

Case Study 3 Model

```
library(randomForest)
```

```
## randomForest 4.6-14
```

```
## Type rfNews() to see new features/changes/bug fixes.
```

```
library(MASS)
```

```
library(cvAUC)
```

```
## Loading required package: ROCR
```

```
## Warning: package 'ROCR' was built under R version 3.6.2
```

```
## Loading required package: data.table
```

```
##
```

```
## cvAUC version: 1.1.0
```

```
## Notice to cvAUC users: Major speed improvements in version 1.1.0
```

```
##
```

```
load("final_data.rda")
```

```
data <- data.frame(new_data)
```

```
summary(data)
```

```
##           id           label           Age           Height           Weight
##  Min.      : 1    Min.      :0.0000    Min.      :24.00    Min.      :165.0    Min.      :54.00
## 1st Qu.: 4    1st Qu.:0.0000    1st Qu.:26.00    1st Qu.:172.0    1st Qu.:66.00
## Median : 8    Median :0.0000    Median :27.00    Median :178.0    Median :75.00
## Mean   : 8    Mean   :0.2129    Mean   :27.47    Mean   :177.6    Mean   :73.13
## 3rd Qu.:12    3rd Qu.:0.0000    3rd Qu.:28.00    3rd Qu.:184.0    3rd Qu.:80.00
## Max.   :15    Max.   :1.0000    Max.   :35.00    Max.   :189.0    Max.   :90.00
##           Gender    ACC_wrist_mean    ACC_wrist_sd    BVP_mean
##  Min.      :0.0000    Min.      :62.71    Min.      :0.1427    Min.      :-7.5896
## 1st Qu.:1.0000    1st Qu.:63.08    1st Qu.:0.4434    1st Qu.: -0.6333
## Median :1.0000    Median :63.31    Median :1.0501    Median : -0.1539
## Mean   :0.8667    Mean   :63.28    Mean   :1.8130    Mean   : -0.3573
## 3rd Qu.:1.0000    3rd Qu.:63.49    3rd Qu.:2.6376    3rd Qu.: 0.2120
## Max.   :1.0000    Max.   :64.33    Max.   :8.9093    Max.   : 4.0981
##           BVP_sd    BVP_HR    EDA_wrist_mean    EDA_wrist_sd
##  Min.      :10.22    Min.      :62.00    Min.      :0.09245    Min.      :0.001092
## 1st Qu.:22.02    1st Qu.:69.00    1st Qu.:0.15780    1st Qu.:0.006928
## Median :41.14    Median :74.00    Median :0.21011    Median :0.014417
## Mean   :49.84    Mean   :73.69    Mean   :0.38472    Mean   :0.026153
## 3rd Qu.:72.10    3rd Qu.:77.00    3rd Qu.:0.60061    3rd Qu.:0.034773
## Max.   :175.53    Max.   :88.00    Max.   :1.38990    Max.   :0.170201
## EDA_wrist_min    EDA_wrist_max    EDA_wrist_range    EDA_wrist_slope
##  Min.      :0.07458    Min.      :0.1015    Min.      :0.005125    Min.      : -0.9392160
## 1st Qu.:0.14121    1st Qu.:0.1732    1st Qu.:0.026907    1st Qu.: -0.0025630
```

```

## Median :0.18862 Median :0.2565 Median :0.066629 Median :-0.0012810
## Mean :0.33864 Mean :0.4609 Mean :0.122283 Mean :-0.0004791
## 3rd Qu.:0.54611 3rd Qu.:0.7038 3rd Qu.:0.155041 3rd Qu.: 0.0012810
## Max. :1.10997 Max. :1.7174 Max. :1.100663 Max. : 1.0442850
## Temp_wrist_mean Temp_wrist_sd Temp_wrist_min Temp_wrist_max
## Min. :32.58 Min. :0.01064 Min. :32.50 Min. :32.65
## 1st Qu.:33.86 1st Qu.:0.02197 1st Qu.:33.75 1st Qu.:33.97
## Median :34.31 Median :0.03260 Median :34.23 Median :34.39
## Mean :34.64 Mean :0.03595 Mean :34.57 Mean :34.70
## 3rd Qu.:35.77 3rd Qu.:0.04315 3rd Qu.:35.68 3rd Qu.:35.83
## Max. :35.93 Max. :0.11552 Max. :35.91 Max. :35.97
## Temp_wrist_range Temp_wrist_slope ACC_chest_mean ACC_chest_sd
## Min. :0.0400 Min. :-0.0700000 Min. :0.9251 Min. :0.002264
## 1st Qu.:0.0900 1st Qu.: -0.0100000 1st Qu.:0.9298 1st Qu.:0.004138
## Median :0.1200 Median : 0.0000000 Median :0.9507 Median :0.004866
## Mean :0.1363 Mean :-0.0002899 Mean :0.9482 Mean :0.007487
## 3rd Qu.:0.1600 3rd Qu.: 0.0100000 3rd Qu.:0.9572 3rd Qu.:0.008228
## Max. :0.4300 Max. : 0.0600000 Max. :0.9827 Max. :0.058868
## ECG_mean ECG_sd ECG_HR EDA_chest_mean
## Min. :-0.0178392 Min. :0.09265 Min. :62.0 Min. :0.4691
## 1st Qu.: -0.0006405 1st Qu.:0.13133 1st Qu.:70.0 1st Qu.:0.7945
## Median : 0.0034052 Median :0.14253 Median :73.0 Median :1.2185
## Mean : 0.0031645 Mean :0.13972 Mean :73.4 Mean :1.4790
## 3rd Qu.: 0.0071976 3rd Qu.:0.15065 3rd Qu.:76.0 3rd Qu.:1.7735
## Max. : 0.0203314 Max. :0.18290 Max. :91.0 Max. :5.4131
## EDA_chest_sd EDA_chest_min EDA_chest_max EDA_chest_range
## Min. :0.01609 Min. :0.2850 Min. :0.5604 Min. :0.0885
## 1st Qu.:0.02444 1st Qu.:0.7504 1st Qu.:0.8865 1st Qu.:0.1266
## Median :0.02920 Median :1.1597 Median :1.3184 Median :0.1518
## Mean :0.05754 Mean :1.3741 Mean :1.6286 Mean :0.2545
## 3rd Qu.:0.06261 3rd Qu.:1.6594 3rd Qu.:1.9260 3rd Qu.:0.2592
## Max. :0.36056 Max. :4.8496 Max. :6.4518 Max. :1.6804
## EDA_chest_slope EMG_mean EMG_sd EMG_range
## Min. :-0.326538 Min. :-6.747e-02 Min. :0.006755 Min. :0.03763
## 1st Qu.: -0.016403 1st Qu.: -8.148e-03 1st Qu.:0.008682 1st Qu.:0.06367
## Median :-0.001907 Median : 0.000e+00 Median :0.009855 Median :0.07045
## Mean :-0.001144 Mean :-3.151e-05 Mean :0.009756 Mean :0.07369
## 3rd Qu.: 0.011826 3rd Qu.: 8.057e-03 3rd Qu.:0.010671 3rd Qu.:0.08340
## Max. : 0.330353 Max. : 6.981e-02 Max. :0.016128 Max. :0.10739
## Resp_Volume Resp_range breath_rate Temp_chest_mean
## Min. :177.4 Min. : 3.677 Min. :11.00 Min. :28.20
## 1st Qu.:288.2 1st Qu.: 5.164 1st Qu.:17.00 1st Qu.:28.58
## Median :321.3 Median : 6.512 Median :19.00 Median :31.27
## Mean :388.1 Mean :10.419 Mean :18.66 Mean :30.56
## 3rd Qu.:454.6 3rd Qu.:14.478 3rd Qu.:21.00 3rd Qu.:31.97
## Max. :990.6 Max. :38.670 Max. :24.00 Max. :33.57
## Temp_chest_sd Temp_chest_min Temp_chest_max Temp_chest_range
## Min. :0.009757 Min. :28.13 Min. :28.34 Min. :0.06625
## 1st Qu.:0.028766 1st Qu.:28.46 1st Qu.:28.79 1st Qu.:0.19137
## Median :0.044203 Median :31.11 Median :31.42 Median :0.24414
## Mean :0.108437 Mean :30.37 Mean :30.81 Mean :0.43353
## 3rd Qu.:0.068514 3rd Qu.:31.62 3rd Qu.:32.14 3rd Qu.:0.31512
## Max. :1.844897 Max. :32.65 Max. :34.28 Max. :5.47601
## Temp_chest_slope

