Addressing Imbalance in Multilabel Classification: Measures and Random Preprocessing Methods

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CONTENTS

I. UNDERSAMPLING METHODS COMPARISON

A. All methods comparison

	Algorithm	Dataset	LP-RUS 10	LP-RUS 20	LP-RUS 25	ML-RUS 10	ML-RUS 20	ML-RUS 25
2	CLR	bibtex	0.2043	0.1958	0.1880	**0.2292**	0.2286	0.2261
3	HOMER	bibtex	0.2409	0.2216	0.2193	**0.2618**	0.2603	0.2580
4	IBLR-ML	bibtex	0.1424	0.1276	0.1221	**0.1684**	0.1654	0.1652
6	RAkEL-BR	bibtex	0.2776	0.2646	0.2657	**0.2966**	0.2937	0.2933
8	CLR	CAL500	0.1787	0.1787	0.1787	0.1708	0.1771	**0.1796**
9	HOMER	CAL500	0.2410	**0.2500**	0.2455	0.2346	0.2324	0.2348
10	IBLR-ML	CAL500	**0.1926**	**0.1926**	**0.1926**	0.1898	0.1843	0.1897
12	RAkEL-BR	CAL500	0.2135	0.2135	0.2135	0.2101	0.2140	**0.2154**
14	CLR	Corel16k001	0.0434	0.0409	0.0401	0.0453	0.0454	**0.0466**
15	HOMER	Corel16k001	0.1080	0.1087	0.1023	0.1118	0.1112	**0.1132**
16	IBLR-ML	Corel16k001	0.0224	0.0208	0.0200	**0.0256**	0.0254	0.0250
18	RAkEL-BR	Corel16k001	0.0618	0.0592	0.0592	0.0633	0.0628	**0.0638**
20	CLR	corel5k	0.0328	0.0319	0.0292	0.0355	**0.0368**	0.0363
21	HOMER	corel5k	0.0956	0.0870	0.0907	**0.1016**	0.0977	0.1010
22	IBLR-ML	corel5k	0.0266	0.0253	0.0235	0.0296	0.0323	**0.0324**
24	RAkEL-BR	corel5k	0.0534	0.0518	0.0480	0.0589	0.0592	**0.0594**
32	CLR	enron	0.3912	0.3456	0.3422	**0.4184**	0.4156	0.4156
33	HOMER	enron	0.3822	0.3353	0.3349	**0.4085**	0.4026	0.3976
34	IBLR-ML	enron	0.2834	0.2756	0.2752	0.3005	0.2946	**0.3147**
36	RAkEL-BR	enron	0.3812	0.3324	0.3292	**0.4034**	0.3966	0.4004
38	CLR	genbase	**0.9822**	0.9816	0.9812	0.9716	0.9528	0.9368
39	HOMER	genbase	0.9802	**0.9822**	0.9796	0.9764	0.9582	0.9411
40	IBLR-ML	genbase	0.9785	**0.9795**	0.9770	0.9671	0.9476	0.9214
42	RAkEL-BR	genbase	**0.9842**	**0.9842**	0.9839	0.9782	0.9616	0.9456
44	CLR	LLOG-F	0.0338	0.0278	0.0239	0.0458	**0.0504**	0.0492
45	HOMER	LLOG-F	0.0866	0.0927	0.0889	**0.1038**	0.0992	0.0972
46	IBLR-ML	LLOG-F	0.0328	0.0288	0.0232	**0.0352**	0.0327	0.0350
48	RAkEL-BR	LLOG-F	0.1243	0.1261	0.1268	**0.1325**	0.1296	0.1258
50	CLR	mediamill	**0.4456**	0.4370	0.4342	0.4438	0.4368	0.4334
51	HOMER	mediamill	0.4026	0.3870	0.3842	**0.4089**	0.4037	0.4012
52	IBLR-ML	mediamill	**0.4620**	0.4539	0.4486	0.4590	0.4504	0.4455
54	RAkEL-BR	mediamill	0.4115	0.4013	0.3964	**0.4144**	0.4088	0.4072
68	CLR	SLASHDOT-F	0.2816	0.2152	0.2024	**0.3194**	0.3117	0.2991
69	HOMER	SLASHDOT-F	**0.3403**	0.3082	0.3216	0.3314	0.3226	0.3084
70	IBLR-ML	SLASHDOT-F	0.0880	0.0854	0.0811	0.1486	0.1364	**0.1548**
72	RAkEL-BR	SLASHDOT-F	0.3015	0.2352	0.2188	**0.3392**	0.3279	0.3159
74	CLR	tmc2007	**0.6061**	0.5938	0.5887	0.6020	0.5860	0.5774
75	HOMER	tmc2007	**0.5930**	0.5760	0.5690	0.5897	0.5801	0.5701
76	IBLR-ML	tmc2007	**0.5266**	0.5168	0.5113	0.5184	0.5119	0.5072
78	RAkEL-BR	tmc2007	**0.5950**	0.5806	0.5731	0.5913	0.5758	0.5676
80	CLR	yeast	0.4621	0.4556	0.4566	**0.4706**	0.4649	0.4549
81	HOMER	yeast	0.4294	0.4130	0.4086	**0.4312**	0.4294	0.4144
82	IBLR-ML	yeast	0.5148	0.5048	0.5017	**0.5150**	0.5102	0.5074
84	RAkEL-BR	yeast	0.4242	0.4144	0.4160	**0.4344**	0.4314	0.4234

TABLE I: Accuracy

	Algorithm	Dataset	LP-RUS 10	LP-RUS 20	LP-RUS 25	ML-RUS 10	ML-RUS 20	ML-RUS 25
2	CLR	bibtex	0.7607	0.7429	0.7322	**0.7793**	0.7740	0.3339
3	HOMER	bibtex	0.3530	0.3346	0.3338	**0.3648**	0.3592	0.3408
4	IBLR-ML	bibtex	**0.3610**	0.3178	0.2986	0.3494	0.3158	0.2423
6	RAkEL-BR	bibtex	0.4878	0.4645	0.4573	**0.5136**	0.5045	0.3978
8	CLR	CAL500	0.6227	0.6227	0.6227	**0.6258**	0.6151	0.2993
9	HOMER	CAL500	0.3749	0.3822	**0.3858**	0.3732	0.3635	0.3787
10	IBLR-ML	CAL500	0.2827	0.2827	0.2827	0.2777	0.2720	**0.3166**
12	RAkEL-BR	CAL500	**0.4343**	**0.4343**	**0.4343**	0.4188	0.4163	0.3518
14	CLR	Corel16k001	0.4188	0.4054	0.3917	**0.4300**	0.4239	0.0878
15	HOMER	Corel16k001	0.2212	0.2152	0.2130	**0.2327**	0.2256	0.1868
16	IBLR-ML	Corel16k001	0.2865	0.2356	0.2092	**0.3049**	0.2600	0.0498
18	RAkEL-BR	Corel16k001	0.3464	0.3369	0.3339	0.3511	**0.3556**	0.1144
20	CLR	corel5k	0.4494	0.4440	0.4248	0.4512	**0.4540**	0.0714
21	HOMER	corel5k	0.2050	0.1964	0.1965	**0.2086**	0.2041	0.1708
22	IBLR-ML	corel5k	0.0378	0.0356	0.0337	0.0434	0.0434	**0.0558**
24	RAkEL-BR	corel5k	0.3716	**0.3756**	0.3652	0.3707	0.3717	0.1108
32	CLR	enron	**0.6842**	0.6677	0.6544	0.6780	0.6814	0.5467
33	HOMER	enron	0.5318	0.5111	0.5004	**0.5482**	0.5446	0.5086
34	IBLR-ML	enron	**0.5660**	0.5418	0.5299	0.5588	0.5279	0.4312
36	RAkEL-BR	enron	**0.6262**	0.6034	0.5858	0.6195	0.6124	0.5218
38	CLR	genbase	**0.9887**	**0.9887**	**0.9887**	0.9844	0.9852	0.9374
39	HOMER	genbase	0.9898	**0.9910**	0.9886	0.9852	0.9786	0.9420
40	IBLR-ML	genbase	0.9768	**0.9799**	0.9767	0.9478	0.8998	0.8920
42	RAkEL-BR	genbase	0.9893	0.9893	0.9893	0.9875	**0.9902**	0.9488
44	CLR	LLOG-F	0.5574	0.5198	0.4866	**0.5863**	0.5851	0.0802
45	HOMER	LLOG-F	0.1378	0.1468	0.1400	**0.1594**	0.1542	0.1452
46	IBLR-ML	LLOG-F	0.0535	0.0440	0.0420	0.0580	0.0565	**0.0588**
48	RAkEL-BR	LLOG-F	0.2698	0.2618	0.2634	**0.2880**	0.2871	0.1914
50	CLR	mediamill	0.7664	0.7560	0.7508	**0.7750**	0.7720	0.5713
51	HOMER	mediamill	0.5602	0.5266	0.5234	0.5882	**0.5944**	0.5372
52	IBLR-ML	mediamill	0.7525	0.7398	0.7326	0.7701	**0.7708**	0.5728
54	RAkEL-BR	mediamill	0.6279	0.6105	0.6013	0.6510	**0.6558**	0.5449
68	CLR	SLASHDOT-F	0.6546	0.6520	**0.6639**	0.6315	0.6354	0.4084
69	HOMER	SLASHDOT-F	0.5781	0.5683	0.5598	**0.5997**	0.5874	0.4001
70	IBLR-ML	SLASHDOT-F	0.6504	**0.6634**	0.6554	0.6505	0.6218	0.2242
72	RAkEL-BR	SLASHDOT-F	0.6985	**0.7146**	0.7098	0.6675	0.6672	0.4248
74	CLR	tmc2007	0.7400	0.7278	0.7228	**0.7500**	0.7454	0.6884
75	HOMER	tmc2007	0.6860	0.6691	0.6614	**0.6908**	0.6893	0.6664
76	IBLR-ML	tmc2007	0.7132	0.7073	0.7036	**0.7221**	0.7220	0.6170
78	RAkEL-BR	tmc2007	0.7243	0.7092	0.7016	**0.7337**	0.7263	0.6699
80	CLR	yeast	0.6462	0.6380	0.6286	0.6516	**0.6573**	0.6055
81	HOMER	yeast	0.5632	0.5504	0.5407	0.5680	**0.5795**	0.5612
82	IBLR-ML	yeast	0.7133	0.7124	0.7083	**0.7137**	0.7129	0.6378
84	RAkEL-BR	yeast	0.5839	0.5712	0.5644	0.5913	**0.5970**	0.5696

TABLE II: MicroFMeasure

	Algorithm	Dataset	LP-RUS 10	LP-RUS 20	LP-RUS 25	ML-RUS 10	ML-RUS 20	ML-RUS 25
2	CLR	bibtex	0.3328	0.3238	0.3240	0.3400	0.3409	**0.3448**
3	HOMER	bibtex	**0.2960**	0.2870	0.2871	0.2920	0.2890	0.2907
4	IBLR-ML	bibtex	**0.2060**	0.1998	0.1904	0.2050	0.1977	0.1954
6	RAkEL-BR	bibtex	0.3358	0.3328	0.3356	**0.3384**	0.3371	0.3371
8	CLR	CAL500	**0.3323**	**0.3323**	**0.3323**	0.3128	0.3137	0.3067
9	HOMER	CAL500	0.3194	0.3274	**0.3302**	0.3194	0.3172	0.3254
10	IBLR-ML	CAL500	0.2770	0.2770	0.2770	0.2744	0.2680	**0.2789**
12	RAkEL-BR	CAL500	0.2934	0.2934	0.2934	**0.3028**	0.3013	0.3021
14	CLR	Corel16k001	0.1001	0.0990	0.0967	0.1031	0.0968	**0.1054**
15	HOMER	Corel16k001	0.1272	0.1222	0.1168	0.1322	0.1374	**0.1380**
16	IBLR-ML	Corel16k001	**0.1056**	0.0988	0.0946	0.1049	0.1054	0.0956
18	RAkEL-BR	Corel16k001	0.1216	0.1180	0.1176	**0.1244**	0.1197	0.1218
20	CLR	corel5k	**0.1410**	0.1298	0.1328	0.1304	0.1386	0.1272
21	HOMER	corel5k	0.1682	0.1660	0.1628	0.1852	0.1840	**0.1856**
22	IBLR-ML	corel5k	0.0939	0.0909	0.0840	0.1092	0.1069	**0.1104**
24	RAkEL-BR	corel5k	0.1631	0.1652	0.1552	0.1792	**0.1831**	0.1775
32	CLR	enron	0.4208	0.4014	0.4184	0.4132	0.4055	**0.4306**
33	HOMER	enron	0.3702	0.3558	0.3641	**0.3798**	0.3746	0.3604
34	IBLR-ML	enron	**0.3450**	0.3333	0.3300	0.3399	0.3296	0.3180
36	RAkEL-BR	enron	0.4062	0.3968	0.4086	0.4039	0.3996	**0.4126**
38	CLR	genbase	**0.9846**	0.9845	0.9842	0.9675	0.9530	0.9303
39	HOMER	genbase	0.9796	**0.9836**	0.9775	0.9718	0.9517	0.9331
40	IBLR-ML	genbase	0.9678	**0.9686**	0.9670	0.9424	0.9122	0.8929
42	RAkEL-BR	genbase	**0.9890**	**0.9890**	0.9887	0.9834	0.9716	0.9501
44	CLR	LLOG-F	0.2224	0.2037	0.2032	0.2550	**0.2670**	0.2534
45	HOMER	LLOG-F	0.2210	0.2336	**0.2398**	0.2267	0.2166	0.2020
46	IBLR-ML	LLOG-F	0.1738	0.1627	0.1589	**0.1998**	0.1786	0.1798
48	RAkEL-BR	LLOG-F	0.2784	0.2791	**0.2927**	0.2670	0.2652	0.2538
50	CLR	mediamill	0.2294	**0.2358**	0.2340	0.2176	0.2218	0.2188
51	HOMER	mediamill	0.2374	**0.2444**	0.2348	0.2290	0.2115	0.2088
52	IBLR-ML	mediamill	**0.2804**	0.2796	0.2776	0.2634	0.2452	0.2362
54	RAkEL-BR	mediamill	0.2778	**0.2791**	0.2766	0.2692	0.2509	0.2434
68	CLR	SLASHDOT-F	0.3800	0.3530	0.3472	**0.3898**	0.3834	0.3661
69	HOMER	SLASHDOT-F	**0.4059**	0.3809	0.3825	0.3766	0.3733	0.3581
70	IBLR-ML	SLASHDOT-F	0.2276	0.2199	0.2192	0.2242	0.2218	**0.2530**
72	RAkEL-BR	SLASHDOT-F	0.3841	0.3675	0.3605	**0.3982**	0.3842	0.3750
74	CLR	tmc2007	**0.6091**	0.6089	0.6078	0.5954	0.5781	0.5717
75	HOMER	tmc2007	**0.5944**	0.5911	0.5861	0.5855	0.5722	0.5662
76	IBLR-ML	tmc2007	0.4716	**0.4760**	0.4758	0.4406	0.4298	0.4260
78	RAkEL-BR	tmc2007	**0.6022**	0.5966	0.5942	0.5878	0.5707	0.5652
80	CLR	yeast	0.4481	0.4538	**0.4562**	0.4483	0.4298	0.4285
81	HOMER	yeast	**0.4431**	0.4345	0.4274	0.4351	0.4238	0.4164
82	IBLR-ML	yeast	**0.4990**	0.4828	0.4761	0.4597	0.4671	0.4570
84	RAkEL-BR	yeast	0.4450	0.4407	0.4436	**0.4474**	0.4367	0.4357

TABLE III: MacroFMeasure

B. Ranking tables

	LP-RUS 10	LP-RUS 20	LP-RUS 25	ML-RUS 10	ML-RUS 20	ML-RUS 25
CLR bibtex	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
HOMER bibtex	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
IBLR-ML bibtex	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
RAkEL-BR bibtex	4.0000	6.0000	5.0000	**1.0000**	2.0000	3.0000
CLR CAL500	3.0000	3.0000	3.0000	6.0000	5.0000	**1.0000**
HOMER CAL500	3.0000	**1.0000**	2.0000	5.0000	6.0000	4.0000
IBLR-ML CAL500	**2.0000**	**2.0000**	**2.0000**	4.0000	6.0000	5.0000
RAkEL-BR CAL500	4.0000	4.0000	4.0000	6.0000	2.0000	**1.0000**
CLR Corel16k001	4.0000	5.0000	6.0000	3.0000	2.0000	**1.0000**
HOMER Corel16k001	5.0000	4.0000	6.0000	2.0000	3.0000	**1.0000**
IBLR-ML Corel16k001	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
RAkEL-BR Corel16k001	4.0000	5.5000	5.5000	2.0000	3.0000	**1.0000**
CLR corel5k	4.0000	5.0000	6.0000	3.0000	**1.0000**	2.0000
HOMER corel5k	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
IBLR-ML corel5k	4.0000	5.0000	6.0000	3.0000	2.0000	**1.0000**
RAkEL-BR corel5k	4.0000	5.0000	6.0000	3.0000	2.0000	**1.0000**
CLR enron	4.0000	5.0000	6.0000	**1.0000**	2.5000	2.5000
HOMER enron	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
IBLR-ML enron	4.0000	5.0000	6.0000	2.0000	3.0000	**1.0000**
RAkEL-BR enron	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
CLR genbase	**1.0000**	2.0000	3.0000	4.0000	5.0000	6.0000
HOMER genbase	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
IBLR-ML genbase	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
RAkEL-BR genbase	**1.5000**	**1.5000**	3.0000	4.0000	5.0000	6.0000
CLR LLOG-F	4.0000	5.0000	6.0000	3.0000	**1.0000**	2.0000
HOMER LLOG-F	6.0000	4.0000	5.0000	**1.0000**	2.0000	3.0000
IBLR-ML LLOG-F	3.0000	5.0000	6.0000	**1.0000**	4.0000	2.0000
RAkEL-BR LLOG-F	6.0000	4.0000	3.0000	**1.0000**	2.0000	5.0000
CLR mediamill	**1.0000**	3.0000	5.0000	2.0000	4.0000	6.0000
HOMER mediamill	3.0000	5.0000	6.0000	**1.0000**	2.0000	4.0000
IBLR-ML mediamill	**1.0000**	3.0000	5.0000	2.0000	4.0000	6.0000
RAkEL-BR mediamill	2.0000	5.0000	6.0000	**1.0000**	3.0000	4.0000
CLR SLASHDOT-F	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
HOMER SLASHDOT-F	**1.0000**	6.0000	4.0000	2.0000	3.0000	5.0000
IBLR-ML SLASHDOT-F	4.0000	5.0000	6.0000	2.0000	3.0000	**1.0000**
RAkEL-BR SLASHDOT-F	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
CLR tmc2007	**1.0000**	3.0000	4.0000	2.0000	5.0000	6.0000
HOMER tmc2007	**1.0000**	4.0000	6.0000	2.0000	3.0000	5.0000
IBLR-ML tmc2007	**1.0000**	3.0000	5.0000	2.0000	4.0000	6.0000
RAkEL-BR tmc2007	**1.0000**	3.0000	5.0000	2.0000	4.0000	6.0000
CLR yeast	3.0000	5.0000	4.0000	**1.0000**	2.0000	6.0000
HOMER yeast	2.5000	5.0000	6.0000	**1.0000**	2.5000	4.0000
IBLR-ML yeast	2.0000	5.0000	6.0000	**1.0000**	3.0000	4.0000
RAkEL-BR yeast	3.0000	6.0000	5.0000	**1.0000**	2.0000	4.0000
Mean Rank	3.1136	4.2273	5.0341	**2.1364**	3.0227	3.4659

