Mixed-Integer Quadratically-Constrained Quadratic Programs: GloMIQO 2.2 Test Suite

Ruth Misener[1,2] and Christodoulos A. Floudas[1,*]

[1] Department of Chemical and Biological Engineering
Princeton University; Princeton, NJ 08544-5263; USA

[2] Department of Chemical Engineering
Imperial College London; South Kensington SW7 2AZ; UK

May 16, 2013

This document outlines the test suite validating GloMIQO 2.2. We document source files from both the academic literature and well-maintained websites, provide links to the modeling files in GAMS scalar format, and record the relative sizes of each of the problems. Table 1 defines a test suite of 1041 problems from standard libraries and the open literature; Tables 2 – 11 in Appendix A give more detailed analysis as to the size and complexity of the individual problems.

We run each computational experiment under 4 termination criteria: (1) a relative optimality gap $\varepsilon = \frac{UB-LB}{|LB|} \leq 1 \times 10^{-6} = 1 \times 10^{-4}\%$; (2) an absolute optimality gap $\varepsilon = UB - LB = 1 \times 10^{-6}$; (3) a 7200 s time limit; (4) an iteration limit of $9 \cdot 10^9$. No other parameters were altered from default. After solving each of the 1041 test cases using GAMS, a Perl script assert the feasibility of the solution returned by each solver. Instances where solvers returned infeasible points are automatically relabelled as failures (*fl*) (violating a variable bound or constraint equation by 10^{-4} or more).

The figures were generated using the GAMS Performance Tools with options: `colselect`; `useobjest`; `bnd=1e-4`; `gaptol=1e-4` (PTOOLS 1.1; `http://www.gamsworld.org/performance/paver/`; accessed 11 March 2013). PTOOLS takes trace files returned by the solver and automatically creates performance profiles. The only processing done in transit between trace files generated by the solvers and the PTOOLS input was to penalize solvers for returning infeasible solutions and to add a column for the `colselect` option.

*To whom all correspondence should be addressed (`floudas@titan.princeton.edu`; Tel: (609)258-4595; Fax: (609)258-0211).

Table 1: MINLP Test Suite of 1041 *Problems*

Problem Class		# Cases	Discrete	Source
Process Networks	Crude Oil Scheduling	31	✓	[18, 19, 20, 26, 27]
	Multi-Period Blending	7	✓	[16, 17]
	Natural Gas Production	3	✓	[21, 22, 33]
	Pooling	19	✓	[25]
	Supply Chain Design	1	✓	[38, 39]
	Unit Commitment	1	✓	[28, 40]
	Water Treatment Network	8	✓	[2, 1, 15, 29]
	Water Treatment System	32		[10, 11]
	Water-Using Network	35		[9, 34, 35]
Computational Geometry	Circles & Polygon Nesting	36		[14]
	Nesting	5		[13]
	Point Packing	14		[4]
QCQP Test Sets	BoxQP	90		[7, 36, 37]
	Randomly-Generated QCQP	135		[5]
	Standard QP	14		[32]
Reformulated Libraries	Reform. GLOBALLib	32		[12, 24, 31]
	Reform. MINLPLib	10	✓	[8, 12]
Test Libraries	Bonmin Test Set	20	✓	[6, 30]
	GLOBALLib	172		[12, 24]
	LINLib	30		
	MacMOOPLib	9		
	MPLLib	22		
	MINLPLib	102	✓	[8, 12]
	PrincetonLib	146		
	QAP	67		[3, 23]

Each figure has a subfigure (a) and (b). Subfigures (a) are the output of PTOOLS using **solver reported time** as a resource measurement and the `objest` option to enforce an objective gap of 10^{-4}. Paraphrasing the PTOOLS output, a solver is considered optimal if it has the proper model and solver return codes and the relative objective value error is within 10^{-4} of the best possible solution. If the best found objective value is 0, then the absolute objective value error is used. Subfigures (b) use the `colselect` command (and switch off `useobjest`); this allows us to compare the solvers with respect to their optimality gap at termination ($100 \cdot \frac{UB-LB}{|LB|}$); this column in the GAMS trace file was created with the same Perl script that asserts feasibility of the solution.

1 137 Process Networks Test Cases

1.1 31 Crude Oil Scheduling [18, 19, 20, 26, 27]

`ex01 ex02 ex03 ex05 ex06 ex11 ex21`

`Scheduler_LeeCrudeOil1_05` `Scheduler_LeeCrudeOil1_06`
`Scheduler_LeeCrudeOil1_07` `Scheduler_LeeCrudeOil1_08`
`Scheduler_LeeCrudeOil1_09` `Scheduler_LeeCrudeOil1_10`
`Scheduler_LeeCrudeOil2_05` `Scheduler_LeeCrudeOil2_06`
`Scheduler_LeeCrudeOil2_07` `Scheduler_LeeCrudeOil2_08`
`Scheduler_LeeCrudeOil2_09` `Scheduler_LeeCrudeOil2_10`
`Scheduler_LeeCrudeOil3_05` `Scheduler_LeeCrudeOil3_06`
`Scheduler_LeeCrudeOil3_07` `Scheduler_LeeCrudeOil3_08`
`Scheduler_LeeCrudeOil3_09` `Scheduler_LeeCrudeOil3_10`
`Scheduler_LeeCrudeOil4_05` `Scheduler_LeeCrudeOil4_06`
`Scheduler_LeeCrudeOil4_07` `Scheduler_LeeCrudeOil4_08`
`Scheduler_LeeCrudeOil4_09` `Scheduler_LeeCrudeOil4_10`

1.2 7 Multi-Period Blending [16, 17]

`MPBP_6T_3P_2Q_029` `MPBP_8T_3P_2Q_146` `MPBP_8T_3P_2Q_718`
`MPBP_8T_3P_2Q_721` `MPBP_8T_4P_2Q_480` `MPBP_8T_4P_2Q_531`
`MPBP_8T_4P_2Q_852`

1.3 3 Natural Gas Production [21, 22, 33]

`Sarawak_Scenario1` `Sarawak_Scenario16` `Sarawak_Scenario81`

1.4 19 Pooling [25]

adhya1	adhya2	adhya3	adhya4	bental4	bental5	
foulds2	foulds3	foulds4	foulds5	haverly1	haverly2	
haverly3	lee1	lee2	meyer04	meyer10	meyer15	rt2

1.5 1 Supply Chain Design [38, 39]

you_supply_chain_design_2

1.6 1 Unit Commitment [28, 40]

zondervan_UC_convex

1.7 8 Water Treatment Network [1, 2, 15, 29]

concbased	Ex1b_WaterNetwokProblem-WOEps_pw4
Ex_2__WaterNetwokProblem-NoEps_pw4	flowbased_pw4
kg_example1	kg_example2_pw4
kg_example3_pw4	kg_example4_pw4

1.8 32 Water Treatment System [10, 11]

castro_etal_2007_wts_Ex01_M1	castro_etal_2007_wts_Ex01_M2
castro_etal_2007_wts_Ex02_M1	castro_etal_2007_wts_Ex02_M2
castro_etal_2007_wts_Ex03_M1	castro_etal_2007_wts_Ex03_M2
castro_etal_2007_wts_Ex04_M1	castro_etal_2007_wts_Ex04_M2
castro_etal_2007_wts_Ex05_M1	castro_etal_2007_wts_Ex05_M2
castro_etal_2007_wts_Ex06_M1	castro_etal_2007_wts_Ex06_M2
castro_etal_2007_wts_Ex07_M1	castro_etal_2007_wts_Ex07_M2
castro_etal_2007_wts_Ex08_M1	castro_etal_2007_wts_Ex08_M2
castro_etal_2007_wts_Ex09_M1	castro_etal_2007_wts_Ex09_M2
castro_etal_2007_wts_Ex10_M1	castro_etal_2007_wts_Ex10_M2
castro_etal_2007_wts_Ex11_M1	castro_etal_2007_wts_Ex11_M2
castro_etal_2007_wts_Ex12_M1	castro_etal_2007_wts_Ex12_M2
castro_etal_2007_wts_Ex13_M1	castro_etal_2007_wts_Ex13_M2
castro_etal_2007_wts_Ex14_M1	castro_etal_2007_wts_Ex14_M2
castro_etal_2007_wts_Ex15_M1	castro_etal_2007_wts_Ex15_M2
castro_etal_2007_wts_Ex16_M1	castro_etal_2007_wts_Ex16_M2

