R Notebook

Parametros:

Measure = F1 measure
Columns = sampling, weight_space, underbagging, learner
Performance = holdout_measure_residual
Filter keys = imba.rate
Filter values = 0.05

```
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        :1230   Mode :logical
##  classif.randomForest:1230   FALSE:2952
##  classif.rusboost    :   0   TRUE :738
##  classif.xgboost     :1230   NA's :0
##
##
##
##                             measure       sampling    underbagging
##  Accuracy                       :   0   ADASYN: 738   Mode :logical
##  Area under the curve           :   0   FALSE :2214   FALSE:2952
##  F1 measure                     :3690   SMOTE : 738   TRUE :738
##  G-mean                         :   0                 NA's :0
##  Matthews correlation coefficient:   0
##
##
##  tuning_measure   holdout_measure  holdout_measure_residual
##  Min.   :0.0000   Min.   :0.0000   Min.   :0.00000
##  1st Qu.:0.3333   1st Qu.:0.1000   1st Qu.:0.07022
##  Median :0.8198   Median :0.5000   Median :0.32530
##  Mean   :0.6671   Mean   :0.4905   Mean   :0.39891
##  3rd Qu.:0.9848   3rd Qu.:0.8333   3rd Qu.:0.73016
##  Max.   :1.0000   Max.   :1.0000   Max.   :1.00000
##  NA's   :51       NA's   :51       NA's   :51
##  iteration_count          dataset       imba.rate
##  Min.   :1       abalone      :  45   Min.   :0.05
##  1st Qu.:1       adult        :  45   1st Qu.:0.05
##  Median :2       annealing    :  45   Median :0.05
##  Mean   :2       arrhythmia   :  45   Mean   :0.05
##  3rd Qu.:3       balance-scale:  45   3rd Qu.:0.05
##  Max.   :3       bank         :  45   Max.   :0.05
##  NA's   :51      (Other)      :3420
```

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] 82 15
```

```
# Renomeando a variavel
df = df_tec_wide_residual

head(df)
```

```
##   ADASYN, FALSE, FALSE, classif.ksvm
## 1                         0.23727721
## 2                         0.33850497
## 3                         0.38740741
## 4                         0.00000000
## 5                         0.24947719
## 6                         0.04761951
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                  0.2388742
## 2                                         NA
## 3                                  0.8300547
## 4                                  0.2222222
## 5                                  0.1476324
## 6                                  0.3940877
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                            0.1518313                          0.1911177
## 2                            0.5534692                          0.3865948
## 3                            0.8293976                          0.3379630
## 4                            0.2452381                          0.0000000
## 5                            0.2064516                          0.2817381
## 6                            0.3279417                          0.1918893
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                              0.004963248
## 2                              0.468817209
```

```
## 3                                0.848200450
## 4                                0.203703704
## 5                                0.204733976
## 6                                0.194984394
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                           0.01857504                        0.69146055
## 2                           0.48553598                        0.81326809
## 3                           0.72770942                        0.44608696
## 4                           0.24074074                        0.03501638
## 5                           0.20645161                        0.23972893
## 6                           0.25793907                        0.58912379
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                                0.7295545
## 2                                       NA
## 3                                0.8460157
## 4                                0.1204065
## 5                                0.3246500
## 6                                0.7201910
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                           0.7342854                         0.1854788
## 2                           0.8529807                         0.3582362
## 3                           0.7948483                         0.3839080
## 4                           0.1310564                         0.0000000
## 5                           0.3118882                         0.2817381
## 6                           0.7133948                         0.1169090
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                              0.004963248
## 2                                       NA
## 3                              0.829357221
## 4                              0.245791246
## 5                              0.187629085
## 6                              0.194984394
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.01203291                        0.25263278
## 2                           0.47185555                        0.34579892
## 3                           0.68869957                        0.40822232
## 4                           0.30740741                        0.00000000
## 5                           0.20645161                        0.13314459
## 6                           0.23904004                        0.09351287
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                                 0.2359375
## 2                                        NA
## 3                                 0.8622336
## 4                                 0.2500000
## 5                                 0.1651708
## 6                                 0.3782196
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                            0.1418643
## 2                            0.5451405
## 3                            0.8020644
## 4                            0.2962963
## 5                            0.1610262
## 6                            0.3517219
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :0.0000
##  1st Qu.:0.0254
##  Median :0.1450
##  Mean   :0.2594
##  3rd Qu.:0.3977
##  Max.   :0.9895
##  NA's   :1
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.1695
##  Median :0.4212
##  Mean   :0.4415
##  3rd Qu.:0.7133
##  Max.   :0.9812
##  NA's   :5
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :0.0000                        Min.   :0.0000
##  1st Qu.:0.1643                        1st Qu.:0.0000
##  Median :0.4248                        Median :0.1292
##  Mean   :0.4712                        Mean   :0.2189
##  3rd Qu.:0.7880                        3rd Qu.:0.3049
##  Max.   :0.9899                        Max.   :0.9949
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :0.00000
##  1st Qu.:0.08468
##  Median :0.30383
##  Mean   :0.37823
##  3rd Qu.:0.67164
##  Max.   :0.97237
##  NA's   :1
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :0.00000                      Min.   :0.0003612
##  1st Qu.:0.08164                      1st Qu.:0.2422053
##  Median :0.29218                      Median :0.4740756
##  Mean   :0.40056                      Mean   :0.4949795
##  3rd Qu.:0.72131                      3rd Qu.:0.7567327
##  Max.   :0.98600                      Max.   :0.9895300
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.00463
##  1st Qu.:0.30767
##  Median :0.67030
##  Mean   :0.58081
##  3rd Qu.:0.85519
##  Max.   :0.98381
##  NA's   :3
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :0.001115                    Min.   :0.0000
##  1st Qu.:0.297551                    1st Qu.:0.0000
##  Median :0.712325                    Median :0.1219
```

