

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	3.394736842105262
CHC	1.5263157894736838
G-CMA-ES	1.973684210526316
VXQR1	3.1052631578947367

Friedman statistic considering reduction performance (distributed according to chi-square with 3 degrees of freedom: 27.268421052631457.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 3 and 54 degrees of freedom: 16.50876261285169.

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	4.460794123306555	8.165650609903726E-6	0.016666666666666666
2	VXQR1	3.7696851746252604	1.634535987808786E-4	0.025
1	G-CMA-ES	1.0680774661438248	0.28548556956100424	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	4.460794123306555	8.165650609903726E-6	0.033333333333333333
2	VXQR1	3.7696851746252604	1.634535987808786E-4	0.05
1	G-CMA-ES	1.0680774661438248	0.28548556956100424	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	8.165650609903726E-6	2.4496951829711176E-5	2.4496951829711176E-5	2.4496951829711176E-5	2.4496951829711176E-5
2	VXQR1	1.634535987808786E-4	4.903607963426357E-4	3.269071975617572E-4	3.269071975617572E-4	3.269071975617572E-4
3	G-CMA-ES	0.28548556956100424	0.85645670868301.27	0.28548556956100424	0.28548556956100424	0.28548556956100424

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

i	algorithms	$z = (R_0 - R_i) / SE$	p	Holm	Shaffer
6	DE vs. CHC	4.460794123306555	8.165650609903726E-6	0.008333333333333333	0.008333333333333333
5	CHC vs. VXQR1	3.7696851746252604	1.634535987808786E-4	0.01	0.016666666666666666
4	DE vs. G-CMA-ES	3.3927166571627305	6.920318080538718E-4	0.0125	0.016666666666666666
3	G-CMA-ES vs. VXQR1	2.7016077084814354	0.006900512590003988	0.016666666666666666	0.016666666666666666
2	CHC vs. G-CMA-ES	1.0680774661438248	0.28548556956100424	0.025	0.025
1	DE vs. VXQR1	0.691108948681295	0.4894970770882321	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 ≤ 0.025 .
 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	4.460794123306555	8.16565060903726E-6	0.016666666666666666	0.016666666666666666
5	CHC vs. VXQR1	3.7696851746252604	1.634535987808786E-4	0.02	0.033333333333333333
4	DE vs. G-CMA-ES	3.3927166571627305	6.920318080538718E-4	0.025	0.033333333333333333
3	G-CMA-ES vs. VXQR1	2.7016077084814354	0.0069000512590003988	0.033333333333333333	0.033333333333333333
2	CHC vs. G-CMA-ES	1.0680774661438248	0.28548556956100424	0.05	0.05
1	DE vs. VXQR1	0.691108948681295	0.4894970770882321	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 ≤ 0.05 .
 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_{Neme}	p_{Holm}	p_{Shaf}	p_{Berq}
1	DE vs .CHC	8.165650609003726E-6	4.899390365942235E-5	4.899390365942235E-5	4.899390365942235E-5	4.899390365942235E-5
2	CHC vs .VXQR1	1.634535987808786E-4	9.8072159268852715E-4	8.17267993904393E-4	4.903607963426357E-4	4.903607963426357E-4
3	DE vs .G-CMA-ES	6.920318080538718E-4	0.004152190848323231	0.0027681272322154873	0.0020760954241616156	0.0020760954241616156
4	G-CMA-ES vs .VXQR1	0.006900512590003988	0.041403075640023926	0.020701537770011963	0.020701537770011963	0.006900512590003988
5	CHC vs .G-CMA-ES	0.28548556956100424	1.7129134173660254	0.5709711391220085	0.5709711391220085	0.5709711391220085
6	DE vs .VXQR1	0.4894970770882321	2.9369824625293925	0.5709711391220085	0.5709711391220085	0.5709711391220085