Shapiro-Wilk normality test

data: archive$chaotic\_deepso

W = 0.97181, p-value = 0.7926

> #DESS

> shapiro.test(archive$DESS)

Shapiro-Wilk normality test

data: archive$DESS

W = 0.73527, p-value = 0.0001084

> #EPSO

> shapiro.test(archive$EPSO)

Shapiro-Wilk normality test

data: archive$EPSO

W = 0.94023, p-value = 0.2421

> #evdeepso

> shapiro.test(archive$evdeepso)

Shapiro-Wilk normality test

data: archive$evdeepso

W = 0.70535, p-value = 4.534e-05

> #Firefly

> shapiro.test(archive$Firefly)

Shapiro-Wilk normality test

data: archive$Firefly

W = 0.7583, p-value = 0.0002198

> #Guide\_DE

> shapiro.test(archive$Guide\_DE)

Shapiro-Wilk normality test

data: archive$Guide\_DE

W = 0.90065, p-value = 0.04242

> #UPSO

> shapiro.test(archive$UPSO)

Shapiro-Wilk normality test

data: archive$UPSO

W = 0.46917, p-value = 1.693e-07

> #GMVNPSO

> shapiro.test(archive$GMVNPSO)

Shapiro-Wilk normality test

data: archive$GMVNPSO

W = 0.8675, p-value = 0.01062

> #VNSDEEPSO

> shapiro.test(archive$VNSDEEPSO)

Shapiro-Wilk normality test

data: archive$VNSDEEPSO

W = 0.91766, p-value = 0.08932

> #PSO\_GBP

> shapiro.test(archive$PSO\_GBP)

Shapiro-Wilk normality test

data: archive$PSO\_GBP

W = 0.97951, p-value = 0.9276

> #CUMDANCauchy

> shapiro.test(archive$CUMDANCauchy)

Shapiro-Wilk normality test

data: archive$CUMDANCauchy

W = 0.92605, p-value = 0.1296

> #HL\_PS\_VNSO

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

Shapiro-Wilk normality test

data: archive$HL\_PS\_VNSO

W = 0.83135, p-value = 0.002637

> #ABC\_DE

> shapiro.test(archive$ABC\_DE)

Shapiro-Wilk normality test

data: archive$ABC\_DE

W = 0.41081, p-value = 5.456e-08

> #AJSO

> shapiro.test(archive$AJSO)

Shapiro-Wilk normality test

data: archive$AJSO

W = 0.44959, p-value = 1.148e-07

> #CE\_CMAES

> shapiro.test(archive$CE\_CMAES)

Shapiro-Wilk normality test

data: archive$CE\_CMAES

W = 0.43142, p-value = 8.069e-08

> #GASAPSO

> shapiro.test(archive$GASAPSO)

Shapiro-Wilk normality test

data: archive$GASAPSO

W = 0.89514, p-value = 0.03346

> #HFEABC

> shapiro.test(archive$HFEABC)

