

# Electronic Companion—“A Branch-Price-and-Cut Algorithm for the Vehicle Routing Problem with Release and Due Dates”

## EC.1. Detailed results for the instances of class A by $CG_b$ , $CG_n$ and $CG_h$

In section 4.2, we have reported the aggregated results of the linear relaxation by  $CG_b$ ,  $CG_n$  and  $CG_h$ . In this section, the corresponding detailed results are presented in Tables EC.1-EC.5. Each name of instance gives the number of vertices including the depot and the number of available vehicles. The subscript 1 (or 2, 3, 4, 5) indicates that the instance is generated by using parameter  $\theta = 0.05$  (or 0.10, 0.15, 0.20, 0.25). For example, the instance 'A - n32 - k5<sub>1</sub>' has 31 customers and 5 available vehicles. The instance is generated by using parameter  $\theta = 0.05$ . The columns have the same meaning as in Table 3.

Table EC. 1: Detailed results for the instances of class A with  $\theta = 0.05$  by  $CG_b$ ,  $CG_n$  and  $CG_h$

Instance	$z_{ip}$	$z_{lp0}$	$z_{lp}$	$CG_b$			$CG_n$		$CG_h$	
				#Iter	$t_{lp}(s)$	$\Delta_{lp}(\%)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
A - n32 - k5 <sub>1</sub>	1138.50	1127.17	1127.17	24	1.1	0.00	20	1.2	21	1.8
A - n33 - k5 <sub>1</sub>	827.50	813.75	813.75	26	1.6	0.00	24	2.6	25	2.7
A - n33 - k6 <sub>1</sub>	904.50	896.21	896.21	18	0.9	0.00	21	1.7	19	1.3
A - n34 - k5 <sub>1</sub>	915.00	893.89	893.76	28	2.4	-0.65	28	5.6	27	12.3
A - n36 - k5 <sub>1</sub>	1081.00	1051.30	1051.30	27	1.8	0.00	25	3.6	27	11.9
A - n37 - k5 <sub>1</sub>	839.00	813.38	813.38	28	2.5	0.00	29	5.2	26	6.4
A - n37 - k6 <sub>1</sub>	1251.50	1228.80	1226.00	31	2.7	-12.33	30	5.8	29	16.9
A - n38 - k5 <sub>1</sub>	894.00	851.53	851.53	49	17.7	0.00	51	273.4	58	2184.2
A - n39 - k5 <sub>1</sub>	1018.50	1004.50	1004.50	39	11.3	0.00	33	20.6	28	66
A - n39 - k6 <sub>1</sub>	1071.50	1071.50	1071.50	24	1.8	0.00	25	2.8	24	6.3
A - n44 - k6 <sub>1</sub>	1147.00	1141.48	1140.90	36	8.8	-10.51	36	22.1	30	134.1
A - n45 - k6 <sub>1</sub>	1122.00	—	1103.77	61	67.6	—	55	751.5	—	—
A - n45 - k7 <sub>1</sub>	1636.00	1617.88	1617.88	25	2.1	0.00	25	3.8	25	19.6
A - n46 - k7 <sub>1</sub>	1214.50	1201.06	1201.06	26	1.4	0.00	27	2.5	26	2.9
A - n48 - k7 <sub>1</sub>	1406.00	1384.30	1384.30	26	3.0	0.00	27	5.2	30	31.9
A - n53 - k7 <sub>1</sub>	1325.50	—	1302.22	48	36.2	—	43	284.6	—	—
A - n54 - k7 <sub>1</sub>	1532.00	1511.72	1511.56	44	14.1	-0.79	40	29.5	39	1031.1
A - n55 - k9 <sub>1</sub>	1344.50	1318.11	1317.96	36	2.6	-0.57	31	3.4	34	7.1
A - n60 - k9 <sub>1</sub>	1731.00	1699.27	1698.61	45	5.7	-2.08	42	9.3	39	54.1
A - n61 - k9 <sub>1</sub>	1178.50	—	1151.30	61	63.5	—	49	227	—	—
A - n62 - k8 <sub>1</sub>	1684.00	—	1664.17	55	28.7	—	53	57.4	—	—
A - n63 - k9 <sub>1</sub>	2234.50	—	2203.38	60	48.2	—	51	1406.4	—	—
A - n63 - k10 <sub>1</sub>	1741.00	1714.65	1714.65	43	7.2	0.00	40	10.5	42	40
A - n64 - k9 <sub>1</sub>	1854.00	1818.20	1818.20	48	11.8	0.00	43	16.4	46	585.6
A - n65 - k9 <sub>1</sub>	1360.00	—	1335.38	52	58.5	—	67	469.1	—	—
A - n69 - k9 <sub>1</sub>	—	—	1369.55	71	41.2	—	68	125.6	—	—
A - n80 - k10 <sub>1</sub>	—	—	2314.03	58	82.4	—	61	154.8	—	—

Table EC. 2: Detailed results for the instances of class A with  $\theta = 0.10$  by  $CG_b$ ,  $CG_n$  and  $CG_h$ 

Instance	$z_{ip}$	$z_{lp0}$	$z_{lp}$	$CG_b$			$CG_n$		$CG_h$	
				#Iter	$t_{lp}(s)$	$\Delta_{lp}(\%)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_2$	1111.0	1111.00	1111.00	19	0.9	0.00	18	1.3	17	1
$A - n33 - k5_2$	849.5	825.83	825.83	18	1.1	0.00	21	1.8	20	1.9
$A - n33 - k6_2$	966.0	950.55	950.55	19	0.9	0.00	18	1.5	18	1.4
$A - n34 - k5_2$	890.0	862.43	862.41	23	1.7	-0.08	25	3.2	23	4.9
$A - n36 - k5_2$	1125.5	1099.01	1098.07	34	3.2	-3.55	31	5	27	21.7
$A - n37 - k5_2$	860.5	831.25	831.25	28	2.5	0.00	29	3.8	30	4.1
$A - n37 - k6_2$	1244.0	1217.64	1215.46	37	3.8	-8.27	29	8.1	42	31.6
$A - n38 - k5_2$	888.0	851.69	851.34	49	19.8	-0.96	53	310.9	62	2697.9
$A - n39 - k5_2$	1034.5	1021.09	1020.71	62	33.7	-2.83	53	572.5	34	418.2
$A - n39 - k6_2$	1123.0	1117.25	1117.25	29	2.2	0.00	27	2.9	31	5.6
$A - n44 - k6_2$	1177.0	1171.13	1170.29	29	7.1	-14.31	33	17.2	26	67.7
$A - n45 - k6_2$	1108.0	-	1098.33	62	40.5	-	62	1248.8	-	-
$A - n45 - k7_2$	1644.0	1626.08	1626.08	28	2.4	0.00	28	3.7	32	53.8
$A - n46 - k7_2$	1211.0	1197.50	1197.50	27	1.3	0.00	26	1.9	25	1.9
$A - n48 - k7_2$	1492.5	1465.00	1465.00	29	3.8	0.00	26	7.4	30	64.7
$A - n53 - k7_2$	1360.0	1330.36	1330.17	45	19.2	-0.64	41	72.3	51	1263.8
$A - n54 - k7_2$	1596.0	1568.61	1568.46	46	27.1	-0.55	43	55.8	46	2052.1
$A - n55 - k9_2$	1387.5	1364.23	1364.23	35	3.1	0.00	37	4.8	40	5.3
$A - n60 - k9_2$	1770.0	1733.40	1731.66	33	4.9	-4.75	30	6.2	34	48.5
$A - n61 - k9_2$	1217.5	-	1174.13	59	50.6	-	51	331.3	-	-
$A - n62 - k8_2$	1765.5	-	1757.05	57	36.8	-	52	49.5	-	-
$A - n63 - k9_2$	2317.5	-	2285.87	46	32.9	-	40	378.7	-	-
$A - n63 - k10_2$	1769.0	1735.13	1735.13	38	6.3	0.00	37	10.3	32	41.5
$A - n64 - k9_2$	1937.0	1904.07	1904.07	46	13.9	0.00	45	29.4	48	545.1
$A - n65 - k9_2$	1429.5	-	1402.72	78	92.1	-	85	1975.5	-	-
$A - n69 - k9_2$	1420.5	-	1377.69	66	35.1	-	66	63.3	-	-
$A - n80 - k10_2$	-	-	2401.32	57	66.3	-	63	138.2	-	-

Table EC. 3: Detailed results for the instances of class A with  $\theta = 0.15$  by  $CG_b$ ,  $CG_n$  and  $CG_h$ 