1.9 35 Water-Using Network [9, 34, 35]

teles_etal_2009_WUN_Ex01	teles_etal_2009_WUN_Ex02
teles_etal_2009_WUN_Ex03	teles_etal_2009_WUN_Ex04
teles_etal_2009_WUN_Ex05	teles_etal_2009_WUN_Ex06
teles_etal_2009_WUN_Ex07	teles_etal_2009_WUN_Ex08
teles_etal_2009_WUN_Ex09	teles_etal_2009_WUN_Ex10
teles_etal_2009_WUN_Ex11	teles_etal_2009_WUN_Ex12
teles_etal_2009_WUN_Ex13	teles_etal_2009_WUN_Ex14
teles_etal_2009_WUN_Ex16	teles_etal_2009_WUN_Ex17
teles_etal_2009_WUN_Ex18	teles_etal_2009_WUN_Ex19
teles_etal_2009_WUN_Ex20	teles_etal_2009_WUN_Ex21
teles_etal_2009_WUN_Ex22	teles_etal_2009_WUN_Ex23
teles_etal_2009_WUN_Ex24	teles_etal_2009_WUN_Ex25
teles_etal_2009_WUN_Ex26	teles_etal_2009_WUN_Ex27
teles_etal_2009_WUN_Ex28	teles_etal_2009_WUN_Ex29
teles_etal_2009_WUN_Ex30	teles_etal_2009_WUN_Ex31
teles_etal_2009_WUN_Ex32	teles_etal_2009_WUN_Ex33
teles_etal_2009_WUN_Ex34	teles_etal_2009_WUN_Ex35
teles_etal_2009_WUN_Ex36	

2 55 Computational Geometry Test Cases

2.1 36 Circles & Polygon Nesting [14]

kall_circles_c6a	kall_circles_c6ax
kall_circles_c6b	kall_circles_c6c
kall_circles_c7a	kall_circles_c8a
kall_circlespolygons_c1p11	kall_circlespolygons_c1p12
kall_circlespolygons_c1p13	kall_circlespolygons_c1p5a
kall_circlespolygons_c1p5b	kall_circlespolygons_c1p6a
kall_circlesrectangles_c1r11	kall_circlesrectangles_c1r12
kall_circlesrectangles_c1r13	kall_circlesrectangles_c6r1
kall_circlesrectangles_c6r29	kall_circlesrectangles_c6r39
kall_congruentcircles_c31	kall_congruentcircles_c32
kall_congruentcircles_c41	kall_congruentcircles_c42
kall_congruentcircles_c51	kall_congruentcircles_c52

kall_congruentcircles_c61 kall_congruentcircles_c62
kall_congruentcircles_c63 kall_congruentcircles_c71
kall_congruentcircles_c72 kall_diffcircles_10
kall_diffcircles_5a kall_diffcircles_5b
kall_diffcircles_6 kall_diffcircles_7
kall_diffcircles_8 kall_diffcircles_9

2.2 5 Nesting [13]

nesting_4B nesting_4F
nesting_6E nesting_6EM nesting_6EMA

2.3 14 Point Packing [4]

pnt_pack_02 pnt_pack_03 pnt_pack_04 pnt_pack_05
pnt_pack_06 pnt_pack_07 pnt_pack_08 pnt_pack_09
pnt_pack_10 pnt_pack_11 pnt_pack_12 pnt_pack_13
pnt_pack_14 pnt_pack_15

3 239 Quadratically-Constrained Quadratic Programs from the Literature

3.1 90 Box-Constrained Quadratic Programs (BoxQP) [7, 36, 37]

spar020-100-1 spar020-100-2 spar020-100-3
spar030-060-1 spar030-060-2 spar030-060-3
spar030-070-1 spar030-070-2 spar030-070-3
spar030-080-1 spar030-080-2 spar030-080-3
spar030-090-1 spar030-090-2 spar030-090-3
spar030-100-1 spar030-100-2 spar030-100-3
spar040-030-1 spar040-030-2 spar040-030-3
spar040-040-1 spar040-040-2 spar040-040-3
spar040-050-1 spar040-050-2 spar040-050-3
spar040-060-1 spar040-060-2 spar040-060-3
spar040-070-1 spar040-070-2 spar040-070-3
spar040-080-1 spar040-080-2 spar040-080-3
spar040-090-1 spar040-090-2 spar040-090-3
spar040-100-1 spar040-100-2 spar040-100-3
spar050-030-1 spar050-030-2 spar050-030-3

spar050-040-1	spar050-040-2	spar050-040-3
spar050-050-1	spar050-050-2	spar050-050-3
spar060-020-1	spar060-020-2	spar060-020-3
spar070-025-1	spar070-025-2	spar070-025-3
spar070-050-1	spar070-050-2	spar070-050-3
spar070-075-1	spar070-075-2	spar070-075-3
spar080-025-1	spar080-025-2	spar080-025-3
spar080-050-1	spar080-050-2	spar080-050-3
spar080-075-1	spar080-075-2	spar080-075-3
spar090-025-1	spar090-025-2	spar090-025-3
spar090-050-1	spar090-050-2	spar090-050-3
spar090-075-1	spar090-075-2	spar090-075-3
spar100-025-1	spar100-025-2	spar100-025-3
spar100-050-1	spar100-050-2	spar100-050-3
spar100-075-1	spar100-075-2	spar100-075-3

3.2 135 Randomly-Generated QCQP [5]

unitbox_c_10_10_1_100	unitbox_c_10_10_1_50	unitbox_c_10_10_2_100
unitbox_c_10_10_2_50	unitbox_c_10_10_3_100	unitbox_c_10_10_3_50
unitbox_c_10_15_1_100	unitbox_c_10_15_1_50	unitbox_c_10_15_2_100
unitbox_c_10_15_2_50	unitbox_c_10_15_3_100	unitbox_c_10_15_3_50
unitbox_c_10_20_1_100	unitbox_c_10_20_1_50	unitbox_c_10_20_2_100
unitbox_c_10_20_2_50	unitbox_c_10_20_3_100	unitbox_c_10_20_3_50
unitbox_c_20_20_1_100	unitbox_c_20_20_1_25	unitbox_c_20_20_1_50
unitbox_c_20_20_2_100	unitbox_c_20_20_2_25	unitbox_c_20_20_2_50
unitbox_c_20_20_3_100	unitbox_c_20_20_3_25	unitbox_c_20_20_3_50
unitbox_c_20_30_1_100	unitbox_c_20_30_1_25	unitbox_c_20_30_1_50
unitbox_c_20_30_2_100	unitbox_c_20_30_2_25	unitbox_c_20_30_2_50
unitbox_c_20_30_3_100	unitbox_c_20_30_3_25	unitbox_c_20_30_3_50
unitbox_c_20_40_1_100	unitbox_c_20_40_1_25	unitbox_c_20_40_1_50
unitbox_c_20_40_2_100	unitbox_c_20_40_2_25	unitbox_c_20_40_2_50
unitbox_c_20_40_3_100	unitbox_c_20_40_3_25	unitbox_c_20_40_3_50
unitbox_c_28_28_1_25	unitbox_c_28_28_2_25	unitbox_c_28_28_3_25
unitbox_c_28_42_1_25	unitbox_c_28_42_2_25	unitbox_c_28_42_3_25
unitbox_c_28_56_1_25	unitbox_c_28_56_2_25	unitbox_c_28_56_3_25

