R Notebook

Parametros:

Measure = Matthews correlation coefficient
Columns = sampling, weight_space, underbagging, learner
Performance = tuning_measure
Filter keys = imba.rate
Filter values = 0.01

```
library("scmamp")
library(dplyr)
```

Tratamento dos dados

Carregando data set compilado

```
ds = read.csv("/home/rodrigo/Dropbox/UNICAMP/IC/estudo_cost_learning/SummaryResults/summary_compilation_

ds = filter(ds, learner != "classif.rusboost")
summary(ds)
```

```
##                  learner      weight_space
##  classif.ksvm        :17100   Mode :logical
##  classif.randomForest:17100   FALSE:41040
##  classif.rusboost    :    0   TRUE :10260
##  classif.xgboost     :17100   NA's :0
##
##
##
##                             measure        sampling     underbagging
##  Accuracy                       :10260   ADASYN:10260   Mode :logical
##  Area under the curve           :10260   FALSE :30780   FALSE:41040
##  F1 measure                     :10260   SMOTE :10260   TRUE :10260
##  G-mean                         :10260                  NA's :0
##  Matthews correlation coefficient:10260
##
##
##  tuning_measure    holdout_measure   holdout_measure_residual
##  Min.   :-0.1277   Min.   :-0.2120   Min.   :-0.4658
##  1st Qu.: 0.6911   1st Qu.: 0.4001   1st Qu.: 0.1994
##  Median : 0.9700   Median : 0.8571   Median : 0.5581
##  Mean   : 0.7903   Mean   : 0.6718   Mean   : 0.5298
##  3rd Qu.: 0.9975   3rd Qu.: 0.9900   3rd Qu.: 0.8755
##  Max.   : 1.0000   Max.   : 1.0000   Max.   : 1.0000
##  NA's   :1077      NA's   :1077      NA's   :1077
##  iteration_count                      dataset        imba.rate
##  Min.   :1       abalone                 :  900   Min.   :0.0010
##  1st Qu.:1       adult                   :  900   1st Qu.:0.0100
##  Median :2       bank                    :  900   Median :0.0300
##  Mean   :2       car                     :  900   Mean   :0.0286
```

```
##  3rd Qu.:3       cardiotocography-10clases:  900   3rd Qu.:0.0500
##  Max.   :3       cardiotocography-3clases :  900   Max.   :0.0500
##  NA's   :1077    (Other)                  :45900
```

Filtrando pela metrica

```
ds = filter(ds, measure == params$measure)
```

Filtrando o data set

```
if(params$filter_keys != 'NULL' && !is.null(params$filter_keys)){
  dots = paste0(params$filter_keys," == '",params$filter_values,"'")
  ds = filter_(ds, .dots = dots)
}

summary(ds)
```

```
##                  learner    weight_space
##  classif.ksvm        :600   Mode :logical
##  classif.randomForest:600   FALSE:1440
##  classif.rusboost    :  0   TRUE :360
##  classif.xgboost     :600   NA's :0
##
##
##
##                              measure       sampling    underbagging
##  Accuracy                        :   0   ADASYN: 360   Mode :logical
##  Area under the curve            :   0   FALSE :1080   FALSE:1440
##  F1 measure                      :   0   SMOTE : 360   TRUE :360
##  G-mean                          :   0                 NA's :0
##  Matthews correlation coefficient:1800
##
##
##  tuning_measure     holdout_measure   holdout_measure_residual
##  Min.   :-0.00646   Min.   :-0.1370   Min.   :-0.06817
##  1st Qu.: 0.23261   1st Qu.: 0.0000   1st Qu.: 0.02011
##  Median : 0.82014   Median : 0.3764   Median : 0.19200
##  Mean   : 0.64070   Mean   : 0.4285   Mean   : 0.29498
##  3rd Qu.: 0.99730   3rd Qu.: 0.8152   3rd Qu.: 0.49996
##  Max.   : 1.00000   Max.   : 1.0000   Max.   : 1.00000
##  NA's   :69         NA's   :69        NA's   :69
##  iteration_count                      dataset       imba.rate
##  Min.   :1       abalone                  :  45   Min.   :0.01
##  1st Qu.:1       adult                    :  45   1st Qu.:0.01
##  Median :2       bank                     :  45   Median :0.01
##  Mean   :2       car                      :  45   Mean   :0.01
##  3rd Qu.:3       cardiotocography-10clases:  45   3rd Qu.:0.01
##  Max.   :3       cardiotocography-3clases :  45   Max.   :0.01
##  NA's   :69      (Other)                  :1530
```

