R Notebook

Parametros:

Measure = Accuracy
Columns = sampling, weight_space, underbagging, learner
Performance = holdout_measure_residual
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                       :1800   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:   0
##
##
##  tuning_measure   holdout_measure   holdout_measure_residual
##  Min.   :0.1269   Min.   :0.01517   Min.   :0.03881
##  1st Qu.:0.9898   1st Qu.:0.98750   1st Qu.:0.38526
##  Median :0.9938   Median :0.99163   Median :0.75447
##  Mean   :0.9691   Mean   :0.96664   Mean   :0.66878
##  3rd Qu.:0.9990   3rd Qu.:0.99687   3rd Qu.:0.95350
##  Max.   :1.0000   Max.   :1.00000   Max.   :1.00000
##  NA's   :57       NA's   :57        NA's   :57
##  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   :57      (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                          0.3572658
## 2                          0.4186973
## 3                          0.6295736
## 4                          0.8769575
## 5                          0.8764259
## 6                          0.7399449
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                  0.3476240
## 2                                  0.4627110
## 3                                  0.6320969
## 4                                  0.7859806
## 5                                  0.8783270
## 6                                  0.7955923
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                            0.3374656                          0.3329890
## 2                            0.5265823                          0.4313027
## 3                            0.6419379                          0.6298259
## 4                            0.7404922                          0.8337062
## 5                            0.9005070                          0.8852978
## 6                            0.8077135                          0.7471074
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                                 0.3286846
## 2                                 0.5260812
```

```
## 3                                0.6298259
## 4                                0.8337062
## 5                                0.8852978
## 6                                0.7922865
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                           0.3286846                         0.6153581
## 2                           0.5114979                         0.5874736
## 3                           0.6303306                         0.6235175
## 4                           0.7613721                         0.9418345
## 5                           0.8846641                         0.8776933
## 6                           0.8082645                         0.7432507
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                                0.6559917
## 2                                0.8212025
## 3                                0.7845067
## 4                                0.7427293
## 5                                0.9176172
## 6                                0.8584022
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                           0.6659780                         0.3297176
## 2                           0.8204114                         0.3964926
## 3                           0.7617966                         0.6298259
## 4                           0.7166294                         0.8337062
## 5                           0.9163498                         0.8852978
## 6                           0.8347107                         0.7471074
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                                0.3286846
## 2                                0.5251319
## 3                                0.6298259
## 4                                0.7740492
## 5                                0.8871990
## 6                                0.7911846
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.3286846                         0.3553719
## 2                           0.5170095                         0.4211234
## 3                           0.6303306                         0.6298259
## 4                           0.7651007                         0.8724832
## 5                           0.8840304                         0.8770596
## 6                           0.8077135                         0.7377410
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                                0.3507231
## 2                                       NA
## 3                                0.6361342
## 4                                0.8187919
## 5                                0.8776933
## 6                                0.7939394
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                           0.3376377
## 2                           0.5168249
## 3                           0.6394146
## 4                           0.7442207
## 5                           0.8986058
## 6                           0.8126722
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :0.03881
##  1st Qu.:0.33192
##  Median :0.68170
##  Mean   :0.63391
##  3rd Qu.:0.94624
##  Max.   :0.99989
##  NA's   :2
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :0.04065
##  1st Qu.:0.43394
##  Median :0.72582
##  Mean   :0.67235
##  3rd Qu.:0.98164
##  Max.   :0.99986
##  NA's   :7
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :0.04525                       Min.   :0.03881
##  1st Qu.:0.51248                       1st Qu.:0.31355
##  Median :0.78380                       Median :0.71294
##  Mean   :0.70389                       Mean   :0.62944
##  3rd Qu.:0.97917                       3rd Qu.:0.94182
##  Max.   :0.99986                       Max.   :0.99991
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :0.06542
##  1st Qu.:0.32642
##  Median :0.70810
##  Mean   :0.64441
##  3rd Qu.:0.97488
##  Max.   :0.99987
##  NA's   :1
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :0.04973                      Min.   :0.04134
##  1st Qu.:0.37904                      1st Qu.:0.43701
##  Median :0.74121                      Median :0.65425
##  Mean   :0.65896                      Mean   :0.63780
##  3rd Qu.:0.97695                      3rd Qu.:0.88591
##  Max.   :0.99985                      Max.   :0.99499
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.2343
##  1st Qu.:0.6994
##  Median :0.8547
##  Mean   :0.7760
##  3rd Qu.:0.9381
##  Max.   :0.9998
##
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :0.2272                      Min.   :0.03881
##  1st Qu.:0.6912                      1st Qu.:0.31355
##  Median :0.8397                      Median :0.71294
```

