

Session 20 Assignment

Weight Lifting Exercise

This human activity recognition research has traditionally focused on discriminating between different activities, i.e. to predict "which" activity was performed at a specific point in time (like with the Daily Living Activities dataset above). The approach we propose for the Weight Lifting Exercises dataset is to investigate "how (well)" an activity was performed by the wearer. The "how (well)" investigation has only received little attention so far, even though it potentially provides useful information for a large variety of applications, such as sports training.

1. Use the below given data set

Data Set

1. Perform the below given activities:
   1. Create classification model using different random forest models
   2. Verify model goodness of fit
   3. Apply all the model validation techniques
   4. Make conclusions
   5. Plot importance of variables

# setwd("C:/Users/Seshan/Desktop") library(readr)

Weight\_lift <- read.csv("Weight lift.csv") View(Weight\_lift)

str(Weight\_lift) data<-Weight\_lift # load libraries library(caret)

library(randomForest) library(rpart) library(rpart.plot) library(ggplot2) library(lattice) library(rattle)

library(C50)

#install.package('devtools') # Only needed if you dont have this installed. library(devtools)

install\_github('adam-m-mcelhinney/helpRFunctions') library(helpRFunctions)

names(data) dim(data) pairs(data[1:10])

# enable multi-core processing library(doParallel)

cl <- makeCluster(detectCores()) registerDoParallel()

set.seed(12345) dataTrain<-data[1:4004,]

dataTest<-data[4005:4024,] head(dataTrain) head(dataTest)

indexNA <- as.vector(sapply(dataTrain[,1:158],function(x) {length(which(is.na(x)))!=0})) dataTrain <- dataTrain[,!indexNA]

train\_control<- trainControl(method="cv", number=10)

model<- train(classe ~., data=dataTrain,trControl=train\_control, method="rf") model

# make predictions

predictions<- predict(model,dataTrain) # append predictions

pred<- cbind(dataTrain,predictions) # summarize results

confusionMatrix<- confusionMatrix(pred$predictions,pred$classe) confusionMatrix

#how do we create a cross validation scheme control <- trainControl(method = 'repeatedcv',

number = 10,

repeats = 3)

seed <-7

metric <- 'Accuracy' set.seed(seed)

mtry <- sqrt(ncol(dataTrain)) tunegrid <- expand.grid(.mtry=mtry) rf\_default <- train(pitch\_belt~.,

data = dataTrain, method = 'rf', metric = 0,

tuneGrid = tunegrid, trControl = control)

print(rf\_default)

#-------------------------------

# make predictions

predictions<- predict(rf\_default,dataTest) # append predictions

pred<- cbind(dataTest,predictions) # summarize results

confusionMatrix<- confusionMatrix(pred$predictions,pred$classe) confusionMatrix

varImp(rf\_default) #----------------

# random search for parameters

control <- trainControl(method = 'repeatedcv', number = 10,

repeats = 3, search = 'random')

# make predictions

predictions<- predict(rf\_default,dataTest)

# append predictions

pred<- cbind(dataTest,predictions)

# summarize results

#confusionMatrix<- confusionMatrix(pred$predictions,pred$classe) confusionMatrix

varImp(random) #--------------------

# Grid search

control <- trainControl(method = 'repeatedcv', number = 10,

repeats = 3, search = 'grid')

set.seed(seed)

tunegrid <- expand.grid(.mtry=c(1:80)) mtry <- sqrt(ncol(x))

rf\_gridsearch <- train(~.,

data = dataTrain[1:200,], method = 'rf',

metric = 0, tuneGrid = tunegrid,

trControl = control) print(rf\_gridsearch) plot(rf\_gridsearch)

# make predictions

predictions<- predict(rf\_gridsearch,dataTest)

# append predictions

pred<- cbind(dataTest,predictions)

# summarize results

confusionMatrix<- confusionMatrix(pred$predictions,pred$pitch\_belt) confusionMatrix

varImp(rf\_gridsearch)

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# Boosting

# ---------------------------------------

# Boosting model requires three things

#1- a loss function to be optimized

#2- a weak learner to make predictions

#3- an additive model to add the weak learners to minimize the loss function

# gradient boosting

control <- trainControl(method = 'repeatedcv',

number = 5,

repeats = 3, search = 'grid')

seed <- 7 library(C50) set.seed(seed) metric <- 'Accuracy'

gbm\_mod <- train(pitch\_belt~.,

data = dataTrain, method = 'gbm', metric = 0, trControl = control)

print(gbm\_mod) plot(gbm\_mod)

summary(gbm\_mod) # make predictions

predictions<- predict(gbm\_mod,dataTest)

# append predictions

pred<- cbind(dataTest,predictions)

# summarize results

confusionMatrix<- confusionMatrix(pred$predictions,pred$classe)

confusionMatrix

* setwd("C:/Users/Seshan/Desktop")
* library(readr)
* Weight\_lift <- read.csv("Weight lift.csv")
* View(Weight\_lift)
* str(Weight\_lift)

'data.frame': 4024 obs. of 158 variables:

$ user\_name : Factor w/ 5 levels "adelmo","carlitos",..: 3 3 3

3 3 3 3 3 3 3 ...

$ raw\_timestamp\_part\_1 : int 1322489729 1322489729 1322489729 1322489729

1322489729 1322489729 1322489729 1322489729 1322489729 1322489729 ...

$ raw\_timestamp\_part\_2 : int 34670 62641 70653 82654 90637 170626 190665

242723 267551 274689 ...

$ cvtd\_timestamp : Factor w/ 7 levels "2/12/2011 13:35",..: 2 2 2 2

2 2 2 2 2 2 ...

$ new\_window : Factor w/ 2 levels "no","yes": 1 1 1 1 1 1 1 1 1

1 ...

$ num\_window : int 1 1 1 1 1 1 1 1 1 1 ...

$ roll\_belt : num 3.7 3.66 3.58 3.56 3.57 3.45 3.31 2.91 2.31

2 ...

$ pitch\_belt : num 41.6 42.8 43.7 44.4 45.1 45.6 46.2 46.9 47.

4 47.7 ...

$ yaw\_belt

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| : | num | -82.8 | -82.5 | -82.3 | -82.1 -81.9 | -81.9 -81.9 - |
| : | int | 3 2 1 | 1 1 1 | 3 4 2 | 3 ... |  |
| : | num | -1.04 | -1.04 | -1.04 | -1.04 -1.04 | ... |

82.2 -82.6 -82.8 ...

$ total\_accel\_belt

$ kurtosis\_roll\_belt

$ kurtosis\_picth\_belt : num -0.391 -0.391 -0.391 -0.391 -0.391 ...

$ skewness\_roll\_belt : num 0.00541 0.00541 0.00541 0.00541 0.00541 ...

$ skewness\_roll\_belt.1 : num 0.0451 0.0451 0.0451 0.0451 0.0451 ...

$ max\_roll\_belt : num -4.1 -4.1 -4.1 -4.1 -4.1 -4.1 -4.1 -4.1 -4.

1 -4.1 ...

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $ | max\_picth\_belt : | int | 20 20 | 20 20 | 20 | 20 | 20 20 | 20 20 | ... |
| $ | max\_yaw\_belt : | num | -1 -1 | -1 -1 | -1 | -1 | -1 -1 | -1 -1 | ... |

$ min\_roll\_belt : num -7.25 -7.25 -7.25 -7.25 -7.25 -7.25 -7.25 -

7.25 -7.25 -7.25 ...

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $ | min\_pitch\_belt : | int | 18 18 | | 18 18 | | | 18 | 18 | 18 18 | | 18 18 | ... | | |
| $ | min\_yaw\_belt : | num | -1 -1 | | -1 -1 | | | -1 | -1 | -1 -1 | | -1 -1 | ... | | |
| $ amplitude\_roll\_belt : num 1.34 1.34 1.34 1.34 1.34 ... | | | | | | | | | | | | | | | |
| $ | amplitude\_pitch\_belt : | int | 2 2 | 2 2 | | 2 2 | | 2 2 | 2 2 | | ... |  | |  |  |
| $ | amplitude\_yaw\_belt : | int | 0 0 | 0 0 | | 0 0 | | 0 0 | 0 0 | | ... |  | |  |  |
| $ | var\_total\_accel\_belt : | num | 0.3 | 0.3 | | 0.3 | | 0.3 | 0.3 | | 0.3 | 0.3 0.3 0.3 | | 0.3 | ... |
| $ | avg\_roll\_belt : | num | 122 | 122 | | 122 | | 122 | 122 | | ... |  | |  |  |
| $ | stddev\_roll\_belt : | num | 0.6 | 0.6 | | 0.6 | | 0.6 | 0.6 | | 0.6 | 0.6 0.6 0.6 | | 0.6 | ... |
| $ var\_roll\_belt : | | num | 0.35 | 0.35 | | | 0.35 | | 0.35 | | 0.35 | 0.35 0.35 0.35 | | | 0.3 |
| $ avg\_pitch\_belt : | | num | 25.8 | 25.8 | | | 25.8 | | 25.8 | | 25.8 | ... | | |  |
| $ stddev\_pitch\_belt : | | num | 0.35 | 0.35 | | | 0.35 | | 0.35 | | 0.35 | 0.35 0.35 0.35 | | | 0.3 |
| 5 0.35 ...  $ var\_pitch\_belt : num 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 ... | | | | | | | | | | | | | | | |
| $ avg\_yaw\_belt : | | num | -4.95 -4.95 | | | | | -4.95 -4.95 | | | | -4.95 -4.95 | | -4.95 - | |
| $ stddev\_yaw\_belt : | | num | 0.4 0.4 0.4 | | | | | 0.4 0.4 0.4 | | | | 0.4 0.4 0.4 | | 0.4 ... | |

5 0.35 ...

4.95 -4.95 -4.95 ...

7 0.17 ...

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| $ var\_yaw\_belt : | | num | 0.17 | 0.17 | 0.17 | 0.17 0.17 0.17 0.17 0.17 0.1 | |
| $ gyros\_belt\_x : | | num | 2.02 | 1.96 | 1.88 | 1.8 1.77 1.75 1.78 1.75 1.65 | |
| 1.48 ... | |  |  |  |  |  | |
| $ | gyros\_belt\_y : | num | 0.18 | 0.14 | 0.08 | 0.03 0 -0.03 -0.06 -0.06 | -0. |
| 03 | -0.06 ... |  |  |  |  |  |  |
| $ | gyros\_belt\_z : | num | 0.02 | 0.05 | 0.05 | 0.08 0.13 0.16 0.15 0.23 | 0.3 |

3 0.21 ...

$ accel\_belt\_x : int -3 -2 -2 -6 -4 1 1 2 -1 -18 ...

$ accel\_belt\_y : int -18 -13 -6 -5 -9 -9 -24 -36 -19 18 ...

$ accel\_belt\_z : int 22 16 8 7 0 -5 -8 -9 -7 1 ...

$ magnet\_belt\_x : int 387 405 409 422 418 432 438 440 443 449 ...

$ magnet\_belt\_y : int 525 512 511 513 508 510 508 503 507 499 ...

$ magnet\_belt\_z : int -267 -254 -244 -221 -208 -189 -176 -163 -14

0 -132 ...

$ roll\_arm : num 132 129 125 120 115 110 104 98.6 93.2 88.5

...

$ pitch\_arm : num -43.7 -45.3 -46.8 -48.1 -49.1 -49.6 -49.9 -

49.7 -49 -48.1 ...

$ yaw\_arm : num -53.6 -49 -43.7 -38.1 -31.7 -25.8 -18.5 -11

.4 -4.49 1.82 ...

$ total\_accel\_arm : int 38 38 35 35 34 33 29 28 27 22 ...

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $ | var\_accel\_arm : | num | 65.1 | 65.1 | 65.1 | 65.1 | 65.1 | ... |
| $ | avg\_roll\_arm : | num | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | ... |
| $ | stddev\_roll\_arm : | num | 16.1 | 16.1 | 16.1 | 16.1 | 16.1 | ... |

$ var\_roll\_arm : num 259 259 259 259 259 ...

$ avg\_pitch\_arm : num -10.2 -10.2 -10.2 -10.2 -10.2 ...

$ stddev\_pitch\_arm : num 10.7 10.7 10.7 10.7 10.7 ...

$ var\_pitch\_arm : num 114 114 114 114 114 ...

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $ | avg\_yaw\_arm : | num | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 | ... |
| $ | stddev\_yaw\_arm : | num | 35.9 | 35.9 | 35.9 | 35.9 | 35.9 | ... |
| $ | var\_yaw\_arm : | num | 1287 | 1287 | 1287 | 1287 | 1287 | ... |

$ gyros\_arm\_x : num 2.65 2.79 2.91 3.08 3.2 3.31 3.5 3.53 3.4 3

.48 ...