TABLE IV: Ranking by Accuracy

	LP-RUS 10	LP-RUS 20	LP-RUS 25	ML-RUS 10	ML-RUS 20	ML-RUS 25
CLR bibtex	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
HOMER bibtex	3.0000	5.0000	6.0000	**1.0000**	2.0000	4.0000
IBLR-ML bibtex	**1.0000**	3.0000	5.0000	2.0000	4.0000	6.0000
RAkEL-BR bibtex	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
CLR CAL500	3.0000	3.0000	3.0000	**1.0000**	5.0000	6.0000
HOMER CAL500	4.0000	2.0000	**1.0000**	5.0000	6.0000	3.0000
IBLR-ML CAL500	3.0000	3.0000	3.0000	5.0000	6.0000	**1.0000**
RAkEL-BR CAL500	**2.0000**	**2.0000**	**2.0000**	4.0000	5.0000	6.0000
CLR Corel16k001	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
HOMER Corel16k001	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
IBLR-ML Corel16k001	2.0000	4.0000	5.0000	**1.0000**	3.0000	6.0000
RAkEL-BR Corel16k001	3.0000	4.0000	5.0000	2.0000	**1.0000**	6.0000
CLR corel5k	3.0000	4.0000	5.0000	2.0000	**1.0000**	6.0000
HOMER corel5k	2.0000	5.0000	4.0000	**1.0000**	3.0000	6.0000
IBLR-ML corel5k	4.0000	5.0000	6.0000	2.5000	2.5000	**1.0000**
RAkEL-BR corel5k	3.0000	**1.0000**	5.0000	4.0000	2.0000	6.0000
CLR enron	**1.0000**	4.0000	5.0000	3.0000	2.0000	6.0000
HOMER enron	3.0000	4.0000	6.0000	**1.0000**	2.0000	5.0000
IBLR-ML enron	**1.0000**	3.0000	4.0000	2.0000	5.0000	6.0000
RAkEL-BR enron	**1.0000**	4.0000	5.0000	2.0000	3.0000	6.0000
CLR genbase	**2.0000**	**2.0000**	**2.0000**	5.0000	4.0000	6.0000
HOMER genbase	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
IBLR-ML genbase	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
RAkEL-BR genbase	3.0000	3.0000	3.0000	5.0000	**1.0000**	6.0000
CLR LLOG-F	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
HOMER LLOG-F	6.0000	3.0000	5.0000	**1.0000**	2.0000	4.0000
IBLR-ML LLOG-F	4.0000	5.0000	6.0000	2.0000	3.0000	**1.0000**
RAkEL-BR LLOG-F	3.0000	5.0000	4.0000	**1.0000**	2.0000	6.0000
CLR mediamill	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
HOMER mediamill	3.0000	5.0000	6.0000	2.0000	**1.0000**	4.0000
IBLR-ML mediamill	3.0000	4.0000	5.0000	2.0000	**1.0000**	6.0000
RAkEL-BR mediamill	3.0000	4.0000	5.0000	2.0000	**1.0000**	6.0000
CLR SLASHDOT-F	2.0000	3.0000	**1.0000**	5.0000	4.0000	6.0000
HOMER SLASHDOT-F	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
IBLR-ML SLASHDOT-F	4.0000	**1.0000**	2.0000	3.0000	5.0000	6.0000
RAkEL-BR SLASHDOT-F	3.0000	**1.0000**	2.0000	4.0000	5.0000	6.0000
CLR tmc2007	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
HOMER tmc2007	3.0000	4.0000	6.0000	**1.0000**	2.0000	5.0000
IBLR-ML tmc2007	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
RAkEL-BR tmc2007	3.0000	4.0000	5.0000	**1.0000**	2.0000	6.0000
CLR yeast	3.0000	4.0000	5.0000	2.0000	**1.0000**	6.0000
HOMER yeast	3.0000	5.0000	6.0000	2.0000	**1.0000**	4.0000
IBLR-ML yeast	2.0000	4.0000	5.0000	**1.0000**	3.0000	6.0000
RAkEL-BR yeast	3.0000	4.0000	6.0000	2.0000	**1.0000**	5.0000
Mean Rank	2.7955	3.5227	4.4318	**2.1932**	2.7159	5.3409

TABLE V: Ranking by MicroFMeasure

	LP-RUS 10	LP-RUS 20	LP-RUS 25	ML-RUS 10	ML-RUS 20	ML-RUS 25
CLR bibtex	4.0000	6.0000	5.0000	3.0000	2.0000	**1.0000**
HOMER bibtex	**1.0000**	6.0000	5.0000	2.0000	4.0000	3.0000
IBLR-ML bibtex	**1.0000**	3.0000	6.0000	2.0000	4.0000	5.0000
RAkEL-BR bibtex	4.0000	6.0000	5.0000	**1.0000**	2.5000	2.5000
CLR CAL500	**2.0000**	**2.0000**	**2.0000**	5.0000	4.0000	6.0000
HOMER CAL500	4.5000	2.0000	**1.0000**	4.5000	6.0000	3.0000
IBLR-ML CAL500	3.0000	3.0000	3.0000	5.0000	6.0000	**1.0000**
RAkEL-BR CAL500	5.0000	5.0000	5.0000	**1.0000**	3.0000	2.0000
CLR Corel16k001	3.0000	4.0000	6.0000	2.0000	5.0000	**1.0000**
HOMER Corel16k001	4.0000	5.0000	6.0000	3.0000	2.0000	**1.0000**
IBLR-ML Corel16k001	**1.0000**	4.0000	6.0000	3.0000	2.0000	5.0000
RAkEL-BR Corel16k001	3.0000	5.0000	6.0000	**1.0000**	4.0000	2.0000
CLR corel5k	**1.0000**	5.0000	3.0000	4.0000	2.0000	6.0000
HOMER corel5k	4.0000	5.0000	6.0000	2.0000	3.0000	**1.0000**
IBLR-ML corel5k	4.0000	5.0000	6.0000	2.0000	3.0000	**1.0000**
RAkEL-BR corel5k	5.0000	4.0000	6.0000	2.0000	**1.0000**	3.0000
CLR enron	2.0000	6.0000	3.0000	4.0000	5.0000	**1.0000**
HOMER enron	3.0000	6.0000	4.0000	**1.0000**	2.0000	5.0000
IBLR-ML enron	**1.0000**	3.0000	4.0000	2.0000	5.0000	6.0000
RAkEL-BR enron	3.0000	6.0000	2.0000	4.0000	5.0000	**1.0000**
CLR genbase	**1.0000**	2.0000	3.0000	4.0000	5.0000	6.0000
HOMER genbase	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
IBLR-ML genbase	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
RAkEL-BR genbase	**1.5000**	**1.5000**	3.0000	4.0000	5.0000	6.0000
CLR LLOG-F	4.0000	5.0000	6.0000	2.0000	**1.0000**	3.0000
HOMER LLOG-F	4.0000	2.0000	**1.0000**	3.0000	5.0000	6.0000
IBLR-ML LLOG-F	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
RAkEL-BR LLOG-F	3.0000	2.0000	**1.0000**	4.0000	5.0000	6.0000
CLR mediamill	3.0000	**1.0000**	2.0000	6.0000	4.0000	5.0000
HOMER mediamill	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
IBLR-ML mediamill	**1.0000**	2.0000	3.0000	4.0000	5.0000	6.0000
RAkEL-BR mediamill	2.0000	**1.0000**	3.0000	4.0000	5.0000	6.0000
CLR SLASHDOT-F	3.0000	5.0000	6.0000	**1.0000**	2.0000	4.0000
HOMER SLASHDOT-F	**1.0000**	3.0000	2.0000	4.0000	5.0000	6.0000
IBLR-ML SLASHDOT-F	2.0000	5.0000	6.0000	3.0000	4.0000	**1.0000**
RAkEL-BR SLASHDOT-F	3.0000	5.0000	6.0000	**1.0000**	2.0000	4.0000
CLR tmc2007	**1.0000**	2.0000	3.0000	4.0000	5.0000	6.0000
HOMER tmc2007	**1.0000**	2.0000	3.0000	4.0000	5.0000	6.0000
IBLR-ML tmc2007	3.0000	**1.0000**	2.0000	4.0000	5.0000	6.0000
RAkEL-BR tmc2007	**1.0000**	2.0000	3.0000	4.0000	5.0000	6.0000
CLR yeast	4.0000	2.0000	**1.0000**	3.0000	5.0000	6.0000
HOMER yeast	**1.0000**	3.0000	4.0000	2.0000	5.0000	6.0000
IBLR-ML yeast	**1.0000**	2.0000	3.0000	5.0000	4.0000	6.0000
RAkEL-BR yeast	2.0000	4.0000	3.0000	**1.0000**	5.0000	6.0000
Mean Rank	**2.5227**	3.4432	3.8409	3.0341	3.9886	4.1705

TABLE VI: Ranking by MacroFMeasure

II. UNDERSAMPLING STATISTICAL TESTS

A. Accuracy

TABLE VII
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
LP-RUS 10	3.113636363636364
LP-RUS 20	4.227272727272728
LP-RUS 25	5.034090909090908
ML-RUS 10	2.136363636363636
ML-RUS 20	3.022727272727272
ML-RUS 25	3.4659090909090895

Friedman statistic considering reduction performance (distributed according to chi-square with 5 degrees of freedom: 64.366883116883. P-value computed by Friedman Test: 5.764033694788395E-11.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 5 and 215 degrees of freedom: 17.783978303953223. P-value computed by Iman and Daveport Test: 9.882929726157857E-15.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.01. Hochberg's procedure rejects those

TABLE VIII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-RUS 25	7.264986749301919	3.730748384780881E-13	0.01
4	LP-RUS 20	5.242186517143351	1.586848419266322E-7	0.0125
3	ML-RUS 25	3.333346861444408	8.580789390913604E-4	0.016666666666666666
2	LP-RUS 10	2.450152393882219	0.01427957641624487	0.025
1	ML-RUS 20	2.2222312409629397	0.02626768219654331	0.05

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

TABLE IX
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-RUS 25	7.264986749301919	3.730748384780881E-13	0.02
4	LP-RUS 20	5.242186517143351	1.586848419266322E-7	0.025
3	ML-RUS 25	3.333346861444408	8.580789390913604E-4	0.03333333333333333
2	LP-RUS 10	2.450152393882219	0.01427957641624487	0.05
1	ML-RUS 20	2.2222312409629397	0.02626768219654331	0.1

hypotheses that have a p-value ≤ 0.02. Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.1. Hommel's procedure rejects all hypotheses. Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$.

TABLE X
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	LP-RUS 25	3.730748384780881E-13	1.8653741923904406E-12	1.8653741923904406E-12	1.8653741923904406E-12	1.8653741923904406E-12
2	LP-RUS 20	1.586848419266322E-7	7.934242096331611E-7	6.347393677065288E-7	6.347393677065288E-7	6.347393677065288E-7
3	ML-RUS 25	8.580789390913604E-4	0.004290394695456802	0.0025742368172740815	0.0025742368172740815	0.0025742368172740815
4	LP-RUS 10	0.01427957641624487	0.07139788208122436	0.02855915283248974	0.02626768219654331	0.02626768219654331
5	ML-RUS 20	0.02626768219654331	0.13133841098271654	0.02855915283248974	0.02626768219654331	0.02626768219654331

Holm's procedure rejects those hypotheses that have a p-value $\leq 0.0071428571428571435$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Bergmann's procedure rejects these hypotheses:

- LP-RUS 10 vs. LP-RUS 20
- LP-RUS 10 vs. LP-RUS 25
- LP-RUS 20 vs. ML-RUS 10
- LP-RUS 20 vs. ML-RUS 20
- LP-RUS 25 vs. ML-RUS 10
- LP-RUS 25 vs. ML-RUS 20
- LP-RUS 25 vs. ML-RUS 25
- ML-RUS 10 vs. ML-RUS 25

TABLE XI
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-RUS 25 vs. ML-RUS 10	7.264986749301919	3.730748384780881E-13	0.0033333333333333335	0.0033333333333333335
14	LP-RUS 20 vs. ML-RUS 10	5.242186517143351	1.586848419266322E-7	0.0035714285714285718	0.005
13	LP-RUS 25 vs. ML-RUS 20	5.0427555083389795	4.588754112267901E-7	0.0038461538461538464	0.005
12	LP-RUS 10 vs. LP-RUS 25	4.8148343554197	1.4732204201198625E-6	0.004166666666666667	0.005
11	LP-RUS 25 vs. ML-RUS 25	3.931639887857511	8.436838033073051E-5	0.004545454545454546	0.005
10	ML-RUS 10 vs. ML-RUS 25	3.333346861444408	8.580789390913604E-4	0.005	0.005
9	LP-RUS 20 vs. ML-RUS 20	3.0199552761804105	0.00252812013866232	0.005555555555555556	0.007142857142857143
8	LP-RUS 10 vs. LP-RUS 20	2.792034123261131	0.005237783216859266	0.00625	0.007142857142857143
7	LP-RUS 10 vs. ML-RUS 10	2.450152393882219	0.01427957641624487	0.007142857142857143	0.007142857142857143
6	ML-RUS 10 vs. ML-RUS 20	2.2222312409629397	0.02626768219654331	0.008333333333333333	0.008333333333333333
5	LP-RUS 20 vs. LP-RUS 25	2.022800232158569	0.043093747745290754	0.01	0.01
4	LP-RUS 20 vs. ML-RUS 25	1.9088396556989422	0.05628277947518823	0.0125	0.0125
3	ML-RUS 20 vs. ML-RUS 25	1.1111156204814683	0.26651858504486337	0.016666666666666666	0.016666666666666666
2	LP-RUS 10 vs. ML-RUS 25	0.8831944675621892	0.3771312102464177	0.025	0.025
1	LP-RUS 10 vs. ML-RUS 20	0.22792115291927906	0.8197075378297859	0.05	0.05

TABLE XII
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-RUS 25 vs. ML-RUS 10	7.264986749301919	3.730748384780881E-13	0.006666666666666667	0.006666666666666667
14	LP-RUS 20 vs. ML-RUS 10	5.242186517143351	1.586848419266322E-7	0.007142857142857143	0.01
13	LP-RUS 25 vs. ML-RUS 20	5.0427555083389795	4.588754112267901E-7	0.007692307692307693	0.01
12	LP-RUS 10 vs. LP-RUS 25	4.8148343554197	1.4732204201198625E-6	0.008333333333333333	0.01
11	LP-RUS 25 vs. ML-RUS 25	3.931639887857511	8.436838033073051E-5	0.009090909090909092	0.01
10	ML-RUS 10 vs. ML-RUS 25	3.333346861444408	8.580789390913604E-4	0.01	0.01
9	LP-RUS 20 vs. ML-RUS 20	3.0199552761804105	0.00252812013866232	0.011111111111111112	0.014285714285714287
8	LP-RUS 10 vs. LP-RUS 20	2.792034123261131	0.005237783216859266	0.0125	0.014285714285714287
7	LP-RUS 10 vs. ML-RUS 10	2.450152393882219	0.01427957641624487	0.014285714285714287	0.014285714285714287
6	ML-RUS 10 vs. ML-RUS 20	2.2222312409629397	0.02626768219654331	0.016666666666666666	0.016666666666666666
5	LP-RUS 20 vs. LP-RUS 25	2.022800232158569	0.043093747745290754	0.02	0.02
4	LP-RUS 20 vs. ML-RUS 25	1.9088396556989422	0.05628277947518823	0.025	0.025
3	ML-RUS 20 vs. ML-RUS 25	1.1111156204814683	0.26651858504486337	0.03333333333333333	0.03333333333333333
2	LP-RUS 10 vs. ML-RUS 25	0.8831944675621892	0.3771312102464177	0.05	0.05
1	LP-RUS 10 vs. ML-RUS 20	0.22792115291927906	0.8197075378297859	0.1	0.1

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. 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 $\leq 0.006666666666666667$. Bergmann's procedure rejects these hypotheses:

- LP-RUS 10 vs. LP-RUS 20
- LP-RUS 10 vs. LP-RUS 25
- LP-RUS 10 vs. ML-RUS 10
- LP-RUS 20 vs. ML-RUS 10
- LP-RUS 20 vs. ML-RUS 20
- LP-RUS 25 vs. ML-RUS 10
- LP-RUS 25 vs. ML-RUS 20
- LP-RUS 25 vs. ML-RUS 25
- ML-RUS 10 vs. ML-RUS 20
- ML-RUS 10 vs. ML-RUS 25

