

Referências Bibliográficas

- [Alba e Domínguez, 2006] ALBA, E.; DOMÍNGUEZ, E.. **Comparative analysis of modern optimization tools for the p-median problem.** Statistical Computing, 16:251–260, 2006. 3.2.3
- [Avella et al., 2007] AVELLA, P.; SASSANO, A. ; VASIL'EV, I.. **Computational study of large-scale p-median problems.** Mathematical Programming, 109:89–114, 2007. 3.4, A.2
- [Baiou e Barahona, 2005] BAIYOU, M.; BARAHONA, F.. **On the p-median polytope of special class of graphs.** Technical report, 2005. 6.1, 6.1.2
- [Baiou e Barahona, 2006] BAIYOU, M.; BARAHONA, F.. **The p-median polytope of restricted y-graphs.** Technical report, 2006. 6.1
- [Beasley, 1985] BEASLEY, J. E.. **A note on solving large p-median problems.** European Journal of Operational Research, 21(2):270–273, 1985. 2.3.1, 3.4
- [Beasley, 1990] BEASLEY, J. E.. **Or-library: Distributing test problems by electronic mail.** Journal of the Operational Research Society, 41:1069–1072, 1990. 2.3.1
- [Bertsimas e Tsitsiklis, 1997] BERTSIMAS, D.; TSITSIKLIS, J. N.. **Introduction to Linear Optimization.** Athena Scientific, 1997. 2.2, 2.2.2, 5.2.1, 5.3.1
- [Bussab et al., 1990] BUSSAB, W. O.; MIAZAKI, E. S. ; ANDRADE, D. F.. **Introdução a análise de agrupamentos.** IME–USP, 1990. 1.1
- [Captivo, 1991] CAPTIVO, M. E.. **Fast primal and dual heuristics for the p-median location problem.** European Journal of Operational Research, 52:65–74, 1991. 2.2.3, 3.2.1, 3.3, 4.2.4, 5.3.2, 5.1
- [Chiyoshi e Galvão, 2000] CHIYOSHI, F.; GALVÃO, R. D.. **A statistical analysis of simulated annealing applied to the p-median problem.** Annals of Operations Research, 96:61–74, 2000. 3.2.3

- [Christofides, 1976] CHRISTOFIDES, N.. **Graph Theory: An Algorithmic Approach**. Academic Press Inc, 1976. 1.1
- [Chvatal, 1983] CHVATAL, V.. **Linear Programming**. Freeman, 1983. 2.2, 2.2.2, 3.1
- [Cornuejols et al., 1977] CORNUEJOLS, G.; FISHER, M. L. ; NEMHAUSER, G. L.. **Location of bank accounts to optimize float: An analytic study of exact and approximate algorithms**. *Management Science*, 23:789–810, 1977. 3.3
- [Cormen et al., 2001] CORMEN, T. H.; LEISERSON, C. E.; RIVEST, R. L. ; STEIN, C.. **Introduction to Algorithms**. MIT Press, 2001. 2.3.1, 5.3.2, 6.1.2
- [Erlenkotter, 1978] ERLINKOTTER, D.. **A dual-based procedure for uncapacitated facility location**. *Operations Research*, 26, 1978. 3.2.1, 3.3, 5.4.2, 5.2
- [Feldman et al., 1966] FELDMAN, E.; LEHRER, F. A. ; RAY, T. L.. **Warehouse locations under continuous economies of scale**. *Management Science*, 12:670–684, 1966. 3.2.1
- [Ferreira e Wakabayashi, 1996] FERREIRA, C. E.; WAKABAYASHI, Y.. **Combinatória poliédrica e planos-de-corte faciais**. Technical report, 1996. (document), 6.1
- [Galvão, 1980] GALVÃO, R. D.. **A dual-bounded algorithm for the p-median problem**. *Operations Research*, 28:1112–1121, 1980. 3.2.1, 3.3
- [Hakimi, 1964] HAKIMI, S. L.. **Optimum locations of switching centers and the absolute centers and medians of a graph**. *Operations Research*, 12:450–459, 1964. 1.1
- [Hanjoul e Peeters, 1985] HANJOUL, P.; PEETERS, D.. **A comparison of two dual-based procedures for solving the p-median problem**. *European Journal of Operational Research*, 20:387–396, 1985. 3.3, 3.4
- [Hansen e Jaumard, 1997] HANSEN, P.; JAUMARD, B.. **Cluster analysis and mathematical programming**. *Mathematical Programming*, 79:191–215, 1997. 1.1
- [Hansen e Mladenovic, 1997] HANSEN, P.; MLADENOVIC, N.. **Variable neighborhood search for the p-median**. *Location Science*, 5:207–226, 1997. 3.2.3

