Complete Numerical Results for the Paper Estimation-based Ant Colony Optimization and Local Search for the Probabilistic Traveling Salesman Problem

Prasanna Balaprakash, Mauro Birattari,
Thomas Stützle, Zhi Yuan, and Marco Dorigo
IRIDIA, CoDE, Université Libre de Bruxelles, Brussels, Belgium
{pbalapra,mbiro,stuetzle,mdorigo}@ulb.ac.be

1 Effectiveness of `2.5-opt-EEais` in `pACS`

Table 1: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance rat783. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	2319	3
	`pACS+1-shift`	2314	14
$p = 0.075$	`pACS+2.5-opt-EEais`	2817	3
	`pACS+1-shift`	2875	37
$p = 0.100$	`pACS+2.5-opt-EEais`	3245	3
	`pACS+1-shift`	3346	36
$p = 0.150$	`pACS+2.5-opt-EEais`	3956	8
	`pACS+1-shift`	4173	65
$p = 0.175$	`pACS+2.5-opt-EEais`	4268	9
	`pACS+1-shift`	4530	56
$p = 0.200$	`pACS+2.5-opt-EEais`	4548	9
	`pACS+1-shift`	4850	57
$p = 0.300$	`pACS+2.5-opt-EEais`	5490	12
	`pACS+1-shift`	6060	86
$p = 0.400$	`pACS+2.5-opt-EEais`	6230	15
	`pACS+1-shift`	6981	131
$p = 0.500$	`pACS+2.5-opt-EEais`	6851	10
	`pACS+1-shift`	7800	123

Table 2: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance att532. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	25511	2
	`pACS+1-shift`	25484	3
$p = 0.075$	`pACS+2.5-opt-EEais`	29952	4
	`pACS+1-shift`	29976	88
$p = 0.100$	`pACS+2.5-opt-EEais`	33702	12
	`pACS+1-shift`	33893	188
$p = 0.150$	`pACS+2.5-opt-EEais`	39700	44
	`pACS+1-shift`	40453	300
$p = 0.175$	`pACS+2.5-opt-EEais`	42272	26
	`pACS+1-shift`	43299	396
$p = 0.200$	`pACS+2.5-opt-EEais`	44692	22
	`pACS+1-shift`	45936	451
$p = 0.300$	`pACS+2.5-opt-EEais`	53101	83
	`pACS+1-shift`	55854	640
$p = 0.400$	`pACS+2.5-opt-EEais`	59967	99
	`pACS+1-shift`	64365	910
$p = 0.500$	`pACS+2.5-opt-EEais`	66053	95
	`pACS+1-shift`	72528	1223

Table 3: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance lin318. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	12580	2
	`pACS+1-shift`	12558	0
$p = 0.075$	`pACS+2.5-opt-EEais`	15084	3
	`pACS+1-shift`	15068	0
$p = 0.100$	`pACS+2.5-opt-EEais`	17205	2
	`pACS+1-shift`	17194	3
$p = 0.150$	`pACS+2.5-opt-EEais`	20690	4
	`pACS+1-shift`	20742	97
$p = 0.175$	`pACS+2.5-opt-EEais`	22160	7
	`pACS+1-shift`	22412	183
$p = 0.200$	`pACS+2.5-opt-EEais`	23500	76
	`pACS+1-shift`	23846	155
$p = 0.300$	`pACS+2.5-opt-EEais`	27879	149
	`pACS+1-shift`	28821	408
$p = 0.400$	`pACS+2.5-opt-EEais`	31222	110
	`pACS+1-shift`	32506	478
$p = 0.500$	`pACS+2.5-opt-EEais`	33851	93
	`pACS+1-shift`	35843	452

Table 4: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance d198. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	5609	0
	`pACS+1-shift`	5606	0
$p = 0.075$	`pACS+2.5-opt-EEais`	6672	0
	`pACS+1-shift`	6670	0
$p = 0.100$	`pACS+2.5-opt-EEais`	7439	1
	`pACS+1-shift`	7437	0
$p = 0.150$	`pACS+2.5-opt-EEais`	8527	1
	`pACS+1-shift`	8524	0
$p = 0.175$	`pACS+2.5-opt-EEais`	8944	1
	`pACS+1-shift`	8940	0
$p = 0.200$	`pACS+2.5-opt-EEais`	9316	1
	`pACS+1-shift`	9312	0
$p = 0.300$	`pACS+2.5-opt-EEais`	10537	5
	`pACS+1-shift`	10536	12
$p = 0.400$	`pACS+2.5-opt-EEais`	11536	3
	`pACS+1-shift`	11565	36
$p = 0.500$	`pACS+2.5-opt-EEais`	12420	4
	`pACS+1-shift`	12486	50

Table 5: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance ch150. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	1771	1
	`pACS+1-shift`	1767	0
$p = 0.075$	`pACS+2.5-opt-EEais`	2164	1
	`pACS+1-shift`	2161	0
$p = 0.100$	`pACS+2.5-opt-EEais`	2481	0
	`pACS+1-shift`	2479	0
$p = 0.150$	`pACS+2.5-opt-EEais`	3012	1
	`pACS+1-shift`	3010	0
$p = 0.175$	`pACS+2.5-opt-EEais`	3235	4
	`pACS+1-shift`	3232	2
$p = 0.200$	`pACS+2.5-opt-EEais`	3421	6
	`pACS+1-shift`	3417	0
$p = 0.300$	`pACS+2.5-opt-EEais`	4055	5
	`pACS+1-shift`	4054	5
$p = 0.400$	`pACS+2.5-opt-EEais`	4574	7
	`pACS+1-shift`	4580	10
$p = 0.500$	`pACS+2.5-opt-EEais`	5005	4
	`pACS+1-shift`	5028	24

Table 6: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance eil101. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	133	0
	`pACS+1-shift`	132	0
$p = 0.075$	`pACS+2.5-opt-EEais`	170	0
	`pACS+1-shift`	169	0
$p = 0.100$	`pACS+2.5-opt-EEais`	197	0
	`pACS+1-shift`	196	0
$p = 0.150$	`pACS+2.5-opt-EEais`	243	0
	`pACS+1-shift`	242	0
$p = 0.175$	`pACS+2.5-opt-EEais`	264	0
	`pACS+1-shift`	263	0
$p = 0.200$	`pACS+2.5-opt-EEais`	283	0
	`pACS+1-shift`	282	0
$p = 0.300$	`pACS+2.5-opt-EEais`	348	1
	`pACS+1-shift`	346	0
$p = 0.400$	`pACS+2.5-opt-EEais`	402	1
	`pACS+1-shift`	401	0
$p = 0.500$	`pACS+2.5-opt-EEais`	450	0
	`pACS+1-shift`	450	1

Table 7: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance kroA100. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost over 30 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`pACS+2.5-opt-EEais`	6470	1
	`pACS+1-shift`	6465	0
$p = 0.075$	`pACS+2.5-opt-EEais`	8021	1
	`pACS+1-shift`	8016	0
$p = 0.100$	`pACS+2.5-opt-EEais`	9038	1
	`pACS+1-shift`	9034	0
$p = 0.150$	`pACS+2.5-opt-EEais`	10521	0
	`pACS+1-shift`	10520	0
$p = 0.175$	`pACS+2.5-opt-EEais`	11142	0
	`pACS+1-shift`	11142	0
$p = 0.200$	`pACS+2.5-opt-EEais`	11715	1
	`pACS+1-shift`	11714	0
$p = 0.300$	`pACS+2.5-opt-EEais`	13680	1
	`pACS+1-shift`	13678	0
$p = 0.400$	`pACS+2.5-opt-EEais`	15253	0
	`pACS+1-shift`	15253	0
$p = 0.500$	`pACS+2.5-opt-EEais`	16569	0
	`pACS+1-shift`	16569	0

Table 8: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance rat783. The table reports the observed relative difference and a 95% confidence interval (CI) obtained through the t-test on the relative difference. For a given comparison A vs. B, the table reports the observed relative difference between the two algorithms A and B and a 95% confidence interval (CI) obtained through the t-test. If the value is positive, algorithm A obtained an average cost that is larger than the one obtained by the algorithm B. In this case, the value is typeset in italics if it is significantly different from zero according to the t-test at a confidence of 95%. If the value is negative, algorithm A obtained an average cost that is smaller than the one obtained by the algorithm B. In this case, the value is typeset in boldface if it is significantly different from zero according to the t-test, at a confidence of 95%.

	`pACS+2.5-opt-EEais` vs. `pACS+1-shift`	
p	Difference	95% CI
0.050-00	*+0.236*	[+0.014, +0.459]
0.075-00	**−2.022**	[−2.509, −1.534]
0.100-00	**−3.029**	[−3.430, −2.628]
0.150-00	**−5.214**	[−5.784, −4.644]
0.175-00	**−5.798**	[−6.270, −5.326]
0.200-00	**−6.214**	[−6.661, −5.766]
0.300-00	**−9.401**	[−9.924, −8.877]
0.400-00	**−10.760**	[−11.451, −10.069]
0.500-00	**−12.176**	[−12.759, −11.593]

Table 9: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance att532. The table reports the observed relative difference and a 95% confidence interval (CI) obtained through the t-test on the relative difference. For a given comparison A vs. B, the table reports the observed relative difference between the two algorithms A and B and a 95% confidence interval (CI) obtained through the t-test. If the value is positive, algorithm A obtained an average cost that is larger than the one obtained by the algorithm B. In this case, the value is typeset in italics if it is significantly different from zero according to the t-test at a confidence of 95%. If the value is negative, algorithm A obtained an average cost that is smaller than the one obtained by the algorithm B. In this case, the value is typeset in boldface if it is significantly different from zero according to the t-test, at a confidence of 95%.

	`pACS+2.5-opt-EEais` vs. `pACS+1-shift`	
p	Difference	95% CI
0.050-00	*+0.105*	[+0.099, +0.110]
0.075-00	−0.080	[−0.190, +0.031]
0.100-00	**−0.564**	[−0.771, −0.357]
0.150-00	**−1.862**	[−2.153, −1.571]
0.175-00	**−2.374**	[−2.716, −2.031]
0.200-00	**−2.708**	[−3.072, −2.345]
0.300-00	**−4.930**	[−5.375, −4.485]
0.400-00	**−6.834**	[−7.369, −6.298]
0.500-00	**−8.928**	[−9.550, −8.306]

Table 10: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance lin318. The table reports the observed relative difference and a 95% confidence interval (CI) obtained through the t-test on the relative difference. For a given comparison A vs. B, the table reports the observed relative difference between the two algorithms A and B and a 95% confidence interval (CI) obtained through the t-test. If the value is positive, algorithm A obtained an average cost that is larger than the one obtained by the algorithm B. In this case, the value is typeset in italics if it is significantly different from zero according to the t-test at a confidence of 95%. If the value is negative, algorithm A obtained an average cost that is smaller than the one obtained by the algorithm B. In this case, the value is typeset in boldface if it is significantly different from zero according to the t-test, at a confidence of 95%.

	`pACS+2.5-opt-EEais` vs. `pACS+1-shift`	
p	Difference	95% CI
0.100-00	*+0.066*	$[+0.058, +0.074]$
0.150-00	$\mathbf{-0.251}$	$[-0.427, -0.075]$
0.175-00	$\mathbf{-1.122}$	$[-1.428, -0.815]$
0.200-00	$\mathbf{-1.451}$	$[-1.732, -1.170]$
0.300-00	$\mathbf{-3.269}$	$[-3.803, -2.735]$
0.400-00	$\mathbf{-3.950}$	$[-4.517, -3.383]$
0.500-00	$\mathbf{-5.558}$	$[-6.014, -5.102]$

Table 11: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance d198. The table reports the observed relative difference and a 95% confidence interval (CI) obtained through the t-test on the relative difference. For a given comparison A vs. B, the table reports the observed relative difference between the two algorithms A and B and a 95% confidence interval (CI) obtained through the t-test. If the value is positive, algorithm A obtained an average cost that is larger than the one obtained by the algorithm B. In this case, the value is typeset in italics if it is significantly different from zero according to the t-test at a confidence of 95%. If the value is negative, algorithm A obtained an average cost that is smaller than the one obtained by the algorithm B. In this case, the value is typeset in boldface if it is significantly different from zero according to the t-test, at a confidence of 95%.

	`pACS+2.5-opt-EEais` vs. `pACS+1-shift`	
p	Difference	95% CI
0.300-00	+0.009	$[-0.035, +0.054]$
0.400-00	**−0.250**	$[-0.366, -0.134]$
0.500-00	**−0.534**	$[-0.684, -0.385]$

Table 12: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance ch150. The table reports the observed relative difference and a 95% confidence interval (CI) obtained through the t-test on the relative difference. For a given comparison A vs. B, the table reports the observed relative difference between the two algorithms A and B and a 95% confidence interval (CI) obtained through the t-test. If the value is positive, algorithm A obtained an average cost that is larger than the one obtained by the algorithm B. In this case, the value is typeset in italics if it is significantly different from zero according to the t-test at a confidence of 95%. If the value is negative, algorithm A obtained an average cost that is smaller than the one obtained by the algorithm B. In this case, the value is typeset in boldface if it is significantly different from zero according to the t-test, at a confidence of 95%.

	`pACS+2.5-opt-EEais` vs. `pACS+1-shift`	
p	Difference	95% CI
0.175-00	*+0.093*	$[+0.042, +0.144]$
0.300-00	$+0.042$	$[-0.009, +0.093]$
0.400-00	$\mathbf{-0.118}$	$[-0.217, -0.019]$
0.500-00	$\mathbf{-0.459}$	$[-0.647, -0.272]$

Table 13: Comparison of the average cost obtained by `pACS+2.5-opt-EEais` and `pACS+1-shift` over 30 independent runs on the PTSPLIB instance eil101. The table reports the observed relative difference and a 95% confidence interval (CI) obtained through the t-test on the relative difference. For a given comparison A vs. B, the table reports the observed relative difference between the two algorithms A and B and a 95% confidence interval (CI) obtained through the t-test. If the value is positive, algorithm A obtained an average cost that is larger than the one obtained by the algorithm B. In this case, the value is typeset in italics if it is significantly different from zero according to the t-test at a confidence of 95%. If the value is negative, algorithm A obtained an average cost that is smaller than the one obtained by the algorithm B. In this case, the value is typeset in boldface if it is significantly different from zero according to the t-test, at a confidence of 95%.

	`pACS+2.5-opt-EEais` vs. `pACS+1-shift`	
p	Difference	95% CI
0.400-00	*+0.116*	$[+0.008, +0.225]$
0.500-00	-0.007	$[-0.063, +0.048]$

2 Estimation-based ant colony system

Table 14: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance ch150 for $n^2/10000$ CPU seconds

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	1775	2
	`pACS`	1775	3
$p = 0.075$	`ACS-EE`	2166	1
	`pACS`	2166	1
$p = 0.100$	`ACS-EE`	2486	4
	`pACS`	2483	1
$p = 0.150$	`ACS-EE`	3016	2
	`pACS`	3015	5
$p = 0.175$	`ACS-EE`	3242	4
	`pACS`	3236	4
$p = 0.200$	`ACS-EE`	3421	1
	`pACS`	3425	8
$p = 0.300$	`ACS-EE`	4060	8
	`pACS`	4062	9
$p = 0.400$	`ACS-EE`	4582	9
	`pACS`	4580	10
$p = 0.500$	`ACS-EE`	5012	13
	`pACS`	5013	11

Table 15: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance ch150 for $n^2/1000$ CPU seconds

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	1774	1
	`pACS`	1773	2
$p = 0.075$	`ACS-EE`	2166	1
	`pACS`	2165	1
$p = 0.100$	`ACS-EE`	2485	2
	`pACS`	2482	0
$p = 0.150$	`ACS-EE`	3015	1
	`pACS`	3015	6
$p = 0.175$	`ACS-EE`	3242	3
	`pACS`	3237	5
$p = 0.200$	`ACS-EE`	3420	0
	`pACS`	3424	7
$p = 0.300$	`ACS-EE`	4060	7
	`pACS`	4059	8
$p = 0.400$	`ACS-EE`	4576	8
	`pACS`	4576	7
$p = 0.500$	`ACS-EE`	5010	6
	`pACS`	5010	9

Table 16: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance d198 for for $n^2/10000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	5638	36
	`pACS`	5625	19
$p = 0.075$	`ACS-EE`	6682	6
	`pACS`	6680	5
$p = 0.100$	`ACS-EE`	7446	3
	`pACS`	7443	3
$p = 0.150$	`ACS-EE`	8534	4
	`pACS`	8532	4
$p = 0.175$	`ACS-EE`	8949	3
	`pACS`	8947	2
$p = 0.200$	`ACS-EE`	9324	3
	`pACS`	9321	4
$p = 0.300$	`ACS-EE`	10550	5
	`pACS`	10547	5
$p = 0.400$	`ACS-EE`	11546	3
	`pACS`	11547	10
$p = 0.500$	`ACS-EE`	12427	4
	`pACS`	12427	11

