

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	3.473684210526314
CHC	1.368421052631579
G-CMA-ES	1.973684210526316
VXQR1	3.1842105263157894

Friedman statistic considering reduction performance (distributed according to chi-square with 3 degrees of freedom: 33.89999999999987.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 3 and 54 degrees of freedom: 26.415584415584167.

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	5.026246899500343	5.001718578552741E-7	0.016666666666666666
2	VXQR1	4.335137950819048	1.4566874163845129E-5	0.025
1	G-CMA-ES	1.4450459836063498	0.14844496988252537	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	5.026246899500343	5.001718578552741E-7	0.03333333333333333
2	VXQR1	4.335137950819048	1.4566874163845129E-5	0.05
1	G-CMA-ES	1.4450459836063498	0.14844496988252537	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 .

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Table 4: Adjusted p-values

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Hommel}
1	DE	5.001718578552741E-7	1.5005155735658224E-6	1.5005155735658224E-6	1.5005155735658224E-6	1.5005155735658224E-6
2	VXQR1	1.4566874163845129E-5	4.370062249153539E-5	2.9133748327690257E-5	2.9133748327690257E-5	2.9133748327690257E-5
3	G-CMA-ES	0.14844496988252537	0.4453349096475761	0.14844496988252537	0.14844496988252537	0.14844496988252537

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

i	algorithms	$z = (R_0 - R_i) / SE$	p	Holm	Shaffer
6	DE vs. CHC	5.026246899500343	5.001718578552741E-7	0.008333333333333333	0.008333333333333333
5	CHC vs. VXQR1	4.335137950819048	1.4566874163845129E-5	0.01	0.016666666666666666
4	DE vs. G-CMA-ES	3.5812009158939926	3.420185079493796E-4	0.0125	0.016666666666666666
3	G-CMA-ES vs. VXQR1	2.8900919672126983	0.0038512913785902596	0.016666666666666666	0.016666666666666666
2	CHC vs. G-CMA-ES	1.4450459836063498	0.14844496988252537	0.025	0.025
1	DE vs. VXQR1	0.6911089486812939	0.48949707708823276	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	5.026246899500343	5.001718578552741E-7	0.016666666666666666	0.016666666666666666
5	CHC vs. VXQR1	4.335137950819048	1.4566874163845129E-5	0.02	0.033333333333333333
4	DE vs. G-CMA-ES	3.5812009158939926	3.420185079493796E-4	0.025	0.033333333333333333
3	G-CMA-ES vs. VXQR1	2.8900919672126983	0.0038512913785902596	0.033333333333333333	0.033333333333333333
2	CHC vs. G-CMA-ES	1.4450459836063498	0.14844496988252537	0.05	0.05
1	DE vs. VXQR1	0.6911089486812939	0.48949707708823276	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	$p_{N\text{ernie}}$	p_{Holm}	p_{Shaf}	p_{Berg}
1	DE vs .CHC	5.001718578552741E-7	3.0010311471316448E-6	3.0010311471316448E-6	3.0010311471316448E-6	3.0010311471316448E-6
2	CHC vs .VXQR1	1.4566874163845129E-5	8.7401244498307078E-5	7.283437081922564E-5	4.370062249153539E-5	4.370062249153539E-5
3	DE vs .G-CMA-ES	3.420185079493796E-4	0.0020521110476962776	0.0013680740317975183	0.0010260555238481388	0.0010260555238481388
4	G-CMA-ES vs .VXQR1	0.0038512913785902596	0.023107748271541557	0.011553874135770779	0.011553874135770779	0.0038512913785902596
5	CHC vs .G-CMA-ES	0.14844496988252537	0.8906698192951522	0.2968893976505074	0.2968893976505074	0.2968893976505074
6	DE vs .VXQR1	0.48949707708823276	2.9369824625293965	0.48949707708823276	0.48949707708823276	0.48949707708823276