

Results

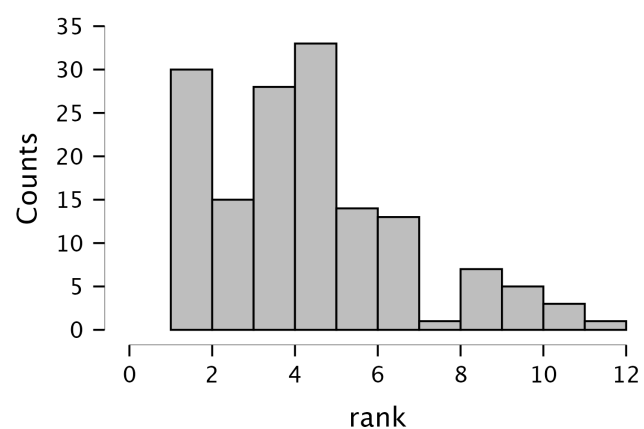
Descriptive Statistics

Descriptive Statistics

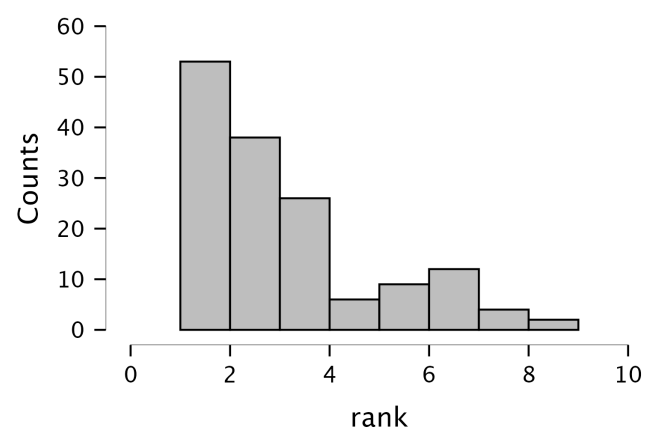
		Valid	Missing	Mean	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Shapiro-Wilk	P-val
rank	adadelta	150	0	4.713	2.494	6.219	0.640	0.198	0.230	0.394	0.940	
rank	adagrad	150	0	3.460	1.982	3.928	0.857	0.198	0.045	0.394	0.898	
rank	adam	150	0	3.620	3.016	9.096	1.284	0.198	0.656	0.394	0.800	
rank	bhh	150	0	8.233	2.367	5.603	−0.550	0.198	−0.182	0.394	0.947	
rank	bhh_gd_only	150	0	5.047	2.103	4.421	0.908	0.198	0.697	0.394	0.919	
rank	de	150	0	10.680	1.873	3.508	−1.644	0.198	2.511	0.394	0.741	
rank	ga	150	0	8.200	1.956	3.826	−0.857	0.198	0.700	0.394	0.926	
rank	momentum	150	0	9.153	2.689	7.231	−0.829	0.198	−0.412	0.394	0.876	
rank	nag	150	0	4.627	1.916	3.672	−0.498	0.198	−0.469	0.394	0.912	
rank	pso	150	0	8.520	2.495	6.224	−1.132	0.198	1.607	0.394	0.898	
rank	rmsprop	150	0	3.360	3.059	9.359	1.680	0.198	1.985	0.394	0.741	
rank	sgd	150	0	8.387	2.473	6.118	−0.763	0.198	−0.146	0.394	0.918	