Computando as médias das iteracoes

```
ds = group_by(ds, learner , weight_space , measure , sampling , underbagging , dataset , imba.rate)
ds = summarise(ds, tuning_measure = mean(tuning_measure), holdout_measure = mean(holdout_measure),
               holdout_measure_residual = mean(holdout_measure_residual))

ds = as.data.frame(ds)
```

Criando dataframe

```
# Dividindo o ds em n, um para cada técnica
splited_df = ds %>% group_by_at(.vars = params$columns) %>% do(vals = as.data.frame(.)) %>% select(vals)

# Juntando cada uma das partes horizontalmente em um data set
df_tec_wide = do.call("cbind", splited_df)

# Renomeando duplicacao de nomes
colnames(df_tec_wide) = make.unique(colnames(df_tec_wide))

# Selecionando apenas as medidas da performance escolhida
df_tec_wide_residual = select(df_tec_wide, matches(paste("^", params$performance, "$|", params$performa

# Renomeando colunas
new_names = NULL
for(i in (1:length(splited_df))){
  id = toString(sapply(splited_df[[i]][1, params$columns], as.character))
  new_names = c(new_names, id)
}
colnames(df_tec_wide_residual) = new_names

# Verificando a dimensao do df
dim(df_tec_wide_residual)
```

```
## [1] 40 15
```

```
# Renomeando a variavel
df = df_tec_wide_residual

head(df)
```

```
##   ADASYN, FALSE, FALSE, classif.ksvm
## 1                          0.9711549
## 2                          0.9840938
## 3                          0.9976886
## 4                          1.0000000
## 5                          1.0000000
## 6                          0.9973459
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                  0.9639089
## 2                                  0.9834259
## 3                                  0.9913813
## 4                                  1.0000000
## 5                                  0.9947464
## 6                                  0.9984513
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                             0.9729427                       -0.00331073
## 2                             0.9882984                        0.03130559
## 3                             0.9865396                        0.00000000
## 4                             1.0000000                        0.84986516
## 5                             0.9949727                        0.53692615
## 6                             0.9986729                        0.66437344
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                                 0.0000000
## 2                                        NA
```

```
## 3                                0.0000000
## 4                                1.0000000
## 5                                0.5461331
## 6                                0.8932206
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                           0.00000000                        0.03775174
## 2                           0.39809263                        0.09124314
## 3                           0.03498764                        0.07291374
## 4                           0.99019903                        0.83204223
## 5                           0.70251830                        0.42292522
## 6                           0.85240511                        0.86395957
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                              0.04138595
## 2                              0.16003091
## 3                              0.17236753
## 4                              0.49950982
## 5                              0.26010542
## 6                              0.65564107
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                           0.05606272                       -0.002739151
## 2                           0.15758863                        0.043297878
## 3                           0.14976876                        0.000000000
## 4                           0.50474181                        0.849865157
## 5                           0.21629241                        0.536926146
## 6                           0.46284332                        0.664373439
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                              0.0000000