```

```

## Min.      :-0.2326660
## 1st Qu.: -0.0118720
## Median :  0.0000000
## Mean     :  0.0003941
## 3rd Qu.:  0.0128480
## Max.     :  0.3354500

nrow(subset(data, label == 1))/nrow(data)

## [1] 0.2128764

nrow(subset(data, label == 0))/nrow(data)

## [1] 0.7871236

data$label = as.factor(data$label)

test = subset(data, id == 1)
train = subset(data, id != 1)

colnames(train)

## [1] "id"          "label"       "Age"         "Height"
## [5] "Weight"     "Gender"     "ACC_wrist_mean" "ACC_wrist_sd"
## [9] "BVP_mean"   "BVP_sd"     "BVP_HR"      "EDA_wrist_mean"
## [13] "EDA_wrist_sd" "EDA_wrist_min" "EDA_wrist_max" "EDA_wrist_range"
## [17] "EDA_wrist_slope" "Temp_wrist_mean" "Temp_wrist_sd" "Temp_wrist_min"
## [21] "Temp_wrist_max" "Temp_wrist_range" "Temp_wrist_slope" "ACC_chest_mean"
## [25] "ACC_chest_sd" "ECG_mean"    "ECG_sd"      "ECG_HR"
## [29] "EDA_chest_mean" "EDA_chest_sd" "EDA_chest_min" "EDA_chest_max"
## [33] "EDA_chest_range" "EDA_chest_slope" "EMG_mean"    "EMG_sd"
## [37] "EMG_range"    "Resp_Volume" "Resp_range"  "breath_rate"
## [41] "Temp_chest_mean" "Temp_chest_sd" "Temp_chest_min" "Temp_chest_max"
## [45] "Temp_chest_range" "Temp_chest_slope"

personal = colnames(train)[3:6]
wrist_acc = colnames(train)[7:8]
chest_acc = colnames(train)[24:25]
wrist_bvp = colnames(train)[9:11]
wrist_eda = colnames(train)[12:17]
wrist_temp = colnames(train)[18:23]
wrist_physio = colnames(train)[9:23]
chest_ecg = colnames(train)[26:28]
chest_eda = colnames(train)[29:34]
chest_emg = colnames(train)[35:37]
chest_resp = colnames(train)[38:40]
chest_temp = colnames(train)[41:46]
chest_physio = colnames(train)[26:46]
all_wrist = colnames(train)[7:23]
all_chest = colnames(train)[24:46]
all_physio = colnames(train)[c(9:23,26:46)]
all_modalities = colnames(train)[c(7:46)]

predictor_vars <- c("personal", "wrist_acc", "chest_acc", "wrist_bvp", "wrist_eda", "wrist_temp", "wrist_physio", "chest_ecg", "chest_eda", "chest_emg", "chest_resp", "chest_temp", "chest_physio", "all_wrist", "all_chest", "all_physio", "all_modalities")

test_sample = test