Instance	$z_{ip}$	$z_{lp0}$	$z_{lp}$	$CG_b$			$CG_n$		$CG_h$	
				#Iter	$t_{lp}(s)$	$\Delta_{lp}(\%)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_3$	1139.5	1136.63	1136.63	27	1.2	0.00	17	1.1	24	2.2
$A - n33 - k5_3$	828.0	807.42	807.42	21	1.4	0.00	26	3.1	24	2.5
$A - n33 - k6_3$	936.0	930.00	930.00	26	1.2	0.00	22	1.8	22	1.7
$A - n34 - k5_3$	951.5	936.81	936.21	26	2.5	-4.08	29	6.6	35	12.4
$A - n36 - k5_3$	1115.5	1095.07	1094.75	31	2.3	-1.57	28	4.5	30	17.8
$A - n37 - k5_3$	879.5	847.88	847.87	38	5.4	-0.01	31	7.2	33	36.2
$A - n37 - k6_3$	1320.5	1300.17	1300.17	33	3.3	0.00	26	9.3	40	25.5
$A - n38 - k5_3$	895.5	848.11	848.11	62	29.7	0.00	63	485.6	57	1521.8
$A - n39 - k5_3$	1090.0	1072.52	1072.52	41	18.3	0.00	43	85.3	29	160.1
$A - n39 - k6_3$	1158.0	1158.00	1158.00	25	2.3	0.00	22	2.9	20	3.2
$A - n44 - k6_3$	1195.5	1181.44	1180.94	30	6.4	-3.56	27	13.2	25	31.5
$A - n45 - k6_3$	1154.0	-	1134.75	58	61.4	-	57	792.3	-	-
$A - n45 - k7_3$	1633.0	1614.17	1614.17	27	3.4	0.00	28	9.2	28	56.8
$A - n46 - k7_3$	1245.0	1238.33	1238.33	33	1.7	0.00	32	2.8	28	2.6
$A - n48 - k7_3$	1483.5	1468.75	1468.75	34	4.2	0.00	33	6.9	38	38.8
$A - n53 - k7_3$	1381.5	-	1350.21	47	26.0	-	50	225.1	-	-
$A - n54 - k7_3$	1595.0	1575.69	1575.56	46	41.6	-0.67	46	136.2	43	3093
$A - n55 - k9_3$	1444.5	1418.48	1418.25	32	2.8	-0.88	32	5.3	35	6.1
$A - n60 - k9_3$	1762.0	1723.09	1723.09	40	6.9	0.00	43	12.1	39	80
$A - n61 - k9_3$	1254.5	-	1216.06	51	58.1	-	48	202.5	-	-
$A - n62 - k8_3$	1746.0	-	1730.78	54	38.7	-	59	60.4	-	-
$A - n63 - k9_3$	2474.5	-	2434.97	35	38.4	-	38	89.1	-	-
$A - n63 - k10_3$	1800.0	1778.74	1778.74	52	13.4	0.00	45	22	46	172.4
$A - n64 - k9_3$	2005.5	1973.66	1973.66	47	16.2	0.00	47	30	46	1417.4
$A - n65 - k9_3$	1449.5	-	1421.83	81	116.9	-	91	1624.7	-	-
$A - n69 - k9_3$	1406.0	-	1380.82	77	57.3	-	70	254.3	-	-
$A - n80 - k10_3$	-	-	2488.87	47	151.9	-	50	132.4	-	-

Table EC. 4: Detailed results for the instances of class A with  $\theta = 0.20$  by  $CG_b$ ,  $CG_n$  and  $CG_h$ 

Instance	$z_{ip}$	$z_{lp0}$	$z_{lp}$	$CG_b$			$CG_n$		$CG_h$	
				#Iter	$t_{lp}(s)$	$\Delta_{lp}(\%)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_4$	1188.0	1185.83	1185.83	20	1.0	0.00	19	1.7	23	1.8
$A - n33 - k5_4$	887.5	876.08	876.08	21	1.5	0.00	23	2.8	20	3.2
$A - n33 - k6_4$	965.0	955.60	955.60	19	1.0	0.00	19	1.8	18	1.4
$A - n34 - k5_4$	927.0	903.21	903.19	22	2.8	-0.07	23	3.5	19	4.8
$A - n36 - k5_4$	1079.0	1055.58	1055.58	29	3.1	0.00	34	4.9	29	12.9
$A - n37 - k5_4$	875.0	838.80	838.80	27	3.3	0.00	28	7.9	24	6.3
$A - n37 - k6_4$	1319.5	1293.89	1293.11	34	3.6	-3.05	30	10.8	36	26.5
$A - n38 - k5_4$	995.0	962.55	962.49	53	26.0	-0.18	55	371.5	56	1270.1
$A - n39 - k5_4$	1181.5	1156.38	1156.15	30	15.2	-0.92	37	78.8	26	201.1
$A - n39 - k6_4$	1156.5	1156.50	1156.50	32	2.0	0.00	31	3.5	26	6.2
$A - n44 - k6_4$	1200.5	1182.77	1182.77	33	6.5	0.00	27	12	28	45.2
$A - n45 - k6_4$	1184.5	—	1160.67	66	80.8	—	55	1108.1	—	—
$A - n45 - k7_4$	1747.5	1732.37	1732.37	29	3.1	0.00	28	7.5	28	23.1
$A - n46 - k7_4$	1255.0	1252.35	1252.35	27	1.6	0.00	25	2.7	23	2.4
$A - n48 - k7_4$	1516.5	1496.42	1496.42	31	4.4	0.00	35	7.7	33	38.1
$A - n53 - k7_4$	1405.0	1377.15	1376.97	49	33.3	-0.65	45	75.2	50	1775.3
$A - n54 - k7_4$	—	1610.87	1610.55	40	33.2	—	39	45.7	37	1364
$A - n55 - k9_4$	1436.5	1413.69	1413.69	43	4.8	0.00	40	13.5	52	73.4
$A - n60 - k9_4$	1786.0	1759.61	1758.60	42	6.2	-3.83	47	8.9	43	48.7
$A - n61 - k9_4$	—	—	1257.79	55	53.7	—	48	638.7	—	—
$A - n62 - k8_4$	1870.5	—	1842.07	48	66.2	—	40	78.9	—	—
$A - n63 - k9_4$	2384.5	—	2370.99	49	60.3	—	48	1856.5	—	—
$A - n63 - k10_4$	1833.5	1811.28	1811.28	35	5.4	0.00	35	13.5	33	110.8
$A - n64 - k9_4$	2072.5	2036.23	2035.84	43	17.4	-1.08	48	34.3	46	1222.4
$A - n65 - k9_4$	1502.5	—	1472.94	79	206.0	—	75	1670	—	—
$A - n69 - k9_4$	1506.0	—	1479.77	71	68.3	—	70	273.1	—	—
$A - n80 - k10_4$	2539.5	—	2504.54	49	158.7	—	56	283.3	—	—

Table EC. 5: Detailed results for the instances of class A with  $\theta = 0.25$  by  $CG_b$ ,  $CG_n$  and  $CG_h$ 

Instance	$z_{ip}$	$z_{lp0}$	$z_{lp}$	$CG_b$			$CG_n$		$CG_h$	
				#Iter	$t_{lp}(s)$	$\Delta_{lp}(\%)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_5$	1177.5	1156.60	1156.60	23	1.3	0.00	23	3	20	1.8
$A - n33 - k5_5$	945.0	921.65	921.65	22	1.3	0.00	24	4.1	22	4.1
$A - n33 - k6_5$	951.0	941.36	941.36	20	1.1	0.00	19	1.8	19	1.8
$A - n34 - k5_5$	956.0	925.62	925.62	26	2.9	0.00	23	7	21	9
$A - n36 - k5_5$	1156.5	1138.25	1138.25	25	2.8	0.00	27	4.2	25	17.6
$A - n37 - k5_5$	854.0	832.00	832.00	31	3.5	0.00	30	5.6	33	6.1
$A - n37 - k6_5$	1370.0	1336.13	1335.12	28	3.4	-2.98	29	12.4	34	28.8
$A - n38 - k5_5$	969.0	924.67	922.33	61	40.8	-5.27	66	546.6	66	1599.8
$A - n39 - k5_5$	1134.0	1107.19	1107.12	36	18.1	-0.26	32	64.4	27	141.3
$A - n39 - k6_5$	1192.5	1192.50	1192.50	28	2.7	0.00	27	4.4	22	8
$A - n44 - k6_5$	1209.0	1197.51	1195.63	33	8.4	-16.36	35	25.7	27	59.9
$A - n45 - k6_5$	1185.0	—	1149.25	62	63.2	—	61	1624.9	—	—
$A - n45 - k7_5$	1779.5	1755.04	1755.04	25	3.5	0.00	25	8.9	25	64.5
$A - n46 - k7_5$	1326.0	1307.67	1307.67	28	1.6	0.00	32	2.7	31	3.6
$A - n48 - k7_5$	1530.0	1509.21	1509.21	31	4.7	0.00	37	10.3	35	239.3
$A - n53 - k7_5$	1438.5	—	1402.72	46	41.3	—	44	500.4	—	—
$A - n54 - k7_5$	1706.0	1671.41	1670.89	43	45.3	-1.50	37	72	38	2437
$A - n55 - k9_5$	1462.5	1432.66	1432.66	44	4.0	0.00	40	5.1	44	8.7
$A - n60 - k9_5$	1873.5	1839.19	1838.45	38	8.0	-2.16	38	10.3	32	112.3
$A - n61 - k9_5$	—	—	1274.86	51	63.0	—	44	317.4	—	—
$A - n62 - k8_5$	1857.0	—	1832.64	52	55.9	—	43	70	—	—
$A - n63 - k9_5$	2558.5	—	2533.70	50	60.9	—	45	489.7	—	—
$A - n63 - k10_5$	1877.5	1849.63	1849.63	33	6.0	0.00	40	9.6	35	58.3
$A - n64 - k9_5$	2104.0	2077.83	2077.46	48	15.9	-1.41	48	31.1	39	554.1
$A - n65 - k9_5$	1521.5	—	1519.32	73	163.1	—	81	2336.9	—	—
$A - n69 - k9_5$	1529.5	—	1503.68	52	50.4	—	55	86.7	—	—
$A - n80 - k10_5$	—	—	2657.40	61	207.1	—	56	300	—	—

## EC.2. Detailed results for the instances of class A by $CG_b$ , $CG_m$ , $CG_t$ and $CG_d$

In this section, the corresponding detailed results are presented in Tables EC.6-EC.10. The columns have the same meaning as in Table 4.