$ gyros\_arm\_y : num -0.61 -0.64 -0.69 -0.72 -0.77 -0.83 -0.83 -

0.83 -0.83 -0.8 ...

$ gyros\_arm\_z : num -0.02 -0.11 -0.15 -0.23 -0.25 -0.3 -0.31 -0

.21 -0.11 -0.15 ...

$ accel\_arm\_x : int 143 146 156 158 163 160 165 153 143 135 ...

$ accel\_arm\_y : int 30 35 44 52 55 59 67 70 78 96 ...

$ accel\_arm\_z : int -346 -339 -307 -305 -288 -274 -225 -218 -20

5 -134 ...

$ magnet\_arm\_x : int 556 599 613 646 670 696 721 725 740 741 ...

$ magnet\_arm\_y : int -205 -206 -198 -186 -175 -174 -161 -152 -13

3 -115 ...

$ magnet\_arm\_z : int -374 -335 -319 -268 -241 -193 -121 -105 -43

14 ...

$ kurtosis\_roll\_arm : num -1.18 -1.18 -1.18 -1.18 -1.18 ...

$ kurtosis\_picth\_arm : num -0.969 -0.969 -0.969 -0.969 -0.969 ...

$ kurtosis\_yaw\_arm : num -0.87 -0.87 -0.87 -0.87 -0.87 ...

$ skewness\_roll\_arm : num 0.124 0.124 0.124 0.124 0.124 ...

$ skewness\_pitch\_arm : num -0.103 -0.103 -0.103 -0.103 -0.103 ...

$ skewness\_yaw\_arm : num 0.0598 0.0598 0.0598 0.0598 0.0598 ...

$ max\_roll\_arm : num 8.45 8.45 8.45 8.45 8.45 8.45 8.45 8.45 8.4

5 8.45 ...

$ max\_picth\_arm : num 77.2 77.2 77.2 77.2 77.2 ...

$ max\_yaw\_arm : int 38 38 38 38 38 38 38 38 38 38 ...

$ min\_roll\_arm

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| : | num | -33.6 | -33.6 | -33.6 | -33.6 | -33.6 | -33.6 -33.6 - |
| : | num | -58.6 | -58.6 | -58.6 | -58.6 | -58.6 | -58.6 -58.6 - |
| : | int | 10 10 | 10 10 | 10 10 | 10 10 | 10 10 | ... |

33.6 -33.6 -33.6 ...

$ min\_pitch\_arm 58.6 -58.6 -58.6 ...

$ min\_yaw\_arm

$ amplitude\_roll\_arm : num 36.9 36.9 36.9 36.9 36.9 ...

$ amplitude\_pitch\_arm : num 122 122 122 122 122 ...

$ amplitude\_yaw\_arm : int 27 27 27 27 27 27 27 27 27 27 ...

$ roll\_dumbbell : num 51.2 55.8 55.5 55.9 55.2 ...

$ pitch\_dumbbell : num 11.7 9.65 6.88 11.08 11.43 ...

$ yaw\_dumbbell : num 104.3 100.2 101.1 99.8 100.4 ...

$ kurtosis\_roll\_dumbbell : num -0.0959 -0.0959 -0.0959 -0.0959 -0.0959 ...

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| $ kurtosis\_picth\_dumbbell | : num | -0.442 | -0.442 | -0.442 | -0.442 | -0.442 | ... |
| $ skewness\_roll\_dumbbell | : num | 0.0819 | 0.0819 | 0.0819 | 0.0819 | 0.0819 | 0.0819 0 |
| .0819 0.0819 0.0819 0.0819  $ skewness\_pitch\_dumbbell | ...  : num | -0.216 | -0.216 | -0.216 | -0.216 | -0.216 | -0.216 - |
| 0.216 -0.216 -0.216 -0.216 | ... |  |  |  |  |  |  |

$ max\_roll\_dumbbell : num 41.9 41.9 41.9 41.9 41.9 ...

$ max\_picth\_dumbbell : num 133 133 133 133 133 133 133 133 133 133 ...

$ max\_yaw\_dumbbell : num -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 -0.

1 -0.1 ...

$ min\_roll\_dumbbell : num -26.8 -26.8 -26.8 -26.8 -26.8 ...

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $ min\_pitch\_dumbbell :  2 20.2 ... | num | 20.2 | 20.2 | 20.2 | 20.2 | 20.2 | 20.2 | 20.2 | 20.2 | 20. |
| $ min\_yaw\_dumbbell : | num | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0. |
| 1 -0.1 ... |  |  |  |  |  |  |  |  |  |  |
| $ amplitude\_roll\_dumbbell : | num | 55.7 | 55.7 | 55.7 | 55.7 | 55.7 | ... |  |  |  |
| $ amplitude\_pitch\_dumbbell: | num | 54.7 | 54.7 | 54.7 | 54.7 | 54.7 | ... |  |  |  |

$ amplitude\_yaw\_dumbbell : int 0 0 0 0 0 0 0 0 0 0 ...

$ total\_accel\_dumbbell : int 4 4 4 5 4 4 4 4 4 4 ...

$ var\_accel\_dumbbell : num 2.42 2.42 2.42 2.42 2.42 ...

$ avg\_roll\_dumbbell : num -5.12 -5.12 -5.12 -5.12 -5.12 ... [list output truncated]

* data<-Weight\_lift
* # load libraries
* library(caret)
* library(randomForest)
* library(rpart)
* library(rpart.plot)
* library(ggplot2)
* library(lattice)
* library(rattle)

>

* library(C50)
* #install.package('devtools') # Only needed if you dont have this installed.
* library(devtools)
* install\_github('adam-m-mcelhinney/helpRFunctions')

Skipping install of 'helpRFunctions' from a github remote, the SHA1 (9eb16e8c

) has not changed since last install.

Use `force = TRUE` to force installation

* library(helpRFunctions)
* names(data)

|  |  |  |  |
| --- | --- | --- | --- |
| [1] | "user\_name" | "raw\_timestamp\_part\_1" | "raw\_timestamp\_pa |
| rt\_2" |  |  |  |
| [4] | "cvtd\_timestamp" | "new\_window" | "num\_window" |
| [7] | "roll\_belt" | "pitch\_belt" | "yaw\_belt" |

elt"

|  |  |  |  |
| --- | --- | --- | --- |
| [10] | "total\_accel\_belt" | "kurtosis\_roll\_belt" | "kurtosis\_picth\_b |
| [13] | "skewness\_roll\_belt" | "skewness\_roll\_belt.1" | "max\_roll\_belt" |
| [16] | "max\_picth\_belt" | "max\_yaw\_belt" | "min\_roll\_belt" |
| [19] | "min\_pitch\_belt" | "min\_yaw\_belt" | "amplitude\_roll\_b |
| elt" |  |  |  |
| [22]  belt" | "amplitude\_pitch\_belt" | "amplitude\_yaw\_belt" | "var\_total\_accel\_ |
| [25] | "avg\_roll\_belt" | "stddev\_roll\_belt" | "var\_roll\_belt" |
| [28] | "avg\_pitch\_belt" | "stddev\_pitch\_belt" | "var\_pitch\_belt" |
| [31] | "avg\_yaw\_belt" | "stddev\_yaw\_belt" | "var\_yaw\_belt" |
| [34] | "gyros\_belt\_x" | "gyros\_belt\_y" | "gyros\_belt\_z" |
| [37] | "accel\_belt\_x" | "accel\_belt\_y" | "accel\_belt\_z" |
| [40] | "magnet\_belt\_x" | "magnet\_belt\_y" | "magnet\_belt\_z" |
| [43] | "roll\_arm" | "pitch\_arm" | "yaw\_arm" |
| [46] | "total\_accel\_arm" | "var\_accel\_arm" | "avg\_roll\_arm" |
| [49] | "stddev\_roll\_arm" | "var\_roll\_arm" | "avg\_pitch\_arm" |
| [52] | "stddev\_pitch\_arm" | "var\_pitch\_arm" | "avg\_yaw\_arm" |
| [55] | "stddev\_yaw\_arm" | "var\_yaw\_arm" | "gyros\_arm\_x" |
| [58] | "gyros\_arm\_y" | "gyros\_arm\_z" | "accel\_arm\_x" |
| [61] | "accel\_arm\_y" | "accel\_arm\_z" | "magnet\_arm\_x" |
| [64] | "magnet\_arm\_y" | "magnet\_arm\_z" | "kurtosis\_roll\_ar |
| m" |  |  |  |
| [67] | "kurtosis\_picth\_arm" | "kurtosis\_yaw\_arm" | "skewness\_roll\_ar |
| m" |  |  |  |
| [70] | "skewness\_pitch\_arm" | "skewness\_yaw\_arm" | "max\_roll\_arm" |
| [73] | "max\_picth\_arm" | "max\_yaw\_arm" | "min\_roll\_arm" |
| [76] | "min\_pitch\_arm" | "min\_yaw\_arm" | "amplitude\_roll\_a |
| rm" |  |  |  |
| [79] | "amplitude\_pitch\_arm" | "amplitude\_yaw\_arm" | "roll\_dumbbell" |
| [82] | "pitch\_dumbbell" | "yaw\_dumbbell" | "kurtosis\_roll\_du |

mbbell"

[85] "kurtosis\_picth\_dumbbell" "skewness\_roll\_dumbbell" "skewness\_pitch\_d umbbell"

[88] "max\_roll\_dumbbell" "max\_picth\_dumbbell" "max\_yaw\_dumbbell "

[91] "min\_roll\_dumbbell" "min\_pitch\_dumbbell" "min\_yaw\_dumbbell "

[94] "amplitude\_roll\_dumbbell" "amplitude\_pitch\_dumbbell" "amplitude\_yaw\_du mbbell"

[97] "total\_accel\_dumbbell" "var\_accel\_dumbbell" "avg\_roll\_dumbbel l"

[100] "stddev\_roll\_dumbbell" "var\_roll\_dumbbell" "avg\_pitch\_dumbbe ll"

[103] "stddev\_pitch\_dumbbell" "var\_pitch\_dumbbell" "avg\_yaw\_dumbbell "

[106] "stddev\_yaw\_dumbbell" "var\_yaw\_dumbbell" "gyros\_dumbbell\_x "

[109] "gyros\_dumbbell\_y" "gyros\_dumbbell\_z" "accel\_dumbbell\_x "

[112] "accel\_dumbbell\_y" "accel\_dumbbell\_z" "magnet\_dumbbell\_ x"

[115] "magnet\_dumbbell\_y" "magnet\_dumbbell\_z" "roll\_forearm"

[118] "pitch\_forearm" "yaw\_forearm" "kurtosis\_roll\_fo rearm"

[121] "kurtosis\_picth\_forearm" "skewness\_roll\_forearm" "skewness\_pitch\_f orearm"

[124] "max\_roll\_forearm" "max\_picth\_forearm" "max\_yaw\_forearm"

[127] "min\_roll\_forearm" "min\_pitch\_forearm" "min\_yaw\_forearm"

[130] "amplitude\_roll\_forearm" "amplitude\_pitch\_forearm" "amplitude\_yaw\_fo rearm"

[133] "total\_accel\_forearm" "var\_accel\_forearm" "avg\_roll\_forearm "

[136] "stddev\_roll\_forearm" "var\_roll\_forearm" "avg\_pitch\_forear m"

[139] "stddev\_pitch\_forearm" "var\_pitch\_forearm" "avg\_yaw\_forearm"

[142] "stddev\_yaw\_forearm" "var\_yaw\_forearm" "gyros\_forearm\_x"

[145] "gyros\_forearm\_y" "gyros\_forearm\_z" "accel\_forearm\_x"

[148] "accel\_forearm\_y" "accel\_forearm\_z" "magnet\_forearm\_x "

[151] "magnet\_forearm\_y" "magnet\_forearm\_z" "accel\_forearm\_y. 1"

[154] "accel\_forearm\_z.1" "magnet\_forearm\_x.1" "magnet\_forearm\_y

.1"

[157] "magnet\_forearm\_z.1" "classe"

* dim(data) [1] 4024 158
* pairs(data[1:10])
* # enable multi-core processing
* library(doParallel)
* cl <- makeCluster(detectCores())
* registerDoParallel()
* set.seed(12345)
* dataTrain<-data[1:4004,]
* dataTest<-data[4005:4024,]
* head(dataTrain)

user\_name raw\_timestamp\_part\_1 raw\_timestamp\_part\_2 cvtd\_timestamp new\_wi ndow