```

```

set.seed(1)
train_indices = sample(nrow(train), 1000)
train_sample = train[train_indices,]
# Run this instead to train on the full train set
# test_sample = train

rf <- function(train_sample, test_sample, predictors){
  set.seed(1)
  model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree = 1000)
  predict_rf <- predict(model_rf, test_sample)
  cat("Accuracy is", mean(test_sample$label == predict_rf)*100, "% \n")
  cat("AUROC is", AUC(as.numeric(as.character(predict_rf)), as.numeric(as.character(test_sample$label))), "\n")
  if (mean(test_sample$label == predict_rf) == 1){
    df <- data.frame(importance(model_rf, type = 1))
    print(df)
  }
}

print_baseline <- function(test_sample){
  predict_rf <- rep(0, nrow(test_sample))
  cat("Accuracy is", mean(test_sample$label == predict_rf)*100, "% \n")
  cat("AUROC is", AUC(as.numeric(as.character(predict_rf)), as.numeric(as.character(test_sample$label))), "\n")
}

print_baseline(test_sample)

## Accuracy is 78.71236 %
## AUROC is 0.5
##

for (i in 1:length(predictor_vars)){
  cat("Predictors: ", predictor_vars[i], "\n")
  rf(train_sample, test_sample, eval(parse(text = predictor_vars[i])))
}

## Predictors: personal
## Accuracy is 78.71236 %
## AUROC is 0.5
##
## Predictors: wrist_acc
## Accuracy is 97.11838 %
## AUROC is 0.9545595
##
## Predictors: chest_acc
## Accuracy is 99.74039 %
## AUROC is 0.996275
##
## Predictors: wrist_bvp
## Accuracy is 93.31949 %
## AUROC is 0.8770462
##
## Predictors: wrist_eda
## Accuracy is 99.64521 %
## AUROC is 0.9977463
##

```

```

## Predictors:  wrist_temp
## Accuracy is 99.06542 %
## AUROC is 0.9796799
##
## Predictors:  wrist_physio
## Accuracy is 100 %
## AUROC is 1
##
##                               MeanDecreaseAccuracy
## BVP_mean                      4.319183
## BVP_sd                        7.682619
## BVP_HR                        4.495062
## EDA_wrist_mean                16.739347
## EDA_wrist_sd                  9.271470
## EDA_wrist_min                 19.887153
## EDA_wrist_max                 12.723459
## EDA_wrist_range               10.035344
## EDA_wrist_slope               2.579260
## Temp_wrist_mean               14.680830
## Temp_wrist_sd                 5.122336
## Temp_wrist_min                15.898713
## Temp_wrist_max                14.696584
## Temp_wrist_range              3.910981
## Temp_wrist_slope              -2.376881
## Predictors:  chest_ecg
## Accuracy is 94.0983 %
## AUROC is 0.8999356
##
## Predictors:  chest_eda
## Accuracy is 99.56732 %
## AUROC is 0.9913202
##
## Predictors:  chest_emg
## Accuracy is 94.55694 %
## AUROC is 0.9047767
##
## Predictors:  chest_resp
## Accuracy is 98.85774 %
## AUROC is 0.9788055
##
## Predictors:  chest_temp
## Accuracy is 99.58463 %
## AUROC is 0.9902439
##
## Predictors:  chest_physio
## Accuracy is 100 %
## AUROC is 1
##
##                               MeanDecreaseAccuracy
## ECG_mean                      6.6988255
## ECG_sd                        3.9304906
## ECG_HR                       12.2129860
## EDA_chest_mean                12.8388670
## EDA_chest_sd                  7.5874125