Table EC. 6: Detailed results for the instances of class A with  $\theta = 0.05$  by  $CG_b$ ,  $CG_m$ ,  $CG_t$  and  $CG_d$

Instance	$z_{lp}$	$CG_b$		$CG_m$		$CG_t$		$CG_d$	
		#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_1$	1127.17	24	1.1	24	3.1	24	1.9	20	1.4
$A - n33 - k5_1$	813.75	26	1.6	35	26.1	35	15.5	49	10.6
$A - n33 - k6_1$	896.21	18	0.9	26	8.5	26	5.2	28	4.2
$A - n34 - k5_1$	893.76	28	2.4	36	22.4	36	15.2	60	14.0
$A - n36 - k5_1$	1051.30	27	1.8	39	38.6	39	26.3	39	11.1
$A - n37 - k5_1$	813.38	28	2.5	45	48.9	45	32.8	42	18.6
$A - n37 - k6_1$	1226.00	31	2.7	60	53.4	60	34.6	58	22.1
$A - n38 - k5_1$	851.53	49	17.7	89	420.5	89	339.7	118	110.1
$A - n39 - k5_1$	1004.50	39	11.3	65	360.4	65	264.8	78	77.2
$A - n39 - k6_1$	1071.50	24	1.8	22	9.3	22	5.9	34	4.0
$A - n44 - k6_1$	1140.90	36	8.8	94	385.1	94	275.7	124	129.0
$A - n45 - k6_1$	1103.77	61	67.6	107	1074.4	107	785.7	160	344.5
$A - n45 - k7_1$	1617.88	25	2.1	40	27.6	40	16.1	53	12.1
$A - n46 - k7_1$	1201.06	26	1.4	31	6.2	31	3.4	36	3.8
$A - n48 - k7_1$	1384.30	26	3.0	40	31.2	40	18.3	43	12.4
$A - n53 - k7_1$	1302.22	48	36.2	82	638.8	82	435.5	130	234.8
$A - n54 - k7_1$	1511.56	44	14.1	74	451.2	74	294.1	80	136.6
$A - n55 - k9_1$	1317.96	36	2.6	46	75.1	46	47	49	14.0
$A - n60 - k9_1$	1698.61	45	5.7	52	87.5	52	51.8	56	55.0
$A - n61 - k9_1$	1151.30	61	63.5	121	1736.9	121	1217.7	158	795.5
$A - n62 - k8_1$	1664.17	55	28.7	79	663.6	79	444.6	140	581.1
$A - n63 - k9_1$	2203.38	60	48.2	104	1398.7	104	971.5	129	245.8
$A - n63 - k10_1$	1714.65	43	7.2	46	61.6	46	38.9	66	40.9
$A - n64 - k9_1$	1818.20	48	11.8	47	339.9	47	226.1	—	—
$A - n65 - k9_1$	1335.38	52	58.5	90	966.0	90	653.2	79	286.2
$A - n69 - k9_1$	1369.55	71	41.2	163	3455.9	163	2525.5	301	985.5
$A - n80 - k10_1$	2314.03	58	82.4	—	—	112	2325.6	173	1201.1

Table EC. 7: Detailed results for the instances of class A with  $\theta = 0.10$  by  $CG_b$ ,  $CG_m$ ,  $CG_t$  and  $CG_d$ 

Instance	$z_{lp}$	$CG_b$		$CG_m$		$CG_t$		$CG_d$	
		#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_2$	1111.00	19	0.9	19	2.8	19	1.7	18	1.4
$A - n33 - k5_2$	825.83	18	1.1	23	7.6	23	4.4	34	5.9
$A - n33 - k6_2$	950.55	19	0.9	21	7.0	21	4.5	33	5.2
$A - n34 - k5_2$	862.41	23	1.7	33	18.4	33	11.6	34	7.8
$A - n36 - k5_2$	1098.07	34	3.2	37	65.4	37	45.2	43	18.8
$A - n37 - k5_2$	831.25	28	2.5	41	59.3	41	38.7	47	8.8
$A - n37 - k6_2$	1215.46	37	3.8	61	75.4	61	50.2	132	42.7
$A - n38 - k5_2$	851.34	49	19.8	80	369.2	80	266.9	150	342.7
$A - n39 - k5_2$	1020.71	62	33.7	95	422.9	95	307.3	85	122.3
$A - n39 - k6_2$	1117.25	29	2.2	21	8.3	21	6.4	41	9.2
$A - n44 - k6_2$	1170.29	29	7.1	50	211.3	50	144.4	58	97.8
$A - n45 - k6_2$	1098.33	62	40.5	—	—	106	3207.8	165	743.7
$A - n45 - k7_2$	1626.08	28	2.4	67	82.5	67	52.8	73	20.2
$A - n46 - k7_2$	1197.50	27	1.3	23	4.1	23	2.3	36	3.6
$A - n48 - k7_2$	1465.00	29	3.8	51	84.5	51	51.7	101	73.2
$A - n53 - k7_2$	1330.17	45	19.2	95	545.3	95	360.9	195	793.7
$A - n54 - k7_2$	1568.46	46	27.1	58	431.6	58	281.9	95	270.5
$A - n55 - k9_2$	1364.23	35	3.1	48	68.7	48	43.9	60	20.4
$A - n60 - k9_2$	1731.66	33	4.9	46	70.1	46	42.5	57	55.8
$A - n61 - k9_2$	1174.13	59	50.6	107	1580.8	107	1100.2	228	788.5
$A - n62 - k8_2$	1757.05	57	36.8	87	557.3	87	372.5	107	291.5
$A - n63 - k9_2$	2285.87	46	32.9	102	796.9	102	574.2	121	332.8
$A - n63 - k10_2$	1735.13	38	6.3	40	59.1	40	37.8	60	35.4
$A - n64 - k9_2$	1904.07	46	13.9	65	673.3	65	422.4	108	207.0
$A - n65 - k9_2$	1402.72	78	92.1	220	2150.4	220	1383.2	296	926.4
$A - n69 - k9_2$	1377.69	66	35.1	141	1874.2	141	1343.9	231	469.5
$A - n80 - k10_2$	2401.32	57	66.3	106	2023.2	106	1458.7	148	1115.5

Table EC. 8: Detailed results for the instances of class A with  $\theta = 0.15$  by  $CG_b$ ,  $CG_m$ ,  $CG_t$  and  $CG_d$ 

Instance	$z_{lp}$	$CG_b$		$CG_m$		$CG_t$		$CG_d$	
		#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_3$	1136.63	27	1.2	22	3.8	22	2.3	34	2.7
$A - n33 - k5_3$	807.42	21	1.4	36	24.6	36	14.9	40	6.1
$A - n33 - k6_3$	930.00	26	1.2	26	9.8	26	6.1	36	5.7
$A - n34 - k5_3$	936.21	26	2.5	44	42.3	44	28.4	78	24.3
$A - n36 - k5_3$	1094.75	31	2.3	35	30.3	35	19.7	69	29.8
$A - n37 - k5_3$	847.87	38	5.4	36	62.2	36	42.8	51	15.3
$A - n37 - k6_3$	1300.17	33	3.3	74	83.4	74	55.6	81	52.6
$A - n38 - k5_3$	848.11	62	29.7	90	569.4	90	419.4	151	488.6
$A - n39 - k5_3$	1072.52	41	18.3	56	516.3	56	384.1	79	96.5
$A - n39 - k6_3$	1158.00	25	2.3	20	8.6	20	5.9	27	5.6
$A - n44 - k6_3$	1180.94	30	6.4	43	138.4	43	90.6	52	59.3
$A - n45 - k6_3$	1134.75	58	61.4	110	3516.5	110	3384	270	1391.8
$A - n45 - k7_3$	1614.17	27	3.4	40	53.3	40	32.1	50	36.9
$A - n46 - k7_3$	1238.33	33	1.7	34	13.3	34	7.5	51	5.4
$A - n48 - k7_3$	1468.75	34	4.2	30	21.7	30	12.7	73	36.8
$A - n53 - k7_3$	1350.21	47	26.0	126	988.0	126	691.2	238	913.4
$A - n54 - k7_3$	1575.56	46	41.6	71	421.8	71	287.2	349	1438.1
$A - n55 - k9_3$	1418.25	32	2.8	43	74.0	43	47.6	82	26.7
$A - n60 - k9_3$	1723.09	40	6.9	63	100.4	65	68.4	63	40.9
$A - n61 - k9_3$	1216.06	51	58.1	89	1797.4	89	1242.7	181	1001.5
$A - n62 - k8_3$	1730.78	54	38.7	73	813.2	73	552.9	106	450.2
$A - n63 - k9_3$	2434.97	35	38.4	82	1318.3	82	870	92	342.2
$A - n63 - k10_3$	1778.74	52	13.4	57	366.0	57	231.5	77	48.4
$A - n64 - k9_3$	1973.66	47	16.2	60	572.1	60	372.7	105	310.8
$A - n65 - k9_3$	1421.83	81	116.9	238	2699.5	238	1621.4	288	876.8
$A - n69 - k9_3$	1380.82	77	57.3	—	—	—	—	243	2483.8
$A - n80 - k10_3$	2488.87	47	151.9	98	3085.8	98	2230.4	144	1655.7

Table EC. 9: Detailed results for the instances of class A with  $\theta = 0.20$  by  $CG_b$ ,  $CG_m$ ,  $CG_t$  and  $CG_d$ 

Instance	$z_{lp}$	$CG_b$		$CG_m$		$CG_t$		$CG_d$	
		#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_4$	1185.83	20	1.0	21	2.9	21	1.8	33	2.9
$A - n33 - k5_4$	876.08	21	1.5	30	21.4	30	13.1	44	7.6
$A - n33 - k6_4$	955.60	19	1.0	18	6.1	18	4	38	7.2
$A - n34 - k5_4$	903.19	22	2.8	28	15.7	28	10.1	40	13.1
$A - n36 - k5_4$	1055.58	29	3.1	52	86.1	52	59.1	40	42.8
$A - n37 - k5_4$	838.80	27	3.3	34	102.0	34	71.3	47	28.2
$A - n37 - k6_4$	1293.11	34	3.6	71	80.7	71	53.6	58	29.3
$A - n38 - k5_4$	962.49	53	26.0	112	589.6	112	449.5	146	217.5
$A - n39 - k5_4$	1156.15	30	15.2	67	591.8	67	434.1	100	264.8
$A - n39 - k6_4$	1156.50	32	2.0	30	23.2	30	16.4	45	22.0
$A - n44 - k6_4$	1182.77	33	6.5	48	156.1	48	103.6	59	66.7
$A - n45 - k6_4$	1160.67	66	80.8	109	1080.8	109	739.8	174	911.6
$A - n45 - k7_4$	1732.37	29	3.1	56	79.0	56	47.2	72	31.9
$A - n46 - k7_4$	1252.35	27	1.6	24	5.0	24	3	31	4.5
$A - n48 - k7_4$	1496.42	31	4.4	38	36.2	38	22.1	58	23.7
$A - n53 - k7_4$	1376.97	49	33.3	75	445.6	75	296.4	139	391.2
$A - n54 - k7_4$	1610.55	40	33.2	60	655.1	60	440.6	90	283.9
$A - n55 - k9_4$	1413.69	43	4.8	79	171.1	79	107.6	141	131.2
$A - n60 - k9_4$	1758.60	42	6.2	55	114.8	55	70	72	84.6
$A - n61 - k9_4$	1257.79	55	53.7	91	2290.6	91	1580.1	188	965.9
$A - n62 - k8_4$	1842.07	48	66.2	65	1212.7	65	796.5	103	473.2
$A - n63 - k9_4$	2370.99	49	60.3	—	—	146	2454.1	193	941.1
$A - n63 - k10_4$	1811.28	35	5.4	52	109.7	52	67.3	83	38.2
$A - n64 - k9_4$	2035.84	43	17.4	68	1642.9	68	1176.5	107	916.0
$A - n65 - k9_4$	1472.94	79	206.0	207	1917.0	207	1362.3	205	488.9
$A - n69 - k9_4$	1479.77	71	68.3	—	—	—	—	280	2973.6
$A - n80 - k10_4$	2504.54	49	158.7	—	—	—	—	182	2386.8

