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)
```

```
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"           "HB_BVP"           "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"           "HB_ECG"
## [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"
```

```r
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)]
```

```r
predictor_vars <- c("personal", "wrist_acc", "chest_acc", "wrist_bvp", "wrist_eda", "wrist_temp", "wrist
```

```r
test_sample = test
```

```r
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
```

```r
rf <- function(train_sample, test_sample, predictors){
  set.seed(1)
  model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree = 5
  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)))
  if (mean(test_sample$label == predict_rf) == 1){
    df <- data.frame(importance(model_rf, type = 1))
    print(df)
  }
}
```

```r
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)))
}
```

```r
print_baseline(test_sample)
```

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

```r
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 99.95673 %
## AUROC is 0.9989837
##
## 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                    3.4097514
## BVP_sd                      7.0191373
## HB_BVP                     12.2865341
## EDA_wrist_mean             16.6155822
## EDA_wrist_sd                8.4932341
## EDA_wrist_min              18.1040235
## EDA_wrist_max              12.5467060
## EDA_wrist_range             8.5158734
## EDA_wrist_slope             1.9065942
## Temp_wrist_mean            13.1540133
## Temp_wrist_sd               4.0589914
## Temp_wrist_min             12.9950892
## Temp_wrist_max             14.1536753
## Temp_wrist_range            3.7429619
## Temp_wrist_slope            0.0466625
## Predictors:  chest_ecg
## Accuracy is 100 %
## AUROC is 1
##
##          MeanDecreaseAccuracy
## ECG_mean             20.71153
## ECG_sd               23.72456
## HB_ECG              127.48369
## 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                     6.2611834
## ECG_sd                       3.9010677
## HB_ECG                      13.6692359
## EDA_chest_mean              12.1894770
## EDA_chest_sd                 6.8638750
## EDA_chest_min               13.1768064
## EDA_chest_max               11.1225222
## EDA_chest_range              7.8422104
## EDA_chest_slope              1.6977386
## EMG_mean                     0.5882867
## EMG_sd                       6.3698007
## EMG_range                    9.4557351
## Resp_Volume                 15.3708152
## Resp_range                  13.0803853
## breath_rate                  5.5403759
## Temp_chest_mean             12.4018469
## Temp_chest_sd                5.1219988
## Temp_chest_min              12.2643348
## Temp_chest_max              13.1225408
## Temp_chest_range             8.3122521
## Temp_chest_slope             0.8809070
## Predictors:  all_wrist
## Accuracy is 100 %
## AUROC is 1
##
##                   MeanDecreaseAccuracy
## ACC_wrist_mean                6.430243
## ACC_wrist_sd                  4.773430
## BVP_mean                      2.445142
## BVP_sd                        5.899550
## HB_BVP                       11.891642
## EDA_wrist_mean               15.811268
## EDA_wrist_sd                  7.306221
## EDA_wrist_min                19.807530
## EDA_wrist_max                12.148825
```

```
## EDA_wrist_range              8.151258
## EDA_wrist_slope              1.701725
## Temp_wrist_mean             12.985022
## Temp_wrist_sd                2.824078
## Temp_wrist_min              14.072430
## Temp_wrist_max              13.324003
## Temp_wrist_range             2.663357
## Temp_wrist_slope             1.416835
## Predictors:  all_chest
## Accuracy is 100 %
## AUROC is 1
##
##                   MeanDecreaseAccuracy
## ACC_chest_mean              15.8440819
## ACC_chest_sd                11.6579148
## ECG_mean                     5.2571195
## ECG_sd                       3.2323461
## HB_ECG                      10.8282760
## EDA_chest_mean              10.8457342
## EDA_chest_sd                 5.8863519
## EDA_chest_min               12.1514297
## EDA_chest_max               10.1792255
## EDA_chest_range              5.5860634
## EDA_chest_slope              1.8237127
## EMG_mean                    -0.2552359
## EMG_sd                       6.3283938
## EMG_range                    9.4908726
## Resp_Volume                 12.4776697
## Resp_range                   9.1859010
## breath_rate                  3.2562503
## Temp_chest_mean             10.1834545
## Temp_chest_sd                3.9922127
## Temp_chest_min              10.2470598
## Temp_chest_max              12.7457926
## Temp_chest_range             7.0916714
## Temp_chest_slope             1.6484105
## Predictors:  all_physio
## Accuracy is 100 %
## AUROC is 1
##
##                   MeanDecreaseAccuracy
## BVP_mean                     2.53909395
## BVP_sd                       4.17307697
## HB_BVP                       7.59715568
## EDA_wrist_mean              13.13345254
## EDA_wrist_sd                 6.03623985
## EDA_wrist_min               15.22316278
## EDA_wrist_max               10.72247204
## EDA_wrist_range              6.83511568
## EDA_wrist_slope              2.68382764
## Temp_wrist_mean             10.11263386
## Temp_wrist_sd                2.50978301
## Temp_wrist_min              10.89832395
## Temp_wrist_max              10.36089119
```