## 2                                     NA
## 3                              0.0000000
## 4                              1.0000000
## 5                              0.5413920
## 6                              0.8577859
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.00000000                          0.9694672
## 2                           0.41553378                          0.9861198
## 3                           0.03464031                          0.9973734
## 4                           0.99019903                          1.0000000
## 5                           0.63325625                          1.0000000
## 6                           0.85240511                          0.9973574
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                              0.9644783
## 2                              0.9842461
## 3                              0.9899064
## 4                              1.0000000
## 5                              0.9966342
## 6                              0.9993362
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                            0.9745849
## 2                            0.9895432
## 3                            0.9885378
## 4                            0.9994734
## 5                            0.9968504
## 6                            0.9988938
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :0.8777
##  1st Qu.:0.9916
##  Median :0.9977
##  Mean   :0.9914
##  3rd Qu.:0.9994
##  Max.   :1.0000
##  NA's   :2
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :0.9639
##  1st Qu.:0.9919
##  Median :0.9968
##  Mean   :0.9938
##  3rd Qu.:0.9989
##  Max.   :1.0000
##  NA's   :8
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :0.6780                        Min.   :-0.003311
##  1st Qu.:0.9879                        1st Qu.: 0.000000
##  Median :0.9962                        Median : 0.231339
##  Mean   :0.9853                        Mean   : 0.329084
##  3rd Qu.:0.9988                        3rd Qu.: 0.566816
##  Max.   :1.0000                        Max.   : 1.000000
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.0495
##  Median :0.5014
##  Mean   :0.4883
##  3rd Qu.:0.8932
##  Max.   :1.0000
##  NA's   :3
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :0.0000                       Min.   :0.03775
##  1st Qu.:0.1496                       1st Qu.:0.12823
##  Median :0.5837                       Median :0.36387
##  Mean   :0.5355                       Mean   :0.39029
##  3rd Qu.:0.8633                       3rd Qu.:0.65133
##  Max.   :1.0000                       Max.   :1.00000
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.04139
##  1st Qu.:0.17332
##  Median :0.28127
##  Mean   :0.35742
##  3rd Qu.:0.47314
##  Max.   :1.00000
##  NA's   :1
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :0.02596                     Min.   :-0.002739
##  1st Qu.:0.15586                     1st Qu.: 0.000000
##  Median :0.25622                     Median : 0.231339
```

```
##  Mean   :0.31237                     Mean   : 0.331758
##  3rd Qu.:0.38715                     3rd Qu.: 0.566816
##  Max.   :1.00000                     Max.   : 1.000000
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :0.00000
##  1st Qu.:0.04833
##  Median :0.47076
##  Mean   :0.47408
##  3rd Qu.:0.85505
##  Max.   :1.00000
##  NA's   :4
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :0.0000                      Min.   :0.8777
##  1st Qu.:0.1929                      1st Qu.:0.9958
##  Median :0.5722                      Median :0.9981
##  Mean   :0.5383                      Mean   :0.9925
##  3rd Qu.:0.8664                      3rd Qu.:1.0000
##  Max.   :1.0000                      Max.   :1.0000
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :0.9645
##  1st Qu.:0.9921
##  Median :0.9983
##  Mean   :0.9941
##  3rd Qu.:0.9998
##  Max.   :1.0000
##  NA's   :5
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :0.9702
##  1st Qu.:0.9903
##  Median :0.9964
##  Mean   :0.9934
##  3rd Qu.:0.9989
##  Max.   :1.0000
##
```