- [Hansen et al., 2001] HANSEN, P.; MLADENOVIC, N. ; PEREZ-BRITOS, D.. **Variable neighborhood decomposition search**. Journal of Heuristics, 7:335–350, 2001. A.2, A.2
- [Hansen et al., 2007] HANSEN, P.; JAUMARD, B.; UROSEVIC, D. ; MLADENOVIC, N.. **Data clustering using large p-median models and primal-dual variable neighborhood search**. 2007. A.2
- [Hansen e Mladenovic, 2008] HANSEN, P.; MLADENOVIC, N.. **Complement to a comparative analysis of heuristics for the p-median problem**. Statistics and Computing, 18:41–46, 2008. 3.2.3, A.2
- [ILOG, 2008] S.A., I.. **Ilog cplex 11.2 user manual and reference manual**. Technical report, 2008. 5.7.1, 5.7.1, 6.1.2, 6.3.1, 6.3.1
- [Kariv e Hakimi, 1979] KARIV, O.; HAKIMI, S. L.. **An algorithmic approach to network location problems. ii: The p-medians**. SIAM Journal on Applied Mathematics, 37:539–560, 1979. 1.1, 2.1
- [Kuehn e Hamburger, 1963] KUEHN, A. A.; HAMBURGER, M. J.. **A heuristic program for locating warehouses**. Management Science, 9:643–666, 1963. 3.2.1
- [Maranzana, 1964] MARANZANA, F. E.. **On the locations of supply points to minimize transport costs**. Operational Research Society, 15:261–270, 1964. 3.2.2
- [Mladenovic et al., 2007] MLADENOVIC, N.; BRIMBERG, J.; HANSEN, P. ; MORENO-PÉREZ, J. A.. **The p-median problem: A survey of metaheuristic approaches**. European Journal of Operational Research, 179:927–939, 2007. 1.1
- [Moreno-Perez et al., 1991] MORENO-PEREZ, J. A.; RODRIGUEZ, C. ; JIMENEZ, N.. **Heuristic cluster algorithm for multiple facility location-allocation problem**. RAIRO - Recherche Operationnelle / Operations Research, 25:97–107, 1991. 3.2.1
- [Narula et al., 1977] NARULA, S. C.; OGBU, U. I. ; SAMUELSON, H. M.. **An algorithm for the p-median problem**. Operations Research, 25:709–713, 1977. 3.3
- [Ng e Han, 1994] NG, R. T.; HAN, J.. **Efficient and effective clustering methods for spatial data mining**. 20th International Conference on Very Large Data Bases, p. 144–155, 1994. 1.1