TABLE XIII
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	LP-RUS 25 vs .ML-RUS 10	3.730748384780881E-13	5.596122577171322E-12	5.596122577171322E-12	5.596122577171322E-12	5.596122577171322E-12
2	LP-RUS 20 vs .ML-RUS 10	1.586848419266322E-7	2.380272628899483E-6	2.221587786972851E-6	1.5868484192663222E-6	1.5868484192663222E-6
3	LP-RUS 25 vs .ML-RUS 20	4.588754112267901E-7	6.883131168401851E-6	5.965380345948271E-6	4.588754112267901E-6	4.588754112267901E-6
4	LP-RUS 10 vs .LP-RUS 25	1.4732204201198625E-6	2.2098306301797935E-5	1.767864504143835E-5	1.4732204201198625E-5	1.0312542940839037E-5
5	LP-RUS 25 vs .ML-RUS 25	8.436838033073051E-5	0.0012655257049609576	9.280521836380356E-4	8.43683803307305E-4	5.062102819843831E-4
6	ML-RUS 10 vs .ML-RUS 25	8.580789390913604E-4	0.012871184086370406	0.008580789390913604	0.008580789390913604	0.006006552573639523
7	LP-RUS 20 vs .ML-RUS 20	0.00252812013866232	0.0379218020799348	0.02275308124796088	0.01769684097063624	0.01516872083197392
8	LP-RUS 10 vs .LP-RUS 20	0.005237783216859266	0.078566748252889	0.04190226573487413	0.036664482518014865	0.020951132867437064
9	LP-RUS 10 vs .ML-RUS 10	0.01427957641624487	0.21419364624367307	0.09995703491371409	0.09995703491371409	0.05711830566497948
10	ML-RUS 10 vs .ML-RUS 20	0.02626768219654331	0.39401523294814966	0.15760609317925986	0.15760609317925986	0.07880304658962993
11	LP-RUS 20 vs .LP-RUS 25	0.043093747745290754	0.6464062161793613	0.21546873872645378	0.17237499098116302	0.17237499098116302
12	LP-RUS 20 vs .ML-RUS 25	0.05628277947518823	0.8442416921278234	0.2251311179007529	0.2251311179007529	0.17237499098116302
13	ML-RUS 20 vs .ML-RUS 25	0.26651858504486337	3.9977787756729506	0.7995557551345901	0.7995557551345901	0.7995557551345901
14	LP-RUS 10 vs .ML-RUS 25	0.3771312102464177	5.656968153696255	0.7995557551345901	0.7995557551345901	0.7995557551345901
15	LP-RUS 10 vs .ML-RUS 20	0.8197075378297859	12.295613067446789	0.8197075378297859	0.8197075378297859	0.8197075378297859

B. MicroFMeasure

TABLE XIV
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
LP-RUS 10	2.795454545454546
LP-RUS 20	3.522727272727272
LP-RUS 25	4.4318181818181825
ML-RUS 10	2.1931818181818175
ML-RUS 20	2.715909090909091
ML-RUS 25	5.340909090909091

Friedman statistic considering reduction performance (distributed according to chi-square with 5 degrees of freedom: 88.96428571428572. P-value computed by Friedman Test: 4.781486317995132E-11.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 5 and 215 degrees of freedom: 29.194058326519492. P-value computed by Iman and Daveport Test: 4.440893539933952E-16.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.01. Holm's procedure rejects those hypotheses

TABLE XV
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	ML-RUS 25	7.89176991982993	2.9793061994898604E-15	0.01
4	LP-RUS 25	5.612558390637173	1.9935690632468965E-8	0.0125
3	LP-RUS 20	3.33334686144441	8.580789390913538E-4	0.016666666666666666
2	LP-RUS 10	1.5099776380902057	0.13104913027103327	0.025
1	ML-RUS 20	1.310546629285838	0.19001098064722505	0.05

that have a p-value ≤ 0.025. Hochberg's procedure rejects those hypotheses that have a p-value $\leq 0.016666666666666666$. Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.025. Bonferroni-Dunn's procedure rejects those hypot-

TABLE XVI
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	ML-RUS 25	7.89176991982993	2.9793061994898604E-15	0.02
4	LP-RUS 25	5.612558390637173	1.9935690632468965E-8	0.025
3	LP-RUS 20	3.33334686144441	8.580789390913538E-4	0.03333333333333333
2	LP-RUS 10	1.5099776380902057	0.13104913027103327	0.05
1	ML-RUS 20	1.310546629285838	0.19001098064722505	0.1

heses that have a p-value ≤ 0.02. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.05. Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.025. Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Holm's

TABLE XVII
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	ML-RUS 25	2.9793061994898604E-15	1.4896530997449302E-14	1.4896530997449302E-14	1.4896530997449302E-14	1.4896530997449302E-14
2	LP-RUS 25	1.9935690632468965E-8	9.96784531623448 3E-8	7.974276252987586E-8	7.974276252987586E-8	7.974276252987586E-8
3	LP-RUS 20	8.580789390913538E-4	0.00429039469545676 9	0.0025742368172740615	0.0025742368172740615	0.0025742368172740615
4	LP-RUS 10	0.13104913027103327	0.6552456513551663	0.26209826054206653	0.19001098064722505	0.19001098064722505
5	ML-RUS 20	0.19001098064722505	0.9500549032361252	0.26209826054206653	0.19001098064722505	0.19001098064722505

procedure rejects those hypotheses that have a p-value $\leq 0.0071428571428571435$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Bergmann's procedure rejects these hypotheses:

- LP-RUS 10 vs. LP-RUS 25
- LP-RUS 10 vs. ML-RUS 25
- LP-RUS 20 vs. ML-RUS 10
- LP-RUS 20 vs. ML-RUS 25
- LP-RUS 25 vs. ML-RUS 10
- LP-RUS 25 vs. ML-RUS 20
- ML-RUS 10 vs. ML-RUS 25
- ML-RUS 20 vs. ML-RUS 25

TABLE XVIII
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	ML-RUS 10 vs. ML-RUS 25	7.89176991982993	2.9793061994898604E-15	0.0033333333333333335	0.0033333333333333335
14	ML-RUS 20 vs. ML-RUS 25	6.5812232905440915	4.6659322795924585E-11	0.0035714285714285718	0.005
13	LP-RUS 10 vs. ML-RUS 25	6.381792281739724	1.7502727197604988E-10	0.0038461538461538464	0.005
12	LP-RUS 25 vs. ML-RUS 10	5.612558390637173	1.9935690632468965E-8	0.004166666666666667	0.005
11	LP-RUS 20 vs. ML-RUS 25	4.55842305838552	5.1539139122596355E-6	0.004545454545454546	0.005
10	LP-RUS 25 vs. ML-RUS 20	4.302011761351335	1.6925432501187203E-5	0.005	0.005
9	LP-RUS 10 vs. LP-RUS 25	4.1025807525469675	4.0856718742536194E-5	0.005555555555555556	0.0071428571428571435
8	LP-RUS 20 vs. ML-RUS 10	3.33334686144441	8.58078939091353 8E-4	0.00625	0.0071428571428571435
7	LP-RUS 20 vs. LP-RUS 25	2.2792115291927626	0.02265449408008913	0.0071428571428571435	0.0071428571428571435
6	LP-RUS 25 vs. ML-RUS 25	2.2792115291927573	0.022654494080089453	0.008333333333333333	0.008333333333333333
5	LP-RUS 20 vs. ML-RUS 20	2.022800232158572	0.04309374774529043	0.01	0.01
4	LP-RUS 10 vs. LP-RUS 20	1.8233692233542045	0.06824748837800171	0.0125	0.0125
3	LP-RUS 10 vs. ML-RUS 10	1.5099776380902057	0.13104913027103327	0.016666666666666666	0.016666666666666666
2	ML-RUS 10 vs. ML-RUS 20	1.310546629285838	0.19001098064722505	0.025	0.025
1	LP-RUS 10 vs. ML-RUS 20	0.19943100880436765	0.8419256061188086	0.05	0.05

TABLE XIX
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	ML-RUS 10 vs. ML-RUS 25	7.89176991982993	2.9793061994898604E-15	0.006666666666666667	0.006666666666666667
14	ML-RUS 20 vs. ML-RUS 25	6.5812232905440915	4.6659322795924585E-11	0.0071428571428571435	0.01
13	LP-RUS 10 vs. ML-RUS 25	6.381792281739724	1.7502727197604988E-10	0.007692307692307693	0.01
12	LP-RUS 25 vs. ML-RUS 10	5.612558390637173	1.9935690632468965E-8	0.008333333333333333	0.01
11	LP-RUS 20 vs. ML-RUS 25	4.55842305838552	5.1539139122596355E-6	0.009090909090909092	0.01
10	LP-RUS 25 vs. ML-RUS 20	4.302011761351335	1.6925432501187203E-5	0.01	0.01
9	LP-RUS 10 vs. LP-RUS 25	4.1025807525469675	4.0856718742536194E-5	0.011111111111111112	0.014285714285714287
8	LP-RUS 20 vs. ML-RUS 10	3.33334686144441	8.58078939091353 8E-4	0.0125	0.014285714285714287
7	LP-RUS 20 vs. LP-RUS 25	2.2792115291927626	0.02265449408008913	0.014285714285714287	0.014285714285714287
6	LP-RUS 25 vs. ML-RUS 25	2.2792115291927573	0.022654494080089453	0.016666666666666666	0.016666666666666666
5	LP-RUS 20 vs. ML-RUS 20	2.022800232158572	0.04309374774529043	0.02	0.02
4	LP-RUS 10 vs. LP-RUS 20	1.8233692233542045	0.06824748837800171	0.025	0.025
3	LP-RUS 10 vs. ML-RUS 10	1.5099776380902057	0.13104913027103327	0.03333333333333333	0.03333333333333333
2	ML-RUS 10 vs. ML-RUS 20	1.310546629285838	0.19001098064722505	0.05	0.05
1	LP-RUS 10 vs. ML-RUS 20	0.19943100880436765	0.8419256061188086	0.1	0.1

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. Holm's procedure rejects those hypotheses that have a p-value $\leq 0.014285714285714287$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. Bergmann's procedure rejects these hypotheses:

- LP-RUS 10 vs. LP-RUS 25
- LP-RUS 10 vs. ML-RUS 25
- LP-RUS 20 vs. LP-RUS 25
- LP-RUS 20 vs. ML-RUS 10
- LP-RUS 20 vs. ML-RUS 25
- LP-RUS 25 vs. ML-RUS 10
- LP-RUS 25 vs. ML-RUS 20
- LP-RUS 25 vs. ML-RUS 25
- ML-RUS 10 vs. ML-RUS 25
- ML-RUS 20 vs. ML-RUS 25

TABLE XX
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	ML-RUS 10 vs .ML-RUS 25	2.9793061994898604E-15	4.4689592992347905E-14	4.4689592992347905E-14	4.4689592992347905E-14	4.4689592992347905E-14
2	ML-RUS 20 vs .ML-RUS 25	4.6659322795924585E-11	6.998898419388688E-10	6.532305191429442E-10	4.665932279592458E-10	4.665932279592458E-10
3	LP-RUS 10 vs .ML-RUS 25	1.7502727197604988E-10	2.6254090796407484E-9	2.2753545356886486E-9	1.7502727197604989E-9	1.2251909038323491E-9
4	LP-RUS 25 vs .ML-RUS 10	1.9935690632468965E-8	2.990353594870345E-7	2.3922828758962756E-7	1.9935690632468965E-7	1.9935690632468965E-7
5	LP-RUS 20 vs .ML-RUS 25	5.1539139122596355E-6	7.730870868389453E-5	5.669305303485599E-5	5.153913912259635E-5	3.0923483473557815E-5
6	LP-RUS 25 vs .ML-RUS 20	1.6925432501187203E-5	2.5388148751780804E-4	1.6925432501187202E-4	1.6925432501187202E-4	1.0155259500712322E-4
7	LP-RUS 10 vs .LP-RUS 25	4.0856718742536194E-5	6.128507811380429E-4	3.6771046868282577E-4	2.8599703119775333E-4	1.6342687497014478E-4
8	LP-RUS 20 vs .ML-RUS 10	8.580789390913538E-4	0.012871184086370308	0.00686463151273083	0.006006552573639476	0.006006552573639476
9	LP-RUS 20 vs .LP-RUS 25	0.02265449408008913	0.33981741120133696	0.15858145856062392	0.15858145856062392	0.09061797632035652
10	LP-RUS 25 vs .ML-RUS 25	0.022654494080089453	0.3398174112013418	0.15858145856062392	0.15858145856062392	0.09061797632035781
11	LP-RUS 20 vs .ML-RUS 20	0.04309374774529043	0.6464062161793565	0.21546873872645214	0.1723749909811617	0.12928124323587128
12	LP-RUS 10 vs .LP-RUS 20	0.06824748837800171	1.0237123256700256	0.27298995351200683	0.27298995351200683	0.13649497675600342
13	LP-RUS 10 vs .ML-RUS 10	0.13104913027103327	1.965736954065499	0.3931473908130998	0.3931473908130998	0.3931473908130998
14	ML-RUS 10 vs .ML-RUS 20	0.19001098064722505	2.8501647097083755	0.3931473908130998	0.3931473908130998	0.3931473908130998
15	LP-RUS 10 vs .ML-RUS 20	0.8419256061188086	12.62888409178213	0.8419256061188086	0.8419256061188086	0.8419256061188086

C. MacroFMeasure

TABLE XXI
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
LP-RUS 10	2.5227272727272734
LP-RUS 20	3.4431818181818192
LP-RUS 25	3.840909090909092
ML-RUS 10	3.0340909090909087
ML-RUS 20	3.988636363636364
ML-RUS 25	4.170454545454544

Friedman statistic considering reduction performance (distributed according to chi-square with 5 degrees of freedom: 24.889610389610553. P-value computed by Friedman Test: 1.4634083724607283E-4.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 5 and 215 degrees of freedom: 5.485372915765341. P-value computed by Iman and Daveport Test: 8.958948206145573E-5.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.01. Holm's procedure rejects those hypotheses

TABLE XXII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	ML-RUS 25	4.131070896661871	3.610771910630678E-5	0.01
4	ML-RUS 20	3.6752285908233238	2.3763654819384635E-4	0.0125
3	LP-RUS 25	3.304856717329502	9.502496592265863E-4	0.016666666666666666
2	LP-RUS 20	2.3077016733076694	0.021015734953282218	0.025
1	ML-RUS 10	1.2820564851709244	0.19982283223025932	0.05

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. Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value

TABLE XXIII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	ML-RUS 25	4.131070896661871	3.610771910630678E-5	0.02
4	ML-RUS 20	3.6752285908233238	2.3763654819384635E-4	0.025
3	LP-RUS 25	3.304856717329502	9.502496592265863E-4	0.03333333333333333
2	LP-RUS 20	2.3077016733076694	0.021015734953282218	0.05
1	ML-RUS 10	1.2820564851709244	0.19982283223025932	0.1

≤ 0.02. 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. Nemenyi's procedure rejects

TABLE XXIV
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	ML-RUS 25	3.610771910630678E-5	1.8053859553153392E-4	1.8053859553153392E-4	1.8053859553153392E-4	1.8053859553153392E-4
2	ML-RUS 20	2.3763654819384635E-4	0.0011881827409692318	9.505461927753854E-4	9.505461927753854E-4	9.505461927753854E-4
3	LP-RUS 25	9.502496592265863E-4	0.004751248296132932	0.002850748977679759	0.002850748977679759	0.002850748977679759
4	LP-RUS 20	0.021015734953282218	0.10507867476641108	0.042031469906564436	0.042031469906564436	0.042031469906564436
5	ML-RUS 10	0.19982283223025932	0.9991141611512966	0.19982283223025932	0.19982283223025932	0.19982283223025932

those hypotheses that have a p-value $\leq 0.0033333333333333335$. Holm's procedure rejects those hypotheses that have a p-value $\leq 0.004166666666666667$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Bergmann's procedure rejects these hypotheses:

- LP-RUS 10 vs. LP-RUS 25
- LP-RUS 10 vs. ML-RUS 20
- LP-RUS 10 vs. ML-RUS 25
- ML-RUS 10 vs. ML-RUS 25

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. Holm's procedure rejects those hypotheses that have a p-value $\leq 0.009090909090909092$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. Bergmann's procedure rejects these hypotheses:

- LP-RUS 10 vs. LP-RUS 25

TABLE XXV
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-RUS 10 vs. ML-RUS 25	4.131070896661871	3.610771910630678E-5	0.0033333333333333335	0.0033333333333333335
14	LP-RUS 10 vs. ML-RUS 20	3.6752285908233238	2.3763654819384635E-4	0.0035714285714285718	0.005
13	LP-RUS 10 vs. LP-RUS 25	3.304856717329502	9.502496592265863E-4	0.0038461538461538464	0.005
12	ML-RUS 10 vs. ML-RUS 25	2.849014411490946	0.004385489392093852	0.004166666666666667	0.005
11	ML-RUS 10 vs. ML-RUS 20	2.3931721056523996	0.016703403847161347	0.004545454545454546	0.005
10	LP-RUS 10 vs. LP-RUS 20	2.3077016733076694	0.021015734953282218	0.005	0.005
9	LP-RUS 25 vs. ML-RUS 10	2.022800232158578	0.043093747745289825	0.005555555555555556	0.005555555555555556
8	LP-RUS 20 vs. ML-RUS 25	1.8233692233542012	0.0682474883780022	0.00625	0.00625
7	LP-RUS 20 vs. ML-RUS 20	1.3675269175156541	0.17146020606432777	0.007142857142857143	0.007142857142857143
6	LP-RUS 10 vs. ML-RUS 10	1.2820564851709244	0.19982283223025932	0.008333333333333333	0.008333333333333333
5	LP-RUS 20 vs. ML-RUS 10	1.0256451881367452	0.30505885926167653	0.01	0.01
4	LP-RUS 20 vs. LP-RUS 25	0.9971550440218326	0.3186892584352793	0.0125	0.0125
3	LP-RUS 25 vs. ML-RUS 25	0.8262141793323686	0.4086826061937448	0.016666666666666666	0.016666666666666666
2	ML-RUS 20 vs. ML-RUS 25	0.45584230583854696	0.6485033796529794	0.025	0.025
1	LP-RUS 25 vs. ML-RUS 20	0.3703718734938216	0.7111054277764286	0.05	0.05