Verificando a média de cada coluna selecionada

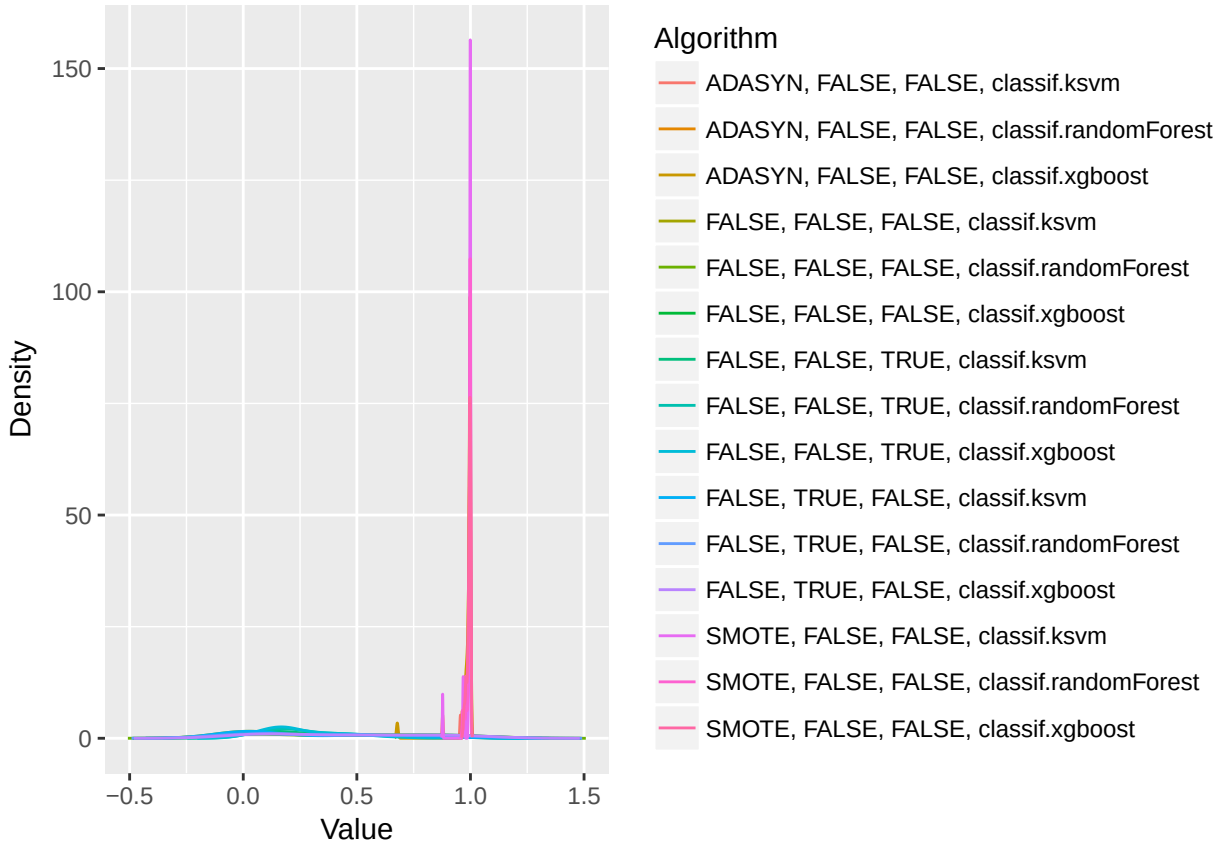
```
for(i in (1:dim(df)[2])){
  print(paste("Media da coluna ", colnames(df)[i], " = ", mean(df[,i], na.rm = TRUE), sep=""))
}
```

```
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.ksvm = 0.991406546238978"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.993806093803093"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.985296703454835"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.329084266711667"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.488324118449376"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.535458277855064"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.390291162248843"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.357418254439452"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.312372123809922"
```

```
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.331757755779061"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.474077898589332"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.538346898451686"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.992481978663669"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.994103700320599"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.993375106025774"
```

Fazendo teste de normalidade

```
plotDensities(data = na.omit(df))
```



Testando as diferencas

```
friedmanTest(df)
```

```
##
##  Friedman's rank sum test
##
## data:  df
## Friedman's chi-squared = 307.43, df = 14, p-value < 2.2e-16
```

