03188347 0.2194794 0.02452875 0.001264668 0.03398185 0.0007704752  
## 115 115 0.03188505 0.2194676 0.02452830 0.001265136 0.03407064 0.0007756005  
## 116 116 0.03188212 0.2195743 0.02452543 0.001263135 0.03394317 0.0007733916  
## 117 117 0.03187470 0.2199156 0.02451663 0.001256561 0.03361564 0.0007710739  
## 118 118 0.03187747 0.2198620 0.02451841 0.001260385 0.03386818 0.0007802845  
## 119 119 0.03188160 0.2197126 0.02452666 0.001267212 0.03399924 0.0007802008  
## 120 120 0.03187774 0.2198847 0.02452816 0.001266420 0.03414245 0.0007791400  
## 121 121 0.03188030 0.2198257 0.02452567 0.001270391 0.03413711 0.0007778574  
## 122 122 0.03187989 0.2198610 0.02452774 0.001281917 0.03459188 0.0007851820  
## 123 123 0.03187734 0.2199204 0.02452925 0.001270782 0.03436853 0.0007813950  
## 124 124 0.03187555 0.2199830 0.02452586 0.001268610 0.03428938 0.0007789648  
## 125 125 0.03187941 0.2197692 0.02452853 0.001273289 0.03411754 0.0007782473  
## 126 126 0.03187638 0.2198846 0.02452279 0.001270266 0.03388716 0.0007756291  
## 127 127 0.03187444 0.2199623 0.02452369 0.001273033 0.03406740 0.0007771733  
## 128 128 0.03187256 0.2200275 0.02452277 0.001262611 0.03386871 0.0007714532  
## 129 129 0.03187037 0.2201394 0.02452382 0.001261166 0.03386449 0.0007670849  
## 130 130 0.03187518 0.2199221 0.02453106 0.001262282 0.03384145 0.0007658806  
## 131 131 0.03187537 0.2199473 0.02453204 0.001262356 0.03393278 0.0007675296  
## 132 132 0.03187453 0.2199839 0.02453047 0.001267870 0.03404682 0.0007730505  
## 133 133 0.03187217 0.2200821 0.02453058 0.001269888 0.03401831 0.0007742334  
## 134 134 0.03187265 0.2200795 0.02452872 0.001269629 0.03414797 0.0007726864  
## 135 135 0.03187773 0.2199002 0.02452553 0.001268622 0.03418623 0.0007722656  
## 136 136 0.03187653 0.2199250 0.02452636 0.001265631 0.03394656 0.0007709245  
## 137 137 0.03187455 0.2200460 0.02452373 0.001265950 0.03407034 0.0007730163  
## 138 138 0.03187677 0.2199276 0.02452532 0.001265603 0.03392550 0.0007749039  
## 139 139 0.03188263 0.2196524 0.02452977 0.001262080 0.03369777 0.0007745642  
## 140 140 0.03188363 0.2195731 0.02453246 0.001252871 0.03323474 0.0007664330  
## 141 141 0.03188509 0.2194951 0.02453127 0.001255986 0.03321435 0.0007701527  
## 142 142 0.03188458 0.2194935 0.02453157 0.001251403 0.03311454 0.0007668800  
## 143 143 0.03188610 0.2193779 0.02453834 0.001249422 0.03288542 0.0007643146  
## 144 144 0.03188474 0.2194468 0.02453378 0.001254259 0.03303804 0.0007693474  
## 145 145 0.03189095 0.2191948 0.02453794 0.001254284 0.03294838 0.0007648022  
## 146 146 0.03188797 0.2193368 0.02453754 0.001249273 0.03299563 0.0007575472  
## 147 147 0.03188196 0.2195855 0.02453303 0.001252640 0.03304865 0.0007613171  
## 148 148 0.03188046 0.2196909 0.02453291 0.001257943 0.03333537 0.0007720409  
## 149 149 0.03187916 0.2197592 0.02453108 0.001256494 0.03324871 0.0007684827  
## 150 150 0.03187853 0.2197653 0.02453332 0.001258522 0.03324834 0.0007671965  
## 151 151 0.03187223 0.2200349 0.02452790 0.001263328 0.03330213 0.0007725280  
## 152 152 0.03186893 0.2201991 0.02452216 0.001262077 0.03327100 0.0007752892  
## 153 153 0.03187212 0.2200624 0.02452257 0.001261897 0.03333152 0.0007761904  
## 154 154 0.03187707 0.2198397 0.02452806 0.001261647 0.03320987 0.0007701261  
## 155 155 0.03188146 0.2196259 0.02453072 0.001260844 0.03299077 0.0007657677  
## 156 156 0.03187984 0.2196863 0.02452687 0.001253630 0.03294364 0.0007613811  
## 157 157 0.03188105 0.2196336 0.02452462 0.001253391 0.03311572 0.0007643478  
## 158 158 0.03188096 0.2196595 0.02452755 0.001247743 0.03301398 0.0007606970  
## 159 159 0.03188197 0.2196189 0.02452384 0.001248529 0.03281152 0.0007597195  
## 160 160 0.03188026 0.2196864 0.02452347 0.001245551 0.03274576 0.0007614076  
## 161 161 0.03187936 0.2197653 0.02452291 0.001249581 0.03302998 0.0007693238  
## 162 162 0.03188255 0.2196137 0.02452934 0.001246713 0.03279438 0.0007640443  
## 163 163 0.03188165 0.2196424 0.02452702 0.001247742 0.03260315 0.0007622662  
## 164 164 0.03188185 0.2196402 0.02453011 0.001247520 0.03260850 0.0007606427  
## 165 165 0.03188467 0.2195084 0.02452966 0.001246511 0.03255856 0.0007589551  
## 166 166 0.03187967 0.2197339 0.02452413 0.001245400 0.03258848 0.0007601963  
## 167 167 0.03187940 0.2197678 0.02452224 0.001249447 0.03276262 0.0007675369  
## 168 168 0.03187377 0.2199961 0.02452216 0.001254509 0.03293516 0.0007752219  
## 169 169 0.03187485 0.2199612 0.02452504 0.001252419 0.03293066 0.0007688983  
## 170 170 0.03187312 0.2200404 0.02452500 0.001251778 0.03297316 0.0007665921  
## 171 171 0.03187053 0.2201354 0.02452481 0.001247494 0.03282611 0.0007646393  
## 172 172 0.03187143 0.2201022 0.02452528 0.001247968 0.03284897 0.0007636662  
## 173 173 0.03187237 0.2200680 0.02452403 0.001249656 0.03292100 0.0007638766  
## 174 174 0.03187143 0.2201282 0.02452152 0.001250097 0.03297223 0.0007632327  
## 175 175 0.03187260 0.2200854 0.02452230 0.001253607 0.03312266 0.0007652687  
## 176 176 0.03187265 0.2201023 0.02452185 0.001253146 0.03323348 0.0007645138  
## 177 177 0.03187456 0.2200163 0.02452585 0.001248857 0.03302637 0.0007620965  
## 178 178 0.03187340 0.2200765 0.02452418 0.001249974 0.03318658 0.0007618075  
## 179 179 0.03187096 0.2201888 0.02452240 0.001249959 0.03325843 0.0007625113  
## 180 180 0.03186940 0.2203039 0.02452074 0.001259328 0.03356066 0.0007701549  
## 181 181 0.03187146 0.2202209 0.02452146 0.001257265 0.03351128 0.0007699045  
## 182 182 0.03187466 0.2200913 0.02452310 0.001252587 0.03340639 0.0007662220  
## 183 183 0.03187381 0.2201139 0.02452182 0.001251987 0.03330887 0.0007661702  
## 184 184 0.03187329 0.2201422 0.02452071 0.001252566 0.03324703 0.0007661760  
## 185 185 0.03187502 0.2200648 0.02452250 0.001253373 0.03332077 0.0007679697  
## 186 186 0.03187450 0.2201022 0.02452403 0.001252431 0.03324197 0.0007657800  
## 187 187 0.03187441 0.2201241 0.02452422 0.001253590 0.03337683 0.0007650038  
## 188 188 0.03187772 0.2199884 0.02452579 0.001255500 0.03335415 0.0007664880  
## 189 189 0.03187513 0.2200892 0.02452331 0.001254519 0.03328397 0.0007677012  
## 190 190 0.03187411 0.2201360 0.02452404 0.001258352 0.03338991 0.0007689162  
## 191 191 0.03187835 0.2199531 0.02452838 0.001258938 0.03345054 0.0007685082  
## 192 192 0.03187687 0.2200273 0.02452738 0.001260572 0.03346321 0.0007712846  
## 193 193 0.03187803 0.2199892 0.02452815 0.001264182 0.03360252 0.0007742470  
## 194 194 0.03187796 0.2199916 0.02452853 0.001264909 0.03352820 0.0007752048  
## 195 195 0.03187881 0.2199578 0.02452873 0.001264768 0.03351084 0.0007746314  
## 196 196 0.03187818 0.2199824 0.02452725 0.001262850 0.03340220 0.0007690979  
## 197 197 0.03187915 0.2199542 0.02452723 0.001265217 0.03357335 0.0007718622  
## 198 198 0.03187914 0.2199598 0.02452799 0.001264183 0.03355281 0.0007729209  
## 199 199 0.03188207 0.2198326 0.02453079 0.001263192 0.03348617 0.0007737019  
## 200 200 0.03188474 0.2197126 0.02453344 0.001261695 0.03347445 0.0007728813  
## 201 201 0.03188289 0.2197828 0.02453126 0.001260649 0.03339259 0.0007701945  
## 202 202 0.03188299 0.2197850 0.02453124 0.001260084 0.03338422 0.0007695172  
## 203 203 0.03188220 0.2198145 0.02453158 0.001261144 0.03338337 0.0007692560  
## 204 204 0.03188295 0.2197830 0.02453206 0.001261324 0.03335357 0.0007672137  
## 205 205 0.03188307 0.2197881 0.02453380 0.001262414 0.03344895 0.0007689398  
## 206 206 0.03188512 0.2196961 0.02453617 0.001259339 0.03332804 0.0007655335  
## 207 207 0.03188481 0.2197082 0.02453516 0.001260929 0.03336741 0.0007661541  
## 208 208 0.03188645 0.2196355 0.02453540 0.001258721 0.03328594 0.0007649622  
## 209 209 0.03188793 0.2195802 0.02453590 0.001258326 0.03326285 0.0007658016  
## 210 210 0.03189142 0.2194302 0.02453828 0.001260153 0.03328686 0.0007687581  
## 211 211 0.03189277 0.2193677 0.02454006 0.001258162 0.03327522 0.0007668322  
## 212 212 0.03189207 0.2193994 0.02453937 0.001257621 0.03324861 0.0007662426  
## 213 213 0.03189335 0.2193482 0.02453912 0.001257078 0.03320663 0.0007661854  
## 214 214 0.03189204 0.2194070 0.02453887 0.001258372 0.03326307 0.0007675771  
## 215 215 0.03189296 0.2193570 0.02454000 0.001258225 0.03325340 0.0007691030  
## 216 216 0.03189409 0.2193031 0.02454041 0.001257655 0.03319324 0.0007680614  
## 217 217 0.03189416 0.2193034 0.02453981 0.001257260 0.03319188 0.0007666832  
## 218 218 0.03189466 0.2192940 0.02454038 0.001257245 0.03317564 0.0007661790  
## 219 219 0.03189619 0.2192292 0.02454099 0.001256916 0.03315944 0.0007651983  
## 220 220 0.03189771 0.2191626 0.02454217 0.001255696 0.03312213 0.0007638091  
## 221 221 0.03189634 0.2192158 0.02454194 0.001254573 0.03306731 0.0007629301  
## 222 222 0.03189606 0.2192234 0.02454171 0.001254729 0.03303553 0.0007631350  
## 223 223 0.03189633 0.2192081 0.02454187 0.001253453 0.03297192 0.0007621361  
## 224 224 0.03189575 0.2192332 0.02454154 0.001253846 0.03297472 0.0007620829  
## 225 225 0.03189570 0.2192368 0.02454169 0.001253529 0.03295627 0.0007621067  
## 226 226 0.03189641 0.2192070 0.02454154 0.001253508 0.03296106 0.0007619221  
## 227 227 0.03189607 0.2192212 0.02454136 0.001253142 0.03296460 0.0007613267  
## 228 228 0.03189653 0.2192001 0.02454114 0.001252899 0.03293337 0.0007618697  
## 229 229 0.03189612 0.2192151 0.02454082 0.001252882 0.03295944 0.0007620508  
## 230 230 0.03189597 0.2192230 0.02454057 0.001253318 0.03296806 0.0007625726  
## 231 231 0.03189595 0.2192265 0.02454058 0.001252957 0.03297027 0.0007624511  
## 232 232 0.03189596 0.2192296 0.02454089 0.001253596 0.03301433 0.0007628382  
## 233 233 0.03189555 0.2192476 0.02454067 0.001253801 0.03301966 0.0007624290  
## 234 234 0.03189556 0.2192464 0.02454076 0.001253804 0.03301476 0.0007622280  
## 235 235 0.03189548 0.2192501 0.02454056 0.001253598 0.03301577 0.0007621963  
## 236 236 0.03189535 0.2192554 0.02454041 0.001253518 0.03301468 0.0007622763  
## 237 237 0.03189510 0.2192668 0.02454011 0.001253675 0.03302636 0.0007624849  
## 238 238 0.03189518 0.2192634 0.02454034 0.001253772 0.03302862 0.0007624618  
## 239 239 0.03189503 0.2192701 0.02454017 0.001253929 0.03303878 0.0007626900  
## 240 240 0.03189502 0.2192704 0.02454015 0.001253926 0.03303777 0.0007626640  
## [1] "Best Model"  
## nvmax  
## 14 14