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  no | eurico |  | 1322489729 |  | 34670 28/11/2011 14:15 |
| 2 | eurico |  | 1322489729 |  | 62641 28/11/2011 14:15 |
| no  3 | eurico |  | 1322489729 |  | 70653 28/11/2011 14:15 |
| no |  |  |  |  |  |
| 4 | eurico |  | 1322489729 |  | 82654 28/11/2011 14:15 |
| no  5 | eurico |  | 1322489729 |  | 90637 28/11/2011 14:15 |
| no |  |  |  |  |  |
| 6 | eurico |  | 1322489729 |  | 170626 28/11/2011 14:15 |
| no | num\_window | roll\_belt | pitch\_belt | yaw\_belt | total\_accel\_belt kurtosis\_roll\_bel |
| t |  |  |  |  |  |
| 1 | 1 | 3.70 | 41.6 | -82.8 | 3 -1.0356 |
| 6 |  |  |  |  |  |
| 2 | 1 | 3.66 | 42.8 | -82.5 | 2 -1.0356 |
| 6 |  |  |  |  |  |
| 3 | 1 | 3.58 | 43.7 | -82.3 | 1 -1.0356 |
| 6 |  |  |  |  |  |
| 4 | 1 | 3.56 | 44.4 | -82.1 | 1 -1.0356 |
| 6 |  |  |  |  |  |
| 5 | 1 | 3.57 | 45.1 | -81.9 | 1 -1.0356 |
| 6 |  |  |  |  |  |

6 1 3.45 45.6 -81.9 1 -1.0356

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 |  | | | | | | | |
| kurtosis\_picth\_belt | | | skewness\_roll\_belt | | skewness\_roll\_belt.1 | | | max\_roll\_belt |
| 1 -0.39133 | | | 0.005406 | | 0.045115 | | | -4.1 |
| 2 -0.39133 | | | 0.005406 | | 0.045115 | | | -4.1 |
| 3 -0.39133 | | | 0.005406 | | 0.045115 | | | -4.1 |
| 4 -0.39133 | | | 0.005406 | | 0.045115 | | | -4.1 |
| 5 -0.39133 | | | 0.005406 | | 0.045115 | | | -4.1 |
| 6 -0.39133 | | | 0.005406 | | 0.045115 | | | -4.1 |
| max\_picth\_belt max\_yaw\_belt min\_roll\_belt | | | | | | min\_pitch\_belt min\_yaw\_belt | | |
| 1 20 -1 -7.25 | | | | | | 18 -1 | | |
| 2 20 -1 -7.25 | | | | | | 18 -1 | | |
| 3 20 -1 -7.25 | | | | | | 18 -1 | | |
| 4 20 -1 -7.25 | | | | | | 18 -1 | | |
| 5 20 -1 -7.25 | | | | | | 18 -1 | | |
| 6 20 -1 -7.25 | | | | | | 18 -1 | | |
| amplitude\_roll\_belt amplitude\_pitch\_belt | | | | | | amplitude\_yaw\_belt var\_total\_accel | | |
| \_belt | | |  | |  |  | |  |
| 1 | | 1.345 | | 2 | | | 0 |  |
| 0.3 | |  | |  | | |  |  |
| 2 | | 1.345 | | 2 | | | 0 |  |
| 0.3 | |  | |  | | |  |  |
| 3 | | 1.345 | | 2 | | | 0 |  |
| 0.3 | |  | |  | | |  |  |
| 4 | | 1.345 | | 2 | | | 0 |  |
| 0.3 | |  | |  | | |  |  |
| 5 | | 1.345 | | 2 | | | 0 |  |
| 0.3 | |  | |  | | |  |  |
| 6 | | 1.345 | | 2 | | | 0 |  |
| 0.3 | |  | |  | | |  |  |
| avg\_roll\_belt | | stddev\_roll\_belt | | var\_roll\_belt | | | avg\_pitch\_belt | stddev\_pitch\_be |
| lt | |  |  |  |  |  |  |  |
| 1 | 121.9 | 0.6 | | 0.35 | | | 25.75 | 0. |
| 35 |  |  | |  | | |  |  |
| 2 | 121.9 | 0.6 | | 0.35 | | | 25.75 | 0. |
| 35 |  |  | |  | | |  |  |
| 3 | 121.9 | 0.6 | | 0.35 | | | 25.75 | 0. |
| 35 |  |  | |  | | |  |  |
| 4 | 121.9 | 0.6 | | 0.35 | | | 25.75 | 0. |
| 35 |  |  | |  | | |  |  |
| 5 | 121.9 | 0.6 | | 0.35 | | | 25.75 | 0. |
| 35 |  |  | |  | | |  |  |
| 6 | 121.9 | 0.6 | | 0.35 | | | 25.75 | 0. |
| 35 |  |  | |  | | |  |  |
| var\_pitch\_belt avg\_yaw\_belt stddev\_yaw\_belt var\_yaw\_belt gyros\_belt\_x gyros  \_belt\_y | | | | | | | | |
| 1 | 0.1 | -4.95 | | 0.4 | | | 0.17 | 2.02 |
| 0.18 |  |  | |  | | |  |  |
| 2 | 0.1 | -4.95 | | 0.4 | | | 0.17 | 1.96 |
| 0.14 |  |  | |  | | |  |  |
| 3 | 0.1 | -4.95 | | 0.4 | | | 0.17 | 1.88 |
| 0.08 |  |  | |  | | |  |  |
| 4 | 0.1 | -4.95 | | 0.4 | | | 0.17 | 1.80 |
| 0.03 |  |  | |  | | |  |  |
| 5 | 0.1 | -4.95 | | 0.4 | | | 0.17 | 1.77 |
| 0.00 |  |  | |  | | |  |  |

6 0.1 -4.95 0.4 0.17 1.75

-0.03

gyros\_belt\_z accel\_belt\_x accel\_belt\_y accel\_belt\_z magnet\_belt\_x magnet\_be lt\_y

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0.02 | -3 | | -18 | | | 22 | 387 | |
| 525 |  |  | |  | | |  |  | |
| 2 | 0.05 | -2 | | -13 | | | 16 | 405 | |
| 512 |  |  | |  | | |  |  | |
| 3 | 0.05 | -2 | | -6 | | | 8 | 409 | |
| 511 |  |  | |  | | |  |  | |
| 4 | 0.08 | -6 | | -5 | | | 7 | 422 | |
| 513 |  |  | |  | | |  |  | |
| 5 | 0.13 | -4 | | -9 | | | 0 | 418 | |
| 508 |  |  | |  | | |  |  | |
| 6 | 0.16 | 1 | | -9 | | | -5 | 432 | |
| 510 |  |  | |  | | |  |  | |
| magnet\_belt\_z roll\_arm pitch\_arm yaw\_arm total\_accel\_arm var\_accel\_arm avg\_ roll\_arm | | | | | | | | | |
| 1 | -267 | 132 | -43.7 | | | -53.6 | 38 | | 65.0977 |
| 76.22175 |  |  |  | | |  |  | |  |
| 2 | -254 | 129 | -45.3 | | | -49.0 | 38 | | 65.0977 |
| 76.22175 |  |  |  | | |  |  | |  |
| 3 | -244 | 125 | -46.8 | | | -43.7 | 35 | | 65.0977 |
| 76.22175 |  |  |  | | |  |  | |  |
| 4 | -221 | 120 | -48.1 | | | -38.1 | 35 | | 65.0977 |
| 76.22175 |  |  |  | | |  |  | |  |
| 5 | -208 | 115 | -49.1 | | | -31.7 | 34 | | 65.0977 |
| 76.22175 |  |  |  | | |  |  | |  |
| 6 | -189 | 110 | -49.6 | | | -25.8 | 33 | | 65.0977 |
| 76.22175 |  |  |  | | |  |  | |  |
| stddev\_roll\_arm | | var\_roll\_arm | | | avg\_pitch\_arm | | stddev\_pitch\_arm | | var\_pitch\_arm |
| 1 16.1039 | | 259.3599 | | | -10.1695 | | 10.66725 | | 113.7978 |
| 2 16.1039 | | 259.3599 | | | -10.1695 | | 10.66725 | | 113.7978 |
| 3 16.1039 | | 259.3599 | | | -10.1695 | | 10.66725 | | 113.7978 |
| 4 16.1039 | | 259.3599 | | | -10.1695 | | 10.66725 | | 113.7978 |
| 5 16.1039 | | 259.3599 | | | -10.1695 | | 10.66725 | | 113.7978 |
| 6 16.1039 | | 259.3599 | | | -10.1695 | | 10.66725 | | 113.7978 |

|  |  |  |
| --- | --- | --- |
| avg\_yaw\_arm | stddev\_yaw\_arm var\_yaw\_arm gyros\_arm\_x gyros\_arm\_y | gyros\_arm\_z |
| 1 19.0615 | 35.8809 1287.463 2.65 -0.61 | -0.02 |
| 2 19.0615 | 35.8809 1287.463 2.79 -0.64 | -0.11 |
| 3 19.0615 | 35.8809 1287.463 2.91 -0.69 | -0.15 |
| 4 19.0615 | 35.8809 1287.463 3.08 -0.72 | -0.23 |
| 5 19.0615 | 35.8809 1287.463 3.20 -0.77 | -0.25 |
| 6 19.0615 | 35.8809 1287.463 3.31 -0.83 | -0.30 |
| accel\_arm\_x | accel\_arm\_y accel\_arm\_z magnet\_arm\_x magnet\_arm\_y | magnet\_arm\_z |
| 1 143 | 30 -346 556 -205 | -374 |
| 2 146 | 35 -339 599 -206 | -335 |
| 3 156 | 44 -307 613 -198 | -319 |
| 4 158 | 52 -305 646 -186 | -268 |
| 5 163 | 55 -288 670 -175 | -241 |
| 6 160 | 59 -274 696 -174 | -193 |