```
## Temp_wrist_range           2.17038270
## Temp_wrist_slope          -0.35766057
## ECG_mean                   3.61903689
## ECG_sd                     2.46876303
## HB_ECG                     6.83097114
## EDA_chest_mean             6.20121071
## EDA_chest_sd               3.21571090
## EDA_chest_min              6.36643214
## EDA_chest_max              5.11651183
## EDA_chest_range            3.09243372
## EDA_chest_slope            1.74551571
## EMG_mean                  -0.02139557
## EMG_sd                     3.92589950
## EMG_range                  4.06073176
## Resp_Volume                8.13389715
## Resp_range                 6.27341914
## breath_rate                5.54478490
## Temp_chest_mean            6.61898006
## Temp_chest_sd              2.84509894
## Temp_chest_min             6.10231749
## Temp_chest_max             6.61878494
## Temp_chest_range           3.49091212
## Temp_chest_slope          -1.00100150
## Predictors:  all_modalities
## Accuracy is 100 %
## AUROC is 1
##
##                   MeanDecreaseAccuracy
## ACC_wrist_mean               6.7882147
## ACC_wrist_sd                 3.7696563
## BVP_mean                     1.3999851
## BVP_sd                       3.3912035
## HB_BVP                       7.3863792
## EDA_wrist_mean              12.9554603
## EDA_wrist_sd                 4.5202051
## EDA_wrist_min               14.6973774
## EDA_wrist_max                9.0448854
## EDA_wrist_range              5.5289155
## EDA_wrist_slope              2.2205156
## Temp_wrist_mean              8.3715288
## Temp_wrist_sd                2.1715966
## Temp_wrist_min              10.1388831
## Temp_wrist_max               9.9338205
## Temp_wrist_range             1.7898225
## Temp_wrist_slope             1.0010015
## ACC_chest_mean               9.3156116
## ACC_chest_sd                 6.8341706
## ECG_mean                     3.5968519
## ECG_sd                       1.9924540
## HB_ECG                       6.5291204
## EDA_chest_mean               5.3054932
## EDA_chest_sd                 3.2692839
## EDA_chest_min                6.1284373
## EDA_chest_max                5.3124480
```

```
## EDA_chest_range             3.4096750
## EDA_chest_slope             1.3343525
## EMG_mean                    0.0000000
## EMG_sd                      3.2287118
## EMG_range                   4.4687715
## Resp_Volume                 8.1409650
## Resp_range                  5.9127028
## breath_rate                 5.3938460
## Temp_chest_mean             6.4769150
## Temp_chest_sd               1.9067641
## Temp_chest_min              6.4380352
## Temp_chest_max              7.4222746
## Temp_chest_range            4.1098051
## Temp_chest_slope            0.9670453
```

LDA

```
LDA <- function(train_sample, test_sample, predictors){
  model_lda <- lda(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), data = train_samp
  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 77.40568 %
## AUROC is 0.5155732
##
## 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 100 %
## AUROC is 1
##
## Predictors:  chest_ecg
## Accuracy is 77.60471 %
## AUROC is 0.5132787
##
## 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 98.22603 %
## AUROC is 0.9771653
##
## Predictors:  all_wrist
## Accuracy is 100 %
## AUROC is 1
##
## Predictors:  all_chest
## Accuracy is 98.93562 %
## AUROC is 0.9905697
##
## Predictors:  all_physio
## Accuracy is 100 %
## AUROC is 1
##
## 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=binor
  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$la
}
```

