

VU Research Portal

Corrigendum to “Extended Formulations and Branch-and-Cut Algorithms for the Black-and-White Traveling Salesman Problem” [European Journal of Operational Research, 262(3) 2017, 908–928]

Gouveia, Luis; Leitner, Markus; Ruthmair, Mario; Sadykov, Ruslan

published in

European Journal of Operational Research
2020

DOI (link to publisher)

[10.1016/j.ejor.2020.02.039](https://doi.org/10.1016/j.ejor.2020.02.039)

document version

Publisher's PDF, also known as Version of record

document license

Article 25fa Dutch Copyright Act

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Gouveia, L., Leitner, M., Ruthmair, M., & Sadykov, R. (2020). Corrigendum to “Extended Formulations and Branch-and-Cut Algorithms for the Black-and-White Traveling Salesman Problem” [European Journal of Operational Research, 262(3) 2017, 908–928]. *European Journal of Operational Research*, 285(3), 1199-1203. <https://doi.org/10.1016/j.ejor.2020.02.039>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:

vuresearchportal.ub@vu.nl



Corrigendum to “Extended Formulations and Branch-and-Cut Algorithms for the Black-and-White Traveling Salesman Problem” [European Journal of Operational Research, 262(3) 2017, 908–928]



Luis Gouveia^a, Markus Leitner^b, Mario Ruthmair^{b,c,*}, Ruslan Sadykov^d

^a Universidade de Lisboa, Faculdade de Ciências, Departamento de Estatística e Investigação Operacional, Lisbon, Portugal

^b Vrije Universiteit Amsterdam, Department of Supply Chain Analytics, Amsterdam, Netherlands

^c University of Vienna, Department of Statistics and Operations Research, Vienna, Austria

^d Inria Bordeaux - Sud-Ouest, Talence, France

A B S T R A C T

In a personal communication with Ruslan Sadykov from Inria, France, we found an implementation error in our code for importing the benchmark instance set MUT leading to wrong numerical results in our original article (Gouveia, Leitner, and Ruthmair, 2017). In this corrigendum we provide corrected results for all experiments on instance set MUT. The general findings and conclusions drawn from the results however do not change.

© 2020 Elsevier B.V. All rights reserved.

Tables 3, 4, 7, and 8 in the original article (Gouveia, Leitner, & Ruthmair, 2017) have to be replaced with the corresponding tables in this corrigendum. Additionally, several numbers of solved instances in a paragraph in Section 7.3 have to be modified as stated below (we only cite relevant parts of the original article):

7.3. Branch-and-cut result overview

...

Finally, note that a direct comparison to the results of the branch-and-price approach in Muter (2015) is only possible for instance set MUT and when $\gamma = 1.0$: The best method from Muter (2015) is able to solve 74 instances within 10800 seconds on a hardware similar to ours while our approach based on model PD⁺ solves 163 instances within 7200 seconds. Since we have different values of L_{\max} (the ones in Muter (2015) have been obtained by a heuristic) the instances for restricted L values are not the same. Generating the L_{\max} values in the same way as we did for the other instances, it seems that we solve less instances than Muter (2015) ($\gamma = 0.7$: 120 by Muter, 118 by DD⁺; $\gamma = 0.8$: 115 by Muter, 93 by PS⁺). To this end, we stress that the (likely) different values of L_{\max} may significantly influence the overall performance, thus avoiding significant conclusions from this comparison. We also note, that the distance-dependent models heavily depend on the range of the distance values. If we for example would divide all the distance values for the MUT instances by 100 and round up the resulting values, we obtain much better results for the DD⁺ model ($\gamma = 0.7$: 155; $\gamma = 0.8$: 151).

DOI of original article: [10.1016/j.ejor.2017.04.061](https://doi.org/10.1016/j.ejor.2017.04.061)

* Corresponding author.

E-mail addresses: legouveia@fc.ul.pt (L. Gouveia), m.leitner@vu.nl (M. Leitner), mario.ruthmair@univie.ac.at, mario@ruthmair.at (M. Ruthmair), ruslan.sadykov@inria.fr (R. Sadykov).

<https://doi.org/10.1016/j.ejor.2020.02.039>

0377-2217/© 2020 Elsevier B.V. All rights reserved.

Table 3
Number of instances (out of 20 in each row) solved by our branch-and-cut algorithms based on different models within 7200 seconds and 5 GB memory. Bold values denote the best algorithms for a set and a model type.