unitbox_c_30_30_1_100	unitbox_c_30_30_1_50	unitbox_c_30_30_2_100
unitbox_c_30_30_2_50	unitbox_c_30_30_3_100	unitbox_c_30_30_3_50
unitbox_c_30_45_1_100	unitbox_c_30_45_1_50	unitbox_c_30_45_2_100
unitbox_c_30_45_2_50	unitbox_c_30_45_3_100	unitbox_c_30_45_3_50
unitbox_c_30_60_1_100	unitbox_c_30_60_1_50	unitbox_c_30_60_2_100
unitbox_c_30_60_2_50	unitbox_c_30_60_3_100	unitbox_c_30_60_3_50
unitbox_c_40_40_1_100	unitbox_c_40_40_1_25	unitbox_c_40_40_1_50
unitbox_c_40_40_2_100	unitbox_c_40_40_2_25	unitbox_c_40_40_2_50
unitbox_c_40_40_3_100	unitbox_c_40_40_3_25	unitbox_c_40_40_3_50
unitbox_c_40_60_1_100	unitbox_c_40_60_1_25	unitbox_c_40_60_1_50
unitbox_c_40_60_2_100	unitbox_c_40_60_2_25	unitbox_c_40_60_2_50
unitbox_c_40_60_3_100	unitbox_c_40_60_3_25	unitbox_c_40_60_3_50
unitbox_c_40_80_1_100	unitbox_c_40_80_1_25	unitbox_c_40_80_1_50
unitbox_c_40_80_2_100	unitbox_c_40_80_2_25	unitbox_c_40_80_2_50
unitbox_c_40_80_3_100	unitbox_c_40_80_3_25	unitbox_c_40_80_3_50
unitbox_c_48_48_1_25	unitbox_c_48_48_2_25	unitbox_c_48_48_3_25
unitbox_c_48_72_1_25	unitbox_c_48_72_2_25	unitbox_c_48_72_3_25
unitbox_c_48_96_1_25	unitbox_c_48_96_2_25	unitbox_c_48_96_3_25
unitbox_c_50_100_1_100	unitbox_c_50_100_1_50	unitbox_c_50_100_2_100
unitbox_c_50_100_2_50	unitbox_c_50_100_3_100	unitbox_c_50_100_3_50
unitbox_c_50_50_1_100	unitbox_c_50_50_1_50	unitbox_c_50_50_2_100
unitbox_c_50_50_2_50	unitbox_c_50_50_3_100	unitbox_c_50_50_3_50
unitbox_c_50_75_1_100	unitbox_c_50_75_1_50	unitbox_c_50_75_2_100
unitbox_c_50_75_2_50	unitbox_c_50_75_3_100	unitbox_c_50_75_3_50
unitbox_c_8_12_1_25	unitbox_c_8_12_2_25	unitbox_c_8_12_3_25
unitbox_c_8_16_1_25	unitbox_c_8_16_2_25	unitbox_c_8_16_3_25
unitbox_c_8_8_1_25	unitbox_c_8_8_2_25	unitbox_c_8_8_3_25

3.3 14 Standard Quadratic Programs (StQP) [32]

Problem_0030_75	Problem_0050_75	Problem_0100_01
Problem_0100_50	Problem_0100_75	Problem_0200_01
Problem_0200_50	Problem_0500_01	Problem_0500_25
Problem_1000_25	Problem_Q030	Problem_Q050
Problem_Q100	Problem_Q150	

4 Examples from Standard Test Libraries

4.1 20 Bonmin Test Set

The examples from the Bonmin Test Set [6, 30] are documented in Table 2.

- `http://egon.cheme.cmu.edu/ibm/page.htm`

4.2 172 GLOBALLib

The examples from GLOBALLib [12, 24] are documented in Table 4.

- `http://www.gamsworld.org/global/globallib/globallib.zip`

4.3 30 LINLib

The examples from LINLib are documented in Table 5.

- `http://www.gamsworld.org/performance/plib/linlib.zip`

4.4 9 MacMOOPLib

The examples from MacMOOPLib are documented in Table 6.

- `http://www.gamsworld.org/performance/macmoop/macmooplib.zip`

4.5 22 MPLLib

The examples from MPLLib are documented in Table 8.

- `http://www.gamsworld.org/performance/mpllib/mpllib.zip`

4.6 102 MINLPLib

The examples from MINLPLib [8, 12] are documented in Table 7.

- `http://www.gamsworld.org/minlp/minlplib/minlplib.zip`

4.7 146 PrincetonLib

The examples from PrincetonLib are documented in Table 9.

- `http://www.gamsworld.org/performance/princetonlib/princeton.zip`

4.8 67 Quadratic Assignment Problems (QAP) [3, 23]

bur26a	bur26b	bur26e	bur26f	bur26g	bur26h	chr12a
chr12b	chr12c	chr15a	chr15b	chr15c	chr18a	chr18b
chr20a	chr20b	chr20c	chr22a	chr22b	chr25a	esc16b
esc16c	esc16d	esc16e	esc16g	esc16h	esc32a	esc32b
had12	had14	had16	had18	had20	kra32	nug05
nug06	nug07	nug08	nug10	nug12	nug14	nug15
nug16a	nug16b	nug17	nug18	nug20	nug21	nug22
nug24	nug25	nug27	nug28	rou12	rou15	rou20
scr12	scr15	tai10a	tai12a	tai15a	tai17a	tai20a
tai25a	tai30a	tai35a	wil50			

5 42 Reformulated Standard Test Libraries

5.1 32 Reformulated GLOBALLib [12, 24, 31]

alkylation_saxena	alkyl_saxena	ex14_1_1_saxena
ex14_1_2_saxena	ex4_1_1_saxena	ex4_1_3_saxena
ex4_1_4_saxena	ex4_1_5_saxena	ex4_1_6_saxena
ex4_1_7_saxena	ex4_1_8_saxena	ex4_1_9_saxena
ex7_3_1_saxena	ex7_3_2_saxena	ex8_1_3_saxena
ex8_1_4_saxena	ex8_1_5_saxena	ex8_1_7_saxena
ex8_1_8_saxena	ex8_4_2_saxena	harker_saxena
mathopt1_saxena	mathopt2_saxena	prob09_saxena
process_saxena	rbrock_saxena	st_e03_saxena
st_e05_saxena	st_e10_saxena	st_e17_saxena
st_e19_saxena	st_e20_saxena	

5.2 10 Reformulated MINLPLib [8, 12]

eniplac_reformulated	fo7_2_reformulated	fo7_reformulated
fo8_reformulated	fo9_reformulated	m3_reformulated
m6_reformulated	m7_reformulated	o7_2_reformulated
o7_reformulated		

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A Test Suite Definition

Table 2: 20 Bonmin Case Studies; Accessed 11 March 2013 at http://egon.cheme.cmu.edu/ibm/page.htm [6, 30]

