Supplementary Material:

Dynamically-Generated Cutting Planes for Mixed-Integer Quadratically-Constrained Quadratic Programs and Their Incorporation into GloMIQO 2

R. Misener, J. B. Smadbeck and C.A. Floudas

Table 1.: BoxQP Sizes [25, 113, 114]

	# Variables	# Nonlinear Terms		
		Ex. 1	Ex. 2	Ex. 3
spar020-100-	20	205	206	207
spar030-060-	30	264	255	305
spar030-070-	30	310	313	334
spar030-080-	30	367	356	372
spar030-090-	30	401	417	403
spar030-100-	30	456	459	458
spar040-030-	40	233	245	234
spar040-040-	40	318	326	321
spar040-050-	40	398	405	415
spar040-060-	40	477	456	516
spar040-070-	40	559	547	570
spar040-080-	40	647	626	672
spar040-090-	40	714	730	724
spar040-100-	40	805	812	802
spar050-030-	50	365	382	367
spar050-040-	50	497	523	503
spar050-050-	50	635	627	651
spar060-020-	60	353	358	363
spar070-025-	70	617	591	629
spar070-050-	70	1226	1140	1192
spar070-075-	70	1837	1813	1814
spar080-025-	80	788	768	810
spar080-050-	80	1624	1521	1548
spar080-075-	80	2387	2359	2383
spar090-025-	90	1011	991	1027
spar090-050-	90	2020	1961	1950
spar090-075-	90	3032	2995	3014
spar100-025-	100	1250	1233	1256
spar100-050-	100	2519	2444	2449
spar100-075-	100	3727	3687	3723

Table 2.: StQP Sizes [96]

	# Variables	# Nonlinear Terms
Problem_0030_75	30	465
Problem_0050_75	50	1,275
Problem_0100_01	100	5,050
Problem_0100_50	100	5,050
Problem_0100_75	100	5,050
Problem_0200_01	200	20,100
Problem_0200_50	200	20,100
Problem_0500_01	500	125,250
Problem_0500_25	500	125,250
Problem_1000_25	1000	500,500
Problem_Q030	30	465
Problem_Q050	50	1,275
Problem_Q100	100	5,050
Problem_Q150	150	11,325

Table 3.: QCQP Sizes from Bao et al. [18]

	# Replicates	# Vars	# Eqns	# Nonlinear Terms
unitbox_c_10_10	6	11	11	110
unitbox_c_10_15	6	11	16	160
unitbox_c_10_20	6	11	21	210
unitbox_c_20_20	9	21	21	420
unitbox_c_20_30	9	21	31	620
unitbox_c_20_40	9	21	41	820
unitbox_c_28_28	3	29	29	812
unitbox_c_28_42	3	29	43	1204
unitbox_c_28_56	3	29	57	1596
unitbox_c_30_30	6	31	31	930
unitbox_c_30_45	6	31	46	1380
unitbox_c_30_60	6	31	61	1830
unitbox_c_40_40	9	41	41	1640
unitbox_c_40_60	9	41	61	2440
unitbox_c_40_80	9	41	81	3240
unitbox_c_48_48	3	49	49	2352
unitbox_c_48_72	3	49	73	3504
unitbox_c_48_96	3	49	97	4656
unitbox_c_50_100	6	51	101	5050
unitbox_c_50_50	6	51	51	2550
unitbox_c_50_75	6	51	76	3800
unitbox_c_8_12	3	9	13	100
unitbox_c_8_16	3	9	17	131
unitbox_c_8_8	3	9	9	69

Table 4.: Analysis of Cut Generation Strategies for 239 QCQP from: [18, 25, 96, 113, 114]

Solution Strategy	% Time in Cut Generation	# Cuts in Each Class				# Variables in a Cut					
		Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var
Original	Average	48.7	2.136e+04	1.442e+02	2.079e+04	1.442e+02	1.891e+00	7.835e+03	1.296e+04	2.824e+00	4.150e+02
	Minimum	0	0	0	0	0	0	0	0	0	0
	Maximum	57	2.579e+03	7	2.000e+05	7	0	395	203	0	0
Naive Facet Gen	Average	64.2	1.868e+04	1.191e+02	1.820e+04	1.191e+02	2.569e+00	7.438e+03	1.076e+04	1.623e+00	3.559e+02
	Minimum	0	0	0	0	0	0	0	0	0	0
	Maximum	79	2.591e+03	6	1.973e+05	6	0	371	178	0	0
No α BB Cuts	Average	100	5.920e+05	2.132e+03	5.920e+05	2.132e+03	184	5.920e+05	3.941e+05	165	0.854e+04
	Minimum	46.5	2.172e+04	2.070e+02	0	2.151e+04	2.070e+02	0.000e+00	1.342e+04	0.000e+00	0.000e+02
	Maximum	49	2.084e+03	9	2.034e+05	9	0	462	292	0	0
No Convexity Cuts	Average	99	6.130e+05	6.320e+03	0	6.130e+05	6.320e+03	0	6.130e+05	5.150e+05	0
	Minimum	48.4	2.736e+04	0	4.948e+02	2.686e+04	0.000e+00	2.724e+00	1.323e+04	2.714e+00	4.804e+00
	Maximum	54	2.599e+03	0	2.069e+05	0	409	255	0	0	0
No EC Cuts	Average	95	0.204e+04	1.365e+02	0.000e+00	1.365e+02	0.929e+00	0.556e+00	0.490e+00	0.356e+00	19.027e+02
	Minimum	0	0	0	0	0	0	0	0	0	0
	Maximum	99	0.301e+05	3.059e+03	3.012e+04	0.000e+00	3.059e+03	105	38	53	31
No Loop Search	Average	52.1	2.143e+04	1.349e+02	2.089e+04	1.349e+02	1.300e+00	7.771e+03	1.311e+04	3.385e+00	4.098e+02
	Minimum	0	0	0	0	0	0	0	0	0	0
	Maximum	66	2.847e+03	7	2.072e+05	7	0	392	305	0	0
Gap $\equiv 100 \cdot \left(\frac{UB-LB}{LB} \right)$; Termination Criteria: Gap = 1×10^{-4} % or Time = 7200 s	Average	99	6.130e+05	2.453e+03	1.148e+04	6.130e+05	2.453e+03	80	6.130e+05	4.780e+05	313
	Minimum	0	0	0	0	0	0	0	0	0	0
	Maximum	15	1.00e-04	2.0	12.9	1476	559	0	814	103	0

Table 5.: Cutting Plane Analysis using Examples from: [18, 25, 96, 113, 114]

Problem Name	Time (s)	Gap	Time Generating Cuts				# Cuts in Each Class				# Variables in a Cut					
			Time (s)	% Total T	Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var		
spar020-100-1	0	1.00e-04	0.0	56.3	400	0	9	391	0	0	391	0	0	0	9	
spar020-100-2	1	1.00e-04	0.3	23.3	575	73	37	465	73	0	441	24	0	0	37	
spar020-100-3	0	1.00e-04	0.1	83.3	441	0	9	432	0	0	432	0	0	0	9	
spar030-060-1	18	1.00e-04	15.5	87.9	858	212	0	646	212	0	462	184	0	0	0	
spar030-060-2	1	1.00e-04	0.1	8.0	374	32	0	342	32	0	342	0	0	0	0	
spar030-060-3	9	1.00e-04	6.4	67.8	972	227	0	745	227	0	658	87	0	0	0	
spar030-070-1	37	1.00e-04	33.5	89.7	1281	177	0	1104	177	0	803	301	0	0	0	
spar030-070-2	1	1.00e-04	0.1	11.8	628	44	0	584	44	0	584	0	0	0	0	
spar030-070-3	15	1.00e-04	2.0	12.9	1476	559	0	917	559	0	814	103	0	0	0	

continued on the next page

Problem Name	Time (s)	Gap	Time Generating Cuts		# Cuts in Each Class				# Variables in a Cut					
			Time (s)	% Total T	Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var
spar030-080-1	13	1.00e-04	6.1	48.8	1485	205	0	1280	205	0	1126	154	0	0
spar030-080-2	0	1.00e-04	0.1	75.8	882	0	0	882	0	0	882	0	0	0
spar030-080-3	0	1.00e-04	0.1	74.4	1006	6	0	1000	6	0	1000	0	0	0
spar030-090-1	0	1.00e-04	0.1	91.5	1000	0	0	1000	0	0	1000	0	0	0
spar030-090-2	6	1.00e-04	1.2	19.5	1544	56	0	1488	56	0	1488	0	0	0
spar030-090-3	0	1.00e-04	0.1	84.5	1162	9	0	1153	9	0	1153	0	0	0
spar030-100-1	13	1.00e-04	4.3	34.4	2579	61	0	2518	61	0	1972	546	0	0
spar030-100-2	0	1.00e-04	0.3	90.6	1985	0	0	1985	0	0	1985	0	0	0
spar030-100-3	5	1.00e-04	1.1	20.2	1166	23	17	1126	23	0	1126	1	0	16
spar040-030-1	0	1.00e-04	0.0	57.7	118	0	0	118	0	0	118	0	0	0
spar040-030-2	0	1.00e-04	0.0	14.2	106	8	0	98	8	0	98	0	0	0
spar040-030-3	0	1.00e-04	0.0	58.8	107	0	0	107	0	0	107	0	0	0
spar040-040-1	17	1.00e-04	12.8	73.5	816	143	0	673	143	0	388	285	0	0
spar040-040-2	0	1.00e-04	0.1	81.1	344	6	0	338	6	0	338	0	0	0
spar040-040-3	4	1.00e-04	1.6	37.6	571	48	0	523	48	0	415	108	0	0
spar040-050-1	7	1.00e-04	1.8	26.8	868	55	0	813	55	0	647	166	0	0
spar040-050-2	4	1.00e-04	0.8	20.7	736	37	0	699	37	0	653	46	0	0
spar040-050-3	0	1.00e-04	0.1	82.4	618	8	0	610	8	0	610	0	0	0
spar040-060-1	361	1.00e-04	3397	94.0	3674	1018	0	2656	1018	0	1366	1290	0	0
spar040-060-2	5	1.00e-04	0.3	7.3	836	44	0	792	44	0	789	3	0	0
spar040-060-3	0	1.00e-04	0.1	86.4	1000	0	0	1000	0	0	1000	0	0	0
spar040-070-1	1	1.00e-04	0.5	89.6	1572	0	0	1572	0	0	1572	0	0	0
spar040-070-2	0	1.00e-04	0.3	87.2	1442	2	0	1440	2	0	1440	0	0	0
spar040-070-3	8	1.00e-04	0.6	8.0	1656	9	0	1647	9	0	1647	0	0	0
spar040-080-1	1	1.00e-04	0.9	93.8	2150	0	0	2150	0	0	2150	0	0	0
spar040-080-2	1	1.00e-04	0.7	91.9	2083	11	0	2072	11	0	2072	0	0	0
spar040-080-3	30	1.00e-04	4.7	15.6	2765	98	0	2667	98	0	2662	5	0	0
spar040-090-1	1	1.00e-04	1.4	95.2	3261	8	0	3253	8	0	3253	0	0	0
spar040-090-2	30	1.00e-04	6.8	22.4	3359	35	0	3324	35	0	3174	150	0	0
spar040-090-3	32	1.00e-04	2.3	7.2	3145	83	0	3062	83	0	3044	18	0	0
spar040-100-1	45	1.00e-04	6.7	14.8	4711	57	0	4654	57	0	4654	0	0	0
spar040-100-2	15	1.00e-04	14.9	99.5	4966	25	10	4931	25	1	3931	1000	0	9
spar040-100-3	724	1.00e-04	625.9	86.5	9006	256	0	8750	256	0	4890	3860	0	0
spar050-030-1	0	1.00e-04	0.1	83.3	221	0	0	221	0	0	221	0	0	0
spar050-030-2	4	1.00e-04	0.4	10.6	445	9	0	436	9	0	341	95	0	0
spar050-030-3	5	1.00e-04	1.1	21.8	543	34	0	509	34	0	354	155	0	0
spar050-040-1	5	1.00e-04	5.0	99.2	996	54	0	942	54	0	670	272	0	0
spar050-040-2	6	1.00e-04	0.6	9.0	848	28	0	820	28	0	820	0	0	0
spar050-040-3	0	1.00e-04	0.2	84.0	608	0	0	608	0	0	608	0	0	0
spar050-050-1	7200	4.96e+00	7134.6	99.1	13048	1310	0	11738	1310	0	3872	7866	0	0
spar050-050-2	7	1.00e-04	7.4	99.6	1598	48	0	1550	48	0	1347	203	0	0
spar050-050-3	161	1.00e-04	143.9	89.1	2567	298	0	2269	298	0	1705	564	0	0
spar060-020-1	1	1.00e-04	0.9	97.6	288	6	0	282	6	0	158	124	0	0
spar060-020-2	0	1.00e-04	0.2	84.2	150	0	0	150	0	0	150	0	0	0
spar060-020-3	2	1.00e-04	2.0	99.0	513	14	0	499	14	0	207	292	0	0
spar070-025-1	29	1.00e-04	9.4	32.5	1336	66	0	1270	66	0	561	709	0	0
spar070-025-2	39	1.00e-04	11.9	30.4	1446	52	0	1394	52	0	571	823	0	0
spar070-025-3	11	1.00e-04	1.5	13.0	759	23	0	736	23	0	558	178	0	0
spar070-050-1	2422	1.00e-04	2296.3	94.8	5468	439	0	5029	439	0	3808	1221	0	0