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

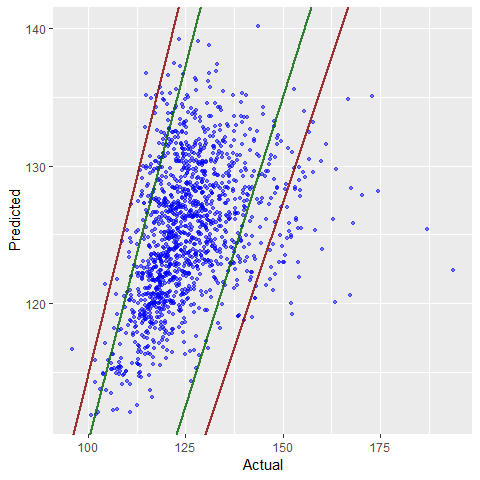


## [1] "Coefficients of final model:"  
## Estimate 2.5 % 97.5 %  
## (Intercept) 1.964602e+00 1.948778e+00 1.980427e+00  
## x4 -5.207358e-05 -6.930021e-05 -3.484695e-05  
## x7 1.131137e-02 1.010033e-02 1.252241e-02  
## x8 4.009270e-04 1.189652e-04 6.828889e-04  
## x9 3.221363e-03 2.590993e-03 3.851734e-03  
## x10 9.876467e-04 3.987372e-04 1.576556e-03  
## x11 2.400354e+05 9.988510e+04 3.801858e+05  
## x16 1.061951e-03 6.535119e-04 1.470390e-03  
## x17 1.564843e-03 9.442564e-04 2.185429e-03  
## x21 1.346751e-04 5.447427e-05 2.148760e-04  
## stat14 -7.485681e-04 -1.216721e-03 -2.804152e-04  
## stat91 -6.554628e-04 -1.126438e-03 -1.844875e-04  
## stat98 3.705004e-03 3.237205e-03 4.172802e-03  
## stat110 -3.353081e-03 -3.824348e-03 -2.881813e-03  
## x18.sqrt 2.623888e-02 2.443859e-02 2.803918e-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.   
## 2.049 2.085 2.098 2.097 2.109 2.147   
## [1] "leapForward Test MSE: 0.00108825076612865"

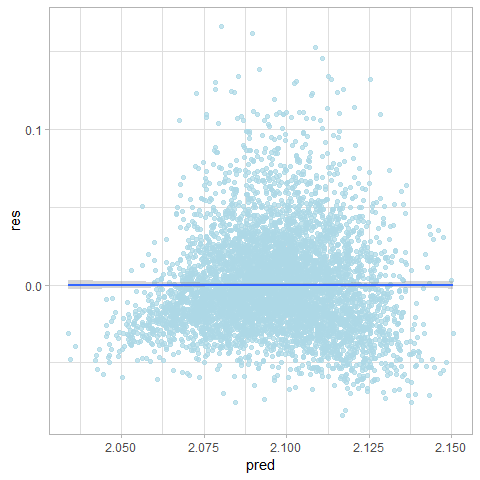
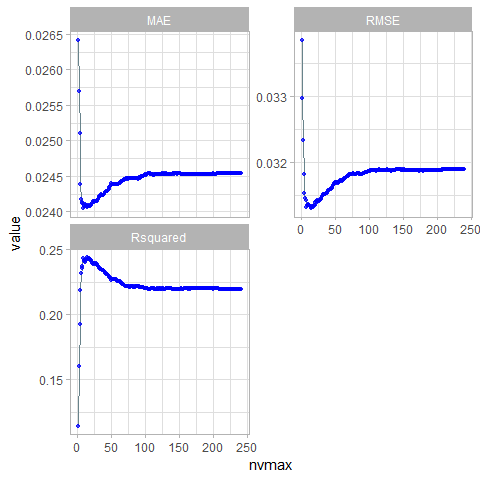