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
BatchS101006M	150	129	1020	49
BatchS121208M	204	203	1512	59
BatchS151208M	243	203	1782	62
BatchS201210M	308	251	2328	67
CLay0203M	13	18	55	48
CLay0204M	21	32	91	64
CLay0205M	31	50	136	80
CLay0303M	13	21	67	72
CLay0304M	21	36	107	96
CLay0305M	31	55	156	120
FLay02H	43	4	52	2
FLay02M	11	4	12	2
FLay03H	111	12	145	3
FLay03M	15	12	25	3
FLay04H	211	24	283	4
FLay04M	19	24	43	4
FLay05H	343	40	466	5
FLay05M	23	40	66	5
FLay06H	507	60	694	6
FLay06M	27	60	94	6
RSyn0805H	272	37	430	9
RSyn0805M	102	69	287	3
RSyn0810H	302	42	484	18
RSyn0810M	112	74	313	6
RSyn0815H	341	47	553	33
RSyn0815M	127	79	348	11
RSyn0820H	366	52	605	42
RSyn0820M	132	84	372	14
RSyn0830H	433	62	717	60
RSyn0830M	157	94	426	20
RSyn0840H	497	72	838	84
RSyn0840M	177	104	485	28
SLay04H	117	24	175	8
SLay04M	21	24	55	8
SLay05H	191	40	291	10

continued on the next page

Table 2 (Bonmin) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
SLay05M	31	40	91	10
SLay06H	283	60	436	12
SLay06M	43	60	136	12
SLay07H	393	84	610	14
SLay07M	57	84	190	14
SLay08H	521	112	813	16
SLay08M	73	112	253	16
SLay09H	667	144	1045	18
SLay09M	91	144	325	18
SLay10H	831	180	1306	20
SLay10M	111	180	406	20
Syn05H	38	5	59	9
Syn05M	16	5	29	3
Syn10H	68	10	113	18
Syn10M02H	155	40	295	36
Syn10M02M	71	40	199	12
Syn10M03H	232	60	487	54
Syn10M03M	106	60	343	18
Syn10M04H	309	80	709	72
Syn10M04M	141	80	517	24
Syn15H	107	15	182	33
Syn15M	41	15	90	11
Syn20H	132	20	234	42
Syn20M	46	20	114	14
Syn30H	199	30	346	60
Syn30M	71	30	168	20
Syn40H	263	40	467	84
Syn40M	91	40	227	28

Table 3: 55 *Computational Geometry Problems [4, 13, 14]*

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
kallrath_packing_2009_circles.c6a	18	0	54	86

continued on the next page

Table 3 (Computational Geometry) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
kallrath_packing_2009_circles.c6ax	18	0	54	86
kallrath_packing_2009_circles.c6b	18	0	54	86
kallrath_packing_2009_circles.c6c	20	0	63	114
kallrath_packing_2009_circles.c7a	20	0	69	114
kallrath_packing_2009_circles.c8a	22	0	86	146
kallrath_packing_2009_circlespolygons.c1p1	43	0	48	42
kallrath_packing_2009_circlespolygons.c1p1	43	0	48	42
kallrath_packing_2009_circlespolygons.c1p1	43	0	48	42
kallrath_packing_2009_circlespolygons.c1p5	158	0	174	212
kallrath_packing_2009_circlespolygons.c1p5	791	0	816	1262
kallrath_packing_2009_circlespolygons.c1p6	1110	0	1134	1808
kallrath_packing_2009_circlesrectangles.c1	49	0	52	48
kallrath_packing_2009_circlesrectangles.c1	49	0	52	48
kallrath_packing_2009_circlesrectangles.c1	49	0	52	48
kallrath_packing_2009_circlesrectangles.c6	184	0	192	298
kallrath_packing_2009_circlesrectangles.c6	390	0	388	600
kallrath_packing_2009_circlesrectangles.c6	634	0	619	968
kallrath_packing_2009_congruentcircles.c31	10	0	16	14
kallrath_packing_2009_congruentcircles.c32	10	0	16	14
kallrath_packing_2009_congruentcircles.c41	12	0	24	26
kallrath_packing_2009_congruentcircles.c42	12	0	24	26
kallrath_packing_2009_congruentcircles.c51	14	0	34	42
kallrath_packing_2009_congruentcircles.c52	14	0	34	42
kallrath_packing_2009_congruentcircles.c61	16	0	46	62
kallrath_packing_2009_congruentcircles.c62	16	0	46	62
kallrath_packing_2009_congruentcircles.c63	16	0	46	62
kallrath_packing_2009_congruentcircles.c71	18	0	60	86
kallrath_packing_2009_congruentcircles.c72	18	0	60	86
kallrath_packing_2009_diffcircles.10	24	0	71	182
kallrath_packing_2009_diffcircles.5a	14	0	24	42
kallrath_packing_2009_diffcircles.5b	14	0	24	42
kallrath_packing_2009_diffcircles.6	16	0	31	62
kallrath_packing_2009_diffcircles.7	18	0	40	86
kallrath_packing_2009_diffcircles.8	20	0	49	114
kallrath_packing_2009_diffcircles.9	22	0	60	146
pnt_pack_02.ORD	6	0	4	4
pnt_pack_03.ORD	8	0	7	12

continued on the next page

Table 3 (Computational Geometry) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
pnt_pack_04.ORD	10	0	11	24
pnt_pack_05.ORD	12	0	16	40
pnt_pack_06.ORD	14	0	22	60
pnt_pack_07.ORD	16	0	29	84
pnt_pack_08.ORD	18	0	37	112
pnt_pack_09.ORD	20	0	46	144
pnt_pack_10.ORD	22	0	56	180
pnt_pack_11.ORD	24	0	67	220
pnt_pack_12.ORD	26	0	79	264
pnt_pack_13.ORD	28	0	92	312
pnt_pack_14.ORD	30	0	106	364
pnt_pack_15.ORD	32	0	121	420
nesting_4B	17	0	218	1088
nesting_4F	17	0	218	1088
nesting_6E	25	0	477	2712
nesting_6EM	25	0	497	2832
nesting_6EMA	25	0	701	3360

Table 4: 172 *GLOBALLib Case Studies [12, 24]; Accessed 11 March 2013 at* `http://www.gamsworld.org/global/globallib/globallib.zip`

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
ex14_1_6	10	0	16	32
ex2_1_1	6	0	2	5
ex2_1_10	21	0	11	20
ex2_1_2	7	0	3	5
ex2_1_3	14	0	10	4
ex2_1_4	7	0	6	1
ex2_1_5	11	0	12	7
ex2_1_6	11	0	6	10
ex2_1_7	21	0	11	20
ex2_1_8	25	0	11	24
ex2_1_9	11	0	2	10

continued on the next page

Table 4 (GLOBALLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
ex3_1_1	9	0	7	8
ex3_1_2	6	0	7	29
ex3_1_3	7	0	7	8
ex3_1_4	4	0	4	3
ex5_2_2_case1	10	0	7	7
ex5_2_2_case2	10	0	7	7
ex5_2_2_case3	10	0	7	7
ex5_2_4	8	0	7	16
ex5_2_5	33	0	20	195
ex5_3_2	23	0	17	24
ex5_3_3	63	0	54	200
ex5_4_2	9	0	7	8
ex7_3_3	6	0	9	5
ex8_3_2	111	0	77	423
ex8_3_3	111	0	77	423
ex8_3_4	111	0	77	423
ex8_3_5	111	0	77	423
ex8_3_8	127	0	94	535
ex8_3_9	79	0	46	214
ex8_4_1	23	0	11	40
ex9_1_1	14	0	13	10
ex9_1_2	11	0	10	8
ex9_1_4	11	0	10	8
ex9_1_5	14	0	13	10
ex9_1_8	15	0	13	10
ex9_2_2	11	0	12	10
ex9_2_3	17	0	16	12
ex9_2_4	9	0	8	6
ex9_2_5	9	0	8	8
ex9_2_6	17	0	13	16
ex9_2_7	11	0	10	10
ex9_2_8	7	0	6	6
st_bpaf1a	11	0	11	10
st_bpaf1b	11	0	11	10
st_bpk1	5	0	7	4
st_bpv1	5	0	5	4
st_bpv2	5	0	6	3

