

Results

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1 Tables of Friedman, Bonferroni-Dunn, Holm, Hochberg and Hommel Tests

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Table 1: Average Rankings of the algorithms

Algorithm	Ranking
DE	3.499999999999982
CHC	1.4210526315789471
G-CMA-ES	2.1052631578947367
VXQR1	2.973684210526316

Friedman statistic considering reduction performance (distributed according to chi-square with 3 degrees of freedom: 29.00526315789461.
Inman and Davenport statistic considering reduction performance (distributed according to F-distribution with 3 and 54 degrees of freedom: 18.649746192893236.

Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value $\leq 0.016666666666666666$.

Holm's procedure rejects those hypotheses that have a p-value ≤ 0.05 .

Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.025 .

Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.05 .

Table 2: Holm / Hochberg Table for $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i) / SE$	p	Holm/Hochberg/Hommel
3	DE	4.963418813256589	6.926300149983597E-7	0.016666666666666666
2	VXQR1	3.7068570883815064	2.0984727918566809E-4	0.025
1	G-CMA-ES	1.6335302423376128	0.10235752557227855	0.05

Table 3: Holm / Hochberg Table for $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i) / SE$	p	Holm/Hochberg/Hommel
3	DE	4.963418813256589	6.926300149983597E-7	0.033333333333333333
2	VXQR1	3.7068570883815064	2.0984727918566809E-4	0.05
1	G-CMA-ES	1.6335302423376128	0.10235752557227855	0.1

Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value $\leq 0.033333333333333333$.
 Holm's procedure rejects those hypotheses that have a p-value ≤ 0.1 .
 Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.05 .
 Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.05 .

Table 4: Adjusted p-values

i	algorithm	unadjusted p	p^{Bonf}	p^{Holm}	p^{Hoch}	p^{Hommel}
1	DE	6.926300149983597E-7	2.077890044995079E-6	2.077890044995079E-6	2.077890044995079E-6	2.077890044995079E-6
2	VXQR1	2.0984727918566809E-4	6.295418375570043E-4	4.1969455837133617E-4	4.1969455837133617E-4	4.1969455837133617E-4
3	G-CMA-ES	0.10235752557227855	0.30707237671683563	0.10235752557227855	0.10235752557227855	0.10235752557227855

Table 5: Holm / Shaffer Table for $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i) / SE$	p	Holm	Shaffer
6	DE vs. CHC	4.963418813256589	6.926300149983597E-7	0.008333333333333333	0.008333333333333333
5	CHC vs. VXQR1	3.7068570883815064	2.0984727918566809E-4	0.01	0.016666666666666666
4	DE vs. G-CMA-ES	3.3298885709189756	8.68807453072025E-4	0.0125	0.016666666666666666
3	G-CMA-ES vs. VXQR1	2.0733268460438934	0.03814187190354867	0.016666666666666666	0.016666666666666666
2	CHC vs. G-CMA-ES	1.6335302423376128	0.10235752557227855	0.025	0.025
1	DE vs. VXQR1	1.256561724875082	0.2089123817407001	0.05	0.05

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.008333333333333333$.

Holm's procedure rejects those hypotheses that have a p-value $\leq 0.016666666666666666$.
 Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.008333333333333333$.
 Bergmann's procedure rejects these hypotheses:

- DE vs. CHC
- DE vs. G-CMA-ES
- CHC vs. VXQR1
- G-CMA-ES vs. VXQR1

Table 6: Holm / Shaffer Table for $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i) / SE$	p	Holm	Shaffer
6	DE vs. CHC	4.963418813256589	6.926300149983597E-7	0.016666666666666666	0.016666666666666666
5	CHC vs. VXQR1	3.7068570883815064	2.0984727948566809E-4	0.02	0.033333333333333333
4	DE vs. G-CMA-ES	3.3298885709189756	8.68807453072025E-4	0.025	0.033333333333333333
3	G-CMA-ES vs. VXQR1	2.0733268460438934	0.03814187190354867	0.033333333333333333	0.033333333333333333
2	CHC vs. G-CMA-ES	1.6335302423376128	0.10235752557227855	0.05	0.05
1	DE vs. VXQR1	1.256561724875082	0.2089123817407001	0.1	0.1

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.008333333333333333$.
 Holm's procedure rejects those hypotheses that have a p-value $\leq 0.033333333333333333$.
 Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.016666666666666666$.
 Bergmann's procedure rejects these hypotheses:

- DE vs. CHC
- DE vs. G-CMA-ES
- CHC vs. VXQR1
- G-CMA-ES vs. VXQR1

Table 7: Adjusted p -values

i	hypothesis	unadjusted p	p_{Nernc}	p_{Holm}	p_{Shaf}	p_{Berq}
1	DE vs .CHC	6.926300149983597E-7	4.155780089990158E-6	4.155780089990158E-6	4.155780089990158E-6	4.155780089990158E-6
2	CHC vs .VXQR1	2.098472918566809E-4	0.0012590836751140086	0.0010492363959283405	6.295418375570043E-4	6.295418375570043E-4
3	DE vs .G-CMA-ES	8.68807453072025E-4	0.00521284471843215	0.0034752298122881	0.002606422359216075	0.002606422359216075
4	G-CMA-ES vs .VXQR1	0.03814187190354867	0.228851231421292	0.114425615710646	0.114425615710646	0.03814187190354867
5	CHC vs .G-CMA-ES	0.1023575255727855	0.6141451534336713	0.2047150511445571	0.2047150511445571	0.2047150511445571
6	DE vs .VXQR1	0.2089123817407001	1.2534742904442004	0.2089123817407001	0.2089123817407001	0.2089123817407001