Set	Q/α	β	γ	PS			PD			PDPS		
					+			+	++		+	++
GLR1	4	1.00	0.6	3	4	7	7	7	5	5	5	
			0.8	5	5	16	16	16	11	12	12	
			1.0	5	5	17	19	19	15	17	17	
		1.33	0.6	5	6	12	12	12	6	5	5	
			0.8	11	13	19	20	20	14	16	15	
			1.0	14	15	20	20	20	17	19	19	
	1.67	0.6	9	10	19	18	19	8	8	8		
		0.8	17	17	20	20	20	19	19	19		
		1.0	18	18	20	20	20	20	20	20		
	8	1.00	0.6	6	5	6	6	6	6	6	6	
			0.8	8	8	10	11	10	9	9	9	
			1.0	9	10	14	16	16	11	14	14	
		1.33	0.6	10	9	10	10	9	6	8	7	
			0.8	16	15	18	20	20	11	13	12	
			1.0	19	19	19	20	20	17	19	19	
	1.67	0.6	9	10	11	11	11	6	7	6		
		0.8	19	18	19	19	19	13	13	13		
		1.0	19	19	20	20	20	18	19	18		
GLR2	4	1.00	0.6	1	0	5	6	6	5	5	5	
			0.8	1	3	14	14	14	9	12	12	
			1.0	1	1	15	18	17	11	14	14	
		1.33	0.6	4	4	6	6	6	5	5	5	
			0.8	5	5	12	19	17	8	9	9	
			1.0	5	5	17	19	18	10	14	14	
	1.67	0.6	4	4	8	9	9	6	6	6		
		0.8	6	5	11	16	15	8	9	9		
		1.0	6	6	17	19	19	10	13	13		
	8	1.00	0.6	3	3	4	4	4	5	5	5	
			0.8	5	5	10	11	11	6	8	7	
			1.0	5	5	12	16	16	9	12	11	
		1.33	0.6	3	5	4	4	4	5	4	4	
			0.8	5	5	8	8	8	5	6	6	
			1.0	5	5	10	13	13	9	10	10	
	1.67	0.6	6	6	6	6	6	6	6	6		
		0.8	6	6	9	12	12	6	8	8		
		1.0	7	7	12	14	14	9	11	11		
MUT	0.2	1.00	0.7	19	20	20	20	20	20	20	20	
			0.8	13	14	14	14	14	13	14	14	
			1.0	4	5	15	16	16	12	14	14	
		1.33	0.7	8	8	9	9	9	7	8	8	
			0.8	6	6	8	8	8	6	6	6	
			1.0	11	12	17	18	17	11	15	15	
	1.67	0.7	6	6	8	8	8	6	7	7		
		0.8	8	9	10	11	11	6	6	6		
		1.0	17	17	18	20	20	16	15	15		
	0.3	1.00	0.7	18	19	17	17	17	17	17	17	
			0.8	7	7	6	7	7	6	6	5	
			1.0	14	16	16	17	16	11	11	11	
		1.33	0.7	7	8	7	7	7	7	7	7	
			0.8	9	9	9	9	9	7	7	7	
			1.0	19	19	20	20	18	14	14	14	
	1.67	0.7	8	8	7	7	7	7	6	6		
		0.8	10	9	8	8	8	6	6	6		
		1.0	20	20	20	20	20	19	17	16		
0.4	1.00	0.7	19	19	19	19	19	19	19	19		
		0.8	12	12	11	11	11	12	11	11		
		1.0	15	15	16	16	16	13	14	14		
	1.33	0.7	9	9	8	8	8	8	8	8		
		0.8	11	11	10	10	10	8	8	8		
		1.0	18	18	17	17	17	14	14	13		
1.67	0.7	8	10	7	7	7	5	5	5			
	0.8	15	16	12	11	11	8	8	8			
	1.0	20	20	19	19	19	19	18	18			
Total				611	628	805	853	843	641	687	677	

Table 4

Number of instances (out of 20 in each row) solved by our branch-and-cut algorithms based on different models within 7200 seconds and 5 GB memory. Bold values denote the best algorithms for a set and a model type.