continued on the next page

Table 4 (GLOBALLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
st_bsj2	4	0	6	3
st_bsj3	7	0	2	6
st_bsj4	7	0	5	6
st_cqpf	5	0	7	4
st_cqpjk1	5	0	3	4
st_cqpjk2	4	0	2	3
st_e01	3	0	2	2
st_e02	4	0	4	4
st_e05	6	0	4	4
st_e07	11	0	8	7
st_e08	3	0	3	4
st_e09	3	0	2	4
st_e18	3	0	5	4
st_e22	3	0	6	2
st_e23	3	0	3	2
st_e24	3	0	5	2
st_e25	5	0	9	4
st_e26	3	0	5	2
st_e28	10	0	5	16
st_e30	15	0	16	14
st_e33	10	0	7	7
st_e34	7	0	5	14
st_e42	8	0	3	4
st_fp7a	21	0	11	20
st_fp7b	21	0	11	20
st_fp7c	21	0	11	20
st_fp7d	21	0	11	20
st_fp7e	21	0	11	20
st_fp8	25	0	21	24
st_glmp_fp1	5	0	9	2
st_glmp_fp2	5	0	10	2
st_glmp_fp3	5	0	9	2
st_glmp_kk90	6	0	8	2
st_glmp_kk92	5	0	9	2
st_glmp_kky	8	0	14	4
st_glmp_ss1	6	0	12	2
st_glmp_ss2	6	0	9	2

continued on the next page

Table 4 (GLOBALLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
st_ht	3	0	4	2
st_iqpbk1	9	0	8	8
st_iqpbk2	9	0	8	8
st_jcbpaf2	11	0	14	10
st_m1	21	0	12	20
st_m2	31	0	22	30
st_pan1	4	0	5	3
st_ph1	7	0	6	6
st_ph10	3	0	5	2
st_ph11	4	0	5	3
st_ph12	4	0	5	3
st_ph13	4	0	11	3
st_ph14	4	0	11	3
st_ph15	5	0	5	4
st_ph2	7	0	6	6
st_ph20	4	0	10	2
st_ph3	7	0	6	4
st_phex	3	0	6	2
st_qpc-m0	3	0	3	2
st_qpc-m1	6	0	6	5
st_qpc-m3a	11	0	11	10
st_qpc-m3b	11	0	11	10
st_qpc-m3c	11	0	11	10
st_qpc-m4	11	0	11	10
st_qpk1	3	0	5	2
st_qpk2	7	0	13	6
st_qpk3	12	0	23	11
st_robot	9	0	9	16
st_rv1	11	0	6	10
st_rv2	21	0	11	20
st_rv3	21	0	21	20
st_rv7	31	0	21	30
st_rv8	41	0	21	40
st_rv9	51	0	21	50
st_z	4	0	6	3
arki0001	1031	0	514	512
camshape100	200	0	201	299

continued on the next page

Table 4 (GLOBALLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
camshape200	400	0	401	599
camshape400	800	0	801	1199
camshape800	1600	0	1601	2399
catmix100	304	0	201	1200
catmix200	604	0	401	2400
catmix400	1204	0	801	4800
catmix800	2404	0	1601	9600
jbearing100	5305	0	1	5304
jbearing25	1405	0	1	1404
jbearing50	2705	0	1	2704
jbearing75	4005	0	1	4004
abel	31	0	15	30
bayes2_10	87	0	78	440
bayes2_20	87	0	78	440
bayes2_30	87	0	78	440
bayes2_50	87	0	78	440
circle	3	0	10	30
demo7	71	0	58	12
dispatch	5	0	3	6
flowchan100	2401	0	2399	1600
flowchan200	4801	0	4799	3200
flowchan400	9601	0	9599	6400
flowchan50	1201	0	1199	800
haverly	13	0	10	7
himmel16	19	0	22	84
house	9	0	9	9
hydro	32	0	25	12
immun	22	0	8	6
meanvar	9	0	3	7
nemhaus	6	0	6	5
pinene100	5006	0	4996	5560
pinene200	10006	0	9996	10960
pinene50	2506	0	2496	2860
popdynm100	5616	0	5593	7584
popdynm200	11216	0	11193	14984
popdynm25	1416	0	1393	2274
popdynm50	2816	0	2793	4044

continued on the next page

Table 4 (GLOBALLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
prob06	2	0	2	4
prolog	21	0	23	14
qp1	51	0	3	50
qp2	51	0	3	50
qp3	101	0	53	100
qp4	80	0	32	29
qp5	109	0	32	0
sambal	18	0	11	13
torsion100	5309	0	5	10606
torsion25	1409	0	5	2806
torsion50	2709	0	5	5406
torsion75	4009	0	5	8006
turkey	519	0	288	55

Table 5: 30 LINLib Case Studies; Accessed 11 March 2013 at `http://www.gamsworld.org/performance/plib/linlib.zip`

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
cl30a13l1	4502	0	4581	1800
cl3a13l1	47	0	54	18
cl60a13l1	18002	0	18161	7200
cl90a13l1	40502	0	40741	16200
iair04	1	8904	824	8904
iair05	1	7195	427	7195
ibc1	1500	252	1914	252
ibienst1	478	28	577	28
icap6000	1	6000	2172	6000
imas284	2	150	69	150
imisc07	2	259	213	259
ineos4	3989	17136	36704	17136
ineos5	3989	17136	36703	17136
iqiu	793	48	1193	48

continued on the next page

Table 5 (LINLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
iran13x13	170	169	196	169
iran8x32	257	256	297	256
iswath2	4192	2213	484	2213
nql30	3602	0	3681	1800
q18a13l1	5478	0	5501	2738
q30a13l1	14886	0	14925	7442
q9a13l1	1446	0	1457	722
qssp18l1	2168	0	1769	1083
qssp30l1	5768	0	4745	2883
qssp60l1	22328	0	18485	11163
qt12a13l1	847	0	828	338
qt18a13l1	1807	0	1780	722
qt30a13l1	4807	0	4764	1922
qt60a13l1	18607	0	18524	7442
qt90a13l1	41407	0	41284	16562
qt9a13l1	502	0	487	200

Table 6: 9 MacMOOPLib Case Studies; Accessed 11 March 2013 at `http://www.gamsworld.org/performance/macmoop/macmooplib.zip`

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
abc-comp	3	0	4	4
hs05x	6	0	4	5
liswetm	9	0	3	7
molpg_1	9	0	9	0
molpg_2	13	0	17	0
molpg_3	11	0	15	0
moqp_1	24	0	14	60
moqp_2	24	0	13	60
moqp_3	24	0	14	60

Table 7: 102 MINLPLib Case Studies [8, 12]; Accessed 11 March 2013 at `http://www.gamsworld.org/minlp/minlplib/minlplib.zip`

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
4stufen	102	48	99	87
alan	5	4	8	3
batch	23	24	74	22
beuster	106	52	115	159
cecil_13	679	162	899	360
chp_partload	2204	45	2517	1916
contvar	210	87	285	530
csched1	14	63	23	8
csched2	93	308	138	58
du-opt	8	13	10	20
eg_all_s	1	7	28	196
eg_disc2_s	5	3	28	196
eg_disc_s	4	4	28	196
eg_int_s	5	3	28	196
elf	31	24	39	30
eniplac	118	24	190	48
enpro48	62	92	215	29
enpro56	55	73	192	24
ex1221	3	3	6	2
ex1222	3	1	4	2
ex1223	8	4	14	17
ex1224	4	8	8	6
ex1225	3	6	11	2
ex1226	3	3	6	2
ex1233	41	12	65	28
ex1243	53	16	97	36
ex1244	73	23	130	52
ex1252	25	15	44	36
ex1263	21	72	56	32
ex1264	21	68	56	32
ex1265	31	100	75	50
ex1266	43	138	96	72
ex3	25	8	32	5
ex4	12	25	31	127
fac1	17	6	19	16