continued on the next page

Table 5 (Cutting Plane Analysis) continued

Problem Name	Time (s)	Gap	Time Generating Cuts		# Cuts in Each Class				# Variables in a Cut					
			Time (s)	% Total T	Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var
spar070-050-2	68	1.00e-04	68.2	99.8	3954	64	0	3890	64	0	3360	530	0	0
spar070-050-3	3	1.00e-04	2.5	95.7	3010	10	0	3000	10	0	3000	0	0	0
spar070-075-1	7200	4.11e+00	6588.6	91.5	11066	19	0	11047	19	0	11047	0	0	0
spar070-075-2	7200	8.29e+00	6682.2	92.8	12019	69	0	11950	69	0	10950	1000	0	0
spar070-075-3	7200	8.09e+00	6677.7	92.7	11799	94	0	11705	94	0	11705	0	0	0
spar080-025-1	2	1.00e-04	1.5	97.3	756	11	0	745	11	0	745	0	0	0
spar080-025-2	1345	1.00e-04	1253.2	93.2	3341	309	0	3032	309	0	1007	2025	0	0
spar080-025-3	45	1.00e-04	28.4	63.8	2048	75	0	1973	75	0	973	1000	0	0
spar080-050-1	7200	6.82e+00	6596.2	91.6	8333	254	0	8079	254	0	6522	1557	0	0
spar080-050-2	122	1.00e-04	10.7	8.8	5026	26	0	5000	26	0	5000	0	0	0
spar080-050-3	1049	1.00e-04	920.4	87.8	6699	211	0	6488	211	0	5094	1394	0	0
spar080-075-1	7200	4.63e+01	5873.9	81.6	33019	19	0	33000	19	0	33000	0	0	0
spar080-075-2	7200	1.62e+01	6518.2	90.5	15009	9	0	15000	9	0	15000	0	0	0
spar080-075-3	7200	2.85e+01	6310.0	87.6	15005	5	0	15000	5	0	15000	0	0	0
spar090-025-1	1863	1.00e-04	1749.2	93.9	3980	348	0	3632	348	0	1475	2157	0	0
spar090-025-2	740	1.00e-04	638.5	86.2	3599	378	0	3221	378	0	1395	1826	0	0
spar090-025-3	266	1.00e-04	183.6	68.9	2104	70	0	2034	70	0	1188	846	0	0
spar090-050-1	7200	1.02e+00	6530.2	90.7	10528	232	0	10296	232	0	8587	1709	0	0
spar090-050-2	576	1.00e-04	364.4	63.3	8860	113	0	8747	113	0	7847	900	0	0
spar090-050-3	1643	1.00e-04	1252.7	76.3	9061	240	0	8821	240	0	7567	1254	0	0
spar090-075-1	7200	1.04e+02	4974.2	69.1	172014	14	0	172000	14	0	172000	0	0	0
spar090-075-2	7200	9.68e+01	5578.9	77.5	228007	7	0	228000	7	0	228000	0	0	0
spar090-075-3	7200	9.19e+01	4994.2	69.4	105007	7	0	105000	7	0	105000	0	0	0
spar100-025-1	5887	1.00e-04	5652.5	96.0	6325	679	0	5646	679	0	2109	3537	0	0
spar100-025-2	1159	1.00e-04	969.9	83.6	4285	159	0	4126	159	0	1888	2238	0	0
spar100-025-3	323	1.00e-04	153.4	47.4	3721	111	0	3610	111	0	1914	1696	0	0
spar100-050-1	7200	1.36e+01	6448.5	89.6	11241	74	0	11167	74	0	11167	0	0	0
spar100-050-2	7200	6.35e+00	6258.8	86.9	11705	212	0	11493	212	0	10494	999	0	0
spar100-050-3	7200	4.22e+00	6257.9	86.9	11978	135	0	11843	135	0	10845	998	0	0
spar100-075-1	7200	1.24e+02	4899.3	68.0	177012	12	0	177000	12	0	177000	0	0	0
spar100-075-2	7200	1.23e+02	5294.8	73.5	620005	5	0	620000	5	0	620000	0	0	0
spar100-075-3	7200	1.18e+02	4841.0	67.2	136010	10	0	136000	10	0	136000	0	0	0
unitbox.e-10.10.1.100	0	1.00e-04	0.0	12.3	71	27	33	11	27	12	18	6	4	4
unitbox.e-10.10.1.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.e-10.10.2.100	0	1.00e-04	0.0	0.0	79	17	18	44	17	0	41	3	13	5
unitbox.e-10.10.2.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.e-10.10.3.100	0	1.00e-04	0.0	0.0	77	14	16	47	14	0	47	0	0	16
unitbox.e-10.10.3.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.e-10.15.1.100	0	1.00e-04	0.0	7.5	147	36	64	47	36	17	48	12	0	34
unitbox.e-10.15.1.50	0	1.00e-04	0.0	0.0	26	0	0	26	0	0	0	26	0	0
unitbox.e-10.15.2.100	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.e-10.15.2.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.e-10.15.3.100	0	1.00e-04	0.0	83.3	102	32	21	49	32	0	49	0	0	21
unitbox.e-10.15.3.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.e-10.20.1.100	0	1.00e-04	0.0	32.6	148	20	89	39	20	0	36	9	41	42
unitbox.e-10.20.1.50	0	1.00e-04	0.0	0.0	44	0	0	44	0	0	0	44	0	0
unitbox.e-10.20.2.100	0	1.00e-04	0.0	0.0	64	16	48	0	16	48	0	0	0	0
unitbox.e-10.20.2.50	0	1.00e-04	0.0	83.3	58	0	0	58	0	0	0	58	0	0
unitbox.e-10.20.3.100	0	1.00e-04	0.0	15.6	134	7	78	49	7	24	49	0	0	54

continued on the next page

Problem Name	Time (s)	Gap	Time Generating Cuts			# Cuts in Each Class			# Variables in a Cut					
			Time (s)	% Total T	Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var
unitbox.c-10.20.3.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.20.1.100	7	1.00e-04	1.1	16.2	689	12	253	424	12	40	466	3	0	168
unitbox.c-20.20.1.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.20.1.50	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.20.2.100	46	1.00e-04	31.6	68.2	4390	252	1328	2810	252	184	2494	342	20	1098
unitbox.c-20.20.2.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.20.2.50	0	1.00e-04	0.1	83.9	1000	0	0	1000	0	0	0	1000	0	0
unitbox.c-20.20.3.100	0	1.00e-04	0.2	71.6	605	0	175	430	0	0	430	0	0	175
unitbox.c-20.20.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.20.3.50	0	1.00e-04	0.1	83.3	808	0	0	808	0	0	0	808	0	0
unitbox.c-20.30.1.100	11	1.00e-04	5.3	46.2	1262	85	409	768	85	0	700	68	0	409
unitbox.c-20.30.1.25	0	1.00e-04	0.0	9.9	223	0	0	223	0	0	0	223	0	0
unitbox.c-20.30.1.50	0	1.00e-04	0.1	86.0	1000	0	0	1000	0	0	0	1000	0	0
unitbox.c-20.30.2.100	23	1.00e-04	7.9	34.8	1260	106	443	711	106	0	589	144	0	421
unitbox.c-20.30.2.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.30.2.50	0	1.00e-04	0.0	61.5	396	0	0	396	0	0	0	396	0	0
unitbox.c-20.30.3.100	23	1.00e-04	1.7	7.1	1028	59	394	575	59	0	523	52	0	394
unitbox.c-20.30.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.30.3.50	0	1.00e-04	0.1	75.9	1000	0	0	1000	0	0	0	1000	0	0
unitbox.c-20.40.1.100	54	1.00e-04	21.7	40.5	2554	451	951	1152	451	0	938	214	40	911
unitbox.c-20.40.1.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-20.40.1.50	5	1.00e-04	0.1	1.8	1000	0	0	1000	0	0	0	1000	0	0
unitbox.c-20.40.2.100	48	1.00e-04	0.9	1.8	962	37	489	436	37	0	471	0	52	402
unitbox.c-20.40.2.25	0	1.00e-04	0.1	22.3	515	0	0	515	0	0	0	515	0	0
unitbox.c-20.40.2.50	7	1.00e-04	0.1	1.7	1000	0	0	1000	0	0	0	1000	0	0
unitbox.c-20.40.3.100	1	1.00e-04	0.7	77.4	1027	14	618	395	14	80	395	0	0	538
unitbox.c-20.40.3.25	0	1.00e-04	0.1	32.7	661	0	0	661	0	0	0	661	0	0
unitbox.c-20.40.3.50	0	1.00e-04	0.1	81.5	552	0	0	552	0	0	0	552	0	0
unitbox.c-28.28.1.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-28.28.2.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-28.28.3.25	2	1.00e-04	0.2	7.4	1001	0	0	1001	0	0	0	1001	0	0
unitbox.c-28.42.1.25	2	1.00e-04	1.9	20	20	0	0	20	0	0	0	20	0	0
unitbox.c-28.42.2.25	0	1.00e-04	0.1	56.6	470	0	0	470	0	0	0	470	0	0
unitbox.c-28.42.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c-28.56.1.25	1	1.00e-04	0.5	88.0	2000	0	0	2000	0	0	0	2000	0	0
unitbox.c-28.56.2.25	0	1.00e-04	0.0	34.1	220	0	0	220	0	0	0	220	0	0
unitbox.c-28.56.3.25	8	1.00e-04	0.3	3.2	1000	0	0	1000	0	0	0	1000	0	0
unitbox.c-30.30.1.100	7200	2.61e-01	6793.9	94.4	31361	2815	2760	25786	2815	0	12809	12977	28	2732
unitbox.c-30.30.1.50	39	1.00e-04	0.9	2.2	3000	0	0	3000	0	0	0	3000	0	0
unitbox.c-30.30.2.100	8	1.00e-04	7.5	95.3	2839	24	381	2434	24	0	2075	421	0	319
unitbox.c-30.30.2.50	15	1.00e-04	1.4	9.5	3080	0	0	3080	0	0	0	3080	0	0
unitbox.c-30.30.3.100	183	1.00e-04	87.9	47.9	3798	229	399	3170	229	0	2078	1123	0	368
unitbox.c-30.30.3.50	1	1.00e-04	0.6	85.0	3000	0	0	3000	0	0	0	3000	0	0
unitbox.c-30.45.1.100	199	1.00e-04	78.9	39.7	3670	247	1092	2331	247	0	1859	472	0	1092
unitbox.c-30.45.1.50	26	1.00e-04	1.9	7.4	3009	0	0	3009	0	0	0	3009	0	0
unitbox.c-30.45.2.100	329	1.00e-04	159.8	48.6	3456	341	745	2370	341	0	2113	316	1	685
unitbox.c-30.45.2.50	11	1.00e-04	0.4	3.2	2120	0	0	2120	0	0	0	2120	0	0
unitbox.c-30.45.3.100	90	1.00e-04	11.0	12.2	2558	36	604	1918	36	46	1959	55	0	462
unitbox.c-30.45.3.50	37	1.00e-04	1.6	4.3	3000	0	0	3000	0	0	0	3000	0	0