Set	Q/α	β	γ	DD		DDPS		PDDD		3PD					
				+	++	+	++	+	++	+	++				
GLR1	4	1.00	0.6	5	5	5	5	5	8	11	11	14	14	14	
			0.8	5	6	6	5	6	6	10	13	12	14	15	14
		1.33	0.6	14	17	16	9	9	9	12	18	16	16	19	19
			0.8	15	16	15	7	9	8	16	19	18	17	19	19
		1.67	0.6	18	20	20	12	12	12	17	20	20	17	20	20
			0.8	19	20	20	13	12	12	20	20	20	20	20	20
	8	1.00	0.6	8	10	9	5	7	7	6	10	10	5	6	5
			0.8	7	8	8	5	6	7	7	9	8	6	8	8
		1.33	0.6	13	16	15	8	10	10	11	13	13	8	11	12
			0.8	15	17	17	9	9	9	14	14	15	9	12	12
		1.67	0.6	16	20	19	9	12	12	13	14	14	10	12	12
			0.8	18	20	19	12	12	12	17	18	17	13	14	13
GLR2	4	1.00	0.6	4	4	4	4	4	5	9	9	11	15	14	
			0.8	3	3	3	3	3	8	13	12	9	13	12	
		1.33	0.6	7	9	9	5	6	6	10	11	11	11	12	12
			0.8	6	6	6	5	5	5	9	9	10	10	12	11
		1.67	0.6	9	10	10	5	7	7	10	13	14	12	15	15
			0.8	8	8	8	5	6	6	9	13	13	10	13	14
	8	1.00	0.6	6	9	8	5	7	7	6	9	8	5	5	5
			0.8	5	6	6	4	5	5	6	7	6	5	5	5
		1.33	0.6	9	11	11	5	7	8	6	10	10	5	9	10
			0.8	8	8	8	5	5	5	6	9	9	5	7	6
		1.67	0.6	10	12	10	6	8	8	9	10	10	6	10	10
			0.8	9	9	9	5	6	6	8	9	9	6	7	7
MUT	0.20	1.00	0.7	19	19	19	19	19	19	19	19	19	19	19	19
			0.8	14	14	14	14	14	14	14	14	14	14	14	14
		1.33	0.7	12	12	12	12	12	11	11	11	11	10	11	11
			0.8	9	9	9	9	9	9	9	8	8	9	7	8
		1.67	0.7	13	13	13	12	12	11	12	13	13	10	10	10
			0.8	10	10	10	9	7	7	9	8	8	9	7	7
	0.30	1.00	0.7	17	17	17	17	17	17	17	17	17	17	17	17
			0.8	7	7	7	7	7	7	6	7	7	5	5	5
		1.33	0.7	9	10	10	10	9	9	10	9	9	10	9	9
			0.8	7	7	7	7	6	6	6	6	6	7	6	6
		1.67	0.7	11	12	12	9	10	10	8	9	9	9	9	9
			0.8	6	6	6	5	6	6	5	5	5	5	5	5
0.40	1.00	0.7	19	19	19	19	19	19	19	19	19	19	19	19	
		0.8	12	12	12	12	12	12	12	12	11	10	10	10	
	1.33	0.7	9	9	9	9	9	9	9	9	9	8	8	8	
		0.8	7	7	7	7	7	7	7	7	7	7	7	7	
	1.67	0.7	6	7	7	6	6	6	6	6	6	6	6	6	
		0.8	9	8	8	7	7	7	9	7	7	7	7	7	
Total				433	468	459	346	366	365	431	487	480	425	469	466

Table 7
Comparison of final optimality gaps, CPU times, and numbers of solved and infeasible instances of our branch-and-cut algorithms based on different models for instances with $|V| \in \{20, 40\}$ from set MUT. Bold values denote the best algorithms in a row. ("tl"...time limit reached, "-"...results not available)