Table EC. 10: Detailed results for the instances of class A with  $\theta = 0.25$  by  $CG_b$ ,  $CG_m$ ,  $CG_t$  and  $CG_d$ 

Instance	$z_{lp}$	$CG_b$		$CG_m$		$CG_t$		$CG_d$	
		#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$	#Iter	$t_{lp}(s)$
$A - n32 - k5_5$	1156.60	23	1.3	23	4.7	23	3	30	4.7
$A - n33 - k5_5$	921.65	22	1.3	35	30.4	35	20.1	31	9.0
$A - n33 - k6_5$	941.36	20	1.1	26	9.8	26	6.2	30	7.8
$A - n34 - k5_5$	925.62	26	2.9	37	24.3	37	15.1	54	16.6
$A - n36 - k5_5$	1138.25	25	2.8	33	57.5	33	41.3	45	14.0
$A - n37 - k5_5$	832.00	31	3.5	40	103.5	40	76.9	41	10.7
$A - n37 - k6_5$	1335.12	28	3.4	50	86.2	50	55.2	109	38.3
$A - n38 - k5_5$	922.33	61	40.8	75	542.7	75	390.2	146	236.4
$A - n39 - k5_5$	1107.12	36	18.1	60	622.3	60	461.1	71	178.9
$A - n39 - k6_5$	1192.50	28	2.7	27	17.4	27	11.5	34	6.3
$A - n44 - k6_5$	1195.63	33	8.4	75	395.4	75	274.1	99	155.1
$A - n45 - k6_5$	1149.25	62	63.2	—	—	—	—	382	1801.8
$A - n45 - k7_5$	1755.04	25	3.5	44	99.3	44	59.8	61	69.9
$A - n46 - k7_5$	1307.67	28	1.6	31	8.2	29	4.9	41	6.5
$A - n48 - k7_5$	1509.21	31	4.7	38	72.7	38	46	52	31.7
$A - n53 - k7_5$	1402.72	46	41.3	84	968.0	84	676.7	145	541.2
$A - n54 - k7_5$	1670.89	43	45.3	69	899.2	69	594.5	92	376.7
$A - n55 - k9_5$	1432.66	44	4.0	49	57.8	49	35.9	52	28.8
$A - n60 - k9_5$	1838.45	38	8.0	55	199.9	55	127	—	—
$A - n61 - k9_5$	1274.86	51	63.0	110	2993.2	110	2055.3	202	1934.9
$A - n62 - k8_5$	1832.64	52	55.9	77	1505.0	77	1026.1	114	1177.8
$A - n63 - k9_5$	2533.70	50	60.9	88	1992.2	88	1551.8	140	1028.3
$A - n63 - k10_5$	1849.63	33	6.0	32	97.1	32	61.1	95	96.5
$A - n64 - k9_5$	2077.46	48	15.9	53	606.8	53	436.5	98	507.8
$A - n65 - k9_5$	1519.32	73	163.1	242	3332.7	242	2302.4	217	635.0
$A - n69 - k9_5$	1503.68	52	50.4	—	2455.8	110	1598.4	151	3153.5
$A - n80 - k10_5$	2657.40	61	207.1	—	—	—	—	344	2504.4

### EC.3. Detailed results for the selected instances by BPC1 and BPC2

Tables EC.11-EC.15 report the detailed results for the selected instances that can not be solved to optimality in the root node. The columns have the same meaning as in Table 5.

Table EC. 11: Detailed results for the selected instances of class A with  $\theta = 0.05$  by BPC1 and BPC2

Instance	$z_{ip}$	BPC1		BPC2			
		#Nodes	$t_T(s)$	#Nodes	$t_T(s)$	$\Delta_{Nodes}(\%)$	$\Delta_{t_T}(\%)$
$A - n36 - k5_1$	1081.0	2	19.4	3	24.1	50.00	24.23
$A - n45 - k7_1$	1636.0	5	18.4	3	14.7	-40.00	-20.11
$A - n46 - k7_1$	1214.5	9	14.4	7	12.3	-22.22	-14.58
$A - n55 - k9_1$	1344.5	7	21.7	8	26.7	14.29	23.04
$A - n61 - k9_1$	1178.5	15	1285.5	22	1096.3	46.67	-14.72
$A - n63 - k9_1$	2234.5	17	310.8	24	393.4	41.18	26.58
$A - n64 - k9_1$	1854.0	105	1178.0	163	1738.3	55.24	47.56
$A - n65 - k9_1$	1360.0	3	171.0	3	157.6	0.00	-7.84

Table EC. 12: Detailed results for the selected instances of class A with  $\theta = 0.10$  by BPC1 and BPC2

Instance	$z_{ip}$	BPC1		BPC2			
		#Nodes	$t_T(s)$	#Nodes	$t_T(s)$	$\Delta_{Nodes}(\%)$	$\Delta_{t_T}(\%)$
$A - n33 - k6_2$	966.0	5	6.1	5	6.0	0.00	-1.64
$A - n34 - k5_2$	890.0	3	8.2	3	8.1	0.00	-1.22
$A - n36 - k5_2$	1125.5	3	17.0	3	15.7	0.00	-7.65
$A - n53 - k7_2$	1360.0	3	299.8	3	279.5	0.00	-6.77
$A - n54 - k7_2$	1596.0	7	339.0	7	324.3	0.00	-4.34
$A - n55 - k9_2$	1387.5	2	11.6	2	11.9	0.00	2.59
$A - n60 - k9_2$	1770.0	25	187.4	37	264.2	48.00	40.98
$A - n61 - k9_2$	1217.5	21	3124.5	31	2985.3	47.62	-4.46
$A - n63 - k9_2$	2317.5	5	241.4	5	204.2	0.00	-15.41
$A - n63 - k10_2$	1769.0	9	120.7	12	113.9	33.33	-5.63
$A - n64 - k9_2$	1937.0	41	613.4	69	881.3	68.29	43.67
$A - n69 - k9_2$	1420.5	17	762.7	11	516.4	-35.29	-32.29

Table EC. 13: Detailed results for the selected instances of class A with  $\theta = 0.15$  by BPC1 and BPC2

Instance	$z_{ip}$	BPC1		BPC2			
		#Nodes	$t_T(s)$	#Nodes	$t_T(s)$	$\Delta_{Nodes}(\%)$	$\Delta_{t_T}(\%)$
$A - n45 - k7_3$	1633.0	4	25.0	3	24.0	-25.00	-4.00
$A - n53 - k7_3$	1381.5	9	503.5	9	448.8	0.00	-10.86
$A - n54 - k7_3$	1595.0	3	143.5	5	153.0	66.67	6.62
$A - n55 - k9_3$	1444.5	3	19.5	3	18.9	0.00	-3.08
$A - n60 - k9_3$	1762.0	7	99.1	7	96.2	0.00	-2.93
$A - n61 - k9_3$	1254.5	15	1473.6	19	1586.2	26.67	7.64
$A - n63 - k9_3$	2474.5	24	732.3	22	589.8	-8.33	-19.46
$A - n63 - k10_3$	1800.0	3	35.8	5	41.3	66.67	15.36
$A - n64 - k9_3$	2005.5	39	512.8	87	818.5	123.08	59.61
$A - n65 - k9_3$	1449.5	3	184.5	3	185.2	0.00	0.38
$A - n69 - k9_3$	1406.0	11	381.9	12	367.8	9.09	-3.69

Table EC. 14: Detailed results for the selected instances of class A with  $\theta = 0.20$  by BPC1 and BPC2

Instance	$z_{ip}$	BPC1		BPC2			
		#Nodes	$t_T(s)$	#Nodes	$t_T(s)$	$\Delta_{Nodes}(\%)$	$\Delta_{t_T}(\%)$
$A - n33 - k6_4$	965.0	3	5.1	3	5.0	0.00	-1.96
$A - n60 - k9_4$	1786.0	4	69.5	5	68.0	25.00	-2.16
$A - n62 - k8_4$	1870.5	13	1954.4	11	1834.0	-15.38	-6.16
$A - n64 - k9_4$	2072.5	147	1618.4	281	3243.0	91.16	100.38
$A - n65 - k9_4$	1502.5	6	351.4	6	428.0	0.00	21.80
$A - n69 - k9_4$	1506.0	5	331.7	5	342.0	0.00	3.11
$A - n80 - k10_4$	2539.5	7	1616.7	11	2173.0	57.14	34.41

Table EC. 15: Detailed results for the selected instances of class A with  $\theta = 0.25$  by BPC1 and BPC2

Instance	$z_{ip}$	BPC1		BPC2			
		#Nodes	$t_T(s)$	#Nodes	$t_T(s)$	$\Delta_{Nodes}(\%)$	$\Delta_{t_T}(\%)$
$A - n37 - k6_5$	1370.0	3	27.7	3	28.5	0.00	2.89
$A - n39 - k5_5$	1134.0	6	287.3	12	267.1	100.00	-7.03
$A - n45 - k7_5$	1779.5	3	49.2	5	65.1	66.67	32.32
$A - n46 - k7_5$	1326.0	4	11.0	5	11.5	25.00	4.55
$A - n53 - k7_5$	1438.5	3	925.4	3	821.7	0.00	-11.21
$A - n54 - k7_5$	1706.0	27	3580.5	29	2423.2	7.41	-32.32
$A - n62 - k8_5$	1857.0	13	945.2	17	976.7	30.77	3.33
$A - n63 - k9_5$	2558.5	5	230.1	3	176.2	-40.00	-23.42
$A - n63 - k10_5$	1877.5	9	172.8	7	129.5	-22.22	-25.06
$A - n64 - k9_5$	2104.0	17	472.6	35	665.1	105.88	40.73
$A - n69 - k9_5$	1529.5	21	663.2	19	451.7	-9.52	-31.89



#### EC.4. Detailed results for all VRPRD instances

Tables EC.16-EC.35 report the detailed results for all VRPRD instances. The columns have the same meaning as in Table 6.