continued on the next page

Table 5 (Cutting Plane Analysis) continued

Problem Name	Time (s)	Gap	Time Generating Cuts			# Cuts in Each Class			# Variables in a Cut					
			Time (s)	% Total T	Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var
unitbox.c.30.60.1.1100	571	1.00e-04	337.0	59.0	4854	343	1747	2764	343	0	2294	837	163	1217
unitbox.c.30.60.1.150	159	1.00e-04	107.3	67.7	19570	0	0	21972	0	0	0	19570	0	0
unitbox.c.30.60.2.1100	4955	1.00e-04	45162	91.1	26648	2702	1974	21972	2702	0	10880	11316	214	1536
unitbox.c.30.60.2.50	53	1.00e-04	26.7	70.8	7637	0	0	7637	0	0	0	7637	0	0
unitbox.c.30.60.3.100	670	1.00e-04	487.9	52.0	7489	1337	1607	4545	1337	0	2898	1708	0	1546
unitbox.c.30.60.3.50	10	1.00e-04	0.9	9.1	3164	0	0	3164	0	0	0	3164	0	0
unitbox.c.40.40.1.100	214	1.00e-04	49.3	23.0	5606	46	405	5155	46	0	4155	1000	0	405
unitbox.c.40.40.1.125	48	1.00e-04	4.0	8.3	6163	0	0	6163	0	0	0	6163	0	0
unitbox.c.40.40.1.150	742	1.00e-04	579.8	78.1	16894	0	0	16894	0	0	0	16894	0	0
unitbox.c.40.40.2.100	1864	1.00e-04	1478.4	79.3	7250	208	528	6514	208	0	4510	2045	0	487
unitbox.c.40.40.2.25	31	1.00e-04	1.1	3.6	6000	0	0	6000	0	0	0	6000	0	0
unitbox.c.40.40.2.50	359	1.00e-04	220.6	61.5	34964	0	0	34964	0	0	0	34964	0	0
unitbox.c.40.40.3.100	15	1.00e-04	11.2	73.5	3372	6	366	3000	6	0	3000	0	0	366
unitbox.c.40.40.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.40.40.3.50	2455	1.00e-04	2232.6	90.9	226204	0	0	226204	0	0	0	226204	0	0
unitbox.c.40.60.1.100	7200	8.52e+00	6268.3	87.1	10578	152	1299	9127	152	0	5458	3669	0	1299
unitbox.c.40.60.1.125	375	1.00e-04	75.1	20.0	13800	0	0	13800	0	0	0	13800	0	0
unitbox.c.40.60.1.150	304	1.00e-04	148.6	48.8	12978	0	0	12978	0	0	0	12978	0	0
unitbox.c.40.60.2.100	7200	2.32e+00	6218.3	86.4	8520	106	813	7601	106	0	4668	2933	0	813
unitbox.c.40.60.2.25	59	1.00e-04	1.2	2.0	6000	0	0	6000	0	0	0	6000	0	0
unitbox.c.40.60.2.50	142	1.00e-04	48.8	34.5	15319	0	0	15319	0	0	0	15319	0	0
unitbox.c.40.60.3.100	7200	7.78e+00	6265.2	87.0	10393	114	1124	9155	114	0	5345	3810	0	1124
unitbox.c.40.60.3.25	83	1.00e-04	9.9	11.9	8403	0	0	8403	0	0	0	8403	0	0
unitbox.c.40.60.3.50	655	1.00e-04	461.8	70.5	42557	0	0	42557	0	0	0	42557	0	0
unitbox.c.40.80.1.100	5856	1.00e-04	5055.6	86.3	7710	244	1455	6011	244	0	4825	1549	81	1011
unitbox.c.40.80.1.125	1232	1.00e-04	1053.7	85.5	36219	0	0	36219	0	0	0	36219	0	0
unitbox.c.40.80.1.150	135	1.00e-04	24.0	17.8	9013	0	0	9013	0	0	0	9013	0	0
unitbox.c.40.80.2.100	5769	1.00e-04	4796.9	83.1	7294	286	849	6159	286	0	4652	1507	0	849
unitbox.c.40.80.2.25	301	1.00e-04	59.1	19.6	12886	0	0	12886	0	0	0	12886	0	0
unitbox.c.40.80.2.50	146	1.00e-04	43.4	29.6	17376	0	0	17376	0	0	0	17376	0	0
unitbox.c.40.80.3.100	7200	5.71e+00	6002.4	83.4	7939	143	1202	6594	143	0	4599	1995	0	1202
unitbox.c.40.80.3.25	201	1.00e-04	85.1	42.3	14609	0	0	14609	0	0	0	14609	0	0
unitbox.c.40.80.3.50	7200	7.87e+00	5701.5	79.2	304555	0	0	304555	0	0	0	304555	0	0
unitbox.c.48.48.1.25	1646	1.00e-04	1069.0	64.9	162000	0	0	162000	0	0	0	162000	0	0
unitbox.c.48.48.2.25	117	1.00e-04	22.1	19.0	15000	0	0	15000	0	0	0	15000	0	0
unitbox.c.48.48.3.25	306	1.00e-04	150.6	49.2	35331	0	0	35331	0	0	0	35331	0	0
unitbox.c.48.72.1.25	97	1.00e-04	7.6	7.9	12000	0	0	12000	0	0	0	12000	0	0
unitbox.c.48.72.2.25	153	1.00e-04	21.0	13.7	17000	0	0	17000	0	0	0	17000	0	0
unitbox.c.48.72.3.25	112	1.00e-04	15.8	14.1	17000	0	0	17000	0	0	0	17000	0	0
unitbox.c.48.96.1.25	365	1.00e-04	121.7	33.3	23301	0	0	23301	0	0	0	23301	0	0
unitbox.c.48.96.2.25	7200	3.43e+00	4894.8	68.0	31000	0	0	31000	0	0	0	31000	0	0
unitbox.c.48.96.3.25	1524	1.00e-04	801.6	52.6	53000	0	0	53000	0	0	0	53000	0	0
unitbox.c.50.100.1.100	7200	1.58e+01	4907.8	68.2	11011	0	2011	9000	0	0	9000	0	0	2011
unitbox.c.50.100.1.150	7200	1.73e+01	5356.3	74.4	18000	0	0	18000	0	0	0	18000	0	0
unitbox.c.50.100.2.100	7200	1.98e+01	5170.9	71.8	12999	0	2017	10082	0	0	9082	1000	0	2017
unitbox.c.50.100.2.50	7200	1.40e+01	5645.1	78.4	172000	0	0	172000	0	0	0	172000	0	0
unitbox.c.50.100.3.100	7200	7.68e+00	5029.2	69.8	10658	39	2188	8431	39	0	8431	0	0	2188
unitbox.c.50.100.3.50	7200	1.80e+01	5538.1	76.9	282000	0	0	282000	0	0	0	282000	0	0
unitbox.c.50.50.1.100	7200	9.36e+00	5924.2	82.3	10974	1	1014	9959	1	0	8959	1000	0	1014

continued on the next page

Table 5 (Cutting Plane Analysis) continued

Problem Name	Time (s)	Gap	Time Generating Cuts		# Cuts in Each Class			# Variables in a Cut						
			Time (s)	% Total T	Total	Convex	α BB	Edge-Conc	1 Var	2 Var	3 Var	4 Var	5 Var	≥ 6 Var
unitbox.c.50.50.1.50	7200	4.57e+01	5782.5	80.3	66000	0	0	66000	0	0	0	66000	0	0
unitbox.c.50.50.2.100	7200	1.92e+01	5951.6	82.7	9072	0	958	8114	0	0	8114	0	0	958
unitbox.c.50.50.2.50	7200	1.28e+01	5941.5	82.5	49000	0	0	49000	0	0	0	49000	0	0
unitbox.c.50.50.3.100	7200	1.07e+01	5697.9	79.1	10864	0	914	9950	0	914	8950	1000	0	914
unitbox.c.50.50.3.50	7200	1.87e+01	5832.8	81.0	476000	0	0	476000	0	0	0	476000	0	0
unitbox.c.50.75.1.100	7200	1.35e+01	5315.7	73.8	10791	62	1771	8958	62	0	8958	0	0	1771
unitbox.c.50.75.1.50	7200	6.37e+00	6002.6	83.4	183000	0	0	183000	0	0	0	183000	0	0
unitbox.c.50.75.2.100	7200	2.52e+01	5484.6	76.2	11243	0	1514	9729	0	0	8729	1000	0	1514
unitbox.c.50.75.2.50	7200	2.75e+01	5662.6	78.6	261000	0	0	261000	0	0	0	261000	0	0
unitbox.c.50.75.3.100	7200	5.76e+00	5477.1	76.1	11391	24	1194	10173	24	0	8176	1997	0	1194
unitbox.c.50.75.3.50	7200	2.31e+01	5600.1	77.8	267000	0	0	267000	0	0	0	267000	0	0
unitbox.c.8.12.1.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.12.2.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.12.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.16.1.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.16.2.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.16.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.8.1.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.8.2.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
unitbox.c.8.8.3.25	0	1.00e-04	0.0	0.0	0	0	0	0	0	0	0	0	0	0
Problem.Q030.75	463	1.00e-04	237.2	51.2	5816	827	3596	1393	827	0	466	932	0	3591
Problem.Q050.75	7200	2.35e+00	4614.1	64.1	16164	2027	12088	2049	2027	0	703	1351	0	12083
Problem.Q100.01	472	1.00e-04	3.3	0.7	48	22	23	3	22	0	4	13	1	8
Problem.Q100.50	7200	2.78e+01	3182.7	44.2	8258	2126	5875	257	2126	0	84	178	0	5870
Problem.Q100.75	7200	-	2889.8	40.1	9384	2066	7141	177	2066	0	46	136	0	7136
Problem.Q200.01	7200	3.60e+01	1107.3	15.4	1594	670	474	450	670	0	450	0	6	468
Problem.Q200.50	7200	2.60e+01	1218.0	16.9	6443	1727	4716	0	1727	0	0	5	0	4711
Problem.Q500.01	1584	1.00e-04	11.1	0.7	41	16	25	0	16	0	21	0	0	4
Problem.Q500.25	7200	-	653.1	9.1	3455	803	2652	0	803	0	0	5	0	2647
Problem.L1000.25	7200	1.84e+07	0.0	0.0	0	0	0	0	0	0	0	0	0	0
Problem.Q030	7200	4.07e+00	5154.4	71.6	15791	1136	10449	4206	1136	0	1566	2640	0	10449
Problem.Q050	7200	1.02e+01	5235.7	72.7	13213	928	8054	4231	928	0	1236	2995	0	8054
Problem.Q100	7200	4.23e+00	4138.0	57.5	12240	884	6566	4790	884	0	1240	3602	11	6503
Problem.Q150	7200	9.84e+00	545.1	7.6	3541	537	1799	1205	537	0	407	798	0	1799