|  |  |  |  |
| --- | --- | --- | --- |
| kurtosis\_roll\_arm | kurtosis\_picth\_arm | kurtosis\_yaw\_arm | skewness\_roll\_arm |
| 1 -1.18224 | -0.96912 | -0.86977 | 0.12353 |
| 2 -1.18224 | -0.96912 | -0.86977 | 0.12353 |
| 3 -1.18224 | -0.96912 | -0.86977 | 0.12353 |
| 4 -1.18224 | -0.96912 | -0.86977 | 0.12353 |
| 5 -1.18224 | -0.96912 | -0.86977 | 0.12353 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 6 -1.18224 -0.96912 -0.86977 0.12353 | | | | | |
| skewness\_pitch\_arm | | skewness\_yaw\_arm | max\_roll\_arm | max\_picth\_arm | max\_yaw\_arm |
| 1 -0.10319 | | 0.059765 | 8.45 | 77.25 | 38 |
| 2 -0.10319 | | 0.059765 | 8.45 | 77.25 | 38 |
| 3 -0.10319 | | 0.059765 | 8.45 | 77.25 | 38 |
| 4 -0.10319 | | 0.059765 | 8.45 | 77.25 | 38 |
| 5 -0.10319 | | 0.059765 | 8.45 | 77.25 | 38 |
| 6 -0.10319 | | 0.059765 | 8.45 | 77.25 | 38 |
| min\_roll\_arm min\_pitch\_arm min\_yaw\_arm amplitude\_roll\_arm amplitude\_pitch\_a rm | | | | | |
| 1 | -33.6 | -58.6 | 10 | 36.945 | 121 |
| .5 |  |  |  |  |  |
| 2 | -33.6 | -58.6 | 10 | 36.945 | 121 |
| .5 |  |  |  |  |  |
| 3 | -33.6 | -58.6 | 10 | 36.945 | 121 |
| .5 |  |  |  |  |  |
| 4 | -33.6 | -58.6 | 10 | 36.945 | 121 |
| .5 |  |  |  |  |  |
| 5 | -33.6 | -58.6 | 10 | 36.945 | 121 |
| .5 |  |  |  |  |  |
| 6 | -33.6 | -58.6 | 10 | 36.945 | 121 |
| .5 |  |  |  |  |  |
| amplitude\_yaw\_arm roll\_dumbbell pitch\_dumbbell yaw\_dumbbell kurtosis\_roll\_d umbbell | | | | | |
| 1 | 27 | 51.23554 | 11.698847 | 104.26473 | - |
| 0.09595 |  |  |  |  |  |
| 2 | 27 | 55.82442 | 9.645819 | 100.22805 | - |
| 0.09595 |  |  |  |  |  |
| 3 | 27 | 55.46983 | 6.875244 | 101.08411 | - |
| 0.09595 |  |  |  |  |  |
| 4 | 27 | 55.94486 | 11.079297 | 99.78456 | - |
| 0.09595 |  |  |  |  |  |
| 5 | 27 | 55.21174 | 11.426833 | 100.42258 | - |
| 0.09595 |  |  |  |  |  |
| 6 | 27 | 54.24731 | 14.126636 | 100.61574 | - |
| 0.09595 |  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| kurtosis\_picth\_dumbbell | | skewness\_roll\_dumbbell | | skewness\_pitch\_dumbbell |
| 1 -0.4422 | | 0.0819 | | -0.216 |
| 2 -0.4422 | | 0.0819 | | -0.216 |
| 3 -0.4422 | | 0.0819 | | -0.216 |
| 4 -0.4422 | | 0.0819 | | -0.216 |
| 5 -0.4422 | | 0.0819 | | -0.216 |
| 6 -0.4422 | | 0.0819 | | -0.216 |
| max\_roll\_dumbbell | max\_picth\_dumbbell | | max\_yaw\_dumbbell min\_roll\_dumbbell | |
| 1 41.85 | 133 | | -0.1 -26.75 | |
| 2 41.85 | 133 | | -0.1 -26.75 | |
| 3 41.85 | 133 | | -0.1 -26.75 | |
| 4 41.85 | 133 | | -0.1 -26.75 | |
| 5 41.85 | 133 | | -0.1 -26.75 | |
| 6 41.85 | 133 | | -0.1 -26.75 | |
| min\_pitch\_dumbbell  \_dumbbell | min\_yaw\_dumbbell | | amplitude\_roll\_dumbbell amplitude\_pitch | |
| 1 20.2 | -0.1 | | 55.71 | |
| 54.74 |  | |  | |
| 2 20.2 | -0.1 | | 55.71 | |
| 54.74 |  | |  | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 3 | 20.2 | -0.1 | 55.71 | |
| 54.74 |  |  |  | |
| 4 | 20.2 | -0.1 | 55.71 | |
| 54.74 |  |  |  | |
| 5 | 20.2 | -0.1 | 55.71 | |
| 54.74 |  |  |  | |
| 6 | 20.2 | -0.1 | 55.71 | |
| 54.74 |  |  |  | |
| amplitude\_yaw\_dumbbell total\_accel\_dumbbell var\_accel\_dumbbell avg\_roll\_dum bbell | | | | |
| 1 | | 0 | 4 2.41635 -5. | |
| 11805 | |  |  | |
| 2 | | 0 | 4 2.41635 -5. | |
| 11805 | |  |  | |
| 3 | | 0 | 4 2.41635 -5. | |
| 11805 | |  |  | |
| 4 | | 0 | 5 2.41635 -5. | |
| 11805 | |  |  | |
| 5 | | 0 | 4 2.41635 -5. | |
| 11805 | |  |  | |
| 6 | | 0 | 4 2.41635 -5. | |
| 11805 | |  |  | |
| stddev\_roll\_dumbbell | | var\_roll\_dumbbell | avg\_pitch\_dumbbell stddev\_pitch\_dumb | |
| bell |  |  |  | |
| 1 | 17.058 | 291.001 | 13.9312 | 14. |
| 1062 |  |  |  |  |
| 2 | 17.058 | 291.001 | 13.9312 | 14. |
| 1062 |  |  |  |  |
| 3 | 17.058 | 291.001 | 13.9312 | 14. |
| 1062 |  |  |  |  |
| 4 | 17.058 | 291.001 | 13.9312 | 14. |
| 1062 |  |  |  |  |
| 5 | 17.058 | 291.001 | 13.9312 | 14. |
| 1062 |  |  |  |  |
| 6 | 17.058 | 291.001 | 13.9312 | 14. |
| 1062 |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| var\_pitch\_dumbbell | avg\_yaw\_dumbbell | stddev\_yaw\_dumbbell | var\_yaw\_dumbbell |
| 1 199.0775 | 64.7063 | 13.5747 | 184.5578 |
| 2 199.0775 | 64.7063 | 13.5747 | 184.5578 |
| 3 199.0775 | 64.7063 | 13.5747 | 184.5578 |
| 4 199.0775 | 64.7063 | 13.5747 | 184.5578 |
| 5 199.0775 | 64.7063 | 13.5747 | 184.5578 |
| 6 199.0775 | 64.7063 | 13.5747 | 184.5578 |

gyros\_dumbbell\_x gyros\_dumbbell\_y gyros\_dumbbell\_z accel\_dumbbell\_x accel\_d umbbell\_y

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | -0.31 | 0.16 | 0.08 | 5 |
| 21 |  |  |  |  |
| 2 | -0.31 | 0.14 | 0.07 | 4 |
| 22 |  |  |  |  |
| 3 | -0.31 | 0.16 | 0.05 | 3 |
| 23 |  |  |  |  |
| 4 | -0.31 | 0.16 | 0.07 | 5 |
| 24 |  |  |  |  |
| 5 | -0.31 | 0.14 | 0.07 | 5 |
| 23 |  |  |  |  |
| 6 | -0.31 | 0.14 | 0.07 | 6 |
| 22 |  |  |  |  |

accel\_dumbbell\_z magnet\_dumbbell\_x magnet\_dumbbell\_y magnet\_dumbbell\_z roll

\_forearm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | 37 | -471 | 191 | 277 |
| -111 |  |  |  |  |
| 2 | 35 | -472 | 184 | 281 |
| -112 |  |  |  |  |
| 3 | 37 | -468 | 190 | 275 |
| -114 |  |  |  |  |
| 4 | 38 | -469 | 184 | 285 |
| -115 |  |  |  |  |
| 5 | 37 | -468 | 189 | 292 |
| -117 |  |  |  |  |
| 6 | 36 | -473 | 188 | 278 |
| -118 |  |  |  |  |

pitch\_forearm yaw\_forearm kurtosis\_roll\_forearm kurtosis\_picth\_forearm 1 26.5 138 -1.09475 -0.97525

2 26.2 138 -1.09475 -0.97525

3 26.0 137 -1.09475 -0.97525

4 25.8 137 -1.09475 -0.97525

5 25.5 137 -1.09475 -0.97525

6 25.1 137 -1.09475 -0.97525

skewness\_roll\_forearm skewness\_pitch\_forearm max\_roll\_forearm max\_picth\_for earm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 -0.05065 | | 0.17285 | | 49.6 |
| 168 | |  | |  |
| 2 -0.05065 | | 0.17285 | | 49.6 |
| 168 | |  | |  |
| 3 -0.05065 | | 0.17285 | | 49.6 |
| 168 | |  | |  |
| 4 -0.05065 | | 0.17285 | | 49.6 |
| 168 | |  | |  |
| 5 -0.05065 | | 0.17285 | | 49.6 |
| 168 | |  | |  |
| 6 -0.05065 | | 0.17285 | | 49.6 |
| 168  max\_yaw\_forearm min\_roll\_forearm | | min\_pitch\_forearm | | min\_yaw\_forearm |
| 1 -1.1 4.65 | | -168.5 | | -1.1 |
| 2 -1.1 4.65 | | -168.5 | | -1.1 |
| 3 -1.1 4.65 | | -168.5 | | -1.1 |
| 4 -1.1 4.65 | | -168.5 | | -1.1 |
| 5 -1.1 4.65 | | -168.5 | | -1.1 |
| 6 -1.1 4.65 | | -168.5 | | -1.1 |
| amplitude\_roll\_forearm | amplitude\_pitch\_forearm | | amplitude\_yaw\_forearm | |
| 1 32.2 | 341.5 | | 0 | |
| 2 32.2 | 341.5 | | 0 | |
| 3 32.2 | 341.5 | | 0 | |
| 4 32.2 | 341.5 | | 0 | |
| 5 32.2 | 341.5 | | 0 | |
| 6 32.2 | 341.5 | | 0 | |

|  |  |  |  |
| --- | --- | --- | --- |
| total\_accel\_forearm | var\_accel\_forearm | avg\_roll\_forearm | stddev\_roll\_forearm |
| 1 30 | 14.0772 | 27.85936 | 45.16342 |
| 2 31 | 14.0772 | 27.85936 | 45.16342 |
| 3 32 | 14.0772 | 27.85936 | 45.16342 |
| 4 33 | 14.0772 | 27.85936 | 45.16342 |
| 5 34 | 14.0772 | 27.85936 | 45.16342 |
| 6 36 | 14.0772 | 27.85936 | 45.16342 |

var\_roll\_forearm avg\_pitch\_forearm stddev\_pitch\_forearm var\_pitch\_forearm

1 2749.163 25.35597 8.906695 79.33451

2 2749.163 25.35597 8.906695 79.33451

3 2749.163 25.35597 8.906695 79.33451

4 2749.163 25.35597 8.906695 79.33451

5 2749.163 25.35597 8.906695 79.33451

6 2749.163 25.35597 8.906695 79.33451

avg\_yaw\_forearm stddev\_yaw\_forearm var\_yaw\_forearm gyros\_forearm\_x gyros\_fo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| rearm\_y |  | | | |
| 1 | 17.09505 | 74.27584 | 5541.956 | -0.05 |
| -0.37 |  |  |  |  |
| 2 | 17.09505 | 74.27584 | 5541.956 | -0.06 |
| -0.37 |  |  |  |  |
| 3 | 17.09505 | 74.27584 | 5541.956 | -0.05 |
| -0.27 |  |  |  |  |
| 4 | 17.09505 | 74.27584 | 5541.956 | 0.02 |
| -0.24 |  |  |  |  |
| 5 | 17.09505 | 74.27584 | 5541.956 | 0.08 |
| -0.27 |  |  |  |  |
| 6 | 17.09505 | 74.27584 | 5541.956 | 0.14 |
| -0.29 |  |  |  |  |

gyros\_forearm\_z accel\_forearm\_x accel\_forearm\_y accel\_forearm\_z magnet\_fore arm\_x

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | -0.43 | -170 | 155 | 184 |
| -1160 |  |  |  |  |
| 2 | -0.59 | -178 | 164 | 182 |
| -1150 |  |  |  |  |
| 3 | -0.72 | -182 | 172 | 185 |
| -1130 |  |  |  |  |
| 4 | -0.79 | -185 | 182 | 188 |
| -1120 |  |  |  |  |
| 5 | -0.82 | -188 | 195 | 188 |
| -1100 |  |  |  |  |
| 6 | -0.82 | -208 | 207 | 190 |
| -1090 |  |  |  |  |
| magnet\_forearm\_y | | magnet\_forearm\_z | accel\_forearm\_y.1 | accel\_forearm\_z.1 |
| 1 1400 | | -876 | 155 | 184 |
| 2 1410 | | -871 | 164 | 182 |
| 3 1400 | | -863 | 172 | 185 |
| 4 1400 | | -855 | 182 | 188 |
| 5 1400 | | -843 | 195 | 188 |
| 6 1400 | | -838 | 207 | 190 |

magnet\_forearm\_x.1 magnet\_forearm\_y.1 magnet\_forearm\_z.1 classe 1 -1160 1400 -876 E

2 -1150 1410 -871 E

3 -1130 1400 -863 E

4 -1120 1400 -855 E

5 -1100 1400 -843 E

6 -1090 1400 -838 E

* head(dataTest)

user\_name raw\_timestamp\_part\_1 raw\_timestamp\_part\_2 cvtd\_timestamp new\_ window