Shapiro-Wilk normality test

data: archive$HFEABC

W = 0.83267, p-value = 0.002768

Friedman's rank sum test

data: x

Friedman's chi-squared = 297.28, df = 16, p-value < 2.2e-16

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

data: x

Corrected Friedman's chi-squared = 248.63, df1 = 16, df2 = 304, p-value <

2.2e-16

Ranking

CUMDANCauchy 1.00

PSO\_GBP 2.15

HL\_PS\_VNSO 3.20

GMVNPSO 3.75

VNSDEEPSO 5.80

UPSO 5.85

HFEABC 6.95

chaotic\_deepso 7.75

EPSO 10.45

DESS 10.85

ABC\_DE 11.25

AJSO 11.70

evdeepso 12.35

GASAPSO 13.15

Guide\_DE 14.10

CE\_CMAES 15.80

Firefly 16.90

P\_value Bonferroni BH Holm Hochberg

Firefly 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00

UPSO 2.387966e-03 3.820746e-02 3.183955e-03 1.193983e-02 1.059266e-02

Guide\_DE 2.220446e-16 3.552714e-15 1.184238e-15 3.108624e-15 3.108624e-15

chaotic\_deepso 2.368130e-05 3.789008e-04 3.789008e-05 1.657691e-04 1.657691e-04

evdeepso 1.180389e-12 1.888623e-11 3.777245e-12 1.416467e-11 1.416467e-11

EPSO 3.262376e-09 5.219801e-08 5.799779e-09 2.609901e-08 2.609901e-08

DESS 6.902405e-10 1.104385e-08 1.380481e-09 6.212165e-09 6.212165e-09

PSO\_GBP 4.714278e-01 1.000000e+00 4.714278e-01 4.714278e-01 4.714278e-01

VNSDEEPSO 2.648164e-03 4.237063e-02 3.259279e-03 1.193983e-02 1.059266e-02

GMVNPSO 8.504836e-02 1.000000e+00 9.719813e-02 2.551451e-01 2.551451e-01

HL\_PS\_VNSO 1.682980e-01 1.000000e+00 1.795178e-01 3.365959e-01 3.365959e-01

ABC\_DE 1.373537e-10 2.197659e-09 3.139513e-10 1.373537e-09 1.373537e-09

HFEABC 1.945158e-04 3.112252e-03 2.829320e-04 1.167095e-03 1.167095e-03

CE\_CMAES 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00 0.000000e+00

AJSO 2.075651e-11 3.321041e-10 5.535069e-11 2.283216e-10 2.283216e-10

GASAPSO 2.775558e-14 4.440892e-13 1.110223e-13 3.608225e-13 3.608225e-13

Hommel BY

Firefly 0.000000e+00 0.000000e+00

UPSO 9.551865e-03 1.076409e-02

Guide\_DE 3.108624e-15 4.003587e-15

chaotic\_deepso 1.657691e-04 1.280961e-04

evdeepso 1.416467e-11 1.276984e-11

EPSO 2.609901e-08 1.960748e-08

DESS 6.212165e-09 4.667032e-09

PSO\_GBP 4.714278e-01 1.000000e+00

VNSDEEPSO 1.059266e-02 1.101874e-02

GMVNPSO 2.524469e-01 3.286005e-01

HL\_PS\_VNSO 3.365959e-01 6.069011e-01

ABC\_DE 1.373537e-09 1.061384e-09

HFEABC 1.167095e-03 9.565165e-04

CE\_CMAES 0.000000e+00 0.000000e+00

AJSO 2.283216e-10 1.871257e-10

GASAPSO 3.608225e-13 3.753363e-13

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs DESS

> Wilcoxontest(archive$CUMDANCauchy, archive$DESS)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs EPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$EPSO)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs evdeepso

> Wilcoxontest( archive$CUMDANCauchy, archive$evdeepso)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs Firefly

> Wilcoxontest( archive$CUMDANCauchy, archive$Firefly)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs Guide\_DE

> Wilcoxontest( archive$CUMDANCauchy, archive$Guide\_DE)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs UPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$UPSO)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs GMVNPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$GMVNPSO)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs VNSDEEPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$VNSDEEPSO)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs PSO\_GBP

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

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs HL\_PS\_VNSO

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

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs ABC\_DE

> Wilcoxontest( archive$CUMDANCauchy, archive$ABC\_DE)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs AJSO

> Wilcoxontest( archive$CUMDANCauchy, archive$AJSO)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs CE\_CMAES

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

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs GASAPSO

> Wilcoxontest( archive$CUMDANCauchy, archive$GASAPSO)

Wilcoxon Signed-Rank test

data: data

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

> #CUMDANCauchy vs HFEABC

> Wilcoxontest( archive$CUMDANCauchy, archive$HFEABC)

Wilcoxon Signed-Rank test

data: data

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

> Wilcoxontest( archive$CUMDANCauchy, archive$CUMDANCauchy)

Wilcoxon Signed-Rank test

data: data

T = 210, p-value = 1