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Table 7 (MINLPLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
fac2	55	12	34	54
fac3	55	12	34	54
feedtray	91	7	92	282
fo7	73	42	212	14
fo8	91	56	274	16
fo9	111	72	344	18
fuel	13	3	16	6
fuzzy	777	120	1057	79
gasnet	81	10	70	130
gastrans	86	21	150	45
gbd	2	3	5	1
gear	1	4	1	4
ghg_1veh	18	12	38	91
ghg_2veh	40	18	63	154
ghg_3veh	61	36	120	307
gkocis	9	3	9	2
hda	710	13	719	464
hmittelman	1	16	8	122
johnall	5	190	193	573
lop97ic	92	1662	92	8822
m3	21	6	44	6
m6	57	30	158	12
m7	73	42	212	14
mbtd	11	200	71	1400
meanvarx	22	14	45	7
minlphix	65	20	93	40
netmod_dol1	1537	462	3138	6
netmod_dol2	1537	462	3081	6
netmod_kar1	321	136	667	4
netmod_kar2	321	136	667	4
no7_ar2_1	71	42	270	14
no7_ar25_1	71	42	270	14
no7_ar3_1	71	42	270	14
no7_ar4_1	71	42	270	14
no7_ar5_1	71	42	270	14
nous1	49	2	44	122
nous2	49	2	44	122

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Table 7 (MINLPLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
nuclear104	12998	10816	14246	61108
nuclear10a	2091	10920	3340	44884
nuclear10b	12907	10920	24972	23252
nuclear14	987	576	1227	5520
nuclear25	1054	625	1304	5990
nuclear49	3335	2401	3874	17539
nuclearva	184	168	318	2024
nuclearvb	184	168	318	1988
nuclearvc	184	168	318	1988
nuclearvd	184	168	318	2864
nuclearve	184	168	318	2864
nuclearvf	184	168	318	2864
nvs01	2	2	4	7
nvs02	4	5	4	16
nvs03	1	2	3	3
nvs04	1	2	1	2
nvs05	7	2	10	24
nvs06	1	2	1	2
nvs07	1	3	3	3
nvs08	2	2	4	7
nvs09	1	10	1	10
nvs10	1	2	3	6
nvs11	1	3	4	12
nvs12	1	4	5	20
nvs13	1	5	6	30
nvs14	4	5	4	16
nvs15	1	3	2	3
nvs16	1	2	1	2
nvs17	1	7	8	56
nvs18	1	6	7	42
nvs19	1	8	9	72
nvs20	12	5	9	16
nvs21	2	2	3	7
nvs22	5	4	10	24
nvs23	1	9	10	90
nvs24	1	10	11	110
o7	73	42	212	14

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Table 7 (MINLPLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
o8_ar4_1	89	56	348	16
o9_ar4_1	109	72	436	18
oaer	7	3	8	2
oil	1517	19	1547	759
ortez	70	18	75	54
parallel	181	25	116	155
pb302035	1	600	51	600
pb302055	1	600	51	600
pb302075	1	600	51	600
pb302095	1	600	51	600
pb351535	1	525	51	525
pb351555	1	525	51	525
pb351575	1	525	51	525
pb351595	1	525	51	525
prob02	1	6	9	10
prob03	1	2	2	2
procsel	8	3	8	2
product	1447	107	1926	264
pump	16	9	35	36
qap	1	225	31	225
ravem	60	53	187	28
risk2b	452	12	581	3
saa_2	4008	400	6206	15400
sep1	28	2	32	12
space25	144	750	236	111
space960	4578	960	6498	4700
spectra2	40	30	73	240
spring	6	12	9	14
st_e13	2	1	3	1
st_e14	8	4	14	17
st_e15	3	3	6	2
st_e27	3	2	7	2
st_e29	4	8	8	6
st_e31	89	24	136	14
st_e32	18	18	19	63
st_e35	26	7	40	16
st_e36	2	1	3	6

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Table 7 (MINLPLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
st_e38	3	2	4	6
st_e40	2	3	9	6
st_miqp1	1	5	2	5
st_miqp2	1	4	4	2
st_miqp3	1	2	2	1
st_miqp4	4	3	5	3
st_miqp5	6	2	14	2
stockcycle	49	432	98	48
st_test1	1	5	2	4
st_test2	1	6	3	5
st_test3	1	13	11	5
st_test4	1	6	6	2
st_test5	1	10	12	7
st_test6	1	10	6	10
st_test8	1	24	21	24
st_testgr1	1	10	6	10
st_testgr3	1	20	21	20
st_testph4	1	3	11	3
super1	1264	44	1659	1201
super2	1264	44	1659	1201
super3	1264	44	1659	1201
synheat	45	12	65	28
synthes1	4	3	7	6
synthes2	7	5	15	8
synthes3	10	8	24	12
tln12	1	168	73	288
tln2	1	8	13	8
tln4	1	24	25	32
tln5	1	35	31	50
tln6	1	48	37	72
tln7	1	63	43	98
tloss	1	48	54	72
tls12	145	668	385	288
tls2	5	33	25	8
tls4	17	89	65	32
tls5	26	136	91	50
tls6	37	179	121	72

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Table 7 (MINLPLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
tls7	50	296	155	98
tltr	1	48	55	54
uselinear	6735	58	7031	14091
util	118	28	168	10
waste	2085	400	1992	2736
water4	70	126	138	46
waterx	57	14	55	60
waterz	70	126	138	46

Table 8: 22 MPLLib Case Studies; Accessed 11 March 2013 at http://www.gamsworld.org/performance/mpllib/mpllib.zip

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
exmpl_13_2-1_nonlinearcons	3	0	3	2
exmpl13_2-2_nonlinearobjective	3	0	4	2
exmpl13_2-3_nonlinearobjective2	3	0	4	2
exmpl_3_1-1_wyndorglass	3	0	4	0
exmpl_3_4-1_marysradiation	3	0	4	0
exmpl_3_4-2_kibbutzim	10	0	13	0
exmpl_3_4-3_noriandleets	7	0	4	0
exmpl_3_4-4b_saveitcomp	22	0	29	0
exmpl_3_4-4_saveitcomp	15	0	22	0
exmpl_3_4-5_unionairways	6	0	11	0
exmpl_3_4-6_distrunlimited	8	0	8	0
exmpl_7_1-1_wyndorglassdual	4	0	3	0
exmpl_7_3-1_upperbound	4	0	3	0
exmpl_8_1-1_pandtcomp	13	0	8	0
exmpl_8_1-2_northairplane	21	0	10	0
exmpl_8_1-3_metrowater	21	0	10	0
exmpl_8_3-1_jobshopco	17	0	9	0
exmpl_8_3-2a_betterprodco	16	0	9	0
exmpl_8_3-2b_betterprodco	26	0	11	0

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Table 8 (MPLLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
exmpl_9_3-1_shortestpath	13	0	8	0
exmpl_9_5-1_maxflow	46	0	8	0
exmpl_9_6-1_mincost	8	0	6	0

Table 9: 146 PrincetonLib Case Studies; Accessed 11 March 2013 at http://www.gamsworld.org/performance/princetonlib/princeton.zip