V	α	β	γ	Avg. optimality gaps in %					Avg. CPU times in seconds					# Instances solved (inf.) (out of 5)					
				PS+	PD+	DD+	PDDD+	3PD+	PS+	PD+	DD+	PDDD+	3PD+	PS+	PD+	DD+	PDDD+	3PD+	
20	0.2	1.00	0.7	-	-	-	-	-	0	0	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)
			0.8	-	-	-	-	-	262	591	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)
		1.33	0.7	4.9	0.0	-	-	-	3776	1	-	-	-	-	3(0)	5(0)	-	-	-
		0.8	0.0	0.0	0.0	0.0	0.0	1441	77	0	1	1	1	1	4(4)	5(5)	5(5)	5(5)	5(5)
		1.0	0.0	0.0	-	-	-	1	1	-	-	-	-	-	5(0)	5(0)	-	-	-
		1.67	0.7	2.8	0.0	0.0	0.0	0.0	1490	7	3	10	5	5	4(3)	5(3)	5(3)	5(3)	5(3)
	0.3	1.00	0.8	2.7	0.0	0.0	0.0	0.0	1469	2	16	28	20	4(2)	5(2)	5(2)	5(2)	5(2)	5(2)
			1.0	0.0	0.0	-	-	-	109	1	-	-	-	-	5(0)	5(0)	-	-	-
		1.33	0.7	-	-	-	-	-	0	0	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)
		0.8	-	-	-	-	-	0	0	1	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)	
		1.0	0.0	0.0	-	-	-	116	1	-	-	-	-	5(0)	5(0)	-	-	-	
		1.67	0.7	-	13.7	-	-	-	386	1440	13	36	33	5(5)	4(4)	5(5)	5(5)	5(5)	5(5)
	0.4	1.00	0.8	0.0	0.0	0.0	0.0	0.0	12	31	108	90	144	5(2)	5(2)	5(2)	5(2)	5(2)	
			1.0	0.0	0.0	-	-	-	1	1	-	-	-	-	5(0)	5(0)	-	-	-
		1.33	0.7	0.0	0.0	0.0	0.0	0.0	47	45	1	0	1	5(4)	5(4)	5(4)	5(4)	5(4)	
		0.8	0.0	0.0	0.0	0.0	0.0	2	1	18	24	55	5(2)	5(2)	5(2)	5(2)	5(2)		
		1.0	0.0	0.0	-	-	-	0	0	-	-	-	-	5(0)	5(0)	-	-	-	
		1.67	0.7	0.0	0.0	0.0	0.0	0.0	3	1	59	101	686	5(4)	5(4)	5(4)	5(4)	5(4)	
	40	0.2	1.00	0.8	16.7	11.9	7.6	10.9	14.7	2880	2880	2880	2880	2880	2880	5(5)	5(5)	5(5)	5(5)
				1.0	3.2	0.0	-	-	-	4841	43	-	-	-	-	2(0)	5(0)	-	-
		1.33	0.7	9.1	8.6	6.3	10.3	5.8	4320	3983	1523	1722	1665	2(2)	3(2)	4(4)	4(4)	4(4)	
		0.8	13.8	12.2	7.3	9.1	8.6	5909	4597	4062	5597	6478	1(0)	2(0)	3(1)	3(1)	2(1)	1(0)	
		1.0	0.4	0.0	-	-	-	1452	10	-	-	-	-	4(0)	5(0)	-	-	-	
		1.67	0.7	17.0	14.0	0.0	0.0	1.3	5760	4858	1250	1210	2184	1(1)	2(1)	5(3)	5(3)	4(3)	
0.3	1.00	0.8	0.0	0.0	0.0	1.2	1.4	2422	317	2139	3791	5098	5(0)	5(0)	5(0)	3(0)	2(0)		
		1.0	0.0	0.0	-	-	-	6	5	-	-	-	-	5(0)	5(0)	-	-	-	
	1.33	0.7	0.0	6.4	6.5	4.8	20.1	525	1772	1494	1616	2413	5(4)	4(4)	4(4)	4(4)	4(4)		
	0.8	4.3	4.3	8.7	8.2	22.0	4347	5187	4877	5385	tl	tl	2(0)	2(0)	2(2)	2(2)	0(0)		
	1.0	0.0	0.0	-	-	-	400	15	-	-	-	-	5(0)	5(0)	-	-	-		
	1.67	0.7	12.1	12.5	2.2	4.0	4.2	4322	4329	2305	2912	2962	2(1)	2(1)	4(3)	3(3)	3(3)		
0.4	1.00	0.8	4.3	4.8	3.8	4.6	10.8	4321	4324	5369	5760	5760	2(1)	2(1)	2(1)	1(1)	1(1)		
		1.0	0.0	0.0	-	-	-	2	4	-	-	-	-	5(0)	5(0)	-	-	-	
	1.33	0.7	12.2	14.1	0.0	1.0	12.0	5760	5760	893	3073	2340	1(1)	1(1)	5(3)	3(3)	4(3)		
	0.8	7.8	7.3	7.3	10.0	10.8	tl	tl	6720	tl	tl	tl	0(0)	0(0)	1(0)	0(0)	0(0)		
	1.0	0.0	0.0	-	-	-	3	4	-	-	-	-	5(0)	5(0)	-	-	-		
	1.67	0.7	-	-	-	-	-	0	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)		
40	1.00	0.8	5.2	4.2	8.5	10.6	8.2	4320	4320	4324	4342	5760	2(2)	2(2)	2(2)	2(2)	1(1)		
		1.0	1.2	0.0	-	-	-	2910	63	-	-	-	-	3(0)	5(0)	-	-	-	
	1.33	0.7	4.0	4.8	6.5	6.6	17.6	2904	4320	2905	2965	4320	3(3)	2(2)	3(3)	3(3)	2(2)		
	0.8	1.1	1.7	5.9	4.7	10.1	1480	1883	5760	5760	5760	5760	4(1)	4(1)	1(1)	1(1)	1(1)		
	1.0	0.0	0.0	-	-	-	3	6	-	-	-	-	5(0)	5(0)	-	-	-		
	1.67	0.7	0.8	3.3	3.6	7.3	12.3	3066	4400	4874	5762	5761	4(1)	2(1)	2(1)	1(1)	1(1)		
0.8	1.9	2.2	1.1	1.4	3.1	1464	1982	2933	4523	4521	4521	4(0)	4(0)	3(1)	2(1)	2(1)			
1.0	0.0	0.0	-	-	-	-	1	2	-	-	-	-	5(0)	5(0)	-	-	-		