rank

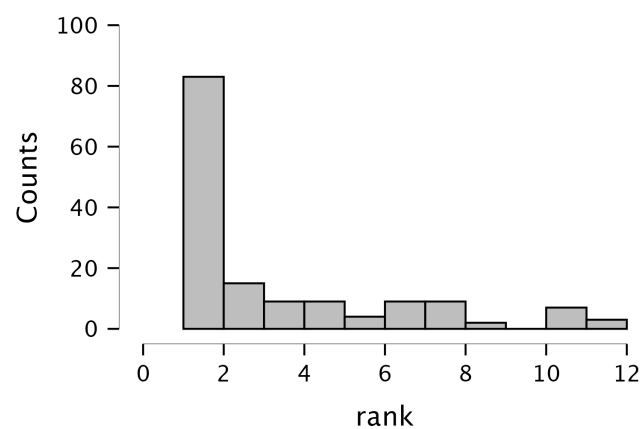
adadelta



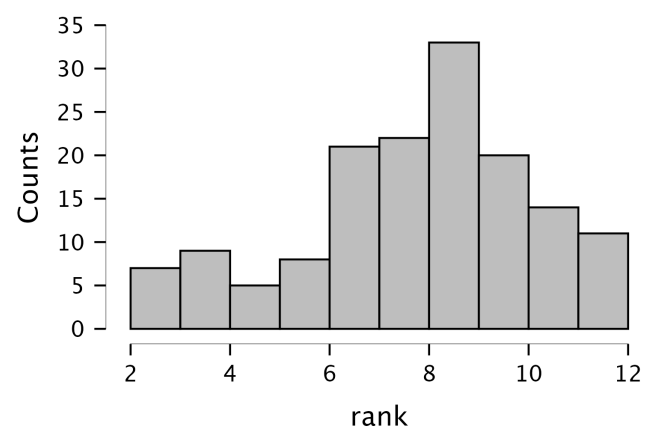
adagrad



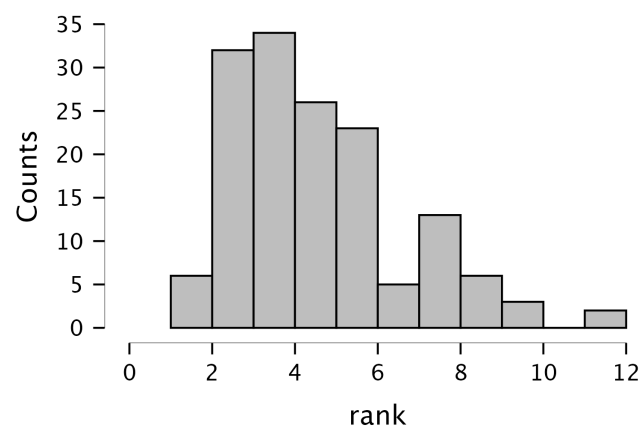
adam



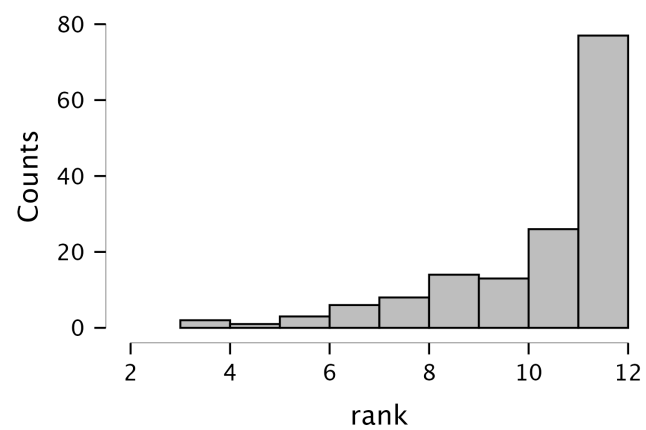
bhh



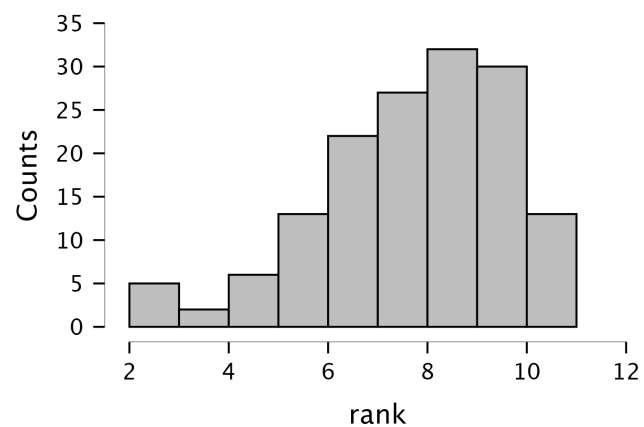
bhh_gd_only



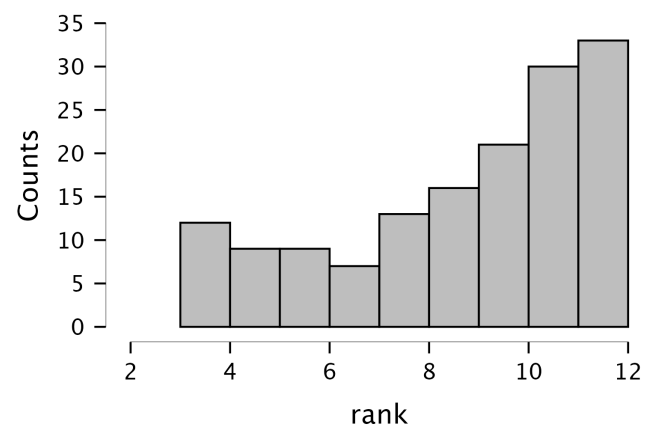
de



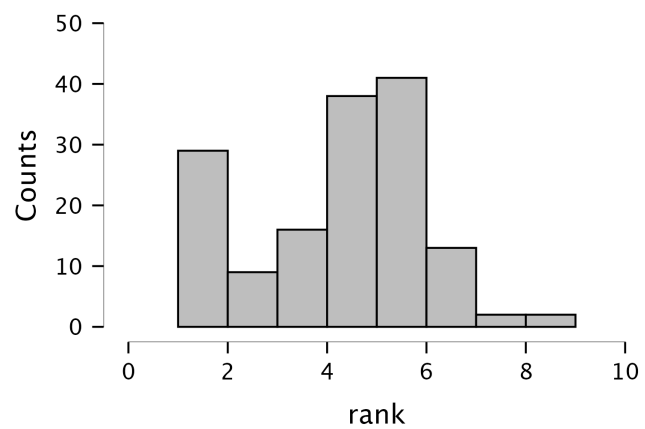
ga



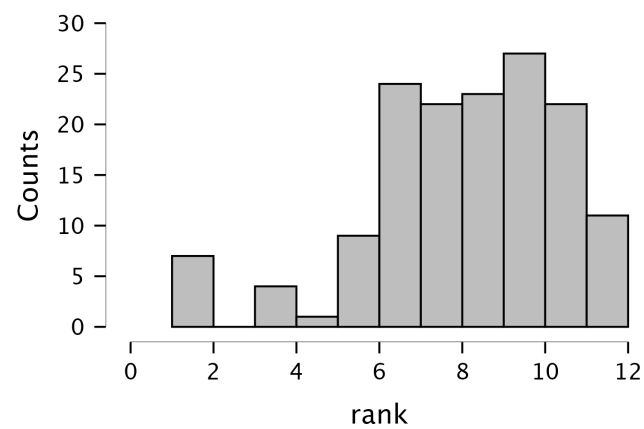
momentum