- [Pizzolato, 1994] PIZZOLATO, N. D.. **A heuristic for large-size p-median location problems with application to school location.** Annals of Operations Research, 50:473–485, 1994. 3.2.1
- [Poggi de Aragão et al., 2001] POGGI DE ARAGÃO, M.; UCHOA, E. ; WERNECK, R. F.. **Dual Heuristics on the Exact Solution of Large Steiner Problems.** Proceedings of the Brazilian Symposium on Graphs, Algorithms and Combinatorics, 2001. 5.6, 6.2
- [ReVelle e Swain, 1970] REVELLE, C.; SWAIN, R.. **Central facilities location.** Geographical Analysis, 2:30–42, 1970. 2.2.1
- [ReVelle et al., 2008] REVELLE, C. S.; EISELT, H. A. ; DASKIN, M. S.. **A bibliography for some fundamental problem categories in discrete location science.** European Journal of Operational Research, 184:817–848, 2008. 1.1
- [Reeves, 1993] REEVES, C. R.. **Modern heuristic techniques for combinatorial problems.** Halsted Press, 1993. 3.2.3, 5.3.1
- [Reese, 2006] REESE, J.. **Solution methods for the p-median problem: An annotated bibliography.** Networks, 48:125–142, 2006. 1.1
- [Reinelt, 1991] REINELT, G.. **TSPLIB - A Traveling Salesman Problem Library.** INFORMS JOURNAL ON COMPUTING, 3(4):376–384, 1991. 2.3.1
- [Resende e Werneck, 2002a] RESENDE, M. G. C.; WERNECK, R. F.. **A grasp with path-relinking for the p-median problem.** Technical report, 2002. 3.2.3
- [Resende e Werneck, 2002b] RESENDE, M. G. C.; WERNECK, R. F.. **A hybrid heuristic for the p-median problem.** Technical report, 2002. 3.2.3
- [Resende e Werneck, 2004] RESENDE, M. G. C.; WERNECK, R. F.. **A fast swap-based local search procedure for location problems.** Technical report, 2004. 3.2.2, 3.2.2, 4.3.1, 4.3.2
- [Rolland et al., 1997] ROLLAND, E.; SCHILLING, D. A. ; CURRENT, J. R.. **An efficient tabu search procedure for the p-median problem.** European Journal of Operational Research, 96:329–342, 1997. 3.2.3
- [Salhi e Atkinson, 1995] SALHI, S.; ATKINSON, R. A.. **Subdrop: a modified drop heuristic for location problems.** Location Science, 3:267–273, 1995. 3.2.1

- [Salhi, 1997] SALHI, S.. **A perturbation heuristic for a class of location problems.** Journal of Operational Research Society, 48:1233–1240, 1997. 3.2.1
- [Senne et al., 2005] SENNE, E. L. F.; LORENA, L. A. N. ; PEREIRA, M. A.. **A branch-and-price approach to p-median location problems.** Computers & Operations Research, 32:1655–1664, 2005. 3.4
- [TSPLib] Tsp-lib. Disponível em <http://www.iwr.uni-heidelberg.de/groups/comopt/software/TSPLIB95/>, última visita em 09 de janeiro de 2009. 2.3.1
- [Taillard, 1996] TAILLARD, E. D.. **Heuristic methods for large centroid clustering problems.** Istituto Dalle Molle Di Studi Sull Intelligenza Artificiale, 1996. A.2
- [Tansel et al., 1983] TANSEL, B. C.; FRANCIS, R. L. ; LOWE, T. J.. **State of the art - location on networks: A survey. part i: The p-center and p-median problems.** Management Science, 29:482–497, 1983. 1.1
- [Teitz e Bart, 1968] TEITZ, M. B.; BART, P.. **Heuristic methods for estimating the generalized vertex median of a weighted graph.** Operations Research, 16:955–961, 1968. 3.2.2, 3.2.2
- [Whitaker, 1983] WHITAKER, R. A.. **A fast algorithm for the greedy interchange for large-scale clustering and median location problems.** INFOR, 21, 1983. 3.2.1, 3.2.2, 3.2.2
- [Wolsey, 1998] WOLSEY, L. A.. **Integer Programming.** Wiley-Interscience, 1998. 5.2.2

A

Soluções Ótimas ou Melhores Conhecidas

Neste capítulo são exibidos os valores das soluções ótimas ou os melhores valores conhecidos para as instâncias de teste consideradas nesta dissertação.