### Backward Elimination with CV

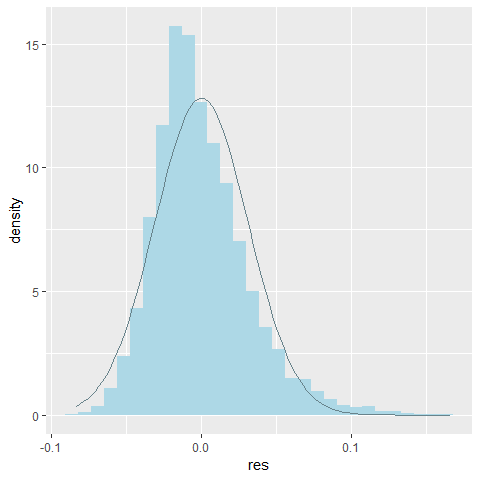
#### Train

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 = 14 on full training set  
## [1] "All models results"  
## nvmax RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.03385738 0.1145667 0.02641424 0.001048112 0.03299944 0.0007434463  
## 2 2 0.03297361 0.1603424 0.02569743 0.001177738 0.03607511 0.0007544725  
## 3 3 0.03232978 0.1926969 0.02510337 0.001223090 0.03748480 0.0007340332  
## 4 4 0.03181266 0.2182469 0.02438175 0.001237239 0.03839796 0.0007718950  
## 5 5 0.03153184 0.2316689 0.02418025 0.001196210 0.03517492 0.0007588363  
## 6 6 0.03145849 0.2354803 0.02413032 0.001234892 0.03753905 0.0007938523  
## 7 7 0.03142398 0.2373029 0.02412418 0.001235519 0.03610509 0.0007735359  
## 8 8 0.03130907 0.2430035 0.02404288 0.001227910 0.03726057 0.0007947536  
## 9 9 0.03134312 0.2413826 0.02408047 0.001249813 0.03770531 0.0007987967  
## 10 10 0.03135267 0.2409749 0.02408432 0.001271804 0.03856028 0.0008117108  
## 11 11 0.03136761 0.2403983 0.02410930 0.001308675 0.03934990 0.0008297917  
## 12 12 0.03134064 0.2416496 0.02408083 0.001315377 0.03924251 0.0008421081  
## 13 13 0.03133591 0.2418348 0.02408769 0.001313317 0.03825367 0.0008238656  
## 14 14 0.03129518 0.2437469 0.02405453 0.001300089 0.03793790 0.0008043731  
## 15 15 0.03131672 0.2427656 0.02408464 0.001320581 0.03817120 0.0008099671  
## 16 16 0.03132873 0.2423422 0.02408214 0.001315174 0.03923137 0.0008192570  
## 17 17 0.03132119 0.2427832 0.02406925 0.001323537 0.04014315 0.0008224553  
## 18 18 0.03132994 0.2423440 0.02407423 0.001294359 0.03951161 0.0008081252  
## 19 19 0.03134559 0.2416410 0.02408971 0.001287808 0.03866651 0.0007781578  
## 20 20 0.03135271 0.2414046 0.02409391 0.001300681 0.03938740 0.0007877757  
## 21 21 0.03138604 0.2399183 0.02411513 0.001293339 0.03932558 0.0007887180  
## 22 22 0.03140442 0.2390769 0.02411866 0.001293317 0.03896394 0.0007792133  
## 23 23 0.03141406 0.2385843 0.02414294 0.001297478 0.03863552 0.0007927619  
## 24 24 0.03139442 0.2394807 0.02412617 0.001278395 0.03842222 0.0007871754  
## 25 25 0.03140633 0.2390531 0.02413920 0.001285624 0.03922233 0.0008031541  
## 26 26 0.03142110 0.2385244 0.02414321 0.001297329 0.03982848 0.0008052978  
## 27 27 0.03141112 0.2390744 0.02414138 0.001294006 0.03997290 0.0008063944  
## 28 28 0.03142867 0.2382955 0.02414682 0.001307743 0.04059350 0.0008205168  
## 29 29 0.03143915 0.2378056 0.02415853 0.001300365 0.04042974 0.0008170603  
## 30 30 0.03145312 0.2371728 0.02418017 0.001324205 0.04008303 0.0008250223  
## 31 31 0.03147825 0.2360741 0.02420485 0.001320598 0.03978709 0.0008210436  
## 32 32 0.03149403 0.2353685 0.02421505 0.001317657 0.03929341 0.0008074884  
## 33 33 0.03150874 0.2347437 0.02422220 0.001328694 0.03971804 0.0008214115  
## 34 34 0.03151864 0.2343496 0.02423921 0.001333061 0.03993765 0.0008276820  
## 35 35 0.03151617 0.2344454 0.02423327 0.001321765 0.04009622 0.0008173436  
## 36 36 0.03151987 0.2342259 0.02423169 0.001297990 0.03937643 0.0008135638  
## 37 37 0.03152627 0.2339824 0.02423325 0.001305874 0.03973697 0.0008195145  
## 38 38 0.03152978 0.2338358 0.02423538 0.001304312 0.03871303 0.0008086355  
## 39 39 0.03155072 0.2329874 0.02424905 0.001301871 0.03818422 0.0008102349  
## 40 40 0.03156959 0.2321809 0.02426747 0.001310028 0.03801876 0.0008132342  
## 41 41 0.03158095 0.2315490 0.02427790 0.001300500 0.03704945 0.0007980431  
## 42 42 0.03158989 0.2311602 0.02429192 0.001294023 0.03687910 0.0007969366  
## 43 43 0.03159375 0.2310346 0.02429038 0.001294617 0.03714617 0.0007979285  
## 44 44 0.03159427 0.2311006 0.02428309 0.001299641 0.03720367 0.0008050981  
## 45 45 0.03161081 0.2303825 0.02430085 0.001288677 0.03691826 0.0007970589  
## 46 46 0.03162580 0.2296604 0.02431833 0.001294457 0.03705923 0.0008028159  
## 47 47 0.03164536 0.2287898 0.02433849 0.001287294 0.03716917 0.0008008582  
## 48 48 0.03166262 0.2280381 0.02435369 0.001293051 0.03702085 0.0008028261  
## 49 49 0.03167824 0.2273869 0.02437077 0.001286041 0.03675881 0.0007933534  
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## 70 70 0.03180225 0.2219577 0.02446255 0.001243698 0.03362703 0.0007470716  
## 71 71 0.03181535 0.2214044 0.02446220 0.001239131 0.03348367 0.0007473152  
## 72 72 0.03181849 0.2213349 0.02447231 0.001243033 0.03361266 0.0007558739  
## 73 73 0.03181174 0.2216512 0.02446521 0.001238131 0.03373967 0.0007458316  
## 74 74 0.03181509 0.2215717 0.02446226 0.001236861 0.03401817 0.0007522270  
## 75 75 0.03182137 0.2213362 0.02446616 0.001244346 0.03474179 0.0007682273  
## 76 76 0.03182908 0.2210553 0.02447669 0.001256415 0.03516258 0.0007838002  
## 77 77 0.03182617 0.2212160 0.02447346 0.001256253 0.03530193 0.0007777336  
## 78 78 0.03182043 0.2215266 0.02447405 0.001258576 0.03559725 0.0007780029  
## 79 79 0.03181713 0.2217134 0.02446669 0.001252307 0.03540046 0.0007807833  
## 80 80 0.03181541 0.2218515 0.02446700 0.001257021 0.03557273 0.0007857606  
## 81 81 0.03181814 0.2216796 0.02446588 0.001253803 0.03537326 0.0007806597  
## 82 82 0.03183011 0.2211639 0.02447252 0.001252130 0.03522744 0.0007877185  
## 83 83 0.03183035 0.2211428 0.02447181 0.001251137 0.03498190 0.0007884014  
## 84 84 0.03182960 0.2212210 0.02447476 0.001254859 0.03521560 0.0007957035  
## 85 85 0.03182411 0.2215110 0.02447177 0.001254271 0.03515796 0.0007924072  
## 86 86 0.03182527 0.2215433 0.02446878 0.001264677 0.03562941 0.0008012826  
## 87 87 0.03181910 0.2218083 0.02446962 0.001259381 0.03535534 0.0007988160  
## 88 88 0.03182200 0.2216854 0.02446791 0.001261644 0.03516934 0.0008026116  
## 89 89 0.03181842 0.2218444 0.02445744 0.001250763 0.03495273 0.0007922051  
## 90 90 0.03182138 0.2217291 0.02446765 0.001259383 0.03511274 0.0007993136  
## 91 91 0.03183500 0.2211277 0.02448159 0.001259564 0.03492799 0.0007979523  
## 92 92 0.03183877 0.2209876 0.02447677 0.001262346 0.03468859 0.0007982803  
## 93 93 0.03183978 0.2210020 0.02448085 0.001271392 0.03502150 0.0008036070  
## 94 94 0.03185071 0.2205554 0.02449462 0.001276158 0.03491974 0.0008096791  
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## 97 97 0.03184748 0.2207311 0.02449946 0.001276353 0.03478927 0.0008087382  
## 98 98 0.03186193 0.2201089 0.02451250 0.001274616 0.03472898 0.0008103134  
## 99 99 0.03186459 0.2199627 0.02452012 0.001270724 0.03448303 0.0008112923  
## 100 100 0.03186153 0.2201071 0.02451753 0.001265398 0.03413579 0.0008012404  
## 101 101 0.03186553 0.2199402 0.02451786 0.001266630 0.03416884 0.0007974167  
## 102 102 0.03187063 0.2197390 0.02452640 0.001263060 0.03394721 0.0007885726  
## 103 103 0.03187216 0.2197203 0.02453059 0.001266345 0.03413984 0.0007897516  
## 104 104 0.03187955 0.2194520 0.02453632 0.001265055 0.03417938 0.0007890368  
## 105 105 0.03188233 0.2193425 0.02453825 0.001263557 0.03415192 0.0007871164  
## 106 106 0.03188299 0.2193586 0.02453169 0.001259064 0.03422169 0.0007864607  
## 107 107 0.03188172 0.2194021 0.02453568 0.001252833 0.03405547 0.0007830775  
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## 119 119 0.03188204 0.2196629 0.02452675 0.001257435 0.03339317 0.0007660711  
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## 130 130 0.03188081 0.2197179 0.02453399 0.001267113 0.03365706 0.0007682868  
## 131 131 0.03187358 0.2200504 0.02452548 0.001266346 0.03381937 0.0007704742  
## 132 132 0.03186842 0.2202730 0.02452188 0.001266310 0.03389797 0.0007674768  
## 133 133 0.03186683 0.2203514 0.02452583 0.001267099 0.03379236 0.0007704900  
## 134 134 0.03187360 0.2200702 0.02452305 0.001264871 0.03386556 0.0007719305  
## 135 135 0.03187623 0.2199639 0.02452689 0.001267977 0.03390476 0.0007744135  
## 136 136 0.03187622 0.2199835 0.02452820 0.001265743 0.03386372 0.0007714149  
## 137 137 0.03187533 0.2200341 0.02452442 0.001269204 0.03405006 0.0007763104  
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## 160 160 0.03187598 0.2198685 0.02451980 0.001242475 0.03248745 0.0007535100  
## 161 161 0.03187401 0.2199704 0.02452101 0.001248404 0.03272469 0.0007613024  
## 162 162 0.03187889 0.2197580 0.02452649 0.001249936 0.03270684 0.0007626871  
## 163 163 0.03188018 0.2196916 0.02452590 0.001249034 0.03257347 0.0007617317  
## 164 164 0.03187994 0.2197081 0.02452851 0.001248866 0.03258267 0.0007602789  
## 165 165 0.03188074 0.2196767 0.02452573 0.001250740 0.03264071 0.0007633855  
## 166 166 0.03187834 0.2198001 0.02452069 0.001248441 0.03273794 0.0007671795  
## 167 167 0.03187977 0.2197346 0.02452530 0.001251277 0.03274630 0.0007666012  
## 168 168 0.03187643 0.2198810 0.02452509 0.001255263 0.03296989 0.0007754331  
## 169 169 0.03187548 0.2199317 0.02452489 0.001254043 0.03294898 0.0007682940  
## 170 170 0.03187417 0.2200007 0.02452574 0.001252976 0.03299114 0.0007672024  
## 171 171 0.03187116 0.2201064 0.02452454 0.001248209 0.03283905 0.0007644186  
## 172 172 0.03187143 0.2201022 0.02452528 0.001247968 0.03284897 0.0007636662  
## 173 173 0.03186978 0.2201897 0.02452206 0.001249753 0.03295641 0.0007651310  
## 174 174 0.03187069 0.2201651 0.02452147 0.001250132 0.03298354 0.0007632670  
## 175 175 0.03187463 0.2199944 0.02452537 0.001253510 0.03305295 0.0007645003  
## 176 176 0.03187368 0.2200540 0.02452375 0.001253078 0.03317556 0.0007643626  
## 177 177 0.03187456 0.2200163 0.02452585 0.001248857 0.03302637 0.0007620965  
## 178 178 0.03187340 0.2200765 0.02452418 0.001249974 0.03318658 0.0007618075  
## 179 179 0.03187364 0.2200957 0.02452499 0.001255409 0.03346743 0.0007674407  
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## 182 182 0.03187520 0.2200587 0.02452311 0.001250722 0.03330900 0.0007617086  
## 183 183 0.03187247 0.2201774 0.02452027 0.001252195 0.03333530 0.0007671646  
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## 186 186 0.03187583 0.2200397 0.02452518 0.001251724 0.03319311 0.0007649405  
## 187 187 0.03187510 0.2200919 0.02452358 0.001252460 0.03332172 0.0007664208  
## 188 188 0.03187770 0.2199871 0.02452392 0.001255543 0.03335200 0.0007706591  
## 189 189 0.03187513 0.2200892 0.02452331 0.001254519 0.03328397 0.0007677012  
## 190 190 0.03187411 0.2201360 0.02452404 0.001258352 0.03338991 0.0007689162  
## 191 191 0.03187835 0.2199531 0.02452838 0.001258938 0.03345054 0.0007685082  
## 192 192 0.03187687 0.2200273 0.02452738 0.001260572 0.03346321 0.0007712846  
## 193 193 0.03187764 0.2199977 0.02452846 0.001264524 0.03359757 0.0007743907  
## 194 194 0.03187808 0.2199799 0.02452855 0.001265847 0.03353149 0.0007751134  
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## 197 197 0.03188055 0.2198846 0.02452913 0.001265743 0.03358896 0.0007723314  
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## 199 199 0.03188349 0.2197653 0.02453230 0.001264730 0.03351219 0.0007749254  
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## 202 202 0.03188299 0.2197850 0.02453124 0.001260084 0.03338422 0.0007695172  
## 203 203 0.03188220 0.2198145 0.02453158 0.001261144 0.03338337 0.0007692560  
## 204 204 0.03188295 0.2197830 0.02453206 0.001261324 0.03335357 0.0007672137  
## 205 205 0.03188275 0.2198077 0.02453328 0.001262695 0.03343756 0.0007686981  
## 206 206 0.03188468 0.2197187 0.02453536 0.001259813 0.03332613 0.0007657085  
## 207 207 0.03188420 0.2197330 0.02453432 0.001261283 0.03336538 0.0007663783  
## 208 208 0.03188620 0.2196378 0.02453537 0.001258675 0.03328543 0.0007650076  
## 209 209 0.03188815 0.2195660 0.02453650 0.001258264 0.03326986 0.0007663364  
## 210 210 0.03189142 0.2194302 0.02453828 0.001260153 0.03328686 0.0007687581  
## 211 211 0.03189277 0.2193677 0.02454006 0.001258162 0.03327522 0.0007668322  
## 212 212 0.03189207 0.2193994 0.02453937 0.001257621 0.03324861 0.0007662426  
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## 216 216 0.03189409 0.2193031 0.02454041 0.001257655 0.03319324 0.0007680614  
## 217 217 0.03189416 0.2193034 0.02453981 0.001257260 0.03319188 0.0007666832  
## 218 218 0.03189466 0.2192940 0.02454038 0.001257245 0.03317564 0.0007661790  
## 219 219 0.03189619 0.2192292 0.02454099 0.001256916 0.03315944 0.0007651983  
## 220 220 0.03189771 0.2191626 0.02454217 0.001255696 0.03312213 0.0007638091  
## 221 221 0.03189634 0.2192158 0.02454194 0.001254573 0.03306731 0.0007629301  
## 222 222 0.03189606 0.2192234 0.02454171 0.001254729 0.03303553 0.0007631350  
## 223 223 0.03189633 0.2192081 0.02454187 0.001253453 0.03297192 0.0007621361  
## 224 224 0.03189575 0.2192332 0.02454154 0.001253846 0.03297472 0.0007620829  
## 225 225 0.03189570 0.2192368 0.02454169 0.001253529 0.03295627 0.0007621067  
## 226 226 0.03189641 0.2192070 0.02454154 0.001253508 0.03296106 0.0007619221  
## 227 227 0.03189607 0.2192212 0.02454136 0.001253142 0.03296460 0.0007613267  
## 228 228 0.03189653 0.2192001 0.02454114 0.001252899 0.03293337 0.0007618697  
## 229 229 0.03189612 0.2192151 0.02454082 0.001252882 0.03295944 0.0007620508  
## 230 230 0.03189597 0.2192230 0.02454057 0.001253318 0.03296806 0.0007625726  
## 231 231 0.03189595 0.2192265 0.02454058 0.001252957 0.03297027 0.0007624511  
## 232 232 0.03189596 0.2192296 0.02454089 0.001253596 0.03301433 0.0007628382  
## 233 233 0.03189555 0.2192476 0.02454067 0.001253801 0.03301966 0.0007624290  
## 234 234 0.03189556 0.2192464 0.02454076 0.001253804 0.03301476 0.0007622280  
## 235 235 0.03189548 0.2192501 0.02454056 0.001253598 0.03301577 0.0007621963  
## 236 236 0.03189535 0.2192554 0.02454041 0.001253518 0.03301468 0.0007622763  
## 237 237 0.03189510 0.2192668 0.02454011 0.001253675 0.03302636 0.0007624849  
## 238 238 0.03189518 0.2192634 0.02454034 0.001253772 0.03302862 0.0007624618  
## 239 239 0.03189503 0.2192701 0.02454017 0.001253929 0.03303878 0.0007626900  
## 240 240 0.03189502 0.2192704 0.02454015 0.001253926 0.03303777 0.0007626640  
## [1] "Best Model"  
## nvmax  
## 14 14



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

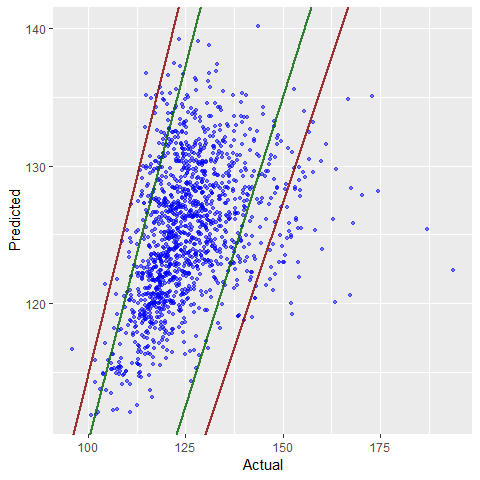


## [1] "Coefficients of final model:"  
## Estimate 2.5 % 97.5 %  
## (Intercept) 1.964602e+00 1.948778e+00 1.980427e+00  
## x4 -5.207358e-05 -6.930021e-05 -3.484695e-05  
## x7 1.131137e-02 1.010033e-02 1.252241e-02  
## x8 4.009270e-04 1.189652e-04 6.828889e-04  
## x9 3.221363e-03 2.590993e-03 3.851734e-03  
## x10 9.876467e-04 3.987372e-04 1.576556e-03  
## x11 2.400354e+05 9.988510e+04 3.801858e+05  
## x16 1.061951e-03 6.535119e-04 1.470390e-03  
## x17 1.564843e-03 9.442564e-04 2.185429e-03  
## x21 1.346751e-04 5.447427e-05 2.148760e-04  
## stat14 -7.485681e-04 -1.216721e-03 -2.804152e-04  
## stat91 -6.554628e-04 -1.126438e-03 -1.844875e-04  
## stat98 3.705004e-03 3.237205e-03 4.172802e-03  
## stat110 -3.353081e-03 -3.824348e-03 -2.881813e-03  
## x18.sqrt 2.623888e-02 2.443859e-02 2.803918e-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.   
## 2.049 2.085 2.098 2.097 2.109 2.147   
## [1] "leapBackward Test MSE: 0.00108825076612865"

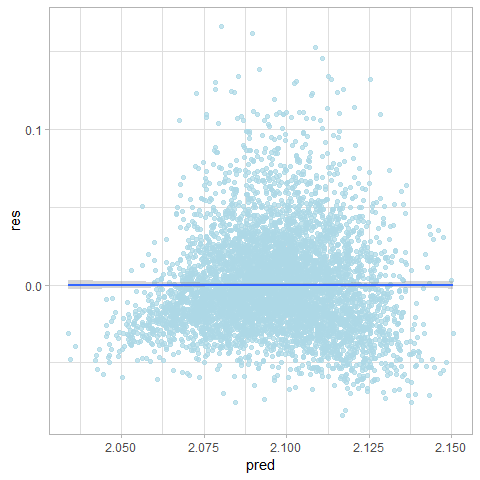
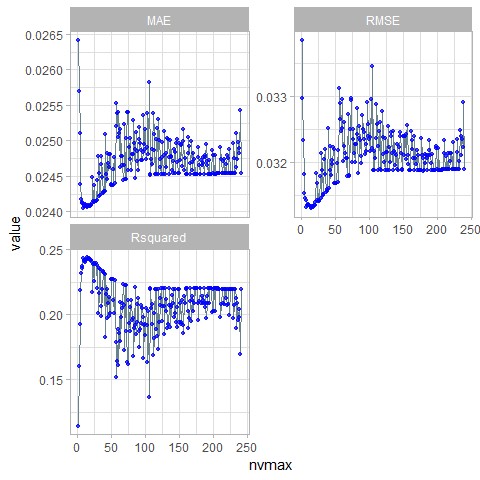