Table 17: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance d198 for for $n^2/1000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	5613	2
	`pACS`	5613	2
$p = 0.075$	`ACS-EE`	6677	2
	`pACS`	6674	1
$p = 0.100$	`ACS-EE`	7446	3
	`pACS`	7440	1
$p = 0.150$	`ACS-EE`	8533	2
	`pACS`	8528	1
$p = 0.175$	`ACS-EE`	8948	2
	`pACS`	8945	1
$p = 0.200$	`ACS-EE`	9324	2
	`pACS`	9318	1
$p = 0.300$	`ACS-EE`	10544	4
	`pACS`	10542	5
$p = 0.400$	`ACS-EE`	11543	4
	`pACS`	11540	4
$p = 0.500$	`ACS-EE`	12424	6
	`pACS`	12422	4

Table 18: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance lin318 for $n^2/10000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	12720	80
	`pACS`	12734	89
$p = 0.075$	`ACS-EE`	15174	55
	`pACS`	15174	67
$p = 0.100$	`ACS-EE`	17408	74
	`pACS`	17378	89
$p = 0.150$	`ACS-EE`	20960	128
	`pACS`	20875	88
$p = 0.175$	`ACS-EE`	22455	136
	`pACS`	22432	103
$p = 0.200$	`ACS-EE`	23727	146
	`pACS`	23846	172
$p = 0.300$	`ACS-EE`	28193	156
	`pACS`	28170	160
$p = 0.400$	`ACS-EE`	31414	158
	`pACS`	31479	177
$p = 0.500$	`ACS-EE`	34041	124
	`pACS`	34127	176

Table 19: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance lin318 for $n^2/1000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	12596	8
	`pACS`	12593	8
$p = 0.075$	`ACS-EE`	15107	8
	`pACS`	15094	4
$p = 0.100$	`ACS-EE`	17223	8
	`pACS`	17212	5
$p = 0.150$	`ACS-EE`	20762	62
	`pACS`	20719	37
$p = 0.175$	`ACS-EE`	22246	72
	`pACS`	22208	56
$p = 0.200$	`ACS-EE`	23522	59
	`pACS`	23533	75
$p = 0.300$	`ACS-EE`	28011	125
	`pACS`	27990	165
$p = 0.400$	`ACS-EE`	31266	92
	`pACS`	31319	143
$p = 0.500$	`ACS-EE`	33900	97
	`pACS`	33923	105

Table 20: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance att532 for $n^2/10000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	25844	186
	`pACS`	25821	176
$p = 0.075$	`ACS-EE`	30248	192
	`pACS`	30161	124
$p = 0.100$	`ACS-EE`	33890	92
	`pACS`	33864	75
$p = 0.150$	`ACS-EE`	40051	108
	`pACS`	40082	155
$p = 0.175$	`ACS-EE`	42724	201
	`pACS`	42723	184
$p = 0.200$	`ACS-EE`	45363	203
	`pACS`	45193	171
$p = 0.300$	`ACS-EE`	53884	309
	`pACS`	53775	228
$p = 0.400$	`ACS-EE`	60710	185
	`pACS`	60761	264
$p = 0.500$	`ACS-EE`	66690	230
	`pACS`	66752	263

Table 21: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance att532 for $n^2/1000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	25534	13
	`pACS`	25532	12
$p = 0.075$	`ACS-EE`	29992	11
	`pACS`	29981	11
$p = 0.100$	`ACS-EE`	33734	23
	`pACS`	33730	18
$p = 0.150$	`ACS-EE`	39779	39
	`pACS`	39750	42
$p = 0.175$	`ACS-EE`	42373	88
	`pACS`	42347	87
$p = 0.200$	`ACS-EE`	44775	88
	`pACS`	44755	51
$p = 0.300$	`ACS-EE`	53271	176
	`pACS`	53185	99
$p = 0.400$	`ACS-EE`	60177	180
	`pACS`	60196	141
$p = 0.500$	`ACS-EE`	66201	115
	`pACS`	66192	134

Table 22: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance rat783 for $n^2/10000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	2360	13
	`pACS`	2358	14
$p = 0.075$	`ACS-EE`	2856	12
	`pACS`	2859	10
$p = 0.100$	`ACS-EE`	3290	12
	`pACS`	3293	13
$p = 0.150$	`ACS-EE`	4018	17
	`pACS`	4021	9
$p = 0.175$	`ACS-EE`	4338	16
	`pACS`	4339	14
$p = 0.200$	`ACS-EE`	4634	16
	`pACS`	4634	23
$p = 0.300$	`ACS-EE`	5617	20
	`pACS`	5621	21
$p = 0.400$	`ACS-EE`	6356	27
	`pACS`	6363	21
$p = 0.500$	`ACS-EE`	6969	21
	`pACS`	6977	21

Table 23: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` on instance rat783 for $n^2/1000$ CPU seconds.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	2329	4
	`pACS`	2328	4
$p = 0.075$	`ACS-EE`	2832	6
	`pACS`	2830	4
$p = 0.100$	`ACS-EE`	3260	6
	`pACS`	3258	5
$p = 0.150$	`ACS-EE`	3970	8
	`pACS`	3969	7
$p = 0.175$	`ACS-EE`	4281	7
	`pACS`	4280	9
$p = 0.200$	`ACS-EE`	4566	10
	`pACS`	4565	12
$p = 0.300$	`ACS-EE`	5523	12
	`pACS`	5521	18
$p = 0.400$	`ACS-EE`	6252	13
	`pACS`	6259	13
$p = 0.500$	`ACS-EE`	6866	13
	`pACS`	6869	15

Table 24: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` over 50 homogeneous clustered instances of size 1000. Each algorithm is allowed to run for 100 CPU seconds. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	4147660	350857
	`pACS+2.5-opt-EEais`	4170183	348178
$p = 0.075$	`ACS-EE`	4563279	332703
	`pACS+2.5-opt-EEais`	4556954	341770
$p = 0.100$	`ACS-EE`	4971086	327017
	`pACS+2.5-opt-EEais`	4968883	330958
$p = 0.125$	`ACS-EE`	5368877	335154
	`pACS+2.5-opt-EEais`	5367466	326788
$p = 0.150$	`ACS-EE`	5742713	344837
	`pACS+2.5-opt-EEais`	5746223	336474
$p = 0.175$	`ACS-EE`	6082206	346206
	`pACS+2.5-opt-EEais`	6074378	346292
$p = 0.200$	`ACS-EE`	6399005	357165
	`pACS+2.5-opt-EEais`	6403956	357972
$p = 0.300$	`ACS-EE`	7469164	383437
	`pACS+2.5-opt-EEais`	7483512	388855
$p = 0.400$	`ACS-EE`	8338501	398825
	`pACS+2.5-opt-EEais`	8338545	400154
$p = 0.500$	`ACS-EE`	9049027	415451
	`pACS+2.5-opt-EEais`	9063175	409587
$p = 0.600$	`ACS-EE`	9656187	419358
	`pACS+2.5-opt-EEais`	9687613	428894
$p = 0.700$	`ACS-EE`	10207070	445970
	`pACS+2.5-opt-EEais`	10256891	440077
$p = 0.800$	`ACS-EE`	10682802	460677
	`pACS+2.5-opt-EEais`	10749186	466840
$p = 0.900$	`ACS-EE`	11094403	454038
	`pACS+2.5-opt-EEais`	11205733	474402

Table 25: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` over 50 homogeneous clustered instances of size 1000. Each algorithm is allowed to run for 1000 CPU seconds. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	4020924	328674
	`pACS+2.5-opt-EEais`	4016236	324891
$p = 0.075$	`ACS-EE`	4475251	319970
	`pACS+2.5-opt-EEais`	4474159	320366
$p = 0.100$	`ACS-EE`	4919834	324647
	`pACS+2.5-opt-EEais`	4918889	325433
$p = 0.125$	`ACS-EE`	5316722	332954
	`pACS+2.5-opt-EEais`	5314542	331382
$p = 0.150$	`ACS-EE`	5673340	336532
	`pACS+2.5-opt-EEais`	5670997	336265
$p = 0.175$	`ACS-EE`	6006411	347613
	`pACS+2.5-opt-EEais`	5999722	345234
$p = 0.200$	`ACS-EE`	6308767	352492
	`pACS+2.5-opt-EEais`	6306068	348663
$p = 0.300$	`ACS-EE`	7358414	366428
	`pACS+2.5-opt-EEais`	7360652	371075
$p = 0.400$	`ACS-EE`	8195261	384698
	`pACS+2.5-opt-EEais`	8200813	387457
$p = 0.500$	`ACS-EE`	8912049	402804
	`pACS+2.5-opt-EEais`	8916664	400761
$p = 0.600$	`ACS-EE`	9531201	412494
	`pACS+2.5-opt-EEais`	9533031	414782
$p = 0.700$	`ACS-EE`	10077123	424410
	`pACS+2.5-opt-EEais`	10086138	436974
$p = 0.800$	`ACS-EE`	10545376	443019
	`pACS+2.5-opt-EEais`	10567157	440587
$p = 0.900$	`ACS-EE`	10978994	447610
	`pACS+2.5-opt-EEais`	10995996	467494

Table 26: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` over 50 homogeneous uniform instances of size 1000. Each algorithm is allowed to run for 100 CPU seconds. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	ACS-EE	6673323	68322
	pACS	6682456	74925
$p = 0.075$	ACS-EE	7899778	62675
	pACS	7899568	57722
$p = 0.100$	ACS-EE	9017943	54590
	pACS	9014007	61173
$p = 0.125$	ACS-EE	10007615	58871
	pACS	10006397	67139
$p = 0.150$	ACS-EE	10896132	74524
	pACS	10877005	73484
$p = 0.175$	ACS-EE	11687129	71896
	pACS	11680565	71793
$p = 0.200$	ACS-EE	12400133	77157
	pACS	12396764	75771
$p = 0.3$	ACS-EE	14844418	123052
	pACS	14855992	111196
$p = 0.4$	ACS-EE	16721860	142174
	pACS	16772194	124662
$p = 0.5$	ACS-EE	18285884	115986
	pACS	18331410	149276
$p = 0.6$	ACS-EE	19608813	160868
	pACS	19681795	163080
$p = 0.7$	ACS-EE	20769007	142839
	pACS	20897352	181502
$p = 0.8$	ACS-EE	21795268	196013
	pACS	21940010	169116
$p = 0.9$	ACS-EE	22669200	182924
	pACS	22881781	183177

Table 27: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` over 50 homogeneous uniform instances of size 1000. Each algorithm is allowed to run for 1000 CPU seconds. The table gives, for each probability level, the mean and the standard deviation (s.d.) of the final solution cost.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`ACS-EE`	6516908	44045
	`pACS`	6514095	50686
$p = 0.075$	`ACS-EE`	7801906	52501
	`pACS`	7795572	53380
$p = 0.100$	`ACS-EE`	8912265	49076
	`pACS`	8906639	49546
$p = 0.125$	`ACS-EE`	9865815	63301
	`pACS`	9863972	59110
$p = 0.150$	`ACS-EE`	10725759	56325
	`pACS`	10717391	60021
$p = 0.175$	`ACS-EE`	11497872	69536
	`pACS`	11493408	64667
$p = 0.200$	`ACS-EE`	12207360	79765
	`pACS`	12210204	69590
$p = 0.3$	`ACS-EE`	14581882	100634
	`pACS`	14594081	96319
$p = 0.4$	`ACS-EE`	16454722	125319
	`pACS`	16460945	115488
$p = 0.5$	`ACS-EE`	18033442	131081
	`pACS`	18039382	129339
$p = 0.6$	`ACS-EE`	19375626	163644
	`pACS`	19395687	135667
$p = 0.7$	`ACS-EE`	20543279	171718
	`pACS`	20567909	165556
$p = 0.8$	`ACS-EE`	21564701	153861
	`pACS`	21595378	175492
$p = 0.9$	`ACS-EE`	22467658	185681
	`pACS`	22540238	190837

Table 28: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` over 50 clustered instances of size 1000.

100 CPU seconds			1000 CPU seconds		
	`ACS-EE` vs. `pACS+2.5-opt-EEais`			`ACS-EE` vs. `pACS+2.5-opt-EEais`	
p	Difference	95% CI	p	Difference	95% CI
0.050	−0.540	[−1.246, +0.166]	0.050	+0.117	[−0.254, +0.488]
0.075	+0.139	[−0.458, +0.736]	0.075	+0.024	[−0.046, +0.095]
0.100	+0.044	[−0.273, +0.361]	0.100	+0.019	[−0.039, +0.077]
0.150	−0.061	[−0.392, +0.270]	0.150	+0.041	[−0.063, +0.145]
0.175	+0.129	[−0.116, +0.374]	0.175	+0.111	[−0.033, +0.256]
0.200	−0.077	[−0.389, +0.235]	0.200	+0.043	[−0.113, +0.199]
0.300	−0.192	[−0.437, +0.054]	0.300	−0.030	[−0.139, +0.078]
0.400	−0.001	[−0.209, +0.208]	0.400	−0.068	[−0.154, +0.019]
0.500	−0.156	[−0.411, +0.099]	0.500	−0.052	[−0.154, +0.050]
0.600	**−0.324**	[−0.555, −0.094]	0.600	−0.019	[−0.116, +0.077]
0.700	**−0.486**	[−0.763, −0.208]	0.700	−0.089	[−0.257, +0.078]
0.800	**−0.618**	[−0.809, −0.426]	0.800	**−0.206**	[−0.308, −0.104]
0.900	**−0.994**	[−1.221, −0.766]	0.900	**−0.155**	[−0.294, −0.015]

Table 29: Comparison of the average cost obtained by `ACS-EE` and `pACS+2.5-opt-EEais` over 50 uniform instances of size 1000.

100 CPU seconds			1000 CPU seconds		
	`ACS-EE` vs. `pACS+2.5-opt-EEais`			`ACS-EE` vs. `pACS+2.5-opt-EEais`	
p	Difference	95% CI	p	Difference	95% CI
0.050	−0.137	[−0.615, +0.341]	0.050	+0.043	[−0.206, +0.293]
0.075	+0.003	[−0.275, +0.280]	0.075	+0.081	[−0.053, +0.216]
0.100	+0.044	[−0.149, +0.237]	0.100	+0.063	[−0.041, +0.168]
0.125	+0.012	[−0.216, +0.240]	0.125	+0.019	[−0.106, +0.143]
0.150	+0.176	[−0.016, +0.367]	0.150	+0.078	[−0.039, +0.195]
0.175	+0.056	[−0.149, +0.262]	0.175	+0.039	[−0.065, +0.143]
0.200	+0.027	[−0.242, +0.296]	0.200	−0.023	[−0.151, +0.104]
0.300	−0.078	[−0.306, +0.150]	0.300	−0.084	[−0.204, +0.037]
0.400	**−0.300**	[−0.486, −0.114]	0.400	−0.038	[−0.171, +0.095]
0.500	**−0.248**	[−0.439, −0.057]	0.500	−0.033	[−0.162, +0.096]
0.600	**−0.371**	[−0.581, −0.161]	0.600	−0.103	[−0.257, +0.050]
0.700	**−0.614**	[−0.774, −0.454]	0.700	−0.120	[−0.260, +0.020]
0.800	**−0.660**	[−0.856, −0.464]	0.800	**−0.142**	[−0.261, −0.023]
0.900	**−0.929**	[−1.102, −0.756]	0.900	**−0.322**	[−0.463, −0.181]

3 Comparison between the estimation-based ACO variants

3.1 Comparison between the variants with default parameter values

Table 30: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance ch150 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	1774	2
	`ACS-EE(t)`	1774	2
	`RAS-EE(t)`	1773	2
	`BWAS-EE(t)`	1774	2
$p = 0.075$	`MMAS-EE(t)`	2166	2
	`ACS-EE(t)`	2167	2
	`RAS-EE(t)`	2166	1
	`BWAS-EE(t)`	2167	1
$p = 0.100$	`MMAS-EE(t)`	2486	2
	`ACS-EE(t)`	2490	4
	`RAS-EE(t)`	2488	3
	`BWAS-EE(t)`	2487	2
$p = 0.150$	`MMAS-EE(t)`	3036	12
	`ACS-EE(t)`	3044	12
	`RAS-EE(t)`	3038	12
	`BWAS-EE(t)`	3037	11
$p = 0.175$	`MMAS-EE(t)`	3272	12
	`ACS-EE(t)`	3276	18
	`RAS-EE(t)`	3275	17
	`BWAS-EE(t)`	3271	11
$p = 0.200$	`MMAS-EE(t)`	3465	14
	`ACS-EE(t)`	3472	17
	`RAS-EE(t)`	3469	16
	`BWAS-EE(t)`	3469	18
$p = 0.300$	`MMAS-EE(t)`	4169	39
	`ACS-EE(t)`	4160	39
	`RAS-EE(t)`	4162	29
	`BWAS-EE(t)`	4160	36
$p = 0.400$	`MMAS-EE(t)`	4751	63
	`ACS-EE(t)`	4724	45
	`RAS-EE(t)`	4748	44
	`BWAS-EE(t)`	4756	45
$p = 0.500$	`MMAS-EE(t)`	5262	53
	`ACS-EE(t)`	5181	68
	`RAS-EE(t)`	5268	58
	`BWAS-EE(t)`	5244	53