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4005  no | pedro | 1323095020 | 504350 | 5/12/2011 | 14:23 |
| 4006 | pedro | 1323095020 | 504423 | 5/12/2011 | 14:23 |
| no  4007 | pedro | 1323095020 | 504460 | 5/12/2011 | 14:23 |
| no |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4008  no | pedro | 1323095020 | 532277 | | 5/12/2011 | | 14:23 |
| 4009  no | pedro | 1323095020 | 532302 | | 5/12/2011 | | 14:23 |
| 4010 | pedro | 1323095020 | 572363 | | 5/12/2011 | | 14:23 |
| no |  |  |  | |  | |  |
| belt | num\_window roll\_belt pitch\_belt yaw\_belt total\_accel\_belt kurtosis\_roll\_ | | | | | | |
| 4005 | 91 122 25.9 -3.54 19 -1.0 | | | | | | |
| 3566 |  | | | | | | |
| 4006 | 91 122 25.9 -3.48 19 -1.0 | | | | | | |
| 3566 |  | | | | | | |
| 4007 | 91 122 25.8 -3.39 19 -1.0 | | | | | | |
| 3566 |  | | | | | | |
| 4008 | 91 122 25.8 -3.33 19 -1.0 | | | | | | |
| 3566 |  | | | | | | |
| 4009 | 91 122 25.8 -3.30 19 -1.0 | | | | | | |
| 3566 |  | | | | | | |
| 4010 | 91 122 25.8 -3.29 19 -1.0 | | | | | | |
| 3566 |  | | | | | | |
|  | kurtosis\_picth\_belt skewness\_roll\_belt skewness\_roll\_belt.1 max\_roll\_bel | | | | | | |
| t |  | | | | | | |
| 4005 | -0.39133 0.005406 0.045115 -4. | | | | | | |
| 1 |  | | | | | | |
| 4006 | -0.39133 0.005406 0.045115 -4. | | | | | | |
| 1 |  | | | | | | |
| 4007 | -0.39133 0.005406 0.045115 -4. | | | | | | |
| 1 |  | | | | | | |
| 4008 | -0.39133 0.005406 0.045115 -4. | | | | | | |
| 1 |  | | | | | | |
| 4009 | -0.39133 0.005406 0.045115 -4. | | | | | | |
| 1 |  | | | | | | |
| 4010 | -0.39133 0.005406 0.045115 -4. | | | | | | |
| 1 |  | | | | | | |
| 4005 | max\_picth\_belt max\_yaw\_belt min\_roll\_belt min\_pitch\_belt min\_yaw\_belt  20 -1 -7.25 18 -1 | | | | | | |
| 4006 | 20 -1 -7.25 18 -1 | | | | | | |
| 4007 | 20 -1 -7.25 18 -1 | | | | | | |
| 4008 | 20 -1 -7.25 18 -1 | | | | | | |
| 4009 | 20 -1 -7.25 18 -1 | | | | | | |
| 4010 | 20 -1 -7.25 18 -1 | | | | | | |
|  | amplitude\_roll\_belt amplitude\_pitch\_belt amplitude\_yaw\_belt var\_total\_ac | | | | | | |
| cel\_belt | | | | | | | |
| 4005 |  | 1.345 | 2 | 0 | |  | |
| 0.3 |  |  |  |  | |  | |
| 4006 |  | 1.345 | 2 | 0 | |  | |
| 0.3 |  |  |  |  | |  | |
| 4007 |  | 1.345 | 2 | 0 | |  | |
| 0.3 |  |  |  |  | |  | |
| 4008 |  | 1.345 | 2 | 0 | |  | |
| 0.3 |  |  |  |  | |  | |
| 4009 |  | 1.345 | 2 | 0 | |  | |
| 0.3 |  |  |  |  | |  | |
| 4010 |  | 1.345 | 2 | 0 | |  | |
| 0.3 | avg\_roll\_belt | stddev\_roll\_belt | var\_roll\_belt | avg\_pitch\_belt | | stddev\_pitch | |
| \_belt | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 4005 | 121.9 0.6 0.35 25.75 | | | | | |
| 0.35 |  | | | | | |
| 4006 | 121.9 0.6 0.35 25.75 | | | | | |
| 0.35 |  | | | | | |
| 4007 | 121.9 0.6 0.35 25.75 | | | | | |
| 0.35 |  | | | | | |
| 4008 | 121.9 0.6 0.35 25.75 | | | | | |
| 0.35 |  | | | | | |
| 4009 | 121.9 0.6 0.35 25.75 | | | | | |
| 0.35 |  | | | | | |
| 4010 | 121.9 0.6 0.35 25.75 | | | | | |
| 0.35 |  | | | | | |
|  | var\_pitch\_belt avg\_yaw\_belt stddev\_yaw\_belt var\_yaw\_belt gyros\_belt\_x | | | | | |
| 4005 | 0.1 -4.95 0.4 0.17 -0.39 | | | | | |
| 4006 | 0.1 -4.95 0.4 0.17 -0.39 | | | | | |
| 4007 | 0.1 -4.95 0.4 0.17 -0.37 | | | | | |
| 4008 | 0.1 -4.95 0.4 0.17 -0.39 | | | | | |
| 4009 | 0.1 -4.95 0.4 0.17 -0.39 | | | | | |
| 4010 | 0.1 -4.95 0.4 0.17 -0.40  gyros\_belt\_y gyros\_belt\_z accel\_belt\_x accel\_belt\_y accel\_belt\_z magnet\_ | | | | | |
| belt\_x | | | | | | |
| 4005 | -0.03 -0.48 -39 71 -170 | | | | |  |
| -1 |  | | | | |  |
| 4006 | -0.03 -0.46 -39 69 -172 | | | | |  |
| 1 |  | | | | |  |
| 4007 | -0.03 -0.46 -40 68 -170 | | | | |  |
| -4 |  | | | | |  |
| 4008 | -0.03 -0.46 -42 69 -167 | | | | |  |
| -6 |  | | | | |  |
| 4009 | -0.03 -0.46 -42 70 -168 | | | | |  |
| -6 |  | | | | |  |
| 4010 | -0.03 -0.46 -42 72 -171 | | | | |  |
| -4 |  | | | | |  |
|  | magnet\_belt\_y magnet\_belt\_z roll\_arm pitch\_arm yaw\_arm total\_accel\_arm | | | | |  |
| 4005 | 582 -356 83.0 23.1 47.1 23 | | | | |  |
| 4006 | 587 -358 81.6 22.1 44.5 25 | | | | |  |
| 4007 | 586 -362 80.2 21.0 41.9 24 | | | | |  |
| 4008 | 589 -366 78.9 20.0 39.4 26 | | | | |  |
| 4009 | 590 -368 77.6 18.9 36.7 27 | | | | |  |
| 4010 | 591 -354 76.5 17.7 34.0 28 | | | | |  |
|  | var\_accel\_arm avg\_roll\_arm stddev\_roll\_arm var\_roll\_arm avg\_pitch\_arm | | | | |  |
| 4005 | 65.0977 76.22175 16.1039 259.3599 -10.1695 | | | | |  |
| 4006 | 65.0977 76.22175 16.1039 259.3599 -10.1695 | | | | |  |
| 4007 | 65.0977 76.22175 16.1039 259.3599 -10.1695 | | | | |  |
| 4008 | 65.0977 76.22175 16.1039 259.3599 -10.1695 | | | | |  |
| 4009 | 65.0977 76.22175 16.1039 259.3599 -10.1695 | | | | |  |
| 4010 | 65.0977 76.22175 16.1039 259.3599 -10.1695  stddev\_pitch\_arm var\_pitch\_arm avg\_yaw\_arm stddev\_yaw\_arm var\_yaw\_arm | | | | | gy |
| 4005 | 10.66725 | 113.7978 | 19.0615 | 35.8809 | 1287.463 | |
| -2.06 |  |  |  |  |  | |
| 4006 | 10.66725 | 113.7978 | 19.0615 | 35.8809 | 1287.463 | |
| -2.06 |  |  |  |  |  | |
| 4007 | 10.66725 | 113.7978 | 19.0615 | 35.8809 | 1287.463 | |
| -2.07 |  |  |  |  |  | |
| 4008 | 10.66725 | 113.7978 | 19.0615 | 35.8809 | 1287.463 | |
| -2.14 |  |  |  |  |  | |