Gap $\equiv 100 \cdot \left(\frac{UB-LB}{LB}\right)$; Termination Criterion: Gap = $1 \times 10^{-4}\%$ or Time = 7200 s

Gap $\equiv 100 \cdot \left(\frac{UB-LB}{|LB|} \right)$; Termination Criteria: Gap = $1 \times 10^{-4}\%$ or Time = 7200 s

Table 6.: BoxQP Results [25, 113, 114]

Problem Name	GloMIQO 2.3				BARON 12.3.3				Couenne 0.4			
	Time	Gap	LB	UB	Time	Gap	LB	UB	Time	Gap	LB	UB
spar020-100-1	0	1.00e-04	-7.065e+02	-7.065e+02	0	1.00e-04	-7.065e+02	-7.065e+02	6	1.00e-04	-7.065e+02	-7.065e+02
spar020-100-2	1	1.00e-04	-8.565e+02	-8.565e+02	3	1.00e-04	-8.565e+02	-8.565e+02	8	1.00e-04	-8.565e+02	-8.565e+02
spar020-100-3	0	1.00e-04	-7.720e+02	-7.720e+02	0	1.00e-04	-7.720e+02	-7.720e+02	7	1.00e-04	-7.720e+02	-7.720e+02
spar030-060-1	21	1.00e-04	-7.060e+02	-7.060e+02	33	1.00e-04	-7.060e+02	-7.060e+02	817	1.00e-04	-7.060e+02	-7.060e+02
spar030-060-2	1	1.00e-04	-1.377e+03	-1.377e+03	0	1.00e-04	-1.377e+03	-1.377e+03	7	1.00e-04	-1.377e+03	-1.377e+03
spar030-060-3	11	1.00e-04	-1.294e+03	-1.294e+03	25	1.00e-04	-1.294e+03	-1.294e+03	129	1.00e-04	-1.294e+03	-1.294e+03
spar030-070-1	38	1.00e-04	-6.540e+02	-6.540e+02	18	1.00e-04	-6.540e+02	-6.540e+02	3045	1.00e-04	-6.540e+02	-6.540e+02
spar030-070-2	1	1.00e-04	-1.313e+03	-1.313e+03	2	1.00e-04	-1.313e+03	-1.313e+03	37	1.00e-04	-1.313e+03	-1.313e+03
spar030-070-3	15	1.00e-04	-1.657e+03	-1.657e+03	6	1.00e-04	-1.657e+03	-1.657e+03	30	1.00e-04	-1.657e+03	-1.657e+03
spar030-080-1	15	1.00e-04	-9.527e+02	-9.527e+02	63	1.00e-04	-9.527e+02	-9.527e+02	7200	6.14e+00	-1.011e+03	-9.527e+02
spar030-080-2	0	1.00e-04	-1.597e+03	-1.597e+03	0	1.00e-04	-1.597e+03	-1.597e+03	19	1.00e-04	-1.597e+03	-1.597e+03
spar030-080-3	0	1.00e-04	-1.810e+03	-1.810e+03	1	1.00e-04	-1.810e+03	-1.810e+03	18	1.00e-04	-1.810e+03	-1.810e+03
spar030-090-1	0	1.00e-04	-1.297e+03	-1.297e+03	35	1.00e-04	-1.297e+03	-1.297e+03	1161	1.00e-04	-1.297e+03	-1.297e+03
spar030-090-2	6	1.00e-04	-1.467e+03	-1.467e+03	101	1.00e-04	-1.467e+03	-1.467e+03	1778	1.00e-04	-1.467e+03	-1.467e+03
spar030-090-3	0	1.00e-04	-1.494e+03	-1.494e+03	16	1.00e-04	-1.494e+03	-1.494e+03	396	1.00e-04	-1.494e+03	-1.494e+03
spar030-100-1	13	1.00e-04	-1.227e+03	-1.227e+03	181	1.00e-04	-1.227e+03	-1.227e+03	7200	7.34e+00	-1.317e+03	-1.227e+03
spar030-100-2	1	1.00e-04	-1.261e+03	-1.261e+03	63	1.00e-04	-1.261e+03	-1.261e+03	7200	9.46e+00	-1.380e+03	-1.260e+03
spar030-100-3	6	1.00e-04	-1.511e+03	-1.511e+03	51	1.00e-04	-1.511e+03	-1.511e+03	2057	1.00e-04	-1.511e+03	-1.511e+03
spar040-030-1	0	1.00e-04	-8.395e+02	-8.395e+02	0	1.00e-04	-8.395e+02	-8.395e+02	7	1.00e-04	-8.395e+02	-8.395e+02
spar040-030-2	0	1.00e-04	-1.429e+03	-1.429e+03	1	1.00e-04	-1.429e+03	-1.429e+03	8	1.00e-04	-1.429e+03	-1.429e+03
spar040-030-3	0	1.00e-04	-1.086e+03	-1.086e+03	0	1.00e-04	-1.086e+03	-1.086e+03	5	1.00e-04	-1.086e+03	-1.086e+03
spar040-040-1	17	1.00e-04	-8.370e+02	-8.370e+02	19	1.00e-04	-8.370e+02	-8.370e+02	1541	1.00e-04	-8.370e+02	-8.370e+02
spar040-040-2	0	1.00e-04	-1.428e+03	-1.428e+03	3	1.00e-04	-1.428e+03	-1.428e+03	23	1.00e-04	-1.428e+03	-1.428e+03
spar040-040-3	5	1.00e-04	-1.174e+03	-1.174e+03	27	1.00e-04	-1.174e+03	-1.174e+03	1370	1.00e-04	-1.174e+03	-1.174e+03
spar040-050-1	6	1.00e-04	-1.155e+03	-1.155e+03	22	1.00e-04	-1.155e+03	-1.155e+03	2326	1.00e-04	-1.154e+03	-1.154e+03
spar040-050-2	5	1.00e-04	-1.431e+03	-1.431e+03	32	1.00e-04	-1.431e+03	-1.431e+03	880	1.00e-04	-1.431e+03	-1.431e+03
spar040-050-3	0	1.00e-04	-1.654e+03	-1.654e+03	19	1.00e-04	-1.654e+03	-1.654e+03	896	1.00e-04	-1.654e+03	-1.654e+03
spar040-060-1	406	1.00e-04	-1.323e+03	-1.323e+03	1386	1.00e-04	-1.323e+03	-1.323e+03	7200	3.69e+01	-1.795e+03	-1.311e+03
spar040-060-2	5	1.00e-04	-2.004e+03	-2.004e+03	14	1.00e-04	-2.004e+03	-2.004e+03	300	1.00e-04	-2.004e+03	-2.004e+03
spar040-060-3	0	1.00e-04	-2.454e+03	-2.454e+03	11	1.00e-04	-2.454e+03	-2.454e+03	190	1.00e-04	-2.454e+03	-2.454e+03
spar040-070-1	0	1.00e-04	-1.605e+03	-1.605e+03	395	1.00e-04	-1.605e+03	-1.605e+03	7200	1.53e+01	-1.851e+03	-1.605e+03
spar040-070-2	0	1.00e-04	-1.868e+03	-1.868e+03	133	1.00e-04	-1.868e+03	-1.868e+03	7200	7.28e+00	-2.004e+03	-1.868e+03
spar040-070-3	8	1.00e-04	-2.437e+03	-2.437e+03	62	1.00e-04	-2.437e+03	-2.437e+03	6535	1.00e-04	-2.437e+03	-2.437e+03
spar040-080-1	1	1.00e-04	-1.839e+03	-1.839e+03	2909	1.00e-04	-1.839e+03	-1.839e+03	7200	3.63e+01	-2.506e+03	-1.838e+03
spar040-080-2	1	1.00e-04	-1.952e+03	-1.952e+03	145	1.00e-04	-1.952e+03	-1.952e+03	7200	2.06e+01	-2.356e+03	-1.952e+03
spar040-080-3	38	1.00e-04	-2.546e+03	-2.546e+03	180	1.00e-04	-2.546e+03	-2.546e+03	7200	1.52e+01	-2.932e+03	-2.544e+03
spar040-090-1	2	1.00e-04	-2.136e+03	-2.136e+03	554	1.00e-04	-2.136e+03	-2.136e+03	7200	3.68e+01	-2.920e+03	-2.136e+03
spar040-090-2	41	1.00e-04	-2.113e+03	-2.113e+03	1356	1.00e-04	-2.113e+03	-2.113e+03	7200	3.71e+01	-2.854e+03	-2.082e+03
spar040-090-3	33	1.00e-04	-2.535e+03	-2.535e+03	197	1.00e-04	-2.535e+03	-2.535e+03	7200	2.04e+01	-3.053e+03	-2.535e+03
spar040-100-1	46	1.00e-04	-2.476e+03	-2.476e+03	2286	1.00e-04	-2.476e+03	-2.476e+03	7200	3.75e+01	-3.405e+03	-2.476e+03
spar040-100-2	16	1.00e-04	-2.103e+03	-2.102e+03	2157	1.00e-04	-2.103e+03	-2.102e+03	7200	5.85e+01	-3.332e+03	-2.102e+03
spar040-100-3	747	1.00e-04	-1.866e+03	-1.866e+03	7200	3.15e+01	-2.453e+03	-1.866e+03	7200	9.04e+01	-3.550e+03	-1.864e+03
spar050-030-1	0	1.00e-04	-1.325e+03	-1.324e+03	2	1.00e-04	-1.325e+03	-1.324e+03	39	1.00e-04	-1.324e+03	-1.324e+03