Table 31: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance ch150 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	1773	1
	`ACS-EE(t)`	1773	1
	`RAS-EE(t)`	1773	1
	`BWAS-EE(t)`	1773	1
$p = 0.075$	`MMAS-EE(t)`	2166	1
	`ACS-EE(t)`	2167	1
	`RAS-EE(t)`	2166	1
	`BWAS-EE(t)`	2167	1
$p = 0.100$	`MMAS-EE(t)`	2487	2
	`ACS-EE(t)`	2489	3
	`RAS-EE(t)`	2487	2
	`BWAS-EE(t)`	2487	1
$p = 0.150$	`MMAS-EE(t)`	3019	3
	`ACS-EE(t)`	3015	1
	`RAS-EE(t)`	3019	2
	`BWAS-EE(t)`	3016	1
$p = 0.175$	`MMAS-EE(t)`	3247	5
	`ACS-EE(t)`	3242	3
	`RAS-EE(t)`	3250	5
	`BWAS-EE(t)`	3242	3
$p = 0.200$	`MMAS-EE(t)`	3422	2
	`ACS-EE(t)`	3422	5
	`RAS-EE(t)`	3433	4
	`BWAS-EE(t)`	3422	4
$p = 0.300$	`MMAS-EE(t)`	4059	6
	`ACS-EE(t)`	4062	9
	`RAS-EE(t)`	4083	8
	`BWAS-EE(t)`	4059	6
$p = 0.400$	`MMAS-EE(t)`	4577	10
	`ACS-EE(t)`	4579	13
	`RAS-EE(t)`	4581	9
	`BWAS-EE(t)`	4578	12
$p = 0.500$	`MMAS-EE(t)`	5007	7
	`ACS-EE(t)`	5008	9
	`RAS-EE(t)`	5006	5
	`BWAS-EE(t)`	5010	12

Table 32: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance d198 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	5633	22
	`ACS-EE(t)`	5631	14
	`RAS-EE(t)`	5632	18
	`BWAS-EE(t)`	5638	24
$p = 0.075$	`MMAS-EE(t)`	6677	2
	`ACS-EE(t)`	6678	3
	`RAS-EE(t)`	6677	2
	`BWAS-EE(t)`	6677	1
$p = 0.100$	`MMAS-EE(t)`	7447	3
	`ACS-EE(t)`	7451	6
	`RAS-EE(t)`	7449	3
	`BWAS-EE(t)`	7448	4
$p = 0.150$	`MMAS-EE(t)`	8567	14
	`ACS-EE(t)`	8567	16
	`RAS-EE(t)`	8572	13
	`BWAS-EE(t)`	8563	12
$p = 0.175$	`MMAS-EE(t)`	8999	20
	`ACS-EE(t)`	8998	25
	`RAS-EE(t)`	9002	20
	`BWAS-EE(t)`	8993	19
$p = 0.200$	`MMAS-EE(t)`	9399	28
	`ACS-EE(t)`	9390	35
	`RAS-EE(t)`	9387	23
	`BWAS-EE(t)`	9389	31
$p = 0.300$	`MMAS-EE(t)`	10705	41
	`ACS-EE(t)`	10713	45
	`RAS-EE(t)`	10701	43
	`BWAS-EE(t)`	10696	49
$p = 0.400$	`MMAS-EE(t)`	11764	58
	`ACS-EE(t)`	11768	48
	`RAS-EE(t)`	11782	49
	`BWAS-EE(t)`	11772	55
$p = 0.500$	`MMAS-EE(t)`	12684	60
	`ACS-EE(t)`	12689	77
	`RAS-EE(t)`	12739	58
	`BWAS-EE(t)`	12711	60

Table 33: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance d198 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	5611	1
	`ACS-EE(t)`	5612	1
	`RAS-EE(t)`	5612	1
	`BWAS-EE(t)`	5612	1
$p = 0.075$	`MMAS-EE(t)`	6678	2
	`ACS-EE(t)`	6679	3
	`RAS-EE(t)`	6677	2
	`BWAS-EE(t)`	6678	2
$p = 0.100$	`MMAS-EE(t)`	7447	4
	`ACS-EE(t)`	7450	5
	`RAS-EE(t)`	7448	3
	`BWAS-EE(t)`	7448	6
$p = 0.150$	`MMAS-EE(t)`	8538	4
	`ACS-EE(t)`	8534	2
	`RAS-EE(t)`	8540	4
	`BWAS-EE(t)`	8535	2
$p = 0.175$	`MMAS-EE(t)`	8952	3
	`ACS-EE(t)`	8948	3
	`RAS-EE(t)`	8958	4
	`BWAS-EE(t)`	8949	3
$p = 0.200$	`MMAS-EE(t)`	9327	3
	`ACS-EE(t)`	9325	3
	`RAS-EE(t)`	9334	4
	`BWAS-EE(t)`	9325	3
$p = 0.300$	`MMAS-EE(t)`	10550	6
	`ACS-EE(t)`	10546	5
	`RAS-EE(t)`	10583	12
	`BWAS-EE(t)`	10548	6
$p = 0.400$	`MMAS-EE(t)`	11546	6
	`ACS-EE(t)`	11546	12
	`RAS-EE(t)`	11600	15
	`BWAS-EE(t)`	11548	9
$p = 0.500$	`MMAS-EE(t)`	12425	5
	`ACS-EE(t)`	12427	4
	`RAS-EE(t)`	12468	18
	`BWAS-EE(t)`	12425	5

Table 34: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance lin318 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(d)`	12708	54
	`ACS-EE(d)`	12689	59
	`RAS-EE(d)`	12699	88
	`BWAS-EE(d)`	12713	88
$p = 0.075$	`MMAS-EE(d)`	15225	139
	`ACS-EE(d)`	15223	128
	`RAS-EE(d)`	15199	81
	`BWAS-EE(d)`	15201	99
$p = 0.100$	`MMAS-EE(d)`	17330	76
	`ACS-EE(d)`	17395	109
	`RAS-EE(d)`	17318	60
	`BWAS-EE(d)`	17348	75
$p = 0.150$	`MMAS-EE(d)`	21151	142
	`ACS-EE(d)`	21404	229
	`RAS-EE(d)`	21145	147
	`BWAS-EE(d)`	21150	106
$p = 0.175$	`MMAS-EE(d)`	22787	250
	`ACS-EE(d)`	22982	213
	`RAS-EE(d)`	22712	229
	`BWAS-EE(d)`	22781	202
$p = 0.200$	`MMAS-EE(d)`	24287	229
	`ACS-EE(d)`	24474	213
	`RAS-EE(d)`	24294	188
	`BWAS-EE(d)`	24307	243
$p = 0.300$	`MMAS-EE(d)`	29173	205
	`ACS-EE(d)`	29048	194
	`RAS-EE(d)`	29089	282
	`BWAS-EE(d)`	29168	245
$p = 0.400$	`MMAS-EE(d)`	32910	291
	`ACS-EE(d)`	32413	238
	`RAS-EE(d)`	32878	319
	`BWAS-EE(d)`	32896	375
$p = 0.500$	`MMAS-EE(d)`	35959	336
	`ACS-EE(d)`	35236	299
	`RAS-EE(d)`	35913	359
	`BWAS-EE(d)`	35952	366

Table 35: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance lin318 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(d)`	12622	20
	`ACS-EE(d)`	12627	22
	`RAS-EE(d)`	12621	19
	`BWAS-EE(d)`	12621	26
$p = 0.075$	`MMAS-EE(d)`	15112	15
	`ACS-EE(d)`	15110	11
	`RAS-EE(d)`	15110	11
	`BWAS-EE(d)`	15110	10
$p = 0.100$	`MMAS-EE(d)`	17250	17
	`ACS-EE(d)`	17226	10
	`RAS-EE(d)`	17244	16
	`BWAS-EE(d)`	17233	9
$p = 0.150$	`MMAS-EE(d)`	20805	35
	`ACS-EE(d)`	20744	50
	`RAS-EE(d)`	20871	42
	`BWAS-EE(d)`	20775	44
$p = 0.175$	`MMAS-EE(d)`	22281	44
	`ACS-EE(d)`	22224	56
	`RAS-EE(d)`	22369	58
	`BWAS-EE(d)`	22247	53
$p = 0.200$	`MMAS-EE(d)`	23578	55
	`ACS-EE(d)`	23548	111
	`RAS-EE(d)`	23745	93
	`BWAS-EE(d)`	23544	80
$p = 0.300$	`MMAS-EE(d)`	27954	155
	`ACS-EE(d)`	27991	121
	`RAS-EE(d)`	28395	100
	`BWAS-EE(d)`	27966	143
$p = 0.400$	`MMAS-EE(d)`	31232	97
	`ACS-EE(d)`	31230	83
	`RAS-EE(d)`	31726	81
	`BWAS-EE(d)`	31301	134
$p = 0.500$	`MMAS-EE(d)`	33884	82
	`ACS-EE(d)`	33885	103
	`RAS-EE(d)`	34421	102
	`BWAS-EE(d)`	33901	76

Table 36: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance att532 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(d)`	25857	177
	`ACS-EE(d)`	25871	214
	`RAS-EE(d)`	25893	149
	`BWAS-EE(d)`	25818	138
$p = 0.075$	`MMAS-EE(d)`	30133	78
	`ACS-EE(d)`	30150	106
	`RAS-EE(d)`	30149	129
	`BWAS-EE(d)`	30132	92
$p = 0.100$	`MMAS-EE(d)`	33980	126
	`ACS-EE(d)`	34081	168
	`RAS-EE(d)`	33960	117
	`BWAS-EE(d)`	33967	102
$p = 0.150$	`MMAS-EE(d)`	40583	219
	`ACS-EE(d)`	40972	307
	`RAS-EE(d)`	40591	195
	`BWAS-EE(d)`	40549	205
$p = 0.175$	`MMAS-EE(d)`	43488	284
	`ACS-EE(d)`	43960	388
	`RAS-EE(d)`	43490	195
	`BWAS-EE(d)`	43433	216
$p = 0.200$	`MMAS-EE(d)`	46136	257
	`ACS-EE(d)`	46864	394
	`RAS-EE(d)`	46107	299
	`BWAS-EE(d)`	46215	273
$p = 0.300$	`MMAS-EE(d)`	55639	356
	`ACS-EE(d)`	56330	463
	`RAS-EE(d)`	55515	472
	`BWAS-EE(d)`	55661	414
$p = 0.400$	`MMAS-EE(d)`	63184	476
	`ACS-EE(d)`	63790	409
	`RAS-EE(d)`	63422	404
	`BWAS-EE(d)`	63209	507
$p = 0.500$	`MMAS-EE(d)`	70182	445
	`ACS-EE(d)`	70232	469
	`RAS-EE(d)`	70190	576
	`BWAS-EE(d)`	69986	583

Table 37: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance att532 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(d)`	25621	60
	`ACS-EE(d)`	25548	19
	`RAS-EE(d)`	25595	38
	`BWAS-EE(d)`	25544	18
$p = 0.075$	`MMAS-EE(d)`	30022	26
	`ACS-EE(d)`	29994	17
	`RAS-EE(d)`	30022	21
	`BWAS-EE(d)`	30008	16
$p = 0.100$	`MMAS-EE(d)`	33823	33
	`ACS-EE(d)`	33749	21
	`RAS-EE(d)`	33838	43
	`BWAS-EE(d)`	33791	30
$p = 0.150$	`MMAS-EE(d)`	39947	68
	`ACS-EE(d)`	39777	32
	`RAS-EE(d)`	40165	99
	`BWAS-EE(d)`	39865	60
$p = 0.175$	`MMAS-EE(d)`	42555	96
	`ACS-EE(d)`	42366	71
	`RAS-EE(d)`	42912	82
	`BWAS-EE(d)`	42465	58
$p = 0.200$	`MMAS-EE(d)`	44981	97
	`ACS-EE(d)`	44763	63
	`RAS-EE(d)`	45525	90
	`BWAS-EE(d)`	44854	87
$p = 0.300$	`MMAS-EE(d)`	53310	127
	`ACS-EE(d)`	53217	134
	`RAS-EE(d)`	54411	181
	`BWAS-EE(d)`	53303	178
$p = 0.400$	`MMAS-EE(d)`	60132	171
	`ACS-EE(d)`	60162	186
	`RAS-EE(d)`	61484	147
	`BWAS-EE(d)`	60229	164
$p = 0.500$	`MMAS-EE(d)`	66170	106
	`ACS-EE(d)`	66253	127
	`RAS-EE(d)`	67762	173
	`BWAS-EE(d)`	66308	212

Table 38: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance rat783 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(d)`	2357	11
	`ACS-EE(d)`	2361	17
	`RAS-EE(d)`	2360	10
	`BWAS-EE(d)`	2361	12
$p = 0.075$	`MMAS-EE(d)`	2862	11
	`ACS-EE(d)`	2858	10
	`RAS-EE(d)`	2864	10
	`BWAS-EE(d)`	2864	13
$p = 0.100$	`MMAS-EE(d)`	3289	7
	`ACS-EE(d)`	3301	9
	`RAS-EE(d)`	3288	8
	`BWAS-EE(d)`	3288	11
$p = 0.150$	`MMAS-EE(d)`	4047	16
	`ACS-EE(d)`	4086	17
	`RAS-EE(d)`	4053	12
	`BWAS-EE(d)`	4052	12
$p = 0.175$	`MMAS-EE(d)`	4386	13
	`ACS-EE(d)`	4432	23
	`RAS-EE(d)`	4387	14
	`BWAS-EE(d)`	4393	14
$p = 0.200$	`MMAS-EE(d)`	4700	15
	`ACS-EE(d)`	4751	27
	`RAS-EE(d)`	4699	15
	`BWAS-EE(d)`	4698	16
$p = 0.300$	`MMAS-EE(d)`	5768	24
	`ACS-EE(d)`	5814	28
	`RAS-EE(d)`	5769	29
	`BWAS-EE(d)`	5778	23
$p = 0.400$	`MMAS-EE(d)`	6609	32
	`ACS-EE(d)`	6597	23
	`RAS-EE(d)`	6607	25
	`BWAS-EE(d)`	6613	36
$p = 0.500$	`MMAS-EE(d)`	7309	34
	`ACS-EE(d)`	7227	34
	`RAS-EE(d)`	7305	35
	`BWAS-EE(d)`	7307	28

Table 39: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the TSPLIB instance rat783 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(d)`	2341	6
	`ACS-EE(d)`	2332	4
	`RAS-EE(d)`	2340	4
	`BWAS-EE(d)`	2334	5
$p = 0.075$	`MMAS-EE(d)`	2844	6
	`ACS-EE(d)`	2832	6
	`RAS-EE(d)`	2840	5
	`BWAS-EE(d)`	2836	5
$p = 0.100$	`MMAS-EE(d)`	3276	6
	`ACS-EE(d)`	3264	6
	`RAS-EE(d)`	3278	7
	`BWAS-EE(d)`	3269	6
$p = 0.150$	`MMAS-EE(d)`	4010	10
	`ACS-EE(d)`	3969	9
	`RAS-EE(d)`	4033	10
	`BWAS-EE(d)`	3996	9
$p = 0.175$	`MMAS-EE(d)`	4324	13
	`ACS-EE(d)`	4280	8
	`RAS-EE(d)`	4368	9
	`BWAS-EE(d)`	4304	14
$p = 0.200$	`MMAS-EE(d)`	4611	17
	`ACS-EE(d)`	4563	11
	`RAS-EE(d)`	4674	9
	`BWAS-EE(d)`	4593	12
$p = 0.300$	`MMAS-EE(d)`	5559	20
	`ACS-EE(d)`	5515	17
	`RAS-EE(d)`	5711	10
	`BWAS-EE(d)`	5541	15
$p = 0.400$	`MMAS-EE(d)`	6268	13
	`ACS-EE(d)`	6246	14
	`RAS-EE(d)`	6483	16
	`BWAS-EE(d)`	6275	15
$p = 0.500$	`MMAS-EE(d)`	6871	14
	`ACS-EE(d)`	6872	15
	`RAS-EE(d)`	7120	15
	`BWAS-EE(d)`	6890	15