Table 8

Comparison of final optimality gaps, CPU times, and numbers of solved and infeasible instances of our branch-and-cut algorithms based on different models for instances with $|V| \in \{60, 80\}$ from set MUT. Bold values denote the best algorithms in a row. ("tl"...time limit reached, "-"...results not available)

V	α	β	γ	Avg. optimality gaps in %					Avg. CPU times in seconds					# Instances solved (inf.) (out of 5)					
				PS+	PD+	DD+	PDDD+	3PD+	PS+	PD+	DD+	PDDD+	3PD+	PS+	PD+	DD+	PDDD+	3PD+	
60	0.2	1.00	0.7	-	-	-	-	-	0	0	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)
			0.8	7.5	4.4	8.7	9.8	-	4320	4320	4320	4320	4320	2(2)	2(2)	2(2)	2(2)	2(2)	
			1.0	4.1	0.0	-	-	-	tl	814	-	-	-	0(0)	5(0)	-	-	-	
			1.33	0.7	9.9	9.6	5.4	9.3	18.6	4491	5760	3245	4645	5434	2(1)	1(1)	3(3)	2(2)	2(2)
			0.8	12.9	9.8	17.5	15.8	33.5	tl	6073	5792	5858	5939	0(0)	1(0)	1(1)	1(1)	1(1)	
			1.0	0.8	0.0	-	-	-	5309	270	-	-	-	2(0)	5(0)	-	-	-	
		1.67	0.7	23.2	23.6	20.3	22.9	26.2	tl	tl	4425	5370	tl	0(0)	0(0)	2(2)	2(2)	0(0)	
		0.8	6.6	6.2	10.4	8.6	25.2	tl	6596	tl	tl	tl	0(0)	1(0)	0(0)	0(0)	0(0)		
		1.0	0.4	0.0	-	-	-	1520	130	-	-	-	4(0)	5(0)	-	-	-		
		0.3	1.00	0.7	-	-	-	-	0	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)	
		0.8		8.2	8.1	16.6	17.5	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)	
		1.0		2.1	0.1	-	-	-	4783	2534	-	-	-	2(0)	4(0)	-	-	-	
	1.33	0.7		9.1	11.3	15.0	17.4	-	5760	5760	5760	5760	5760	1(1)	1(1)	1(1)	1(1)	1(1)	
	0.8	5.8		5.2	12.5	15.7	-	5138	5560	tl	tl	tl	2(0)	2(0)	0(0)	0(0)	0(0)		
	1.0	0.9		0.0	-	-	-	1449	819	-	-	-	4(0)	5(0)	-	-	-		
	1.67	0.7	10.9	11.5	14.1	10.9	33.1	5762	5765	5794	5961	tl	1(0)	1(0)	1(0)	1(0)	0(0)		
	0.8	4.1	3.2	15.4	15.3	-	3285	4150	tl	tl	tl	3(0)	3(0)	0(0)	0(0)	0(0)			
	1.0	0.0	0.0	-	-	-	10	12	-	-	-	5(0)	5(0)	-	-	-			
	0.4	1.00	0.7	14.3	10.1	-	-	-	1440	1440	1440	1440	1440	4(4)	4(4)	4(4)	4(4)	4(4)	
	0.8		10.1	5.3	-	-	-	4320	4320	4320	4320	4320	2(2)	2(2)	2(2)	2(2)	2(2)		
	1.0		4.2	0.1	-	-	-	3348	2044	-	-	-	3(0)	4(0)	-	-	-		
	1.33		0.7	8.7	9.8	17.3	17.3	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)	
	0.8		6.5	7.7	19.9	22.7	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)		
	1.0		0.8	0.7	-	-	-	2899	2964	-	-	-	3(0)	3(0)	-	-	-		
1.67	0.7	10.7	11.7	14.2	14.7	22.0	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)			