continued on the next page

Table 6 (BoxQP Results) continued

Problem Name	GloMIQO 2.3				BARON 12.3.3				Couenne 0.4			
	Time	Gap	LB	UB	Time	Gap	LB	UB	Time	Gap	LB	UB
spar050-030-2	4	1.00e-04	-1.668e+03	-1.668e+03	17	1.00e-04	-1.668e+03	-1.668e+03	326	1.00e-04	-1.668e+03	-1.668e+03
spar050-030-3	6	1.00e-04	-1.454e+03	-1.454e+03	10	1.00e-04	-1.454e+03	-1.454e+03	163	1.00e-04	-1.454e+03	-1.454e+03
spar050-040-1	5	1.00e-04	-1.411e+03	-1.411e+03	239	1.00e-04	-1.411e+03	-1.411e+03	7200	1.55e+01	-1.629e+03	-1.411e+03
spar050-040-2	7	1.00e-04	-1.746e+03	-1.746e+03	145	1.00e-04	-1.746e+03	-1.746e+03	7200	9.43e+00	-1.910e+03	-1.746e+03
spar050-040-3	0	1.00e-04	-2.095e+03	-2.094e+03	66	1.00e-04	-2.095e+03	-2.094e+03	7200	3.83e+00	-2.175e+03	-2.094e+03
spar050-050-1	7200	5.07e+00	-1.259e+03	-1.198e+03	7200	1.99e+01	-1.437e+03	-1.198e+03	7200	1.02e+02	-2.410e+03	-1.193e+03
spar050-050-2	9	1.00e-04	-1.776e+03	-1.776e+03	845	1.00e-04	-1.776e+03	-1.776e+03	7200	3.18e+01	-2.341e+03	-1.776e+03
spar050-050-3	176	1.00e-04	-2.106e+03	-2.106e+03	1121	1.00e-04	-2.106e+03	-2.106e+03	7200	4.11e+01	-2.972e+03	-2.106e+03
spar060-020-1	1	1.00e-04	-1.212e+03	-1.212e+03	9	1.00e-04	-1.212e+03	-1.212e+03	160	1.00e-04	-1.212e+03	-1.212e+03
spar060-020-2	0	1.00e-04	-1.926e+03	-1.926e+03	1	1.00e-04	-1.926e+03	-1.926e+03	14	1.00e-04	-1.926e+03	-1.926e+03
spar060-020-3	2	1.00e-04	-1.483e+03	-1.483e+03	16	1.00e-04	-1.483e+03	-1.483e+03	390	1.00e-04	-1.483e+03	-1.483e+03
spar070-025-1	30	1.00e-04	-2.539e+03	-2.539e+03	362	1.00e-04	-2.539e+03	-2.539e+03	7200	1.56e+01	-2.934e+03	-2.539e+03
spar070-025-2	51	1.00e-04	-1.888e+03	-1.888e+03	888	1.00e-04	-1.888e+03	-1.888e+03	7200	2.48e+01	-2.356e+03	-1.888e+03
spar070-025-3	16	1.00e-04	-2.812e+03	-2.812e+03	147	1.00e-04	-2.812e+03	-2.812e+03	7200	1.36e+01	-3.186e+03	-2.804e+03
spar070-050-1	2650	1.00e-04	-3.253e+03	-3.252e+03	7200	2.31e+01	-4.003e+03	-3.252e+03	7200	7.61e+01	-5.723e+03	-3.249e+03
spar070-050-2	71	1.00e-04	-3.296e+03	-3.296e+03	7200	1.51e+01	-3.793e+03	-3.296e+03	7200	6.12e+01	-5.313e+03	-3.296e+03
spar070-050-3	3	1.00e-04	-4.307e+03	-4.306e+03	7200	5.42e+00	-4.540e+03	-4.306e+03	7200	4.09e+01	-6.068e+03	-4.306e+03
spar070-075-1	7200	4.22e+00	-4.852e+03	-4.656e+03	7200	4.68e+01	-6.835e+03	-4.656e+03	7200	1.11e+02	-9.826e+03	-4.656e+03
spar070-075-2	7200	8.35e+00	-4.188e+03	-3.865e+03	7200	7.47e+01	-6.754e+03	-3.865e+03	7200	1.37e+02	-9.079e+03	-3.832e+03
spar070-075-3	7200	8.11e+00	-4.680e+03	-4.329e+03	7200	6.35e+01	-7.076e+03	-4.329e+03	7200	1.17e+02	-9.392e+03	-4.329e+03
spar080-025-1	2	1.00e-04	-3.157e+03	-3.157e+03	495	1.00e-04	-3.157e+03	-3.157e+03	7200	2.35e+01	-3.900e+03	-3.157e+03
spar080-025-2	1543	1.00e-04	-2.312e+03	-2.312e+03	7200	7.20e+00	-2.479e+03	-2.312e+03	7200	4.91e+01	-3.448e+03	-2.312e+03
spar080-025-3	54	1.00e-04	-3.091e+03	-3.091e+03	3465	1.00e-04	-3.091e+03	-3.091e+03	7200	3.42e+01	-4.146e+03	-3.089e+03
spar080-050-1	7200	6.86e+00	-3.671e+03	-3.435e+03	7200	6.30e+01	-5.622e+03	-3.448e+03	7200	1.40e+02	-8.230e+03	-3.435e+03
spar080-050-2	130	1.00e-04	-4.449e+03	-4.449e+03	7200	2.58e+01	-5.597e+03	-4.449e+03	7200	7.46e+01	-7.737e+03	-4.432e+03
spar080-050-3	1089	1.00e-04	-4.886e+03	-4.886e+03	7200	2.91e+01	-6.310e+03	-4.886e+03	7200	7.51e+01	-8.542e+03	-4.879e+03
spar080-075-1	7200	4.63e+01	-8.624e+03	-5.338e+03	7200	6.57e+01	-9.770e+03	-5.896e+03	7200	1.25e+02	-1.325e+04	-5.896e+03
spar080-075-2	7200	1.58e+01	-6.184e+03	-5.980e+03	7200	6.89e+01	-9.021e+03	-5.341e+03	7200	1.32e+02	-1.237e+04	-5.338e+03
spar080-075-3	7200	2.80e+01	-7.657e+03	-5.980e+03	7200	6.58e+01	-9.914e+03	-5.980e+03	7200	1.19e+02	-1.307e+04	-5.980e+03
spar090-025-1	2432	1.00e-04	-3.373e+03	-3.372e+03	7200	1.18e+01	-3.771e+03	-3.372e+03	7200	5.33e+01	-5.152e+03	-3.362e+03
spar090-025-2	977	1.00e-04	-3.506e+03	-3.506e+03	7200	7.66e+00	-3.768e+03	-3.506e+03	7200	4.27e+01	-4.994e+03	-3.506e+03
spar090-025-3	312	1.00e-04	-4.299e+03	-4.299e+03	7200	5.03e+00	-4.515e+03	-4.299e+03	7200	3.16e+01	-5.647e+03	-4.292e+03
spar090-050-1	7200	9.36e-01	-5.200e+03	-5.152e+03	7200	5.85e+01	-8.165e+03	-5.152e+03	7200	1.14e+02	-1.101e+04	-5.140e+03
spar090-050-2	700	1.00e-04	-5.387e+03	-5.386e+03	7200	4.11e+01	-7.603e+03	-5.386e+03	7200	9.19e+01	-1.034e+04	-5.386e+03
spar090-050-3	1438	1.00e-04	-6.151e+03	-6.151e+03	7200	3.33e+01	-8.196e+03	-6.151e+03	7200	7.61e+01	-1.083e+04	-6.148e+03
spar090-075-1	7200	1.05e+02	-1.274e+04	-6.216e+03	7200	1.16e+02	-1.344e+04	-6.232e+03	7200	1.78e+02	-1.720e+04	-6.180e+03
spar090-075-2	7200	9.84e+01	-1.120e+04	-5.648e+03	7200	1.25e+02	-1.272e+04	-5.648e+03	7200	1.90e+02	-1.637e+04	-5.648e+03
spar090-075-3	7200	9.23e+01	-1.240e+04	-6.450e+03	7200	1.07e+02	-1.337e+04	-6.450e+03	7200	1.64e+02	-1.700e+04	-6.450e+03
spar100-025-1	6088	1.00e-04	-4.028e+03	-4.028e+03	7200	2.06e+01	-4.859e+03	-4.028e+03	7200	6.28e+01	-6.556e+03	-4.028e+03
spar100-025-2	1275	1.00e-04	-3.893e+03	-3.893e+03	7200	2.40e+01	-4.828e+03	-3.893e+03	7200	5.98e+01	-6.208e+03	-3.884e+03
spar100-025-3	310	1.00e-04	-4.454e+03	-4.454e+03	7200	1.90e+01	-5.254e+03	-4.454e+03	7200	5.30e+01	-6.802e+03	-4.444e+03
spar100-050-1	7200	1.37e+01	-6.225e+03	-5.473e+03	7200	9.39e+01	-1.046e+04	-5.490e+03	7200	1.51e+02	-1.366e+04	-5.439e+03
spar100-050-2	7200	6.47e+00	-6.246e+03	-5.866e+03	7200	7.66e+01	-1.036e+04	-5.866e+03	7200	1.26e+02	-1.324e+04	-5.856e+03
spar100-050-3	7200	4.07e+00	-6.749e+03	-6.485e+03	7200	7.04e+01	-1.105e+04	-6.485e+03	7200	1.16e+02	-1.398e+04	-6.485e+03
spar100-075-1	7200	1.24e+02	-1.650e+04	-7.380e+03	7200	1.35e+02	-1.731e+04	-7.380e+03	7200	1.93e+02	-2.133e+04	-7.290e+03
spar100-075-2	7200	1.22e+02	-1.500e+04	-6.750e+03	7200	1.52e+02	-1.705e+04	-6.756e+03	7200	2.02e+02	-2.036e+04	-6.750e+03
spar100-075-3	7200	1.22e+02	-1.677e+04	-7.554e+03	7200	1.25e+02	-1.700e+04	-7.554e+03	7200	1.82e+02	-2.122e+04	-7.534e+03

Gap $\equiv 100 \cdot \left(\frac{UB-LB}{LB} \right)$; Termination Criteria: Gap = $1 \times 10^{-4} \%$ or Time = 7200 s

Table 7.: StQP Results [96]