```
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 79.22291 %
## AUROC is 0.5137713
##
## 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 77.84701 %
## AUROC is 0.4949479
##
## 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 100 %
## AUROC is 1
##
## Predictors:  all_wrist
## Accuracy is 100 %
## AUROC is 1
##
## Predictors:  all_chest
## Accuracy is 100 %
## AUROC is 1
##
## 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_physi
colnames(cv) <- c("predictor", c(1:15))
cv$predictor <- c("wrist_physio", "wrist_physio", "chest_ecg", "chest_ecg", "chest_physio", "chest_physi
```

```
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$predictor[(i-1)*2+1]
    predictors = eval(parse(text = predictor))
    model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree =
    predict_rf <- predict(model_rf, test_sample)
    acc = mean(test_sample$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 98.3731395 98.3731395 98.3731395 98.3731395
## wrist_physio auc     wrist_physio  0.9617886  0.9617886  0.9617886  0.9617886
## chest_ecg acc           chest_ecg 90.2734510 90.2734510 90.2734510 90.2734510
## chest_ecg auc           chest_ecg  0.7715447  0.7715447  0.7715447  0.7715447
## chest_physio acc     chest_physio 94.8771201 94.8771201 94.8771201 94.8771201
## chest_physio auc     chest_physio  0.8796748  0.8796748  0.8796748  0.8796748
## all_wrist acc           all_wrist 98.3212184 98.3212184 98.3212184 98.3212184
## all_wrist auc           all_wrist  0.9605691  0.9605691  0.9605691  0.9605691
## all_chest acc           all_chest 95.7857390 95.7857390 95.7857390 95.7857390
## all_chest auc           all_chest  0.9010163  0.9010163  0.9010163  0.9010163
## all_physio acc         all_physio 99.3423330 99.3423330 99.3423330 99.3423330
## all_physio auc         all_physio  0.9845528  0.9845528  0.9845528  0.9845528
## all_modalities acc all_modalities 99.1779162 99.1779162 99.1779162 99.1779162
## all_modalities auc all_modalities  0.9806911  0.9806911  0.9806911  0.9806911
##                             5          6          7          8          9
## wrist_physio acc   98.3731395 98.3731395 98.3731395 98.3731395 98.3731395
## wrist_physio auc    0.9617886  0.9617886  0.9617886  0.9617886  0.9617886
## chest_ecg acc      90.2734510 90.2734510 90.2734510 90.2734510 90.2734510
## chest_ecg auc       0.7715447  0.7715447  0.7715447  0.7715447  0.7715447
## chest_physio acc   94.8771201 94.8771201 94.8771201 94.8771201 94.8771201
## chest_physio auc    0.8796748  0.8796748  0.8796748  0.8796748  0.8796748
## all_wrist acc      98.3212184 98.3212184 98.3212184 98.3212184 98.3212184
## all_wrist auc       0.9605691  0.9605691  0.9605691  0.9605691  0.9605691
## all_chest acc      95.7857390 95.7857390 95.7857390 95.7857390 95.7857390
## all_chest auc       0.9010163  0.9010163  0.9010163  0.9010163  0.9010163
## all_physio acc     99.3423330 99.3423330 99.3423330 99.3423330 99.3423330
## all_physio auc      0.9845528  0.9845528  0.9845528  0.9845528  0.9845528
```