```

```

## EDA_chest_min          14.0286171
## EDA_chest_max          12.0272278
## EDA_chest_range        8.1981175
## EDA_chest_slope        1.3078949
## EMG_mean               -0.3084886
## EMG_sd                 6.5121985
## EMG_range              11.2215000
## Resp_Volume            16.7583067
## Resp_range             14.5606940
## breath_rate            5.7257642
## Temp_chest_mean        13.3635724
## Temp_chest_sd          5.9434996
## Temp_chest_min         14.1403830
## Temp_chest_max         13.2845713
## Temp_chest_range       8.8749328
## Temp_chest_slope       2.1291886
## Predictors: all_wrist
## Accuracy is 100 %
## AUROC is 1
##
##                               MeanDecreaseAccuracy
## ACC_wrist_mean              6.6951610
## ACC_wrist_sd                5.2619092
## BVP_mean                   3.6297462
## BVP_sd                     7.1904097
## BVP_HR                     4.0775254
## EDA_wrist_mean             16.6829697
## EDA_wrist_sd               8.5487622
## EDA_wrist_min              18.5476518
## EDA_wrist_max              13.0438337
## EDA_wrist_range            9.4698249
## EDA_wrist_slope            1.7202631
## Temp_wrist_mean            14.7236211
## Temp_wrist_sd              3.7773476
## Temp_wrist_min             14.9430432
## Temp_wrist_max             14.9600073
## Temp_wrist_range           3.3367182
## Temp_wrist_slope           0.5653082
## Predictors: all_chest
## Accuracy is 100 %
## AUROC is 1
##
##                               MeanDecreaseAccuracy
## ACC_chest_mean             17.6260104
## ACC_chest_sd               11.9029036
## ECG_mean                   5.7070711
## ECG_sd                     4.8907281
## ECG_HR                     10.5248818
## EDA_chest_mean             12.0254306
## EDA_chest_sd               5.4118708
## EDA_chest_min              12.7304447
## EDA_chest_max              10.3459192
## EDA_chest_range            6.6462040
## EDA_chest_slope            2.5677951

```

```

## EMG_mean          0.5817064
## EMG_sd            7.1481590
## EMG_range         9.5533834
## Resp_Volume       13.1043645
## Resp_range        10.3279586
## breath_rate       3.7371049
## Temp_chest_mean   10.3893992
## Temp_chest_sd     4.7713608
## Temp_chest_min    11.0309029
## Temp_chest_max    12.1298918
## Temp_chest_range  8.5358437
## Temp_chest_slope  1.2154956
## Predictors:  all_physio
## Accuracy is 100 %
## AUROC is 1
##
##                               MeanDecreaseAccuracy
## BVP_mean          1.7790057
## BVP_sd            3.4397530
## BVP_HR            3.7260342
## EDA_wrist_mean    13.5308838
## EDA_wrist_sd      5.0995229
## EDA_wrist_min     14.6153219
## EDA_wrist_max     10.2518851
## EDA_wrist_range   7.9190235
## EDA_wrist_slope   1.3514281
## Temp_wrist_mean    11.0308965
## Temp_wrist_sd      2.1607031
## Temp_wrist_min    11.3424148
## Temp_wrist_max    11.1857107
## Temp_wrist_range   2.5847804
## Temp_wrist_slope   0.9959215
## ECG_mean          3.5262657
## ECG_sd            2.2052947
## ECG_HR            8.0688762
## EDA_chest_mean     5.6241211
## EDA_chest_sd       2.6446547
## EDA_chest_min      6.7191841
## EDA_chest_max      5.4189197
## EDA_chest_range    2.6790167
## EDA_chest_slope    0.0000000
## EMG_mean          0.0000000
## EMG_sd            3.9379426
## EMG_range         4.3389098
## Resp_Volume       8.1933249
## Resp_range        6.7686616
## breath_rate       4.8050995
## Temp_chest_mean    7.2408086
## Temp_chest_sd      1.9016826
## Temp_chest_min     7.3530787
## Temp_chest_max     7.1042307
## Temp_chest_range   4.3064495
## Temp_chest_slope   1.2618833
## Predictors:  all_modalities

```

```
## Accuracy is 100 %
## AUROC is 1
##
##                               MeanDecreaseAccuracy
## ACC_wrist_mean                6.2601695
## ACC_wrist_sd                  3.1092664
## BVP_mean                      1.8384803
## BVP_sd                       3.2528456
## BVP_HR                       2.2567656
## EDA_wrist_mean               12.1584440
## EDA_wrist_sd                 4.7844619
## EDA_wrist_min                13.8293043
## EDA_wrist_max                10.5993268
## EDA_wrist_range              6.3029863
## EDA_wrist_slope              1.5957613
## Temp_wrist_mean              10.8804676
## Temp_wrist_sd                1.9625699
## Temp_wrist_min               10.0437985
## Temp_wrist_max               10.7454659
## Temp_wrist_range             1.9930191
## Temp_wrist_slope             -1.0010015
## ACC_chest_mean               9.2135835
## ACC_chest_sd                 7.3094568
## ECG_mean                     2.1407779
## ECG_sd                       1.8315675
## ECG_HR                       7.9491294
## EDA_chest_mean               5.6095948
## EDA_chest_sd                 3.5396862
## EDA_chest_min                6.0100523
## EDA_chest_max                5.2609414
## EDA_chest_range              3.6009246
## EDA_chest_slope              0.7336264
## EMG_mean                     1.0010015
## EMG_sd                       3.9580095
## EMG_range                    4.3271137
## Resp_Volume                  6.9210121
## Resp_range                   5.3603365
## breath_rate                  5.2242940
## Temp_chest_mean              7.7642098
## Temp_chest_sd                1.5873409
## Temp_chest_min               6.8772185
## Temp_chest_max               7.8080712
## Temp_chest_range             3.9964008
## Temp_chest_slope             0.2881026
```