```
##  Mean   :0.7737                     Mean   :0.62880
##  3rd Qu.:0.9344                     3rd Qu.:0.94182
##  Max.   :0.9998                     Max.   :0.99991
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :0.06468
##  1st Qu.:0.32630
##  Median :0.70976
##  Mean   :0.63451
##  3rd Qu.:0.96145
##  Max.   :0.99985
##  NA's   :2
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :0.05697                     Min.   :0.03881
##  1st Qu.:0.37442                     1st Qu.:0.31836
##  Median :0.74837                     Median :0.67752
##  Mean   :0.65848                     Mean   :0.60995
##  3rd Qu.:0.97751                     3rd Qu.:0.93342
##  Max.   :0.99985                     Max.   :0.99991
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :0.04019
##  1st Qu.:0.35072
##  Median :0.74272
##  Mean   :0.65895
##  3rd Qu.:0.97429
##  Max.   :0.99992
##  NA's   :7
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :0.04582
##  1st Qu.:0.50530
##  Median :0.78663
##  Mean   :0.70532
##  3rd Qu.:0.97503
##  Max.   :0.99986
##
```

Verificando a média de cada coluna selecionada

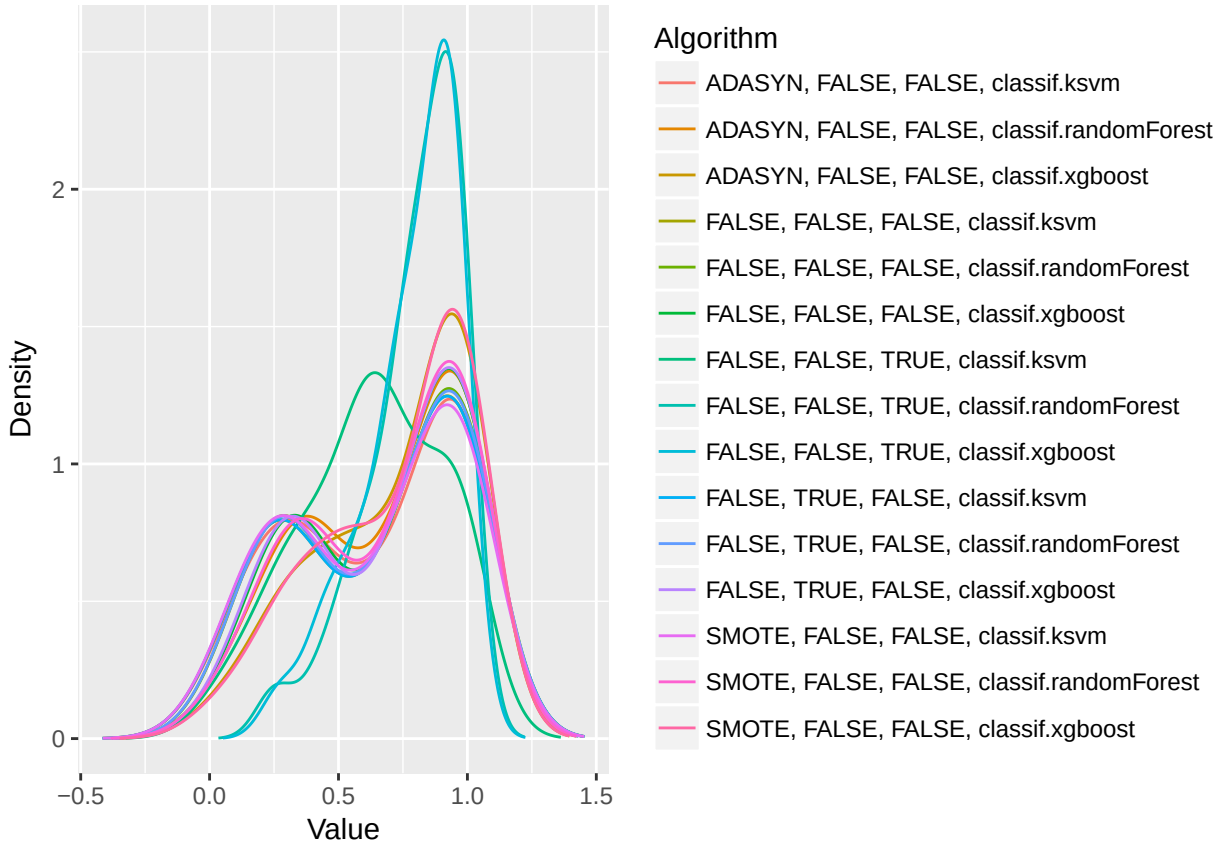
```
for(i in (1:dim(df)[2])){
  print(paste("Media da coluna ", colnames(df)[i], " = ", mean(df[,i], na.rm = TRUE), sep=""))
}
```

```
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.ksvm = 0.633907593305194"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.672353480444275"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.703887285006395"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.629443338349023"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.644411745490461"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.658960156606477"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.637795721759456"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.775998938757073"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.773741725204044"
```

```
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.628798680357285"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.634505082480885"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.658478176017329"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.609954394657382"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.658946551488674"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.705322232154112"
```

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 = 94.667, df = 14, p-value = 4.952e-14
```

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

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

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

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

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

Plotando os ranks

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

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                    10.9125
## ADASYN, FALSE, FALSE, classif.randomForest
##                                     8.5375
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                     5.5000
##          FALSE, FALSE, FALSE, classif.ksvm
##                                     9.3250
##  FALSE, FALSE, FALSE, classif.randomForest
##                                     8.3875
##       FALSE, FALSE, FALSE, classif.xgboost
##                                     7.3875
##           FALSE, FALSE, TRUE, classif.ksvm
##                                     8.8500
##   FALSE, FALSE, TRUE, classif.randomForest
##                                     5.8250
##        FALSE, FALSE, TRUE, classif.xgboost
##                                     5.5625
##           FALSE, TRUE, FALSE, classif.ksvm
##                                     9.3750
##   FALSE, TRUE, FALSE, classif.randomForest
##                                     8.8125
##        FALSE, TRUE, FALSE, classif.xgboost
##                                     7.0500
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                    10.5875
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                     8.7125
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                     5.1750
```

Plotando grafico de Critical Diference

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