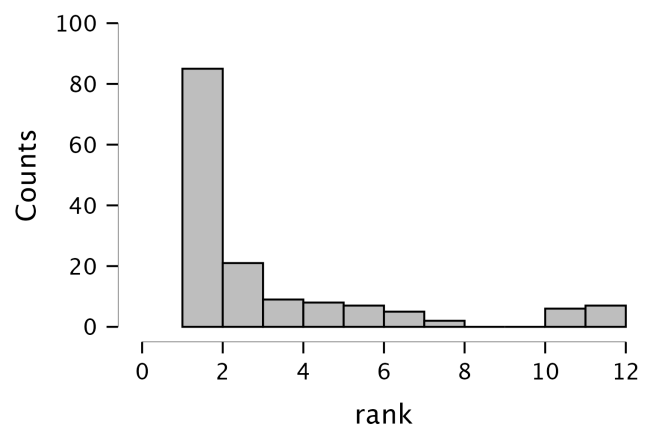
nag



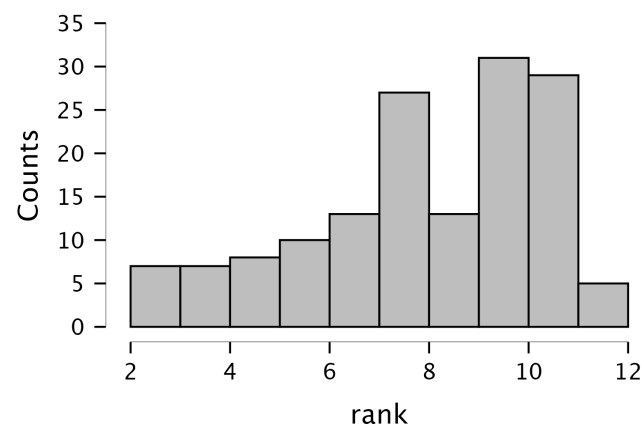
pso



rmsprop

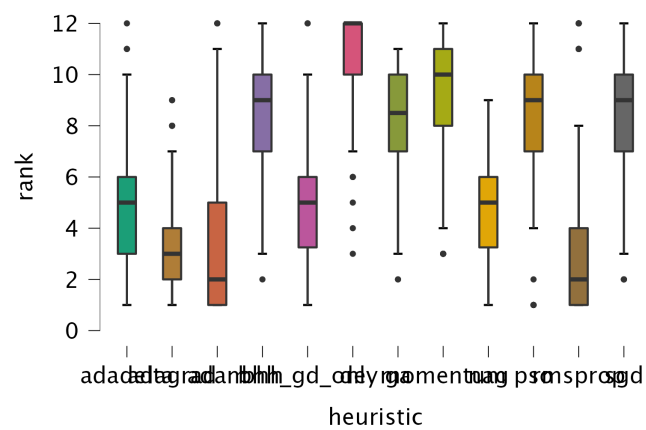


sgd



Boxplots

rank



ANOVA

ANOVA – rank

Cases	Sum of Squares	df	Mean Square	F	p
heuristic	11138.440	11	1012.585	175.580	< .001
Residuals	10311.560	1788	5.767		

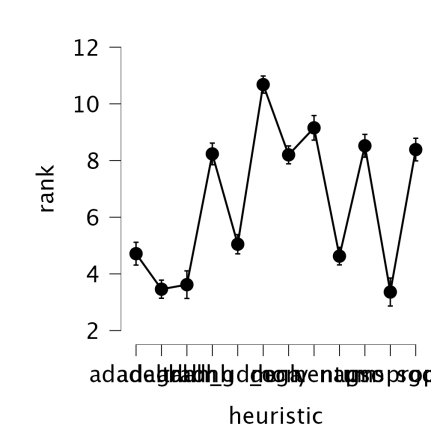
Note. Type III Sum of Squares

Descriptives

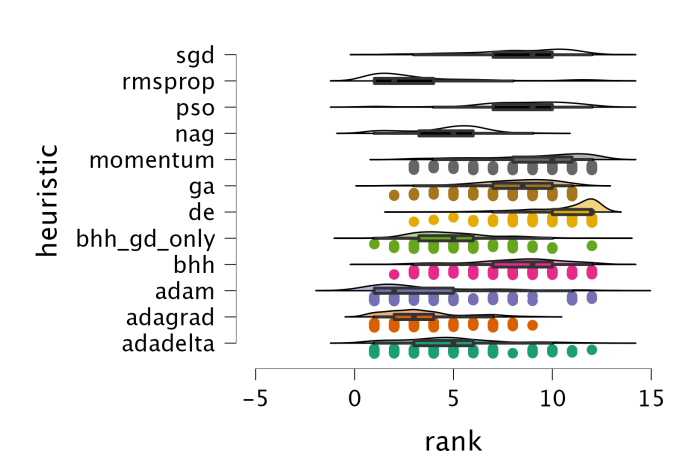
Descriptives – rank

heuristic	Mean	SD	N
adadelta	4.713	2.494	150
adagrad	3.460	1.982	150
adam	3.620	3.016	150
bhh	8.233	2.367	150
bhh_gd_only	5.047	2.103	150
de	10.680	1.873	150
ga	8.200	1.956	150
momentum	9.153	2.689	150
nag	4.627	1.916	150
pso	8.520	2.495	150
rmsprop	3.360	3.059	150
sgd	8.387	2.473	150

Descriptives plots



Raincloud plots



Assumption Checks

Test for Equality of Variances (Levene's)