### Stepwise Selection with CV

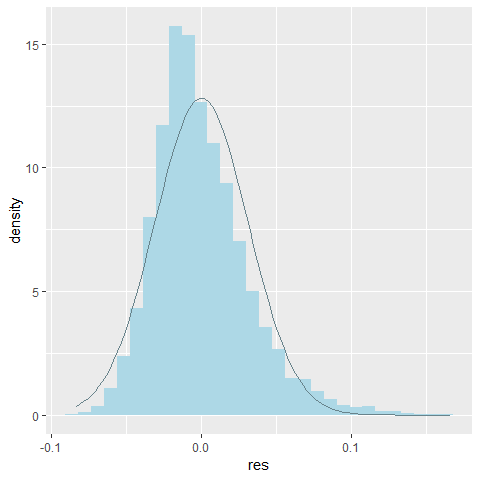
#### Train

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 = 14 on full training set  
## [1] "All models results"  
## nvmax RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.03385738 0.1145667 0.02641424 0.0010481124 0.03299944 0.0007434463  
## 2 2 0.03297361 0.1603424 0.02569743 0.0011777376 0.03607511 0.0007544725  
## 3 3 0.03232978 0.1926969 0.02510337 0.0012230895 0.03748480 0.0007340332  
## 4 4 0.03181266 0.2182469 0.02438175 0.0012372392 0.03839796 0.0007718950  
## 5 5 0.03153184 0.2316689 0.02418025 0.0011962104 0.03517492 0.0007588363  
## 6 6 0.03145849 0.2354803 0.02413032 0.0012348918 0.03753905 0.0007938523  
## 7 7 0.03142398 0.2373029 0.02412418 0.0012355186 0.03610509 0.0007735359  
## 8 8 0.03130907 0.2430035 0.02404288 0.0012279100 0.03726057 0.0007947536  
## 9 9 0.03134312 0.2413826 0.02408047 0.0012498127 0.03770531 0.0007987967  
## 10 10 0.03135267 0.2409749 0.02408432 0.0012718036 0.03856028 0.0008117108  
## 11 11 0.03136761 0.2403983 0.02410930 0.0013086753 0.03934990 0.0008297917  
## 12 12 0.03134064 0.2416496 0.02408083 0.0013153769 0.03924251 0.0008421081  
## 13 13 0.03133591 0.2418348 0.02408769 0.0013133167 0.03825367 0.0008238656  
## 14 14 0.03129518 0.2437469 0.02405453 0.0013000892 0.03793790 0.0008043731  
## 15 15 0.03131672 0.2427656 0.02408464 0.0013205810 0.03817120 0.0008099671  
## 16 16 0.03132297 0.2425894 0.02408072 0.0013213503 0.03922834 0.0008193356  
## 17 17 0.03132119 0.2427832 0.02406925 0.0013235367 0.04014315 0.0008224553  
## 18 18 0.03132994 0.2423440 0.02407423 0.0012943591 0.03951161 0.0008081252  
## 19 19 0.03134959 0.2414151 0.02409620 0.0012877111 0.03840347 0.0007757009  
## 20 20 0.03135271 0.2414046 0.02409391 0.0013006813 0.03938740 0.0007877757  
## 21 21 0.03139086 0.2396816 0.02411602 0.0012938121 0.03930146 0.0007884677  
## 22 22 0.03183100 0.2173637 0.02448622 0.0018828875 0.06733307 0.0013451600  
## 23 23 0.03141406 0.2385843 0.02414294 0.0012974784 0.03863552 0.0007927619  
## 24 24 0.03167553 0.2254761 0.02436478 0.0015888917 0.05826930 0.0010432183  
## 25 25 0.03140554 0.2391034 0.02413459 0.0012852063 0.03922006 0.0008022194  
## 26 26 0.03142108 0.2385533 0.02414269 0.0012973151 0.03982681 0.0008051963  
## 27 27 0.03141252 0.2390377 0.02414382 0.0012947178 0.03997346 0.0008067397  
## 28 28 0.03178443 0.2203581 0.02443620 0.0018458724 0.06934433 0.0012478640  
## 29 29 0.03144538 0.2375004 0.02416032 0.0012995080 0.04102249 0.0008155679  
## 30 30 0.03213843 0.2012822 0.02477688 0.0015857592 0.08053897 0.0014002601  
## 31 31 0.03187438 0.2159252 0.02453724 0.0011833297 0.04990561 0.0007328748  
## 32 32 0.03149870 0.2351308 0.02422156 0.0013191936 0.04011124 0.0008146795  
## 33 33 0.03151352 0.2345153 0.02423080 0.0013178453 0.04009569 0.0008220952  
## 34 34 0.03204857 0.2065670 0.02466266 0.0021501290 0.08442607 0.0015029535  
## 35 35 0.03220045 0.1985277 0.02478145 0.0011630530 0.07087406 0.0009728037  
## 36 36 0.03182252 0.2191375 0.02448066 0.0015923746 0.05868635 0.0010225756  
## 37 37 0.03154644 0.2330891 0.02425587 0.0012888841 0.03883173 0.0008141666  
## 38 38 0.03156293 0.2323124 0.02426972 0.0012970411 0.03780514 0.0008020006  
## 39 39 0.03158355 0.2314901 0.02429248 0.0012995223 0.03747841 0.0008054669  
## 40 40 0.03252119 0.1826853 0.02509202 0.0011760228 0.06386064 0.0010361621  
## 41 41 0.03159685 0.2308877 0.02429000 0.0013030013 0.03745765 0.0008050309  
## 42 42 0.03188483 0.2157652 0.02452251 0.0016767457 0.06537509 0.0011080889  
## 43 43 0.03223646 0.1970805 0.02482844 0.0011545544 0.06965442 0.0009541808  
## 44 44 0.03180670 0.2194974 0.02446017 0.0017487889 0.06495257 0.0011799324  
## 45 45 0.03203483 0.2087311 0.02467695 0.0018124539 0.06265638 0.0012857174  
## 46 46 0.03196881 0.2128029 0.02462975 0.0019639249 0.06990053 0.0014082028  
## 47 47 0.03222694 0.1983068 0.02481402 0.0015659042 0.07651249 0.0011952121  
## 48 48 0.03219236 0.2007821 0.02480757 0.0022329676 0.08457760 0.0016082116  
## 49 49 0.03168407 0.2271868 0.02436926 0.0012771516 0.03674973 0.0007971482  
## 50 50 0.03168570 0.2270898 0.02438667 0.0012691638 0.03629293 0.0007787316  
## 51 51 0.03168639 0.2270469 0.02437801 0.0012665483 0.03578765 0.0007778625  
## 52 52 0.03168293 0.2272140 0.02437144 0.0012700721 0.03604398 0.0007837666  
## 53 53 0.03197854 0.2110889 0.02459999 0.0013506675 0.06659345 0.0010805024  
## 54 54 0.03218701 0.2006712 0.02476323 0.0014593063 0.06278015 0.0010201592  
## 55 55 0.03170217 0.2265122 0.02439338 0.0012983427 0.03675964 0.0008051733  
## 56 56 0.03312374 0.1515446 0.02552779 0.0018562932 0.08090426 0.0013520169  
## 57 57 0.03265901 0.1787074 0.02519596 0.0018774009 0.07336518 0.0012919920  
## 58 58 0.03290056 0.1641367 0.02538549 0.0018533124 0.08290529 0.0013170610  
## 59 59 0.03247164 0.1883219 0.02504105 0.0022692614 0.08055571 0.0016775657  
## 60 60 0.03296364 0.1613133 0.02540015 0.0021035877 0.08141024 0.0014387958  
## 61 61 0.03251314 0.1854792 0.02510142 0.0019501421 0.07353657 0.0014826279  
## 62 62 0.03200921 0.2096753 0.02462027 0.0013373959 0.06552306 0.0010675581  
## 63 63 0.03261231 0.1792061 0.02516169 0.0016675242 0.07328024 0.0012022273  
## 64 64 0.03223584 0.1978283 0.02477383 0.0015504890 0.06926290 0.0011075445  
## 65 65 0.03214029 0.2045045 0.02477803 0.0015510907 0.05953965 0.0011648958  
## 66 66 0.03205771 0.2083134 0.02465044 0.0016187639 0.06218311 0.0010524514  
## 67 67 0.03178105 0.2228220 0.02443603 0.0012435271 0.03390284 0.0007492869  
## 68 68 0.03206155 0.2073885 0.02464826 0.0012987340 0.06406392 0.0010358464  
## 69 69 0.03273591 0.1728256 0.02522759 0.0018364445 0.08689903 0.0014676468  
## 70 70 0.03180017 0.2220296 0.02445801 0.0012489111 0.03378560 0.0007535991  
## 71 71 0.03179270 0.2223972 0.02444915 0.0012370853 0.03412475 0.0007474171  
## 72 72 0.03249582 0.1871733 0.02502677 0.0018908583 0.06722028 0.0013044004  
## 73 73 0.03293943 0.1636192 0.02540553 0.0021787199 0.08893110 0.0015250114  
## 74 74 0.03296646 0.1618658 0.02539675 0.0023174712 0.08644416 0.0015770504  
## 75 75 0.03199508 0.2109701 0.02458354 0.0011793192 0.04916041 0.0008523152  
## 76 76 0.03235302 0.1932422 0.02490091 0.0015046184 0.07208824 0.0011388575  
## 77 77 0.03250349 0.1871398 0.02503707 0.0019234024 0.06884568 0.0013373322  
## 78 78 0.03213141 0.2054971 0.02473195 0.0011542017 0.04579085 0.0006959863  
## 79 79 0.03199767 0.2109071 0.02458028 0.0011814584 0.04960653 0.0008576102  
## 80 80 0.03227830 0.1956400 0.02480499 0.0012162437 0.07168641 0.0011313155  
## 81 81 0.03226914 0.1973028 0.02480162 0.0013856952 0.05925879 0.0009665637  
## 82 82 0.03281584 0.1681455 0.02528659 0.0017797470 0.07997515 0.0013380993  
## 83 83 0.03243324 0.1892296 0.02496197 0.0011516749 0.06826711 0.0009875890  
## 84 84 0.03183339 0.2209877 0.02446420 0.0012504823 0.03495989 0.0007855981  
## 85 85 0.03236762 0.1920749 0.02488262 0.0010109140 0.05588898 0.0007533254  
## 86 86 0.03254028 0.1850211 0.02511097 0.0013812912 0.06310099 0.0010203593  
## 87 87 0.03233480 0.1937789 0.02484477 0.0015865266 0.07193165 0.0011365898  
## 88 88 0.03209659 0.2077542 0.02470681 0.0014932081 0.05201956 0.0009540527  
## 89 89 0.03197976 0.2121509 0.02458633 0.0016280060 0.05982446 0.0010734711  
## 90 90 0.03270742 0.1747288 0.02518990 0.0017907641 0.07892423 0.0013530803  
## 91 91 0.03249580 0.1872318 0.02501979 0.0015159135 0.06790195 0.0009880838  
## 92 92 0.03245244 0.1883747 0.02496724 0.0017166940 0.06974817 0.0013296573  
## 93 93 0.03234794 0.1931677 0.02486793 0.0015911055 0.07265823 0.0011481542  
## 94 94 0.03211424 0.2071214 0.02471927 0.0015038067 0.05194717 0.0009609420  
## 95 95 0.03216271 0.2043720 0.02471918 0.0017698762 0.06345290 0.0011637094  
## 96 96 0.03226851 0.1979428 0.02483585 0.0017992320 0.06889489 0.0011826485  
## 97 97 0.03291379 0.1665185 0.02535392 0.0019105663 0.07389549 0.0013300037  
## 98 98 0.03239513 0.1918803 0.02495250 0.0018381068 0.07316701 0.0014145647  
## 99 99 0.03257443 0.1837386 0.02516476 0.0013761276 0.06215782 0.0010244673  
## 100 100 0.03235229 0.1925616 0.02488477 0.0012614002 0.07359188 0.0011679819  
## 101 101 0.03216361 0.2044222 0.02473490 0.0017595205 0.06296271 0.0011569850  
## 102 102 0.03237294 0.1917515 0.02490430 0.0012694973 0.07420073 0.0011863493  
## 103 103 0.03295872 0.1632095 0.02538653 0.0020817445 0.08570193 0.0015019630  
## 104 104 0.03221080 0.2023840 0.02481363 0.0011487102 0.04617184 0.0006974034  
## 105 105 0.03346552 0.1365991 0.02582728 0.0018726598 0.08764280 0.0015911616  
## 106 106 0.03187639 0.2196300 0.02451809 0.0012575316 0.03420889 0.0007806504  
## 107 107 0.03187439 0.2197303 0.02452164 0.0012455997 0.03393096 0.0007735469  
## 108 108 0.03216918 0.2044826 0.02473821 0.0016414840 0.06313872 0.0010785131  
## 109 109 0.03206638 0.2080712 0.02466438 0.0012003736 0.05086676 0.0008586548  
## 110 110 0.03236809 0.1925023 0.02488380 0.0015580828 0.07052002 0.0011063001  
## 111 111 0.03288581 0.1685909 0.02537947 0.0016945005 0.06622895 0.0011464599  
## 112 112 0.03258205 0.1816847 0.02509480 0.0020837112 0.08415220 0.0015573649  
## 113 113 0.03224614 0.2010780 0.02486641 0.0015707998 0.06041285 0.0011783016  
## 114 114 0.03188112 0.2195460 0.02452889 0.0012626229 0.03403054 0.0007746807  
## 115 115 0.03247855 0.1887458 0.02501377 0.0020904993 0.07699086 0.0015061993  
## 116 116 0.03188633 0.2193896 0.02452661 0.0012607471 0.03375064 0.0007721917  
## 117 117 0.03260215 0.1830434 0.02516815 0.0013860849 0.06257679 0.0010102283  
## 118 118 0.03188250 0.2196521 0.02452088 0.0012638265 0.03380541 0.0007776112  
## 119 119 0.03278214 0.1730640 0.02530555 0.0019573807 0.08098827 0.0015597827  
## 120 120 0.03238632 0.1936744 0.02500278 0.0010498557 0.05622996 0.0009201870  
## 121 121 0.03212646 0.2069672 0.02473875 0.0012948745 0.05753560 0.0010864258  
## 122 122 0.03200245 0.2120990 0.02462548 0.0012092014 0.04222984 0.0008190861  
## 123 123 0.03188120 0.2197500 0.02452523 0.0012692582 0.03421214 0.0007833159  
## 124 124 0.03235939 0.1950319 0.02497020 0.0015663915 0.05935011 0.0011415537  
## 125 125 0.03215675 0.2062670 0.02476359 0.0017899890 0.05861593 0.0012240194  
## 126 126 0.03187328 0.2200244 0.02452234 0.0012727108 0.03403045 0.0007761484  
## 127 127 0.03214862 0.2061594 0.02479940 0.0010856079 0.03677968 0.0006199390  
## 128 128 0.03254472 0.1850419 0.02513510 0.0015083896 0.05796265 0.0010434854  
## 129 129 0.03187339 0.2200324 0.02452887 0.0012635584 0.03393796 0.0007706519  
## 130 130 0.03222978 0.2025108 0.02481875 0.0016622692 0.05219004 0.0011640600  
## 131 131 0.03200453 0.2118358 0.02463031 0.0011946433 0.04197055 0.0008060564  
## 132 132 0.03245234 0.1897374 0.02503496 0.0018671869 0.06233400 0.0013257111  
## 133 133 0.03239450 0.1928285 0.02502210 0.0013408349 0.04971713 0.0007931639  
## 134 134 0.03213649 0.2069724 0.02477001 0.0010916874 0.03624495 0.0005912704  
## 135 135 0.03188057 0.2197562 0.02452771 0.0012652612 0.03385095 0.0007681554  
## 136 136 0.03246982 0.1899123 0.02501041 0.0012587494 0.04633491 0.0006153813  
## 137 137 0.03216490 0.2058479 0.02477448 0.0015449347 0.04502319 0.0010735196  
## 138 138 0.03213901 0.2069494 0.02476636 0.0010862281 0.03597584 0.0005903993  
## 139 139 0.03195732 0.2143771 0.02458205 0.0012018074 0.03765544 0.0007825516  
## 140 140 0.03210334 0.2082534 0.02471127 0.0015820957 0.05152894 0.0010395427  
## 141 141 0.03188742 0.2193992 0.02453539 0.0012589066 0.03326738 0.0007745583  
## 142 142 0.03227587 0.1975553 0.02487462 0.0017235692 0.06077494 0.0012298683  
## 143 143 0.03188106 0.2196156 0.02453533 0.0012554020 0.03323686 0.0007750305  
## 144 144 0.03222998 0.2008436 0.02483228 0.0009860142 0.03738939 0.0005739311  
## 145 145 0.03239551 0.1940088 0.02495630 0.0017750033 0.05642608 0.0012432854  
## 146 146 0.03245466 0.1898873 0.02502198 0.0013962446 0.04977748 0.0008989144  
## 147 147 0.03212972 0.2053265 0.02469014 0.0013456398 0.04788881 0.0008597035  
## 148 148 0.03188611 0.2194189 0.02453900 0.0012516360 0.03294581 0.0007621328  
## 149 149 0.03188164 0.2196350 0.02453499 0.0012548485 0.03310851 0.0007620195  
## 150 150 0.03240002 0.1938032 0.02495930 0.0017845526 0.05666012 0.0012412305  
## 151 151 0.03210586 0.2087015 0.02471840 0.0016673573 0.05203349 0.0011020765  
## 152 152 0.03239204 0.1924071 0.02493847 0.0011306888 0.04576768 0.0006455719  
## 153 153 0.03238954 0.1943278 0.02494550 0.0017865834 0.05663032 0.0012491717  
## 154 154 0.03204968 0.2108797 0.02463840 0.0014167619 0.04619178 0.0008633668  
## 155 155 0.03242014 0.1915214 0.02499517 0.0014095307 0.05447556 0.0008604042  
## 156 156 0.03256958 0.1854424 0.02516633 0.0016003679 0.04980646 0.0011303925  
## 157 157 0.03196695 0.2138410 0.02458008 0.0011871131 0.03760915 0.0007680710  
## 158 158 0.03210001 0.2085856 0.02475658 0.0013202706 0.04169299 0.0009234063  
## 159 159 0.03188160 0.2196318 0.02452248 0.0012479476 0.03280047 0.0007572501  
## 160 160 0.03187554 0.2198986 0.02451913 0.0012470437 0.03270277 0.0007616005  
## 161 161 0.03187401 0.2199704 0.02452101 0.0012484035 0.03272469 0.0007613024  
## 162 162 0.03246992 0.1891664 0.02505268 0.0015694173 0.05866457 0.0009978236  
## 163 163 0.03219224 0.2024812 0.02481676 0.0012417966 0.04369305 0.0009165323  
## 164 164 0.03233871 0.1967145 0.02491631 0.0012351804 0.04644941 0.0006801430  
## 165 165 0.03206680 0.2103649 0.02468751 0.0013726115 0.04169800 0.0008202416  
## 166 166 0.03187785 0.2198205 0.02452123 0.0012484588 0.03274388 0.0007668302  
## 167 167 0.03239035 0.1948041 0.02499108 0.0014963910 0.05098636 0.0009498470  
## 168 168 0.03205622 0.2108845 0.02468963 0.0013720756 0.04152715 0.0008413822  
## 169 169 0.03196404 0.2139729 0.02458554 0.0011853216 0.03770235 0.0007755774  
## 170 170 0.03218601 0.2027886 0.02482125 0.0012523205 0.04423096 0.0009324380  
## 171 171 0.03187116 0.2201064 0.02452454 0.0012482086 0.03283905 0.0007644186  
## 172 172 0.03211280 0.2086290 0.02473100 0.0016775392 0.05213198 0.0011235072  
## 173 173 0.03187237 0.2200680 0.02452403 0.0012496564 0.03292100 0.0007638766  
## 174 174 0.03187143 0.2201282 0.02452152 0.0012500972 0.03297223 0.0007632327  
## 175 175 0.03187360 0.2200426 0.02452336 0.0012535650 0.03310993 0.0007646126  
## 176 176 0.03187368 0.2200540 0.02452375 0.0012530782 0.03317556 0.0007643626  
## 177 177 0.03236482 0.1957955 0.02490178 0.0016669718 0.05389912 0.0011407706  
## 178 178 0.03209901 0.2087366 0.02476327 0.0013354519 0.04272854 0.0009461458  
## 179 179 0.03206517 0.2103743 0.02465135 0.0014364876 0.04787494 0.0008758705  
## 180 180 0.03186900 0.2203208 0.02452058 0.0012585264 0.03352266 0.0007698357  
## 181 181 0.03187146 0.2202209 0.02452146 0.0012572653 0.03351128 0.0007699045  
## 182 182 0.03211759 0.2085856 0.02472511 0.0016828071 0.05248932 0.0011188554  
## 183 183 0.03198666 0.2137797 0.02464608 0.0015076051 0.04964086 0.0010514893  
## 184 184 0.03210549 0.2085080 0.02476592 0.0013402323 0.04297448 0.0009557878  
## 185 185 0.03205351 0.2111618 0.02468159 0.0013605377 0.04107492 0.0008231302  
## 186 186 0.03187583 0.2200397 0.02452518 0.0012517243 0.03319311 0.0007649405  
## 187 187 0.03210558 0.2085397 0.02477014 0.0013408841 0.04306602 0.0009575479  
## 188 188 0.03218687 0.2051575 0.02478714 0.0015713631 0.04593744 0.0011157836  
## 189 189 0.03233627 0.1973219 0.02495370 0.0011750340 0.04198263 0.0006242241  
## 190 190 0.03210056 0.2087097 0.02470281 0.0016098520 0.05270976 0.0010497978  
## 191 191 0.03199000 0.2136664 0.02465546 0.0015109145 0.04964056 0.0010612047  
## 192 192 0.03187687 0.2200273 0.02452738 0.0012605720 0.03346321 0.0007712846  
## 193 193 0.03212144 0.2084969 0.02472837 0.0016929215 0.05258597 0.0011206791  
## 194 194 0.03187755 0.2200007 0.02452883 0.0012652668 0.03352302 0.0007753443  
## 195 195 0.03187953 0.2199257 0.02452867 0.0012655639 0.03352403 0.0007745749  
## 196 196 0.03187807 0.2199917 0.02452645 0.0012625264 0.03337679 0.0007682976  
## 197 197 0.03187844 0.2199832 0.02452654 0.0012644399 0.03356191 0.0007712951  
## 198 198 0.03223865 0.2019999 0.02485796 0.0018770847 0.06302767 0.0013183948  
## 199 199 0.03221793 0.2022587 0.02479479 0.0016242985 0.05413923 0.0011111985  
## 200 200 0.03188601 0.2196643 0.02453379 0.0012630637 0.03349291 0.0007731639  
## 201 201 0.03188442 0.2197170 0.02453207 0.0012620902 0.03341738 0.0007708307  
## 202 202 0.03221952 0.2022178 0.02479592 0.0016206768 0.05402281 0.0011099126  
## 203 203 0.03188220 0.2198145 0.02453158 0.0012611441 0.03338337 0.0007692560  
## 204 204 0.03188295 0.2197830 0.02453206 0.0012613241 0.03335357 0.0007672137  
## 205 205 0.03188307 0.2197881 0.02453380 0.0012624138 0.03344895 0.0007689398  
## 206 206 0.03188512 0.2196961 0.02453617 0.0012593388 0.03332804 0.0007655335  
## 207 207 0.03188438 0.2197262 0.02453443 0.0012613956 0.03336848 0.0007663726  
## 208 208 0.03188631 0.2196397 0.02453557 0.0012585743 0.03328432 0.0007651034  
## 209 209 0.03188815 0.2195660 0.02453650 0.0012582638 0.03326986 0.0007663364  
## 210 210 0.03233818 0.1975952 0.02490890 0.0016398156 0.06262130 0.0012573452  
## 211 211 0.03213626 0.2079047 0.02473921 0.0016843016 0.05199224 0.0011118277  
## 212 212 0.03189207 0.2193994 0.02453937 0.0012576207 0.03324861 0.0007662426  
## 213 213 0.03189335 0.2193482 0.02453912 0.0012570778 0.03320663 0.0007661854  
## 214 214 0.03209779 0.2089335 0.02471393 0.0012461412 0.05117022 0.0010138865  
## 215 215 0.03189296 0.2193570 0.02454000 0.0012582247 0.03325340 0.0007691030  
## 216 216 0.03213271 0.2074573 0.02473088 0.0016367892 0.05368742 0.0010720016  
## 217 217 0.03189416 0.2193034 0.02453981 0.0012572598 0.03319188 0.0007666832  
## 218 218 0.03189466 0.2192940 0.02454038 0.0012572447 0.03317564 0.0007661790  
## 219 219 0.03201304 0.2127619 0.02466798 0.0015212858 0.04991300 0.0010582564  
## 220 220 0.03214294 0.2069647 0.02479811 0.0013657376 0.04454896 0.0009786278  
## 221 221 0.03214092 0.2077333 0.02475120 0.0016829867 0.05182942 0.0011328789  
## 222 222 0.03189606 0.2192234 0.02454171 0.0012547294 0.03303553 0.0007631350  
## 223 223 0.03229721 0.1992009 0.02488400 0.0013474294 0.05596491 0.0010411333  
## 224 224 0.03189575 0.2192332 0.02454154 0.0012538458 0.03297472 0.0007620829  
## 225 225 0.03189570 0.2192368 0.02454169 0.0012535289 0.03295627 0.0007621067  
## 226 226 0.03189641 0.2192070 0.02454154 0.0012535081 0.03296106 0.0007619221  
## 227 227 0.03189607 0.2192212 0.02454136 0.0012531417 0.03296460 0.0007613267  
## 228 228 0.03189653 0.2192001 0.02454114 0.0012528989 0.03293337 0.0007618697  
## 229 229 0.03235167 0.1968404 0.02496237 0.0018182662 0.05930481 0.0013583993  
## 230 230 0.03215711 0.2066807 0.02474936 0.0016804486 0.05520170 0.0011085981  
## 231 231 0.03189595 0.2192265 0.02454058 0.0012529574 0.03297027 0.0007624511  
## 232 232 0.03189596 0.2192296 0.02454089 0.0012535959 0.03301433 0.0007628382  
## 233 233 0.03201141 0.2121705 0.02462546 0.0011769795 0.03941364 0.0007812979  
## 234 234 0.03247916 0.1896750 0.02510444 0.0015452748 0.06612728 0.0013160543  
## 235 235 0.03211275 0.2084407 0.02473225 0.0012508126 0.05183053 0.0010450025  
## 236 236 0.03239629 0.1951506 0.02497378 0.0016554335 0.05038544 0.0011533869  
## 237 237 0.03234527 0.1976803 0.02489906 0.0018079832 0.06047620 0.0012153484  
## 238 238 0.03222084 0.2039168 0.02482294 0.0016047395 0.04715111 0.0011531306  
## 239 239 0.03291230 0.1698167 0.02542518 0.0015950331 0.05402914 0.0011655560  
## 240 240 0.03189502 0.2192704 0.02454015 0.0012539255 0.03303777 0.0007626640  
## [1] "Best Model"  
## nvmax  
## 14 14