Problem Name	GloMIQO 2.3				BARON 12.3.3				Couenne 0.4			
	Time	Gap	LB	UB	Time	Gap	LB	UB	Time	Gap	LB	UB
Problem_0030_75	452	1.00e-04	-6.337e+00	-6.337e+00	13	1.00e-04	-6.337e+00	-6.337e+00	7200	4.29e+01	-9.056e+00	-6.337e+00
Problem_0050_75	7200	2.32e+00	-6.534e+00	-6.386e+00	7200	1.20e+03	-8.317e+01	-6.386e+00	7200	4.04e+02	-3.216e+01	-6.386e+00
Problem_0100_01	386	1.00e-04	1.053e-02	1.053e-02	282	1.00e-04	1.053e-02	1.053e-02	87	1.00e-04	1.053e-02	1.053e-02
Problem_0100_50	7200	2.82e+01	-8.017e+00	-6.251e+00	7200	2.37e+03	-1.549e+02	-6.280e+00	7200	9.15e+02	-6.203e+01	-6.110e+00
Problem_0100_75	7200	2.39e+01	-8.213e+00	-6.630e+00	7200	3.40e+03	-2.321e+02	-6.630e+00	7200	1.49e+03	-1.006e+02	-6.336e+00
Problem_0200_01	7200	4.08e+01	7.614e-03	1.287e-02	7200	3.35e+01	8.562e-03	1.287e-02	7200	4.65e+01	6.882e-03	1.287e-02
Problem_0200_50	7200	2.69e+01	-8.722e+00	-6.874e+00	7200	5.41e+03	-3.787e+02	-6.874e+00	7200	2.07e+03	-1.494e+02	-6.880e+00
Problem_0500_01	7200	1.00e+02	0.000e+00	1.049e-03	7200	1.00e+02	0.000e+00	1.049e-03	7200	1.00e+02	0.000e+00	1.048e-03
Problem_0500_25	7200	3.70e+03	-2.274e+02	-5.986e+00	7200	8.09e+03	-5.030e+02	-6.144e+00	7200	8.21e+03	-5.057e+02	-6.089e+00
Problem_1000_25	7200	1.84e+07	-1.016e+06	-5.522e+00	7200	8.59e+00	1.390e+01	1.520e+01	9724	1.79e+04	-1.016e+03	-5.641e+00
Problem_Q030	7200	3.93e+00	1.460e+01	1.520e+01	7200	4.03e+01	5.936e+00	9.947e+00	7200	3.56e+01	9.790e+00	1.520e+01
Problem_Q050	7200	9.89e+00	8.963e+00	9.947e+00	7200	4.03e+01	5.936e+00	9.947e+00	7200	4.80e+01	5.168e+00	9.946e+00
Problem_Q100	7200	4.21e+00	3.371e+01	3.519e+01	7200	5.33e+01	1.643e+01	3.519e+01	8133	6.03e+01	1.396e+01	3.519e+01
Problem_Q150	7200	9.84e+00	4.202e+01	4.660e+01	7200	5.73e+01	1.988e+01	4.660e+01	8116	6.30e+01	1.726e+01	4.660e+01

† Terminated in preprocessing

Gap $\equiv 100 \cdot \left(\frac{UB-LB}{UB} \right)$; Termination Criteria: Gap = $1 \times 10^{-4}\%$ or Time = 7200 s

Table 8.: QCQP from Bao et al. [18] Results

Problem Name	GloMIQO 2.3				BARON 12.3.3				Couenne 0.4			
	Time	Gap	LB	UB	Time	Gap	LB	UB	Time	Gap	LB	UB
unitbox.c:30.30.1.100	7200	6.03e-01	-4.445e+01	-4.419e+01	7200	2.20e+01	-5.392e+01	-4.419e+01	7200	5.24e+01	-6.733e+01	-4.419e+01
unitbox.c:30.30.1.50	36	1.00e-04	-5.466e+01	-5.466e+01	10	1.00e-04	-5.466e+01	-5.466e+01	40	1.00e-04	-5.466e+01	-5.466e+01
unitbox.c:30.30.2.100	9	1.00e-04	-4.473e+01	-4.473e+01	7200	1.42e+01	-5.109e+01	-4.473e+01	7200	3.91e+01	-6.224e+01	-4.473e+01
unitbox.c:30.30.2.50	20	1.00e-04	-4.851e+01	-4.851e+01	44	1.00e-04	-4.851e+01	-4.851e+01	63	1.00e-04	-4.851e+01	-4.851e+01
unitbox.c:30.30.3.100	175	1.00e-04	-3.823e+01	-3.823e+01	7200	2.14e+01	-4.641e+01	-3.823e+01	7200	6.17e+01	-5.973e+01	-3.692e+01
unitbox.c:30.30.3.50	1	1.00e-04	-4.445e+01	-4.445e+01	27	1.00e-04	-4.445e+01	-4.445e+01	59	1.00e-04	-4.445e+01	-4.445e+01
unitbox.c:30.45.1.100	210	1.00e-04	-8.000e+01	-8.000e+01	765	1.00e-04	-8.000e+01	-8.000e+01	3384	1.00e-04	-8.000e+01	-8.000e+01
unitbox.c:30.45.1.50	24	1.00e-04	-5.321e+01	-5.321e+01	49	1.00e-04	-5.321e+01	-5.321e+01	64	1.00e-04	-5.321e+01	-5.321e+01
unitbox.c:30.45.2.100	360	1.00e-04	-7.714e+01	-7.714e+01	1862	1.00e-04	-7.714e+01	-7.714e+01	2683	1.00e-04	-7.714e+01	-7.714e+01
unitbox.c:30.45.2.50	11	1.00e-04	-5.605e+01	-5.605e+01	6	1.00e-04	-5.605e+01	-5.605e+01	37	1.00e-04	-5.605e+01	-5.605e+01
unitbox.c:30.45.3.100	92	1.00e-04	-4.759e+01	-4.759e+01	-	fl	fl	fl	7200	2.99e+01	-6.181e+01	-4.759e+01
unitbox.c:30.45.3.50	38	1.00e-04	-5.397e+01	-5.397e+01	14	1.00e-04	-5.397e+01	-5.397e+01	45	1.00e-04	-5.397e+01	-5.397e+01
unitbox.c:30.60.1.100	537	1.00e-04	-7.208e+01	-7.208e+01	1785	1.00e-04	-7.208e+01	-7.208e+01	7200	1.29e+00	-7.301e+01	-7.208e+01
unitbox.c:30.60.1.50	188	1.00e-04	-3.595e+01	-3.595e+01	2018	1.00e-04	-3.595e+01	-3.595e+01	835	1.00e-04	-3.595e+01	-3.595e+01
unitbox.c:30.60.2.100	5037	1.00e-04	-4.391e+01	-4.391e+01	7200	2.79e+01	-5.617e+01	-4.391e+01	7200	5.23e+01	-6.687e+01	-4.391e+01
unitbox.c:30.60.2.50	54	1.00e-04	-3.389e+01	-3.389e+01	812	1.00e-04	-3.389e+01	-3.389e+01	619	1.00e-04	-3.389e+01	-3.389e+01
unitbox.c:30.60.3.100	894	1.00e-04	-6.142e+01	-6.142e+01	7200	1.08e+01	-6.807e+01	-6.142e+01	7200	2.83e+01	-7.879e+01	-6.142e+01
unitbox.c:30.60.3.50	9	1.00e-04	-4.771e+01	-4.771e+01	32	1.00e-04	-4.771e+01	-4.771e+01	90	1.00e-04	-4.771e+01	-4.771e+01
unitbox.c:40.40.1.100	235	1.00e-04	-9.082e+01	-9.082e+01	7200	3.24e+01	-1.202e+02	-9.082e+01	7200	6.01e+01	-1.454e+02	-9.082e+01
unitbox.c:40.40.1.25	45	1.00e-04	-4.837e+01	-4.837e+01	11	1.00e-04	-4.837e+01	-4.837e+01	49	1.00e-04	-4.837e+01	-4.837e+01
unitbox.c:40.40.1.50	608	1.00e-04	-5.190e+01	-5.190e+01	7200	1.20e+01	-5.812e+01	-5.190e+01	7200	1.59e+01	-6.014e+01	-5.190e+01
unitbox.c:40.40.2.100	2133	1.00e-04	-7.136e+01	-7.136e+01	7200	5.78e+01	-1.126e+02	-7.136e+01	7200	1.02e+02	-1.439e+02	-7.136e+01
unitbox.c:40.40.2.25	41	1.00e-04	-4.465e+01	-4.465e+01	19	1.00e-04	-4.465e+01	-4.465e+01	90	1.00e-04	-4.465e+01	-4.465e+01
unitbox.c:40.40.2.50	306	1.00e-04	-5.571e+01	-5.571e+01	7200	1.02e+01	-6.140e+01	-5.571e+01	7200	1.03e+01	-6.119e+01	-5.571e+01
unitbox.c:40.40.3.100	10	1.00e-04	-9.769e+01	-9.769e+01	7200	1.33e+01	-1.107e+02	-9.769e+01	7200	4.25e+01	-1.392e+02	-9.769e+01
unitbox.c:40.40.3.25	0	1.00e-04	-6.216e+01	-6.216e+01	1	1.00e-04	-6.216e+01	-6.216e+01	0	1.00e-04	-6.216e+01	-6.216e+01
unitbox.c:40.40.3.50	2484	1.00e-04	-5.409e+01	-5.409e+01	7200	1.66e+01	-6.309e+01	-5.409e+01	7200	2.35e+01	-6.647e+01	-5.381e+01
unitbox.c:40.60.1.100	7200	8.65e+00	-5.737e+01	-5.281e+01	7200	1.02e+02	-1.066e+02	-5.282e+01	7200	1.68e+02	-1.397e+02	-5.223e+01
unitbox.c:40.60.1.25	414	1.00e-04	-4.806e+01	-4.806e+01	198	1.00e-04	-4.806e+01	-4.806e+01	178	1.00e-04	-4.806e+01	-4.806e+01
unitbox.c:40.60.1.50	282	1.00e-04	-7.681e+01	-7.681e+01	7200	3.91e+00	-7.981e+01	-7.681e+01	-	fl	fl	fl
unitbox.c:40.60.2.100	7200	2.33e+00	-7.884e+01	-7.708e+01	7200	5.71e+01	-1.211e+02	-7.708e+01	7200	1.05e+02	-1.533e+02	-7.473e+01
unitbox.c:40.60.2.25	45	1.00e-04	-4.176e+01	-4.176e+01	16	1.00e-04	-4.176e+01	-4.176e+01	80	1.00e-04	-4.176e+01	-4.176e+01
unitbox.c:40.60.2.50	176	1.00e-04	-5.507e+01	-5.507e+01	7200	9.62e+00	-6.037e+01	-5.507e+01	7200	6.79e+00	-5.881e+01	-5.507e+01
unitbox.c:40.60.3.100	7200	7.78e+00	-5.502e+01	-5.105e+01	7200	1.06e+02	-1.049e+02	-5.105e+01	7200	1.63e+02	-1.343e+02	-5.105e+01
unitbox.c:40.60.3.25	106	1.00e-04	-3.886e+01	-3.886e+01	72	1.00e-04	-3.886e+01	-3.886e+01	207	1.00e-04	-3.886e+01	-3.886e+01
unitbox.c:40.60.3.50	546	1.00e-04	-5.643e+01	-5.643e+01	7200	9.85e+00	-6.200e+01	-5.643e+01	7200	1.45e+01	-6.459e+01	-5.643e+01
unitbox.c:40.80.1.100	6957	1.00e-04	-9.777e+01	-9.777e+01	7200	3.26e+01	-1.296e+02	-9.777e+01	7200	6.67e+01	-1.621e+02	-9.725e+01
unitbox.c:40.80.1.25	1184	1.00e-04	-3.273e+01	-3.273e+01	6523	1.00e-04	-3.273e+01	-3.273e+01	1032	1.00e-04	-3.273e+01	-3.273e+01
unitbox.c:40.80.1.50	112	1.00e-04	-8.564e+01	-8.564e+01	430	1.00e-04	-8.564e+01	-8.564e+01	604	1.00e-04	-8.564e+01	-8.564e+01
unitbox.c:40.80.2.100	7200	1.40e-04	-1.039e+02	-1.039e+02	7200	2.33e+01	-1.281e+02	-1.039e+02	7200	5.39e+01	-1.590e+02	-1.033e+02
unitbox.c:40.80.2.25	338	1.00e-04	-4.842e+01	-4.842e+01	92	1.00e-04	-4.842e+01	-4.842e+01	122	1.00e-04	-4.842e+01	-4.842e+01
unitbox.c:40.80.2.50	202	1.00e-04	-5.993e+01	-5.993e+01	7200	7.20e+00	-6.424e+01	-5.993e+01	7200	8.13e+00	-6.480e+01	-5.993e+01
unitbox.c:40.80.3.100	7200	5.73e+00	-8.872e+01	-8.391e+01	7200	4.97e+01	-1.256e+02	-8.391e+01	7200	8.65e+01	-1.565e+02	-8.391e+01