TABLE XXVI
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-RUS 10 vs. ML-RUS 25	4.131070896661871	3.610771910630678E-5	0.006666666666666667	0.006666666666666667
14	LP-RUS 10 vs. ML-RUS 20	3.6752285908233238	2.3763654819384635E-4	0.007142857142857143	0.01
13	LP-RUS 10 vs. LP-RUS 25	3.304856717329502	9.502496592265863E-4	0.007692307692307693	0.01
12	ML-RUS 10 vs. ML-RUS 25	2.849014411490946	0.004385489392093852	0.008333333333333333	0.01
11	ML-RUS 10 vs. ML-RUS 20	2.3931721056523996	0.016703403847161347	0.009090909090909092	0.01
10	LP-RUS 10 vs. LP-RUS 20	2.3077016733076694	0.021015734953282218	0.01	0.01
9	LP-RUS 25 vs. ML-RUS 10	2.022800232158578	0.043093747745289825	0.011111111111111112	0.011111111111111112
8	LP-RUS 20 vs. ML-RUS 25	1.8233692233542012	0.0682474883780022	0.0125	0.0125
7	LP-RUS 20 vs. ML-RUS 20	1.3675269175156541	0.17146020606432777	0.014285714285714287	0.014285714285714287
6	LP-RUS 10 vs. ML-RUS 10	1.2820564851709244	0.19982283223025932	0.016666666666666666	0.016666666666666666
5	LP-RUS 20 vs. ML-RUS 10	1.0256451881367452	0.30505885926167653	0.02	0.02
4	LP-RUS 20 vs. LP-RUS 25	0.9971550440218326	0.3186892584352793	0.025	0.025
3	LP-RUS 25 vs. ML-RUS 25	0.8262141793323686	0.4086826061937448	0.03333333333333333	0.03333333333333333
2	ML-RUS 20 vs. ML-RUS 25	0.45584230583854696	0.6485033796529794	0.05	0.05
1	LP-RUS 25 vs. ML-RUS 20	0.3703718734938216	0.7111054277764286	0.1	0.1

- LP-RUS 10 vs. ML-RUS 20
- LP-RUS 10 vs. ML-RUS 25
- ML-RUS 10 vs. ML-RUS 25

TABLE XXVII
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	LP-RUS 10 vs .ML-RUS 25	3.610771910630678E-5	5.416157865946017E-4	5.416157865946017E-4	5.416157865946017E-4	5.416157865946017E-4
2	LP-RUS 10 vs .ML-RUS 20	2.3763654819384635E-4	0.003564548222907695	0.003326911674713849	0.0023763654819384636	0.0023763654819384636
3	LP-RUS 10 vs .LP-RUS 25	9.502496592265863E-4	0.014253744888398794	0.012353245569945622	0.009502496592265864	0.006651747614586104
4	ML-RUS 10 vs .ML-RUS 25	0.004385489392093852	0.06578234088140779	0.052625872705126225	0.043854893920938526	0.043854893920938526
5	ML-RUS 10 vs .ML-RUS 20	0.016703403847161347	0.2505510577074202	0.1837374423187748	0.16703403847161347	0.10022042308296808
6	LP-RUS 10 vs .LP-RUS 20	0.021015734953282218	0.31523602429923325	0.2101573495328221 7	0.21015734953282217	0.12609440971969332
7	LP-RUS 25 vs .ML-RUS 10	0.043093747745289825	0.6464062161793473	0.38784372970760844	0.30165623421702875	0.1723749909811593
8	LP-RUS 20 vs .ML-RUS 25	0.0682474883780022	1.023712325670033	0.5459799070240176	0.47773241864601534	0.47773241864601534
9	LP-RUS 20 vs .ML-RUS 20	0.17146020606432777	2.5719030909649163	1.2002214424502944	1.2002214424502944	0.6858408242573111
10	LP-RUS 10 vs .ML-RUS 10	0.19982283223025932	2.99734248345389	1.2002214424502944	1.2002214424502944	0.7992913289210373
11	LP-RUS 20 vs .ML-RUS 10	0.30505885926167653	4.575882888925148	1.5252942963083826	1.2202354370467061	1.2202354370467061
12	LP-RUS 20 vs .LP-RUS 25	0.3186892584352793	4.780338876529189	1.5252942963083826	1.2747570337411172	1.2202354370467061
13	LP-RUS 25 vs .ML-RUS 25	0.4086826061937448	6.130239092906172	1.5252942963083826	1.2747570337411172	1.2260478185812345
14	ML-RUS 20 vs .ML-RUS 25	0.6485033796529794	9.727550694794692	1.5252942963083826	1.2970067593059589	1.2260478185812345
15	LP-RUS 25 vs .ML-RUS 20	0.7111054277764286	10.666581416646428	1.5252942963083826	1.2970067593059589	1.2260478185812345

III. Oversampling methods comparison

A. All methods comparison

	Algorithm	Dataset	LP-ROS 10	LP-ROS 20	LP-ROS 25	ML-ROS 10	ML-ROS 20	ML-ROS 25
2	CLR	bibtex	0.1670	0.1688	0.1724	0.2364	0.2367	**0.2388**
3	HOMER	bibtex	0.1515	0.1542	0.1504	**0.2677**	0.2614	0.2548
4	IBLR-ML	bibtex	0.1007	0.1014	0.1038	0.1768	0.1767	**0.1783**
6	RAkEL-BR	bibtex	0.2072	0.2064	0.2066	**0.2925**	0.2882	0.2888
8	CLR	CAL500	**0.2150**	0.2147	0.2110	0.2038	0.2138	0.2140
9	HOMER	CAL500	0.2040	0.2062	0.2030	**0.2210**	0.2116	0.2128
10	IBLR-ML	CAL500	0.1940	0.1896	0.1896	0.1900	**0.1941**	0.1940
12	RAkEL-BR	CAL500	0.2060	0.2036	0.2047	**0.2121**	0.2102	0.2109
14	CLR	Corel16k001	0.0555	0.0576	**0.0584**	0.0480	0.0508	0.0500
15	HOMER	Corel16k001	0.0764	0.0759	0.0760	**0.1107**	0.1039	0.1026
16	IBLR-ML	Corel16k001	0.0454	0.0472	**0.0475**	0.0292	0.0324	0.0344
18	RAkEL-BR	Corel16k001	0.0590	0.0594	0.0603	**0.0700**	0.0698	0.0690
20	CLR	corel5k	0.0417	0.0426	**0.0444**	0.0390	0.0416	0.0429
21	HOMER	corel5k	0.0696	0.0700	0.0727	**0.0996**	0.0958	0.0946
22	IBLR-ML	corel5k	0.0347	0.0361	**0.0368**	0.0327	0.0340	0.0351
24	RAkEL-BR	corel5k	0.0621	0.0608	0.0608	0.0612	0.0634	**0.0650**
32	CLR	enron	0.3167	0.3160	0.3170	**0.4068**	0.4019	0.4030
33	HOMER	enron	0.2665	0.2653	0.2598	**0.4024**	0.3840	0.3926
34	IBLR-ML	enron	0.2530	0.2457	0.2466	0.3155	**0.3182**	0.3147
36	RAkEL-BR	enron	0.2802	0.2797	0.2783	**0.3890**	0.3838	0.3808
38	CLR	genbase	0.9755	0.9770	0.9764	0.9842	0.9844	**0.9849**
39	HOMER	genbase	0.9776	0.9792	0.9800	0.9834	**0.9849**	0.9820
40	IBLR-ML	genbase	0.9798	0.9809	0.9809	**0.9842**	0.9836	0.9841
42	RAkEL-BR	genbase	0.9820	0.9842	0.9844	0.9864	0.9866	**0.9871**
44	CLR	LLOG-F	0.0272	0.0258	0.0246	**0.0470**	0.0437	0.0443
45	HOMER	LLOG-F	0.0642	0.0672	0.0672	**0.1105**	0.1031	0.0961
46	IBLR-ML	LLOG-F	0.0497	**0.0533**	0.0524	0.0357	0.0367	0.0353
48	RAkEL-BR	LLOG-F	0.0922	0.0950	0.0940	**0.1324**	0.1286	0.1315
50	CLR	mediamill	0.3876	0.3884	0.3881	**0.4559**	0.4558	0.4556
51	HOMER	mediamill	0.2749	0.2770	0.2776	**0.4002**	0.3946	0.3925
52	IBLR-ML	mediamill	0.3205	0.3210	0.3214	**0.4644**	0.4633	0.4624
54	RAkEL-BR	mediamill	0.2808	0.2816	0.2816	**0.4114**	0.4062	0.4046
68	CLR	SLASHDOT-F	0.1993	0.2212	0.2298	0.3260	0.3258	**0.3302**
69	HOMER	SLASHDOT-F	0.2610	0.2713	0.2585	**0.3550**	0.3432	0.3488
70	IBLR-ML	SLASHDOT-F	0.1646	0.1700	**0.1723**	0.1343	0.1384	0.1392
72	RAkEL-BR	SLASHDOT-F	0.2116	0.2370	0.2458	0.3496	0.3518	**0.3578**
74	CLR	tmc2007	0.4845	0.4858	0.4850	0.6148	**0.6164**	0.6152
75	HOMER	tmc2007	0.4020	0.4056	0.4073	0.6012	0.6012	**0.6016**
76	IBLR-ML	tmc2007	0.3481	0.3483	0.3492	**0.5281**	0.5232	0.5232
78	RAkEL-BR	tmc2007	0.4170	0.4180	0.4182	0.6022	**0.6023**	0.6008
80	CLR	yeast	0.3928	0.3894	0.3866	**0.4614**	0.4567	0.4572
81	HOMER	yeast	0.3316	0.3293	0.3290	**0.4053**	0.3979	0.3982
82	IBLR-ML	yeast	0.3910	0.3936	0.3946	**0.5142**	0.5048	0.4998
84	RAkEL-BR	yeast	0.3422	0.3380	0.3394	**0.4101**	0.4022	0.4063

TABLE XXVIII: Accuracy

	Algorithm	Dataset	LP-ROS 10	LP-ROS 20	LP-ROS 25	ML-ROS 10	ML-ROS 20	ML-ROS 25
2	CLR	bibtex	0.6529	0.6514	0.6535	**0.7690**	0.7555	0.7542
3	HOMER	bibtex	0.2084	0.2104	0.2098	**0.3656**	0.3532	0.3520
4	IBLR-ML	bibtex	0.1661	0.1698	0.1728	0.4070	0.4053	**0.4074**
6	RAkEL-BR	bibtex	0.2999	0.2961	0.2946	**0.4756**	0.4567	0.4444
8	CLR	CAL500	0.5526	0.5569	0.5526	**0.5911**	0.5729	0.5669
9	HOMER	CAL500	0.3385	0.3404	0.3358	**0.3512**	0.3451	0.3460
10	IBLR-ML	CAL500	0.2790	0.2737	0.2724	0.2802	0.2822	**0.2828**
12	RAkEL-BR	CAL500	0.3387	0.3356	0.3376	**0.3709**	0.3510	0.3520
14	CLR	Corel16k001	0.3140	0.3209	0.3209	**0.4232**	0.4168	0.4070
15	HOMER	Corel16k001	0.1339	0.1348	0.1337	**0.2128**	0.2032	0.2002
16	IBLR-ML	Corel16k001	0.1156	0.1204	0.1208	**0.2718**	0.2456	0.2366
18	RAkEL-BR	Corel16k001	0.1352	0.1336	0.1335	**0.2998**	0.2602	0.2446
20	CLR	corel5k	0.3489	0.3484	0.3527	**0.4402**	0.4326	0.4290
21	HOMER	corel5k	0.1335	0.1310	0.1334	**0.2040**	0.1966	0.1915
22	IBLR-ML	corel5k	0.0500	0.0523	0.0530	0.0512	0.0570	**0.0604**
24	RAkEL-BR	corel5k	0.1980	0.1861	0.1839	**0.3113**	0.2932	0.2888
32	CLR	enron	0.5929	0.5952	0.5929	**0.6772**	0.6752	0.6762
33	HOMER	enron	0.3840	0.3852	0.3858	**0.5237**	0.5108	0.5074
34	IBLR-ML	enron	0.4513	0.4419	0.4438	0.5934	**0.5975**	0.5914
36	RAkEL-BR	enron	0.4336	0.4297	0.4254	**0.5924**	0.5845	0.5706
38	CLR	genbase	0.9850	0.9840	0.9846	0.9868	**0.9874**	0.9868
39	HOMER	genbase	0.9794	0.9845	0.9869	0.9904	**0.9916**	0.9821
40	IBLR-ML	genbase	0.9814	0.9836	0.9843	0.9863	**0.9868**	0.9862
42	RAkEL-BR	genbase	0.9880	0.9881	0.9887	0.9898	**0.9904**	0.9898
44	CLR	LLOG-F	0.3919	0.4208	0.4098	0.5974	0.5949	**0.6476**
45	HOMER	LLOG-F	0.0955	0.0898	0.0941	**0.1645**	0.1512	0.1520
46	IBLR-ML	LLOG-F	0.0560	0.0604	0.0606	0.0688	**0.0757**	0.0752
48	RAkEL-BR	LLOG-F	0.1220	0.1219	0.1203	**0.2525**	0.2429	0.2493
50	CLR	mediamill	0.6112	0.6141	0.6138	**0.7650**	0.7608	0.7600
51	HOMER	mediamill	0.3611	0.3629	0.3646	**0.5516**	0.5379	0.5354
52	IBLR-ML	mediamill	0.4084	0.4068	0.4064	**0.7386**	0.7176	0.7109
54	RAkEL-BR	mediamill	0.3663	0.3677	0.3681	**0.6024**	0.5863	0.5817
68	CLR	SLASHDOT-F	0.5188	0.5272	0.5272	**0.6537**	0.6448	0.6528
69	HOMER	SLASHDOT-F	0.3381	0.3346	0.3456	0.5554	**0.5934**	0.5775
70	IBLR-ML	SLASHDOT-F	0.2881	0.2911	0.2934	**0.6385**	0.5937	0.5712
72	RAkEL-BR	SLASHDOT-F	0.4196	0.4308	0.4281	**0.6848**	0.6786	0.6786
74	CLR	tmc2007	0.5973	0.6016	0.6032	**0.7530**	0.7515	0.7512
75	HOMER	tmc2007	0.4740	0.4752	0.4774	**0.6941**	0.6912	0.6891
76	IBLR-ML	tmc2007	0.4519	0.4522	0.4529	**0.7135**	0.7049	0.7038
78	RAkEL-BR	tmc2007	0.4917	0.4958	0.4970	**0.7283**	0.7214	0.7192
80	CLR	yeast	0.5389	0.5388	0.5356	**0.6359**	0.6338	0.6332
81	HOMER	yeast	0.4604	0.4604	0.4546	**0.5475**	0.5440	0.5445
82	IBLR-ML	yeast	0.4976	0.5000	0.5015	**0.7039**	0.6843	0.6767
84	RAkEL-BR	yeast	0.4748	0.4715	0.4733	**0.5639**	0.5578	0.5606

TABLE XXIX: MicroFMeasure

	Algorithm	Dataset	LP-ROS 10	LP-ROS 20	LP-ROS 25	ML-ROS 10	ML-ROS 20	ML-ROS 25
2	CLR	bibtex	0.2927	0.2923	0.2974	**0.3386**	0.3358	0.3379
3	HOMER	bibtex	0.2180	0.2212	0.2210	**0.2970**	0.2945	0.2863
4	IBLR-ML	bibtex	0.1533	0.1558	0.1550	**0.2200**	0.2176	0.2184
6	RAkEL-BR	bibtex	0.2754	0.2739	0.2755	**0.3288**	0.3229	0.3236
8	CLR	CAL500	0.3236	0.3238	0.3199	0.3202	**0.3318**	0.3221
9	HOMER	CAL500	0.2888	0.2900	0.2841	**0.3019**	0.2967	0.2958
10	IBLR-ML	CAL500	**0.2756**	0.2705	0.2742	0.2700	0.2750	0.2755
12	RAkEL-BR	CAL500	0.2915	0.2906	0.2924	0.2966	0.2971	**0.2972**
14	CLR	Corel16k001	0.1059	0.1046	0.1075	0.1033	0.1076	**0.1080**
15	HOMER	Corel16k001	0.0861	0.0893	0.0910	**0.1363**	0.1292	0.1273
16	IBLR-ML	Corel16k001	0.0778	0.0805	0.0804	**0.1094**	0.1055	0.1085
18	RAkEL-BR	Corel16k001	0.0835	0.0832	0.0822	**0.1278**	0.1176	0.1192
20	CLR	corel5k	0.1366	0.1374	0.1395	0.1355	0.1384	**0.1431**
21	HOMER	corel5k	0.1418	0.1398	0.1451	**0.1896**	0.1884	0.1877
22	IBLR-ML	corel5k	0.0987	0.1012	0.1008	0.1157	0.1192	**0.1235**
24	RAkEL-BR	corel5k	0.1555	0.1552	0.1521	0.1784	**0.1851**	0.1850
32	CLR	enron	0.3819	0.3760	0.3792	**0.4220**	0.3968	0.4082
33	HOMER	enron	0.2957	0.3117	0.2988	**0.3740**	0.3597	0.3575
34	IBLR-ML	enron	0.3088	0.3046	0.3092	**0.3580**	0.3447	0.3485
36	RAkEL-BR	enron	0.3188	0.3252	0.3177	**0.3930**	0.3856	0.3880
38	CLR	genbase	0.9732	0.9754	0.9755	0.9800	0.9802	**0.9804**
39	HOMER	genbase	0.9746	0.9746	0.9754	0.9814	**0.9877**	0.9778
40	IBLR-ML	genbase	0.9730	0.9737	0.9734	**0.9799**	0.9756	0.9787
42	RAkEL-BR	genbase	0.9834	0.9876	0.9878	0.9890	0.9893	**0.9894**
44	CLR	LLOG-F	0.2241	0.1763	0.1823	**0.2508**	0.2308	0.2418
45	HOMER	LLOG-F	0.2020	0.2040	0.1942	0.2495	**0.2510**	0.2494
46	IBLR-ML	LLOG-F	0.1662	0.1694	0.1730	0.2096	**0.2240**	0.2124
48	RAkEL-BR	LLOG-F	0.2316	0.2318	0.2372	0.2921	0.2744	**0.3018**
50	CLR	mediamill	0.2020	0.2037	0.2073	0.2322	0.2318	**0.2336**
51	HOMER	mediamill	0.1565	0.1572	0.1582	**0.2422**	0.2350	0.2348
52	IBLR-ML	mediamill	0.2086	0.2091	0.2106	0.2800	0.2813	**0.2834**
54	RAkEL-BR	mediamill	0.1705	0.1721	0.1685	**0.2618**	0.2579	0.2556
68	CLR	SLASHDOT-F	0.3410	0.3463	0.3602	0.4061	0.4069	**0.4203**
69	HOMER	SLASHDOT-F	0.3298	0.3272	0.3288	0.3907	**0.3978**	0.3941
70	IBLR-ML	SLASHDOT-F	0.2256	0.2274	0.2284	0.2319	**0.2328**	0.2112
72	RAkEL-BR	SLASHDOT-F	0.3280	0.3407	0.3516	0.4002	0.4024	**0.4137**
74	CLR	tmc2007	0.5731	0.5782	0.5777	0.6332	**0.6440**	0.6430
75	HOMER	tmc2007	0.4673	0.4692	0.4727	0.6068	0.6082	**0.6114**
76	IBLR-ML	tmc2007	0.3880	0.3891	0.3886	0.4740	0.4765	**0.4844**
78	RAkEL-BR	tmc2007	0.4870	0.4895	0.4916	0.6138	**0.6180**	0.6162
80	CLR	yeast	0.4206	0.4260	0.4159	0.4537	0.4464	**0.4590**
81	HOMER	yeast	0.3985	0.3925	0.3963	**0.4314**	0.4134	0.4182
82	IBLR-ML	yeast	0.4433	0.4460	0.4467	0.4566	0.4622	**0.4704**
84	RAkEL-BR	yeast	0.4233	0.4166	0.4150	**0.4528**	0.4512	0.4507