Table EC. 16: Detailed results for the instances of class A with  $\theta = 0.05$

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$A - n32 - k5_1$	1138.50	1127.17	1138.50	5.0	100.00	3	6	1	5.0
$A - n33 - k5_1$	827.50	813.75	827.50	5.1	100.00	18	6	1	5.1
$A - n33 - k6_1$	904.50	896.21	904.50	3.0	100.00	7	14	1	3.0
$A - n34 - k5_1$	915.00	893.76	915.00	9.6	100.00	22	8	1	9.6
$A - n36 - k5_1$	1081.00	1051.30	1080.67	15.0	98.89	8	36	2	19.4
$A - n37 - k5_1$	839.00	813.38	839.00	10.6	100.00	13	14	1	10.7
$A - n37 - k6_1$	1251.50	1226.00	1251.50	9.9	100.00	25	6	1	9.9
$A - n38 - k5_1$	894.00	851.53	894.00	45.3	100.00	34	12	1	45.3
$A - n39 - k5_1$	1018.50	1004.50	1018.50	26.8	100.00	18	12	1	26.8
$A - n39 - k6_1$	1071.50	1071.50	1071.50	2.0	—	0	0	1	2.0
$A - n44 - k6_1$	1147.00	1140.90	1147.00	12.7	100.00	6	6	1	12.7
$A - n45 - k6_1$	1122.00	1103.77	1122.00	180.1	100.00	28	24	1	180.1
$A - n45 - k7_1$	1636.00	1617.88	1633.92	10.9	88.52	25	18	5	18.4
$A - n46 - k7_1$	1214.50	1201.06	1210.00	5.9	66.52	21	12	9	14.4
$A - n48 - k7_1$	1406.00	1384.30	1406.00	15.6	100.00	20	24	1	15.6
$A - n53 - k7_1$	1325.50	1302.22	1325.50	304.7	100.00	33	36	1	304.7
$A - n54 - k7_1$	1532.00	1511.56	1532.00	77.5	100.00	18	26	1	77.5
$A - n55 - k9_1$	1344.50	1317.96	1341.16	10.4	87.42	35	18	7	21.7
$A - n60 - k9_1$	1731.00	1698.61	1731.00	77.3	100.00	44	26	1	77.3
$A - n61 - k9_1$	1178.50	1151.30	1171.21	285.4	73.20	36	36	15	1285.5
$A - n62 - k8_1$	1684.00	1664.17	1684.00	165.4	100.00	50	6	1	165.4
$A - n63 - k9_1$	2234.50	2203.38	2226.99	123.5	75.87	61	30	17	310.8
$A - n63 - k10_1$	1741.00	1714.65	1741.00	32.4	100.00	20	20	1	32.4
$A - n64 - k9_1$	1854.00	1818.20	1841.20	55.9	64.25	21	30	105	1178.0
$A - n65 - k9_1$	1360.00	1335.38	1358.98	134.8	95.86	47	36	3	171.0

Table EC. 17: Detailed results for the instances of class A with  $\theta = 0.10$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$A - n32 - k5_2$	1111.00	1111.00	1111.00	1.0	—	0	0	1	1.0
$A - n33 - k5_2$	849.50	825.83	849.50	4.7	100.00	20	8	1	4.7
$A - n33 - k6_2$	966.00	950.55	963.58	3.3	84.34	8	18	5	6.1
$A - n34 - k5_2$	890.00	862.41	889.13	6.2	96.84	17	12	3	8.2
$A - n36 - k5_2$	1125.50	1098.07	1124.73	10.8	97.19	10	18	3	17.0
$A - n37 - k5_2$	860.50	831.25	860.50	14.5	100.00	8	24	1	14.5
$A - n37 - k6_2$	1244.00	1215.46	1244.00	18.3	100.00	22	18	1	18.3
$A - n38 - k5_2$	888.00	851.34	888.00	50.5	100.00	23	14	1	50.6
$A - n39 - k5_2$	1034.50	1020.71	1034.50	55.2	100.00	16	6	1	55.2
$A - n39 - k6_2$	1123.00	1117.25	1123.00	3.5	100.00	3	2	1	3.5
$A - n44 - k6_2$	1177.00	1170.29	1177.00	12.1	100.00	10	6	1	12.1
$A - n45 - k6_2$	1108.00	1098.32	1108.00	88.5	100.00	25	4	1	88.5
$A - n45 - k7_2$	1644.00	1626.08	1644.00	6.6	100.00	18	6	1	6.6
$A - n46 - k7_2$	1211.00	1197.50	1211.00	6.9	100.00	22	18	1	6.9
$A - n48 - k7_2$	1492.50	1465.00	1492.50	20.3	100.00	18	20	1	20.3
$A - n53 - k7_2$	1360.00	1330.17	1358.40	233.6	94.64	38	36	3	299.8
$A - n54 - k7_2$	1596.00	1568.46	1592.54	152.1	87.44	22	42	7	339
$A - n55 - k9_2$	1387.50	1364.23	1387.29	10.3	99.10	33	12	2	11.6
$A - n60 - k9_2$	1770.00	1731.66	1761.70	44.2	78.35	38	24	25	187.4
$A - n61 - k9_2$	1217.50	1174.13	1208.82	828.2	79.99	60	49	21	3124.5
$A - n62 - k8_2$	1765.50	1757.05	1765.50	176.8	100.00	28	6	1	176.8
$A - n63 - k9_2$	2317.50	2285.87	2314.17	143.7	89.47	48	48	5	241.4
$A - n63 - k10_2$	1769.00	1735.13	1766.01	48.1	91.17	28	36	9	120.7
$A - n64 - k9_2$	1937.00	1904.07	1928.24	85.3	73.40	14	30	41	613.4
$A - n65 - k9_2$	1429.50	1402.72	1429.50	186.9	100.00	49	18	1	186.9
$A - n69 - k9_2$	1420.50	1377.69	1413.47	222.4	83.58	45	42	17	762.7

Table EC. 18: Detailed results for the instances of class A with  $\theta = 0.15$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$A - n32 - k5_3$	1139.50	1136.63	1139.50	1.3	100.00	1	0	1	1.3
$A - n33 - k5_3$	828.00	807.42	828.00	7.7	100.00	22	14	1	7.7
$A - n33 - k6_3$	936.00	930.00	936.00	2.4	100.00	8	2	1	2.4
$A - n34 - k5_3$	951.50	936.21	951.50	8.8	100.00	21	2	1	8.8
$A - n36 - k5_3$	1115.50	1094.75	1115.50	7.9	100.00	5	20	1	7.9
$A - n37 - k5_3$	879.50	847.87	879.50	23.8	100.00	10	22	1	23.8
$A - n37 - k6_3$	1320.50	1300.17	1320.50	13.0	100.00	21	16	1	13.1
$A - n38 - k5_3$	895.50	848.11	895.50	68.4	100.00	27	24	1	68.4
$A - n39 - k5_3$	1090.00	1072.52	1090.00	58.7	100.00	12	14	1	58.7
$A - n39 - k6_3$	1158.00	1158.00	1158.00	2.3	—	0	0	1	2.3
$A - n44 - k6_3$	1195.50	1180.94	1195.50	28.0	100.00	15	24	1	28.0
$A - n45 - k6_3$	1154.00	1134.75	1154.00	227.3	100.00	17	18	1	227.4
$A - n45 - k7_3$	1633.00	1614.17	1630.96	17.1	89.17	32	24	4	25.0
$A - n46 - k7_3$	1245.00	1238.33	1245.00	3.7	100.00	1	10	1	3.7
$A - n48 - k7_3$	1483.50	1468.75	1483.50	8.2	100.00	10	0	1	8.2
$A - n53 - k7_3$	1381.50	1350.21	1376.86	182	85.17	32	30	9	503.5
$A - n54 - k7_3$	1595.00	1575.56	1592.87	103.2	89.04	26	24	3	143.5
$A - n55 - k9_3$	1444.50	1418.25	1443.18	14.9	94.97	39	24	3	19.5
$A - n60 - k9_3$	1762.00	1723.09	1757.93	62.1	89.54	48	30	7	99.1
$A - n61 - k9_3$	1254.50	1216.06	1248.50	445.5	84.39	39	48	15	1473.6
$A - n62 - k8_3$	1746.00	1730.78	1746.00	240.3	100.00	40	8	1	240.3
$A - n63 - k9_3$	2474.50	2434.97	2464.01	146.8	73.46	39	36	24	732.3
$A - n63 - k10_3$	1800.00	1778.74	1797.55	28.4	88.48	12	24	3	35.8
$A - n64 - k9_3$	2005.50	1973.66	1995.77	60	69.44	19	18	39	512.8
$A - n65 - k9_3$	1449.50	1421.83	1446.00	160.6	87.35	35	12	3	184.5
$A - n69 - k9_3$	1406.00	1380.82	1399.77	159.8	75.26	26	24	11	381.9