Testando as diferencas par a par

```
test <- nemenyiTest (df, alpha=0.05)
abs(test$diff.matrix) > test$statistic
```

```
##       ADASYN, FALSE, FALSE, classif.ksvm
##  [1,]                              FALSE
##  [2,]                              FALSE
##  [3,]                              FALSE
##  [4,]                               TRUE
##  [5,]                               TRUE
##  [6,]                               TRUE
##  [7,]                               TRUE
##  [8,]                               TRUE
##  [9,]                               TRUE
## [10,]                               TRUE
## [11,]                               TRUE
## [12,]                               TRUE
## [13,]                              FALSE
## [14,]                              FALSE
## [15,]                              FALSE
##       ADASYN, FALSE, FALSE, classif.randomForest
##  [1,]                                      FALSE
##  [2,]                                      FALSE
##  [3,]                                      FALSE
##  [4,]                                       TRUE
##  [5,]                                       TRUE
##  [6,]                                      FALSE
##  [7,]                                       TRUE
##  [8,]                                       TRUE
##  [9,]                                       TRUE
## [10,]                                       TRUE
## [11,]                                       TRUE
## [12,]                                      FALSE
## [13,]                                      FALSE
## [14,]                                      FALSE
## [15,]                                      FALSE
##       ADASYN, FALSE, FALSE, classif.xgboost
##  [1,]                                 FALSE
##  [2,]                                 FALSE
##  [3,]                                 FALSE
##  [4,]                                  TRUE
##  [5,]                                  TRUE
##  [6,]                                  TRUE
##  [7,]                                  TRUE
##  [8,]                                  TRUE
##  [9,]                                  TRUE
## [10,]                                  TRUE
## [11,]                                  TRUE
## [12,]                                  TRUE
## [13,]                                 FALSE
## [14,]                                 FALSE
## [15,]                                 FALSE
```

```
##       FALSE, FALSE, FALSE, classif.ksvm
##  [1,]                               TRUE
##  [2,]                               TRUE
##  [3,]                               TRUE
##  [4,]                              FALSE
##  [5,]                              FALSE
##  [6,]                               TRUE
##  [7,]                              FALSE
##  [8,]                              FALSE
##  [9,]                              FALSE
## [10,]                              FALSE
## [11,]                              FALSE
## [12,]                               TRUE
## [13,]                               TRUE
## [14,]                               TRUE
## [15,]                               TRUE
##       FALSE, FALSE, FALSE, classif.randomForest
##  [1,]                                      TRUE
##  [2,]                                      TRUE
##  [3,]                                      TRUE
##  [4,]                                     FALSE
##  [5,]                                     FALSE
##  [6,]                                     FALSE
##  [7,]                                     FALSE
##  [8,]                                     FALSE
##  [9,]                                     FALSE
## [10,]                                     FALSE
## [11,]                                     FALSE
## [12,]                                     FALSE
## [13,]                                      TRUE
## [14,]                                      TRUE
## [15,]                                      TRUE
##       FALSE, FALSE, FALSE, classif.xgboost
##  [1,]                                 TRUE
##  [2,]                                FALSE
##  [3,]                                 TRUE
##  [4,]                                 TRUE
##  [5,]                                FALSE
##  [6,]                                FALSE
##  [7,]                                FALSE
##  [8,]                                FALSE
##  [9,]                                FALSE
## [10,]                                 TRUE
## [11,]                                FALSE
## [12,]                                FALSE
## [13,]                                 TRUE
## [14,]                                 TRUE
## [15,]                                 TRUE
##       FALSE, FALSE, TRUE, classif.ksvm
##  [1,]                              TRUE
##  [2,]                              TRUE
##  [3,]                              TRUE
##  [4,]                             FALSE
##  [5,]                             FALSE
```

```
##  [6,]                            FALSE
##  [7,]                            FALSE
##  [8,]                            FALSE
##  [9,]                            FALSE
## [10,]                            FALSE
## [11,]                            FALSE
## [12,]                            FALSE
## [13,]                             TRUE
## [14,]                             TRUE
## [15,]                             TRUE
##       FALSE, FALSE, TRUE, classif.randomForest
##  [1,]                                     TRUE
##  [2,]                                     TRUE
##  [3,]                                     TRUE
##  [4,]                                    FALSE
##  [5,]                                    FALSE
##  [6,]                                    FALSE
##  [7,]                                    FALSE
##  [8,]                                    FALSE
##  [9,]                                    FALSE
## [10,]                                    FALSE
## [11,]                                    FALSE
## [12,]                                    FALSE
## [13,]                                     TRUE
## [14,]                                     TRUE
## [15,]                                     TRUE
##       FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  [1,]                                TRUE                                TRUE
##  [2,]                                TRUE                                TRUE
##  [3,]                                TRUE                                TRUE
##  [4,]                               FALSE                               FALSE
##  [5,]                               FALSE                               FALSE
##  [6,]                               FALSE                                TRUE
##  [7,]                               FALSE                               FALSE
##  [8,]                               FALSE                               FALSE
##  [9,]                               FALSE                               FALSE
## [10,]                               FALSE                               FALSE
## [11,]                               FALSE                               FALSE
## [12,]                               FALSE                                TRUE
## [13,]                                TRUE                                TRUE
## [14,]                                TRUE                                TRUE
## [15,]                                TRUE                                TRUE
##       FALSE, TRUE, FALSE, classif.randomForest
##  [1,]                                     TRUE
##  [2,]                                     TRUE
##  [3,]                                     TRUE
##  [4,]                                    FALSE
##  [5,]                                    FALSE
##  [6,]                                    FALSE
##  [7,]                                    FALSE
##  [8,]                                    FALSE
##  [9,]                                    FALSE
## [10,]                                    FALSE
## [11,]                                    FALSE
```

```
## [12,]                                    FALSE
## [13,]                                     TRUE
## [14,]                                     TRUE
## [15,]                                     TRUE
##       FALSE, TRUE, FALSE, classif.xgboost
##  [1,]                                  TRUE
##  [2,]                                 FALSE
##  [3,]                                  TRUE
##  [4,]                                  TRUE
##  [5,]                                 FALSE
##  [6,]                                 FALSE
##  [7,]                                 FALSE
##  [8,]                                 FALSE
##  [9,]                                 FALSE
## [10,]                                  TRUE
## [11,]                                 FALSE
## [12,]                                 FALSE
## [13,]                                  TRUE
## [14,]                                  TRUE
## [15,]                                  TRUE
##       SMOTE, FALSE, FALSE, classif.ksvm
##  [1,]                               FALSE
##  [2,]                               FALSE
##  [3,]                               FALSE
##  [4,]                                TRUE
##  [5,]                                TRUE
##  [6,]                                TRUE
##  [7,]                                TRUE
##  [8,]                                TRUE
##  [9,]                                TRUE
## [10,]                                TRUE
## [11,]                                TRUE
## [12,]                                TRUE
## [13,]                               FALSE
## [14,]                               FALSE
## [15,]                               FALSE
##       SMOTE, FALSE, FALSE, classif.randomForest
##  [1,]                                     FALSE
##  [2,]                                     FALSE
##  [3,]                                     FALSE
##  [4,]                                      TRUE
##  [5,]                                      TRUE
##  [6,]                                      TRUE
##  [7,]                                      TRUE
##  [8,]                                      TRUE
##  [9,]                                      TRUE
## [10,]                                      TRUE
## [11,]                                      TRUE
## [12,]                                      TRUE
## [13,]                                     FALSE
## [14,]                                     FALSE
## [15,]                                     FALSE
##       SMOTE, FALSE, FALSE, classif.xgboost
##  [1,]                                FALSE
```

```
##  [2,]                                FALSE
##  [3,]                                FALSE
##  [4,]                                 TRUE
##  [5,]                                 TRUE
##  [6,]                                 TRUE
##  [7,]                                 TRUE
##  [8,]                                 TRUE
##  [9,]                                 TRUE
## [10,]                                 TRUE
## [11,]                                 TRUE
## [12,]                                 TRUE
## [13,]                                FALSE
## [14,]                                FALSE
## [15,]                                FALSE
```

Plotando os ranks

```
print(colMeans(rankMatrix(df)))
```

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                     3.7625
## ADASYN, FALSE, FALSE, classif.randomForest
##                                     5.9875
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                     4.3750
##          FALSE, FALSE, FALSE, classif.ksvm
##                                    12.2125
##  FALSE, FALSE, FALSE, classif.randomForest
##                                     9.8375
##       FALSE, FALSE, FALSE, classif.xgboost
##                                     8.6125
##           FALSE, FALSE, TRUE, classif.ksvm
##                                    10.2750
##   FALSE, FALSE, TRUE, classif.randomForest
##                                    10.8250
##        FALSE, FALSE, TRUE, classif.xgboost
##                                    11.2375
##           FALSE, TRUE, FALSE, classif.ksvm
##                                    12.0875
##   FALSE, TRUE, FALSE, classif.randomForest
##                                    10.4625
##        FALSE, TRUE, FALSE, classif.xgboost
##                                     8.3750
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                     2.9000
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                     4.9500
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                     4.1000
```

Plotando grafico de Critical Diference

```
result = tryCatch({
    plotCD(df, alpha=0.05, cex = 0.35)
}, error = function(e) {})
```