A.1

OR-Library

Instância	(n,p)	Ótimo Primal
pmed1	(100,5)	5819
pmed2	(100,10)	4093
pmed3	(100,10)	4250
pmed4	(100,20)	3034
pmed5	(100,33)	1355
pmed6	(200,5)	7824
pmed7	(200,10)	5631
pmed8	(200,20)	4445
pmed9	(200,40)	2734
pmed10	(200,67)	1255
pmed11	(300,5)	7696
pmed12	(300,10)	6634
pmed13	(300,30)	4374
pmed14	(300,60)	2968
pmed15	(300,100)	1729
pmed16	(400,5)	8162
pmed17	(400,10)	6999
pmed18	(400,40)	4809
pmed19	(400,80)	2845
pmed20	(400,133)	1789
pmed21	(500,5)	9138
pmed22	(500,10)	8579
pmed23	(500,50)	4619
pmed24	(500,100)	2961
pmed25	(600,167)	1828
pmed26	(600,5)	9917
pmed27	(600,10)	8307
pmed28	(600,60)	4498
pmed29	(600,120)	3033
pmed30	(600,200)	1989
pmed31	(700,5)	10086
pmed32	(700,10)	9297
pmed33	(700,70)	4700
pmed34	(700,140)	3013
pmed35	(800,5)	10400
pmed36	(800,10)	9934
pmed37	(800,80)	5057
pmed38	(900,5)	11060
pmed39	(900,10)	9423
pmed40	(900,90)	5128

Tabela A.1: Valor da solução ótima das instâncias da classe *OR-Library*

A.2

TSP-Library

p	Melhor Primal Valor Origem	Melhor Dual Valor Origem
10	101249,47 (Hansen et al., 2001)	–
20	57857,55 (Hansen et al., 2001)	–
30	44013,02 (Hansen e Mladenovic, 2008)	–
40	35002,02 (Hansen e Mladenovic, 2008)	–
50	29089,71 (Hansen e Mladenovic, 2008)	–
60	25160,40 (Hansen e Mladenovic, 2008)	–
70	22125,46 (Hansen e Mladenovic, 2008)	–
80	19870,28 (Hansen e Mladenovic, 2008)	–
90	17987,91 (Hansen e Mladenovic, 2008)	–
100	15962 (Avella et al., 2007)	15962 (Avella et al., 2007)
150	12026,47 –	–
200	8806 (Avella et al., 2007)	8806 (Avella et al., 2007)
250	7741,51 –	–
300	6099 (Avella et al., 2007)	6099 (Avella et al., 2007)
350	5720,91 –	–
400	4643 (Avella et al., 2007)	4643 (Avella et al., 2007)
450	4474,96 –	–
500	3760 (Avella et al., 2007)	3760 (Avella et al., 2007)

Tabela A.2: Melhores soluções conhecidas para os diferentes valores de p na instância *f1400* da classe *TSP-Library*