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

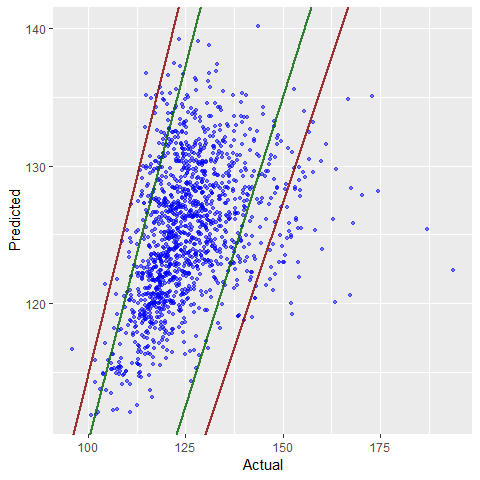


## [1] "Coefficients of final model:"  
## Estimate 2.5 % 97.5 %  
## (Intercept) 1.964602e+00 1.948778e+00 1.980427e+00  
## x4 -5.207358e-05 -6.930021e-05 -3.484695e-05  
## x7 1.131137e-02 1.010033e-02 1.252241e-02  
## x8 4.009270e-04 1.189652e-04 6.828889e-04  
## x9 3.221363e-03 2.590993e-03 3.851734e-03  
## x10 9.876467e-04 3.987372e-04 1.576556e-03  
## x11 2.400354e+05 9.988510e+04 3.801858e+05  
## x16 1.061951e-03 6.535119e-04 1.470390e-03  
## x17 1.564843e-03 9.442564e-04 2.185429e-03  
## x21 1.346751e-04 5.447427e-05 2.148760e-04  
## stat14 -7.485681e-04 -1.216721e-03 -2.804152e-04  
## stat91 -6.554628e-04 -1.126438e-03 -1.844875e-04  
## stat98 3.705004e-03 3.237205e-03 4.172802e-03  
## stat110 -3.353081e-03 -3.824348e-03 -2.881813e-03  
## x18.sqrt 2.623888e-02 2.443859e-02 2.803918e-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.   
## 2.049 2.085 2.098 2.097 2.109 2.147   
## [1] "leapSeq Test MSE: 0.00108825076612865"