continued on the next page

Table 8 (QCQP from Bao et al. [18] Results) continued

Problem Name	GloMIQO 2.3				BARON 12.3.3				Couenne 0.4			
	Time	Gap	LB	UB	Time	Gap	LB	UB	Time	Gap	LB	UB
unitbox.c.40.80.3.25	203	1.00e-04	-3.090e+01	-3.090e+01	886	1.00e-04	-3.090e+01	-3.090e+01	689	1.00e-04	-3.090e+01	-3.090e+01
unitbox.c.40.80.3.50	7200	7.97e+00	-5.494e+01	-5.088e+01	7200	2.87e+00	-6.548e+01	-5.088e+01	7200	3.87e+01	-7.004e+01	-5.048e+01
unitbox.c.48.48.1.25	2140	1.00e-04	-5.211e+01	-5.211e+01	7200	5.94e+00	-5.521e+01	-5.211e+01	7200	1.93e+00	-5.297e+01	-5.197e+01
unitbox.c.48.48.2.25	108	1.00e-04	-5.099e+01	-5.099e+01	296	1.00e-04	-5.099e+01	-5.099e+01	643	1.00e-04	-5.099e+01	-5.099e+01
unitbox.c.48.48.3.25	393	1.00e-04	-5.580e+01	-5.580e+01	5627	1.00e-04	-5.580e+01	-5.580e+01	2241	1.00e-04	-5.580e+01	-5.580e+01
unitbox.c.48.72.1.25	85	1.00e-04	-4.915e+01	-4.915e+01	248	1.00e-04	-4.915e+01	-4.915e+01	550	1.00e-04	-4.915e+01	-4.915e+01
unitbox.c.48.72.2.25	206	1.00e-04	-6.377e+01	-6.377e+01	198	1.00e-04	-6.377e+01	-6.377e+01	502	1.00e-04	-6.377e+01	-6.377e+01
unitbox.c.48.72.3.25	112	1.00e-04	-5.976e+01	-5.976e+01	1502	1.00e-04	-5.976e+01	-5.976e+01	1199	1.00e-04	-5.976e+01	-5.976e+01
unitbox.c.48.96.1.25	381	1.00e-04	-7.068e+01	-7.068e+01	149	1.00e-04	-7.068e+01	-7.068e+01	430	1.00e-04	-7.068e+01	-7.068e+01
unitbox.c.48.96.2.25	7200	3.34e+00	-4.052e+01	-3.921e+01	7200	1.50e+01	-4.509e+01	-3.921e+01	7200	2.43e+01	-4.706e+01	-3.786e+01
unitbox.c.48.96.3.25	1420	1.00e-04	-3.831e+01	-3.831e+01	7200	1.06e+01	-4.236e+01	-3.831e+01	7200	1.26e+01	-4.314e+01	-3.830e+01
unitbox.c.10.10.1.00	0	1.00e-04	-1.418e+01	-1.418e+01	0	1.00e-04	-1.418e+01	-1.418e+01	1	1.00e-04	-1.418e+01	-1.418e+01
unitbox.c.10.10.1.50	0	1.00e-04	-7.380e+00	-7.380e+00	0	1.00e-04	-7.380e+00	-7.380e+00	0	1.00e-04	-7.380e+00	-7.380e+00
unitbox.c.10.10.2.100	0	1.00e-04	-6.547e+00	-6.547e+00	0	1.00e-04	-6.547e+00	-6.547e+00	0	1.00e-04	-6.547e+00	-6.547e+00
unitbox.c.10.10.2.50	0	1.00e-04	-6.950e+00	-6.950e+00	0	1.00e-04	-6.950e+00	-6.950e+00	0	1.00e-04	-6.950e+00	-6.950e+00
unitbox.c.10.10.3.100	0	1.00e-04	-1.179e+01	-1.179e+01	0	1.00e-04	-1.179e+01	-1.179e+01	0	1.00e-04	-1.179e+01	-1.179e+01
unitbox.c.10.10.3.50	0	1.00e-04	-1.030e+01	-1.030e+01	0	1.00e-04	-1.030e+01	-1.030e+01	0	1.00e-04	-1.030e+01	-1.030e+01
unitbox.c.10.15.1.100	0	1.00e-04	-1.164e+01	-1.164e+01	0	1.00e-04	-1.164e+01	-1.164e+01	1	1.00e-04	-1.164e+01	-1.164e+01
unitbox.c.10.15.1.50	0	1.00e-04	-5.390e+00	-5.390e+00	0	1.00e-04	-5.390e+00	-5.390e+00	0	1.00e-04	-5.390e+00	-5.390e+00
unitbox.c.10.15.2.100	0	1.00e-04	-2.807e+01	-2.807e+01	0	1.00e-04	-2.807e+01	-2.807e+01	0	1.00e-04	-2.807e+01	-2.807e+01
unitbox.c.10.15.2.50	0	1.00e-04	-1.160e+01	-1.160e+01	0	1.00e-04	-1.160e+01	-1.160e+01	0	1.00e-04	-1.160e+01	-1.160e+01
unitbox.c.10.15.3.100	0	1.00e-04	-7.980e+00	-7.980e+00	0	1.00e-04	-7.980e+00	-7.980e+00	0	1.00e-04	-7.980e+00	-7.980e+00
unitbox.c.10.15.3.50	0	1.00e-04	-7.830e+00	-7.830e+00	0	1.00e-04	-7.830e+00	-7.830e+00	0	1.00e-04	-7.830e+00	-7.830e+00
unitbox.c.10.20.1.100	0	1.00e-04	-8.190e+00	-8.190e+00	0	1.00e-04	-8.190e+00	-8.190e+00	1	1.00e-04	-8.190e+00	-8.190e+00
unitbox.c.10.20.1.50	0	1.00e-04	-5.400e+00	-5.400e+00	0	1.00e-04	-5.400e+00	-5.400e+00	0	1.00e-04	-5.400e+00	-5.400e+00
unitbox.c.10.20.2.100	0	1.00e-04	-1.594e+01	-1.594e+01	0	1.00e-04	-1.594e+01	-1.594e+01	1	1.00e-04	-1.594e+01	-1.594e+01
unitbox.c.10.20.2.50	0	1.00e-04	-3.130e+00	-3.130e+00	0	1.00e-04	-3.130e+00	-3.130e+00	2	1.00e-04	-3.130e+00	-3.130e+00
unitbox.c.10.20.3.100	0	1.00e-04	-5.899e+00	-5.899e+00	0	1.00e-04	-5.899e+00	-5.899e+00	1	1.00e-04	-5.899e+00	-5.899e+00
unitbox.c.10.20.3.50	0	1.00e-04	-7.490e+00	-7.490e+00	0	1.00e-04	-7.490e+00	-7.490e+00	0	1.00e-04	-7.490e+00	-7.490e+00
unitbox.c.20.20.1.100	7	1.00e-04	-2.819e+01	-2.819e+01	39	1.00e-04	-2.819e+01	-2.819e+01	92	1.00e-04	-2.819e+01	-2.819e+01
unitbox.c.20.20.1.25	0	1.00e-04	-1.286e+01	-1.286e+01	0	1.00e-04	-1.286e+01	-1.286e+01	0	1.00e-04	-1.286e+01	-1.286e+01
unitbox.c.20.20.1.50	0	1.00e-04	-2.660e+01	-2.660e+01	0	1.00e-04	-2.660e+01	-2.660e+01	1	1.00e-04	-2.660e+01	-2.660e+01
unitbox.c.20.20.2.100	44	1.00e-04	-1.888e+01	-1.888e+01	83	1.00e-04	-1.888e+01	-1.888e+01	177	1.00e-04	-1.888e+01	-1.888e+01
unitbox.c.20.20.2.25	0	1.00e-04	-9.880e+00	-9.880e+00	0	1.00e-04	-9.880e+00	-9.880e+00	0	1.00e-04	-9.880e+00	-9.880e+00
unitbox.c.20.20.2.50	0	1.00e-04	-1.703e+01	-1.703e+01	1	1.00e-04	-1.703e+01	-1.703e+01	8	1.00e-04	-1.703e+01	-1.703e+01
unitbox.c.20.20.3.100	0	1.00e-04	-2.610e+01	-2.610e+01	33	1.00e-04	-2.610e+01	-2.610e+01	82	1.00e-04	-2.610e+01	-2.610e+01
unitbox.c.20.20.3.25	0	1.00e-04	-2.343e+01	-2.343e+01	0	1.00e-04	-2.343e+01	-2.343e+01	0	1.00e-04	-2.343e+01	-2.343e+01
unitbox.c.20.20.3.50	0	1.00e-04	-1.854e+01	-1.854e+01	0	1.00e-04	-1.854e+01	-1.854e+01	1	1.00e-04	-1.854e+01	-1.854e+01
unitbox.c.20.30.1.100	12	1.00e-04	-1.708e+01	-1.708e+01	292	1.00e-04	-1.708e+01	-1.708e+01	428	1.00e-04	-1.708e+01	-1.708e+01
unitbox.c.20.30.1.25	0	1.00e-04	-1.336e+01	-1.336e+01	0	1.00e-04	-1.336e+01	-1.336e+01	1	1.00e-04	-1.336e+01	-1.336e+01
unitbox.c.20.30.1.50	0	1.00e-04	-2.009e+01	-2.009e+01	2	1.00e-04	-2.009e+01	-2.009e+01	9	1.00e-04	-2.009e+01	-2.009e+01
unitbox.c.20.30.2.100	25	1.00e-04	-1.995e+01	-1.995e+01	52	1.00e-04	-1.995e+01	-1.995e+01	137	1.00e-04	-1.995e+01	-1.995e+01
unitbox.c.20.30.2.25	0	1.00e-04	-1.368e+01	-1.368e+01	0	1.00e-04	-1.368e+01	-1.368e+01	0	1.00e-04	-1.368e+01	-1.368e+01
unitbox.c.20.30.2.50	0	1.00e-04	-2.471e+01	-2.471e+01	0	1.00e-04	-2.471e+01	-2.471e+01	0	1.00e-04	-2.471e+01	-2.471e+01
unitbox.c.20.30.3.100	32	1.00e-04	-2.406e+01	-2.406e+01	42	1.00e-04	-2.406e+01	-2.406e+01	108	1.00e-04	-2.406e+01	-2.406e+01
unitbox.c.20.30.3.25	0	1.00e-04	-9.544e+00	-9.544e+00	0	1.00e-04	-9.544e+00	-9.544e+00	0	1.00e-04	-9.544e+00	-9.544e+00
unitbox.c.20.30.3.50	0	1.00e-04	-2.883e+01	-2.883e+01	0	1.00e-04	-2.883e+01	-2.883e+01	1	1.00e-04	-2.883e+01	-2.883e+01
unitbox.c.20.40.1.100	60	1.00e-04	-1.931e+01	-1.931e+01	230	1.00e-04	-1.931e+01	-1.931e+01	311	1.00e-04	-1.931e+01	-1.931e+01
unitbox.c.20.40.1.25	0	1.00e-04	-1.059e+01	-1.059e+01	0	1.00e-04	-1.059e+01	-1.059e+01	0	1.00e-04	-1.059e+01	-1.059e+01