p	Melhor Primal Valor Origem	Melhor Dual Valor Origem
10	1213082,03 –	–
20	840844,53 –	–
30	677306,76 –	–
40	571887,75 –	–
50	507582,13 –	507416,09 (Hansen et al., 2007)
60	460771,87 –	460745,16 (Hansen et al., 2007)
70	426068,24 –	425976,50 (Hansen et al., 2007)
80	397529,25 –	397329,06 (Hansen et al., 2007)
90	373241,86 (Hansen et al., 2007)	373224,66 (Hansen et al., 2007)
100	352628,35 –	352494,41 (Hansen et al., 2007)
150	281193,96 (Taillard, 1996)	281086,81 (Hansen et al., 2007)
200	238367,93 (Hansen et al., 2007)	238279,20 (Hansen et al., 2007)
250	209236,68 (Hansen et al., 2007)	209149,48 (Hansen et al., 2007)
300	187709,08 (Hansen et al., 2007)	187640,91 (Hansen et al., 2007)
350	170927,03 (Hansen et al., 2007)	170896,64 (Hansen et al., 2007)
400	157030,46 (Taillard, 1996)	157017,64 (Hansen et al., 2007)
450	145368,44 (Hansen et al., 2007)	145346,09 (Hansen et al., 2007)
500	135447,39 (Hansen et al., 2007)	135410,73 (Hansen et al., 2007)
550	126835,38 (Hansen et al., 2007)	126809,49 (Hansen et al., 2007)
600	119105,86 (Hansen et al., 2007)	119041,29 (Hansen et al., 2007)
650	112029,58 (Hansen et al., 2007)	112006,08 (Hansen et al., 2007)
700	105838,14 (Hansen et al., 2007)	105790,66 (Hansen et al., 2007)
750	100348,53 (Hansen et al., 2007)	100286,90 (Hansen et al., 2007)
800	95389,16 (Hansen et al., 2007)	95345,52 (Hansen et al., 2007)
850	90989,91 (Hansen et al., 2007)	90908,38 (Hansen et al., 2007)
900	86967,49 (Hansen et al., 2007)	86880,02 (Hansen et al., 2007)
950	83278,78 –	82978,74 (Hansen et al., 2007)
1000	79852,15 (Hansen et al., 2007)	79745,45 (Hansen et al., 2007)

Tabela A.3: Melhores soluções conhecidas para os diferentes valores de p na instância *pcb3038* da classe *TSP-Library*

p	Melhor Primal		Melhor Dual	
	Valor	Origem	Valor	Origem
10	9794951,00	(Hansen et al., 2001)	—	—
20	6718848,19	—	—	—
30	5374936,14	—	—	—
40	4550364,60	—	—	—
50	4032379,97	—	—	—
60	3642397,88	—	—	—
70	3343712,45	—	—	—
80	3094824,49	—	—	—
90	2893362,39	—	—	—
100	2725180,81	—	—	—
150	2147881,53	—	—	—
200	1808179,07	—	—	—
250	1569941,34	—	—	—
300	1394115,39	—	—	—
350	1256844,04	—	—	—
400	1145669,38	(Hansen et al., 2001)	—	—
450	1053363,64	—	—	—
500	973995,18	—	—	—
600	848283,85	—	—	—
700	752068,38	(Hansen et al., 2001)	—	—
800	676795,78	—	—	—
900	613367,44	(Hansen et al., 2001)	—	—
1000	558802,38	(Hansen et al., 2001)	—	—
1100	511813,19	(Hansen et al., 2001)	—	—
1200	470295,38	(Hansen et al., 2001)	—	—
1300	433597,44	(Hansen et al., 2001)	—	—
1400	401853,00	(Hansen et al., 2001)	—	—
1500	374014,57	—	—	—

Tabela A.4: Melhores soluções conhecidas para os diferentes valores de p na instância *rl5934* da classe *TSP-Library*

B

Tempo de Execução das Heurísticas Construtivas

As tabelas B.1, B.2, B.3 e B.4 apresentam os tempos de execuções das heurísticas construtivas já incluindo o tempo gasto com a heurística de refinamento.