Table 40: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the clustered instances of size 1000 for 100 seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	MMAS-EE(d)	4374698	446663
	ACS-EE(d)	4491475	472454
	RAS-EE(d)	4427947	502224
	BWAS-EE(d)	4458108	479762
$p = 0.075$	MMAS-EE(d)	4757749	448712
	ACS-EE(d)	4622715	432053
	RAS-EE(d)	4786247	460180
	BWAS-EE(d)	4772766	422401
$p = 0.100$	MMAS-EE(d)	5139042	457430
	ACS-EE(d)	4938350	427685
	RAS-EE(d)	5020786	443524
	BWAS-EE(d)	4991101	457574
$p = 0.125$	MMAS-EE(d)	5375411	440664
	ACS-EE(d)	5322564	430118
	RAS-EE(d)	5349909	434020
	BWAS-EE(d)	5329998	440454
$p = 0.150$	MMAS-EE(d)	5737006	454071
	ACS-EE(d)	5697048	442312
	RAS-EE(d)	5731734	452556
	BWAS-EE(d)	5703725	445289
$p = 0.175$	MMAS-EE(d)	6089386	462871
	ACS-EE(d)	6026438	461995
	RAS-EE(d)	6086602	454819
	BWAS-EE(d)	6051701	450660
$p = 0.200$	MMAS-EE(d)	6418386	467346
	ACS-EE(d)	6343778	465912
	RAS-EE(d)	6413096	474335
	BWAS-EE(d)	6377132	460499
$p = 0.300$	MMAS-EE(d)	7565140	511879
	ACS-EE(d)	7395142	495970
	RAS-EE(d)	7547226	503640
	BWAS-EE(d)	7483040	514697
$p = 0.400$	MMAS-EE(d)	8467527	543114
	ACS-EE(d)	8204142	531915
	RAS-EE(d)	8447704	544122
	BWAS-EE(d)	8336366	544197
$p = 0.500$	MMAS-EE(d)	9184723	572314
	ACS-EE(d)	8879886	553487
	RAS-EE(d)	9182258	577258
	BWAS-EE(d)	9035761	566633
$p = 0.600$	MMAS-EE(d)	9797965	602129
	ACS-EE(d)	9478634	585929
	RAS-EE(d)	9829753	603344
	BWAS-EE(d)	9640730	592668

Table 41: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the clustered instances of size 1000 for 1000 seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	MMAS-EE(d)	4074972	407949
	ACS-EE(d)	3997851	398735
	RAS-EE(d)	4041347	401461
	BWAS-EE(d)	4034365	403323
$p = 0.075$	MMAS-EE(d)	4521857	411328
	ACS-EE(d)	4440309	403161
	RAS-EE(d)	4502017	410769
	BWAS-EE(d)	4477324	412996
$p = 0.100$	MMAS-EE(d)	4909640	421732
	ACS-EE(d)	4873033	415815
	RAS-EE(d)	4907397	418015
	BWAS-EE(d)	4891545	419359
$p = 0.125$	MMAS-EE(d)	5294843	430150
	ACS-EE(d)	5260257	427569
	RAS-EE(d)	5303968	426121
	BWAS-EE(d)	5282804	431738
$p = 0.150$	MMAS-EE(d)	5656771	438786
	ACS-EE(d)	5612055	436792
	RAS-EE(d)	5683764	444281
	BWAS-EE(d)	5643998	440801
$p = 0.175$	MMAS-EE(d)	5988978	454070
	ACS-EE(d)	5933596	448004
	RAS-EE(d)	6038521	451957
	BWAS-EE(d)	5966562	449636
$p = 0.200$	MMAS-EE(d)	6291929	456447
	ACS-EE(d)	6231764	457752
	RAS-EE(d)	6366718	467615
	BWAS-EE(d)	6260014	460287
$p = 0.300$	MMAS-EE(d)	7298438	497878
	ACS-EE(d)	7253328	492006
	RAS-EE(d)	7492238	500245
	BWAS-EE(d)	7273365	491953
$p = 0.400$	MMAS-EE(d)	8091205	525116
	ACS-EE(d)	8072577	519518
	RAS-EE(d)	8374745	539255
	BWAS-EE(d)	8096180	518896
$p = 0.500$	MMAS-EE(d)	8778254	545685
	ACS-EE(d)	8766055	539932
	RAS-EE(d)	9121760	567788
	BWAS-EE(d)	8801746	542085
$p = 0.600$	MMAS-EE(d)	9375577	572045
	ACS-EE(d)	9381698	572438
	RAS-EE(d)	9760497	604534
	BWAS-EE(d)	9398013	567083

Table 42: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the uniform instances of size 1000 for $n^2/10000$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	MMAS-EE(d)	6910763	77425
	ACS-EE(d)	7034406	206422
	RAS-EE(d)	6933591	121310
	BWAS-EE(d)	6974971	133203
$p = 0.075$	MMAS-EE(d)	8236144	82097
	ACS-EE(d)	8032349	78886
	RAS-EE(d)	8237148	89213
	BWAS-EE(d)	8239246	86588
$p = 0.100$	MMAS-EE(d)	9241282	67287
	ACS-EE(d)	9037977	63581
	RAS-EE(d)	9123181	68244
	BWAS-EE(d)	9057788	71417
$p = 0.125$	MMAS-EE(d)	10089500	75232
	ACS-EE(d)	10049148	76289
	RAS-EE(d)	10095539	74824
	BWAS-EE(d)	10037175	69019
$p = 0.150$	MMAS-EE(d)	11022201	78937
	ACS-EE(d)	10936072	83677
	RAS-EE(d)	11024829	78699
	BWAS-EE(d)	10942533	76964
$p = 0.175$	MMAS-EE(d)	11854754	94655
	ACS-EE(d)	11740364	97578
	RAS-EE(d)	11869620	78995
	BWAS-EE(d)	11770992	83194
$p = 0.200$	MMAS-EE(d)	12624614	93861
	ACS-EE(d)	12463098	96886
	RAS-EE(d)	12648742	85037
	BWAS-EE(d)	12527787	96416
$p = 0.3$	MMAS-EE(d)	15292164	100621
	ACS-EE(d)	14854118	113898
	RAS-EE(d)	15286445	110945
	BWAS-EE(d)	15093020	130972
$p = 0.4$	MMAS-EE(d)	17288833	123504
	ACS-EE(d)	16693966	151786
	RAS-EE(d)	17276006	124855
	BWAS-EE(d)	17008296	159686
$p = 0.5$	MMAS-EE(d)	18881810	149761
	ACS-EE(d)	18223264	148396
	RAS-EE(d)	18901545	156115
	BWAS-EE(d)	18557754	173131
$p = 0.6$	MMAS-EE(d)	20161721	182699
	ACS-EE(d)	19566148	200112
	RAS-EE(d)	20284133	151956
	BWAS-EE(d)	19817599	209563

Table 43: The average and the standard deviation of the cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the uniform instances of size 1000 for $n^2/1000$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	MMAS-EE(d)	6682762	58494
	ACS-EE(d)	6549876	50964
	RAS-EE(d)	6660497	51823
	BWAS-EE(d)	6622664	50109
$p = 0.075$	MMAS-EE(d)	7925778	59502
	ACS-EE(d)	7816906	60248
	RAS-EE(d)	7917664	59578
	BWAS-EE(d)	7863756	68082
$p = 0.100$	MMAS-EE(d)	9014820	63187
	ACS-EE(d)	8929585	64418
	RAS-EE(d)	9029225	65786
	BWAS-EE(d)	8982451	64449
$p = 0.125$	MMAS-EE(d)	9972863	76419
	ACS-EE(d)	9876558	76555
	RAS-EE(d)	10046530	69172
	BWAS-EE(d)	9940088	71044
$p = 0.150$	MMAS-EE(d)	10838446	83344
	ACS-EE(d)	10729050	75049
	RAS-EE(d)	10973762	79324
	BWAS-EE(d)	10789411	83792
$p = 0.175$	MMAS-EE(d)	11606302	96657
	ACS-EE(d)	11496403	80536
	RAS-EE(d)	11819450	79740
	BWAS-EE(d)	11554946	85361
$p = 0.200$	MMAS-EE(d)	12303276	91345
	ACS-EE(d)	12203897	85471
	RAS-EE(d)	12584507	81043
	BWAS-EE(d)	12257889	88911
$p = 0.3$	MMAS-EE(d)	14631137	102982
	ACS-EE(d)	14585849	115694
	RAS-EE(d)	15186177	100150
	BWAS-EE(d)	14629375	109135
$p = 0.4$	MMAS-EE(d)	16461778	121859
	ACS-EE(d)	16459537	131996
	RAS-EE(d)	17175858	130372
	BWAS-EE(d)	16514221	130254
$p = 0.5$	MMAS-EE(d)	18012458	137699
	ACS-EE(d)	18044999	151848
	RAS-EE(d)	18786128	144401
	BWAS-EE(d)	18074489	139540
$p = 0.6$	MMAS-EE(d)	19362035	161423
	ACS-EE(d)	19388889	159717
	RAS-EE(d)	20171457	181809
	BWAS-EE(d)	19418631	178390

Table 44: Comparison of the average cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)` over 30 independent runs on instance lin318.

	$n^2/10000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	-0.139	$[-0.417, +0.140]$	-0.107	$[-0.447, +0.233]$	-0.185	$[-0.565, +0.196]$
0.075-00	-0.018	$[-0.651, +0.616]$	$+0.224$	$[-0.219, +0.667]$	$+0.211$	$[-0.332, +0.754]$
0.100-00	*+0.443*	$[+0.129, +0.756]$	*+0.526*	$[+0.257, +0.794]$	*+0.360*	$[+0.079, +0.641]$
0.150-00	*+1.168*	$[+0.678, +1.658]$	*+1.225*	$[+0.752, +1.697]$	*+1.175*	$[+0.744, +1.606]$
0.175-00	*+0.852*	$[+0.269, +1.434]$	*+1.188*	$[+0.688, +1.688]$	*+0.879*	$[+0.357, +1.401]$
0.200-00	*+0.771*	$[+0.333, +1.210]$	*+0.743*	$[+0.303, +1.183]$	*+0.644*	$[+0.068, +1.219]$
0.300-00	**−0.503**	$[-0.887, -0.118]$	-0.154	$[-0.641, +0.332]$	-0.413	$[-0.876, +0.050]$
0.400-00	**−1.511**	$[-1.953, -1.069]$	**−1.457**	$[-1.914, -0.999]$	**−1.469**	$[-1.990, -0.947]$
0.500-00	**−2.012**	$[-2.484, -1.539]$	**−1.886**	$[-2.439, -1.334]$	**−1.986**	$[-2.516, -1.456]$

	$n^2/1000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	$+0.024$	$[-0.079, +0.127]$	$+0.045$	$[-0.073, +0.163]$	$+0.024$	$[-0.109, +0.156]$
0.075-00	-0.025	$[-0.078, +0.028]$	$+0.000$	$[-0.056, +0.056]$	$+0.000$	$[-0.054, +0.054]$
0.100-00	**−0.167**	$[-0.220, -0.114]$	**−0.128**	$[-0.186, -0.069]$	**−0.051**	$[-0.093, -0.010]$
0.150-00	**−0.237**	$[-0.383, -0.091]$	**−0.574**	$[-0.739, -0.410]$	-0.086	$[-0.221, +0.048]$
0.175-00	**−0.228**	$[-0.371, -0.084]$	**−0.620**	$[-0.763, -0.478]$	-0.056	$[-0.238, +0.126]$
0.200-00	-0.086	$[-0.308, +0.136]$	**−0.826**	$[-1.060, -0.592]$	$+0.035$	$[-0.194, +0.263]$
0.300-00	$+0.088$	$[-0.281, +0.458]$	**−1.424**	$[-1.667, -1.181]$	$+0.091$	$[-0.237, +0.419]$
0.400-00	$+0.014$	$[-0.141, +0.170]$	**−1.551**	$[-1.732, -1.371]$	-0.200	$[-0.416, +0.016]$
0.500-00	$+0.039$	$[-0.103, +0.180]$	**−1.535**	$[-1.720, -1.351]$	-0.034	$[-0.190, +0.123]$

Table 45: Comparison of the average cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)` over 30 independent runs on instance att532.

	$n^2/10000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.172	[−0.274, +0.618]	−0.034	[−0.426, +0.358]	+0.253	[−0.177, +0.684]
0.075-00	+0.094	[−0.107, +0.295]	+0.007	[−0.247, +0.262]	+0.063	[−0.107, +0.233]
0.100-00	*+0.371*	[+0.127, +0.615]	*+0.383*	[+0.159, +0.606]	*+0.347*	[+0.120, +0.575]
0.150-00	*+0.957*	[+0.639, +1.276]	*+0.949*	[+0.634, +1.265]	*+1.042*	[+0.677, +1.407]
0.175-00	*+1.085*	[+0.716, +1.454]	*+1.082*	[+0.713, +1.452]	*+1.205*	[+0.771, +1.639]
0.200-00	*+1.622*	[+1.268, +1.976]	*+1.673*	[+1.219, +2.127]	*+1.433*	[+0.994, +1.872]
0.300-00	*+1.274*	[+0.811, +1.737]	*+1.505*	[+1.094, +1.916]	*+1.186*	[+0.785, +1.586]
0.400-00	*+0.959*	[+0.584, +1.334]	*+0.580*	[+0.259, +0.901]	*+0.918*	[+0.500, +1.337]
0.500-00	+0.121	[−0.324, +0.566]	+0.082	[−0.268, +0.432]	+0.364	[−0.015, +0.742]

	$n^2/1000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	**−0.284**	[−0.393, −0.175]	**−0.177**	[−0.248, −0.107]	+0.022	[−0.029, +0.073]
0.075-00	**−0.099**	[−0.137, −0.061]	**−0.095**	[−0.136, −0.054]	**−0.049**	[−0.086, −0.013]
0.100-00	**−0.194**	[−0.240, −0.148]	**−0.269**	[−0.332, −0.206]	**−0.126**	[−0.175, −0.077]
0.150-00	**−0.433**	[−0.510, −0.356]	**−0.979**	[−1.093, −0.865]	**−0.216**	[−0.287, −0.144]
0.175-00	**−0.446**	[−0.572, −0.321]	**−1.245**	[−1.346, −1.144]	**−0.222**	[−0.299, −0.146]
0.200-00	**−0.492**	[−0.607, −0.378]	**−1.652**	[−1.758, −1.546]	**−0.198**	[−0.301, −0.096]
0.300-00	**−0.175**	[−0.299, −0.050]	**−2.194**	[−2.345, −2.044]	−0.160	[−0.333, +0.012]
0.400-00	+0.024	[−0.149, +0.197]	**−2.174**	[−2.320, −2.028]	−0.119	[−0.266, +0.028]
0.500-00	*+0.126*	[+0.035, +0.218]	**−2.217**	[−2.346, −2.088]	−0.105	[−0.269, +0.060]

Table 46: Comparison of the average cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)` over 30 independent runs on instance rat783.

	$n^2/10000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.117	[−0.338, +0.572]	+0.148	[−0.271, +0.568]	−0.105	[−0.494, +0.284]
0.075-00	−0.159	[−0.424, +0.106]	−0.183	[−0.394, +0.027]	−0.171	[−0.414, +0.071]
0.100-00	*+0.397*	[+0.195, +0.599]	*+0.372*	[+0.165, +0.579]	*+0.472*	[+0.232, +0.711]
0.150-00	*+0.996*	[+0.731, +1.261]	*+0.809*	[+0.575, +1.043]	*+0.758*	[+0.483, +1.034]
0.175-00	*+1.027*	[+0.753, +1.301]	*+1.020*	[+0.754, +1.286]	*+0.905*	[+0.635, +1.175]
0.200-00	*+1.009*	[+0.736, +1.281]	*+1.046*	[+0.752, +1.341]	*+1.055*	[+0.758, +1.352]
0.300-00	*+0.808*	[+0.549, +1.066]	*+0.802*	[+0.465, +1.140]	*+0.638*	[+0.392, +0.885]
0.400-00	−0.136	[−0.368, +0.097]	−0.105	[−0.335, +0.126]	−0.196	[−0.472, +0.080]
0.500-00	**−1.105**	[−1.388, −0.821]	**−1.054**	[−1.357, −0.752]	**−1.040**	[−1.290, −0.791]

	$n^2/1000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	**−0.440**	[−0.642, −0.238]	**−0.335**	[−0.540, −0.131]	−0.036	[−0.241, +0.169]
0.075-00	**−0.440**	[−0.640, −0.240]	**−0.317**	[−0.492, −0.142]	−0.133	[−0.337, +0.071]
0.100-00	**−0.365**	[−0.514, −0.215]	**−0.413**	[−0.565, −0.260]	−0.133	[−0.327, +0.061]
0.150-00	**−0.982**	[−1.154, −0.811]	**−1.557**	[−1.724, −1.391]	**−0.629**	[−0.773, −0.485]
0.175-00	**−0.999**	[−1.182, −0.816]	**−1.982**	[−2.100, −1.863]	**−0.563**	[−0.749, −0.377]
0.200-00	**−1.032**	[−1.231, −0.834]	**−2.350**	[−2.532, −2.168]	**−0.667**	[−0.853, −0.481]
0.300-00	**−0.830**	[−1.055, −0.605]	**−3.429**	[−3.574, −3.284]	**−0.515**	[−0.710, −0.321]
0.400-00	**−0.396**	[−0.530, −0.262]	**−3.652**	[−3.791, −3.513]	**−0.479**	[−0.605, −0.354]
0.500-00	+0.024	[−0.098, +0.147]	**−3.452**	[−3.592, −3.311]	**−0.276**	[−0.429, −0.124]

Table 47: Comparison of the average cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the clustered instances of size 1000.