TABLE XXX: MacroFMeasure

B. Ranking tables

	LP-ROS 10	LP-ROS 20	LP-ROS 25	ML-ROS 10	ML-ROS 20	ML-ROS 25
CLR bibtex	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
HOMER bibtex	5.0000	4.0000	6.0000	**1.0000**	2.0000	3.0000
IBLR-ML bibtex	6.0000	5.0000	4.0000	2.0000	3.0000	**1.0000**
RAkEL-BR bibtex	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
CLR CAL500	**1.0000**	2.0000	5.0000	6.0000	4.0000	3.0000
HOMER CAL500	5.0000	4.0000	6.0000	**1.0000**	3.0000	2.0000
IBLR-ML CAL500	2.5000	5.5000	5.5000	4.0000	**1.0000**	2.5000
RAkEL-BR CAL500	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
CLR Corel16k001	3.0000	2.0000	**1.0000**	6.0000	4.0000	5.0000
HOMER Corel16k001	4.0000	6.0000	5.0000	**1.0000**	2.0000	3.0000
IBLR-ML Corel16k001	3.0000	2.0000	**1.0000**	6.0000	5.0000	4.0000
RAkEL-BR Corel16k001	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
CLR corel5k	4.0000	3.0000	**1.0000**	6.0000	5.0000	2.0000
HOMER corel5k	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML corel5k	4.0000	2.0000	**1.0000**	6.0000	5.0000	3.0000
RAkEL-BR corel5k	3.0000	5.5000	5.5000	4.0000	2.0000	**1.0000**
CLR enron	5.0000	6.0000	4.0000	**1.0000**	3.0000	2.0000
HOMER enron	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
IBLR-ML enron	4.0000	6.0000	5.0000	2.0000	**1.0000**	3.0000
RAkEL-BR enron	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
CLR genbase	6.0000	4.0000	5.0000	3.0000	2.0000	**1.0000**
HOMER genbase	6.0000	5.0000	4.0000	2.0000	**1.0000**	3.0000
IBLR-ML genbase	6.0000	4.5000	4.5000	**1.0000**	3.0000	2.0000
RAkEL-BR genbase	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
CLR LLOG-F	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
HOMER LLOG-F	6.0000	4.5000	4.5000	**1.0000**	2.0000	3.0000
IBLR-ML LLOG-F	3.0000	**1.0000**	2.0000	5.0000	4.0000	6.0000
RAkEL-BR LLOG-F	6.0000	4.0000	5.0000	**1.0000**	3.0000	2.0000
CLR mediamill	6.0000	4.0000	5.0000	**1.0000**	2.0000	3.0000
HOMER mediamill	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML mediamill	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
RAkEL-BR mediamill	6.0000	4.5000	4.5000	**1.0000**	2.0000	3.0000
CLR SLASHDOT-F	6.0000	5.0000	4.0000	2.0000	3.0000	**1.0000**
HOMER SLASHDOT-F	5.0000	4.0000	6.0000	**1.0000**	3.0000	2.0000
IBLR-ML SLASHDOT-F	3.0000	2.0000	**1.0000**	6.0000	5.0000	4.0000
RAkEL-BR SLASHDOT-F	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
CLR tmc2007	6.0000	4.0000	5.0000	3.0000	**1.0000**	2.0000
HOMER tmc2007	6.0000	5.0000	4.0000	2.5000	2.5000	**1.0000**
IBLR-ML tmc2007	6.0000	5.0000	4.0000	**1.0000**	2.5000	2.5000
RAkEL-BR tmc2007	6.0000	5.0000	4.0000	2.0000	**1.0000**	3.0000
CLR yeast	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
HOMER yeast	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
IBLR-ML yeast	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
RAkEL-BR yeast	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
Mean Rank	4.8295	4.4886	4.3068	**2.2841**	2.6364	2.4545

TABLE XXXI: Ranking by Accuracy

	LP-ROS 10	LP-ROS 20	LP-ROS 25	ML-ROS 10	ML-ROS 20	ML-ROS 25
CLR bibtex	5.0000	6.0000	4.0000	**1.0000**	2.0000	3.0000
HOMER bibtex	6.0000	4.0000	5.0000	**1.0000**	2.0000	3.0000
IBLR-ML bibtex	6.0000	5.0000	4.0000	2.0000	3.0000	**1.0000**
RAkEL-BR bibtex	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
CLR CAL500	5.5000	4.0000	5.5000	**1.0000**	2.0000	3.0000
HOMER CAL500	5.0000	4.0000	6.0000	**1.0000**	3.0000	2.0000
IBLR-ML CAL500	4.0000	5.0000	6.0000	3.0000	2.0000	**1.0000**
RAkEL-BR CAL500	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
CLR Corel16k001	6.0000	4.5000	4.5000	**1.0000**	2.0000	3.0000
HOMER Corel16k001	5.0000	4.0000	6.0000	**1.0000**	2.0000	3.0000
IBLR-ML Corel16k001	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
RAkEL-BR Corel16k001	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
CLR corel5k	5.0000	6.0000	4.0000	**1.0000**	2.0000	3.0000
HOMER corel5k	4.0000	6.0000	5.0000	**1.0000**	2.0000	3.0000
IBLR-ML corel5k	6.0000	4.0000	3.0000	5.0000	2.0000	**1.0000**
RAkEL-BR corel5k	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
CLR enron	5.5000	4.0000	5.5000	**1.0000**	3.0000	2.0000
HOMER enron	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML enron	4.0000	6.0000	5.0000	2.0000	**1.0000**	3.0000
RAkEL-BR enron	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
CLR genbase	4.0000	6.0000	5.0000	2.5000	**1.0000**	2.5000
HOMER genbase	6.0000	4.0000	3.0000	2.0000	**1.0000**	5.0000
IBLR-ML genbase	6.0000	5.0000	4.0000	2.0000	**1.0000**	3.0000
RAkEL-BR genbase	6.0000	5.0000	4.0000	2.5000	**1.0000**	2.5000
CLR LLOG-F	6.0000	4.0000	5.0000	2.0000	3.0000	**1.0000**
HOMER LLOG-F	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
IBLR-ML LLOG-F	6.0000	5.0000	4.0000	3.0000	**1.0000**	2.0000
RAkEL-BR LLOG-F	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
CLR mediamill	6.0000	4.0000	5.0000	**1.0000**	2.0000	3.0000
HOMER mediamill	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML mediamill	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
RAkEL-BR mediamill	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
CLR SLASHDOT-F	6.0000	4.5000	4.5000	**1.0000**	3.0000	2.0000
HOMER SLASHDOT-F	5.0000	6.0000	4.0000	3.0000	**1.0000**	2.0000
IBLR-ML SLASHDOT-F	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
RAkEL-BR SLASHDOT-F	6.0000	4.0000	5.0000	**1.0000**	2.5000	2.5000
CLR tmc2007	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
HOMER tmc2007	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML tmc2007	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
RAkEL-BR tmc2007	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
CLR yeast	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
HOMER yeast	4.5000	4.5000	6.0000	**1.0000**	3.0000	2.0000
IBLR-ML yeast	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
RAkEL-BR yeast	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
Mean Rank	5.1932	4.9432	4.7727	**1.4091**	2.0795	2.6023

TABLE XXXII: Ranking by MicroFMeasure

	LP-ROS 10	LP-ROS 20	LP-ROS 25	ML-ROS 10	ML-ROS 20	ML-ROS 25
CLR bibtex	5.0000	6.0000	4.0000	**1.0000**	3.0000	2.0000
HOMER bibtex	6.0000	4.0000	5.0000	**1.0000**	2.0000	3.0000
IBLR-ML bibtex	6.0000	4.0000	5.0000	**1.0000**	3.0000	2.0000
RAkEL-BR bibtex	5.0000	6.0000	4.0000	**1.0000**	3.0000	2.0000
CLR CAL500	3.0000	2.0000	6.0000	5.0000	**1.0000**	4.0000
HOMER CAL500	5.0000	4.0000	6.0000	**1.0000**	2.0000	3.0000
IBLR-ML CAL500	**1.0000**	5.0000	4.0000	6.0000	3.0000	2.0000
RAkEL-BR CAL500	5.0000	6.0000	4.0000	3.0000	2.0000	**1.0000**
CLR Corel16k001	4.0000	5.0000	3.0000	6.0000	2.0000	**1.0000**
HOMER Corel16k001	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML Corel16k001	6.0000	4.0000	5.0000	**1.0000**	3.0000	2.0000
RAkEL-BR Corel16k001	4.0000	5.0000	6.0000	**1.0000**	3.0000	2.0000
CLR corel5k	5.0000	4.0000	2.0000	6.0000	3.0000	**1.0000**
HOMER corel5k	5.0000	6.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML corel5k	6.0000	4.0000	5.0000	3.0000	2.0000	**1.0000**
RAkEL-BR corel5k	4.0000	5.0000	6.0000	3.0000	**1.0000**	2.0000
CLR enron	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
HOMER enron	6.0000	4.0000	5.0000	**1.0000**	2.0000	3.0000
IBLR-ML enron	5.0000	6.0000	4.0000	**1.0000**	3.0000	2.0000
RAkEL-BR enron	5.0000	4.0000	6.0000	**1.0000**	3.0000	2.0000
CLR genbase	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
HOMER genbase	5.5000	5.5000	4.0000	2.0000	**1.0000**	3.0000
IBLR-ML genbase	6.0000	4.0000	5.0000	**1.0000**	3.0000	2.0000
RAkEL-BR genbase	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
CLR LLOG-F	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
HOMER LLOG-F	5.0000	4.0000	6.0000	2.0000	**1.0000**	3.0000
IBLR-ML LLOG-F	6.0000	5.0000	4.0000	3.0000	**1.0000**	2.0000
RAkEL-BR LLOG-F	6.0000	5.0000	4.0000	2.0000	3.0000	**1.0000**
CLR mediamill	6.0000	5.0000	4.0000	2.0000	3.0000	**1.0000**
HOMER mediamill	6.0000	5.0000	4.0000	**1.0000**	2.0000	3.0000
IBLR-ML mediamill	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
RAkEL-BR mediamill	5.0000	4.0000	6.0000	**1.0000**	2.0000	3.0000
CLR SLASHDOT-F	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
HOMER SLASHDOT-F	4.0000	6.0000	5.0000	3.0000	**1.0000**	2.0000
IBLR-ML SLASHDOT-F	5.0000	4.0000	3.0000	2.0000	**1.0000**	6.0000
RAkEL-BR SLASHDOT-F	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
CLR tmc2007	6.0000	4.0000	5.0000	3.0000	**1.0000**	2.0000
HOMER tmc2007	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
IBLR-ML tmc2007	6.0000	4.0000	5.0000	3.0000	2.0000	**1.0000**
RAkEL-BR tmc2007	6.0000	5.0000	4.0000	3.0000	**1.0000**	2.0000
CLR yeast	5.0000	4.0000	6.0000	2.0000	3.0000	**1.0000**
HOMER yeast	4.0000	6.0000	5.0000	**1.0000**	3.0000	2.0000
IBLR-ML yeast	6.0000	5.0000	4.0000	3.0000	2.0000	**1.0000**
RAkEL-BR yeast	4.0000	5.0000	6.0000	**1.0000**	2.0000	3.0000
Mean Rank	5.1705	4.8068	4.5909	2.2500	2.1591	**2.0227**

TABLE XXXIII: Ranking by MacroFMeasure

IV. Oversampling statistical tests

A. Accuracy

TABLE XXXIV
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
LP-ROS 10	4.829545454545454
LP-ROS 20	4.488636363636363
LP-ROS 25	4.30681818181818
ML-ROS 10	2.284090909090909
ML-ROS 20	2.636363636363636
ML-ROS 25	2.454545454545454

Friedman statistic considering reduction performance (distributed according to chi-square with 5 degrees of freedom: 84.39610389610348. P-value computed by Friedman Test: 7.533762502731634E-11.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 5 and 215 degrees of freedom: 26.76200737441917. P-value computed by Iman and Daveport Test: -2.2203929483527293E-16.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.01. Holm's procedure rejects those hypotheses

TABLE XXXV
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-ROS 10	6.381792281739724	1.7502727197604988E-10	0.01
4	LP-ROS 20	5.52708795829244	3.255897478592335E-8	0.0125
3	LP-ROS 25	5.071245652453884	3.9522021999433183E-7	0.016666666666666666
2	ML-ROS 20	0.8831944675621926	0.37713121024641594	0.025
1	ML-ROS 25	0.4273521617236411	0.6691228454457296	0.05

that have a p-value ≤ 0.025. Hochberg's procedure rejects those hypotheses that have a p-value $\leq 0.016666666666666666$. Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.025. Bonferroni-Dunn's procedure rejects those hypot-

TABLE XXXVI
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-ROS 10	6.381792281739724	1.7502727197604988E-10	0.02
4	LP-ROS 20	5.52708795829244	3.255897478592335E-8	0.025
3	LP-ROS 25	5.071245652453884	3.9522021999433183E-7	0.03333333333333333
2	ML-ROS 20	0.8831944675621926	0.37713121024641594	0.05
1	ML-ROS 25	0.4273521617236411	0.6691228454457296	0.1

heses that have a p-value ≤ 0.02. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.05. Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.025. Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Holm's

TABLE XXXVII
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	LP-ROS 10	1.7502727197604988E-10	8.751363598802494E-10	8.751363598802494E-10	8.751363598802494E-10	8.751363598802494E-10
2	LP-ROS 20	3.255897478592335E-8	1.6279487392961674E-7	1.302358991436934E-7	1.302358991436934E-7	1.302358991436934E-7
3	LP-ROS 25	3.9522021999433183E-7	1.9761010999716593E-6	1.1856606599829956E-6	1.1856606599829956E-6	1.1856606599829956E-6
4	ML-ROS 20	0.37713121024641594	1.8856560512320797	0.7542624204928319	0.6691228454457296	0.6691228454457296
5	ML-ROS 25	0.6691228454457296	3.345614227228648	0.7542624204928319	0.6691228454457296	0.6691228454457296

procedure rejects those hypotheses that have a p-value $\leq 0.008333333333333333$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Bergmann's procedure rejects these hypotheses:

- LP-ROS 10 vs. ML-ROS 10
- LP-ROS 10 vs. ML-ROS 20
- LP-ROS 10 vs. ML-ROS 25
- LP-ROS 20 vs. ML-ROS 10
- LP-ROS 20 vs. ML-ROS 20
- LP-ROS 20 vs. ML-ROS 25
- LP-ROS 25 vs. ML-ROS 10

TABLE XXXVIII
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-ROS 10 vs. ML-ROS 10	6.381792281739724	1.7502727197604988E-10	0.0033333333333333335	0.0033333333333333335
14	LP-ROS 10 vs. ML-ROS 25	5.954440120016083	2.6096365291043563E-9	0.0035714285714285718	0.005
13	LP-ROS 20 vs. ML-ROS 10	5.52708795829244	3.255897478592335E-8	0.0038461538461538464	0.005
12	LP-ROS 10 vs. ML-ROS 20	5.498597814177532	3.8282316543936355E-8	0.004166666666666667	0.005
11	LP-ROS 20 vs. ML-ROS 25	5.099735796568798	3.401279106365518E-7	0.004545454545454546	0.005
10	LP-ROS 25 vs. ML-ROS 10	5.071245652453884	3.9522021999433183E-7	0.005	0.005
9	LP-ROS 20 vs. ML-ROS 20	4.643893490730247	3.4190387037433147E-6	0.005555555555555556	0.0071428571428571435
8	LP-ROS 25 vs. ML-ROS 25	4.6438934907302425	3.419038703743385E-6	0.00625	0.0071428571428571435
7	LP-ROS 25 vs. ML-ROS 20	4.188051184891691	2.8136006928253306E-5	0.0071428571428571435	0.0071428571428571435
6	LP-ROS 10 vs. LP-ROS 25	1.3105466292858403	0.19001098064722427	0.008333333333333333	0.008333333333333333
5	ML-ROS 10 vs. ML-ROS 20	0.8831944675621926	0.37713121024641594	0.01	0.01
4	LP-ROS 10 vs. LP-ROS 20	0.8547043234472844	0.3927148564552703	0.0125	0.0125
3	LP-ROS 20 vs. LP-ROS 25	0.4558423058385559	0.648503379652973	0.016666666666666666	0.016666666666666666
2	ML-ROS 20 vs. ML-ROS 25	0.4558423058385514	0.6485033796529763	0.025	0.025
1	ML-ROS 10 vs. ML-ROS 25	0.4273521617236411	0.6691228454457296	0.05	0.05

- LP-ROS 25 vs. ML-ROS 20
- LP-ROS 25 vs. ML-ROS 25

TABLE XXXIX
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-ROS 10 vs. ML-ROS 10	6.381792281739724	1.7502727197604988E-10	0.006666666666666667	0.006666666666666667
14	LP-ROS 10 vs. ML-ROS 25	5.954440120016083	2.6096365291043563E-9	0.007142857142857143	0.01
13	LP-ROS 20 vs. ML-ROS 10	5.52708795829244	3.255897478592335E-8	0.007692307692307693	0.01
12	LP-ROS 10 vs. ML-ROS 20	5.498597814177532	3.8282316543936355E-8	0.008333333333333333	0.01
11	LP-ROS 20 vs. ML-ROS 25	5.099735796568798	3.401279106365518E-7	0.009090909090909092	0.01
10	LP-ROS 25 vs. ML-ROS 10	5.071245652453884	3.9522021999433183E-7	0.01	0.01
9	LP-ROS 20 vs. ML-ROS 20	4.643893490730247	3.4190387037433147E-6	0.011111111111111112	0.014285714285714287
8	LP-ROS 25 vs. ML-ROS 25	4.6438934907302425	3.419038703743385E-6	0.0125	0.014285714285714287
7	LP-ROS 25 vs. ML-ROS 20	4.188051184891691	2.8136006928253306E-5	0.014285714285714287	0.014285714285714287
6	LP-ROS 10 vs. LP-ROS 25	1.3105466292858403	0.19001098064722427	0.016666666666666666	0.016666666666666666
5	ML-ROS 10 vs. ML-ROS 20	0.8831944675621926	0.37713121024641594	0.02	0.02
4	LP-ROS 10 vs. LP-ROS 20	0.8547043234472844	0.3927148564552703	0.025	0.025
3	LP-ROS 20 vs. LP-ROS 25	0.4558423058385559	0.648503379652973	0.03333333333333333	0.03333333333333333
2	ML-ROS 20 vs. ML-ROS 25	0.4558423058385514	0.6485033796529763	0.05	0.05
1	ML-ROS 10 vs. ML-ROS 25	0.4273521617236411	0.6691228454457296	0.1	0.1