```
## all_modalities acc 99.1779162 99.1779162 99.1779162 99.1779162 99.1779162
## all_modalities auc  0.9806911  0.9806911  0.9806911  0.9806911  0.9806911
##                            10         11         12         13         14
## wrist_physio acc   98.3731395 98.3731395 98.3731395 98.3731395 98.3731395
## wrist_physio auc    0.9617886  0.9617886  0.9617886  0.9617886  0.9617886
## chest_ecg acc      90.2734510 90.2734510 90.2734510 90.2734510 90.2734510
## chest_ecg auc       0.7715447  0.7715447  0.7715447  0.7715447  0.7715447
## chest_physio acc   94.8771201 94.8771201 94.8771201 94.8771201 94.8771201
## chest_physio auc    0.8796748  0.8796748  0.8796748  0.8796748  0.8796748
## all_wrist acc      98.3212184 98.3212184 98.3212184 98.3212184 98.3212184
## all_wrist auc       0.9605691  0.9605691  0.9605691  0.9605691  0.9605691
## all_chest acc      95.7857390 95.7857390 95.7857390 95.7857390 95.7857390
## all_chest auc       0.9010163  0.9010163  0.9010163  0.9010163  0.9010163
## all_physio acc     99.3423330 99.3423330 99.3423330 99.3423330 99.3423330
## all_physio auc      0.9845528  0.9845528  0.9845528  0.9845528  0.9845528
## all_modalities acc 99.1779162 99.1779162 99.1779162 99.1779162 99.1779162
## all_modalities auc  0.9806911  0.9806911  0.9806911  0.9806911  0.9806911
##                            15
## wrist_physio acc   98.3731395
## wrist_physio auc    0.9617886
## chest_ecg acc      90.2734510
## chest_ecg auc       0.7715447
## chest_physio acc   94.8771201
## chest_physio auc    0.8796748
## all_wrist acc      98.3212184
## all_wrist auc       0.9605691
## all_chest acc      95.7857390
## all_chest auc       0.9010163
## all_physio acc     99.3423330
## all_physio auc      0.9845528
## all_modalities acc 99.1779162
## all_modalities auc  0.9806911
```

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$predictor[(i-1)*2+1]
    predictors = eval(parse(text = predictor))
    model_rf <- randomForest(as.formula(paste("label ~ ", paste(predictors, collapse = ' + '))), ntree =
    predict_rf <- predict(model_rf, test_sample)
    acc = mean(test_sample$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   4   5   6   7   8   9  10  11
## wrist_physio acc     wrist_physio 100 100 100 100 100 100 100 100 100 100 100
## wrist_physio auc     wrist_physio   1   1   1   1   1   1   1   1   1   1   1
## chest_ecg acc           chest_ecg 100 100 100 100 100 100 100 100 100 100 100
## chest_ecg auc           chest_ecg   1   1   1   1   1   1   1   1   1   1   1
## chest_physio acc     chest_physio 100 100 100 100 100 100 100 100 100 100 100
## chest_physio auc     chest_physio   1   1   1   1   1   1   1   1   1   1   1
## all_wrist acc           all_wrist 100 100 100 100 100 100 100 100 100 100 100
## all_wrist auc           all_wrist   1   1   1   1   1   1   1   1   1   1   1
## all_chest acc           all_chest 100 100 100 100 100 100 100 100 100 100 100
## all_chest auc           all_chest   1   1   1   1   1   1   1   1   1   1   1
## all_physio acc         all_physio 100 100 100 100 100 100 100 100 100 100 100
## all_physio auc         all_physio   1   1   1   1   1   1   1   1   1   1   1
## all_modalities acc all_modalities 100 100 100 100 100 100 100 100 100 100 100
## all_modalities auc all_modalities   1   1   1   1   1   1   1   1   1   1   1
##                       12  13  14  15
## wrist_physio acc     100 100 100 100
## wrist_physio auc       1   1   1   1
## chest_ecg acc        100 100 100 100
## chest_ecg auc          1   1   1   1
## chest_physio acc     100 100 100 100
## chest_physio auc       1   1   1   1
## all_wrist acc        100 100 100 100
## all_wrist auc          1   1   1   1
## all_chest acc        100 100 100 100
## all_chest auc          1   1   1   1
## all_physio acc       100 100 100 100
## all_physio auc         1   1   1   1
## all_modalities acc 100 100 100 100
## all_modalities auc   1   1   1   1
```