LDA

```
LDA <- function(train_sample, test_sample, predictors){
  model_lda <- lda(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), data = train_sample)
  predict_lda <- predict(model_lda, test_sample)[[1]]
  cat("Accuracy is", mean(test_sample$label == predict_lda)*100, "% \n")
  cat("AUROC is", AUC(as.numeric(as.character(predict_lda)), as.numeric(as.character(test_sample$label)))
```



```

}

for (i in 1:length(predictor_vars)){
  cat("Predictors: ", predictor_vars[i], "\n")
  LDA(train_sample, test_sample, eval(parse(text = predictor_vars[i])))
}

```

```

## Predictors:  personal
## Accuracy is 78.71236 %
## AUROC is 0.5
##
## Predictors:  wrist_acc
## Accuracy is 92.96469 %
## AUROC is 0.8721234
##
## Predictors:  chest_acc
## Accuracy is 78.08065 %
## AUROC is 0.6724438
##
## Predictors:  wrist_bvp
## Accuracy is 76.41918 %
## AUROC is 0.5189451
##
## Predictors:  wrist_eda
## Accuracy is 95.64728 %
## AUROC is 0.9105165
##
## Predictors:  wrist_temp
## Accuracy is 89.47733 %
## AUROC is 0.7782019
##
## Predictors:  wrist_physio
## Accuracy is 98.5116 %
## AUROC is 0.9883211
##
## Predictors:  chest_ecg
## Accuracy is 88.07546 %
## AUROC is 0.7847183
##
## Predictors:  chest_eda
## Accuracy is 82.20838 %
## AUROC is 0.6148843
##
## Predictors:  chest_emg
## Accuracy is 81.10073 %
## AUROC is 0.6376531
##
## Predictors:  chest_resp
## Accuracy is 87.41779 %
## AUROC is 0.7317556
##
## Predictors:  chest_temp
## Accuracy is 78.71236 %
## AUROC is 0.5

```

```
##
## Predictors: chest_physio
## Accuracy is 97.45587 %
## AUROC is 0.9641174
##
## Predictors: all_wrist
## Accuracy is 99.42021 %
## AUROC is 0.9954274
##
## Predictors: all_chest
## Accuracy is 99.22118 %
## AUROC is 0.9920871
##
## Predictors: all_physio
## Accuracy is 99.95673 %
## AUROC is 0.9997252
##
## Predictors: all_modalities
## Accuracy is 100 %
## AUROC is 1
##
```

Logistic Regression

```
logistic <- function(train_sample, test_sample, predictors){
  model_logistic <- glm(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), family=binomial)
  predict_logistic <- predict(model_logistic, test_sample)
  predict_logistic <- ifelse(predict_logistic > 0.5, 1, 0)
  cat("Accuracy is", mean(test_sample$label == predict_logistic)*100, "% \n")
  cat("AUROC is", AUC(as.numeric(as.character(predict_logistic)), as.numeric(as.character(test_sample$label))), "% \n")
}
```

```
for (i in 1:length(predictor_vars)){
  cat("Predictors: ", predictor_vars[i], "\n")
  logistic(train_sample, test_sample, eval(parse(text = predictor_vars[i])))
}
```

```
## Predictors: personal
## Accuracy is 78.71236 %
## AUROC is 0.5
##
## Predictors: wrist_acc
## Accuracy is 92.56663 %
## AUROC is 0.8556562
##
## Predictors: chest_acc
## Accuracy is 75.62305 %
## AUROC is 0.531237
##
## Predictors: wrist_bvp
## Accuracy is 77.55279 %
## AUROC is 0.4926341
##
```

```

## Predictors:  wrist_eda
## Accuracy is 96.41745 %
## AUROC is 0.929644
##
## Predictors:  wrist_temp
## Accuracy is 90.38595 %
## AUROC is 0.7816011
##
## Predictors:  wrist_physio
## Accuracy is 100 %
## AUROC is 1
##
## Predictors:  chest_ecg
## Accuracy is 86.37937 %
## AUROC is 0.7244179
##
## Predictors:  chest_eda
## Accuracy is 80.34787 %
## AUROC is 0.5581362
##
## Predictors:  chest_emg
## Accuracy is 80.5296 %
## AUROC is 0.5718946
##
## Predictors:  chest_resp
## Accuracy is 88.11007 %
## AUROC is 0.7527608
##
## Predictors:  chest_temp
## Accuracy is 80.91035 %
## AUROC is 0.6032284
##
## Predictors:  chest_physio
## Accuracy is 99.99135 %
## AUROC is 0.999945
##
## Predictors:  all_wrist
## Accuracy is 100 %
## AUROC is 1
##
## Predictors:  all_chest
## Accuracy is 99.8875 %
## AUROC is 0.9992854
##
## Predictors:  all_physio
## Accuracy is 100 %
## AUROC is 1
##
## Predictors:  all_modalities
## Accuracy is 100 %
## AUROC is 1
##