	$n^2/10000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	*+2.669*	[+0.613, +4.726]	+1.435	[−0.582, +3.451]	+0.748	[−1.386, +2.883]
0.075	**−2.838**	[−3.421, −2.255]	**−3.417**	[−4.030, −2.803]	**−3.144**	[−3.649, −2.638]
0.100	**−3.905**	[−4.362, −3.448]	**−1.642**	[−2.049, −1.235]	**−1.057**	[−1.729, −0.385]
0.125	**−0.983**	[−1.180, −0.786]	**−0.511**	[−0.716, −0.306]	−0.139	[−0.308, +0.029]
0.150	**−0.696**	[−0.882, −0.511]	**−0.605**	[−0.838, −0.373]	−0.117	[−0.289, +0.055]
0.175	**−1.034**	[−1.238, −0.830]	**−0.988**	[−1.176, −0.801]	**−0.417**	[−0.623, −0.212]
0.200	**−1.162**	[−1.357, −0.968]	**−1.081**	[−1.257, −0.904]	**−0.523**	[−0.688, −0.358]
0.3	**−2.247**	[−2.451, −2.043]	**−2.015**	[−2.164, −1.866]	**−1.175**	[−1.374, −0.975]
0.4	**−3.111**	[−3.323, −2.898]	**−2.883**	[−3.068, −2.699]	**−1.586**	[−1.773, −1.399]
0.5	**−3.319**	[−3.528, −3.110]	**−3.293**	[−3.477, −3.109]	**−1.725**	[−1.925, −1.525]
0.6	**−3.259**	[−3.443, −3.075]	**−3.572**	[−3.764, −3.380]	**−1.681**	[−1.864, −1.499]

	$n^2/1000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−1.893**	[−2.222, −1.563]	**−1.076**	[−1.427, −0.725]	**−0.905**	[−1.176, −0.635]
0.075	**−1.803**	[−2.008, −1.599]	**−1.371**	[−1.517, −1.224]	**−0.827**	[−1.010, −0.643]
0.100	**−0.746**	[−0.846, −0.646]	**−0.700**	[−0.793, −0.608]	**−0.378**	[−0.464, −0.293]
0.125	**−0.653**	[−0.716, −0.590]	**−0.824**	[−0.892, −0.757]	**−0.427**	[−0.502, −0.352]
0.150	**−0.790**	[−0.873, −0.708]	**−1.262**	[−1.363, −1.160]	**−0.566**	[−0.655, −0.477]
0.175	**−0.925**	[−1.032, −0.818]	**−1.738**	[−1.831, −1.644]	**−0.553**	[−0.637, −0.468]
0.200	**−0.956**	[−1.057, −0.856]	**−2.120**	[−2.236, −2.004]	**−0.451**	[−0.544, −0.358]
0.3	**−0.618**	[−0.730, −0.506]	**−3.189**	[−3.307, −3.070]	**−0.275**	[−0.379, −0.172]
0.4	**−0.230**	[−0.327, −0.134]	**−3.608**	[−3.769, −3.447]	**−0.292**	[−0.402, −0.181]
0.5	**−0.139**	[−0.246, −0.032]	**−3.900**	[−4.031, −3.768]	**−0.406**	[−0.501, −0.310]
0.6	+0.065	[−0.036, +0.167]	**−3.881**	[−4.056, −3.706]	**−0.174**	[−0.274, −0.074]

Table 48: Comparison of the average cost obtained by `ACS-EE(d)`, `MMAS-EE(d)`, `RAS-EE(d)`, and `BWAS-EE(d)`, on the uniform instances of size 1000.

	$n^2/10000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	*+1.789*	[+0.935, +2.643]	*+1.454*	[+0.502, +2.406]	+0.852	[−0.046, +1.750]
0.075	**−2.474**	[−2.797, −2.152]	**−2.486**	[−2.833, −2.140]	**−2.511**	[−2.801, −2.221]
0.100	**−2.200**	[−2.351, −2.049]	**−0.934**	[−1.101, −0.767]	**−0.219**	[−0.378, −0.059]
0.125	**−0.400**	[−0.544, −0.256]	**−0.460**	[−0.601, −0.318]	+0.119	[−0.049, +0.288]
0.150	**−0.781**	[−0.957, −0.606]	**−0.805**	[−0.961, −0.649]	−0.059	[−0.224, +0.106]
0.175	**−0.965**	[−1.156, −0.774]	**−1.089**	[−1.267, −0.911]	**−0.260**	[−0.478, −0.043]
0.200	**−1.279**	[−1.447, −1.111]	**−1.468**	[−1.636, −1.299]	**−0.516**	[−0.694, −0.339]
0.3	**−2.865**	[−3.021, −2.708]	**−2.828**	[−2.955, −2.701]	**−1.583**	[−1.766, −1.399]
0.4	**−3.441**	[−3.600, −3.282]	**−3.369**	[−3.513, −3.225]	**−1.848**	[−2.059, −1.638]
0.5	**−3.488**	[−3.652, −3.324]	**−3.588**	[−3.716, −3.461]	**−1.802**	[−1.974, −1.631]
0.6	**−2.954**	[−3.129, −2.779]	**−3.540**	[−3.698, −3.382]	**−1.269**	[−1.453, −1.084]

	$n^2/1000$ CPU seconds					
	`ACS-EE(d)` vs. `MMAS-EE(d)`		`ACS-EE(d)` vs. `RAS-EE(d)`		`ACS-EE(d)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−1.988**	[−2.230, −1.747]	**−1.661**	[−1.844, −1.477]	**−1.099**	[−1.287, −0.911]
0.075	**−1.374**	[−1.472, −1.275]	**−1.273**	[−1.399, −1.146]	**−0.596**	[−0.737, −0.455]
0.100	**−0.946**	[−1.044, −0.847]	**−1.104**	[−1.184, −1.023]	**−0.589**	[−0.693, −0.484]
0.125	**−0.966**	[−1.087, −0.845]	**−1.692**	[−1.795, −1.589]	**−0.639**	[−0.763, −0.516]
0.050	**−1.988**	[−2.230, −1.747]	**−1.661**	[−1.844, −1.477]	**−1.099**	[−1.287, −0.911]
0.075	**−1.374**	[−1.472, −1.275]	**−1.273**	[−1.399, −1.146]	**−0.596**	[−0.737, −0.455]
0.100	**−0.946**	[−1.044, −0.847]	**−1.104**	[−1.184, −1.023]	**−0.589**	[−0.693, −0.484]
0.125	**−0.966**	[−1.087, −0.845]	**−1.692**	[−1.795, −1.589]	**−0.639**	[−0.763, −0.516]
0.150	**−0.977**	[−1.152, −0.802]	**−2.230**	[−2.330, −2.130]	**−0.559**	[−0.670, −0.448]
0.175	**−0.947**	[−1.088, −0.805]	**−2.733**	[−2.841, −2.625]	**−0.507**	[−0.605, −0.408]
0.200	**−0.808**	[−0.916, −0.699]	**−3.024**	[−3.135, −2.914]	**−0.440**	[−0.555, −0.326]
0.3	**−0.310**	[−0.415, −0.204]	**−3.973**	[−4.258, −3.688]	**−0.298**	[−0.408, −0.187]
0.4	−0.014	[−0.130, +0.103]	**−4.171**	[−4.272, −4.069]	**−0.331**	[−0.456, −0.206]
0.5	*+0.181*	[+0.084, +0.277]	**−3.945**	[−4.059, −3.831]	**−0.163**	[−0.268, −0.059]
0.6	*+0.139*	[+0.042, +0.236]	**−3.880**	[−3.984, −3.775]	**−0.153**	[−0.242, −0.064]

3.2 Comparison between the variants with default and tuned parameter values

Table 49: Comparison of the average cost obtained by the four variants with tuned values to ones with default values on the instance att532.

	$n^2/10000$ CPU seconds							
	`ACS-EE(t)` vs. `ACS-EE(d)`		`MMAS-EE(t)` vs. `MMAS-EE(d)`		`RAS-EE(t)` vs. `RAS-EE(d)`		`BWAS-EE(t)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.433	[−0.046, +0.911]	+0.134	[−0.236, +0.504]	+0.067	[−0.370, +0.504]	−0.044	[−0.436, +0.349]
0.075-00	−0.029	[−0.494, +0.436]	−0.019	[−0.700, +0.661]	+0.064	[−0.212, +0.340]	+0.019	[−0.355, +0.393]
0.100-00	*+0.992*	[+0.498, +1.487]	*+1.147*	[+0.671, +1.624]	*+1.155*	[+0.718, +1.592]	*+0.673*	[+0.153, +1.193]
0.150-00	*+1.228*	[+0.508, +1.948]	+0.680	[−0.124, +1.484]	*+1.578*	[+1.038, +2.118]	*+1.671*	[+1.057, +2.286]
0.175-00	*+0.963*	[+0.253, +1.674]	+0.788	[−0.028, +1.604]	*+1.423*	[+0.940, +1.907]	*+1.308*	[+0.557, +2.059]
0.200-00	*+1.130*	[+0.625, +1.635]	*+0.951*	[+0.382, +1.519]	*+1.383*	[+0.723, +2.042]	*+0.986*	[+0.461, +1.511]
0.300-00	**−0.578**	[−0.954, −0.201]	**−0.497**	[−0.965, −0.029]	*+1.000*	[+0.351, +1.649]	*+1.190*	[+0.574, +1.806]
0.400-00	−0.156	[−0.484, +0.173]	**−0.558**	[−1.013, −0.104]	+0.205	[−0.274, +0.684]	*+1.434*	[+0.772, +2.095]
0.500-00	−0.341	[−0.791, +0.110]	**−0.870**	[−1.463, −0.278]	*+0.558*	[+0.146, +0.970]	*+1.259*	[+0.580, +1.938]

	$n^2/1000$ CPU seconds							
	`ACS-EE(t)` vs. `ACS-EE(d)`		`MMAS-EE(t)` vs. `MMAS-EE(d)`		`RAS-EE(t)` vs. `RAS-EE(d)`		`BWAS-EE(t)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	**−0.219**	[−0.299, −0.140]	**−0.120**	[−0.200, −0.039]	**−0.121**	[−0.212, −0.029]	**−0.227**	[−0.335, −0.118]
0.075-00	**−0.055**	[−0.094, −0.017]	−0.052	[−0.114, +0.011]	−0.025	[−0.081, +0.031]	**−0.049**	[−0.095, −0.004]
0.100-00	−0.031	[−0.068, +0.006]	**−0.173**	[−0.217, −0.129]	−0.072	[−0.206, +0.062]	**−0.066**	[−0.102, −0.030]
0.150-00	+0.095	[−0.100, +0.290]	**−0.246**	[−0.380, −0.112]	**−0.637**	[−0.754, −0.520]	−0.085	[−0.230, +0.059]
0.175-00	−0.077	[−0.287, +0.133]	**−0.268**	[−0.393, −0.142]	**−0.563**	[−0.704, −0.423]	−0.088	[−0.216, +0.039]
0.200-00	+0.083	[−0.266, +0.432]	**−0.152**	[−0.282, −0.022]	**−0.716**	[−0.975, −0.456]	+0.043	[−0.174, +0.260]
0.300-00	+0.155	[−0.136, +0.447]	−0.033	[−0.355, +0.289]	**−1.572**	[−1.770, −1.374]	−0.146	[−0.444, +0.153]
0.400-00	+0.156	[−0.076, +0.389]	+0.175	[−0.031, +0.380]	**−1.277**	[−1.462, −1.092]	−0.033	[−0.268, +0.202]
0.500-00	+0.021	[−0.150, +0.191]	+0.120	[−0.042, +0.282]	**−1.079**	[−1.262, −0.896]	+0.060	[−0.100, +0.220]

Table 50: Comparison of the average cost obtained by the four variants with tuned values to ones with default values on the instance att532.

	$n^2/10000$ CPU seconds							
	`ACS-EE(t)` vs. `ACS-EE(d)`		`MMAS-EE(t)` vs. `MMAS-EE(d)`		`RAS-EE(t)` vs. `RAS-EE(d)`		`BWAS-EE(t)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	*+0.732*	[+0.054, +1.410]	*+0.537*	[+0.113, +0.962]	*+1.551*	[+1.034, +2.068]	*+1.541*	[+0.784, +2.297]
0.075-00	*+0.709*	[+0.319, +1.100]	+0.185	[−0.039, +0.409]	*+0.576*	[+0.155, +0.996]	*+0.482*	[+0.220, +0.744]
0.100-00	*+0.766*	[+0.405, +1.126]	*+0.620*	[+0.295, +0.944]	*+1.103*	[+0.759, +1.447]	*+0.937*	[+0.654, +1.220]
0.150-00	*+1.106*	[+0.641, +1.571]	*+0.506*	[+0.073, +0.940]	*+1.125*	[+0.643, +1.607]	*+1.024*	[+0.667, +1.381]
0.175-00	*+1.344*	[+0.760, +1.929]	+0.228	[−0.161, +0.617]	*+1.186*	[+0.700, +1.671]	*+1.199*	[+0.769, +1.630]
0.200-00	*+0.663*	[+0.125, +1.202]	*+0.600*	[+0.217, +0.984]	*+1.455*	[+0.794, +2.117]	*+0.703*	[+0.243, +1.164]
0.300-00	+0.047	[−0.355, +0.449]	−0.155	[−0.540, +0.229]	*+0.894*	[+0.394, +1.394]	*+1.105*	[+0.567, +1.642]
0.400-00	+0.200	[−0.163, +0.564]	−0.124	[−0.662, +0.415]	*+0.636*	[+0.153, +1.119]	*+1.087*	[+0.543, +1.632]
0.500-00	−0.033	[−0.490, +0.424]	**−0.372**	[−0.689, −0.054]	+0.339	[−0.167, +0.846]	*+1.099*	[+0.474, +1.723]

	$n^2/1000$ CPU seconds							
	`ACS-EE(t)` vs. `ACS-EE(d)`		`MMAS-EE(t)` vs. `MMAS-EE(d)`		`RAS-EE(t)` vs. `RAS-EE(d)`		`BWAS-EE(t)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	**−0.093**	[−0.132, −0.053]	**−0.349**	[−0.444, −0.254]	**−0.253**	[−0.327, −0.180]	−0.035	[−0.073, +0.002]
0.075-00	**−0.047**	[−0.077, −0.017]	**−0.131**	[−0.181, −0.081]	**−0.149**	[−0.188, −0.110]	**−0.083**	[−0.116, −0.051]
0.100-00	**−0.070**	[−0.114, −0.026]	**−0.253**	[−0.298, −0.207]	**−0.315**	[−0.386, −0.244]	**−0.218**	[−0.261, −0.174]
0.150-00	+0.007	[−0.068, +0.082]	**−0.383**	[−0.492, −0.275]	**−0.936**	[−1.036, −0.837]	**−0.120**	[−0.200, −0.040]
0.175-00	+0.006	[−0.120, +0.132]	**−0.474**	[−0.596, −0.352]	**−1.174**	[−1.283, −1.066]	−0.066	[−0.187, +0.056]
0.200-00	+0.091	[−0.028, +0.210]	**−0.419**	[−0.536, −0.302]	**−1.289**	[−1.506, −1.071]	*+0.173*	[+0.002, +0.344]
0.300-00	−0.130	[−0.260, +0.001]	**−0.163**	[−0.312, −0.014]	**−2.120**	[−2.287, −1.953]	−0.044	[−0.198, +0.109]
0.400-00	−0.062	[−0.202, +0.079]	−0.063	[−0.209, +0.083]	**−1.968**	[−2.100, −1.836]	−0.014	[−0.188, +0.159]
0.500-00	−0.064	[−0.166, +0.039]	−0.000	[−0.086, +0.085]	**−1.892**	[−2.047, −1.737]	−0.050	[−0.190, +0.089]

Table 51: Comparison of the average cost obtained by the four variants with tuned values to ones with default values on the instance rat783.