Instância	(n,p)	A	GA	GD	H	PD	Cplex
pmed1	(100,5)	0,01	0,00	0,02	0,00	0,02	8,69
pmed2	(100,10)	0,00	0,00	0,00	0,00	0,00	8,53
pmed3	(100,10)	0,00	0,00	0,00	0,00	0,00	7,55
pmed4	(100,20)	0,00	0,00	0,00	0,00	0,00	6,58
pmed5	(100,33)	0,00	0,02	0,00	0,00	0,00	6,74
pmed6	(200,5)	0,00	0,02	0,02	0,00	0,03	100,15
pmed7	(200,10)	0,00	0,00	0,00	0,00	0,02	29,58
pmed8	(200,20)	0,00	0,02	0,02	0,00	0,03	36,54
pmed9	(200,40)	0,01	0,02	0,02	0,02	0,03	44,54
pmed10	(200,67)	0,02	0,02	0,02	0,03	0,06	45,08
pmed11	(300,5)	0,00	0,00	0,05	0,02	0,05	170,71
pmed12	(300,10)	0,01	0,02	0,05	0,02	0,06	171,69
pmed13	(300,30)	0,02	0,03	0,06	0,03	0,08	112,82
pmed14	(300,60)	0,04	0,03	0,06	0,05	0,08	156,69
pmed15	(300,100)	0,07	0,06	0,06	0,09	0,14	109,78
pmed16	(400,5)	0,01	0,00	0,13	0,02	0,08	1109,44
pmed17	(400,10)	0,01	0,02	0,13	0,02	0,11	613,30
pmed18	(400,40)	0,03	0,06	0,14	0,06	0,14	410,36
pmed19	(400,80)	0,09	0,11	0,16	0,14	0,28	230,79
pmed20	(400,133)	0,17	0,17	0,14	0,22	0,42	228,74
pmed21	(500,5)	0,02	0,02	0,23	0,02	0,19	370,41
pmed22	(500,10)	0,02	0,02	0,23	0,03	0,19	1098,10
pmed23	(500,50)	0,08	0,11	0,27	0,14	0,30	367,16
pmed24	(500,100)	0,20	0,22	0,33	0,27	0,56	376,46
pmed25	(600,167)	0,33	0,39	0,36	0,44	0,95	606,01
pmed26	(600,5)	0,03	0,03	0,41	0,03	0,31	2240,91
pmed27	(600,10)	0,03	0,05	0,42	0,06	0,30	1783,25
pmed28	(600,60)	0,20	0,23	0,50	0,27	0,63	516,95
pmed29	(600,120)	0,45	0,47	0,59	0,50	1,08	510,35
pmed30	(600,200)	0,67	0,64	0,56	0,80	2,25	510,82
pmed31	(700,5)	0,04	0,03	0,66	0,05	0,34	3242,93
pmed32	(700,10)	0,04	0,05	0,66	0,08	0,44	2700,70
pmed33	(700,70)	0,38	0,42	0,81	0,44	1,05	731,55
pmed34	(700,140)	0,81	0,77	0,88	0,84	2,16	709,35
pmed35	(800,5)	0,06	0,06	1,00	0,06	0,47	5091,11
pmed36	(800,10)	0,06	0,09	0,98	0,09	0,52	1151,42
pmed37	(800,80)	0,64	0,69	1,20	0,75	1,47	2325,98
pmed38	(900,5)	0,10	0,09	1,44	0,11	0,63	3295,97
pmed39	(900,10)	0,08	0,11	1,39	0,13	0,59	575,20
pmed40	(900,90)	0,92	1,00	1,75	1,11	2,16	390,95

Tabela B.1: Resultados - Tempo de execução das heurísticas construtivas e do CPLEX aplicadas as instâncias da classe *OR-Library*

p	A	GA	GD	H	PD
10	0,22	0,47	3,75	0,42	10,67
20	0,30	0,88	3,80	0,91	8,05
30	0,52	1,28	4,03	1,25	5,86
40	0,78	1,75	4,14	1,72	5,98
50	1,09	2,14	4,23	2,52	6,61
60	1,33	2,75	4,41	2,92	5,75
70	1,66	3,11	4,56	3,05	5,77
80	2,05	3,53	4,91	3,39	5,42
90	2,42	3,95	5,03	3,78	5,98
100	2,85	4,53	5,16	4,17	6,80
150	4,88	7,66	6,64	6,52	10,02
200	7,03	9,94	7,48	8,98	12,42
250	9,64	11,97	8,14	11,58	17,59
300	11,43	12,91	8,52	12,59	23,00
350	13,10	14,58	8,86	14,78	24,33
400	15,44	15,56	7,77	17,11	31,16
450	16,37	15,86	7,89	19,72	33,95
500	17,80	17,69	6,45	20,38	36,22