0.8	2.6	4.7	16.1	14.8	-	3186	5851	tl	tl	tl	3(0)	1(0)	0(0)	0(0)	0(0)				
1.0	0.0	0.0	-	-	-	4	29	-	-	-	5(0)	5(0)	-	-	-				
80	0.2	1.00	0.7	-	-	10.5	10.5	-	97	10	1440	1440	1440	5	5	4(4)	4(4)	4(4)	
			0.8	13.7	8.3	21.7	21.7	-	1440	1440	1440	1440	1440	4(4)	4(4)	4(4)	4(4)	4(4)	
			1.0	6.8	1.7	-	-	-	tl	5794	-	-	-	0(0)	1(0)	-	-	-	
			1.33	0.7	16.7	16.3	18.1	18.6	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)
			0.8	6.7	6.7	27.5	27.6	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)	
			1.0	2.2	0.3	-	-	-	5787	4345	-	-	-	1(0)	3(0)	-	-	-	
		1.67	0.7	12.8	13.2	16.8	16.4	-	5760	5760	5760	5760	5760	1(1)	1(1)	1(1)	1(1)	1(1)	
		0.8	5.1	5.5	17.9	16.4	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)		
		1.0	1.0	0.0	-	-	-	3736	1805	-	-	-	3(0)	5(0)	-	-	-		
		0.3	1.00	0.7	2.5	1.5	-	-	-	2668	2880	2880	2880	2880	4(4)	3(3)	3(3)	3(3)	3(3)
		0.8		7.3	7.3	-	-	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)	
		1.0		0.9	0.7	-	-	-	2890	4326	-	-	-	4(0)	3(0)	-	-	-	
	1.33	0.7		9.2	9.8	22.7	21.1	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)	
	0.8	4.7		5.9	-	-	-	tl	tl	tl	tl	tl	0(0)	0(0)	0(0)	0(0)	0(0)		
	1.0	0.0		0.0	-	-	-	1618	3138	-	-	-	5(0)	5(0)	-	-	-		
	1.67	0.7	10.6	13.9	23.2	19.4	-	7085	tl	5921	tl	tl	1(0)	0(0)	1(1)	0(0)	0(0)		
	0.8	5.0	6.6	17.5	18.9	-	6350	tl	tl	tl	tl	1(0)	0(0)	0(0)	0(0)	0(0)			
	1.0	0.0	0.0	-	-	-	34	384	-	-	-	5(0)	5(0)	-	-	-			
	0.4	1.00	0.7	-	-	-	-	0	0	0	0	0	5(5)	5(5)	5(5)	5(5)	5(5)		
	0.8		5.8	7.2	-	-	-	2880	2880	2880	2880	2880	3(3)	3(3)	3(3)	3(3)	3(3)		
	1.0		0.2	0.7	-	-	-	1743	4511	-	-	-	4(0)	2(0)	-	-	-		
	1.33		0.7	7.5	8.7	-	-	-	5760	5760	5760	5760	5760	1(1)	1(1)	1(1)	1(1)	1(1)	
	0.8		3.6	4.0	-	-	-	5422	5760	5760	5760	5760	2(1)	1(1)	1(1)	1(1)	1(1)		
	1.0		0.0	0.1	-	-	-	585	3195	-	-	-	5(0)	4(0)	-	-	-		
1.67	0.7	4.7	7.0	-	-	-	6517	tl	tl	tl	tl	1(0)	0(0)	0(0)	0(0)	0(0)			
0.8	0.2	3.1	-	-	-	-	3565	6056	tl	tl	tl	4(0)	1(0)	0(0)	0(0)	0(0)			
1.0	0.0	0.2	-	-	-	-	467	1455	-	-	-	5(0)	4(0)	-	-	-			

References

Gouveia, L., Leitner, M., & Ruthmair, M. (2017). Extended formulations and branch-and-cut algorithms for the black-and-white traveling salesman problem. *European Journal of Operational Research*, 262(3), 908–928.
 Muter, I. (2015). A new formulation and approach for the black and white traveling salesman problem. *Computers & Operations Research*, 53, 96–106.