continued on the next page

Table 8 (QCQP from Bao et al. [18] Results) continued

Problem Name	GloMIQO 2.3				BARON 12.3.3				Couenne 0.4			
	Time	Gap	LB	UB	Time	Gap	LB	UB	Time	Gap	LB	UB
unitbox.c.20.40.1.50	5	1.00e-04	-2.197e+01	-2.197e+01	2	1.00e-04	-2.197e+01	-2.197e+01	4	1.00e-04	-2.197e+01	-2.197e+01
unitbox.c.20.40.2.100	50	1.00e-04	-3.051e+01	-3.051e+01	34	1.00e-04	-3.051e+01	-3.051e+01	67	1.00e-04	-3.051e+01	-3.051e+01
unitbox.c.20.40.2.25	0	1.00e-04	-1.083e+01	-1.083e+01	0	1.00e-04	-1.083e+01	-1.083e+01	1	1.00e-04	-1.083e+01	-1.083e+01
unitbox.c.20.40.2.50	8	1.00e-04	-2.426e+01	-2.426e+01	2	1.00e-04	-2.426e+01	-2.426e+01	84	1.00e-04	-2.426e+01	-2.426e+01
unitbox.c.20.40.3.100	1	1.00e-04	-2.627e+01	-2.627e+01	36	1.00e-04	-2.627e+01	-2.627e+01	8	1.00e-04	-2.627e+01	-2.627e+01
unitbox.c.20.40.3.25	0	1.00e-04	-1.377e+01	-1.377e+01	0	1.00e-04	-1.377e+01	-1.377e+01	4	1.00e-04	-1.377e+01	-1.377e+01
unitbox.c.20.40.3.50	0	1.00e-04	-2.741e+01	-2.741e+01	0	1.00e-04	-2.741e+01	-2.741e+01	0	1.00e-04	-2.741e+01	-2.741e+01
unitbox.c.28.28.1.25	0	1.00e-04	-3.023e+01	-3.023e+01	0	1.00e-04	-3.023e+01	-3.023e+01	0	1.00e-04	-3.023e+01	-3.023e+01
unitbox.c.28.28.2.25	0	1.00e-04	-2.715e+01	-2.715e+01	0	1.00e-04	-2.715e+01	-2.715e+01	0	1.00e-04	-2.715e+01	-2.715e+01
unitbox.c.28.28.2.50	2	1.00e-04	-2.853e+01	-2.853e+01	1	1.00e-04	-2.853e+01	-2.853e+01	2	1.00e-04	-2.853e+01	-2.853e+01
unitbox.c.28.28.3.25	2	1.00e-04	-3.753e+01	-3.753e+01	1	1.00e-04	-3.753e+01	-3.753e+01	6	1.00e-04	-3.753e+01	-3.753e+01
unitbox.c.28.42.1.25	0	1.00e-04	-2.678e+01	-2.678e+01	0	1.00e-04	-2.678e+01	-2.678e+01	1	1.00e-04	-2.678e+01	-2.678e+01
unitbox.c.28.42.2.25	0	1.00e-04	-2.984e+01	-2.984e+01	0	1.00e-04	-2.984e+01	-2.984e+01	0	1.00e-04	-2.984e+01	-2.984e+01
unitbox.c.28.42.3.25	1	1.00e-04	-1.798e+01	-1.798e+01	1	1.00e-04	-1.798e+01	-1.798e+01	3	1.00e-04	-1.798e+01	-1.798e+01
unitbox.c.28.56.1.25	0	1.00e-04	-2.501e+01	-2.501e+01	1	1.00e-04	-2.501e+01	-2.501e+01	1	1.00e-04	-2.501e+01	-2.501e+01
unitbox.c.28.56.2.25	0	1.00e-04	-3.265e+01	-3.265e+01	2	1.00e-04	-3.265e+01	-3.265e+01	24	1.00e-04	-3.265e+01	-3.265e+01
unitbox.c.28.56.3.25	8	1.00e-04	-1.099e+02	-9.490e+01	7200	1.01e+02	-1.903e+02	-9.490e+01	7200	1.61e+02	-2.479e+02	-9.490e+01
unitbox.c.50.100.1.100	7200	1.71e+01	-1.012e+02	-8.639e+01	7200	3.32e+01	-1.151e+02	-8.639e+01	7200	5.11e+01	-1.285e+02	-8.502e+01
unitbox.c.50.100.1.50	7200	1.99e+01	-1.179e+02	-9.835e+01	7200	1.12e+02	-2.085e+02	-9.835e+01	7200	1.75e+02	-2.707e+02	-9.835e+01
unitbox.c.50.100.2.100	7200	1.38e+01	-8.904e+01	-7.824e+01	7200	3.66e+01	-1.068e+02	-7.824e+01	7200	5.43e+01	-1.185e+02	-7.682e+01
unitbox.c.50.100.2.50	7200	7.70e+00	-1.455e+02	-1.351e+02	7200	6.68e+01	-2.253e+02	-1.351e+02	7200	1.12e+02	-2.789e+02	-1.319e+02
unitbox.c.50.100.3.100	7200	1.82e+01	-8.009e+01	-6.773e+01	7200	4.54e+01	-9.847e+01	-6.773e+01	7200	6.81e+01	-1.139e+02	-6.773e+01
unitbox.c.50.100.3.50	7200	9.46e+00	-1.105e+02	-1.010e+02	7200	9.07e+01	-1.925e+02	-1.010e+02	7200	1.46e+02	-2.479e+02	-1.010e+02
unitbox.c.50.50.1.100	7200	4.54e+01	-8.428e+01	-5.796e+01	7200	6.84e+01	-9.762e+01	-5.796e+01	7200	8.94e+01	-1.098e+02	-5.796e+01
unitbox.c.50.50.1.50	7200	1.93e+01	-9.261e+01	-7.762e+01	7200	1.20e+02	-1.708e+02	-7.762e+01	7200	1.96e+02	-2.299e+02	-7.762e+01
unitbox.c.50.50.2.100	7200	1.24e+01	-8.844e+01	-7.867e+01	7200	3.76e+01	-1.082e+02	-7.867e+01	7200	5.17e+01	-1.194e+02	-7.867e+01
unitbox.c.50.50.2.50	7200	1.08e+01	-1.331e+02	-1.201e+02	7200	7.68e+01	-2.123e+02	-1.201e+02	7200	1.24e+02	-2.690e+02	-1.201e+02
unitbox.c.50.50.3.100	7200	1.82e+01	-9.245e+01	-7.822e+01	7200	3.71e+01	-1.072e+02	-7.822e+01	7200	5.49e+01	-1.197e+02	-7.725e+01
unitbox.c.50.50.3.50	7200	1.35e+01	-1.599e+02	-1.409e+02	7200	6.34e+01	-2.303e+02	-1.409e+02	7200	1.00e+02	-2.819e+02	-1.408e+02
unitbox.c.50.75.1.100	7200	6.25e+00	-9.865e+01	-9.285e+01	7200	2.10e+01	-1.123e+02	-9.285e+01	7200	3.25e+01	-1.230e+02	-9.282e+01
unitbox.c.50.75.1.50	7200	2.54e+01	-9.411e+01	-7.504e+01	7200	1.44e+02	-1.828e+02	-7.504e+01	7200	2.25e+02	-2.428e+02	-7.469e+01
unitbox.c.50.75.2.100	7200	2.74e+01	-8.790e+01	-6.901e+01	7200	5.24e+01	-1.052e+02	-6.901e+01	7200	7.44e+01	-1.186e+02	-6.801e+01
unitbox.c.50.75.2.50	7200	5.95e+00	-1.137e+02	-1.074e+02	7200	8.39e+01	-1.979e+02	-1.074e+02	7200	1.34e+02	-2.522e+02	-1.076e+02
unitbox.c.50.75.3.100	7200	2.35e+01	-8.104e+01	-6.562e+01	7200	5.07e+01	-9.888e+01	-6.562e+01	7200	6.95e+01	-1.112e+02	-6.562e+01
unitbox.c.8.12.1.25	0	1.00e-04	-6.440e+00	-6.440e+00	0	1.00e-04	-6.440e+00	-6.440e+00	0	1.00e-04	-6.440e+00	-6.440e+00
unitbox.c.8.12.2.25	0	1.00e-04	-2.140e+00	-2.140e+00	0	1.00e-04	-2.140e+00	-2.140e+00	0	1.00e-04	-2.140e+00	-2.140e+00
unitbox.c.8.12.3.25	0	1.00e-04	-9.210e+00	-9.210e+00	0	1.00e-04	-9.210e+00	-9.210e+00	0	1.00e-04	-9.210e+00	-9.210e+00
unitbox.c.8.16.1.25	0	1.00e-04	-2.490e+00	-2.490e+00	0	1.00e-04	-2.490e+00	-2.490e+00	0	1.00e-04	-2.490e+00	-2.490e+00
unitbox.c.8.16.2.25	0	1.00e-04	-2.790e+00	-2.790e+00	0	1.00e-04	-2.790e+00	-2.790e+00	0	1.00e-04	-2.790e+00	-2.790e+00
unitbox.c.8.16.3.25	0	1.00e-04	-2.440e+00	-2.440e+00	0	1.00e-04	-2.440e+00	-2.440e+00	0	1.00e-04	-2.440e+00	-2.440e+00
unitbox.c.8.16.4.25	0	1.00e-04	-3.970e+00	-3.970e+00	0	1.00e-04	-3.970e+00	-3.970e+00	0	1.00e-04	-3.970e+00	-3.970e+00
unitbox.c.8.16.5.25	0	1.00e-04	-5.600e-01	-5.600e-01	0	1.00e-04	-5.600e-01	-5.600e-01	0	1.00e-04	-5.600e-01	-5.600e-01
unitbox.c.8.16.6.25	0	1.00e-04	-5.300e+00	-5.300e+00	0	1.00e-04	-5.300e+00	-5.300e+00	0	1.00e-04	-5.300e+00	-5.300e+00
unitbox.c.8.3.25	0	1.00e-04	-5.300e+00	-5.300e+00	0	1.00e-04	-5.300e+00	-5.300e+00	0	1.00e-04	-5.300e+00	-5.300e+00

Gap $\equiv 100 \cdot \left(\frac{UB-LB}{LB} \right)$; Termination Criteria: Gap $\equiv 1 \times 10^{-4}\%$ or Time = 7200 s