Tabela B.2: Resultados - Tempo de execução das heurísticas construtivas aplicadas a instância *fl1400* da classe *TSP-Library*

p	A	GA	GD	H	PD
10	1,58	3,41	58,53	2,73	328,25
20	1,39	5,17	58,20	4,67	149,30
30	2,01	7,41	58,33	7,64	119,23
40	2,75	9,56	59,92	9,53	95,92
50	3,85	12,78	60,11	12,09	87,33
60	4,97	14,92	61,48	14,23	78,86
70	6,39	17,61	62,03	17,20	72,13
80	7,90	20,89	62,61	19,03	68,95
90	9,81	24,17	63,50	22,41	66,44
100	11,60	26,81	64,20	25,89	70,45
150	22,66	43,33	73,03	39,45	76,73
200	34,53	60,13	81,16	51,88	85,05
250	47,31	74,34	86,44	65,44	101,81
300	60,93	86,98	95,86	80,73	115,59
350	74,84	103,77	102,66	94,63	132,41
400	88,96	118,47	107,38	108,88	161,11
450	100,70	139,47	112,81	116,34	164,92
500	112,95	152,64	111,45	128,11	189,61
550	135,03	169,34	120,64	151,81	208,33
600	141,57	174,45	117,05	157,86	228,42
650	147,00	185,91	120,30	167,17	253,88
700	154,07	194,05	120,39	178,61	278,00
750	162,82	206,53	123,61	180,30	291,20
800	169,80	222,84	120,23	197,36	328,88
850	176,68	227,23	117,88	211,55	362,63
900	193,19	237,27	123,30	225,55	383,63
950	193,47	267,45	134,86	255,05	393,02
1000	215,45	256,70	120,69	240,06	411,55

Tabela B.3: Resultados - Tempo de execução das heurísticas construtivas aplicadas a instância *pcb3038* da classe *TSP-Library*

p	A	GA	GD	H	PD
10	9,52	24,33	413,44	23,16	2608,53
20	8,00	40,73	412,25	42,50	1383,13
30	6,27	60,06	412,17	63,75	964,84
40	9,06	80,47	413,53	79,39	805,16
50	10,5	97,83	411,45	97,66	603,58
60	12,2	119,09	412,20	117,89	566,64
70	16,4	136,75	424,70	150,55	537,86
80	20,7	161,52	427,73	166,89	549,36
90	25,8	200,38	436,27	179,14	501,48
100	29,2	206,80	431,23	195,58	485,61
150	55,6	306,23	442,38	294,70	531,17
200	87,8	416,73	473,67	393,33	621,41
250	127,	539,23	490,92	496,30	673,48
300	166,	639,52	528,75	591,61	792,45
350	212,	788,81	548,31	698,91	909,20
400	262,	878,64	565,30	798,23	1037,91
450	310,	984,33	608,39	901,81	1106,33
500	361,	1102,52	619,16	996,64	1209,33
600	460,	1442,97	673,28	1223,05	1411,30
700	568,	1557,05	712,00	1402,03	1668,91
800	670,	1747,06	743,80	1578,52	1865,64
900	766,	1951,88	793,34	1716,27	2110,55
1000	840,	2097,34	814,55	1914,69	2379,53
1100	938,	2263,94	839,48	2053,92	2597,17
1200	993,	2419,98	840,36	2207,27	2868,03
1300	1094	2630,95	875,30	2364,02	3205,55
1400	1150	2767,03	874,33	2511,61	3456,52
1500	1220	2946,91	862,34	2689,34	3835,20

Tabela B.4: Resultados - Tempo de execução das heurísticas construtivas aplicadas a instância *rl5934* da classe *TSP-Library*