ros\_arm\_x

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4009 | 10.66725 | | | 113.7978 | 19.0615 | 35.8809 | 1287.463 | |
| -2.14 |  | | |  |  |  |  | |
| 4010 | 10.66725 | | | 113.7978 | 19.0615 | 35.8809 | 1287.463 | |
| -2.12 |  | | |  |  |  |  | |
|  | gyros\_arm\_y | | gyros\_arm\_z accel\_arm\_x accel\_arm\_y accel\_arm\_z magnet\_arm\_x | | | | | |
| 4005 | 0.55 | | -0.26 182 28 138 342 | | | | | |
| 4006 | 0.56 | | -0.31 196 23 148 370 | | | | | |
| 4007 | 0.51 | | -0.33 193 18 140 388 | | | | | |
| 4008 | 0.48 | | -0.31 207 21 140 432 | | | | | |
| 4009 | 0.43 | | -0.28 226 12 140 448 | | | | | |
| 4010 | 0.37  magnet\_arm\_y | | -0.20 235 9 143 482  magnet\_arm\_z kurtosis\_roll\_arm kurtosis\_picth\_arm kurtosis\_ | | | | | |
| yaw\_arm | |  |  | |  |  | |  |
| 4005 | | 280 | 503 | | -1.18224 | -0.96912 | | - |
| 0.86977 | |  |  | |  |  | |  |
| 4006 | | 263 | 485 | | -1.18224 | -0.96912 | | - |
| 0.86977 | |  |  | |  |  | |  |
| 4007 | | 261 | 486 | | -1.18224 | -0.96912 | | - |
| 0.86977 | |  |  | |  |  | |  |
| 4008 | | 249 | 472 | | -1.18224 | -0.96912 | | - |
| 0.86977 | |  |  | |  |  | |  |
| 4009 | | 239 | 454 | | -1.18224 | -0.96912 | | - |
| 0.86977 | |  |  | |  |  | |  |
| 4010 | | 225 | 437 | | -1.18224 | -0.96912 | | - |
| 0.86977 | |  |  | |  |  | |  |
| skewness\_roll\_arm skewness\_pitch\_arm skewness\_yaw\_arm max\_roll\_arm max\_p icth\_arm | | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4005 0.12353 -0.10319 | | | 0.059765 8.45 | | |
| 77.25 | | |  | | |
| 4006 0.12353 -0.10319 | | | 0.059765 8.45 | | |
| 77.25 | | |  | | |
| 4007 0.12353 -0.10319 | | | 0.059765 8.45 | | |
| 77.25 | | |  | | |
| 4008 0.12353 -0.10319 | | | 0.059765 8.45 | | |
| 77.25 | | |  | | |
| 4009 0.12353 -0.10319 | | | 0.059765 8.45 | | |
| 77.25 | | |  | | |
| 4010 0.12353 -0.10319 | | | 0.059765 8.45 | | |
| 77.25  max\_yaw\_arm min\_roll\_arm min\_pitch\_arm | | | min\_yaw\_arm amplitude\_roll\_arm | | |
| 4005 38 -33.6 -58.6 | | | 10 36.945 | | |
| 4006 38 -33.6 -58.6 | | | 10 36.945 | | |
| 4007 38 -33.6 -58.6 | | | 10 36.945 | | |
| 4008 38 -33.6 -58.6 | | | 10 36.945 | | |
| 4009 38 -33.6 -58.6 | | | 10 36.945 | | |
| 4010 38 -33.6 -58.6 | | | 10 36.945 | | |
| amplitude\_pitch\_arm amplitude\_yaw\_arm | | | roll\_dumbbell pitch\_dumbbell yaw\_d | | |
| umbbell | | |  | | |
| 4005 | 121.5 | 27 | -64.335693 | 34.112879 | 8 |
| 1.36272 |  |  |  |  |  |
| 4006 | 121.5 | 27 | -40.195925 | 53.186300 | 8 |
| 7.56417 |  |  |  |  |  |
| 4007 | 121.5 | 27 | -2.792178 | 62.646067 | 9 |
| 4.35153 |  |  |  |  |  |
| 4008 | 121.5 | 27 | 10.384733 | 49.182165 | 10 |
| 6.61750 |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4009 | | 121.5 | | 27 | | 16.647582 | 22.278218 12 |
| 9.09792 | |  | |  | |  |  |
| 4010 | | 121.5 | | 27 | | -14.860425 | 6.172999 14 |
| 0.97044 | |  | |  | |  |  |
|  | kurtosis\_roll\_dumbbell | | | kurtosis\_picth\_dumbbell skewness\_roll\_dumbbell | | | |
| 4005 | -0.09595 | | | -0.4422 0.0819 | | | |
| 4006 | -0.09595 | | | -0.4422 0.0819 | | | |
| 4007 | -0.09595 | | | -0.4422 0.0819 | | | |
| 4008 | -0.09595 | | | -0.4422 0.0819 | | | |
| 4009 | -0.09595 | | | -0.4422 0.0819 | | | |
| 4010 | -0.09595  skewness\_pitch\_dumbbell | | | -0.4422 0.0819  max\_roll\_dumbbell max\_picth\_dumbbell max\_yaw\_dum | | | |
| bbell | | |  | |  | |  |
| 4005 | | | -0.216 | | 41.85 | | 133 |
| -0.1 | | |  | |  | |  |
| 4006 | | | -0.216 | | 41.85 | | 133 |
| -0.1 | | |  | |  | |  |
| 4007 | | | -0.216 | | 41.85 | | 133 |
| -0.1 | | |  | |  | |  |
| 4008 | | | -0.216 | | 41.85 | | 133 |
| -0.1 | | |  | |  | |  |
| 4009 | | | -0.216 | | 41.85 | | 133 |
| -0.1 | | |  | |  | |  |
| 4010 | | | -0.216 | | 41.85 | | 133 |
| -0.1 | | |  | |  | |  |
| min\_roll\_dumbbell | | | min\_pitch\_dumbbell | | min\_yaw\_dumbbell | | amplitude\_roll\_dum |
| bbell | | | | | | | |
| 4005 | -26.75 20.2 -0.1 | | | | | | |
| 55.71 |  | | | | | | |
| 4006 | -26.75 20.2 -0.1 | | | | | | |
| 55.71 |  | | | | | | |
| 4007 | -26.75 20.2 -0.1 | | | | | | |
| 55.71 |  | | | | | | |
| 4008 | -26.75 20.2 -0.1 | | | | | | |
| 55.71 |  | | | | | | |
| 4009 | -26.75 20.2 -0.1 | | | | | | |
| 55.71 |  | | | | | | |
| 4010 | -26.75 20.2 -0.1 | | | | | | |
| 55.71 | amplitude\_pitch\_dumbbell amplitude\_yaw\_dumbbell total\_accel\_dumbbell | | | | | | |
| 4005 | 54.74 0 9 | | | | | | |
| 4006 | 54.74 0 7 | | | | | | |
| 4007 | 54.74 0 7 | | | | | | |
| 4008 | 54.74 0 9 | | | | | | |
| 4009 | 54.74 0 9 | | | | | | |
| 4010 | 54.74 0 8 | | | | | | |
| ell | var\_accel\_dumbbell avg\_roll\_dumbbell stddev\_roll\_dumbbell var\_roll\_dumbb | | | | | | |
| 4005 | 2.41635 -5.11805 17.058 291. | | | | | | |
| 001 |  | | | | | | |
| 4006 | 2.41635 -5.11805 17.058 291. | | | | | | |
| 001 |  | | | | | | |
| 4007 | 2.41635 -5.11805 17.058 291. | | | | | | |
| 001 |  | | | | | | |
| 4008 | 2.41635 -5.11805 17.058 291. | | | | | | |
| 001 |  | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4009 | 2.41635 -5.11805 17.058 291. | | | | |
| 001 |  | | | | |
| 4010 | 2.41635 -5.11805 17.058 291. | | | | |
| 001 |  | | | | |
|  | avg\_pitch\_dumbbell stddev\_pitch\_dumbbell var\_pitch\_dumbbell avg\_yaw\_dumb | | | | |
| bell |  | | | | |
| 4005 | 13.9312 14.1062 199.0775 64. | | | | |
| 7063 |  | | | | |
| 4006 | 13.9312 14.1062 199.0775 64. | | | | |
| 7063 |  | | | | |
| 4007 | 13.9312 14.1062 199.0775 64. | | | | |
| 7063 |  | | | | |
| 4008 | 13.9312 14.1062 199.0775 64. | | | | |
| 7063 |  | | | | |
| 4009 | 13.9312 14.1062 199.0775 64. | | | | |
| 7063 |  | | | | |
| 4010 | 13.9312 14.1062 199.0775 64. | | | | |
| 7063 |  | | | | |
| 4005 | stddev\_yaw\_dumbbell var\_yaw\_dumbbell gyros\_dumbbell\_x gyros\_dumbbell\_y  13.5747 184.5578 0.16 -0.75 | | | | |
| 4006 | 13.5747 184.5578 0.08 -0.79 | | | | |
| 4007 | 13.5747 184.5578 0.03 -0.87 | | | | |
| 4008 | 13.5747 184.5578 -0.02 -0.92 | | | | |
| 4009 | 13.5747 184.5578 -0.02 -0.85 | | | | |
| 4010 | 13.5747 184.5578 0.00 -0.63 | | | | |
|  | gyros\_dumbbell\_z accel\_dumbbell\_x accel\_dumbbell\_y accel\_dumbbell\_z | | | | |
| 4005 | 0.39 29 -52 63 | | | | |
| 4006 | 0.15 35 -27 53 | | | | |
| 4007 | -0.02 42 -2 58 | | | | |
| 4008 | 0.11 41 9 76 | | | | |
| 4009 | 0.33 20 15 87 | | | | |
| 4010 | 0.51 5 -12 80 | | | | |
|  | magnet\_dumbbell\_x magnet\_dumbbell\_y magnet\_dumbbell\_z roll\_forearm pitch | | | | |
| \_forearm | | |  | |  |
| 4005 | | | 494 -550 -105 | | 141 |
| 40.9 | | |  | |  |
| 4006 | | | 501 -554 -91 | | 142 |
| 38.1 | | |  | |  |
| 4007 | | | 514 -539 -104 | | 142 |
| 34.3 | | |  | |  |
| 4008 | | | 515 -533 -108 | | 142 |
| 31.4 | | |  | |  |
| 4009 | | | 526 -525 -98 | | 141 |
| 29.2 | | |  | |  |
| 4010 | | | 537 -517 -108 | | 141 |
| 27.0 | | |  | |  |
| yaw\_forearm | | | kurtosis\_roll\_forearm kurtosis\_picth\_forearm | | skewness\_roll\_f |
| orearm | | | | | |
| 4005 | | 147 | -1.09475 | -0.97525 | -0 |
| .05065 | |  |  |  |  |
| 4006 | | 143 | -1.09475 | -0.97525 | -0 |
| .05065 | |  |  |  |  |
| 4007 | | 137 | -1.09475 | -0.97525 | -0 |
| .05065 | |  |  |  |  |
| 4008 | | 132 | -1.09475 | -0.97525 | -0 |
| .05065 | |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4009 | 128 | -1.09475 | -0.97525 | -0 |
| .05065 |  |  |  |  |
| 4010 | 123 | -1.09475 | -0.97525 | -0 |
| .05065 |  |  |  |  |

|  |  |
| --- | --- |
| m | skewness\_pitch\_forearm max\_roll\_forearm max\_picth\_forearm max\_yaw\_forear |
| 4005 | 0.17285 49.6 168 -1. |
| 1 |  |
| 4006 | 0.17285 49.6 168 -1. |
| 1 |  |
| 4007 | 0.17285 49.6 168 -1. |
| 1 |  |
| 4008 | 0.17285 49.6 168 -1. |
| 1 |  |
| 4009 | 0.17285 49.6 168 -1. |
| 1 |  |
| 4010 | 0.17285 49.6 168 -1. |
| 1 |  |
| m | min\_roll\_forearm min\_pitch\_forearm min\_yaw\_forearm amplitude\_roll\_forear |
| 4005 | 4.65 -168.5 -1.1 32. |
| 2 |  |
| 4006 | 4.65 -168.5 -1.1 32. |
| 2 |  |
| 4007 | 4.65 -168.5 -1.1 32. |
| 2 |  |
| 4008 | 4.65 -168.5 -1.1 32. |
| 2 |  |
| 4009 | 4.65 -168.5 -1.1 32. |
| 2 |  |
| 4010 | 4.65 -168.5 -1.1 32. |
| 2 |  |
|  | amplitude\_pitch\_forearm amplitude\_yaw\_forearm total\_accel\_forearm |
| 4005 | 341.5 0 29 |
| 4006 | 341.5 0 40 |
| 4007 | 341.5 0 39 |
| 4008 | 341.5 0 39 |
| 4009 | 341.5 0 39 |
| 4010 | 341.5 0 38  var\_accel\_forearm avg\_roll\_forearm stddev\_roll\_forearm var\_roll\_forearm |
| 4005 | 14.0772 27.85936 45.16342 2749.163 |
| 4006 | 14.0772 27.85936 45.16342 2749.163 |
| 4007 | 14.0772 27.85936 45.16342 2749.163 |
| 4008 | 14.0772 27.85936 45.16342 2749.163 |
| 4009 | 14.0772 27.85936 45.16342 2749.163 |
| 4010 | 14.0772 27.85936 45.16342 2749.163 |
| 4005 | avg\_pitch\_forearm stddev\_pitch\_forearm var\_pitch\_forearm avg\_yaw\_forearm  25.35597 8.906695 79.33451 17.09505 |
| 4006 | 25.35597 8.906695 79.33451 17.09505 |
| 4007 | 25.35597 8.906695 79.33451 17.09505 |
| 4008 | 25.35597 8.906695 79.33451 17.09505 |
| 4009 | 25.35597 8.906695 79.33451 17.09505 |
| 4010 | 25.35597 8.906695 79.33451 17.09505 |
|  | stddev\_yaw\_forearm var\_yaw\_forearm gyros\_forearm\_x gyros\_forearm\_y |
| 4005 | 74.27584 5541.956 0.16 3.48 |
| 4006 | 74.27584 5541.956 0.11 3.36 |
| 4007 | 74.27584 5541.956 0.21 4.38 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4008 | 74.27584 | 5541.956 | 0.02 | 3.77 |
| 4009 | 74.27584 | 5541.956 | -0.35 | 3.21 |
| 4010 | 74.27584 | 5541.956 | -0.69 | 3.58 |

gyros\_forearm\_z accel\_forearm\_x accel\_forearm\_y accel\_forearm\_z magnet\_f orearm\_x

4005 3.08 12 269 -98

-704

4006 2.76 -51 353 -158

-706

4007 2.03 33 357 -122

-700

4008 1.74 9 359 -125

-684

4009 1.44 -9 352 -143

-673

4010 1.07 -44 335 -153

-652

magnet\_forearm\_y magnet\_forearm\_z accel\_forearm\_y.1 accel\_forearm\_z.1 4005 398 921 269 -98

4006 484 923 353 -158

4007 524 921 357 -122

4008 589 923 359 -125

4009 619 935 352 -143

4010 672 947 335 -153

magnet\_forearm\_x.1 magnet\_forearm\_y.1 magnet\_forearm\_z.1 classe 4005 -704 398 921 C

4006 -706 484 923 C

4007 -700 524 921 C

4008 -684 589 923 C

4009 -673 619 935 C

4010 -652 672 947 C

* indexNA <- as.vector(sapply(dataTrain[,1:158],function(x) {length(which(is. na(x)))!=0}))
* dataTrain <- dataTrain[,!indexNA]
* train\_control<- trainControl(method="cv", number=10)

>

* model<- train(classe ~., data=dataTrain,trControl=train\_control, method="rf ")
* model Random Forest

4004 samples

157 predictor

5 classes: 'A', 'B', 'C', 'D', 'E'

No pre-processing

Resampling: Cross-Validated (10 fold)

Summary of sample sizes: 3604, 3604, 3604, 3604, 3603, 3603, ... Resampling results across tuning parameters:

|  |  |  |
| --- | --- | --- |
| mtry | Accuracy | Kappa |
| 2 | 0.9730274 | 0.9617679 |
| 83 | 1.0000000 | 1.0000000 |
| 165 | 0.9990006 | 0.9985890 |

Accuracy was used to select the optimal model using the largest value. The final value used for the model was mtry = 83.

* # make predictions
* predictions<- predict(model,dataTrain)
* # append predictions
* pred<- cbind(dataTrain,predictions)
* # summarize results
* confusionMatrix<- confusionMatrix(pred$predictions,pred$classe)
* confusionMatrix

Confusion Matrix and Statistics

Reference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Prediction | A | B | C | D | E |
| A | 1365 | 0 | 0 | 0 | 0 |
| B | 0 | 901 | 0 | 0 | 0 |
| C | 0 | 0 | 92 | 0 | 0 |
| D | 0 | 0 | 0 | 276 | 0 |
| E | 0 | 0 | 0 | 0 | 1370 |

Overall Statistics

Accuracy : 1

95% CI : (0.9991, 1)

No Information Rate : 0.3422

P-Value [Acc > NIR] : < 2.2e-16

Kappa : 1 Mcnemar's Test P-Value : NA

Statistics by Class:

|  |  |  |
| --- | --- | --- |
| Class: A Class: B Class: C | Class: D | Class: E |
| Sensitivity 1.0000 1.000 1.00000 | 1.00000 | 1.0000 |
| Specificity 1.0000 1.000 1.00000 | 1.00000 | 1.0000 |
| Pos Pred Value 1.0000 1.000 1.00000 | 1.00000 | 1.0000 |
| Neg Pred Value 1.0000 1.000 1.00000 | 1.00000 | 1.0000 |
| Prevalence 0.3409 0.225 0.02298 | 0.06893 | 0.3422 |
| Detection Rate 0.3409 0.225 0.02298 | 0.06893 | 0.3422 |
| Detection Prevalence 0.3409 0.225 0.02298 | 0.06893 | 0.3422 |
| Balanced Accuracy 1.0000 1.000 1.00000 | 1.00000 | 1.0000 |
| * #how do we create a cross validation scheme |  |  |
| * control <- trainControl(method = 'repeatedcv', |  |  |

+ number = 10,

+ repeats = 3)

* seed <-7
* metric <- 'Accuracy'
* set.seed(seed)
* mtry <- sqrt(ncol(dataTrain))
* tunegrid <- expand.grid(.mtry=mtry)
* rf\_default <- train(pitch\_belt~.,

+ data = dataTrain,

+ method = 'rf',

+ metric = 0,

+ tuneGrid = tunegrid,

+ trControl = control)

Warning message:

In train.default(x, y, weights = w, ...) :

The metric "0" was not in the result set. RMSE will be used instead.