```
##  Mean   :0.575417                    Mean   :0.2083
##  3rd Qu.:0.849056                    3rd Qu.:0.3022
##  Max.   :0.982204                    Max.   :0.9949
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :0.00000
##  1st Qu.:0.07677
##  Median :0.32566
##  Mean   :0.38785
##  3rd Qu.:0.67472
##  Max.   :1.00000
##  NA's   :3
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :0.00000                     Min.   :0.00000
##  1st Qu.:0.09852                     1st Qu.:0.02247
##  Median :0.30378                     Median :0.15839
##  Mean   :0.39343                     Mean   :0.25228
##  3rd Qu.:0.69440                     3rd Qu.:0.37444
##  Max.   :1.00000                     Max.   :0.96181
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.1649
##  Median :0.4002
##  Mean   :0.4553
##  3rd Qu.:0.7570
##  Max.   :0.9832
##  NA's   :4
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :0.006122
##  1st Qu.:0.176907
##  Median :0.448104
##  Mean   :0.475252
##  3rd Qu.:0.782271
##  Max.   :0.988373
##
```

Verificando a média de cada coluna selecionada

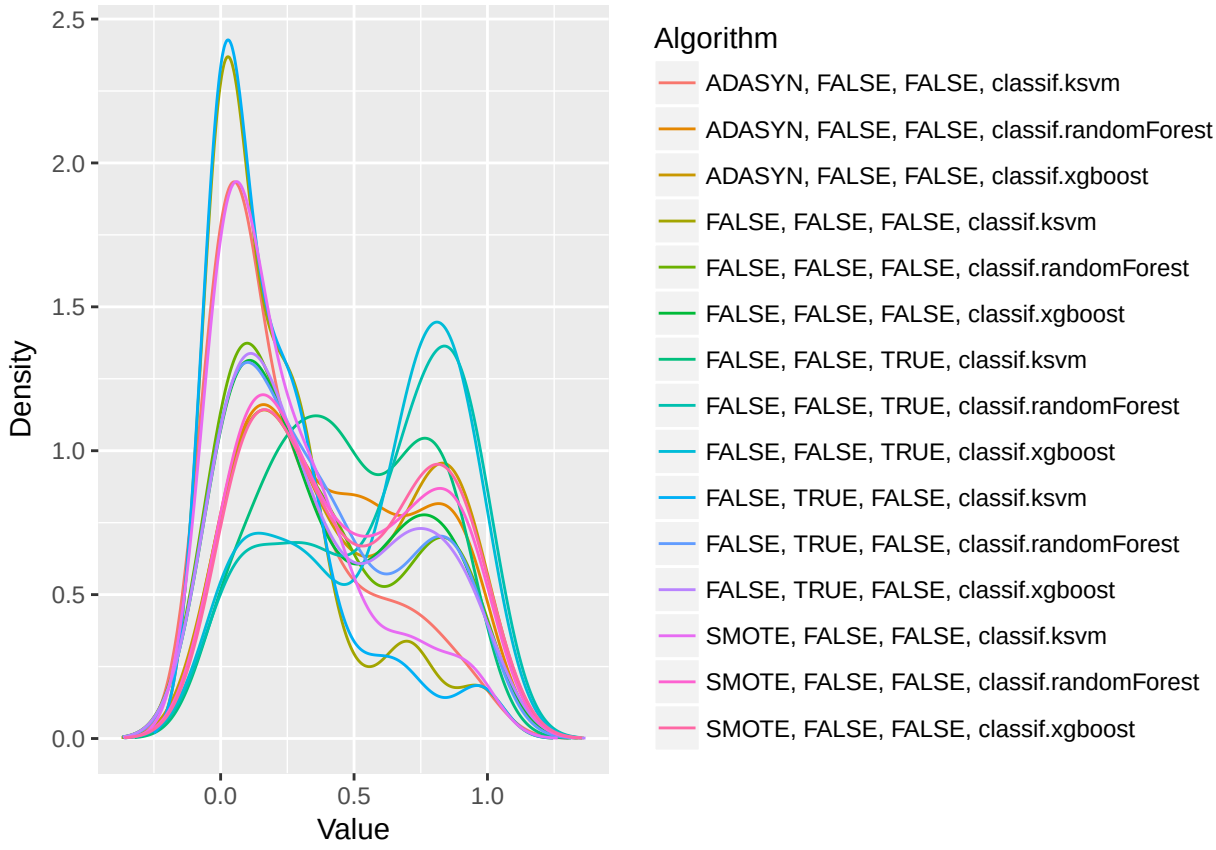
```
for(i in (1:dim(df)[2])){
  print(paste("Media da coluna ", colnames(df)[i], " = ", mean(df[,i], na.rm = TRUE), sep=""))
}
```