Table EC. 19: Detailed results for the instances of class A with  $\theta = 0.20$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$A - n32 - k5_4$	1188.00	1185.83	1188.00	1.6	100.00	2	2	1	1.6
$A - n33 - k5_4$	887.50	876.08	887.50	4.2	100.00	9	2	1	4.2
$A - n33 - k6_4$	965.00	955.60	964.20	3.8	91.49	7	18	3	5.1
$A - n34 - k5_4$	927.00	903.19	927.00	14.1	100.00	20	14	1	14.2
$A - n36 - k5_4$	1079.00	1055.58	1079.00	16.2	100.00	9	24	1	16.2
$A - n37 - k5_4$	875.00	838.80	875.00	24.8	100.00	17	22	1	24.8
$A - n37 - k6_4$	1319.50	1293.11	1319.50	20.7	100.00	15	34	1	20.7
$A - n38 - k5_4$	995.00	962.49	995.00	65.1	100.00	21	18	1	65.1
$A - n39 - k5_4$	1181.50	1156.15	1181.50	164.3	100.00	19	34	1	164.3
$A - n39 - k6_4$	1156.50	1156.50	1156.50	2.2	—	0	0	1	2.2
$A - n44 - k6_4$	1200.50	1182.77	1200.50	42.5	100.00	11	16	1	42.5
$A - n45 - k6_4$	1184.50	1160.67	1184.50	289.3	100.00	20	16	1	289.3
$A - n45 - k7_4$	1747.50	1732.37	1747.50	9.2	100.00	19	6	1	9.2
$A - n46 - k7_4$	1255.00	1252.35	1255.00	2.6	100.00	1	6	1	2.6
$A - n48 - k7_4$	1516.50	1496.42	1516.50	20.1	100.00	14	14	1	20.1
$A - n53 - k7_4$	1405.00	1376.97	1405.00	444.5	100.00	28	42	1	444.5
$A - n55 - k9_4$	1436.50	1413.69	1436.50	18.0	100.00	35	14	1	18.0
$A - n60 - k9_4$	1786.00	1758.60	1784.54	49.4	94.67	48	12	4	69.5
$A - n62 - k8_4$	1870.50	1842.07	1866.97	640.8	87.58	29	36	13	1954.4
$A - n63 - k9_4$	2384.50	2370.99	2384.50	110.9	100.00	23	18	1	110.9
$A - n63 - k10_4$	1833.50	1811.28	1833.50	33.9	100.00	34	18	1	34.0
$A - n64 - k9_4$	2072.50	2035.84	2052.54	63.7	45.55	21	12	147	1618.4
$A - n65 - k9_4$	1502.50	1472.94	1496.22	280.4	78.76	48	18	6	351.4
$A - n69 - k9_4$	1506.00	1479.77	1503.60	232.7	90.85	31	30	5	331.7
$A - n80 - k10_4$	2539.50	2504.54	2536.01	875.8	90.02	22	42	7	1616.7

Table EC. 20: Detailed results for the instances of class A with  $\theta = 0.25$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$A - n32 - k5_5$	1177.50	1156.60	1177.50	3.7	100.00	6	6	1	3.7
$A - n33 - k5_5$	945.00	921.65	945.00	5.2	100.00	11	10	1	5.2
$A - n33 - k6_5$	951.00	941.36	951.00	2.6	100.00	8	8	1	2.6
$A - n34 - k5_5$	956.00	925.62	956.00	18.2	100.00	25	18	1	18.2
$A - n36 - k5_5$	1156.50	1138.25	1156.50	6.6	100.00	4	12	1	6.6
$A - n37 - k5_5$	854.00	832.00	854.00	13.4	100.00	13	6	1	13.4
$A - n37 - k6_5$	1370.00	1335.12	1369.38	19.50	98.22	19	24	3	27.7
$A - n38 - k5_5$	969.00	922.33	969.00	94.0	100.00	20	24	1	94.0
$A - n39 - k5_5$	1134.00	1107.12	1128.76	94.10	80.51	11	24	12	287.3
$A - n39 - k6_5$	1192.50	1192.50	1192.50	2.9	—	0	0	1	2.9
$A - n44 - k6_5$	1209.00	1195.63	1209.00	28.3	100.00	14	14	1	28.3
$A - n45 - k6_5$	1185.00	1149.25	1185.00	300.2	100.00	30	16	1	300.2
$A - n45 - k7_5$	1779.50	1755.04	1776.92	37.80	89.45	24	36	3	49.2
$A - n46 - k7_5$	1326.00	1307.67	1324.81	7.40	93.51	8	24	4	11
$A - n48 - k7_5$	1530.00	1509.21	1530.00	13.2	100.00	13	4	1	13.2
$A - n53 - k7_5$	1438.50	1402.72	1436.66	571.40	94.86	30	49	3	925.4
$A - n54 - k7_5$	1706.00	1670.89	1694.83	400.60	68.19	20	36	27	3580.5
$A - n55 - k9_5$	1462.50	1432.66	1462.50	19.4	100.00	38	24	1	19.4
$A - n60 - k9_5$	1873.50	1838.45	1873.50	54.3	100.00	29	14	1	54.3
$A - n62 - k8_5$	1857.00	1832.64	1851.72	358.8	78.33	27	12	13	945.2
$A - n63 - k9_5$	2558.50	2533.70	2555.44	149.2	87.66	27	24	5	230.1
$A - n63 - k10_5$	1877.50	1849.63	1872.37	76.1	81.59	24	48	9	172.8
$A - n64 - k9_5$	2104.00	2077.46	2095.76	112.5	68.95	16	42	17	472.6
$A - n65 - k9_5$	1521.50	1519.32	1521.50	160.7	100.00	5	0	1	160.7
$A - n69 - k9_5$	1529.50	1503.68	1523.18	160.8	75.52	25	30	21	663.2

Table EC. 21: Detailed results for the instances of class B with  $\theta = 0.05$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$B - n31 - k5_1$	1218.50	1206.83	1217.50	4	91.43	11	6	5	6.8
$B - n34 - k5_1$	1252.00	1232.71	1252.00	23.9	100.00	20	2	1	23.9
$B - n35 - k5_1$	1831.00	1661.93	1831.00	3.3	100.00	14	6	1	3.3
$B - n38 - k6_1$	1298.00	1241.92	1298.00	4.1	100.00	12	8	1	4.1
$B - n39 - k5_1$	990.50	950.67	987.44	27.2	92.31	12	6	3	34.2
$B - n41 - k6_1$	1317.00	1251.81	1317.00	16.9	100.00	8	12	1	16.9
$B - n43 - k6_1$	1058.00	1038.29	1058.00	9.5	100.00	9	0	1	9.5
$B - n44 - k7_1$	1526.50	1446.03	1526.50	9.6	100.00	12	18	1	9.6
$B - n45 - k5_1$	927.00	848.048	925.74	697.8	98.40	29	12	3	902
$B - n45 - k6_1$	966.50	938.337	959.46	697.6	74.98	23	30	12	2625.3
$B - n50 - k7_1$	1098.50	1010.81	1098.50	9.8	100.00	22	10	1	9.8
$B - n50 - k8_1$	1951.00	1915.34	1950.34	64.3	98.15	36	24	4	88
$B - n52 - k7_1$	1367.50	1306.93	1367.50	56.4	100.00	6	0	1	56.4
$B - n56 - k7_1$	1286.50	1203.6	1282.63	37.1	95.33	14	12	20	169.6
$B - n57 - k7_1$	2046.00	2802.51	2046.00	3474.3	100.00	22	8	1	3474.3
$B - n57 - k9_1$	3038.00	2998.59	3038.00	11	100.00	21	10	1	11
$B - n63 - k10_1$	2725.00	2681.69	2725.00	62.2	100.00	42	12	1	62.2
$B - n66 - k9_1$	2177.50	2140.14	2171.51	333.2	83.97	25	12	30	2122.9
$B - n68 - k9_1$	2244.50	2175.99	2243.82	550.1	99.01	35	24	3	636.2

Table EC. 22: Detailed results for the instances of class B with  $\theta = 0.10$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$B - n31 - k5_2$	1243.00	1238.2	1243.00	2.3	100.00	4	2	1	2.3
$B - n34 - k5_2$	1276.50	1250.57	1276.50	21.3	100.00	14	4	1	21.3
$B - n35 - k5_2$	1803.00	1640.71	1803.00	2.4	100.00	9	6	1	2.4
$B - n38 - k6_2$	1303.00	1257.28	1303.00	2.5	100.00	6	0	1	2.5
$B - n39 - k5_2$	1027.00	985.644	1020.93	33.9	85.32	12	6	10	105.8
$B - n41 - k6_2$	1271.50	1258.52	1271.50	15.6	100.00	6	0	1	15.6
$B - n43 - k6_2$	1088.50	1056.46	1087.33	27.9	96.35	19	18	3	51.2
$B - n44 - k7_2$	1583.00	1500.35	1582.40	19.5	99.27	22	12	3	24
$B - n45 - k5_2$	917.00	843	917.00	994.3	100.00	21	4	1	994.3
$B - n45 - k6_2$	1024.00	994.222	1019.13	910.1	83.65	21	30	7	1946.7
$B - n50 - k7_2$	1121.50	1047.07	1121.50	7	100.00	8	2	1	7
$B - n50 - k8_2$	1978.50	1945.6	1977.54	50.7	97.08	27	18	3	60.5
$B - n51 - k7_2$	1612.00	1506.47	1612.00	989	100.00	49	14	1	989
$B - n52 - k7_2$	1364.00	1310.88	1364.00	119.7	100.00	6	0	1	119.7
$B - n56 - k7_2$	1327.00	1249.98	1324.90	41.2	97.27	12	18	5	56.7
$B - n57 - k9_2$	3105.00	3073.45	3103.19	13.9	94.26	14	12	4	24.1
$B - n63 - k10_2$	2799.50	2751.36	2799.50	102.7	100.00	46	14	1	102.7
$B - n68 - k9_2$	2365.00	2301.6	2357.32	301.3	87.89	25	12	35	1968.4

