> shapiro.test(archive$RDG3\_DEEPSO)

Shapiro-Wilk normality test

data: archive$RDG3\_DEEPSO

W = 0.56236, p-value = 1.229e-06

> shapiro.test(archive$CE\_CMAES)

Shapiro-Wilk normality test

data: archive$CE\_CMAES

W = 0.96071, p-value = 0.5582

> shapiro.test(archive$HFEABC)

Shapiro-Wilk normality test

data: archive$HFEABC

W = 0.81223, p-value = 0.001323

> shapiro.test(archive$DE\_TLBO)

Shapiro-Wilk normality test

data: archive$DE\_TLBO

W = 0.92473, p-value = 0.1222

> shapiro.test(archive$PSO\_GBP)

Shapiro-Wilk normality test

data: archive$PSO\_GBP

W = 0.8954, p-value = 0.03385

> shapiro.test(archive$GASAPSO)

Shapiro-Wilk normality test

data: archive$GASAPSO

W = 0.97186, p-value = 0.7936

> shapiro.test(archive$AJSO)

Shapiro-Wilk normality test

data: archive$AJSO

W = 0.98242, p-value = 0.9614

> shapiro.test(archive$CUMDANCauchy)

Shapiro-Wilk normality test

data: archive$CUMDANCauchy

W = 0.87202, p-value = 0.01275

> shapiro.test(archive$EHL\_PS\_VNSO)

Shapiro-Wilk normality test

data: archive$EHL\_PS\_VNSO

W = 0.78942, p-value = 0.0006033

> shapiro.test(archive$Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO)

Shapiro-Wilk normality test

data: archive$Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO

W = 0.6854, p-value = 2.602e-05

> shapiro.test(archive$DEEDA)

Shapiro-Wilk normality test

data: archive$DEEDA

W = 0.92568, p-value = 0.1275

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs DESS

> Wilcoxontest(archive$CUMDANCauchy, archive$CE\_CMAES)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs EPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$HFEABC)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs evdeepso

> Wilcoxontest( archive$CUMDANCauchy, archive$DE\_TLBO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs Firefly

> Wilcoxontest( archive$CUMDANCauchy, archive$PSO\_GBP)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs Guide\_DE

> Wilcoxontest( archive$CUMDANCauchy, archive$GASAPSO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs UPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$AJSO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs GMVNPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$CUMDANCauchy)

Wilcoxon Signed-Rank test

data: data

T = 210, p-value = 1

> #CUMDANCauchy vs VNSDEEPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$EHL\_PS\_VNSO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs PSO\_GBP

> Wilcoxontest( archive$CUMDANCauchy, archive$Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs HL\_PS\_VNSO

> Wilcoxontest( archive$CUMDANCauchy, archive$DEEDA)

Wilcoxon Signed-Rank test

data: data

T = 5, p-value = 9.451e-05

Friedman's rank sum test

data: x

Friedman's chi-squared = 198.93, df = 10, p-value < 2.2e-16

Iman Davenport's correction of Friedman's rank sum test

data: x

Corrected Friedman's chi-squared = 3523.4, df1 = 10, df2 = 190, p-value <

2.2e-16

Ranking

CUMDANCauchy 1.05

DEEDA 1.95

GASAPSO 3.00

DE\_TLBO 4.00

AJSO 5.00

EHL\_PS\_VNSO 6.00

PSO\_GBP 7.00

Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO 8.25

CE\_CMAES 8.80

RDG3\_DEEPSO 9.95

HFEABC 11.00

P\_value Bonferroni BH

RDG3\_DEEPSO 0.000000e+00 0.000000e+00 0.000000e+00

CE\_CMAES 1.476597e-13 1.476597e-12 4.921989e-13

HFEABC 0.000000e+00 0.000000e+00 0.000000e+00

DE\_TLBO 4.912523e-03 4.912523e-02 6.140653e-03

PSO\_GBP 1.402343e-08 1.402343e-07 2.804687e-08

GASAPSO 6.299142e-02 6.299142e-01 6.999047e-02

AJSO 1.657661e-04 1.657661e-03 2.368088e-04

EHL\_PS\_VNSO 2.362626e-06 2.362626e-05 3.937710e-06

Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO 6.652456e-12 6.652456e-11 1.663114e-11

DEEDA 3.908282e-01 1.000000e+00 3.908282e-01

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RDG3\_DEEPSO 0.000000e+00 0.000000e+00 0.000000e+00