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
```

```
##                          predictor          1          2          3          4
## wrist_physio acc     wrist_physio 98.3731395 98.3731395 98.3731395 98.3731395
## wrist_physio auc     wrist_physio  0.9617886  0.9617886  0.9617886  0.9617886
## chest_ecg acc           chest_ecg 90.2734510 90.2734510 90.2734510 90.2734510
## chest_ecg auc           chest_ecg  0.7715447  0.7715447  0.7715447  0.7715447
## chest_physio acc     chest_physio 94.8771201 94.8771201 94.8771201 94.8771201
## chest_physio auc     chest_physio  0.8796748  0.8796748  0.8796748  0.8796748
## all_wrist acc           all_wrist 98.3212184 98.3212184 98.3212184 98.3212184
## all_wrist auc           all_wrist  0.9605691  0.9605691  0.9605691  0.9605691
## all_chest acc           all_chest 95.7857390 95.7857390 95.7857390 95.7857390
## all_chest auc           all_chest  0.9010163  0.9010163  0.9010163  0.9010163
## all_physio acc         all_physio 99.3423330 99.3423330 99.3423330 99.3423330
## all_physio auc         all_physio  0.9845528  0.9845528  0.9845528  0.9845528
## all_modalities acc all_modalities 99.1779162 99.1779162 99.1779162 99.1779162
## all_modalities auc all_modalities  0.9806911  0.9806911  0.9806911  0.9806911
##                             5          6          7          8          9
## wrist_physio acc   98.3731395 98.3731395 98.3731395 98.3731395 98.3731395
## wrist_physio auc    0.9617886  0.9617886  0.9617886  0.9617886  0.9617886
## chest_ecg acc      90.2734510 90.2734510 90.2734510 90.2734510 90.2734510
## chest_ecg auc       0.7715447  0.7715447  0.7715447  0.7715447  0.7715447
## chest_physio acc   94.8771201 94.8771201 94.8771201 94.8771201 94.8771201
## chest_physio auc    0.8796748  0.8796748  0.8796748  0.8796748  0.8796748
## all_wrist acc      98.3212184 98.3212184 98.3212184 98.3212184 98.3212184
## all_wrist auc       0.9605691  0.9605691  0.9605691  0.9605691  0.9605691
## all_chest acc      95.7857390 95.7857390 95.7857390 95.7857390 95.7857390
## all_chest auc       0.9010163  0.9010163  0.9010163  0.9010163  0.9010163
## all_physio acc     99.3423330 99.3423330 99.3423330 99.3423330 99.3423330
## all_physio auc      0.9845528  0.9845528  0.9845528  0.9845528  0.9845528
## all_modalities acc 99.1779162 99.1779162 99.1779162 99.1779162 99.1779162
## all_modalities auc  0.9806911  0.9806911  0.9806911  0.9806911  0.9806911
##                            10         11         12         13         14
## wrist_physio acc   98.3731395 98.3731395 98.3731395 98.3731395 98.3731395
## wrist_physio auc    0.9617886  0.9617886  0.9617886  0.9617886  0.9617886
## chest_ecg acc      90.2734510 90.2734510 90.2734510 90.2734510 90.2734510
## chest_ecg auc       0.7715447  0.7715447  0.7715447  0.7715447  0.7715447
## chest_physio acc   94.8771201 94.8771201 94.8771201 94.8771201 94.8771201
## chest_physio auc    0.8796748  0.8796748  0.8796748  0.8796748  0.8796748
## all_wrist acc      98.3212184 98.3212184 98.3212184 98.3212184 98.3212184
## all_wrist auc       0.9605691  0.9605691  0.9605691  0.9605691  0.9605691
## all_chest acc      95.7857390 95.7857390 95.7857390 95.7857390 95.7857390
## all_chest auc       0.9010163  0.9010163  0.9010163  0.9010163  0.9010163
```

```
## all_physio acc     99.3423330 99.3423330 99.3423330 99.3423330 99.3423330
## all_physio auc      0.9845528  0.9845528  0.9845528  0.9845528  0.9845528
## all_modalities acc 99.1779162 99.1779162 99.1779162 99.1779162 99.1779162
## all_modalities auc  0.9806911  0.9806911  0.9806911  0.9806911  0.9806911
##                            15
## wrist_physio acc   98.3731395
## wrist_physio auc    0.9617886
## chest_ecg acc      90.2734510
## chest_ecg auc       0.7715447
## chest_physio acc   94.8771201
## chest_physio auc    0.8796748
## all_wrist acc      98.3212184
## all_wrist auc       0.9605691
## all_chest acc      95.7857390
## all_chest auc       0.9010163
## all_physio acc     99.3423330
## all_physio auc      0.9845528
## all_modalities acc 99.1779162
## all_modalities auc  0.9806911
```