```

We choose the Random Forest

Cross-Validation

- We got 100 percent accuracy for predictors wrist_physio, chest_ecg, chest_physio, all_wrist, all_chest, all_physio, all_modalities
- Let us do cross validation.

```
cv <- data.frame(matrix(ncol = 16, nrow = 14))
rownames(cv) <- c("wrist_physio acc", "wrist_physio auc", "chest_ecg acc", "chest_ecg auc", "chest_physio acc", "chest_physio auc", "all_wrist acc", "all_wrist auc", "all_chest acc", "all_chest auc", "all_physio acc", "all_physio auc", "all_modalities acc", "all_modalities auc")
colnames(cv) <- c("predictor", c(1:15))
cv$predictor <- c("wrist_physio", "wrist_physio", "chest_ecg", "chest_ecg", "chest_physio", "chest_physio", "all_wrist", "all_wrist", "all_chest", "all_chest", "all_physio", "all_physio", "all_modalities", "all_modalities")
```

cv

```
##               predictor  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
## wrist_physio acc      wrist_physio NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## wrist_physio auc      wrist_physio NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## chest_ecg acc         chest_ecg NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## chest_ecg auc         chest_ecg NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## chest_physio acc      chest_physio NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## chest_physio auc      chest_physio NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_wrist acc         all_wrist NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_wrist auc         all_wrist NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_chest acc         all_chest NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_chest auc         all_chest NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_physio acc        all_physio NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_physio auc        all_physio NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_modalities acc    all_modalities NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## all_modalities auc    all_modalities NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
```

```
for(i in 1:7){
  for (j in 1:15){
    set.seed(1)
    test = subset(data, id == j)
    train = subset(data, id != j)
    test_sample = test

    # Run this instead to train on the full train set
    # test_sample = train
    train_indices = sample(nrow(train), 100)
    train_sample = train[train_indices,]

    predictor = cv$predictor[(i-1)*2+1]
    predictors = eval(parse(text = predictor))
    model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree = 1000)
    predict_rf <- predict(model_rf, test_sample)
    acc = mean(test_sample$label == predict_rf)*100
    auc = AUC(as.numeric(as.character(predict_rf)), as.numeric(as.character(test_sample$label)))

    cv[(i-1)*2+1,j+1] <- acc
    cv[(i-1)*2+2,j+1] <- auc
  }
}
```

cv

##	predictor	1	2	3	4
## wrist_physio acc	wrist_physio	98.6067844	98.6067844	98.6067844	98.6067844
## wrist_physio auc	wrist_physio	0.9672764	0.9672764	0.9672764	0.9672764
## chest_ecg acc	chest_ecg	85.2890273	85.2890273	85.2890273	85.2890273
## chest_ecg auc	chest_ecg	0.6833867	0.6833867	0.6833867	0.6833867
## chest_physio acc	chest_physio	93.4406369	93.4406369	93.4406369	93.4406369
## chest_physio auc	chest_physio	0.8459350	0.8459350	0.8459350	0.8459350
## all_wrist acc	all_wrist	98.9356179	98.9356179	98.9356179	98.9356179
## all_wrist auc	all_wrist	0.9750000	0.9750000	0.9750000	0.9750000
## all_chest acc	all_chest	95.2838352	95.2838352	95.2838352	95.2838352
## all_chest auc	all_chest	0.8892276	0.8892276	0.8892276	0.8892276
## all_physio acc	all_physio	99.5240568	99.5240568	99.5240568	99.5240568
## all_physio auc	all_physio	0.9888211	0.9888211	0.9888211	0.9888211
## all_modalities acc	all_modalities	99.3163724	99.3163724	99.3163724	99.3163724
## all_modalities auc	all_modalities	0.9839431	0.9839431	0.9839431	0.9839431
##	5	6	7	8	9
## wrist_physio acc	98.6067844	98.6067844	98.6067844	98.6067844	98.6067844
## wrist_physio auc	0.9672764	0.9672764	0.9672764	0.9672764	0.9672764
## chest_ecg acc	85.2890273	85.2890273	85.2890273	85.2890273	85.2890273
## chest_ecg auc	0.6833867	0.6833867	0.6833867	0.6833867	0.6833867
## chest_physio acc	93.4406369	93.4406369	93.4406369	93.4406369	93.4406369
## chest_physio auc	0.8459350	0.8459350	0.8459350	0.8459350	0.8459350
## all_wrist acc	98.9356179	98.9356179	98.9356179	98.9356179	98.9356179
## all_wrist auc	0.9750000	0.9750000	0.9750000	0.9750000	0.9750000
## all_chest acc	95.2838352	95.2838352	95.2838352	95.2838352	95.2838352
## all_chest auc	0.8892276	0.8892276	0.8892276	0.8892276	0.8892276
## all_physio acc	99.5240568	99.5240568	99.5240568	99.5240568	99.5240568
## all_physio auc	0.9888211	0.9888211	0.9888211	0.9888211	0.9888211
## all_modalities acc	99.3163724	99.3163724	99.3163724	99.3163724	99.3163724
## all_modalities auc	0.9839431	0.9839431	0.9839431	0.9839431	0.9839431
##	10	11	12	13	14
## wrist_physio acc	98.6067844	98.6067844	98.6067844	98.6067844	98.6067844
## wrist_physio auc	0.9672764	0.9672764	0.9672764	0.9672764	0.9672764
## chest_ecg acc	85.2890273	85.2890273	85.2890273	85.2890273	85.2890273
## chest_ecg auc	0.6833867	0.6833867	0.6833867	0.6833867	0.6833867
## chest_physio acc	93.4406369	93.4406369	93.4406369	93.4406369	93.4406369
## chest_physio auc	0.8459350	0.8459350	0.8459350	0.8459350	0.8459350
## all_wrist acc	98.9356179	98.9356179	98.9356179	98.9356179	98.9356179
## all_wrist auc	0.9750000	0.9750000	0.9750000	0.9750000	0.9750000
## all_chest acc	95.2838352	95.2838352	95.2838352	95.2838352	95.2838352
## all_chest auc	0.8892276	0.8892276	0.8892276	0.8892276	0.8892276
## all_physio acc	99.5240568	99.5240568	99.5240568	99.5240568	99.5240568
## all_physio auc	0.9888211	0.9888211	0.9888211	0.9888211	0.9888211
## all_modalities acc	99.3163724	99.3163724	99.3163724	99.3163724	99.3163724
## all_modalities auc	0.9839431	0.9839431	0.9839431	0.9839431	0.9839431
##	15				
## wrist_physio acc	98.6067844				
## wrist_physio auc	0.9672764				
## chest_ecg acc	85.2890273				
## chest_ecg auc	0.6833867				
## chest_physio acc	93.4406369				
## chest_physio auc	0.8459350				

```
## all_wrist acc      98.9356179
## all_wrist auc      0.9750000
## all_chest acc      95.2838352
## all_chest auc      0.8892276
## all_physio acc     99.5240568
## all_physio auc     0.9888211
## all_modalities acc 99.3163724
## all_modalities auc 0.9839431
```