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. 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 $\leq 0.006666666666666667$. Bergmann's procedure rejects these hypotheses:

- LP-ROS 10 vs. ML-ROS 10
- LP-ROS 10 vs. ML-ROS 20
- LP-ROS 10 vs. ML-ROS 25
- LP-ROS 20 vs. ML-ROS 10
- LP-ROS 20 vs. ML-ROS 20
- LP-ROS 20 vs. ML-ROS 25
- LP-ROS 25 vs. ML-ROS 10
- LP-ROS 25 vs. ML-ROS 20
- LP-ROS 25 vs. ML-ROS 25

TABLE XL
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	LP-ROS 10 vs .ML-ROS 10	1.7502727197604988E-10	2.6254090796407484E-9	2.6254090796407484E-9	2.6254090796407484E-9	2.6254090796407484E-9
2	LP-ROS 10 vs .ML-ROS 25	2.6096365291043563E-9	3.9144547936565344E-8	3.653491140746099E-8	2.6096365291043563E-8	2.6096365291043563E-8
3	LP-ROS 20 vs .ML-ROS 10	3.255897478592335E-8	4.883846217888502E-7	4.2326667221700354E-7	3.255897478592335E-7	3.255897478592335E-7
4	LP-ROS 10 vs .ML-ROS 20	3.8282316543936355E-8	5.742347481590454E-7	4.593877985272363E-7	3.8282316543936354E-7	3.255897478592335E-7
5	LP-ROS 20 vs .ML-ROS 25	3.401279106365518E-7	5.101918659548276E-6	3.7414070170020695E-6	3.401279106365178E-6	2.0407674638193107E-6
6	LP-ROS 25 vs .ML-ROS 10	3.9522021999433183E-7	5.928303299914977 5E-6	3.952202199943319E-6	3.952202199943319E-6	2.766541539960323E-6
7	LP-ROS 20 vs .ML-ROS 20	3.4190387037433147E-6	5.128558055614972E-5	3.0771348333689835E-5	2.9333270926203204E-5	1.3676154814973259E-5
8	LP-ROS 25 vs .ML-ROS 25	3.419038703743385E-6	5.128558055614972E-5	3.0771348333689835E-5	2.9333270926203695E-5	1.367615481497354E-5
9	LP-ROS 25 vs .ML-ROS 20	2.8136006928253306E-5	4.2204010392379957E-4	1.9695204849777315E-4	1.9695204849777315E-4	8.440802078475992E-5
10	LP-ROS 10 vs .LP-ROS 25	0.19001098064722427	2.850164709708364	1.1400658838833455	1.1400658838833455	1.1400658838833455
11	ML-ROS 10 vs .ML-ROS 20	0.37713121024641594	5.656968153696239	1.8856560512320797	1.5085248409856638	1.5085248409856638
12	LP-ROS 10 vs .LP-ROS 20	0.3927148564552703	5.890722846829055	1.8856560512320797	1.5708594258210813	1.5085248409856638
13	LP-ROS 20 vs .LP-ROS 25	0.648503379652973	9.727550694794594	1.945510138958919	1.945510138958919	1.5085248409856638
14	ML-ROS 20 vs .ML-ROS 25	0.6485033796529763	9.727550694794646	1.945510138958919	1.945510138958919	1.5085248409856638
15	ML-ROS 10 vs .ML-ROS 25	0.6691228454457296	10.036842681685945	1.945510138958919	1.945510138958919	1.5085248409856638

B. MicroFMeasure

TABLE XLI
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
LP-ROS 10	5.193181818181818
LP-ROS 20	4.943181818181817
LP-ROS 25	4.772727272727272
ML-ROS 10	1.4090909090909083
ML-ROS 20	2.0795454545454537
ML-ROS 25	2.602272727272727

Friedman statistic considering reduction performance (distributed according to chi-square with 5 degrees of freedom: 173.04545454545422. P-value computed by Friedman Test: 9.595213512625378E-11.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 5 and 215 degrees of freedom: 158.47144240077304. P-value computed by Iman and Daveport Test: 4.68924481106325E-70.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.01. Holm's procedure rejects those hypotheses

TABLE XLII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-ROS 10	9.487217990264861	2.3728227274666712E-21	0.01
4	LP-ROS 20	8.860434819736849	7.970295090031392E-19	0.0125
3	LP-ROS 25	8.433082658013207	3.366767205572596E-17	0.016666666666666666
2	ML-ROS 25	2.991465132065498	0.002776422428320982	0.025
1	ML-ROS 20	1.6809185027796598	0.09277874549290166	0.05

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. Bonferroni-Dunn's procedure rejects those hypotheses that have a

TABLE XLIII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-ROS 10	9.487217990264861	2.3728227274666712E-21	0.02
4	LP-ROS 20	8.860434819736849	7.970295090031392E-19	0.025
3	LP-ROS 25	8.433082658013207	3.366767205572596E-17	0.03333333333333333
2	ML-ROS 25	2.991465132065498	0.002776422428320982	0.05
1	ML-ROS 20	1.6809185027796598	0.09277874549290166	0.1

p-value ≤ 0.02. Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.1. Hommel's procedure rejects all hypotheses. Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Holm's

TABLE XLIV
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	LP-ROS 10	2.3728227274666712E-21	1.1864113637333355E-20	1.1864113637333355E-20	1.1864113637333355E-20	1.1864113637333355E-20
2	LP-ROS 20	7.970295090031392E-19	3.985147545015696E-18	3.188118036012557E-18	3.188118036012557E-18	3.188118036012557E-18
3	LP-ROS 25	3.366767205572596E-17	1.683383602786298E-16	1.0100301616717789E-16	1.0100301616717789E-16	1.0100301616717789E-16
4	ML-ROS 25	0.002776422428320982	0.013882112141604910	0.005552844856641964	0.005552844856641964	0.005552844856641964
5	ML-ROS 20	0.09277874549290166	0.4638937274645083	0.09277874549290166	0.09277874549290166	0.09277874549290166

procedure rejects those hypotheses that have a p-value ≤ 0.01. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Bergmann's procedure rejects these hypotheses:

- LP-ROS 10 vs. ML-ROS 10
- LP-ROS 10 vs. ML-ROS 20
- LP-ROS 10 vs. ML-ROS 25
- LP-ROS 20 vs. ML-ROS 10
- LP-ROS 20 vs. ML-ROS 20
- LP-ROS 20 vs. ML-ROS 25
- LP-ROS 25 vs. ML-ROS 10
- LP-ROS 25 vs. ML-ROS 20
- LP-ROS 25 vs. ML-ROS 25

TABLE XLV
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-ROS 10 vs. ML-ROS 10	9.487217990264861	2.3728227274666712E-21	0.0033333333333333335	0.0033333333333333335
14	LP-ROS 20 vs. ML-ROS 10	8.860434819736849	7.970295090031392E-19	0.0035714285714285718	0.005
13	LP-ROS 25 vs. ML-ROS 10	8.433082658013207	3.366767205572596E-17	0.0038461538461538464	0.005
12	LP-ROS 10 vs. ML-ROS 20	7.8062994874852025	5.889154360869871E-15	0.004166666666666667	0.005
11	LP-ROS 20 vs. ML-ROS 20	7.179516316957189	6.995847364941654E-13	0.004545454545454546	0.005
10	LP-ROS 25 vs. ML-ROS 20	6.752164155233548	1.4565593923854623E-11	0.005	0.005
9	LP-ROS 10 vs. ML-ROS 25	6.495752858199364	8.261919206731629E-11	0.005555555555555556	0.0071428571428571435
8	LP-ROS 20 vs. ML-ROS 25	5.868969687671351	4.38511591619244 7E-9	0.00625	0.0071428571428571435
7	LP-ROS 25 vs. ML-ROS 25	5.44161752594771	5.2798941609046963E-8	0.0071428571428571435	0.0071428571428571435
6	ML-ROS 10 vs. ML-ROS 25	2.991465132065498	0.002776422428320982	0.008333333333333333	0.008333333333333333
5	ML-ROS 10 vs. ML-ROS 20	1.6809185027796598	0.09277874549290166	0.01	0.0125
4	ML-ROS 20 vs. ML-ROS 25	1.310546629285838	0.19001098064722505	0.0125	0.0125
3	LP-ROS 10 vs. LP-ROS 25	1.0541353322516542	0.2918209618929514	0.016666666666666666	0.016666666666666666
2	LP-ROS 10 vs. LP-ROS 20	0.6267831705280132	0.5308013766975753	0.025	0.025
1	LP-ROS 20 vs. LP-ROS 25	0.4273521617236411	0.6691228454457296	0.05	0.05

TABLE XLVI
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-ROS 10 vs. ML-ROS 10	9.487217990264861	2.3728227274666712E-21	0.006666666666666667	0.006666666666666667
14	LP-ROS 20 vs. ML-ROS 10	8.860434819736849	7.970295090031392E-19	0.0071428571428571435	0.01
13	LP-ROS 25 vs. ML-ROS 10	8.433082658013207	3.366767205572596E-17	0.007692307692307693	0.01
12	LP-ROS 10 vs. ML-ROS 20	7.8062994874852025	5.889154360869871E-15	0.008333333333333333	0.01
11	LP-ROS 20 vs. ML-ROS 20	7.179516316957189	6.995847364941654E-13	0.009090909090909092	0.01
10	LP-ROS 25 vs. ML-ROS 20	6.752164155233548	1.4565593923854623E-11	0.01	0.01
9	LP-ROS 10 vs. ML-ROS 25	6.495752858199364	8.261919206731629E-11	0.011111111111111112	0.014285714285714287
8	LP-ROS 20 vs. ML-ROS 25	5.868969687671351	4.38511591619244 7E-9	0.0125	0.014285714285714287
7	LP-ROS 25 vs. ML-ROS 25	5.44161752594771	5.2798941609046963E-8	0.014285714285714287	0.014285714285714287
6	ML-ROS 10 vs. ML-ROS 25	2.991465132065498	0.002776422428320982	0.016666666666666666	0.016666666666666666
5	ML-ROS 10 vs. ML-ROS 20	1.6809185027796598	0.09277874549290166	0.02	0.025
4	ML-ROS 20 vs. ML-ROS 25	1.310546629285838	0.19001098064722505	0.025	0.025
3	LP-ROS 10 vs. LP-ROS 25	1.0541353322516542	0.2918209618929514	0.033333333333333333	0.033333333333333333
2	LP-ROS 10 vs. LP-ROS 20	0.6267831705280132	0.5308013766975753	0.05	0.05
1	LP-ROS 20 vs. LP-ROS 25	0.4273521617236411	0.6691228454457296	0.1	0.1

- ML-ROS 10 vs. ML-ROS 25

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.02. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. Bergmann's procedure rejects these hypotheses:

- LP-ROS 10 vs. ML-ROS 10
- LP-ROS 10 vs. ML-ROS 20
- LP-ROS 10 vs. ML-ROS 25
- LP-ROS 20 vs. ML-ROS 10
- LP-ROS 20 vs. ML-ROS 20
- LP-ROS 20 vs. ML-ROS 25
- LP-ROS 25 vs. ML-ROS 10
- LP-ROS 25 vs. ML-ROS 20
- LP-ROS 25 vs. ML-ROS 25
- ML-ROS 10 vs. ML-ROS 25

TABLE XLVII
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	LP-ROS 10 vs .ML-ROS 10	2.3728227274666712E-21	3.5592340912000066E-20	3.5592340912000066E-20	3.5592340912000066E-20	3.5592340912000066E-20
2	LP-ROS 20 vs .ML-ROS 10	7.970295090031392E-19	1.1955442635047088E-17	1.115841312604395E-17	7.970295090031392E-18	7.970295090031392E-18
3	LP-ROS 25 vs .ML-ROS 10	3.366767205572596E-17	5.050150808358894E-16	4.376797367244375E-16	3.366767205572596E-16	2.3567370439008175E-16
4	LP-ROS 10 vs .ML-ROS 20	5.889154360869871E-15	8.833731541304806E-14	7.066985233043845E-14	5.889154360869871E-14	5.889154360869871E-14
5	LP-ROS 20 vs .ML-ROS 20	6.995847364941654E-13	1.049377104741248E-11	7.695432101435819E-12	6.995847364941654E-12	4.197508418964992E-12
6	LP-ROS 25 vs .ML-ROS 20	1.4565593923854623E-11	2.1848390885781934E-10	1.4565593923854623E-10	1.4565593923854623E-10	5.826237569541849E-11
7	LP-ROS 10 vs .ML-ROS 25	8.261919206731629E-11	1.2392878810097444E-9	7.435727286058465E-10	5.783343444712141E-10	5.783343444712141E-10
8	LP-ROS 20 vs .ML-ROS 25	4.38511591619244 7E-9	6.577673874288671E-8	3.508092732953958E-8	3.069581141334713E-8	1.754046366476979E-8
9	LP-ROS 25 vs .ML-ROS 25	5.2798941609046963E-8	7.919841241357044E-7	3.695925912633287E-7	3.695925912633287E-7	1.583968248271409E-7
10	ML-ROS 10 vs .ML-ROS 25	0.002776422428320982	0.04164633642481473	0.016658534569925894	0.016658534569925894	0.016658534569925894
11	ML-ROS 10 vs .ML-ROS 20	0.09277874549290166	1.391681182393525	0.4638937274645083	0.37111498197160664	0.37111498197160664
12	ML-ROS 20 vs .ML-ROS 25	0.19001098064722505	2.850164709708375 5	0.7600439225889002	0.7600439225889002	0.7600439225889002
13	LP-ROS 10 vs .LP-ROS 25	0.2918209618929514	4.377314428394271	0.8754628856788542	0.8754628856788542	0.8754628856788542
14	LP-ROS 10 vs .LP-ROS 20	0.5308013766975753	7.9620206504636295	1.0616027533951506	1.0616027533951506	0.8754628856788542
15	LP-ROS 20 vs .LP-ROS 25	0.6691228454457296	10.036842681685945	1.0616027533951506	1.0616027533951506	0.8754628856788542

C. MacroFMeasure

TABLE XLVIII
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
LP-ROS 10	5.170454545454545
LP-ROS 20	4.806818181818181
LP-ROS 25	4.59090909090909
ML-ROS 10	2.2499999999999996
ML-ROS 20	2.159090909090908
ML-ROS 25	2.0227272727272716

Friedman statistic considering reduction performance (distributed according to chi-square with 5 degrees of freedom: 141.19155844155802. P-value computed by Friedman Test: 6.218636716681658E-11.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 5 and 215 degrees of freedom: 77.03790219585483. P-value computed by Iman and Daveport Test: 5.205896983908294E-46.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.01. Holm's procedure rejects those hypotheses

TABLE XLIX
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-ROS 10	7.89176991982993	2.9793061994898604E-15	0.01
4	LP-ROS 20	6.980085308152825	2.950008794905302E-12	0.0125
3	LP-ROS 25	6.438772569969545	1.204435128362206E-10	0.016666666666666666
2	ML-ROS 10	0.5698028822981915	0.5688114004133361	0.025
1	ML-ROS 20	0.34188172937891353	0.7324398999038728	0.05

that have a p-value ≤ 0.025. Hochberg's procedure rejects those hypotheses that have a p-value $\leq 0.016666666666666666$. Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.025. Bonferroni-Dunn's procedure rejects those hypot-

TABLE L
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
5	LP-ROS 10	7.89176991982993	2.9793061994898604E-15	0.02
4	LP-ROS 20	6.980085308152825	2.950008794905302E-12	0.025
3	LP-ROS 25	6.438772569969545	1.204435128362206E-10	0.03333333333333333
2	ML-ROS 10	0.5698028822981915	0.5688114004133361	0.05
1	ML-ROS 20	0.34188172937891353	0.7324398999038728	0.1

heses that have a p-value ≤ 0.02. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.05. Hochberg's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Hommel's procedure rejects those hypotheses that have a p-value ≤ 0.025. Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Holm's

TABLE LI
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	LP-ROS 10	2.9793061994898604E-15	1.4896530997449302E-14	1.4896530997449302E-14	1.4896530997449302E-14	1.4896530997449302E-14
2	LP-ROS 20	2.950008794905302E-12	1.475004397452651E-11	1.1800035179621208E-11	1.1800035179621208E-11	1.1800035179621208E-11
3	LP-ROS 25	1.204435128362206E-10	6.02217564181103E-10	3.6133053850866176E-10	3.6133053850866176E-10	3.6133053850866176E-10
4	ML-ROS 10	0.5688114004133361	2.8440570020666804	1.1376228008266722	0.7324398999038728	0.7324398999038728
5	ML-ROS 20	0.7324398999038728	3.662199499519364	1.1376228008266722	0.7324398999038728	0.7324398999038728

procedure rejects those hypotheses that have a p-value $\leq 0.008333333333333333$. Shaffer's procedure rejects those hypotheses that have a p-value $\leq 0.0033333333333333335$. Bergmann's procedure rejects these hypotheses:

- LP-ROS 10 vs. ML-ROS 10
- LP-ROS 10 vs. ML-ROS 20
- LP-ROS 10 vs. ML-ROS 25
- LP-ROS 20 vs. ML-ROS 10
- LP-ROS 20 vs. ML-ROS 20
- LP-ROS 20 vs. ML-ROS 25
- LP-ROS 25 vs. ML-ROS 10
- LP-ROS 25 vs. ML-ROS 20