Table EC. 23: Detailed results for the instances of class B with  $\theta = 0.15$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$B - n31 - k5_3$	1265.50	1254.03	1265.50	5.3	100.00	9	12	1	5.3
$B - n34 - k5_3$	1302.50	1282.89	1302.50	24.2	100.00	7	2	1	24.2
$B - n35 - k5_3$	1921.00	1785.36	1921.00	31.3	100.00	15	26	1	31.3
$B - n38 - k6_3$	1387.50	1336.58	1387.50	3.7	100.00	13	2	1	3.7
$B - n39 - k5_3$	1022.50	986.043	1022.50	76.1	100.00	15	6	1	76.1
$B - n41 - k6_3$	1294.00	1271.26	1294.00	17.7	100.00	9	6	1	17.7
$B - n43 - k6_3$	1133.00	1115.44	1133.00	11.7	100.00	6	0	1	11.7
$B - n44 - k7_3$	1546.50	1486.19	1546.50	6.4	100.00	5	0	1	6.4
$B - n45 - k5_3$	939.00	850.1	939.00	1667.5	100.00	23	20	1	1667.5
$B - n45 - k6_3$	1011.50	988.252	1010.78	541.4	96.90	20	24	3	743.8
$B - n50 - k7_3$	1153.50	1071.77	1153.42	23.5	99.90	10	10	2	27.1
$B - n50 - k8_3$	2024.00	1993.33	2023.54	44.1	98.50	29	24	4	65.9
$B - n52 - k7_3$	1452.00	1387.42	1452.00	139.9	100.00	16	0	1	139.9
$B - n56 - k7_3$	1330.00	1254.05	1330.00	49.2	100.00	8	6	1	49.2
$B - n57 - k9_3$	3216.00	3174.89	3210.31	19	86.16	15	24	32	113.2
$B - n63 - k10_3$	2869.50	2822.77	2869.50	155.7	100.00	28	36	1	155.7
$B - n66 - k9_3$	2300.50	2278.16	2295.99	978.2	79.81	32	18	7	1714.7
$B - n68 - k9_3$	2406.50	2342.75	2398.69	496	87.75	27	18	33	3430.9

Table EC. 24: Detailed results for the instances of class B with  $\theta = 0.20$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$B - n31 - k5_4$	1308.50	1299.57	1308.50	4.1	100.00	4	6	1	4.1
$B - n34 - k5_4$	1306.00	1302.07	1306.00	15.4	100.00	5	0	1	15.4
$B - n35 - k5_4$	1884.00	1750.49	1884.00	24.3	100.00	15	20	1	24.3
$B - n38 - k6_4$	1389.50	1338.28	1389.50	4	100.00	13	10	1	4
$B - n39 - k5_4$	1038.50	994.179	1036.75	104.2	96.05	15	18	3	152.9
$B - n41 - k6_4$	1316.00	1297.84	1316.00	28.2	100.00	5	6	1	28.2
$B - n43 - k6_4$	1138.50	1109.58	1133.61	44.8	83.09	19	18	6	80
$B - n44 - k7_4$	1641.50	1565.42	1639.14	13	96.90	9	12	7	25.6
$B - n45 - k5_4$	987.50	905.043	987.50	1395.5	100.00	27	8	1	1395.5
$B - n45 - k6_4$	1060.50	1055.17	1060.50	115.5	100.00	3	0	1	115.5
$B - n50 - k7_4$	1191.00	1115.85	1191.00	8.6	100.00	10	2	1	8.6
$B - n50 - k8_4$	2040.50	2020.39	2040.50	47.6	100.00	47	16	1	47.6
$B - n51 - k7_4$	1753.00	1661.82	1753.00	717.1	100.00	37	6	1	717.1
$B - n52 - k7_4$	1499.50	1438.48	1499.50	114.3	100.00	9	0	1	114.3
$B - n56 - k7_4$	1387.50	1304.87	1384.32	55	96.15	12	18	13	149.6
$B - n57 - k7_4$	2237.00	2205.61	2237.00	2909.4	100.00	13	0	1	2909.4
$B - n57 - k9_4$	3193.00	3171.6	3193.00	15.7	100.00	14	16	1	15.7
$B - n63 - k10_4$	2895.00	2851.98	2895.00	126.6	100.00	32	24	1	126.7
$B - n66 - k9_4$	2336.00	2299.82	2325.06	730.2	69.76	31	18	19	3592.1
$B - n67 - k10_4$	1516.50	1435.44	1501.57	69.5	81.58	35	30	167	2795.2
$B - n68 - k9_4$	2423.00	2369.57	2421.63	823.2	97.44	26	24	6	1450.8

Table EC. 25: Detailed results for the instances of class B with  $\theta = 0.25$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$B - n31 - k5_5$	1337.00	1327	1330.94	6.2	39.40	1	12	11	36.2
$B - n34 - k5_5$	1380.50	1376.27	1380.50	25.2	100.00	8	2	1	25.2
$B - n35 - k5_5$	1926.00	1780.5	1926.00	3.5	100.00	11	4	1	3.5
$B - n38 - k6_5$	1446.00	1386	1441.92	9.9	93.20	16	30	4	14
$B - n39 - k5_5$	1021.00	985.341	1021.00	17.3	100.00	8	0	1	17.3
$B - n41 - k6_5$	1391.50	1362.19	1391.50	27.7	100.00	5	12	1	27.7
$B - n43 - k6_5$	1151.00	1121.36	1150.91	18.6	99.70	15	6	3	25.8
$B - n44 - k7_5$	1696.00	1617.35	1695.83	19.5	99.78	10	18	2	22.9
$B - n45 - k5_5$	1014.00	926.817	1014.00	1117.4	100.00	16	12	1	1117.4
$B - n45 - k6_5$	1114.50	1101.52	1114.50	328.7	100.00	12	12	1	328.8
$B - n50 - k7_5$	1246.50	1174.86	1246.50	14.2	100.00	10	12	1	14.2
$B - n50 - k8_5$	2108.00	2096.31	2108.00	27	100.00	19	8	1	27
$B - n51 - k7_5$	1835.50	1733.36	1835.50	2306.7	100.00	17	30	1	2306.7
$B - n52 - k7_5$	1531.50	1463.59	1531.50	865.3	100.00	13	18	1	865.3
$B - n56 - k7_5$	1409.00	1322.99	1404.90	40	95.23	9	12	15	187.5
$B - n57 - k9_5$	3282.50	3247.77	3275.65	38.5	80.28	16	36	9	153.7
$B - n63 - k10_5$	2970.00	2915.58	2967.06	175	94.60	30	30	5	442.3
$B - n66 - k9_5$	2389.50	2353.05	2387.44	774.4	94.35	27	30	4	1053.6
$B - n68 - k9_5$	2492.00	2443.59	2491.27	314.7	98.49	21	18	3	380.6

Table EC. 26: Detailed results for the instances of class E-F-M with  $\theta = 0.05$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$E - n51 - k5_1$	568.00	563.22	568.00	1610.8	100.00	9	8	1	1610.8
$E - n76 - k8_1$	779.00	769.69	778.52	1630.2	94.88	14	30	2	1760.6
$E - n76 - k14_1$	1162.00	1147.23	1157.92	24.4	72.38	22	12	22	88.6
$M - n101 - k10_1$	942.00	942.00	942.00	613.3	—	0	0	1	613.3

Table EC. 27: Detailed results for the instances of class E-F-M with  $\theta = 0.10$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$E - n51 - k5_2$	614.00	606.11	614.00	3133.9	100.00	6	18	1	3134
$E - n76 - k7_2$	723.00	715.68	720.69	922.3	68.38	3	18	8	1940.1
$E - n76 - k14_2$	1170.50	1152.53	1164.60	41.1	67.17	29	36	27	142.7
$E - n101 - k14_2$	1277.50	1259.77	1271.45	129.1	65.88	23	36	155	3028.1
$M - n101 - k10_2$	953.50	953.50	953.50	1590.3	—	0	0	1	1590.3

Table EC. 28: Detailed results for the instances of class E-F-M with  $\theta = 0.15$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$E - n51 - k5_3$	632.00	624.56	632.00	2851	100.00	12	12	1	2851
$E - n76 - k14_3$	1182.50	1172.97	1182.22	35.2	97.06	25	24	3	42.9
$F - n45 - k4_3$	845.00	835.00	845.00	2585.3	100.00	0	6	1	2585.3
$M - n101 - k10_3$	1017.00	1013.17	1017.00	1409.1	100.00	1	6	1	1409.1

Table EC. 29: Detailed results for the instances of class E-F-M with  $\theta = 0.20$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$E - n76 - k14_4$	1196.50	1191.06	1196.50	31.1	100.00	22	14	1	31.1
$M - n101 - k10_4$	1031.50	1031.50	1031.50	1013.8	–	0	0	1	1013.8

Table EC. 30: Detailed results for the instances of class E-F-M with  $\theta = 0.25$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$E - n76 - k14_5$	1255.00	1234.95	1245.64	45.4	53.32	29	36	81	485.8
$M - n101 - k10_5$	1056.50	1056.50	1056.50	1351.3	–	0	0	1	1351.3