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
antenna	372	0	488	314
antenna_nonconvex	372	0	488	322
braess	5	0	5	4
catenary	203	0	102	402
hs106	9	0	7	8
hs116	14	0	16	31
hs23	3	0	6	8
hs35	4	0	2	3
hs44	5	0	7	4
hs6	3	0	2	2
hs8	3	0	3	4
nnls	301	0	1	300
nnls2	651	0	501	500
pca2	99	0	50	1281
polygon2	43	0	192	802
rosenbr	5	0	3	3
s324	3	0	3	6
fir_convex	11	0	305	1001
grasp_nonconvex	51	0	51	20
markowitz	9	0	2	8
markowitz2	1201	0	202	200
nb_L2	3205	0	4564	6084
nb_L2_nocheb	1221	0	1059	414
nbsup_L2	3205	0	3043	3042

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Table 9 (PrincetonLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
optreward	9	0	3	8
optrisk	9	0	3	8
optriskreward	9	0	2	8
hs006	3	0	2	2
hs008	3	0	3	4
hs010	3	0	2	2
hs011	3	0	2	3
hs012	3	0	2	4
hs014	3	0	3	4
hs018	3	0	3	6
hs021	3	0	2	2
hs022	3	0	3	3
hs023	3	0	6	8
hs028	4	0	2	3
hs030	4	0	2	5
hs031	4	0	2	5
hs035	4	0	2	3
hs042	5	0	2	6
hs044	5	0	7	4
hs048	6	0	3	3
hs051	6	0	4	5
hs052	6	0	4	5
hs053	6	0	4	5
hs054	7	0	7	6
hs061	4	0	3	5
hs063	4	0	3	6
hs065	4	0	2	6
hs076	5	0	4	4
hs083	6	0	7	29
hs084	6	0	7	35
hs095	7	0	5	14
hs096	7	0	5	14
hs097	7	0	5	14
hs098	7	0	5	14
hs106	9	0	7	8
hs108	10	0	14	48
hs113	11	0	9	21

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Table 9 (PrincetonLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
hs116	14	0	16	31
hs118	16	0	30	15
antenna	353	0	599	297
logcheb	353	0	600	298
logcheb1	353	0	599	297
structure3	535	0	1507	3914
structure4	1527	0	735	5680
structure5	120	0	50	364
structure6	457	0	197	1512
structure7	498	0	226	1740
structure8	948	0	5	956
structure9	555	0	257	1984
rocket	303	0	201	400
s201	3	0	1	2
s204	6	0	4	9
s215	3	0	2	1
s217	3	0	3	2
s218	3	0	2	1
s224	3	0	5	2
s225	3	0	6	8
s226	3	0	3	6
s227	3	0	3	4
s228	3	0	3	3
s240	4	0	1	3
s243	8	0	5	13
s248	4	0	3	3
s249	4	0	2	5
s255	5	0	1	4
s262	5	0	5	0
s264	5	0	4	15
s266	16	0	11	60
s268	6	0	6	5
s269	6	0	4	5
s271	7	0	1	6
s274	3	0	1	2
s275	5	0	1	4
s276	7	0	1	6

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Table 9 (PrincetonLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
s277	5	0	5	0
s278	7	0	7	0
s279	9	0	9	0
s280	11	0	11	0
s284	16	0	11	126
s285	16	0	11	126
s290	3	0	1	2
s291	11	0	1	10
s292	31	0	1	30
s293	51	0	1	50
s300	21	0	1	20
s301	51	0	1	50
s302	101	0	1	100
s315	3	0	4	4
s316	3	0	2	4
s317	3	0	2	4
s318	3	0	2	4
s319	3	0	2	4
s320	3	0	2	4
s321	3	0	2	4
s322	3	0	2	4
s323	3	0	3	3
s324	3	0	3	6
s325	3	0	4	4
s332	3	0	1	2
s335	4	0	3	4
s336	4	0	3	3
s337	4	0	2	5
s338	4	0	3	6
s352	5	0	1	4
s353	6	0	5	4
s359	6	0	15	0
s360	6	0	3	15
s361	6	0	7	35
s374	46	0	71	350
s375	11	0	10	20
s384	16	0	11	126

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Table 9 (PrincetonLib) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
s385	16	0	11	126
s386	3	0	1	2
s387	16	0	12	141
s388	16	0	26	141
s389	16	0	26	141
s392	34	0	31	33
ex3_3_1a	1603	0	1600	2
ex3_3_1b	2403	0	2399	800
ex3_3_1c	2403	0	2399	801
ex3_4_1	2402	0	1600	801
masa	9	0	6	4
maxcut	51	0	31	68
maxmineig1	201	0	111	588
maxmineig2	201	0	112	588
springs_nonconvex	33	0	11	60

Table 10: 137 *Process Networks Problems [2, 1, 10, 11, 9, 15, 16, 17, 18, 21, 22, 19, 20, 25, 26, 27, 28, 29, 33, 34, 35, 38, 39, 40]*

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
Scheduler_LeeCrudeOil1_05	496	40	1241	640
Scheduler_LeeCrudeOil1_06	595	48	1504	768
Scheduler_LeeCrudeOil1_07	694	56	1777	896
Scheduler_LeeCrudeOil1_08	793	64	2060	1024
Scheduler_LeeCrudeOil1_09	892	72	2353	1152
Scheduler_LeeCrudeOil1_10	991	80	2656	1280
Scheduler_LeeCrudeOil2_05	1086	70	2582	1680
Scheduler_LeeCrudeOil2_06	1303	84	3118	2016
Scheduler_LeeCrudeOil2_07	1520	98	3671	2352
Scheduler_LeeCrudeOil2_08	1737	112	4241	2688
Scheduler_LeeCrudeOil2_09	1954	126	4828	3024
Scheduler_LeeCrudeOil2_10	2171	140	5432	3360
Scheduler_LeeCrudeOil3_05	1211	70	2787	1960

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Table 10 (Process Networks) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
Scheduler_LeeCrudeOil3_06	1453	84	3360	2352
Scheduler_LeeCrudeOil3_07	1695	98	3950	2744
Scheduler_LeeCrudeOil3_08	1937	112	4557	3136
Scheduler_LeeCrudeOil3_09	2179	126	5181	3528
Scheduler_LeeCrudeOil3_10	2421	140	5822	3920
Scheduler_LeeCrudeOil4_05	1861	95	4242	3040
Scheduler_LeeCrudeOil4_06	2233	114	5094	3648
Scheduler_LeeCrudeOil4_07	2605	133	5966	4256
Scheduler_LeeCrudeOil4_08	2977	152	6858	4864
Scheduler_LeeCrudeOil4_09	3349	171	7770	5472
Scheduler_LeeCrudeOil4_10	3721	190	8702	6080
Ex1b_WaterNetwokProblem-WOEps_pw4	303	128	273	92
Ex_2__WaterNetwokProblem-NoEps_pw4	926	408	838	450
adhya1	14	0	31	153
adhya2	14	0	39	209
adhya3	21	0	44	328
adhya4	19	0	58	468
bental4	9	0	8	7
bental5	39	0	26	96
concbased	401	25	355	520
flowbased_pw4	461	25	415	300
foulds2	23	0	13	26
foulds3	169	0	49	392
foulds4	169	0	49	392
foulds5	101	0	41	196
haverly1	8	0	7	7
haverly2	8	0	7	7
haverly3	8	0	7	7
kg_example1	78	0	65	92
kg_example2_pw4	325	84	211	184
kg_example3_pw4	268	56	179	180
kg_example4_pw4	557	108	385	450
lee1	41	9	83	128
lee2	45	9	93	192
meyer04	64	55	142	156
meyer10	208	187	424	930
meyer15	383	352	769	2070