F	df1	df2	p
7.350	11.000	1788.000	< .001

Post Hoc Tests

Standard

Post Hoc Comparisons – heuristic

		95% CI for Mean Difference			SE	t	Ptukey
		Mean Difference	Lower	Upper			
adadelata	adagrad	1.253	0.346	2.161	0.277	4.520	< .001***
	adam	1.093	0.186	2.001	0.277	3.943	0.005**
	bhh	−3.520	−4.427	−2.613	0.277	−12.694	< .001***
	bhh_gd_only	−0.333	−1.241	0.574	0.277	−1.202	0.989
	de	−5.967	−6.874	−5.059	0.277	−21.517	< .001***
	ga	−3.487	−4.394	−2.579	0.277	−12.574	< .001***
	momentum	−4.440	−5.347	−3.533	0.277	−16.012	< .001***
	nag	0.087	−0.821	0.994	0.277	0.313	1.000
	pso	−3.807	−4.714	−2.899	0.277	−13.728	< .001***
	rmsprop	1.353	0.446	2.261	0.277	4.880	< .001***
adagrad	sgd	−3.673	−4.581	−2.766	0.277	−13.247	< .001***
	adam	−0.160	−1.067	0.747	0.277	−0.577	1.000
	bhh	−4.773	−5.681	−3.866	0.277	−17.214	< .001***
	bhh_gd_only	−1.587	−2.494	−0.679	0.277	−5.722	< .001***
	de	−7.220	−8.127	−6.313	0.277	−26.037	< .001***
	ga	−4.740	−5.647	−3.833	0.277	−17.093	< .001***
	momentum	−5.693	−6.601	−4.786	0.277	−20.531	< .001***
	nag	−1.167	−2.074	−0.259	0.277	−4.207	0.002**
	pso	−5.060	−5.967	−4.153	0.277	−18.247	< .001***
	rmsprop	0.100	−0.807	1.007	0.277	0.361	1.000
adam	sgd	−4.927	−5.834	−4.019	0.277	−17.767	< .001***
	bhh	−4.613	−5.521	−3.706	0.277	−16.637	< .001***
	bhh_gd_only	−1.427	−2.334	−0.519	0.277	−5.145	< .001***
	de	−7.060	−7.967	−6.153	0.277	−25.460	< .001***
	ga	−4.580	−5.487	−3.673	0.277	−16.516	< .001***
	momentum	−5.533	−6.441	−4.626	0.277	−19.954	< .001***
	nag	−1.007	−1.914	−0.099	0.277	−3.630	0.015*
	pso	−4.900	−5.807	−3.993	0.277	−17.670	< .001***
	rmsprop	0.260	−0.647	1.167	0.277	0.938	0.999
	sgd	−4.767	−5.674	−3.859	0.277	−17.190	< .001***
bhh	bhh_gd_only	3.187	2.279	4.094	0.277	11.492	< .001***
	de	−2.447	−3.354	−1.539	0.277	−8.823	< .001***
	ga	0.033	−0.874	0.941	0.277	0.120	1.000
	momentum	−0.920	−1.827	−0.013	0.277	−3.318	0.043*
	nag	3.607	2.699	4.514	0.277	13.006	< .001***
	pso	−0.287	−1.194	0.621	0.277	−1.034	0.997
	rmsprop	4.873	3.966	5.781	0.277	17.574	< .001***
	sgd	−0.153	−1.061	0.754	0.277	−0.553	1.000
	de	−5.633	−6.541	−4.726	0.277	−20.315	< .001***
	ga	−3.153	−4.061	−2.246	0.277	−11.372	< .001***
bhh_gd_only	momentum	−4.107	−5.014	−3.199	0.277	−14.810	< .001***
	nag	0.420	−0.487	1.327	0.277	1.515	0.937
	pso	−3.473	−4.381	−2.566	0.277	−12.526	< .001***
	rmsprop	1.687	0.779	2.594	0.277	6.082	< .001***
	sgd	−3.340	−4.247	−2.433	0.277	−12.045	< .001***
	ga	2.480	1.573	3.387	0.277	8.943	< .001***
	momentum	1.527	0.619	2.434	0.277	5.505	< .001***
	nag	6.053	5.146	6.961	0.277	21.830	< .001***
	pso	2.160	1.253	3.067	0.277	7.789	< .001***
	rmsprop	7.320	6.413	8.227	0.277	26.398	< .001***
de	sgd	2.293	1.386	3.201	0.277	8.270	< .001***
	momentum	−0.953	−1.861	−0.046	0.277	−3.438	0.030*
	nag	3.573	2.666	4.481	0.277	12.886	< .001***
	pso	−0.320	−1.227	0.587	0.277	−1.154	0.992
	rmsprop	4.840	3.933	5.747	0.277	17.454	< .001***
	sgd	−0.187	−1.094	0.721	0.277	−0.673	1.000
	momentum	4.527	3.619	5.434	0.277	16.324	< .001***
	pso	0.633	−0.274	1.541	0.277	2.284	0.488
	rmsprop	5.793	4.886	6.701	0.277	20.892	< .001***
	sgd	0.767	−0.141	1.674	0.277	2.765	0.196
nag	pso	−3.893	−4.801	−2.986	0.277	−14.040	< .001***
	rmsprop	1.267	0.359	2.174	0.277	4.568	< .001***
	sgd	−3.760	−4.667	−2.853	0.277	−13.559	< .001***
pso	rmsprop	5.160	4.253	6.067	0.277	18.608	< .001***
	sgd	0.133	−0.774	1.041	0.277	0.481	1.000
rmsprop	sgd	−5.027	−5.934	−4.119	0.277	−18.127	< .001***

Note. P-value and confidence intervals adjusted for comparing a family of 12 estimates (confidence intervals corrected using the tukey method).

* p < .05, ** p < .01, *** p < .001

Kruskal–Wallis Test

Kruskal–Wallis Test

Factor	Statistic	df	p
heuristic	934.175	11	< .001