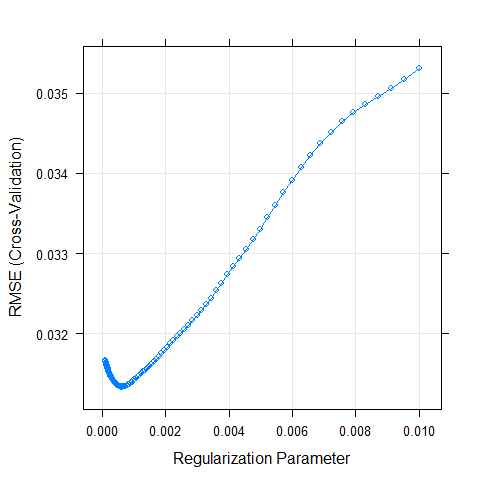


### LASSO with CV

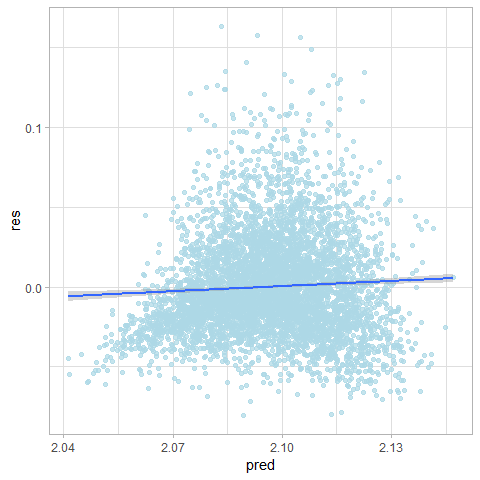
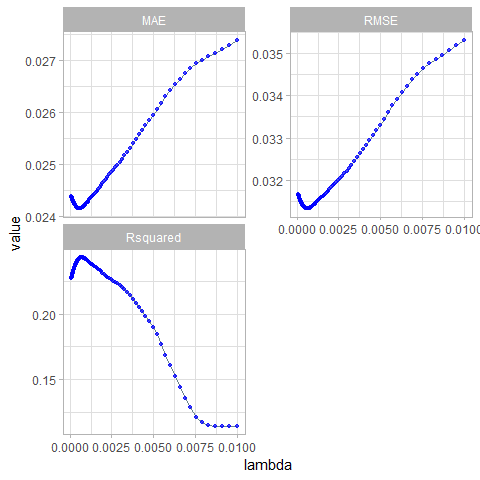
#### Train

if (algo.LASSO.caret == TRUE){  
 set.seed(1)  
 tune.grid= expand.grid(alpha = 1,lambda = 10^seq(from=-4,to=-2,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  
}

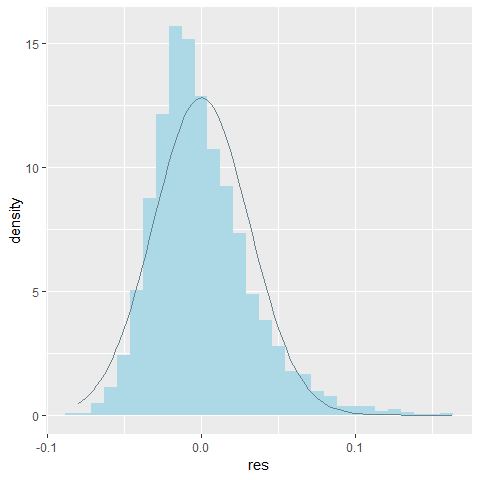
## Aggregating results  
## Selecting tuning parameters  
## Fitting alpha = 1, lambda = 0.000614 on full training set  
## glmnet   
##   
## 5584 samples  
## 240 predictor  
##   
## No pre-processing  
## Resampling: Cross-Validated (10 fold)   
## Summary of sample sizes: 5026, 5026, 5026, 5025, 5025, 5026, ...   
## Resampling results across tuning parameters:  
##   
## lambda RMSE Rsquared MAE   
## 0.0001000000 0.03167003 0.2273090 0.02437360  
## 0.0001047616 0.03166195 0.2276128 0.02436766  
## 0.0001097499 0.03165362 0.2279281 0.02436157  
## 0.0001149757 0.03164518 0.2282479 0.02435554  
## 0.0001204504 0.03163671 0.2285696 0.02434948  
## 0.0001261857 0.03162805 0.2288997 0.02434327  
## 0.0001321941 0.03161929 0.2292363 0.02433711  
## 0.0001384886 0.03161044 0.2295786 0.02433093  
## 0.0001450829 0.03160142 0.2299298 0.02432452  
## 0.0001519911 0.03159227 0.2302884 0.02431794  
## 0.0001592283 0.03158282 0.2306625 0.02431130  
## 0.0001668101 0.03157318 0.2310480 0.02430453  
## 0.0001747528 0.03156319 0.2314529 0.02429741  
## 0.0001830738 0.03155308 0.2318671 0.02429024  
## 0.0001917910 0.03154304 0.2322820 0.02428323  
## 0.0002009233 0.03153314 0.2326952 0.02427625  
## 0.0002104904 0.03152351 0.2331005 0.02426931  
## 0.0002205131 0.03151388 0.2335102 0.02426234  
## 0.0002310130 0.03150394 0.2339402 0.02425516  
## 0.0002420128 0.03149409 0.2343710 0.02424801  
## 0.0002535364 0.03148408 0.2348159 0.02424082  
## 0.0002656088 0.03147418 0.2352614 0.02423354  
## 0.0002782559 0.03146394 0.2357301 0.02422610  
## 0.0002915053 0.03145397 0.2361922 0.02421895  
## 0.0003053856 0.03144378 0.2366715 0.02421160  
## 0.0003199267 0.03143372 0.2371517 0.02420405  
## 0.0003351603 0.03142401 0.2376229 0.02419634  
## 0.0003511192 0.03141485 0.2380776 0.02418887  
## 0.0003678380 0.03140591 0.2385329 0.02418162  
## 0.0003853529 0.03139747 0.2389769 0.02417460  
## 0.0004037017 0.03138880 0.2394479 0.02416799  
## 0.0004229243 0.03138048 0.2399139 0.02416228  
## 0.0004430621 0.03137262 0.2403741 0.02415792  
## 0.0004641589 0.03136522 0.2408250 0.02415433  
## 0.0004862602 0.03135807 0.2412763 0.02415130  
## 0.0005094138 0.03135194 0.2416897 0.02414853  
## 0.0005336699 0.03134608 0.2421001 0.02414553  
## 0.0005590810 0.03134159 0.2424568 0.02414329  
## 0.0005857021 0.03133845 0.2427600 0.02414165  
## 0.0006135907 0.03133713 0.2429852 0.02414136  
## 0.0006428073 0.03133774 0.2431276 0.02414407  
## 0.0006734151 0.03133970 0.2432160 0.02414786  
## 0.0007054802 0.03134323 0.2432394 0.02415290  
## 0.0007390722 0.03134775 0.2432274 0.02415943  
## 0.0007742637 0.03135451 0.2431130 0.02416841  
## 0.0008111308 0.03136311 0.2429201 0.02417917  
## 0.0008497534 0.03137339 0.2426551 0.02419073  
## 0.0008902151 0.03138548 0.2423160 0.02420426  
## 0.0009326033 0.03139958 0.2419015 0.02422020  
## 0.0009770100 0.03141489 0.2414479 0.02423737  
## 0.0010235310 0.03143033 0.2410207 0.02425427  
## 0.0010722672 0.03144702 0.2405516 0.02427212  
## 0.0011233240 0.03146488 0.2400480 0.02429069  
## 0.0011768120 0.03148437 0.2394876 0.02431113  
## 0.0012328467 0.03150448 0.2389321 0.02433251  
## 0.0012915497 0.03152594 0.2383405 0.02435528  
## 0.0013530478 0.03154751 0.2377898 0.02437743  
## 0.0014174742 0.03157043 0.2372085 0.02440027  
## 0.0014849683 0.03159455 0.2366162 0.02442409  
## 0.0015556761 0.03162088 0.2359533 0.02445000  
## 0.0016297508 0.03164957 0.2352195 0.02447869  
## 0.0017073526 0.03168111 0.2343838 0.02451049  
## 0.0017886495 0.03171594 0.2334206 0.02454564  
## 0.0018738174 0.03175383 0.2323433 0.02458346  
## 0.0019630407 0.03179392 0.2312110 0.02462339  
## 0.0020565123 0.03183613 0.2300323 0.02466506  
## 0.0021544347 0.03187726 0.2290274 0.02470688  
## 0.0022570197 0.03192057 0.2279978 0.02475074  
## 0.0023644894 0.03196392 0.2271121 0.02479356  
## 0.0024770764 0.03200999 0.2261863 0.02483809  
## 0.0025950242 0.03205781 0.2253124 0.02488363  
## 0.0027185882 0.03210930 0.2243580 0.02493170  
## 0.0028480359 0.03216512 0.2232929 0.02498350  
## 0.0029836472 0.03222627 0.2220471 0.02503944  
## 0.0031257158 0.03229326 0.2205847 0.02509981  
## 0.0032745492 0.03236662 0.2188615 0.02516435  
## 0.0034304693 0.03244694 0.2168227 0.02523411  
## 0.0035938137 0.03253488 0.2144007 0.02530944  
## 0.0037649358 0.03263091 0.2115247 0.02539050  
## 0.0039442061 0.03273504 0.2081606 0.02547741  
## 0.0041320124 0.03283864 0.2050086 0.02556341  
## 0.0043287613 0.03294621 0.2017180 0.02565209  
## 0.0045348785 0.03305572 0.1985302 0.02574130  
## 0.0047508102 0.03317444 0.1947135 0.02583658  
## 0.0049770236 0.03330413 0.1900057 0.02593943  
## 0.0052140083 0.03344587 0.1841470 0.02605145  
## 0.0054622772 0.03360062 0.1768297 0.02617208  
## 0.0057223677 0.03376456 0.1682668 0.02629814  
## 0.0059948425 0.03391677 0.1606644 0.02641322  
## 0.0062802914 0.03407345 0.1522144 0.02652961  
## 0.0065793322 0.03422267 0.1442582 0.02663647  
## 0.0068926121 0.03437440 0.1355245 0.02674274  
## 0.0072208090 0.03451152 0.1284084 0.02683602  
## 0.0075646333 0.03464843 0.1208376 0.02692984  
## 0.0079248290 0.03475689 0.1171332 0.02700384  
## 0.0083021757 0.03485957 0.1147482 0.02707285  
## 0.0086974900 0.03495707 0.1145667 0.02713920  
## 0.0091116276 0.03506234 0.1145667 0.02721256  
## 0.0095454846 0.03517751 0.1145667 0.02729353  
## 0.0100000000 0.03530348 0.1145667 0.02738251  
##   
## 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 = 0.0006135907.