	$n^2/10000$ CPU seconds							
	ACS-EE(t) vs. ACS-EE(d)		MMAS-EE(t) vs. MMAS-EE(d)		RAS-EE(t) vs. RAS-EE(d)		BWAS-EE(t) vs. BWAS-EE(d)	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.155	[−0.231, +0.541]	−0.089	[−0.452, +0.274]	+0.231	[−0.315, +0.776]	*+0.618*	[+0.162, +1.075]
0.075-00	−0.114	[−0.423, +0.194]	−0.130	[−0.349, +0.089]	+0.217	[−0.097, +0.530]	+0.090	[−0.288, +0.467]
0.100-00	+0.130	[−0.104, +0.363]	*+0.290*	[+0.121, +0.458]	*+0.801*	[+0.527, +1.075]	*+0.732*	[+0.465, +0.998]
0.150-00	*+0.599*	[+0.258, +0.940]	*+0.575*	[+0.385, +0.765]	*+0.530*	[+0.337, +0.723]	*+0.453*	[+0.188, +0.718]
0.175-00	*+0.770*	[+0.424, +1.117]	*+0.327*	[+0.073, +0.581]	*+0.573*	[+0.293, +0.853]	*+0.547*	[+0.280, +0.813]
0.200-00	*+0.837*	[+0.489, +1.185]	*+0.223*	[+0.051, +0.395]	*+0.828*	[+0.532, +1.124]	*+0.545*	[+0.262, +0.829]
0.300-00	+0.218	[−0.081, +0.518]	+0.041	[−0.164, +0.246]	*+0.404*	[+0.109, +0.698]	*+0.519*	[+0.195, +0.842]
0.400-00	−0.102	[−0.358, +0.154]	**−0.294**	[−0.554, −0.035]	+0.223	[−0.001, +0.447]	*+0.387*	[+0.069, +0.705]
0.500-00	−0.070	[−0.314, +0.174]	**−0.322**	[−0.608, −0.035]	*+0.293*	[+0.021, +0.565]	*+0.570*	[+0.299, +0.842]

	$n^2/1000$ CPU seconds							
	ACS-EE(t) vs. ACS-EE(d)		MMAS-EE(t) vs. MMAS-EE(d)		RAS-EE(t) vs. RAS-EE(d)		BWAS-EE(t) vs. BWAS-EE(d)	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	**−0.270**	[−0.482, −0.059]	**−0.654**	[−0.839, −0.468]	**−0.461**	[−0.607, −0.314]	−0.193	[−0.388, +0.003]
0.075-00	**−0.232**	[−0.403, −0.060]	**−0.773**	[−0.975, −0.572]	**−0.561**	[−0.689, −0.433]	**−0.212**	[−0.388, −0.035]
0.100-00	**−0.445**	[−0.604, −0.287]	**−0.761**	[−0.928, −0.594]	**−0.750**	[−0.884, −0.615]	**−0.448**	[−0.587, −0.308]
0.150-00	**−0.172**	[−0.308, −0.037]	**−1.050**	[−1.215, −0.885]	**−1.621**	[−1.806, −1.436]	**−0.722**	[−0.898, −0.546]
0.175-00	−0.064	[−0.196, +0.068]	**−1.024**	[−1.232, −0.816]	**−2.170**	[−2.339, −2.000]	**−0.577**	[−0.796, −0.359]
0.200-00	−0.112	[−0.278, +0.054]	**−1.090**	[−1.256, −0.925]	**−2.418**	[−2.543, −2.293]	**−0.597**	[−0.756, −0.437]
0.300-00	*+0.255*	[+0.104, +0.406]	**−0.768**	[−0.952, −0.584]	**−3.396**	[−3.519, −3.273]	**−0.216**	[−0.396, −0.037]
0.400-00	+0.059	[−0.131, +0.249]	**−0.248**	[−0.396, −0.101]	**−3.280**	[−3.446, −3.113]	−0.103	[−0.279, +0.073]
0.500-00	−0.017	[−0.175, +0.141]	−0.007	[−0.164, +0.149]	**−3.082**	[−3.234, −2.929]	−0.047	[−0.160, +0.067]

Table 52: Comparison of the average cost obtained by the four variants with tuned values to ones with default values on the clustered instances of size 1000.

	$n^2/10000$ CPU seconds							
	ACS-EE(t) vs. ACS-EE(d)		MMAS-EE(t) vs. MMAS-EE(d)		RAS-EE(t) vs. RAS-EE(d)		BWAS-EE(t) vs. BWAS-EE(d)	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−8.051**	[−9.708, −6.394]	**−5.030**	[−6.240, −3.819]	**−8.629**	[−10.088, −7.170]	**−7.874**	[−9.468, −6.281]
0.075	**−2.177**	[−2.727, −1.626]	**−5.838**	[−6.372, −5.305]	**−6.998**	[−7.582, −6.413]	**−5.706**	[−6.130, −5.282]
0.100	−0.208	[−0.486, +0.070]	**−4.813**	[−5.248, −4.378]	**−2.795**	[−3.143, −2.448]	**−1.741**	[−2.480, −1.001]
0.125	**−0.824**	[−0.966, −0.683]	**−1.832**	[−2.022, −1.641]	**−1.185**	[−1.352, −1.017]	**−0.799**	[−0.943, −0.655]
0.150	**−1.060**	[−1.278, −0.842]	**−1.751**	[−1.924, −1.579]	**−1.754**	[−1.950, −1.558]	**−1.134**	[−1.292, −0.977]
0.175	**−0.972**	[−1.170, −0.774]	**−2.062**	[−2.238, −1.885]	**−2.046**	[−2.170, −1.921]	**−1.263**	[−1.406, −1.119]
0.200	**−1.136**	[−1.287, −0.986]	**−2.268**	[−2.467, −2.069]	**−2.227**	[−2.423, −2.031]	**−1.479**	[−1.637, −1.321]
0.3	**−0.663**	[−0.824, −0.501]	**−2.779**	[−2.968, −2.591]	**−2.654**	[−2.826, −2.482]	**−1.577**	[−1.766, −1.388]
0.4	**−0.443**	[−0.612, −0.274]	**−3.282**	[−3.486, −3.077]	**−3.242**	[−3.435, −3.050]	**−1.601**	[−1.804, −1.399]
0.5	−0.053	[−0.178, +0.071]	**−3.192**	[−3.393, −2.991]	**−3.099**	[−3.297, −2.900]	**−1.157**	[−1.364, −0.949]
0.6	+0.074	[−0.063, +0.210]	**−3.146**	[−3.333, −2.958]	**−2.968**	[−3.164, −2.773]	**−0.791**	[−0.981, −0.601]

	$n^2/1000$ CPU seconds							
	ACS-EE(t) vs. ACS-EE(d)		MMAS-EE(t) vs. MMAS-EE(d)		RAS-EE(t) vs. RAS-EE(d)		BWAS-EE(t) vs. BWAS-EE(d)	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−1.138**	[−1.423, −0.852]	**−2.641**	[−2.944, −2.338]	**−2.819**	[−3.062, −2.577]	**−1.654**	[−1.902, −1.405]
0.075	**−0.297**	[−0.360, −0.234]	**−2.077**	[−2.283, −1.871]	**−1.670**	[−1.812, −1.528]	**−1.094**	[−1.299, −0.888]
0.100	**−0.216**	[−0.260, −0.173]	**−0.949**	[−1.055, −0.843]	**−0.918**	[−1.016, −0.820]	**−0.582**	[−0.671, −0.494]
0.125	**−0.133**	[−0.186, −0.080]	**−0.810**	[−0.873, −0.747]	**−0.983**	[−1.052, −0.914]	**−0.618**	[−0.701, −0.535]
0.150	**−0.155**	[−0.223, −0.088]	**−0.941**	[−1.040, −0.842]	**−1.436**	[−1.532, −1.340]	**−0.681**	[−0.778, −0.585]
0.175	−0.038	[−0.111, +0.035]	**−1.056**	[−1.159, −0.954]	**−1.834**	[−1.921, −1.746]	**−0.610**	[−0.692, −0.529]
0.200	**−0.087**	[−0.170, −0.004]	**−1.067**	[−1.153, −0.980]	**−2.134**	[−2.257, −2.012]	**−0.440**	[−0.536, −0.345]
0.3	*+0.186*	[+0.077, +0.295]	**−0.721**	[−0.819, −0.624]	**−3.188**	[−3.294, −3.083]	**−0.106**	[−0.210, −0.001]
0.4	+0.073	[−0.016, +0.162]	**−0.228**	[−0.319, −0.138]	**−3.393**	[−3.570, −3.217]	−0.066	[−0.168, +0.036]
0.5	+0.104	[−0.001, +0.210]	−0.089	[−0.184, +0.007]	**−3.531**	[−3.663, −3.399]	−0.104	[−0.225, +0.017]
0.6	−0.024	[−0.122, +0.075]	−0.023	[−0.122, +0.076]	**−3.475**	[−3.645, −3.304]	+0.033	[−0.045, +0.110]

Table 53: Comparison of the average cost obtained by the four variants with tuned values to ones with default values on the uniform instances of size 1000.

	$n^2/10000$ CPU seconds							
	`ACS-EE(t)` vs. `ACS-EE(d)`		`MMAS-EE(t)` vs. `MMAS-EE(d)`		`RAS-EE(t)` vs. `RAS-EE(d)`		`BWAS-EE(t)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−4.932**	[−5.876, −3.988]	**−3.053**	[−3.484, −2.623]	**−4.877**	[−5.409, −4.344]	**−4.446**	[−5.017, −3.874]
0.075	**−1.655**	[−1.863, −1.446]	**−4.507**	[−4.774, −4.241]	**−4.871**	[−5.191, −4.550]	**−4.380**	[−4.659, −4.102]
0.100	+0.098	[−0.052, +0.248]	**−2.889**	[−3.071, −2.708]	**−1.755**	[−1.960, −1.549]	**−0.775**	[−0.962, −0.588]
0.150	**−1.093**	[−1.269, −0.916]	**−1.957**	[−2.106, −1.809]	**−2.016**	[−2.149, −1.882]	**−1.093**	[−1.248, −0.938]
0.175	**−1.039**	[−1.228, −0.851]	**−1.996**	[−2.172, −1.820]	**−2.085**	[−2.263, −1.907]	**−1.135**	[−1.328, −0.942]
0.200	**−0.727**	[−0.920, −0.534]	**−2.144**	[−2.291, −1.997]	**−2.322**	[−2.485, −2.159]	**−0.890**	[−1.128, −0.653]
0.3	**−0.401**	[−0.584, −0.219]	**−3.280**	[−3.432, −3.128]	**−3.255**	[−3.397, −3.113]	**−1.571**	[−1.793, −1.349]
0.4	−0.134	[−0.316, +0.048]	**−3.489**	[−3.640, −3.337]	**−3.276**	[−3.417, −3.134]	**−1.346**	[−1.528, −1.165]
0.5	*+0.194*	[+0.034, +0.354]	**−3.341**	[−3.477, −3.205]	**−2.884**	[−3.038, −2.730]	**−0.870**	[−1.051, −0.688]

	$n^2/1000$ CPU seconds							
	`ACS-EE(t)` vs. `ACS-EE(d)`		`MMAS-EE(t)` vs. `MMAS-EE(d)`		`RAS-EE(t)` vs. `RAS-EE(d)`		`BWAS-EE(t)` vs. `BWAS-EE(d)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−1.011**	[−1.241, −0.782]	**−2.859**	[−3.121, −2.598]	**−2.917**	[−3.144, −2.691]	**−2.017**	[−2.276, −1.758]
0.075	**−0.356**	[−0.555, −0.157]	**−1.693**	[−1.926, −1.459]	**−1.633**	[−1.842, −1.424]	**−1.024**	[−1.215, −0.832]
0.100	**−0.247**	[−0.453, −0.042]	**−1.237**	[−1.428, −1.046]	**−1.319**	[−1.515, −1.122]	**−0.957**	[−1.161, −0.753]
0.150	−0.032	[−0.236, +0.171]	**−1.103**	[−1.289, −0.917]	**−2.267**	[−2.490, −2.044]	**−0.510**	[−0.750, −0.270]
0.175	+0.057	[−0.152, +0.267]	**−0.921**	[−1.152, −0.690]	**−2.615**	[−2.844, −2.386]	**−0.378**	[−0.595, −0.160]
0.200	+0.095	[−0.118, +0.309]	**−0.754**	[−1.008, −0.501]	**−2.814**	[−3.047, −2.582]	**−0.256**	[−0.494, −0.019]
0.3	+0.032	[−0.252, +0.316]	**−0.392**	[−0.644, −0.141]	**−3.865**	[−4.071, −3.660]	−0.035	[−0.288, +0.219]
0.4	−0.017	[−0.304, +0.271]	−0.039	[−0.312, +0.235]	**−3.760**	[−4.023, −3.497]	+0.007	[−0.266, +0.279]
0.5	−0.069	[−0.373, +0.235]	+0.051	[−0.236, +0.337]	**−3.433**	[−3.730, −3.136]	+0.105	[−0.186, +0.396]

3.3 Comparison between the variants with tuned parameter values

Table 54: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance ch150 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	1774	3
	`ACS-EE(t)`	1775	2
	`RAS-EE(t)`	1773	2
	`BWAS-EE(t)`	1774	2
$p = 0.075$	`MMAS-EE(t)`	2168	2
	`ACS-EE(t)`	2169	1
	`RAS-EE(t)`	2168	2
	`BWAS-EE(t)`	2169	3
$p = 0.100$	`MMAS-EE(t)`	2493	6
	`ACS-EE(t)`	2498	8
	`RAS-EE(t)`	2496	8
	`BWAS-EE(t)`	2490	5
$p = 0.150$	`MMAS-EE(t)`	3055	23
	`ACS-EE(t)`	3061	26
	`RAS-EE(t)`	3060	28
	`BWAS-EE(t)`	3066	25
$p = 0.175$	`MMAS-EE(t)`	3290	31
	`ACS-EE(t)`	3281	18
	`RAS-EE(t)`	3293	19
	`BWAS-EE(t)`	3298	29
$p = 0.200$	`MMAS-EE(t)`	3498	44
	`ACS-EE(t)`	3500	29
	`RAS-EE(t)`	3502	40
	`BWAS-EE(t)`	3494	34
$p = 0.300$	`MMAS-EE(t)`	4145	25
	`ACS-EE(t)`	4157	43
	`RAS-EE(t)`	4236	53
	`BWAS-EE(t)`	4204	61
$p = 0.400$	`MMAS-EE(t)`	4727	35
	`ACS-EE(t)`	4729	56
	`RAS-EE(t)`	4815	92
	`BWAS-EE(t)`	4801	89
$p = 0.500$	`MMAS-EE(t)`	5217	49
	`ACS-EE(t)`	5181	74
	`RAS-EE(t)`	5303	81
	`BWAS-EE(t)`	5347	102

Table 55: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance ch150 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	1773	1
	`ACS-EE(t)`	1774	2
	`RAS-EE(t)`	1773	1
	`BWAS-EE(t)`	1774	2
$p = 0.075$	`MMAS-EE(t)`	2166	1
	`ACS-EE(t)`	2169	2
	`RAS-EE(t)`	2166	1
	`BWAS-EE(t)`	2169	2
$p = 0.100$	`MMAS-EE(t)`	2486	2
	`ACS-EE(t)`	2496	8
	`RAS-EE(t)`	2486	2
	`BWAS-EE(t)`	2494	8
$p = 0.150$	`MMAS-EE(t)`	3016	1
	`ACS-EE(t)`	3016	6
	`RAS-EE(t)`	3015	2
	`BWAS-EE(t)`	3016	2
$p = 0.175$	`MMAS-EE(t)`	3241	3
	`ACS-EE(t)`	3243	5
	`RAS-EE(t)`	3243	3
	`BWAS-EE(t)`	3242	3
$p = 0.200$	`MMAS-EE(t)`	3421	1
	`ACS-EE(t)`	3422	6
	`RAS-EE(t)`	3426	8
	`BWAS-EE(t)`	3423	3
$p = 0.300$	`MMAS-EE(t)`	4058	6
	`ACS-EE(t)`	4062	9
	`RAS-EE(t)`	4063	9
	`BWAS-EE(t)`	4058	4
$p = 0.400$	`MMAS-EE(t)`	4578	10
	`ACS-EE(t)`	4581	13
	`RAS-EE(t)`	4589	12
	`BWAS-EE(t)`	4579	9
$p = 0.500$	`MMAS-EE(t)`	5009	8
	`ACS-EE(t)`	5009	9
	`RAS-EE(t)`	5019	15
	`BWAS-EE(t)`	5010	10

Table 56: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance d198 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	MMAS-EE(t)	5629	17
	ACS-EE(t)	5632	24
	RAS-EE(t)	5629	21
	BWAS-EE(t)	5634	20
$p = 0.075$	MMAS-EE(t)	6701	25
	ACS-EE(t)	6700	30
	RAS-EE(t)	6698	27
	BWAS-EE(t)	6700	26
$p = 0.100$	MMAS-EE(t)	7502	50
	ACS-EE(t)	7490	46
	RAS-EE(t)	7480	29
	BWAS-EE(t)	7470	28
$p = 0.150$	MMAS-EE(t)	8689	123
	ACS-EE(t)	8700	102
	RAS-EE(t)	8694	120
	BWAS-EE(t)	8700	105
$p = 0.175$	MMAS-EE(t)	9117	103
	ACS-EE(t)	9239	176
	RAS-EE(t)	9181	140
	BWAS-EE(t)	9135	128
$p = 0.200$	MMAS-EE(t)	9599	157
	ACS-EE(t)	9625	205
	RAS-EE(t)	9577	153
	BWAS-EE(t)	9607	192
$p = 0.300$	MMAS-EE(t)	10687	43
	ACS-EE(t)	10707	52
	RAS-EE(t)	10747	66
	BWAS-EE(t)	10917	228
$p = 0.400$	MMAS-EE(t)	11757	49
	ACS-EE(t)	11759	65
	RAS-EE(t)	11834	64
	BWAS-EE(t)	12024	287
$p = 0.500$	MMAS-EE(t)	12710	70
	ACS-EE(t)	12681	77
	RAS-EE(t)	12758	87
	BWAS-EE(t)	12975	257