Let us use fewer training samples

1000 Training Samples

```
for(i in 1:7){
  for (j in 1:15){
    set.seed(1)
    test = subset(data, id == j)
    train = subset(data, id != j)
    test_sample = test

    train_indices = sample(nrow(train), 1000)
    train_sample = train[train_indices,]

    predictor = cv$predictor[(i-1)*2+1]
    predictors = eval(parse(text = predictor))
    model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree = 500)
    predict_rf <- predict(model_rf, test_sample)
    acc = mean(test_sample$label == predict_rf)*100
    auc = AUC(as.numeric(predict_rf), as.numeric(test_sample$label))

    cv[(i-1)*2+1,j+1] <- acc
    cv[(i-1)*2+2,j+1] <- auc
  }
}
```

cv

##		predictor	1	2	3		
##	wrist_physio acc	wrist_physio	100.0000000	100.0000000	100.0000000		
##	wrist_physio auc	wrist_physio	1.0000000	1.0000000	1.0000000		
##	chest_ecg acc	chest_ecg	94.3319488	94.3319488	94.3319488		
##	chest_ecg auc	chest_ecg	0.9027544	0.9027544	0.9027544		
##	chest_physio acc	chest_physio	100.0000000	100.0000000	100.0000000		
##	chest_physio auc	chest_physio	1.0000000	1.0000000	1.0000000		
##	all_wrist acc	all_wrist	100.0000000	100.0000000	100.0000000		
##	all_wrist auc	all_wrist	1.0000000	1.0000000	1.0000000		
##	all_chest acc	all_chest	100.0000000	100.0000000	100.0000000		
##	all_chest auc	all_chest	1.0000000	1.0000000	1.0000000		
##	all_physio acc	all_physio	100.0000000	100.0000000	100.0000000		
##	all_physio auc	all_physio	1.0000000	1.0000000	1.0000000		
##	all_modalities acc	all_modalities	100.0000000	100.0000000	100.0000000		
##	all_modalities auc	all_modalities	1.0000000	1.0000000	1.0000000		
##			4	5	6	7	8
##	wrist_physio acc		100.0000000	100.0000000	100.0000000	100.0000000	100.0000000

```

## wrist_physio auc      1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## chest_ecg acc        94.3319488  94.3319488  94.3319488  94.3319488  94.3319488
## chest_ecg auc        0.9027544  0.9027544  0.9027544  0.9027544  0.9027544
## chest_physio acc     100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## chest_physio auc     1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_wrist acc        100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_wrist auc        1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_chest acc        100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_chest auc        1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_physio acc       100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_physio auc       1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_modalities acc   100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_modalities auc   1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
##                      9          10          11          12          13
## wrist_physio acc     100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## wrist_physio auc     1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## chest_ecg acc        94.3319488  94.3319488  94.3319488  94.3319488  94.3319488
## chest_ecg auc        0.9027544  0.9027544  0.9027544  0.9027544  0.9027544
## chest_physio acc     100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## chest_physio auc     1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_wrist acc        100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_wrist auc        1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_chest acc        100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_chest auc        1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_physio acc       100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_physio auc       1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
## all_modalities acc   100.0000000  100.0000000  100.0000000  100.0000000  100.0000000
## all_modalities auc   1.0000000  1.0000000  1.0000000  1.0000000  1.0000000
##                      14          15
## wrist_physio acc     100.0000000  100.0000000
## wrist_physio auc     1.0000000  1.0000000
## chest_ecg acc        94.3319488  94.3319488
## chest_ecg auc        0.9027544  0.9027544
## chest_physio acc     100.0000000  100.0000000
## chest_physio auc     1.0000000  1.0000000
## all_wrist acc        100.0000000  100.0000000
## all_wrist auc        1.0000000  1.0000000
## all_chest acc        100.0000000  100.0000000
## all_chest auc        1.0000000  1.0000000
## all_physio acc       100.0000000  100.0000000
## all_physio auc       1.0000000  1.0000000
## all_modalities acc   100.0000000  100.0000000
## all_modalities auc   1.0000000  1.0000000