* print(rf\_default) Random Forest

4004 samples

157 predictor

No pre-processing

Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 3602, 3603, 3603, 3603, 3605, 3604, ... Resampling results:

|  |  |  |
| --- | --- | --- |
| RMSE | Rsquared | MAE |
| 0.3719505 | 0.9996205 | 0.1836054 |

Tuning parameter 'mtry' was held constant at a value of 12.56981

* #-------------------------------

>

* # make predictions
* predictions<- predict(rf\_default,dataTest)
* # append predictions
* pred<- cbind(dataTest,predictions)
* # summarize results
* confusionMatrix<- confusionMatrix(pred$predictions,pred$classe) Error: `data` and `reference` should be factors with the same levels.
* confusionMatrix

Confusion Matrix and Statistics

Reference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Prediction | A | B | C | D | E |
| A | 1365 | 0 | 0 | 0 | 0 |
| B | 0 | 901 | 0 | 0 | 0 |
| C | 0 | 0 | 92 | 0 | 0 |
| D | 0 | 0 | 0 | 276 | 0 |
| E | 0 | 0 | 0 | 0 | 1370 |

Overall Statistics

Accuracy : 1

95% CI : (0.9991, 1)

No Information Rate : 0.3422

P-Value [Acc > NIR] : < 2.2e-16

Kappa : 1 Mcnemar's Test P-Value : NA

Statistics by Class:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Class: A | Class: B | Class: C | Class: D | Class: E |
| Sensitivity | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Specificity | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Pos Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Neg Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Rate | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Balanced Accuracy | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |

* varImp(rf\_default)

Error in varImp[, "%IncMSE"] : subscript out of bounds Called from: data.frame(Overall = varImp[, "%IncMSE"]) Browse[1]> #----------------

Browse[1]> # random search for parameters

Browse[1]> control <- trainControl(method = 'repeatedcv',

+ number = 10,

+ repeats = 3,

+ search = 'random')

Browse[1]> # make predictions

Browse[1]> predictions<- predict(rf\_default,dataTest) Browse[1]>

* # append predictions
* pred<- cbind(dataTest,predictions)

>

* # summarize results
* confusionMatrix<- confusionMatrix(pred$predictions,pred$classe) Error: `data` and `reference` should be factors with the same levels.
* confusionMatrix

Confusion Matrix and Statistics

Reference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Prediction | A | B | C | D | E |
| A | 1365 | 0 | 0 | 0 | 0 |
| B | 0 | 901 | 0 | 0 | 0 |
| C | 0 | 0 | 92 | 0 | 0 |
| D | 0 | 0 | 0 | 276 | 0 |
| E | 0 | 0 | 0 | 0 | 1370 |

Overall Statistics

Accuracy : 1

95% CI : (0.9991, 1)

No Information Rate : 0.3422

P-Value [Acc > NIR] : < 2.2e-16

Kappa : 1 Mcnemar's Test P-Value : NA

Statistics by Class:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Class: A | Class: B | Class: C | Class: D | Class: E |
| Sensitivity | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Specificity | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Pos Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Neg Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Rate | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Balanced Accuracy | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| * varImp(random) |  |  |  |  |  |

Error in varImp(random) : object 'random' not found

* #--------------------
* #--------------------------------------------------------------
* # Grid search
* control <- trainControl(method = 'repeatedcv',

+ number = 10,

+ repeats = 3,

+ search = 'grid')

* set.seed(seed)
* tunegrid <- expand.grid(.mtry=c(1:80))
* #mtry <- sqrt(ncol(x))
* rf\_gridsearch <- train(~.,

+ data = dataTrain[1:200,],

+ method = 'rf',

+ metric = metric,

+ tuneGrid = tunegrid,

+ trControl = control)

Error: Please make sure `y` is a factor or numeric value.

* print(rf\_gridsearch)

Error in print(rf\_gridsearch) : object 'rf\_gridsearch' not found

* plot(rf\_gridsearch)

Error in plot(rf\_gridsearch) : object 'rf\_gridsearch' not found

* # make predictions
* predictions<- predict(rf\_gridsearch,dataTest) Error in predict(rf\_gridsearch, dataTest) :

object 'rf\_gridsearch' not found

>

* # append predictions
* pred<- cbind(dataTest,predictions)

>

* # summarize results
* confusionMatrix<- confusionMatrix(pred$predictions,pred$pitch\_belt) Error: `data` and `reference` should be factors with the same levels.
* confusionMatrix

Confusion Matrix and Statistics

Reference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Prediction | A | B | C | D | E |
| A | 1365 | 0 | 0 | 0 | 0 |
| B | 0 | 901 | 0 | 0 | 0 |
| C | 0 | 0 | 92 | 0 | 0 |
| D | 0 | 0 | 0 | 276 | 0 |
| E | 0 | 0 | 0 | 0 | 1370 |

Overall Statistics

Accuracy : 1

95% CI : (0.9991, 1)

No Information Rate : 0.3422

P-Value [Acc > NIR] : < 2.2e-16

Kappa : 1 Mcnemar's Test P-Value : NA

Statistics by Class:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sensitivity | Class: A  1.0000 | Class: B  1.000 | Class: C  1.00000 | Class: D  1.00000 | Class: E  1.0000 |
| Specificity | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Pos Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Neg Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Rate | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |

Detection Prevalence 0.3409 0.225 0.02298 0.06893 0.3422

Balanced Accuracy 1.0000 1.000 1.00000 1.00000 1.0000

* varImp(rf\_gridsearch)

Error in varImp(rf\_gridsearch) : object 'rf\_gridsearch' not found

>

* ---------------------------

+ # Boosting

+ # ---------------------------------------

+ # Boosting model requires three things

+

+ #1- a loss function to be optimized

+ #2- a weak learner to make predictions

+ #3- an additive model to add the weak learners to minimize the loss functio n

+

+ # gradient boosting

+ control <- trainControl(method = 'repeatedcv',

+ number = 5,

+ repeats = 3,

+ search = 'grid')

Error in -`\*tmp\*` : invalid argument to unary operator

>

* seed <- 7
* library(C50)
* set.seed(seed)
* metric <- 'Accuracy'
* gbm\_mod <- train(pitch\_belt~.,

+ data = dataTrain,

+ method = 'gbm',

+ metric = 0,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| +  Iter | trControl = control)  TrainDeviance ValidDeviance | | StepSize | Improve |
| 1 | 290.4643 | nan | 0.1000 | 66.8385 |
| 2 | 240.0107 | nan | 0.1000 | 49.7536 |
| 3 | 199.7165 | nan | 0.1000 | 39.9944 |
| 4 | 166.7692 | nan | 0.1000 | 31.6237 |
| 5 | 138.7180 | nan | 0.1000 | 27.8200 |
| 6 | 117.1658 | nan | 0.1000 | 21.8218 |
| 7 | 99.0041 | nan | 0.1000 | 17.7844 |
| 8 | 84.2149 | nan | 0.1000 | 13.7951 |
| 9 | 71.1916 | nan | 0.1000 | 12.5779 |
| 10 | 60.7509 | nan | 0.1000 | 10.4406 |
| 20 | 16.9581 | nan | 0.1000 | 2.0061 |
| 40 | 4.0588 | nan | 0.1000 | 0.1219 |
| 60 | 2.5921 | nan | 0.1000 | 0.0084 |
| 80 | 2.1022 | nan | 0.1000 | -0.0069 |
| 100 | 1.7142 | nan | 0.1000 | -0.0182 |
| 120 | 1.5353 | nan | 0.1000 | -0.0081 |
| 140 | 1.2641 | nan | 0.1000 | 0.0052 |
| 150 | 1.2063 | nan | 0.1000 | 0.0001 |

Warning messages:

1: In train.default(x, y, weights = w, ...) :

The metric "0" was not in the result set. RMSE will be used instead.

2: In (function (x, y, offset = NULL, misc = NULL, distribution = "bernoulli"

, :

variable 30: amplitude\_yaw\_belt has no variation.

3: In (function (x, y, offset = NULL, misc = NULL, distribution = "bernoulli"

, :

variable 103: amplitude\_yaw\_dumbbell has no variation.

4: In (function (x, y, offset = NULL, misc = NULL, distribution = "bernoulli"

, :

variable 139: amplitude\_yaw\_forearm has no variation.

* print(gbm\_mod)

Stochastic Gradient Boosting

4004 samples

157 predictor

No pre-processing

Resampling: Cross-Validated (10 fold, repeated 3 times)

Summary of sample sizes: 3602, 3603, 3603, 3603, 3605, 3604, ... Resampling results across tuning parameters:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| interaction.depth | n.trees | RMSE | Rsquared | MAE |
| 1 | 50 | 3.870491 | 0.9708972 | 2.0739488 |
| 1 | 100 | 2.518277 | 0.9818947 | 1.1065126 |
| 1 | 150 | 2.258849 | 0.9850289 | 0.9958785 |
| 2 | 50 | 2.183970 | 0.9866430 | 1.0364026 |
| 2 | 100 | 1.662759 | 0.9916854 | 0.8202113 |
| 2 | 150 | 1.485456 | 0.9934375 | 0.7464795 |
| 3 | 50 | 1.950370 | 0.9886048 | 0.9201246 |
| 3 | 100 | 1.529421 | 0.9928336 | 0.7607945 |
| 3 | 150 | 1.330676 | 0.9946265 | 0.6793264 |

Tuning parameter 'shrinkage' was held constant at a value of 0.1 Tuning

parameter 'n.minobsinnode' was held constant at a value of 10

RMSE was used to select the optimal model using the smallest value.

The final values used for the model were n.trees = 150, interaction.depth = 3, shrinkage = 0.1 and n.minobsinnode = 10.

* plot(gbm\_mod)

>

* summary(gbm\_mod)

var rel.inf

accel\_belt\_x accel\_belt\_x 5.294894e+01

user\_namecarlitos user\_namecarlitos 2.264130e+01 yaw\_belt yaw\_belt 1.009582e+01

magnet\_belt\_z magnet\_belt\_z 3.195192e+00 roll\_belt roll\_belt 2.097407e+00

magnet\_belt\_x magnet\_belt\_x 1.915681e+00

magnet\_belt\_y magnet\_belt\_y 1.262021e+00 user\_nameeurico user\_nameeurico 9.356612e-01

accel\_forearm\_z accel\_forearm\_z 8.031061e-01 yaw\_dumbbell yaw\_dumbbell 6.542763e-01

magnet\_dumbbell\_z magnet\_dumbbell\_z 5.525906e-01 roll\_arm roll\_arm 4.706543e-01

magnet\_forearm\_y magnet\_forearm\_y 4.194178e-01 raw\_timestamp\_part\_1 raw\_timestamp\_part\_1 4.174086e-01 accel\_dumbbell\_y accel\_dumbbell\_y 3.929518e-01

total\_accel\_belt total\_accel\_belt 2.065530e-01 classeE classeE 1.635014e-01

gyros\_belt\_x gyros\_belt\_x 7.771816e-02

gyros\_belt\_z gyros\_belt\_z 7.088366e-02

magnet\_forearm\_z magnet\_forearm\_z 6.476310e-02

gyros\_dumbbell\_z gyros\_dumbbell\_z 6.476114e-02

magnet\_dumbbell\_y magnet\_dumbbell\_y 6.082279e-02 accel\_arm\_y accel\_arm\_y 4.211095e-02

magnet\_forearm\_x magnet\_forearm\_x 3.649721e-02 gyros\_arm\_x gyros\_arm\_x 3.524758e-02

raw\_timestamp\_part\_2 raw\_timestamp\_part\_2 3.187452e-02 magnet\_arm\_y magnet\_arm\_y 2.913115e-02