CE\_CMAES 1.181277e-12 1.181277e-12 1.181277e-12

HFEABC 0.000000e+00 0.000000e+00 0.000000e+00

DE\_TLBO 1.473757e-02 1.473757e-02 1.473757e-02

PSO\_GBP 8.414060e-08 8.414060e-08 8.414060e-08

GASAPSO 1.259828e-01 1.259828e-01 1.259828e-01

AJSO 6.630646e-04 6.630646e-04 6.630646e-04

EHL\_PS\_VNSO 1.181313e-05 1.181313e-05 1.181313e-05

Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO 4.656719e-11 4.656719e-11 4.656719e-11

DEEDA 3.908282e-01 3.908282e-01 3.908282e-01

BY

RDG3\_DEEPSO 0.000000e+00

CE\_CMAES 1.441635e-12

HFEABC 0.000000e+00

DE\_TLBO 1.798578e-02

PSO\_GBP 8.214839e-08

GASAPSO 2.049999e-01

AJSO 6.936054e-04

EHL\_PS\_VNSO 1.153343e-05

Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO 4.871208e-11

DEEDA 1.000000e+00

Time\_T2

> shapiro.test(archive$RDG3\_DEEPSO)

Shapiro-Wilk normality test

data: archive$RDG3\_DEEPSO

W = 0.97048, p-value = 0.765

> shapiro.test(archive$CE\_CMAES)

Shapiro-Wilk normality test

data: archive$CE\_CMAES

W = 0.61851, p-value = 4.607e-06

> shapiro.test(archive$HFEABC)

Shapiro-Wilk normality test

data: archive$HFEABC

W = 0.61957, p-value = 4.729e-06

> shapiro.test(archive$DE\_TLBO)

Shapiro-Wilk normality test

data: archive$DE\_TLBO

W = 0.90421, p-value = 0.04949

> shapiro.test(archive$PSO\_GBP)

Shapiro-Wilk normality test

data: archive$PSO\_GBP

W = 0.93654, p-value = 0.2061

> shapiro.test(archive$GASAPSO)

Shapiro-Wilk normality test

data: archive$GASAPSO

W = 0.80678, p-value = 0.001093

> shapiro.test(archive$AJSO)

Shapiro-Wilk normality test

data: archive$AJSO

W = 0.23966, p-value = 2.859e-09

> shapiro.test(archive$CUMDANCauchy)

Shapiro-Wilk normality test

data: archive$CUMDANCauchy

W = 0.79342, p-value = 0.0006904

> shapiro.test(archive$EHL\_PS\_VNSO)

Shapiro-Wilk normality test

data: archive$EHL\_PS\_VNSO

W = 0.89202, p-value = 0.0293

> shapiro.test(archive$Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO)

Error in shapiro.test(archive$Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO) :

is.numeric(x) is not TRUE

In addition: Warning message:

Unknown or uninitialised column: 'Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO'.

> shapiro.test(archive$`Ensembled\_method\_of\_CBBO\_Cauchy and DEEPSO`)

Shapiro-Wilk normality test

data: archive$`Ensembled\_method\_of\_CBBO\_Cauchy and DEEPSO`

W = 0.83676, p-value = 0.003224

> shapiro.test(archive$DEEDA)

Shapiro-Wilk normality test

data: archive$DEEDA

W = 0.88974, p-value = 0.02659

> shapiro.test(archive$VNS\_DEEPSO)

Shapiro-Wilk normality test

data: archive$VNS\_DEEPSO

W = 0.91554, p-value = 0.08135

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs DESS

> Wilcoxontest(archive$CUMDANCauchy, archive$CE\_CMAES)

Wilcoxon Signed-Rank test

data: data

T = 23, p-value = 0.001102

> #CUMDANCauchy vs EPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$HFEABC)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs evdeepso

> Wilcoxontest( archive$CUMDANCauchy, archive$DE\_TLBO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs Firefly

> Wilcoxontest( archive$CUMDANCauchy, archive$PSO\_GBP)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs Guide\_DE

> Wilcoxontest( archive$CUMDANCauchy, archive$GASAPSO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs UPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$AJSO)

Wilcoxon Signed-Rank test

data: data

T = 1, p-value = 5.167e-05

> #CUMDANCauchy vs GMVNPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$CUMDANCauchy)

Wilcoxon Signed-Rank test

data: data

T = 210, p-value = 1

> #CUMDANCauchy vs VNSDEEPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$EHL\_PS\_VNSO)