TABLE LII
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-ROS 10 vs. ML-ROS 25	7.89176991982993	2.9793061994898604E-15	0.0033333333333333335	0.0033333333333333335
14	LP-ROS 10 vs. ML-ROS 20	7.549888190451016	4.3563206178466763E-14	0.0035714285714285718	0.005
13	LP-ROS 10 vs. ML-ROS 10	7.3219670375317385	2.443621838624757E-13	0.0038461538461538464	0.005
12	LP-ROS 20 vs. ML-ROS 25	6.980085308152825	2.950008794905302E-12	0.004166666666666667	0.005
11	LP-ROS 20 vs. ML-ROS 20	6.638203578773911	3.1752912193870845E-11	0.004545454545454546	0.005
10	LP-ROS 25 vs. ML-ROS 25	6.438772569969545	1.204435128362206E-10	0.005	0.005
9	LP-ROS 20 vs. ML-ROS 10	6.410282425854634	1.4525030712560907E-10	0.005555555555555556	0.0071428571428571435
8	LP-ROS 25 vs. ML-ROS 20	6.096890840590631	1.0815131731015844E-9	0.00625	0.0071428571428571435
7	LP-ROS 25 vs. ML-ROS 10	5.8689696876713535	4.385115916192384E-9	0.0071428571428571435	0.0071428571428571435
6	LP-ROS 10 vs. LP-ROS 25	1.4529973498603852	0.1462244898160767	0.008333333333333333	0.008333333333333333
5	LP-ROS 10 vs. LP-ROS 20	0.911684611677105	0.3619347669211916	0.01	0.01
4	ML-ROS 10 vs. ML-ROS 25	0.5698028822981915	0.5688114004133361	0.0125	0.0125
3	LP-ROS 20 vs. LP-ROS 25	0.5413172381832801	0.5882920419799121	0.016666666666666666	0.016666666666666666
2	ML-ROS 20 vs. ML-ROS 25	0.34188172937891353	0.7324398999038728	0.025	0.025
1	ML-ROS 10 vs. ML-ROS 20	0.22792115291927795	0.8197075378297867	0.05	0.05

TABLE LIII
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
15	LP-ROS 10 vs. ML-ROS 25	7.89176991982993	2.9793061994898604E-15	0.006666666666666667	0.006666666666666667
14	LP-ROS 10 vs. ML-ROS 20	7.549888190451016	4.3563206178466763E-14	0.0071428571428571435	0.01
13	LP-ROS 10 vs. ML-ROS 10	7.3219670375317385	2.443621838624757E-13	0.007692307692307693	0.01
12	LP-ROS 20 vs. ML-ROS 25	6.980085308152825	2.950008794905302E-12	0.008333333333333333	0.01
11	LP-ROS 20 vs. ML-ROS 20	6.638203578773911	3.1752912193870845E-11	0.009090909090909092	0.01
10	LP-ROS 25 vs. ML-ROS 25	6.438772569969545	1.204435128362206E-10	0.01	0.01
9	LP-ROS 20 vs. ML-ROS 10	6.410282425854634	1.4525030712560907E-10	0.011111111111111112	0.014285714285714287
8	LP-ROS 25 vs. ML-ROS 20	6.096890840590631	1.0815131731015844E-9	0.0125	0.014285714285714287
7	LP-ROS 25 vs. ML-ROS 10	5.8689696876713535	4.385115916192384E-9	0.014285714285714287	0.014285714285714287
6	LP-ROS 10 vs. LP-ROS 25	1.4529973498603852	0.1462244898160767	0.016666666666666666	0.016666666666666666
5	LP-ROS 10 vs. LP-ROS 20	0.911684611677105	0.3619347669211916	0.02	0.02
4	ML-ROS 10 vs. ML-ROS 25	0.5698028822981915	0.5688114004133361	0.025	0.025
3	LP-ROS 20 vs. LP-ROS 25	0.5413172381832801	0.5882920419799121	0.03333333333333333	0.03333333333333333
2	ML-ROS 20 vs. ML-ROS 25	0.34188172937891353	0.7324398999038728	0.05	0.05
1	ML-ROS 10 vs. ML-ROS 20	0.22792115291927795	0.8197075378297867	0.1	0.1

- LP-ROS 25 vs. ML-ROS 25

Nemenyi's procedure rejects those hypotheses that have a p-value $\leq 0.006666666666666667$. 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 $\leq 0.006666666666666667$. Bergmann's procedure rejects these hypotheses:

- LP-ROS 10 vs. ML-ROS 10
- LP-ROS 10 vs. ML-ROS 20
- LP-ROS 10 vs. ML-ROS 25
- LP-ROS 20 vs. ML-ROS 10
- LP-ROS 20 vs. ML-ROS 20
- LP-ROS 20 vs. ML-ROS 25
- LP-ROS 25 vs. ML-ROS 10
- LP-ROS 25 vs. ML-ROS 20
- LP-ROS 25 vs. ML-ROS 25

TABLE LIV
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	$pNeme$	$pHolm$	$pShaf$	$pBerg$
1	LP-ROS 10 vs .ML-ROS 25	2.9793061994898604E-15	4.4689592992347905E-14	4.4689592992347905E-14	4.4689592992347905E-14	4.4689592992347905E-14
2	LP-ROS 10 vs .ML-ROS 20	4.3563206178466763E-14	6.534480926770015E-13	6.098848864985347E-13	4.356320617846676E-13	4.356320617846676E-13
3	LP-ROS 10 vs .ML-ROS 10	2.443621838624757E-13	3.6654327579371136E-12	3.1767083902121842E-12	2.443621838624757E-12	1.71053528703733E-12
4	LP-ROS 20 vs .ML-ROS 25	2.950008794905302E-12	4.425013192357953E-11	3.540010553886362E-11	2.950008794905302E-11	2.950008794905302E-11
5	LP-ROS 20 vs .ML-ROS 20	3.1752912193870845E-11	4.762936829080627E-10	3.492820341325793E-10	3.1752912193870844E-10	1.9051747316322508E-10
6	LP-ROS 25 vs .ML-ROS 25	1.204435128362206E-10	1.806652692543309E-9	1.204435128362206E-9	1.204435128362206E-9	8.431045898535441E-10
7	LP-ROS 20 vs .ML-ROS 10	1.4525030712560907E-10	2.178754606884136E-9	1.3072527641304816E-9	1.204435128362206E-9	8.431045898535441E-10
8	LP-ROS 25 vs .ML-ROS 20	1.0815131731015844E-9	1.6222697596523766E-8	8.652105384812675E-9	7.57059221171109E-9	4.326052692406338E-9
9	LP-ROS 25 vs .ML-ROS 10	4.385115916192384E-9	6.5776738742885576E-8	3.0695811413346669E-8	3.0695811413346669E-8	1.3155347748577152E-8
10	LP-ROS 10 vs .LP-ROS 25	0.1462244898160767	2.1933673472411503	0.8773469388964601	0.8773469388964601	0.8773469388964601
11	LP-ROS 10 vs .LP-ROS 20	0.3619347669211916	5.429021503817874	1.809673834605958	1.4477390676847663	1.4477390676847663
12	ML-ROS 10 vs .ML-ROS 25	0.5688114004133361	8.532171006200041	2.2752456016533444	2.2752456016533444	2.2752456016533444
13	LP-ROS 20 vs .LP-ROS 25	0.5882920419799121	8.824380629698682	2.2752456016533444	2.2752456016533444	2.2752456016533444
14	ML-ROS 20 vs .ML-ROS 25	0.7324398999038728	10.986598498558092	2.2752456016533444	2.2752456016533444	2.2752456016533444
15	ML-ROS 10 vs .ML-ROS 20	0.8197075378297867	12.2956130674468	2.2752456016533444	2.2752456016533444	2.2752456016533444

V. BEST METHODS COMPARISON

A. All methods comparison

	Algorithm	Dataset	Base	ML-RUS 10	ML-ROS 10
2	CLR	bibtex	0.2316	0.2292	**0.2364**
3	HOMER	bibtex	**0.2714**	0.2618	0.2677
4	IBLR-ML	bibtex	0.1746	0.1684	**0.1768**
6	RAkEL-BR	bibtex	**0.3002**	0.2966	0.2925
9	RAkEL-BR	CAL500	**0.2135**	0.1708	0.2038
10	HOMER	CAL500	**0.2496**	0.2346	0.2210
11	CLR	CAL500	0.1787	0.1898	**0.1900**
12	IBLR-ML	CAL500	0.1922	0.2101	**0.2121**
14	CLR	Corel16k001	0.0456	0.0453	**0.0480**
15	HOMER	Corel16k001	**0.1138**	0.1118	0.1107
16	IBLR-ML	Corel16k001	0.0253	0.0256	**0.0292**
18	RAkEL-BR	Corel16k001	0.0645	0.0633	**0.0700**
21	RAkEL-BR	corel5k	**0.0586**	0.0355	0.0390
22	HOMER	corel5k	**0.1029**	0.1016	0.0996
23	CLR	corel5k	**0.0360**	0.0296	0.0327
24	IBLR-ML	corel5k	0.0315	0.0589	**0.0612**
33	RAkEL-BR	enron	0.4010	**0.4184**	0.4068
34	HOMER	enron	**0.4110**	0.4085	0.4024
35	CLR	enron	**0.4171**	0.3005	0.3155
36	IBLR-ML	enron	0.3226	**0.4034**	0.3890
39	RAkEL-BR	genbase	**0.9842**	0.9716	**0.9842**
40	HOMER	genbase	0.9792	0.9764	**0.9834**
41	CLR	genbase	0.9837	0.9671	**0.9842**
42	IBLR-ML	genbase	0.9790	0.9782	**0.9864**
44	CLR	LLOG-F	0.0456	0.0458	**0.0470**
45	HOMER	LLOG-F	0.1053	0.1038	**0.1105**
46	IBLR-ML	LLOG-F	0.0322	0.0352	**0.0357**
48	RAkEL-BR	LLOG-F	**0.1419**	0.1325	0.1324
50	CLR	mediamill	0.4490	0.4438	**0.4559**
51	HOMER	mediamill	0.4088	**0.4089**	0.4002
52	IBLR-ML	mediamill	**0.4660**	0.4590	0.4644
54	RAkEL-BR	mediamill	**0.4194**	0.4144	0.4114
68	CLR	SLASHDOT-F	0.3236	0.3194	**0.3260**
69	HOMER	SLASHDOT-F	0.3534	0.3314	**0.3550**
70	IBLR-ML	SLASHDOT-F	0.1269	**0.1486**	0.1343
72	RAkEL-BR	SLASHDOT-F	0.3452	0.3392	**0.3496**
74	CLR	tmc2007	0.6132	0.6020	**0.6148**
75	HOMER	tmc2007	**0.6029**	0.5897	0.6012
76	IBLR-ML	tmc2007	**0.5322**	0.5184	0.5281
78	RAkEL-BR	tmc2007	**0.6044**	0.5913	0.6022
81	RAkEL-BR	yeast	0.4338	**0.4706**	0.4614
82	HOMER	yeast	0.4292	**0.4312**	0.4053
83	CLR	yeast	0.4698	**0.5150**	0.5142
84	IBLR-ML	yeast	**0.5210**	0.4344	0.4101

TABLE LV: Accuracy

	Algorithm	Dataset	Base	ML-RUS 10	ML-ROS 10
2	CLR	bibtex	0.3371	**0.7793**	0.7690
3	HOMER	bibtex	0.3568	0.3648	**0.3656**
4	IBLR-ML	bibtex	0.2628	0.3494	**0.4070**
6	RAkEL-BR	bibtex	0.4021	**0.5136**	0.4756
9	RAkEL-BR	CAL500	0.3488	**0.6258**	0.5911
10	HOMER	CAL500	**0.3978**	0.3732	0.3512
11	CLR	CAL500	**0.2977**	0.2777	0.2802
12	IBLR-ML	CAL500	0.3184	**0.4188**	0.3709
14	CLR	Corel16k001	0.0846	**0.4300**	0.4232
15	HOMER	Corel16k001	0.1866	**0.2327**	0.2128
16	IBLR-ML	Corel16k001	0.0504	**0.3049**	0.2718
18	RAkEL-BR	Corel16k001	0.1145	**0.3511**	0.2998
21	RAkEL-BR	corel5k	0.1096	**0.4512**	0.4402
22	HOMER	corel5k	0.1744	**0.2086**	0.2040
23	CLR	corel5k	**0.0706**	0.0434	0.0512
24	IBLR-ML	corel5k	0.0542	**0.3707**	0.3113
33	RAkEL-BR	enron	0.5334	**0.6780**	0.6772
34	HOMER	enron	0.5265	**0.5482**	0.5237
35	CLR	enron	0.5596	0.5588	**0.5934**
36	IBLR-ML	enron	0.4561	**0.6195**	0.5924
39	RAkEL-BR	genbase	0.9867	0.9844	**0.9868**
40	HOMER	genbase	0.9820	0.9852	**0.9904**
41	CLR	genbase	0.9852	0.9478	**0.9863**
42	IBLR-ML	genbase	0.9768	0.9875	**0.9898**
44	CLR	LLOG-F	0.0734	0.5863	**0.5974**
45	HOMER	LLOG-F	0.1491	0.1594	**0.1645**
46	IBLR-ML	LLOG-F	0.0560	0.0580	**0.0688**
48	RAkEL-BR	LLOG-F	0.2062	**0.2880**	0.2525
50	CLR	mediamill	0.5928	**0.7750**	0.7650
51	HOMER	mediamill	0.5493	**0.5882**	0.5516
52	IBLR-ML	mediamill	0.5987	**0.7701**	0.7386
54	RAkEL-BR	mediamill	0.5622	**0.6510**	0.6024
68	CLR	SLASHDOT-F	0.4416	0.6315	**0.6537**
69	HOMER	SLASHDOT-F	0.4429	**0.5997**	0.5554
70	IBLR-ML	SLASHDOT-F	0.2042	**0.6505**	0.6385
72	RAkEL-BR	SLASHDOT-F	0.4598	0.6675	**0.6848**
74	CLR	tmc2007	0.7228	0.7500	**0.7530**
75	HOMER	tmc2007	**0.6982**	0.6908	0.6941
76	IBLR-ML	tmc2007	0.6447	**0.7221**	0.7135
78	RAkEL-BR	tmc2007	0.7063	**0.7337**	0.7283
81	RAkEL-BR	yeast	0.5796	**0.6516**	0.6359
82	HOMER	yeast	**0.5763**	0.5680	0.5475
83	CLR	yeast	0.6168	**0.7137**	0.7039
84	IBLR-ML	yeast	**0.6502**	0.5913	0.5639

TABLE LVI: MicroFMeasure

	Algorithm	Dataset	Base	ML-RUS 10	ML-ROS 10
2	CLR	bibtex	0.3342	**0.3400**	0.3386
3	HOMER	bibtex	**0.3042**	0.2920	0.2970
4	IBLR-ML	bibtex	0.2140	0.2050	**0.2200**
6	RAkEL-BR	bibtex	0.3368	**0.3384**	0.3288
9	RAkEL-BR	CAL500	0.2934	0.3128	**0.3202**
10	HOMER	CAL500	**0.3316**	0.3194	0.3019
11	CLR	CAL500	**0.3323**	0.2744	0.2700
12	IBLR-ML	CAL500	0.2772	**0.3028**	0.2966
14	CLR	Corel16k001	0.1003	0.1031	**0.1033**
15	HOMER	Corel16k001	**0.1363**	0.1322	**0.1363**
16	IBLR-ML	Corel16k001	**0.1141**	0.1049	0.1094
18	RAkEL-BR	Corel16k001	0.1277	0.1244	**0.1278**
21	RAkEL-BR	corel5k	**0.1774**	0.1304	0.1355
22	HOMER	corel5k	**0.1916**	0.1852	0.1896
23	CLR	corel5k	**0.1330**	0.1092	0.1157
24	IBLR-ML	corel5k	0.1059	**0.1792**	0.1784
33	RAkEL-BR	enron	0.4029	0.4132	**0.4220**
34	HOMER	enron	0.3790	**0.3798**	0.3740
35	CLR	enron	**0.4198**	0.3399	0.3580
36	IBLR-ML	enron	0.3458	**0.4039**	0.3930
39	RAkEL-BR	genbase	**0.9890**	0.9675	0.9800
40	HOMER	genbase	0.9780	0.9718	**0.9814**
41	CLR	genbase	**0.9848**	0.9424	0.9799
42	IBLR-ML	genbase	0.9655	0.9834	**0.9890**
44	CLR	LLOG-F	0.2330	**0.2550**	0.2508
45	HOMER	LLOG-F	0.2380	0.2267	**0.2495**
46	IBLR-ML	LLOG-F	0.1830	0.1998	**0.2096**
48	RAkEL-BR	LLOG-F	0.2824	0.2670	**0.2921**
50	CLR	mediamill	0.2276	0.2176	**0.2322**
51	HOMER	mediamill	0.2404	0.2290	**0.2422**
52	IBLR-ML	mediamill	**0.2806**	0.2634	0.2800
54	RAkEL-BR	mediamill	**0.2774**	0.2692	0.2618
68	CLR	SLASHDOT-F	0.3982	0.3898	**0.4061**
69	HOMER	SLASHDOT-F	**0.3996**	0.3766	0.3907
70	IBLR-ML	SLASHDOT-F	**0.2382**	0.2242	0.2319
72	RAkEL-BR	SLASHDOT-F	**0.4038**	0.3982	0.4002
74	CLR	tmc2007	0.6073	0.5954	**0.6332**
75	HOMER	tmc2007	0.5968	0.5855	**0.6068**
76	IBLR-ML	tmc2007	0.4668	0.4406	**0.4740**
78	RAkEL-BR	tmc2007	0.6015	0.5878	**0.6138**
81	RAkEL-BR	yeast	0.4466	0.4483	**0.4537**
82	HOMER	yeast	0.4334	**0.4351**	0.4314
83	CLR	yeast	0.4480	**0.4597**	0.4566
84	IBLR-ML	yeast	**0.4944**	0.4474	0.4528