## alpha lambda  
## 40 1 0.0006135907  
## alpha lambda RMSE Rsquared MAE RMSESD RsquaredSD MAESD  
## 1 1 0.0001000000 0.03167003 0.2273090 0.02437360 0.0012560428 0.03481348 0.0007690831  
## 2 1 0.0001047616 0.03166195 0.2276128 0.02436766 0.0012556436 0.03487716 0.0007691353  
## 3 1 0.0001097499 0.03165362 0.2279281 0.02436157 0.0012551573 0.03493903 0.0007691666  
## 4 1 0.0001149757 0.03164518 0.2282479 0.02435554 0.0012546303 0.03499975 0.0007692381  
## 5 1 0.0001204504 0.03163671 0.2285696 0.02434948 0.0012540451 0.03505491 0.0007691293  
## 6 1 0.0001261857 0.03162805 0.2288997 0.02434327 0.0012534815 0.03511310 0.0007690140  
## 7 1 0.0001321941 0.03161929 0.2292363 0.02433711 0.0012531288 0.03518078 0.0007689774  
## 8 1 0.0001384886 0.03161044 0.2295786 0.02433093 0.0012529803 0.03525886 0.0007690565  
## 9 1 0.0001450829 0.03160142 0.2299298 0.02432452 0.0012530454 0.03534503 0.0007692111  
## 10 1 0.0001519911 0.03159227 0.2302884 0.02431794 0.0012531705 0.03543307 0.0007694030  
## 11 1 0.0001592283 0.03158282 0.2306625 0.02431130 0.0012533349 0.03551965 0.0007694583  
## 12 1 0.0001668101 0.03157318 0.2310480 0.02430453 0.0012536060 0.03561548 0.0007696265  
## 13 1 0.0001747528 0.03156319 0.2314529 0.02429741 0.0012538202 0.03571875 0.0007699654  
## 14 1 0.0001830738 0.03155308 0.2318671 0.02429024 0.0012540212 0.03582807 0.0007704008  
## 15 1 0.0001917910 0.03154304 0.2322820 0.02428323 0.0012540747 0.03594360 0.0007707459  
## 16 1 0.0002009233 0.03153314 0.2326952 0.02427625 0.0012540911 0.03606358 0.0007710919  
## 17 1 0.0002104904 0.03152351 0.2331005 0.02426931 0.0012539486 0.03618619 0.0007714210  
## 18 1 0.0002205131 0.03151388 0.2335102 0.02426234 0.0012537748 0.03631285 0.0007718358  
## 19 1 0.0002310130 0.03150394 0.2339402 0.02425516 0.0012535043 0.03643605 0.0007718483  
## 20 1 0.0002420128 0.03149409 0.2343710 0.02424801 0.0012531523 0.03655134 0.0007717101  
## 21 1 0.0002535364 0.03148408 0.2348159 0.02424082 0.0012527328 0.03666144 0.0007714225  
## 22 1 0.0002656088 0.03147418 0.2352614 0.02423354 0.0012521692 0.03677038 0.0007712347  
## 23 1 0.0002782559 0.03146394 0.2357301 0.02422610 0.0012514244 0.03687794 0.0007707852  
## 24 1 0.0002915053 0.03145397 0.2361922 0.02421895 0.0012504618 0.03698066 0.0007702083  
## 25 1 0.0003053856 0.03144378 0.2366715 0.02421160 0.0012491930 0.03707588 0.0007693793  
## 26 1 0.0003199267 0.03143372 0.2371517 0.02420405 0.0012478171 0.03717574 0.0007682126  
## 27 1 0.0003351603 0.03142401 0.2376229 0.02419634 0.0012466043 0.03729454 0.0007674554  
## 28 1 0.0003511192 0.03141485 0.2380776 0.02418887 0.0012454812 0.03741706 0.0007665391  
## 29 1 0.0003678380 0.03140591 0.2385329 0.02418162 0.0012447740 0.03753596 0.0007651277  
## 30 1 0.0003853529 0.03139747 0.2389769 0.02417460 0.0012442813 0.03765796 0.0007636763  
## 31 1 0.0004037017 0.03138880 0.2394479 0.02416799 0.0012434657 0.03776710 0.0007620670  
## 32 1 0.0004229243 0.03138048 0.2399139 0.02416228 0.0012423210 0.03786470 0.0007604826  
## 33 1 0.0004430621 0.03137262 0.2403741 0.02415792 0.0012409972 0.03794787 0.0007592809  
## 34 1 0.0004641589 0.03136522 0.2408250 0.02415433 0.0012398472 0.03804020 0.0007582770  
## 35 1 0.0004862602 0.03135807 0.2412763 0.02415130 0.0012394629 0.03817060 0.0007578925  
## 36 1 0.0005094138 0.03135194 0.2416897 0.02414853 0.0012393762 0.03831189 0.0007574563  
## 37 1 0.0005336699 0.03134608 0.2421001 0.02414553 0.0012390167 0.03844387 0.0007572382  
## 38 1 0.0005590810 0.03134159 0.2424568 0.02414329 0.0012390804 0.03859679 0.0007576947  
## 39 1 0.0005857021 0.03133845 0.2427600 0.02414165 0.0012391871 0.03876859 0.0007591324  
## 40 1 0.0006135907 0.03133713 0.2429852 0.02414136 0.0012393225 0.03893503 0.0007607999  
## 41 1 0.0006428073 0.03133774 0.2431276 0.02414407 0.0012377369 0.03903456 0.0007610495  
## 42 1 0.0006734151 0.03133970 0.2432160 0.02414786 0.0012351071 0.03907956 0.0007604096  
## 43 1 0.0007054802 0.03134323 0.2432394 0.02415290 0.0012318092 0.03905212 0.0007588222  
## 44 1 0.0007390722 0.03134775 0.2432274 0.02415943 0.0012284089 0.03899127 0.0007567268  
## 45 1 0.0007742637 0.03135451 0.2431130 0.02416841 0.0012245291 0.03888993 0.0007536116  
## 46 1 0.0008111308 0.03136311 0.2429201 0.02417917 0.0012210772 0.03880378 0.0007504829  
## 47 1 0.0008497534 0.03137339 0.2426551 0.02419073 0.0012179051 0.03870739 0.0007475105  
## 48 1 0.0008902151 0.03138548 0.2423160 0.02420426 0.0012152040 0.03861621 0.0007448089  
## 49 1 0.0009326033 0.03139958 0.2419015 0.02422020 0.0012120391 0.03855410 0.0007423424  
## 50 1 0.0009770100 0.03141489 0.2414479 0.02423737 0.0012084338 0.03852695 0.0007400513  
## 51 1 0.0010235310 0.03143033 0.2410207 0.02425427 0.0012052411 0.03856992 0.0007383553  
## 52 1 0.0010722672 0.03144702 0.2405516 0.02427212 0.0012015495 0.03860464 0.0007364999  
## 53 1 0.0011233240 0.03146488 0.2400480 0.02429069 0.0011973104 0.03864442 0.0007342838  
## 54 1 0.0011768120 0.03148437 0.2394876 0.02431113 0.0011929902 0.03867643 0.0007324197  
## 55 1 0.0012328467 0.03150448 0.2389321 0.02433251 0.0011886617 0.03869205 0.0007304775  
## 56 1 0.0012915497 0.03152594 0.2383405 0.02435528 0.0011842841 0.03869909 0.0007284871  
## 57 1 0.0013530478 0.03154751 0.2377898 0.02437743 0.0011803093 0.03870861 0.0007265251  
## 58 1 0.0014174742 0.03157043 0.2372085 0.02440027 0.0011759278 0.03868544 0.0007241967  
## 59 1 0.0014849683 0.03159455 0.2366162 0.02442409 0.0011720371 0.03868152 0.0007215619  
## 60 1 0.0015556761 0.03162088 0.2359533 0.02445000 0.0011682714 0.03867230 0.0007180047  
## 61 1 0.0016297508 0.03164957 0.2352195 0.02447869 0.0011646389 0.03868297 0.0007142026  
## 62 1 0.0017073526 0.03168111 0.2343838 0.02451049 0.0011608504 0.03868900 0.0007099499  
## 63 1 0.0017886495 0.03171594 0.2334206 0.02454564 0.0011566044 0.03868209 0.0007048217  
## 64 1 0.0018738174 0.03175383 0.2323433 0.02458346 0.0011520161 0.03866262 0.0006992708  
## 65 1 0.0019630407 0.03179392 0.2312110 0.02462339 0.0011480084 0.03868322 0.0006939073  
## 66 1 0.0020565123 0.03183613 0.2300323 0.02466506 0.0011438156 0.03873844 0.0006886546  
## 67 1 0.0021544347 0.03187726 0.2290274 0.02470688 0.0011403035 0.03885372 0.0006849770  
## 68 1 0.0022570197 0.03192057 0.2279978 0.02475074 0.0011372956 0.03899530 0.0006809678  
## 69 1 0.0023644894 0.03196392 0.2271121 0.02479356 0.0011350441 0.03922255 0.0006771892  
## 70 1 0.0024770764 0.03200999 0.2261863 0.02483809 0.0011325290 0.03942131 0.0006728658  
## 71 1 0.0025950242 0.03205781 0.2253124 0.02488363 0.0011299047 0.03964767 0.0006682810  
## 72 1 0.0027185882 0.03210930 0.2243580 0.02493170 0.0011267364 0.03985076 0.0006633082  
## 73 1 0.0028480359 0.03216512 0.2232929 0.02498350 0.0011230602 0.04007945 0.0006579884  
## 74 1 0.0029836472 0.03222627 0.2220471 0.02503944 0.0011191683 0.04031232 0.0006520554  
## 75 1 0.0031257158 0.03229326 0.2205847 0.02509981 0.0011150654 0.04054636 0.0006456509  
## 76 1 0.0032745492 0.03236662 0.2188615 0.02516435 0.0011107418 0.04077748 0.0006386504  
## 77 1 0.0034304693 0.03244694 0.2168227 0.02523411 0.0011061879 0.04099990 0.0006310163  
## 78 1 0.0035938137 0.03253488 0.2144007 0.02530944 0.0011013943 0.04120558 0.0006228009  
## 79 1 0.0037649358 0.03263091 0.2115247 0.02539050 0.0010959785 0.04135364 0.0006149023  
## 80 1 0.0039442061 0.03273504 0.2081606 0.02547741 0.0010898653 0.04148293 0.0006070758  
## 81 1 0.0041320124 0.03283864 0.2050086 0.02556341 0.0010834153 0.04124671 0.0005994563  
## 82 1 0.0043287613 0.03294621 0.2017180 0.02565209 0.0010756699 0.04087288 0.0005931897  
## 83 1 0.0045348785 0.03305572 0.1985302 0.02574130 0.0010684770 0.04081271 0.0005882928  
## 84 1 0.0047508102 0.03317444 0.1947135 0.02583658 0.0010616662 0.04064897 0.0005838570  
## 85 1 0.0049770236 0.03330413 0.1900057 0.02593943 0.0010547022 0.04038800 0.0005801455  
## 86 1 0.0052140083 0.03344587 0.1841470 0.02605145 0.0010476397 0.03997722 0.0005769530  
## 87 1 0.0054622772 0.03360062 0.1768297 0.02617208 0.0010406261 0.03934928 0.0005743463  
## 88 1 0.0057223677 0.03376456 0.1682668 0.02629814 0.0010311955 0.03902613 0.0005710360  
## 89 1 0.0059948425 0.03391677 0.1606644 0.02641322 0.0010201633 0.03828019 0.0005631683  
## 90 1 0.0062802914 0.03407345 0.1522144 0.02652961 0.0010121160 0.03735528 0.0005589805  
## 91 1 0.0065793322 0.03422267 0.1442582 0.02663647 0.0010066735 0.03644307 0.0005563483  
## 92 1 0.0068926121 0.03437440 0.1355245 0.02674274 0.0009999428 0.03569085 0.0005540026  
## 93 1 0.0072208090 0.03451152 0.1284084 0.02683602 0.0009943921 0.03511401 0.0005470603  
## 94 1 0.0075646333 0.03464843 0.1208376 0.02692984 0.0009910535 0.03468912 0.0005416070  
## 95 1 0.0079248290 0.03475689 0.1171332 0.02700384 0.0009928245 0.03387776 0.0005366117  
## 96 1 0.0083021757 0.03485957 0.1147482 0.02707285 0.0009956081 0.03282061 0.0005335287  
## 97 1 0.0086974900 0.03495707 0.1145667 0.02713920 0.0009967780 0.03299944 0.0005314537  
## 98 1 0.0091116276 0.03506234 0.1145667 0.02721256 0.0009984826 0.03299944 0.0005299772  
## 99 1 0.0095454846 0.03517751 0.1145667 0.02729353 0.0010006294 0.03299944 0.0005296903  
## 100 1 0.0100000000 0.03530348 0.1145667 0.02738251 0.0010032625 0.03299944 0.0005307449



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

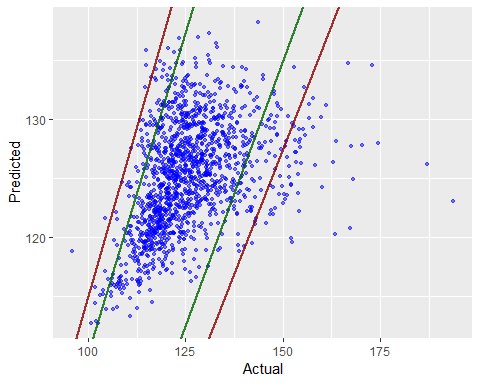


## [1] "Coefficients"  
## model.coef  
## (Intercept) 1.988693e+00  
## x4 -3.904420e-05  
## x7 1.042096e-02  
## x8 1.814053e-04  
## x9 2.762769e-03  
## x10 5.584938e-04  
## x11 1.434271e+05  
## x14 -1.461027e-04  
## x16 7.875821e-04  
## x17 1.063635e-03  
## x21 7.509373e-05  
## stat14 -3.914665e-04  
## stat23 1.753694e-04  
## stat25 -2.426583e-04  
## stat26 -4.018318e-05  
## stat29 8.917677e-05  
## stat41 -1.743274e-04  
## stat50 6.662724e-05  
## stat51 2.346295e-05  
## stat53 -1.129288e-04  
## stat59 1.859888e-05  
## stat60 3.028789e-05  
## stat61 -5.375110e-05  
## stat78 -6.993302e-07  
## stat83 -1.223065e-04  
## stat87 -8.735496e-05  
## stat91 -2.951032e-04  
## stat92 -7.191783e-06  
## stat98 3.362849e-03  
## stat100 1.679516e-04  
## stat110 -3.000314e-03  
## stat114 6.936248e-05  
## stat144 1.650040e-04  
## stat146 -9.494922e-05  
## stat147 -1.452350e-04  
## stat148 -6.994830e-05  
## stat149 -2.982519e-04  
## stat156 4.419228e-05  
## stat166 -1.195967e-06  
## stat198 -5.216831e-05  
## stat200 -9.394738e-06  
## stat207 1.478074e-04  
## stat214 -3.105086e-05  
## stat215 -2.558508e-05  
## stat217 5.320285e-06  
## x18.sqrt 2.496188e-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.   
## 2.052 2.086 2.098 2.097 2.109 2.141   
## [1] "glmnet LASSO Test MSE: 0.00108708594092293"