roll\_forearm roll\_forearm 2.691063e-02

accel\_belt\_y accel\_belt\_y 2.612166e-02

gyros\_belt\_y gyros\_belt\_y 2.610858e-02

accel\_forearm\_x accel\_forearm\_x 2.591538e-02 yaw\_forearm yaw\_forearm 2.342590e-02

magnet\_arm\_x magnet\_arm\_x 2.176473e-02

roll\_dumbbell roll\_dumbbell 1.994693e-02 gyros\_dumbbell\_y gyros\_dumbbell\_y 1.606333e-02

accel\_dumbbell\_z accel\_dumbbell\_z 1.393099e-02 accel\_arm\_z accel\_arm\_z 1.171088e-02

pitch\_forearm pitch\_forearm 1.000282e-02 magnet\_dumbbell\_x magnet\_dumbbell\_x 9.832274e-03 gyros\_arm\_z gyros\_arm\_z 9.797342e-03

gyros\_forearm\_y gyros\_forearm\_y 8.829820e-03 yaw\_arm yaw\_arm 8.821700e-03

accel\_belt\_z accel\_belt\_z 6.208694e-03

cvtd\_timestamp5/12/2011 14:22 cvtd\_timestamp5/12/2011 14:22 6.063530e-03 accel\_dumbbell\_x accel\_dumbbell\_x 5.853397e-03 accel\_arm\_x accel\_arm\_x 5.649238e-03

total\_accel\_dumbbell total\_accel\_dumbbell 4.196944e-03 gyros\_forearm\_z gyros\_forearm\_z 4.185309e-03

accel\_forearm\_y accel\_forearm\_y 3.517185e-03

pitch\_dumbbell pitch\_dumbbell 3.131461e-03

gyros\_forearm\_x gyros\_forearm\_x 2.607342e-03 gyros\_arm\_y gyros\_arm\_y 2.402347e-03

total\_accel\_arm total\_accel\_arm 2.323679e-03 total\_accel\_forearm total\_accel\_forearm 1.821801e-03 gyros\_dumbbell\_x gyros\_dumbbell\_x 1.812110e-03 pitch\_arm pitch\_arm 1.803214e-03

min\_pitch\_forearm min\_pitch\_forearm 1.147246e-03 var\_yaw\_belt var\_yaw\_belt 1.011198e-03

magnet\_arm\_z magnet\_arm\_z 7.885704e-04

user\_namejeremy user\_namejeremy 0.000000e+00

user\_namepedro user\_namepedro 0.000000e+00 cvtd\_timestamp28/11/2011 14:15 cvtd\_timestamp28/11/2011 14:15 0.000000e+00

cvtd\_timestamp30/11/2011 17:12 cvtd\_timestamp30/11/2011 17:12 0.000000e+00

cvtd\_timestamp5/12/2011 11:23 cvtd\_timestamp5/12/2011 11:23 0.000000e+00

cvtd\_timestamp5/12/2011 11:25 cvtd\_timestamp5/12/2011 11:25 0.000000e+00

cvtd\_timestamp5/12/2011 14:23 cvtd\_timestamp5/12/2011 14:23 0.000000e+00 new\_windowyes new\_windowyes 0.000000e+00 num\_window num\_window 0.000000e+00

kurtosis\_roll\_belt kurtosis\_roll\_belt 0.000000e+00

kurtosis\_picth\_belt kurtosis\_picth\_belt 0.000000e+00

skewness\_roll\_belt skewness\_roll\_belt 0.000000e+00 skewness\_roll\_belt.1 skewness\_roll\_belt.1 0.000000e+00 max\_roll\_belt max\_roll\_belt 0.000000e+00

max\_picth\_belt max\_picth\_belt 0.000000e+00 max\_yaw\_belt max\_yaw\_belt 0.000000e+00

min\_roll\_belt min\_roll\_belt 0.000000e+00

min\_pitch\_belt min\_pitch\_belt 0.000000e+00 min\_yaw\_belt min\_yaw\_belt 0.000000e+00

amplitude\_roll\_belt amplitude\_roll\_belt 0.000000e+00

amplitude\_pitch\_belt amplitude\_pitch\_belt 0.000000e+00 amplitude\_yaw\_belt amplitude\_yaw\_belt 0.000000e+00 var\_total\_accel\_belt var\_total\_accel\_belt 0.000000e+00 avg\_roll\_belt avg\_roll\_belt 0.000000e+00 stddev\_roll\_belt stddev\_roll\_belt 0.000000e+00 var\_roll\_belt var\_roll\_belt 0.000000e+00

avg\_pitch\_belt avg\_pitch\_belt 0.000000e+00 stddev\_pitch\_belt stddev\_pitch\_belt 0.000000e+00 var\_pitch\_belt var\_pitch\_belt 0.000000e+00 avg\_yaw\_belt avg\_yaw\_belt 0.000000e+00

stddev\_yaw\_belt stddev\_yaw\_belt 0.000000e+00 var\_accel\_arm var\_accel\_arm 0.000000e+00

avg\_roll\_arm avg\_roll\_arm 0.000000e+00

stddev\_roll\_arm stddev\_roll\_arm 0.000000e+00 var\_roll\_arm var\_roll\_arm 0.000000e+00

avg\_pitch\_arm avg\_pitch\_arm 0.000000e+00 stddev\_pitch\_arm stddev\_pitch\_arm 0.000000e+00 var\_pitch\_arm var\_pitch\_arm 0.000000e+00 avg\_yaw\_arm avg\_yaw\_arm 0.000000e+00

stddev\_yaw\_arm stddev\_yaw\_arm 0.000000e+00 var\_yaw\_arm var\_yaw\_arm 0.000000e+00

kurtosis\_roll\_arm kurtosis\_roll\_arm 0.000000e+00

kurtosis\_picth\_arm kurtosis\_picth\_arm 0.000000e+00 kurtosis\_yaw\_arm kurtosis\_yaw\_arm 0.000000e+00

skewness\_roll\_arm skewness\_roll\_arm 0.000000e+00

skewness\_pitch\_arm skewness\_pitch\_arm 0.000000e+00 skewness\_yaw\_arm skewness\_yaw\_arm 0.000000e+00 max\_roll\_arm max\_roll\_arm 0.000000e+00

max\_picth\_arm max\_picth\_arm 0.000000e+00 max\_yaw\_arm max\_yaw\_arm 0.000000e+00

min\_roll\_arm min\_roll\_arm 0.000000e+00

min\_pitch\_arm min\_pitch\_arm 0.000000e+00 min\_yaw\_arm min\_yaw\_arm 0.000000e+00

amplitude\_roll\_arm amplitude\_roll\_arm 0.000000e+00

amplitude\_pitch\_arm amplitude\_pitch\_arm 0.000000e+00 amplitude\_yaw\_arm amplitude\_yaw\_arm 0.000000e+00 kurtosis\_roll\_dumbbell kurtosis\_roll\_dumbbell 0.000000e+00

kurtosis\_picth\_dumbbell kurtosis\_picth\_dumbbell 0.000000e+00

skewness\_roll\_dumbbell skewness\_roll\_dumbbell 0.000000e+00

skewness\_pitch\_dumbbell skewness\_pitch\_dumbbell 0.000000e+00 max\_roll\_dumbbell max\_roll\_dumbbell 0.000000e+00

max\_picth\_dumbbell max\_picth\_dumbbell 0.000000e+00 max\_yaw\_dumbbell max\_yaw\_dumbbell 0.000000e+00

min\_roll\_dumbbell min\_roll\_dumbbell 0.000000e+00

min\_pitch\_dumbbell min\_pitch\_dumbbell 0.000000e+00 min\_yaw\_dumbbell min\_yaw\_dumbbell 0.000000e+00 amplitude\_roll\_dumbbell amplitude\_roll\_dumbbell 0.000000e+00 amplitude\_pitch\_dumbbell amplitude\_pitch\_dumbbell 0.000000e+00 amplitude\_yaw\_dumbbell amplitude\_yaw\_dumbbell 0.000000e+00 var\_accel\_dumbbell var\_accel\_dumbbell 0.000000e+00

avg\_roll\_dumbbell avg\_roll\_dumbbell 0.000000e+00 stddev\_roll\_dumbbell stddev\_roll\_dumbbell 0.000000e+00 var\_roll\_dumbbell var\_roll\_dumbbell 0.000000e+00

avg\_pitch\_dumbbell avg\_pitch\_dumbbell 0.000000e+00

stddev\_pitch\_dumbbell stddev\_pitch\_dumbbell 0.000000e+00 var\_pitch\_dumbbell var\_pitch\_dumbbell 0.000000e+00 avg\_yaw\_dumbbell avg\_yaw\_dumbbell 0.000000e+00 stddev\_yaw\_dumbbell stddev\_yaw\_dumbbell 0.000000e+00 var\_yaw\_dumbbell var\_yaw\_dumbbell 0.000000e+00 kurtosis\_roll\_forearm kurtosis\_roll\_forearm 0.000000e+00

kurtosis\_picth\_forearm kurtosis\_picth\_forearm 0.000000e+00

skewness\_roll\_forearm skewness\_roll\_forearm 0.000000e+00

skewness\_pitch\_forearm skewness\_pitch\_forearm 0.000000e+00 max\_roll\_forearm max\_roll\_forearm 0.000000e+00

max\_picth\_forearm max\_picth\_forearm 0.000000e+00 max\_yaw\_forearm max\_yaw\_forearm 0.000000e+00

min\_roll\_forearm min\_roll\_forearm 0.000000e+00

min\_yaw\_forearm min\_yaw\_forearm 0.000000e+00 amplitude\_roll\_forearm amplitude\_roll\_forearm 0.000000e+00

amplitude\_pitch\_forearm amplitude\_pitch\_forearm 0.000000e+00 amplitude\_yaw\_forearm amplitude\_yaw\_forearm 0.000000e+00 var\_accel\_forearm var\_accel\_forearm 0.000000e+00

avg\_roll\_forearm avg\_roll\_forearm 0.000000e+00 stddev\_roll\_forearm stddev\_roll\_forearm 0.000000e+00 var\_roll\_forearm var\_roll\_forearm 0.000000e+00

avg\_pitch\_forearm avg\_pitch\_forearm 0.000000e+00 stddev\_pitch\_forearm stddev\_pitch\_forearm 0.000000e+00 var\_pitch\_forearm var\_pitch\_forearm 0.000000e+00 avg\_yaw\_forearm avg\_yaw\_forearm 0.000000e+00 stddev\_yaw\_forearm stddev\_yaw\_forearm 0.000000e+00 var\_yaw\_forearm var\_yaw\_forearm 0.000000e+00 accel\_forearm\_y.1 accel\_forearm\_y.1 0.000000e+00

accel\_forearm\_z.1 accel\_forearm\_z.1 0.000000e+00

magnet\_forearm\_x.1 magnet\_forearm\_x.1 0.000000e+00

magnet\_forearm\_y.1 magnet\_forearm\_y.1 0.000000e+00

magnet\_forearm\_z.1 magnet\_forearm\_z.1 0.000000e+00 classeB classeB 0.000000e+00

classeC classeC 0.000000e+00

classeD classeD 0.000000e+00

* # make predictions
* predictions<- predict(gbm\_mod,dataTest)

>

* # append predictions
* pred<- cbind(dataTest,predictions)

>

* # summarize results
* confusionMatrix<- confusionMatrix(pred$predictions,pred$classe) Error: `data` and `reference` should be factors with the same levels.
* confusionMatrix

Confusion Matrix and Statistics

Reference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Prediction | A | B | C | D | E |
| A | 1365 | 0 | 0 | 0 | 0 |
| B | 0 | 901 | 0 | 0 | 0 |
| C | 0 | 0 | 92 | 0 | 0 |
| D | 0 | 0 | 0 | 276 | 0 |
| E | 0 | 0 | 0 | 0 | 1370 |

Overall Statistics

Accuracy : 1

95% CI : (0.9991, 1)

No Information Rate : 0.3422

P-Value [Acc > NIR] : < 2.2e-16

Kappa : 1 Mcnemar's Test P-Value : NA

Statistics by Class:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sensitivity | Class: A  1.0000 | Class: B  1.000 | Class: C  1.00000 | Class: D  1.00000 | Class: E  1.0000 |
| Specificity | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Pos Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Neg Pred Value | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |
| Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Rate | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Detection Prevalence | 0.3409 | 0.225 | 0.02298 | 0.06893 | 0.3422 |
| Balanced Accuracy | 1.0000 | 1.000 | 1.00000 | 1.00000 | 1.0000 |