TABLE LVII: MacroFMeasure

B. Ranking tables

	Base	ML-RUS 10	ML-ROS 10
CLR bibtex	2.0000	3.0000	**1.0000**
HOMER bibtex	**1.0000**	3.0000	2.0000
IBLR-ML bibtex	2.0000	3.0000	**1.0000**
RAkEL-BR bibtex	**1.0000**	2.0000	3.0000
RAkEL-BR CAL500	**1.0000**	3.0000	2.0000
HOMER CAL500	**1.0000**	2.0000	3.0000
CLR CAL500	3.0000	2.0000	**1.0000**
IBLR-ML CAL500	3.0000	2.0000	**1.0000**
CLR Corel16k001	2.0000	3.0000	**1.0000**
HOMER Corel16k001	**1.0000**	2.0000	3.0000
IBLR-ML Corel16k001	3.0000	2.0000	**1.0000**
RAkEL-BR Corel16k001	2.0000	3.0000	**1.0000**
RAkEL-BR corel5k	**1.0000**	3.0000	2.0000
HOMER corel5k	**1.0000**	2.0000	3.0000
CLR corel5k	**1.0000**	3.0000	2.0000
IBLR-ML corel5k	3.0000	2.0000	**1.0000**
RAkEL-BR enron	3.0000	**1.0000**	2.0000
HOMER enron	**1.0000**	2.0000	3.0000
CLR enron	**1.0000**	3.0000	2.0000
IBLR-ML enron	3.0000	**1.0000**	2.0000
RAkEL-BR genbase	**1.5000**	3.0000	**1.5000**
HOMER genbase	2.0000	3.0000	**1.0000**
CLR genbase	2.0000	3.0000	**1.0000**
IBLR-ML genbase	2.0000	3.0000	**1.0000**
CLR LLOG-F	3.0000	2.0000	**1.0000**
HOMER LLOG-F	2.0000	3.0000	**1.0000**
IBLR-ML LLOG-F	3.0000	2.0000	**1.0000**
RAkEL-BR LLOG-F	**1.0000**	2.0000	3.0000
CLR mediamill	2.0000	3.0000	**1.0000**
HOMER mediamill	2.0000	**1.0000**	3.0000
IBLR-ML mediamill	**1.0000**	3.0000	2.0000
RAkEL-BR mediamill	**1.0000**	2.0000	3.0000
CLR SLASHDOT-F	2.0000	3.0000	**1.0000**
HOMER SLASHDOT-F	2.0000	3.0000	**1.0000**
IBLR-ML SLASHDOT-F	3.0000	**1.0000**	2.0000
RAkEL-BR SLASHDOT-F	2.0000	3.0000	**1.0000**
CLR tmc2007	2.0000	3.0000	**1.0000**
HOMER tmc2007	**1.0000**	3.0000	2.0000
IBLR-ML tmc2007	**1.0000**	3.0000	2.0000
RAkEL-BR tmc2007	**1.0000**	3.0000	2.0000
RAkEL-BR yeast	3.0000	**1.0000**	2.0000
HOMER yeast	2.0000	**1.0000**	3.0000
CLR yeast	3.0000	**1.0000**	2.0000
IBLR-ML yeast	**1.0000**	2.0000	3.0000
Mean Rank	1.8523	2.3636	**1.7841**

TABLE LVIII: Ranking by Accuracy

	Base	ML-RUS 10	ML-ROS 10
CLR bibtex	3.0000	**1.0000**	2.0000
HOMER bibtex	3.0000	2.0000	**1.0000**
IBLR-ML bibtex	3.0000	2.0000	**1.0000**
RAkEL-BR bibtex	3.0000	**1.0000**	2.0000
RAkEL-BR CAL500	3.0000	**1.0000**	2.0000
HOMER CAL500	**1.0000**	2.0000	3.0000
CLR CAL500	**1.0000**	3.0000	2.0000
IBLR-ML CAL500	3.0000	**1.0000**	2.0000
CLR Corel16k001	3.0000	**1.0000**	2.0000
HOMER Corel16k001	3.0000	**1.0000**	2.0000
IBLR-ML Corel16k001	3.0000	**1.0000**	2.0000
RAkEL-BR Corel16k001	3.0000	**1.0000**	2.0000
RAkEL-BR corel5k	3.0000	**1.0000**	2.0000
HOMER corel5k	3.0000	**1.0000**	2.0000
CLR corel5k	**1.0000**	3.0000	2.0000
IBLR-ML corel5k	3.0000	**1.0000**	2.0000
RAkEL-BR enron	3.0000	**1.0000**	2.0000
HOMER enron	2.0000	**1.0000**	3.0000
CLR enron	2.0000	3.0000	**1.0000**
IBLR-ML enron	3.0000	**1.0000**	2.0000
RAkEL-BR genbase	2.0000	3.0000	**1.0000**
HOMER genbase	3.0000	2.0000	**1.0000**
CLR genbase	2.0000	3.0000	**1.0000**
IBLR-ML genbase	3.0000	2.0000	**1.0000**
CLR LLOG-F	3.0000	2.0000	**1.0000**
HOMER LLOG-F	3.0000	2.0000	**1.0000**
IBLR-ML LLOG-F	3.0000	2.0000	**1.0000**
RAkEL-BR LLOG-F	3.0000	**1.0000**	2.0000
CLR mediamill	3.0000	**1.0000**	2.0000
HOMER mediamill	3.0000	**1.0000**	2.0000
IBLR-ML mediamill	3.0000	**1.0000**	2.0000
RAkEL-BR mediamill	3.0000	**1.0000**	2.0000
CLR SLASHDOT-F	3.0000	2.0000	**1.0000**
HOMER SLASHDOT-F	3.0000	**1.0000**	2.0000
IBLR-ML SLASHDOT-F	3.0000	**1.0000**	2.0000
RAkEL-BR SLASHDOT-F	3.0000	2.0000	**1.0000**
CLR tmc2007	3.0000	2.0000	**1.0000**
HOMER tmc2007	**1.0000**	3.0000	2.0000
IBLR-ML tmc2007	3.0000	**1.0000**	2.0000
RAkEL-BR tmc2007	3.0000	**1.0000**	2.0000
RAkEL-BR yeast	3.0000	**1.0000**	2.0000
HOMER yeast	**1.0000**	2.0000	3.0000
CLR yeast	3.0000	**1.0000**	2.0000
IBLR-ML yeast	**1.0000**	2.0000	3.0000
Mean Rank	2.6364	**1.5682**	1.7955

TABLE LIX: Ranking by MicroFMeasure

	Base	ML-RUS 10	ML-ROS 10
CLR bibtex	3.0000	**1.0000**	2.0000
HOMER bibtex	**1.0000**	3.0000	2.0000
IBLR-ML bibtex	2.0000	3.0000	**1.0000**
RAkEL-BR bibtex	2.0000	**1.0000**	3.0000
RAkEL-BR CAL500	3.0000	2.0000	**1.0000**
HOMER CAL500	**1.0000**	2.0000	3.0000
CLR CAL500	**1.0000**	2.0000	3.0000
IBLR-ML CAL500	3.0000	**1.0000**	2.0000
CLR Corel16k001	3.0000	2.0000	**1.0000**
HOMER Corel16k001	**1.5000**	3.0000	**1.5000**
IBLR-ML Corel16k001	**1.0000**	3.0000	2.0000
RAkEL-BR Corel16k001	2.0000	3.0000	**1.0000**
RAkEL-BR corel5k	**1.0000**	3.0000	2.0000
HOMER corel5k	**1.0000**	3.0000	2.0000
CLR corel5k	**1.0000**	3.0000	2.0000
IBLR-ML corel5k	3.0000	**1.0000**	2.0000
RAkEL-BR enron	3.0000	2.0000	**1.0000**
HOMER enron	2.0000	**1.0000**	3.0000
CLR enron	**1.0000**	3.0000	2.0000
IBLR-ML enron	3.0000	**1.0000**	2.0000
RAkEL-BR genbase	**1.0000**	3.0000	2.0000
HOMER genbase	2.0000	3.0000	**1.0000**
CLR genbase	**1.0000**	3.0000	2.0000
IBLR-ML genbase	3.0000	2.0000	**1.0000**
CLR LLOG-F	3.0000	**1.0000**	2.0000
HOMER LLOG-F	2.0000	3.0000	**1.0000**
IBLR-ML LLOG-F	3.0000	2.0000	**1.0000**
RAkEL-BR LLOG-F	2.0000	3.0000	**1.0000**
CLR mediamill	2.0000	3.0000	**1.0000**
HOMER mediamill	2.0000	3.0000	**1.0000**
IBLR-ML mediamill	**1.0000**	3.0000	2.0000
RAkEL-BR mediamill	**1.0000**	2.0000	3.0000
CLR SLASHDOT-F	2.0000	3.0000	**1.0000**
HOMER SLASHDOT-F	**1.0000**	3.0000	2.0000
IBLR-ML SLASHDOT-F	**1.0000**	3.0000	2.0000
RAkEL-BR SLASHDOT-F	**1.0000**	3.0000	2.0000
CLR tmc2007	2.0000	3.0000	**1.0000**
HOMER tmc2007	2.0000	3.0000	**1.0000**
IBLR-ML tmc2007	2.0000	3.0000	**1.0000**
RAkEL-BR tmc2007	2.0000	3.0000	**1.0000**
RAkEL-BR yeast	3.0000	2.0000	**1.0000**
HOMER yeast	2.0000	**1.0000**	3.0000
CLR yeast	3.0000	**1.0000**	2.0000
IBLR-ML yeast	**1.0000**	3.0000	2.0000
Mean Rank	1.8977	2.3864	**1.7159**

TABLE LX: Ranking by MacroFMeasure

VI. Bests statistical tests

A. Accuracy

TABLE LXI
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
Base	1.8522727272727262
ML-RUS 10	2.3636363636363633
ML-ROS 10	1.784090909090908

Friedman statistic considering reduction performance (distributed according to chi-square with 2 degrees of freedom: 8.829545454544956. P-value computed by Friedman Test: 0.0120973032122077.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 2 and 86 degrees of freedom: 4.795607865652061. P-value computed by Iman and Daveport Test: 0.010603763869840858.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.025. Holm's procedure rejects those hypotheses

TABLE LXII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
2	ML-RUS 10	2.7183091353340364	0.006561650103122652	0.025
1	Base	0.31980107453341533	0.7491191330005955	0.05

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. Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value

TABLE LXIII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
2	ML-RUS 10	2.7183091353340364	0.006561650103122652	0.05
1	Base	0.31980107453341533	0.7491191330005955	0.1

≤ 0.05. 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. Nemenyi's procedure

TABLE LXIV
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	ML-RUS 10	0.006561650103122652	0.013123300206245305	0.013123300206245305	0.013123300206245305	0.013123300206245305
2	Base	0.7491191330005955	1.498238266001191	0.7491191330005955	0.7491191330005955	0.7491191330005955

TABLE LXV
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
3	ML-RUS 10 vs. ML-ROS 10	2.7183091335340364	0.006561650103122652	0.016666666666666666	0.016666666666666666
2	Base vs. ML-RUS 10	2.398508059000621	0.01646201423758714	0.025	0.05
1	Base vs. ML-ROS 10	0.31980107453341533	0.7491191330005955	0.05	0.05

rejects those hypotheses that have a p-value $\leq 0.016666666666666666$. 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:

- Base vs. ML-RUS 10
- ML-RUS 10 vs. ML-ROS 10

Nemenyi's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.1. Shaffer's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Bergmann's procedure rejects these hypotheses:

- Base vs. ML-RUS 10
- ML-RUS 10 vs. ML-ROS 10

TABLE LXVI
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
3	ML-RUS 10 vs. ML-ROS 10	2.7183091335340364	0.006561650103122652	0.03333333333333333	0.03333333333333333
2	Base vs. ML-RUS 10	2.398508059000621	0.01646201423758714	0.05	0.1
1	Base vs. ML-ROS 10	0.31980107453341533	0.7491191330005955	0.1	0.1

TABLE LXVII
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	ML-RUS 10 vs .ML-ROS 10	0.006561650103122652	0.019684950309367958	0.019684950309367958	0.019684950309367958	0.019684950309367958
2	Base vs .ML-RUS 10	0.01646201423758714	0.049386042712761424	0.03292402847517428	0.019684950309367958	0.019684950309367958
3	Base vs .ML-ROS 10	0.7491191330005955	2.2473573990017863	0.7491191330005955	0.7491191330005955	0.7491191330005955

B. MicroFMeasure

TABLE LXVIII
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
Base	2.636363636363637
ML-RUS 10	1.5681818181818172
ML-ROS 10	1.7954545454545445

Friedman statistic considering reduction performance (distributed according to chi-square with 2 degrees of freedom: 27.863636363636196. P-value computed by Friedman Test: 8.902334736049511E-7.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 2 and 86 degrees of freedom: 19.923658352229605. P-value computed by Iman and Daveport Test: 7.765029719231375E-8.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.025. Holm's procedure rejects those hypotheses

TABLE LXIX
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
2	Base	5.010216834356853	5.436874190380729E-7	0.025
1	ML-ROS 10	1.0660035817780522	0.2864220227778588	0.05

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. Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value

TABLE LXX
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
2	Base	5.010216834356853	5.436874190380729E-7	0.05
1	ML-ROS 10	1.0660035817780522	0.2864220227778588	0.1

≤ 0.05. 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. Nemenyi's procedure

TABLE LXXI
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	Base	5.436874190380729E-7	1.0873748380761459E-6	1.0873748380761459E-6	1.0873748380761459E-6	1.0873748380761459E-6
2	ML-ROS 10	0.2864220227778588	0.5728440455557176	0.2864220227778588	0.2864220227778588	0.2864220227778588

TABLE LXXII
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
3	Base vs. ML-RUS 10	5.010216834356853	5.436874190380729E-7	0.016666666666666666	0.016666666666666666
2	Base vs. ML-ROS 10	3.944213252578801	8.006238931164592E-5	0.025	0.05
1	ML-RUS 10 vs. ML-ROS 10	1.0660035817780522	0.2864220227778588	0.05	0.05

rejects those hypotheses that have a p-value $\leq 0.016666666666666666$. 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:

- Base vs. ML-RUS 10
- Base vs. ML-ROS 10

TABLE LXXIII
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
3	Base vs. ML-RUS 10	5.010216834356853	5.436874190380729E-7	0.03333333333333333	0.03333333333333333
2	Base vs. ML-ROS 10	3.944213252578801	8.006238931164592E-5	0.05	0.1
1	ML-RUS 10 vs. ML-ROS 10	1.0660035817780522	0.2864220227778588	0.1	0.1

Nemenyi's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.1. Shaffer's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Bergmann's procedure rejects these hypotheses:

- Base vs. ML-RUS 10
- Base vs. ML-ROS 10

TABLE LXXIV
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	Base vs .ML-RUS 10	5.436874190380729E-7	1.6310622571142187E-6	1.6310622571142187E-6	1.6310622571142187E-6	1.6310622571142187E-6
2	Base vs .ML-ROS 10	8.006238931164592E-5	2.4018716793493776E-4	1.6012477862329183E-4	8.006238931164592E-5	8.006238931164592E-5
3	ML-RUS 10 vs .ML-ROS 10	0.2864220227778588	0.8592660683335763	0.2864220227778588	0.2864220227778588	0.2864220227778588

C. MacroFMeasure

TABLE LXXV
AVERAGE RANKINGS OF THE ALGORITHMS

Algorithm	Ranking
Base	1.8977272727272714
ML-RUS 10	2.3863636363636362
ML-ROS 10	1.71590909090909

Friedman statistic considering reduction performance (distributed according to chi-square with 2 degrees of freedom: 10.579545454545084. P-value computed by Friedman Test: 0.005042906263954872.
Iman and Davenport statistic considering reduction performance (distributed according to F-distribution with 2 and 86 degrees of freedom: 5.87597240569476. P-value computed by Iman and Daveport Test: 0.004055467444993967.
Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value ≤ 0.025. Holm's procedure rejects those hypotheses

TABLE LXXVI
HOLM / HOCHBERG TABLE FOR $\alpha = 0.05$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
2	ML-RUS 10	3.1447105662452577	0.0016625122099821479	0.025
1	Base	0.8528028654224399	0.39376863464299383	0.05

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. Bonferroni-Dunn's procedure rejects those hypotheses that have a p-value

TABLE LXXVII
HOLM / HOCHBERG TABLE FOR $\alpha = 0.10$

i	algorithm	$z = (R_0 - R_i)/SE$	p	Holm/Hochberg/Hommel
2	ML-RUS 10	3.1447105662452577	0.0016625122099821479	0.05
1	Base	0.8528028654224399	0.39376863464299383	0.1

≤ 0.05. 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. Nemenyi's procedure

TABLE LXXVIII
ADJUSTED p-VALUES

i	algorithm	unadjusted p	p_{Bonf}	p_{Holm}	p_{Hoch}	p_{Homm}
1	ML-RUS 10	0.0016625122099821479	0.0033250244199642958	0.0033250244199642958	0.0033250244199642958	0.0033250244199642958
2	Base	0.39376863464299383	0.7875372692859877	0.39376863464299383	0.39376863464299383	0.39376863464299383

TABLE LXXIX
HOLM / SHAFFER TABLE FOR $\alpha = 0.05$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
3	ML-RUS 10 vs. ML-ROS 10	3.1447105662452577	0.0016625122099821479	0.016666666666666666	0.016666666666666666
2	Base vs. ML-RUS 10	2.2919077008228177	0.02191096980205308	0.025	0.05
1	Base vs. ML-ROS 10	0.8528028654224399	0.39376863464299383	0.05	0.05

rejects those hypotheses that have a p-value $\leq 0.016666666666666666$. 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:

- Base vs. ML-RUS 10
- ML-RUS 10 vs. ML-ROS 10

TABLE LXXX
HOLM / SHAFFER TABLE FOR $\alpha = 0.10$

i	algorithms	$z = (R_0 - R_i)/SE$	p	Holm	Shaffer
3	ML-RUS 10 vs. ML-ROS 10	3.1447105662452577	0.0016625122099821479	0.03333333333333333	0.03333333333333333
2	Base vs. ML-RUS 10	2.2919077008228177	0.02191096980205308	0.05	0.1
1	Base vs. ML-ROS 10	0.8528028654224399	0.39376863464299383	0.1	0.1

Nemenyi's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Holm's procedure rejects those hypotheses that have a p-value ≤ 0.1. Shaffer's procedure rejects those hypotheses that have a p-value ≤ 0.03333333333333333. Bergmann's procedure rejects these hypotheses:

- Base vs. ML-RUS 10
- ML-RUS 10 vs. ML-ROS 10

TABLE LXXXI
ADJUSTED p-VALUES

i	hypothesis	unadjusted p	p_{Neme}	p_{Holm}	p_{Shaf}	p_{Berg}
1	ML-RUS 10 vs .ML-ROS 10	0.0016625122099821479	0.004987536629946444	0.004987536629946444	0.004987536629946444	0.004987536629946444
2	Base vs .ML-RUS 10	0.02191096980205308	0.06573290940615924	0.04382193960410616	0.02191096980205308	0.02191096980205308
3	Base vs .ML-ROS 10	0.39376863464299383	1.1813059039289815	0.39376863464299383	0.39376863464299383	0.39376863464299383