Table 57: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance d198 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	5613	1
	`ACS-EE(t)`	5628	20
	`RAS-EE(t)`	5612	1
	`BWAS-EE(t)`	5633	21
$p = 0.075$	`MMAS-EE(t)`	6680	3
	`ACS-EE(t)`	6697	24
	`RAS-EE(t)`	6677	2
	`BWAS-EE(t)`	6693	13
$p = 0.100$	`MMAS-EE(t)`	7451	7
	`ACS-EE(t)`	7497	64
	`RAS-EE(t)`	7447	3
	`BWAS-EE(t)`	7472	36
$p = 0.150$	`MMAS-EE(t)`	8533	2
	`ACS-EE(t)`	8532	2
	`RAS-EE(t)`	8533	2
	`BWAS-EE(t)`	8534	2
$p = 0.175$	`MMAS-EE(t)`	8948	3
	`ACS-EE(t)`	8947	2
	`RAS-EE(t)`	8948	2
	`BWAS-EE(t)`	8949	3
$p = 0.200$	`MMAS-EE(t)`	9324	3
	`ACS-EE(t)`	9325	2
	`RAS-EE(t)`	9326	4
	`BWAS-EE(t)`	9323	3
$p = 0.300$	`MMAS-EE(t)`	10546	5
	`ACS-EE(t)`	10547	5
	`RAS-EE(t)`	10549	5
	`BWAS-EE(t)`	10548	5
$p = 0.400$	`MMAS-EE(t)`	11543	5
	`ACS-EE(t)`	11547	7
	`RAS-EE(t)`	11561	18
	`BWAS-EE(t)`	11550	12
$p = 0.500$	`MMAS-EE(t)`	12425	5
	`ACS-EE(t)`	12427	4
	`RAS-EE(t)`	12443	21
	`BWAS-EE(t)`	12428	4

Table 58: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance lin318 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	12756	121
	`ACS-EE(t)`	12734	135
	`RAS-EE(t)`	12704	100
	`BWAS-EE(t)`	12709	74
$p = 0.075$	`MMAS-EE(t)`	15218	120
	`ACS-EE(t)`	15216	86
	`RAS-EE(t)`	15215	78
	`BWAS-EE(t)`	15213	87
$p = 0.100$	`MMAS-EE(t)`	17529	207
	`ACS-EE(t)`	17585	161
	`RAS-EE(t)`	17528	172
	`BWAS-EE(t)`	17452	187
$p = 0.150$	`MMAS-EE(t)`	21319	331
	`ACS-EE(t)`	21653	266
	`RAS-EE(t)`	21458	266
	`BWAS-EE(t)`	21511	334
$p = 0.175$	`MMAS-EE(t)`	23004	345
	`ACS-EE(t)`	23236	290
	`RAS-EE(t)`	23034	259
	`BWAS-EE(t)`	23079	401
$p = 0.200$	`MMAS-EE(t)`	24560	224
	`ACS-EE(t)`	24759	274
	`RAS-EE(t)`	24606	369
	`BWAS-EE(t)`	24546	311
$p = 0.300$	`MMAS-EE(t)`	28998	272
	`ACS-EE(t)`	28867	232
	`RAS-EE(t)`	29361	417
	`BWAS-EE(t)`	29501	416
$p = 0.400$	`MMAS-EE(t)`	32740	222
	`ACS-EE(t)`	32376	270
	`RAS-EE(t)`	32972	333
	`BWAS-EE(t)`	33357	464
$p = 0.500$	`MMAS-EE(t)`	35689	324
	`ACS-EE(t)`	35156	277
	`RAS-EE(t)`	36080	284
	`BWAS-EE(t)`	36448	529

Table 59: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance lin318 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	12609	14
	`ACS-EE(t)`	12592	10
	`RAS-EE(t)`	12606	15
	`BWAS-EE(t)`	12596	10
$p = 0.075$	`MMAS-EE(t)`	15107	7
	`ACS-EE(t)`	15103	7
	`RAS-EE(t)`	15105	8
	`BWAS-EE(t)`	15103	7
$p = 0.100$	`MMAS-EE(t)`	17224	9
	`ACS-EE(t)`	17220	7
	`RAS-EE(t)`	17230	36
	`BWAS-EE(t)`	17223	8
$p = 0.150$	`MMAS-EE(t)`	20748	57
	`ACS-EE(t)`	20763	83
	`RAS-EE(t)`	20748	56
	`BWAS-EE(t)`	20747	49
$p = 0.175$	`MMAS-EE(t)`	22220	62
	`ACS-EE(t)`	22208	61
	`RAS-EE(t)`	22242	69
	`BWAS-EE(t)`	22223	60
$p = 0.200$	`MMAS-EE(t)`	23542	66
	`ACS-EE(t)`	23582	141
	`RAS-EE(t)`	23583	98
	`BWAS-EE(t)`	23554	83
$p = 0.300$	`MMAS-EE(t)`	27945	137
	`ACS-EE(t)`	28038	116
	`RAS-EE(t)`	27946	154
	`BWAS-EE(t)`	27911	149
$p = 0.400$	`MMAS-EE(t)`	31297	155
	`ACS-EE(t)`	31271	113
	`RAS-EE(t)`	31321	114
	`BWAS-EE(t)`	31281	115
$p = 0.500$	`MMAS-EE(t)`	33922	89
	`ACS-EE(t)`	33899	83
	`RAS-EE(t)`	34040	138
	`BWAS-EE(t)`	33920	108

Table 60: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance att532 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	26014	263
	`ACS-EE(t)`	26076	326
	`RAS-EE(t)`	26283	297
	`BWAS-EE(t)`	26200	457
$p = 0.075$	`MMAS-EE(t)`	30198	114
	`ACS-EE(t)`	30362	269
	`RAS-EE(t)`	30332	295
	`BWAS-EE(t)`	30284	177
$p = 0.100$	`MMAS-EE(t)`	34195	249
	`ACS-EE(t)`	34354	316
	`RAS-EE(t)`	34348	249
	`BWAS-EE(t)`	34284	223
$p = 0.150$	`MMAS-EE(t)`	40838	478
	`ACS-EE(t)`	41435	419
	`RAS-EE(t)`	41061	419
	`BWAS-EE(t)`	40972	343
$p = 0.175$	`MMAS-EE(t)`	43605	327
	`ACS-EE(t)`	44515	541
	`RAS-EE(t)`	44012	471
	`BWAS-EE(t)`	43962	407
$p = 0.200$	`MMAS-EE(t)`	46404	314
	`ACS-EE(t)`	47194	477
	`RAS-EE(t)`	46784	630
	`BWAS-EE(t)`	46536	451
$p = 0.300$	`MMAS-EE(t)`	55566	437
	`ACS-EE(t)`	56367	380
	`RAS-EE(t)`	56000	558
	`BWAS-EE(t)`	56323	788
$p = 0.400$	`MMAS-EE(t)`	63121	562
	`ACS-EE(t)`	63917	469
	`RAS-EE(t)`	63825	683
	`BWAS-EE(t)`	63897	641
$p = 0.500$	`MMAS-EE(t)`	69897	335
	`ACS-EE(t)`	70250	622
	`RAS-EE(t)`	70395	681
	`BWAS-EE(t)`	70762	955

Table 61: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance att532 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	25529	12
	`ACS-EE(t)`	25524	7
	`RAS-EE(t)`	25533	11
	`BWAS-EE(t)`	25534	13
$p = 0.075$	`MMAS-EE(t)`	29983	14
	`ACS-EE(t)`	29980	15
	`RAS-EE(t)`	29977	15
	`BWAS-EE(t)`	29981	16
$p = 0.100$	`MMAS-EE(t)`	33733	21
	`ACS-EE(t)`	33724	16
	`RAS-EE(t)`	33729	27
	`BWAS-EE(t)`	33721	15
$p = 0.150$	`MMAS-EE(t)`	39798	59
	`ACS-EE(t)`	39786	80
	`RAS-EE(t)`	39788	42
	`BWAS-EE(t)`	39823	70
$p = 0.175$	`MMAS-EE(t)`	42355	80
	`ACS-EE(t)`	42366	96
	`RAS-EE(t)`	42397	87
	`BWAS-EE(t)`	42440	127
$p = 0.200$	`MMAS-EE(t)`	44797	104
	`ACS-EE(t)`	44810	105
	`RAS-EE(t)`	44939	200
	`BWAS-EE(t)`	44933	176
$p = 0.300$	`MMAS-EE(t)`	53223	126
	`ACS-EE(t)`	53148	81
	`RAS-EE(t)`	53260	144
	`BWAS-EE(t)`	53279	184
$p = 0.400$	`MMAS-EE(t)`	60108	147
	`ACS-EE(t)`	60125	178
	`RAS-EE(t)`	60280	181
	`BWAS-EE(t)`	60222	181
$p = 0.500$	`MMAS-EE(t)`	66170	131
	`ACS-EE(t)`	66202	138
	`RAS-EE(t)`	66468	201
	`BWAS-EE(t)`	66282	126

Table 62: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance rat783 for $n^2/10000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	26014	263
	`ACS-EE(t)`	26076	326
	`RAS-EE(t)`	26283	297
	`BWAS-EE(t)`	26200	457
$p = 0.075$	`MMAS-EE(t)`	30198	114
	`ACS-EE(t)`	30362	269
	`RAS-EE(t)`	30332	295
	`BWAS-EE(t)`	30284	177
$p = 0.100$	`MMAS-EE(t)`	34195	249
	`ACS-EE(t)`	34354	316
	`RAS-EE(t)`	34348	249
	`BWAS-EE(t)`	34284	223
$p = 0.150$	`MMAS-EE(t)`	40838	478
	`ACS-EE(t)`	41435	419
	`RAS-EE(t)`	41061	419
	`BWAS-EE(t)`	40972	343
$p = 0.175$	`MMAS-EE(t)`	43605	327
	`ACS-EE(t)`	44515	541
	`RAS-EE(t)`	44012	471
	`BWAS-EE(t)`	43962	407
$p = 0.200$	`MMAS-EE(t)`	46404	314
	`ACS-EE(t)`	47194	477
	`RAS-EE(t)`	46784	630
	`BWAS-EE(t)`	46536	451
$p = 0.300$	`MMAS-EE(t)`	55566	437
	`ACS-EE(t)`	56367	380
	`RAS-EE(t)`	56000	558
	`BWAS-EE(t)`	56323	788
$p = 0.400$	`MMAS-EE(t)`	63121	562
	`ACS-EE(t)`	63917	469
	`RAS-EE(t)`	63825	683
	`BWAS-EE(t)`	63897	641
$p = 0.500$	`MMAS-EE(t)`	69897	335
	`ACS-EE(t)`	70250	622
	`RAS-EE(t)`	70395	681
	`BWAS-EE(t)`	70762	955

Table 63: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the TSPLIB instance rat783 for $n^2/1000$ CPU seconds. The statistics is computed over 30 runs.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	2327	3
	`ACS-EE(t)`	2325	4
	`RAS-EE(t)`	2329	5
	`BWAS-EE(t)`	2331	4
$p = 0.075$	`MMAS-EE(t)`	2825	5
	`ACS-EE(t)`	2825	6
	`RAS-EE(t)`	2826	5
	`BWAS-EE(t)`	2828	5
$p = 0.100$	`MMAS-EE(t)`	3250	5
	`ACS-EE(t)`	3250	4
	`RAS-EE(t)`	3253	8
	`BWAS-EE(t)`	3252	5
$p = 0.150$	`MMAS-EE(t)`	3968	7
	`ACS-EE(t)`	3964	9
	`RAS-EE(t)`	3965	9
	`BWAS-EE(t)`	3968	11
$p = 0.175$	`MMAS-EE(t)`	4279	10
	`ACS-EE(t)`	4277	8
	`RAS-EE(t)`	4274	9
	`BWAS-EE(t)`	4279	10
$p = 0.200$	`MMAS-EE(t)`	4560	9
	`ACS-EE(t)`	4560	10
	`RAS-EE(t)`	4562	10
	`BWAS-EE(t)`	4566	10
$p = 0.300$	`MMAS-EE(t)`	5517	15
	`ACS-EE(t)`	5527	14
	`RAS-EE(t)`	5518	11
	`BWAS-EE(t)`	5528	15
$p = 0.400$	`MMAS-EE(t)`	6254	15
	`ACS-EE(t)`	6249	15
	`RAS-EE(t)`	6270	13
	`BWAS-EE(t)`	6268	15
$p = 0.500$	`MMAS-EE(t)`	6868	16
	`ACS-EE(t)`	6871	16
	`RAS-EE(t)`	6898	24
	`BWAS-EE(t)`	6891	16

Table 64: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the clustered instances of size 1000 for $n^2/10000$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	4154669	452491
	`ACS-EE(t)`	4129846	413981
	`RAS-EE(t)`	4045869	408527
	`BWAS-EE(t)`	4107063	424843
$p = 0.075$	`MMAS-EE(t)`	4479973	418208
	`ACS-EE(t)`	4522099	433592
	`RAS-EE(t)`	4451324	413349
	`BWAS-EE(t)`	4500436	412211
$p = 0.100$	`MMAS-EE(t)`	4891716	423719
	`ACS-EE(t)`	4928093	422101
	`RAS-EE(t)`	4880445	418645
	`BWAS-EE(t)`	4904211	420934
$p = 0.125$	`MMAS-EE(t)`	5276942	432665
	`ACS-EE(t)`	5278680	432332
	`RAS-EE(t)`	5286530	433786
	`BWAS-EE(t)`	5287407	432039
$p = 0.150$	`MMAS-EE(t)`	5636531	441683
	`ACS-EE(t)`	5636643	439241
	`RAS-EE(t)`	5631215	437036
	`BWAS-EE(t)`	5639036	437937
$p = 0.175$	`MMAS-EE(t)`	5963852	453152
	`ACS-EE(t)`	5967840	448411
	`RAS-EE(t)`	5962076	451636
	`BWAS-EE(t)`	5975282	446311
$p = 0.200$	`MMAS-EE(t)`	6272814	460130
	`ACS-EE(t)`	6271695	460155
	`RAS-EE(t)`	6270279	455541
	`BWAS-EE(t)`	6282823	459022
$p = 0.300$	`MMAS-EE(t)`	7354882	498010
	`ACS-EE(t)`	7346139	489293
	`RAS-EE(t)`	7346943	495163
	`BWAS-EE(t)`	7365029	500832
$p = 0.400$	`MMAS-EE(t)`	8189628	514667
	`ACS-EE(t)`	8167796	520441
	`RAS-EE(t)`	8173807	513866
	`BWAS-EE(t)`	8202871	523815
$p = 0.500$	`MMAS-EE(t)`	8891573	559500
	`ACS-EE(t)`	8875149	553337
	`RAS-EE(t)`	8897728	549491
	`BWAS-EE(t)`	8931251	550048
$p = 0.600$	`MMAS-EE(t)`	9489767	572070
	`ACS-EE(t)`	9485632	574030
	`RAS-EE(t)`	9537968	582504
	`BWAS-EE(t)`	9564461	589887