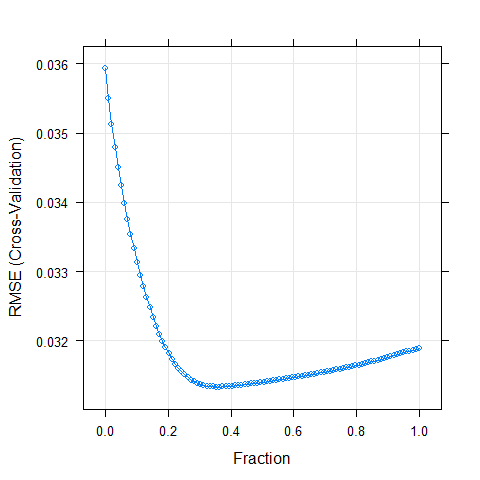
### LARS with CV

#### 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  
}

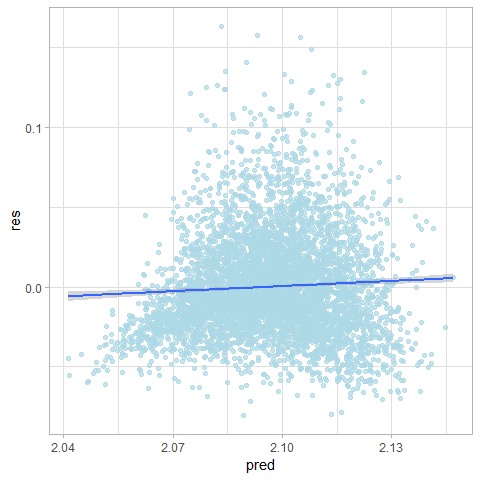
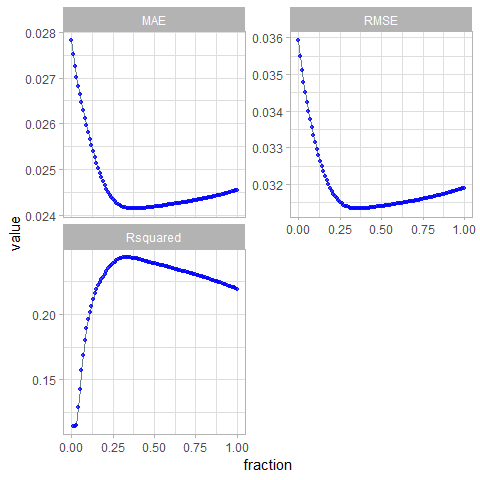
## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info = trainInfo, : There were missing values in resampled  
## performance measures.

## Aggregating results  
## Selecting tuning parameters  
## Fitting fraction = 0.364 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 0.03592567 NaN 0.02782381  
## 0.01010101 0.03549902 0.1145667 0.02751923  
## 0.02020202 0.03511830 0.1145667 0.02724941  
## 0.03030303 0.03478605 0.1148798 0.02701964  
## 0.04040404 0.03450029 0.1289499 0.02682581  
## 0.05050505 0.03423623 0.1425814 0.02664509  
## 0.06060606 0.03398830 0.1567527 0.02646625  
## 0.07070707 0.03375876 0.1683261 0.02629277  
## 0.08080808 0.03353801 0.1798474 0.02612268  
## 0.09090909 0.03332937 0.1889170 0.02595878  
## 0.10101010 0.03313328 0.1959619 0.02580302  
## 0.11111111 0.03295006 0.2014219 0.02565484  
## 0.12121212 0.03278363 0.2063748 0.02551749  
## 0.13131313 0.03262561 0.2115302 0.02538562  
## 0.14141414 0.03247638 0.2158770 0.02525893  
## 0.15151515 0.03233764 0.2194000 0.02513849  
## 0.16161616 0.03220953 0.2222416 0.02502400  
## 0.17171717 0.03209219 0.2245212 0.02491603  
## 0.18181818 0.03198875 0.2264161 0.02481745  
## 0.19191919 0.03189896 0.2283358 0.02472855  
## 0.20202020 0.03181527 0.2305668 0.02464459  
## 0.21212121 0.03173603 0.2328722 0.02456632  
## 0.22222222 0.03166375 0.2348895 0.02449372  
## 0.23232323 0.03160223 0.2364859 0.02443246  
## 0.24242424 0.03155052 0.2378046 0.02438257  
## 0.25252525 0.03150718 0.2389574 0.02433766  
## 0.26262626 0.03146810 0.2400433 0.02429668  
## 0.27272727 0.03143426 0.2409886 0.02426124  
## 0.28282828 0.03140644 0.2417643 0.02423064  
## 0.29292929 0.03138288 0.2424500 0.02420434  
## 0.30303030 0.03136422 0.2429812 0.02418394  
## 0.31313131 0.03135211 0.2432579 0.02416913  
## 0.32323232 0.03134365 0.2434117 0.02415752  
## 0.33333333 0.03133838 0.2434362 0.02414985  
## 0.34343434 0.03133513 0.2433876 0.02414445  
## 0.35353535 0.03133305 0.2433071 0.02414045  
## 0.36363636 0.03133266 0.2431667 0.02413814  
## 0.37373737 0.03133380 0.2429707 0.02413736  
## 0.38383838 0.03133581 0.2427428 0.02413798  
## 0.39393939 0.03133899 0.2424707 0.02413974  
## 0.40404040 0.03134327 0.2421537 0.02414212  
## 0.41414141 0.03134808 0.2418215 0.02414443  
## 0.42424242 0.03135364 0.2414606 0.02414729  
## 0.43434343 0.03135926 0.2411056 0.02415006  
## 0.44444444 0.03136504 0.2407503 0.02415283  
## 0.45454545 0.03137070 0.2404125 0.02415550  
## 0.46464646 0.03137689 0.2400562 0.02415906  
## 0.47474747 0.03138337 0.2396928 0.02416323  
## 0.48484848 0.03138980 0.2393394 0.02416779  
## 0.49494949 0.03139576 0.2390195 0.02417255  
## 0.50505051 0.03140170 0.2387061 0.02417743  
## 0.51515152 0.03140783 0.2383885 0.02418257  
## 0.52525253 0.03141399 0.2380759 0.02418769  
## 0.53535354 0.03142050 0.2377528 0.02419297  
## 0.54545455 0.03142743 0.2374151 0.02419829  
## 0.55555556 0.03143463 0.2370682 0.02420378  
## 0.56565657 0.03144201 0.2367178 0.02420953  
## 0.57575758 0.03144947 0.2363676 0.02421522  
## 0.58585859 0.03145709 0.2360116 0.02422099  
## 0.59595960 0.03146481 0.2356557 0.02422674  
## 0.60606061 0.03147267 0.2352974 0.02423248  
## 0.61616162 0.03148039 0.2349484 0.02423821  
## 0.62626263 0.03148819 0.2345997 0.02424387  
## 0.63636364 0.03149610 0.2342505 0.02424938  
## 0.64646465 0.03150423 0.2338959 0.02425534  
## 0.65656566 0.03151224 0.2335511 0.02426131  
## 0.66666667 0.03152023 0.2332105 0.02426722  
## 0.67676768 0.03152822 0.2328737 0.02427302  
## 0.68686869 0.03153632 0.2325355 0.02427875  
## 0.69696970 0.03154481 0.2321834 0.02428464  
## 0.70707071 0.03155382 0.2318115 0.02429091  
## 0.71717172 0.03156316 0.2314300 0.02429761  
## 0.72727273 0.03157251 0.2310522 0.02430423  
## 0.73737374 0.03158194 0.2306751 0.02431079  
## 0.74747475 0.03159119 0.2303113 0.02431725  
## 0.75757576 0.03160071 0.2299385 0.02432414  
## 0.76767677 0.03161033 0.2295650 0.02433088  
## 0.77777778 0.03162003 0.2291914 0.02433770  
## 0.78787879 0.03163013 0.2288054 0.02434489  
## 0.79797980 0.03164049 0.2284108 0.02435232  
## 0.80808081 0.03165107 0.2280098 0.02435984  
## 0.81818182 0.03166205 0.2275946 0.02436778  
## 0.82828283 0.03167303 0.2271829 0.02437580  
## 0.83838384 0.03168437 0.2267583 0.02438418  
## 0.84848485 0.03169593 0.2263290 0.02439267  
## 0.85858586 0.03170771 0.2258941 0.02440133  
## 0.86868687 0.03171980 0.2254499 0.02441023  
## 0.87878788 0.03173213 0.2249984 0.02441935  
## 0.88888889 0.03174479 0.2245369 0.02442883  
## 0.89898990 0.03175771 0.2240684 0.02443856  
## 0.90909091 0.03177078 0.2235980 0.02444850  
## 0.91919192 0.03178413 0.2231195 0.02445865  
## 0.92929293 0.03179767 0.2226375 0.02446875  
## 0.93939394 0.03181134 0.2221545 0.02447876  
## 0.94949495 0.03182513 0.2216704 0.02448874  
## 0.95959596 0.03183885 0.2211925 0.02449866  
## 0.96969697 0.03185270 0.2207133 0.02450883  
## 0.97979798 0.03186671 0.2202316 0.02451921  
## 0.98989899 0.03188083 0.2197504 0.02452959  
## 1.00000000 0.03189502 0.2192704 0.02454015  
##   
## RMSE was used to select the optimal model using the smallest value.  
## The final value used for the model was fraction = 0.3636364.

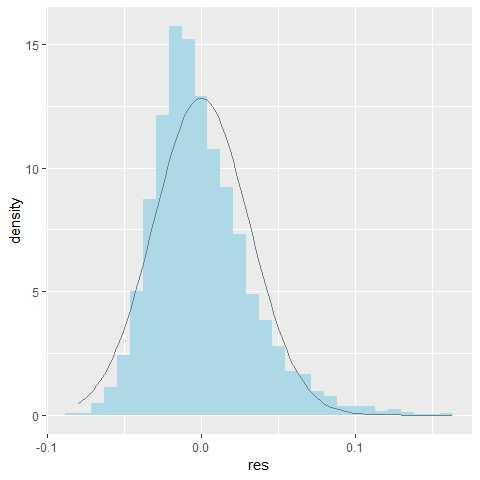


## fraction  
## 37 0.3636364

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



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

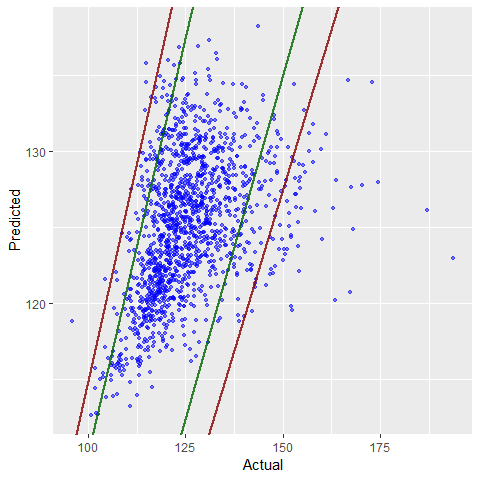


## [1] "Coefficients"  
## x4 x7 x8 x9 x10 x11 x14 x16   
## -1.853902e-03 7.041186e-03 5.261249e-04 3.584771e-03 7.769123e-04 8.368916e-04 -1.946053e-04 1.577397e-03   
## x17 x21 stat14 stat23 stat25 stat26 stat29 stat41   
## 1.402688e-03 7.663562e-04 -6.841199e-04 3.042285e-04 -4.222478e-04 -6.969310e-05 1.523931e-04 -3.050772e-04   
## stat50 stat51 stat53 stat59 stat60 stat61 stat78 stat83   
## 1.160425e-04 4.039605e-05 -1.945476e-04 3.197055e-05 5.210840e-05 -9.247421e-05 -8.891283e-07 -2.120776e-04   
## stat87 stat91 stat92 stat98 stat100 stat110 stat114 stat144   
## -1.508931e-04 -5.124467e-04 -1.204867e-05 5.884360e-03 2.923541e-04 -5.210863e-03 1.202739e-04 2.882449e-04   
## stat146 stat147 stat148 stat149 stat156 stat166 stat198 stat200   
## -1.627700e-04 -2.498547e-04 -1.220264e-04 -5.147146e-04 7.593016e-05 -1.724073e-06 -8.976710e-05 -1.610171e-05   
## stat207 stat214 stat215 stat217 x18.sqrt   
## 2.554702e-04 -5.345020e-05 -4.390061e-05 8.909424e-06 1.135237e-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.   
## 2.052 2.086 2.098 2.097 2.109 2.141   
## [1] "lars Test MSE: 0.00108708408217467"



# 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\_0.8.0.1 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\_1.3.0 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