```

100 Training Samples

```

for(i in 1:7){
  for (j in 1:15){
    set.seed(1)
    test = subset(data, id == j)
    train = subset(data, id != j)
    test_sample = test
  }
}

```

```

train_indices = sample(nrow(train), 100)
train_sample = train[train_indices,]

predictor = cv$predictor[(i-1)*2+1]
predictors = eval(parse(text = predictor))
model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree
predict_rf <- predict(model_rf, test_sample)
acc = mean(test_sample$label == predict_rf)*100
auc = AUC(as.numeric(predict_rf), as.numeric(test_sample$label))

cv[(i-1)*2+1,j+1] <- acc
cv[(i-1)*2+2,j+1] <- auc
}
}

```

cv

			1	2	3	4
##		predictor				
##	wrist_physio acc	wrist_physio	98.6067844	98.6067844	98.6067844	98.6067844
##	wrist_physio auc	wrist_physio	0.9672764	0.9672764	0.9672764	0.9672764
##	chest_ecg acc	chest_ecg	85.2890273	85.2890273	85.2890273	85.2890273
##	chest_ecg auc	chest_ecg	0.6833867	0.6833867	0.6833867	0.6833867
##	chest_physio acc	chest_physio	93.4406369	93.4406369	93.4406369	93.4406369
##	chest_physio auc	chest_physio	0.8459350	0.8459350	0.8459350	0.8459350
##	all_wrist acc	all_wrist	98.9356179	98.9356179	98.9356179	98.9356179
##	all_wrist auc	all_wrist	0.9750000	0.9750000	0.9750000	0.9750000
##	all_chest acc	all_chest	95.2838352	95.2838352	95.2838352	95.2838352
##	all_chest auc	all_chest	0.8892276	0.8892276	0.8892276	0.8892276
##	all_physio acc	all_physio	99.5240568	99.5240568	99.5240568	99.5240568
##	all_physio auc	all_physio	0.9888211	0.9888211	0.9888211	0.9888211
##	all_modalities acc	all_modalities	99.3163724	99.3163724	99.3163724	99.3163724
##	all_modalities auc	all_modalities	0.9839431	0.9839431	0.9839431	0.9839431
##			5	6	7	8
##	wrist_physio acc		98.6067844	98.6067844	98.6067844	98.6067844
##	wrist_physio auc		0.9672764	0.9672764	0.9672764	0.9672764
##	chest_ecg acc		85.2890273	85.2890273	85.2890273	85.2890273
##	chest_ecg auc		0.6833867	0.6833867	0.6833867	0.6833867
##	chest_physio acc		93.4406369	93.4406369	93.4406369	93.4406369
##	chest_physio auc		0.8459350	0.8459350	0.8459350	0.8459350
##	all_wrist acc		98.9356179	98.9356179	98.9356179	98.9356179
##	all_wrist auc		0.9750000	0.9750000	0.9750000	0.9750000
##	all_chest acc		95.2838352	95.2838352	95.2838352	95.2838352
##	all_chest auc		0.8892276	0.8892276	0.8892276	0.8892276
##	all_physio acc		99.5240568	99.5240568	99.5240568	99.5240568
##	all_physio auc		0.9888211	0.9888211	0.9888211	0.9888211
##	all_modalities acc		99.3163724	99.3163724	99.3163724	99.3163724
##	all_modalities auc		0.9839431	0.9839431	0.9839431	0.9839431
##			10	11	12	13
##	wrist_physio acc		98.6067844	98.6067844	98.6067844	98.6067844
##	wrist_physio auc		0.9672764	0.9672764	0.9672764	0.9672764
##	chest_ecg acc		85.2890273	85.2890273	85.2890273	85.2890273
##	chest_ecg auc		0.6833867	0.6833867	0.6833867	0.6833867
##	chest_physio acc		93.4406369	93.4406369	93.4406369	93.4406369
##	chest_physio auc		0.8459350	0.8459350	0.8459350	0.8459350


```

## all_wrist acc      98.9356179 98.9356179 98.9356179 98.9356179 98.9356179
## all_wrist auc      0.9750000 0.9750000 0.9750000 0.9750000 0.9750000
## all_chest acc      95.2838352 95.2838352 95.2838352 95.2838352 95.2838352
## all_chest auc      0.8892276 0.8892276 0.8892276 0.8892276 0.8892276
## all_physio acc     99.5240568 99.5240568 99.5240568 99.5240568 99.5240568
## all_physio auc     0.9888211 0.9888211 0.9888211 0.9888211 0.9888211
## all_modalities acc 99.3163724 99.3163724 99.3163724 99.3163724 99.3163724
## all_modalities auc 0.9839431 0.9839431 0.9839431 0.9839431 0.9839431
##                  15
## wrist_physio acc   98.6067844
## wrist_physio auc   0.9672764
## chest_ecg acc      85.2890273
## chest_ecg auc      0.6833867
## chest_physio acc   93.4406369
## chest_physio auc   0.8459350
## all_wrist acc      98.9356179
## all_wrist auc      0.9750000
## all_chest acc      95.2838352
## all_chest auc      0.8892276
## all_physio acc     99.5240568
## all_physio auc     0.9888211
## all_modalities acc 99.3163724
## all_modalities auc 0.9839431

```