Wilcoxon Signed-Rank test

data: data

T = 0, p-value = 4.429e-05

> #CUMDANCauchy vs PSO\_GBP

> Wilcoxontest( archive$CUMDANCauchy, archive$Ensembled\_method\_of\_CBBO\_Cauchy\_and\_DEEPSO)

C:\Users\Yoan M\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\825DC133.tmp Show Traceback

C:\Users\Yoan M\AppData\Local\Microsoft\Windows\INetCache\Content.MSO\999444B9.tmp Rerun with Debug

Error in wilcoxonSignedTest(x, y) :

This is a paired test, so the two vectors have to have the same length

> Wilcoxontest( archive$CUMDANCauchy, archive$Ensembled\_method\_of\_CBBO\_Cauchy.and.DEEPSO)

Wilcoxon Signed-Rank test

data: data

T = 32, p-value = 0.003212

> #CUMDANCauchy vs HL\_PS\_VNSO

> Wilcoxontest( archive$CUMDANCauchy, archive$DEEDA)

Wilcoxon Signed-Rank test

data: data

T = 89, p-value = 0.2751

Friedman's rank sum test

data: x

Friedman's chi-squared = 209.16, df = 11, p-value < 2.2e-16

Iman Davenport's correction of Friedman's rank sum test

data: x

Corrected Friedman's chi-squared = 366.66, df1 = 11, df2 = 209, p-value <

2.2e-16

Ranking

EHL\_PS\_VNSO 1.00

GASAPSO 2.00

AJSO 3.45

DE\_TLBO 3.95

RDG3\_DEEPSO 5.30

HFEABC 5.60

VNS\_DEEPSO 7.15

Ensembled\_method\_of\_CBBO\_Cauchy.and.DEEPSO 7.95

CUMDANCauchy 9.35

CE\_CMAES 9.70

DEEDA 10.60

PSO\_GBP 11.95

P\_value Bonferroni BH

RDG3\_DEEPSO 1.623671e-04 1.786038e-03 2.232547e-04

CE\_CMAES 2.331468e-14 2.564615e-13 8.548717e-14

HFEABC 5.472641e-05 6.019905e-04 8.599864e-05

DE\_TLBO 9.672539e-03 1.063979e-01 1.182199e-02

PSO\_GBP 0.000000e+00 0.000000e+00 0.000000e+00

GASAPSO 3.804551e-01 1.000000e+00 3.804551e-01

AJSO 3.165088e-02 3.481597e-01 3.481597e-02

CUMDANCauchy 2.418066e-13 2.659872e-12 6.649681e-13

Ensembled\_method\_of\_CBBO\_Cauchy.and.DEEPSO 1.090596e-09 1.199656e-08 2.399311e-09

VNS\_DEEPSO 6.894198e-08 7.583618e-07 1.263936e-07

DEEDA 0.000000e+00 0.000000e+00 0.000000e+00

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RDG3\_DEEPSO 6.494683e-04 6.494683e-04 6.494683e-04

CE\_CMAES 2.098322e-13 2.098322e-13 2.098322e-13

HFEABC 2.736320e-04 2.736320e-04 2.736320e-04

DE\_TLBO 2.901762e-02 2.901762e-02 2.901762e-02

PSO\_GBP 0.000000e+00 0.000000e+00 0.000000e+00

GASAPSO 3.804551e-01 3.804551e-01 3.804551e-01

AJSO 6.330176e-02 6.330176e-02 6.330176e-02

CUMDANCauchy 1.934453e-12 1.934453e-12 1.934453e-12

Ensembled\_method\_of\_CBBO\_Cauchy.and.DEEPSO 7.634172e-09 7.634172e-09 7.634172e-09

VNS\_DEEPSO 4.136519e-07 4.136519e-07 4.136519e-07

DEEDA 0.000000e+00 0.000000e+00 0.000000e+00

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RDG3\_DEEPSO 6.742019e-04

CE\_CMAES 2.581608e-13

HFEABC 2.597053e-04

DE\_TLBO 3.570097e-02

PSO\_GBP 0.000000e+00

GASAPSO 1.000000e+00

AJSO 1.051400e-01

CUMDANCauchy 2.008122e-12

Ensembled\_method\_of\_CBBO\_Cauchy.and.DEEPSO 7.245626e-09

VNS\_DEEPSO 3.816933e-07

DEEDA 0.000000e+00