Table EC. 31: Detailed results for the instances of class P with  $\theta = 0.05$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$P - n16 - k8_1$	589.0	588.17	589.00	0.6	100.00	3	0	1	0.6
$P - n19 - k2_1$	321.5	312.75	321.50	18.4	100.00	2	6	1	18.4
$P - n20 - k2_1$	278.5	278.17	278.50	15.9	100.00	2	0	1	15.9
$P - n21 - k2_1$	290.0	290.00	290.00	11.2	–	0	0	1	11.2
$P - n22 - k2_1$	301.5	301.50	301.50	16.7	–	0	0	1	16.7
$P - n22 - k8_1$	763.0	730.00	761.17	0.7	94.45	7	8	3	0.8
$P - n23 - k8_1$	680.0	680.00	680.00	0.5	–	0	0	1	0.5
$P - n40 - k5_1$	550.5	550.50	550.50	8.5	–	0	0	1	8.5
$P - n45 - k5_1$	585.0	579.06	585.00	134.5	100.00	5	12	1	134.5
$P - n50 - k7_1$	638.5	633.19	638.50	11.6	100.00	14	6	1	11.6
$P - n50 - k8_1$	777.5	744.86	761.92	114.1	52.27	36	36	69	3588.3
$P - n50 - k10_1$	868.0	854.17	865.96	6.5	85.23	32	30	3	8.0
$P - n51 - k10_1$	839.0	828.06	834.89	11.3	62.47	30	18	11	29.6
$P - n55 - k7_1$	688.0	682.97	686.38	29.5	67.69	10	6	5	50.3
$P - n55 - k8_1$	758.0	727.20	745.95	138.3	60.89	38	30	63	2744.4
$P - n55 - k10_1$	792.0	790.32	792.00	3.9	100.00	18	2	1	3.9
$P - n55 - k15_1$	1155.0	1128.35	1147.49	12.3	71.82	47	42	9	24.0
$P - n60 - k10_1$	873.5	864.89	871.91	11.5	81.56	16	18	6	19.4
$P - n60 - k15_1$	1129.5	1122.18	1128.00	3.7	79.51	52	26	5	5.4
$P - n65 - k10_1$	970.0	956.35	962.60	19.1	45.82	16	18	43	135.2
$P - n70 - k10_1$	944.5	924.36	935.40	123.8	54.80	41	30	75	1191.3

Table EC. 32: Detailed results for the instances of class P with  $\theta = 0.10$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$P - n16 - k8_2$	595.0	594.50	595.00	0.4	100.00	2	0	1	0.4
$P - n19 - k2_2$	325.0	316.00	325.00	54.1	100.00	2	8	1	54.1
$P - n20 - k2_2$	300.0	293.00	300.00	58.5	100.00	3	4	1	58.5
$P - n21 - k2_2$	292.5	292.50	292.50	9.3	—	0	0	1	9.3
$P - n22 - k2_2$	286.0	286.00	286.00	25.3	—	0	0	1	25.3
$P - n22 - k8_2$	758.0	727.75	756.33	0.5	94.49	10	8	3	0.6
$P - n23 - k8_2$	706.0	706.00	706.00	0.5	—	0	0	1	0.5
$P - n40 - k5_2$	598.0	592.80	598.00	21.7	100.00	4	12	1	21.7
$P - n45 - k5_2$	572.0	566.97	572.00	127.9	100.00	10	12	1	127.9
$P - n50 - k7_2$	656.5	649.43	653.28	12.9	54.47	24	6	8	24.8
$P - n50 - k10_2$	852.0	841.40	852.00	6.5	100.00	31	26	1	6.5
$P - n51 - k10_2$	850.0	834.98	846.99	11.7	79.95	24	30	7	24.6
$P - n55 - k7_2$	699.0	686.55	697.37	58.1	86.88	14	30	5	102.9
$P - n55 - k10_2$	807.0	800.48	807.00	4.5	100.00	28	8	1	4.5
$P - n55 - k15_2$	1177.5	1148.88	1168.55	12.6	68.73	42	42	9	23.5
$P - n60 - k10_2$	902.0	887.83	896.08	14.2	58.18	18	30	17	53.1
$P - n60 - k15_2$	1136.0	1123.59	1132.00	5	67.77	42	42	12	11.2
$P - n65 - k10_2$	977.5	967.87	974.80	14.1	71.93	21	12	8	28.1
$P - n70 - k10_2$	964.0	948.54	958.93	164.1	67.19	48	36	25	734.2

Table EC. 33: Detailed results for the instances of class P with  $\theta = 0.15$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$P - n16 - k8_3$	602.0	600.00	602.00	0.5	100.00	3	0	1	0.5
$P - n19 - k2_3$	327.5	319.14	327.50	28.4	100.00	4	2	1	28.4
$P - n20 - k2_3$	303.0	301.33	303.00	14.9	100.00	1	0	1	14.9
$P - n21 - k2_3$	275.5	275.50	275.50	12.6	—	0	0	1	12.6
$P - n22 - k2_3$	302.0	302.00	302.00	31.9	—	0	0	1	31.9
$P - n22 - k8_3$	772.0	740.80	768.33	0.7	88.25	16	10	3	0.8
$P - n23 - k8_3$	708.5	708.50	708.50	0.5	—	0	0	1	0.5
$P - n40 - k5_3$	597.5	592.13	597.50	25.5	100.00	2	10	1	25.5
$P - n45 - k5_3$	593.0	584.48	593.00	424.9	100.00	9	18	1	424.9
$P - n50 - k7_3$	662.0	652.18	661.43	18.8	94.24	18	18	3	25.9
$P - n50 - k10_3$	904.5	887.84	901.49	6.6	81.93	29	24	5	11.0
$P - n51 - k10_3$	855.0	838.98	852.38	20.8	83.65	48	49	9	47.0
$P - n55 - k7_3$	706.0	699.06	706.00	75.9	100.00	16	22	1	75.9
$P - n55 - k10_3$	837.5	831.11	837.50	4.5	100.00	22	8	1	4.5
$P - n55 - k15_3$	1198.0	1178.09	1195.48	15.2	87.34	50	48	3	19.0
$P - n60 - k10_3$	868.0	863.42	868.00	12.3	100.00	23	6	1	12.3
$P - n60 - k15_3$	1165.0	1157.39	1163.39	4.4	78.84	50	18	5	6.2
$P - n65 - k10_3$	987.5	976.70	986.86	49.7	94.07	31	36	3	65.8

Table EC. 34: Detailed results for the instances of class P with  $\theta = 0.20$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$P - n16 - k8_4$	607.0	604.33	607.00	0.4	100.00	4	0	1	0.4
$P - n19 - k2_4$	332.0	328.23	332.00	11.6	100.00	2	2	1	11.6
$P - n20 - k2_4$	305.0	305.00	305.00	20.9	–	0	0	1	20.9
$P - n21 - k2_4$	307.5	307.50	307.50	21.3	–	0	0	1	21.3
$P - n22 - k2_4$	329.0	329.00	329.00	23.0	–	0	0	1	23
$P - n22 - k8_4$	781.5	747.50	778.67	0.5	91.67	11	4	3	0.6
$P - n23 - k8_4$	698.0	698.00	698.00	0.5	–	0	0	1	0.5
$P - n40 - k5_4$	613.5	606.82	613.50	27.9	100.00	3	8	1	27.9
$P - n45 - k5_4$	589.0	585.25	587.48	86.5	59.36	5	6	4	128.8
$P - n50 - k7_4$	656.0	648.50	655.78	22.3	97.05	16	24	4	31.4
$P - n50 - k10_4$	902.0	885.13	899.16	5.4	83.16	26	30	5	8.4
$P - n51 - k10_4$	893.0	874.08	885.84	16.6	62.18	21	30	36	114.4
$P - n55 - k7_4$	721.0	712.25	721.00	69.0	100.00	18	18	1	69
$P - n55 - k10_4$	832.5	825.40	830.19	3.1	67.49	17	6	10	7.7
$P - n55 - k15_4$	1192.0	1158.07	1176.01	12.3	52.87	42	36	47	97.8
$P - n60 - k10_4$	876.5	876.50	876.50	3.2	–	0	0	1	3.2
$P - n60 - k15_4$	1172.5	1161.69	1170.02	3.4	77.06	37	24	9	6.8
$P - n65 - k10_4$	1043.0	1026.85	1036.27	39.8	58.33	14	36	33	252.9
$P - n70 - k10_4$	1008.0	980.41	996.88	192.8	59.71	26	30	109	2610.3

Table EC. 35: Detailed results for the instances of class P with  $\theta = 0.25$ 

Instance	$z_{ip}$	$z_{lp}$	$z_{lpc}$	$t_{root}(s)$	$\Delta_{lpc}(\%)$	#CC	#SR	#Nodes	$t_T(s)$
$P - n16 - k8_5$	616.5	614.33	616.50	0.5	100.00	4	0	1	0.5
$P - n19 - k2_5$	357.5	350.00	357.50	19.4	100.00	1	0	1	19.4
$P - n20 - k2_5$	314.0	300.25	314.00	62.0	100.00	1	6	1	62
$P - n21 - k2_5$	319.5	319.50	319.50	14.4	–	0	0	1	14.4
$P - n22 - k2_5$	312.5	312.50	312.50	17.7	–	0	0	1	17.7
$P - n22 - k8_5$	790.0	763.17	790.00	0.5	100.00	12	3	1	0.5
$P - n23 - k8_5$	719.0	719.00	719.00	0.5	–	0	0	1	0.5
$P - n40 - k5_5$	614.5	605.64	614.50	36.2	100.00	5	18	1	36.2
$P - n50 - k7_5$	678.5	669.51	678.50	38.5	100.00	20	18	1	38.5
$P - n50 - k10_5$	922.5	900.80	913.68	6.3	59.36	25	24	35	44.3
$P - n51 - k10_5$	922.0	902.74	912.43	9.5	50.31	19	18	59	142.6
$P - n55 - k7_5$	759.0	741.83	751.75	55.1	57.76	10	12	24	329.2
$P - n55 - k10_5$	848.5	844.69	848.50	5.4	100.00	17	6	1	5.4
$P - n55 - k15_5$	1218.5	1188.37	1206.77	9	61.07	35	24	27	46.8
$P - n60 - k10_5$	934.5	915.96	928.84	21.7	69.45	19	30	37	151.4
$P - n60 - k15_5$	1159.0	1150.60	1159.00	2.7	100.00	34	10	1	2.7
$P - n65 - k10_5$	1040.5	1028.19	1040.50	45.8	100.00	28	42	1	45.8
$P - n70 - k10_5$	1030.5	1006.52	1018.19	214.5	48.67	29	36	93	2192.9