```
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.ksvm = 0.259448788538673"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.441474157964024"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.471167010966672"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.218865427361255"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.378232764365048"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.400556109264134"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.494979456445285"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.580806118393993"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.575416728305805"
```

```
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.208308011677194"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.387847506789137"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.393430237712404"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.252281727176568"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.455285475909701"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.475252067555195"
```

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 = 313.09, 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,]                               TRUE
##  [3,]                               TRUE
##  [4,]                              FALSE
##  [5,]                              FALSE
##  [6,]                               TRUE
##  [7,]                               TRUE
##  [8,]                               TRUE
##  [9,]                               TRUE
## [10,]                              FALSE
## [11,]                              FALSE
## [12,]                              FALSE
## [13,]                              FALSE
## [14,]                               TRUE
## [15,]                               TRUE
##       ADASYN, FALSE, FALSE, classif.randomForest
##  [1,]                                       TRUE
##  [2,]                                      FALSE
##  [3,]                                      FALSE
##  [4,]                                       TRUE
##  [5,]                                      FALSE
##  [6,]                                      FALSE
##  [7,]                                      FALSE
##  [8,]                                       TRUE
##  [9,]                                      FALSE
## [10,]                                       TRUE
## [11,]                                      FALSE
## [12,]                                      FALSE
## [13,]                                       TRUE
## [14,]                                      FALSE
## [15,]                                      FALSE
##       ADASYN, FALSE, FALSE, classif.xgboost
##  [1,]                                  TRUE
##  [2,]                                 FALSE
##  [3,]                                 FALSE
##  [4,]                                  TRUE
##  [5,]                                  TRUE
##  [6,]                                 FALSE
##  [7,]                                 FALSE
##  [8,]                                 FALSE
##  [9,]                                 FALSE
## [10,]                                  TRUE
## [11,]                                  TRUE
## [12,]                                  TRUE
## [13,]                                  TRUE
## [14,]                                 FALSE
## [15,]                                 FALSE
```

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

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

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

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

Plotando os ranks

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

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                   10.591463
## ADASYN, FALSE, FALSE, classif.randomForest
##                                    7.310976
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                    5.871951
##          FALSE, FALSE, FALSE, classif.ksvm
##                                   11.493902
##  FALSE, FALSE, FALSE, classif.randomForest
##                                    8.829268
##       FALSE, FALSE, FALSE, classif.xgboost
##                                    8.170732
##           FALSE, FALSE, TRUE, classif.ksvm
##                                    6.006098
##   FALSE, FALSE, TRUE, classif.randomForest
##                                    4.713415
##        FALSE, FALSE, TRUE, classif.xgboost
##                                    5.006098
##           FALSE, TRUE, FALSE, classif.ksvm
##                                   11.640244
##   FALSE, TRUE, FALSE, classif.randomForest
##                                    8.853659
##        FALSE, TRUE, FALSE, classif.xgboost
##                                    8.530488
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                   10.548780
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                    6.871951
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                    5.560976
```

Plotando grafico de Critical Diference

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