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Table 10 (Process Networks) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
rt2	17	0	29	152
you_supply_chain_design_2	25	3	31	6
zondervan_UC_convex	241	720	5330	240
castro_etal_2007_wts_Ex01_M1	13	0	11	6
castro_etal_2007_wts_Ex01_M2	28	0	34	8
castro_etal_2007_wts_Ex02_M1	20	0	15	16
castro_etal_2007_wts_Ex02_M2	42	0	45	24
castro_etal_2007_wts_Ex03_M1	23	0	16	16
castro_etal_2007_wts_Ex03_M2	51	0	54	24
castro_etal_2007_wts_Ex04_M1	24	0	22	32
castro_etal_2007_wts_Ex04_M2	56	0	66	36
castro_etal_2007_wts_Ex05_M1	47	0	41	90
castro_etal_2007_wts_Ex05_M2	134	0	152	96
castro_etal_2007_wts_Ex06_M1	47	0	41	90
castro_etal_2007_wts_Ex06_M2	134	0	152	96
castro_etal_2007_wts_Ex07_M1	47	0	41	90
castro_etal_2007_wts_Ex07_M2	134	0	152	96
castro_etal_2007_wts_Ex08_M1	73	0	73	180
castro_etal_2007_wts_Ex08_M2	279	0	335	168
castro_etal_2007_wts_Ex09_M1	127	0	113	420
castro_etal_2007_wts_Ex09_M2	517	0	573	420
castro_etal_2007_wts_Ex10_M1	65	0	31	70
castro_etal_2007_wts_Ex10_M2	156	0	138	120
castro_etal_2007_wts_Ex11_M1	119	0	43	126
castro_etal_2007_wts_Ex11_M2	304	0	252	224
castro_etal_2007_wts_Ex12_M1	197	0	58	240
castro_etal_2007_wts_Ex12_M2	517	0	408	440
castro_etal_2007_wts_Ex13_M1	383	0	84	510
castro_etal_2007_wts_Ex13_M2	1040	0	783	960
castro_etal_2007_wts_Ex14_M1	75	0	47	140
castro_etal_2007_wts_Ex14_M2	209	0	205	180
castro_etal_2007_wts_Ex15_M1	47	0	41	90
castro_etal_2007_wts_Ex15_M2	134	0	152	96
castro_etal_2007_wts_Ex16_M1	88	0	54	192
castro_etal_2007_wts_Ex16_M2	244	0	234	252
Sarawak_Scenario1	94	38	213	68
Sarawak_Scenario16	1489	38	2253	1088

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Table 10 (Process Networks) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
Sarawak_Scenario81	7534	38	11093	5508
ex01	297	48	696	112
ex02	1193	105	5005	108
ex03	849	116	2443	384
ex05	825	116	1917	384
ex06	849	116	2437	384
ex11	1046	132	3506	384
ex21	1189	160	4682	384
MPBP_6T_3P_2Q_029	67	36	214	64
MPBP_8T_3P_2Q_146	136	87	625	256
MPBP_8T_3P_2Q_718	136	87	607	244
MPBP_8T_3P_2Q_721	136	87	628	256
MPBP_8T_4P_2Q_480	185	120	857	376
MPBP_8T_4P_2Q_531	169	104	737	358
MPBP_8T_4P_2Q_852	185	120	861	376
teles_etal_2009_WUN_Ex01	41	0	39	78
teles_etal_2009_WUN_Ex02	69	0	77	208
teles_etal_2009_WUN_Ex03	65	0	77	208
teles_etal_2009_WUN_Ex04	71	0	55	136
teles_etal_2009_WUN_Ex05	94	0	60	152
teles_etal_2009_WUN_Ex06	106	0	116	375
teles_etal_2009_WUN_Ex07	111	0	136	450
teles_etal_2009_WUN_Ex08	91	0	96	300
teles_etal_2009_WUN_Ex09	133	0	163	612
teles_etal_2009_WUN_Ex10	51	0	52	117
teles_etal_2009_WUN_Ex11	65	0	65	156
teles_etal_2009_WUN_Ex12	53	0	45	104
teles_etal_2009_WUN_Ex13	99	0	91	272
teles_etal_2009_WUN_Ex14	126	0	136	456
teles_etal_2009_WUN_Ex16	83	0	84	240
teles_etal_2009_WUN_Ex17	75	0	67	180
teles_etal_2009_WUN_Ex18	61	0	65	156
teles_etal_2009_WUN_Ex19	69	0	77	208
teles_etal_2009_WUN_Ex20	176	0	133	460
teles_etal_2009_WUN_Ex21	121	0	127	408
teles_etal_2009_WUN_Ex22	147	0	136	456
teles_etal_2009_WUN_Ex23	159	0	154	570

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Table 10 (Process Networks) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
teles_etal_2009_WUN_Ex24	140	0	136	456
teles_etal_2009_WUN_Ex25	122	0	88	285
teles_etal_2009_WUN_Ex26	337	0	289	1740
teles_etal_2009_WUN_Ex27	433	0	209	1184
teles_etal_2009_WUN_Ex28	761	0	541	5400
teles_etal_2009_WUN_Ex29	669	0	433	3780
teles_etal_2009_WUN_Ex30	721	0	451	4050
teles_etal_2009_WUN_Ex31	781	0	541	5400
teles_etal_2009_WUN_Ex32	661	0	381	3600
teles_etal_2009_WUN_Ex33	425	0	245	1628
teles_etal_2009_WUN_Ex34	489	0	269	1924
teles_etal_2009_WUN_Ex35	483	0	324	2405
teles_etal_2009_WUN_Ex36	325	0	240	1395

Table 11: 67 Quadratic Assignment Problems [3, 23]

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
bur26a	1	676	53	676
bur26b	1	676	53	676
bur26e	1	676	53	676
bur26f	1	676	53	676
bur26g	1	676	53	676
bur26h	1	676	53	676
chr12a	1	144	25	144
chr12b	1	144	25	144
chr12c	1	144	25	144
chr15a	1	225	31	225
chr15b	1	225	31	225
chr15c	1	225	31	225
chr18a	1	324	37	324
chr18b	1	324	37	324
chr20a	1	400	41	400

continued on the next page

Table 11 (QAP) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
chr20b	1	400	41	400
chr20c	1	400	41	400
chr22a	1	484	45	484
chr22b	1	484	45	484
chr25a	1	625	51	625
esc16b	1	256	33	240
esc16c	1	256	33	240
esc16d	1	256	33	224
esc16e	1	256	33	144
esc16g	1	256	33	128
esc16h	1	256	33	256
esc32a	1	1024	65	800
esc32b	1	1024	65	768
had12	1	144	25	144
had14	1	196	29	196
had16	1	256	33	256
had18	1	324	37	324
had20	1	400	41	400
kra32	1	1024	65	960
nug05	1	25	11	25
nug06	1	36	13	36
nug07	1	49	15	49
nug08	1	64	17	64
nug10	1	100	21	100
nug12	1	144	25	144
nug14	1	196	29	196
nug15	1	225	31	225
nug16a	1	256	33	256
nug16b	1	256	33	256
nug17	1	289	35	289
nug18	1	324	37	324
nug20	1	400	41	400
nug21	1	441	43	441
nug22	1	484	45	484
nug24	1	576	49	576
nug25	1	625	51	625
nug27	1	729	55	729

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Table 11 (QAP) continued

Problem Name	# Variables		# Constraints	# Nonlinear Terms
	Contin	Discrete		
nug28	1	784	57	784
rou12	1	144	25	144
rou15	1	225	31	225
rou20	1	400	41	400
scr12	1	144	25	144
scr15	1	225	31	225
tai10a	1	100	21	100
tai12a	1	144	25	144
tai15a	1	225	31	225
tai17a	1	289	35	289
tai20a	1	400	41	400
tai25a	1	625	51	625
tai30a	1	900	61	900
tai35a	1	1225	71	1225
wil50	1	2500	101	2500