Table 65: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the clustered instances of size 1000 for $n^2/1000$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	3967361	400230
	`ACS-EE(t)`	3952366	394118
	`RAS-EE(t)`	3927418	389503
	`BWAS-EE(t)`	3967641	400511
$p = 0.075$	`MMAS-EE(t)`	4427950	402282
	`ACS-EE(t)`	4427119	402671
	`RAS-EE(t)`	4426817	404066
	`BWAS-EE(t)`	4428350	402493
$p = 0.100$	`MMAS-EE(t)`	4863055	414240
	`ACS-EE(t)`	4862498	415046
	`RAS-EE(t)`	4862337	414546
	`BWAS-EE(t)`	4863064	414372
$p = 0.125$	`MMAS-EE(t)`	5251964	427420
	`ACS-EE(t)`	5253255	426528
	`RAS-EE(t)`	5251840	426464
	`BWAS-EE(t)`	5250149	424944
$p = 0.150$	`MMAS-EE(t)`	5603525	436485
	`ACS-EE(t)`	5603337	437978
	`RAS-EE(t)`	5602156	436425
	`BWAS-EE(t)`	5605538	438403
$p = 0.175$	`MMAS-EE(t)`	5925723	448196
	`ACS-EE(t)`	5931361	448555
	`RAS-EE(t)`	5927796	449434
	`BWAS-EE(t)`	5930137	447889
$p = 0.200$	`MMAS-EE(t)`	6224811	456482
	`ACS-EE(t)`	6226358	459295
	`RAS-EE(t)`	6230829	457910
	`BWAS-EE(t)`	6232441	459464
$p = 0.300$	`MMAS-EE(t)`	7245784	489095
	`ACS-EE(t)`	7266836	495840
	`RAS-EE(t)`	7253354	490057
	`BWAS-EE(t)`	7265673	495601
$p = 0.400$	`MMAS-EE(t)`	8072748	518515
	`ACS-EE(t)`	8078461	522209
	`RAS-EE(t)`	8090552	513623
	`BWAS-EE(t)`	8090840	518521
$p = 0.500$	`MMAS-EE(t)`	8770470	545064
	`ACS-EE(t)`	8775206	546671
	`RAS-EE(t)`	8799687	540616
	`BWAS-EE(t)`	8792614	546606
$p = 0.600$	`MMAS-EE(t)`	9373393	567591
	`ACS-EE(t)`	9379491	565826
	`RAS-EE(t)`	9421367	564999
	`BWAS-EE(t)`	9401072	573021

Table 66: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the clustered instances of size 1000 for $n^2/100$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	3918780	420641
	`ACS-EE(t)`	3912329	417905
	`RAS-EE(t)`	3906280	416594
	`BWAS-EE(t)`	3908926	416976
$p = 0.075$	`MMAS-EE(t)`	4411445	430096
	`ACS-EE(t)`	4410839	430043
	`RAS-EE(t)`	4410121	429662
	`BWAS-EE(t)`	4410014	430021
$p = 0.100$	`MMAS-EE(t)`	4846524	442816
	`ACS-EE(t)`	4845178	442968
	`RAS-EE(t)`	4847303	443874
	`BWAS-EE(t)`	4846073	441653
$p = 0.125$	`MMAS-EE(t)`	5235381	454169
	`ACS-EE(t)`	5234568	454113
	`RAS-EE(t)`	5233427	454719
	`BWAS-EE(t)`	5233859	453148
$p = 0.150$	`MMAS-EE(t)`	5586270	463489
	`ACS-EE(t)`	5584289	464161
	`RAS-EE(t)`	5583163	463645
	`BWAS-EE(t)`	5587070	465430
$p = 0.175$	`MMAS-EE(t)`	5910637	478180
	`ACS-EE(t)`	5906468	474885
	`RAS-EE(t)`	5906524	471893
	`BWAS-EE(t)`	5908820	473720
$p = 0.200$	`MMAS-EE(t)`	6206547	483462
	`ACS-EE(t)`	6206760	485485
	`RAS-EE(t)`	6210050	483186
	`BWAS-EE(t)`	6207542	481151
$p = 0.300$	`MMAS-EE(t)`	7219962	510793
	`ACS-EE(t)`	7220007	511682
	`RAS-EE(t)`	7230740	513677
	`BWAS-EE(t)`	7226796	514440
$p = 0.400$	`MMAS-EE(t)`	8037882	536100
	`ACS-EE(t)`	8045408	532753
	`RAS-EE(t)`	8072346	529512
	`BWAS-EE(t)`	8048145	530967
$p = 0.500$	`MMAS-EE(t)`	8736567	553157
	`ACS-EE(t)`	8738006	554994
	`RAS-EE(t)`	8780395	554992
	`BWAS-EE(t)`	8743113	553923
$p = 0.600$	`MMAS-EE(t)`	9337342	577163
	`ACS-EE(t)`	9346084	584074
	`RAS-EE(t)`	9393237	568904
	`BWAS-EE(t)`	9349998	572360

Table 67: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the uniform instances of size 1000 for $n^2/10000$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	6699753	84958
	`ACS-EE(t)`	6687455	84207
	`RAS-EE(t)`	6595473	73064
	`BWAS-EE(t)`	6664887	71199
$p = 0.075$	`MMAS-EE(t)`	7864904	60155
	`ACS-EE(t)`	7899449	68006
	`RAS-EE(t)`	7835949	65598
	`BWAS-EE(t)`	7878336	63622
$p = 0.100$	`MMAS-EE(t)`	8974268	62896
	`ACS-EE(t)`	9046815	69103
	`RAS-EE(t)`	8963113	79654
	`BWAS-EE(t)`	8987604	75374
$p = 0.125$	`MMAS-EE(t)`	9936859	65115
	`ACS-EE(t)`	9934485	78237
	`RAS-EE(t)`	9937183	72885
	`BWAS-EE(t)`	9932888	75196
$p = 0.150$	`MMAS-EE(t)`	10806490	89448
	`ACS-EE(t)`	10816594	83262
	`RAS-EE(t)`	10802622	84626
	`BWAS-EE(t)`	10822897	81421
$p = 0.175$	`MMAS-EE(t)`	11618102	84161
	`ACS-EE(t)`	11618340	91368
	`RAS-EE(t)`	11622136	106621
	`BWAS-EE(t)`	11637411	100128
$p = 0.200$	`MMAS-EE(t)`	12353966	88093
	`ACS-EE(t)`	12372471	106471
	`RAS-EE(t)`	12355056	99701
	`BWAS-EE(t)`	12416242	106530
$p = 0.3$	`MMAS-EE(t)`	14790544	112933
	`ACS-EE(t)`	14794485	110679
	`RAS-EE(t)`	14788913	100727
	`BWAS-EE(t)`	14855156	106633
$p = 0.4$	`MMAS-EE(t)`	16685685	131257
	`ACS-EE(t)`	16671647	116385
	`RAS-EE(t)`	16710081	118492
	`BWAS-EE(t)`	16779312	129706
$p = 0.5$	`MMAS-EE(t)`	18251039	166685
	`ACS-EE(t)`	18258627	148503
	`RAS-EE(t)`	18356361	145789
	`BWAS-EE(t)`	18396365	143692
$p = 0.6$	`MMAS-EE(t)`	19611667	171425
	`ACS-EE(t)`	19601294	184314
	`RAS-EE(t)`	19760047	185800
	`BWAS-EE(t)`	19766183	184703

Table 68: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the uniform instances of size 1000 for $n^2/1000$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	`MMAS-EE(t)`	6491848	52590
	`ACS-EE(t)`	6483765	50661
	`RAS-EE(t)`	6465669	50237
	`BWAS-EE(t)`	6488376	48832
$p = 0.075$	`MMAS-EE(t)`	7792539	60274
	`ACS-EE(t)`	7789182	57883
	`RAS-EE(t)`	7789815	57731
	`BWAS-EE(t)`	7784623	58432
$p = 0.100$	`MMAS-EE(t)`	8904520	63204
	`ACS-EE(t)`	8908003	70583
	`RAS-EE(t)`	8910624	64871
	`BWAS-EE(t)`	8897612	65940
$p = 0.125$	`MMAS-EE(t)`	9868890	69216
	`ACS-EE(t)`	9867486	70377
	`RAS-EE(t)`	9858016	67898
	`BWAS-EE(t)`	9864361	72927
$p = 0.150$	`MMAS-EE(t)`	10716389	77806
	`ACS-EE(t)`	10726535	79568
	`RAS-EE(t)`	10726217	88712
	`BWAS-EE(t)`	10735012	80141
$p = 0.175$	`MMAS-EE(t)`	11500235	85922
	`ACS-EE(t)`	11503696	81004
	`RAS-EE(t)`	11510115	89735
	`BWAS-EE(t)`	11511693	90725
$p = 0.200$	`MMAS-EE(t)`	12209745	88322
	`ACS-EE(t)`	12215052	92200
	`RAS-EE(t)`	12230311	80961
	`BWAS-EE(t)`	12227248	94517
$p = 0.3$	`MMAS-EE(t)`	14572689	107869
	`ACS-EE(t)`	14588415	114591
	`RAS-EE(t)`	14600076	118614
	`BWAS-EE(t)`	14622454	113585
$p = 0.4$	`MMAS-EE(t)`	16453745	122917
	`ACS-EE(t)`	16455445	122368
	`RAS-EE(t)`	16529895	131153
	`BWAS-EE(t)`	16513191	118816
$p = 0.5$	`MMAS-EE(t)`	18021170	135757
	`ACS-EE(t)`	18030982	123883
	`RAS-EE(t)`	18139365	151093
	`BWAS-EE(t)`	18090709	136451
$p = 0.6$	`MMAS-EE(t)`	19372737	150802
	`ACS-EE(t)`	19382278	157420
	`RAS-EE(t)`	19521735	179879
	`BWAS-EE(t)`	19420778	180044

Table 69: The average and the standard deviation of the cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the uniform instances of size 1000 for $n^2/100$ CPU seconds. The statistics is computed over 50 instances.

	Algorithm	Solution Cost	
		mean	s.d.
$p = 0.050$	MMAS-EE(t)	6449051	57254
	ACS-EE(t)	6435462	51444
	RAS-EE(t)	6429758	51438
	BWAS-EE(t)	6432187	58952
$p = 0.075$	MMAS-EE(t)	7764054	64957
	ACS-EE(t)	7765313	70626
	RAS-EE(t)	7760715	68723
	BWAS-EE(t)	7760272	72717
$p = 0.100$	MMAS-EE(t)	8884442	73941
	ACS-EE(t)	8888426	83946
	RAS-EE(t)	8895474	90434
	BWAS-EE(t)	8887032	84656
$p = 0.125$	MMAS-EE(t)	9844078	85210
	ACS-EE(t)	9848324	85715
	RAS-EE(t)	9842314	83076
	BWAS-EE(t)	9856090	84739
$p = 0.150$	MMAS-EE(t)	10708924	92816
	ACS-EE(t)	10705984	100268
	RAS-EE(t)	10716376	96932
	BWAS-EE(t)	10705588	100430
$p = 0.175$	MMAS-EE(t)	11475513	105417
	ACS-EE(t)	11497938	103203
	RAS-EE(t)	11502897	100829
	BWAS-EE(t)	11482550	97933
$p = 0.200$	MMAS-EE(t)	12189776	99046
	ACS-EE(t)	12205512	109547
	RAS-EE(t)	12209988	98861
	BWAS-EE(t)	12203464	111042
$p = 0.3$	MMAS-EE(t)	14537333	106584
	ACS-EE(t)	14549235	120152
	RAS-EE(t)	14602640	135624
	BWAS-EE(t)	14572074	116758
$p = 0.4$	MMAS-EE(t)	16403189	144029
	ACS-EE(t)	16441269	148359
	RAS-EE(t)	16506027	121543
	BWAS-EE(t)	16436718	146974
$p = 0.5$	MMAS-EE(t)	17967330	161775
	ACS-EE(t)	17981216	155289
	RAS-EE(t)	18127166	160740
	BWAS-EE(t)	17990635	161565
$p = 0.6$	MMAS-EE(t)	19291402	186547
	ACS-EE(t)	19343449	184152
	RAS-EE(t)	19485059	193581
	BWAS-EE(t)	19326763	190472

Table 70: Comparison of the average cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)` over 30 independent runs on instance lin318.

	$n^2/10000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.116	[−0.361, +0.593]	+0.239	[−0.282, +0.759]	+0.299	[−0.247, +0.846]
0.075-00	−0.006	[−0.531, +0.520]	+0.038	[−0.257, +0.333]	+0.088	[−0.196, +0.372]
0.100-00	+0.250	[−0.396, +0.896]	+0.364	[−0.174, +0.902]	*+0.664*	[+0.089, +1.240]
0.150-00	*+1.572*	[+0.729, +2.415]	*+0.940*	[+0.301, +1.579]	*+0.734*	[+0.009, +1.459]
0.175-00	*+0.993*	[+0.222, +1.763]	*+0.825*	[+0.168, +1.482]	+0.556	[−0.249, +1.362]
0.200-00	*+0.886*	[+0.333, +1.439]	+0.524	[−0.079, +1.127]	*+0.756*	[+0.139, +1.373]
0.300-00	**−0.488**	[−0.960, −0.016]	**−1.714**	[−2.335, −1.093]	**−2.068**	[−2.654, −1.481]
0.400-00	**−1.005**	[−1.422, −0.588]	**−1.753**	[−2.237, −1.269]	**−2.890**	[−3.517, −2.262]
0.500-00	**−1.422**	[−1.978, −0.866]	**−2.600**	[−3.088, −2.112]	**−3.344**	[−3.941, −2.747]

	$n^2/1000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	**−0.157**	[−0.230, −0.084]	**−0.116**	[−0.191, −0.041]	−0.022	[−0.076, +0.032]
0.075-00	−0.030	[−0.066, +0.006]	−0.018	[−0.068, +0.033]	+0.002	[−0.038, +0.042]
0.100-00	**−0.030**	[−0.054, −0.005]	−0.097	[−0.228, +0.033]	−0.016	[−0.052, +0.020]
0.150-00	+0.133	[−0.094, +0.360]	+0.153	[−0.084, +0.390]	+0.110	[−0.085, +0.304]
0.175-00	−0.019	[−0.218, +0.179]	−0.131	[−0.342, +0.080]	−0.028	[−0.195, +0.139]
0.200-00	+0.182	[−0.075, +0.439]	−0.028	[−0.336, +0.279]	+0.128	[−0.124, +0.381]
0.300-00	*+0.305*	[+0.008, +0.601]	+0.335	[−0.010, +0.679]	*+0.392*	[+0.113, +0.672]
0.400-00	+0.032	[−0.232, +0.296]	−0.149	[−0.355, +0.057]	+0.012	[−0.241, +0.266]
0.500-00	−0.062	[−0.209, +0.086]	**−0.442**	[−0.623, −0.261]	−0.075	[−0.233, +0.084]

Table 71: Comparison of the average cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)` over 30 independent runs on instance att532.

	$n^2/10000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.286	[−0.323, +0.895]	**−0.842**	[−1.587, −0.097]	−0.535	[−1.390, +0.320]
0.075-00	*+0.558*	[+0.079, +1.036]	+0.168	[−0.390, +0.726]	+0.290	[−0.168, +0.748]
0.100-00	*+0.564*	[+0.094, +1.034]	+0.082	[−0.383, +0.546]	+0.253	[−0.182, +0.688]
0.150-00	*+1.544*	[+1.005, +2.082]	*+0.949*	[+0.392, +1.505]	*+1.205*	[+0.632, +1.778]
0.175-00	*+2.188*	[+1.658, +2.717]	*+1.182*	[+0.499, +1.864]	*+1.349*	[+0.728, +1.971]
0.200-00	*+1.629*	[+1.241, +2.018]	*+0.876*	[+0.276, +1.477]	*+1.392*	[+0.788, +1.996]
0.300-00	*+1.479*	[+1.135, +1.823]	*+0.655*	[+0.249, +1.060]	+0.126	[−0.457, +0.709]
0.400-00	*+1.238*	[+0.809, +1.668]	+0.097	[−0.329, +0.523]	+0.033	[−0.407, +0.473]
0.500-00	*+0.445*	[+0.000, +0.890]	−0.237	[−0.700, +0.225]	**−0.760**	[−1.362, −0.158]

	$n^2/1000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	−0.021	[−0.048, +0.005]	**−0.036**	[−0.062, −0.010]	**−0.051**	[−0.082, −0.020]
0.075-00	+0.000	[−0.041, +0.042]	+0.011	[−0.011, +0.033]	+0.002	[−0.036, +0.039]
0.100-00	−0.026	[−0.061, +0.008]	−0.006	[−0.042, +0.031]	+0.019	[−0.014, +0.051]
0.150-00	−0.031	[−0.135, +0.073]	+0.004	[−0.094, +0.101]	−0.070	[−0.192, +0.052]
0.175-00	+0.023	[−0.102, +0.148]	−0.066	[−0.161, +0.030]	**−0.166**	[−0.300, −0.032]
0.200-00	+0.018	[−0.122, +0.158]	**−0.270**	[−0.479, −0.061]	**−0.262**	[−0.437, −0.087]
0.300-00	−0.118	[−0.253, +0.016]	**−0.219**	[−0.340, −0.099]	**−0.228**	[−0.365, −0.092]
0.400-00	+0.029	[−0.085, +0.142]	**−0.255**	[−0.417, −0.092]	**−0.176**	[−0.323, −0.029]
0.500-00	+0.064	[−0.051, +0.179]	**−0.404**	[−0.554, −0.253]	−0.112	[−0.238, +0.013]

Table 72: Comparison of the average cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)` over 30 independent runs on instance rat783.

	$n^2/10000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	+0.206	[−0.181, +0.593]	−0.068	[−0.517, +0.381]	**−0.565**	[−1.093, −0.038]
0.075-00	−0.099	[−0.295, +0.096]	**−0.486**	[−0.731, −0.241]	**−0.343**	[−0.618, −0.069]
0.100-00	*+0.292*	[+0.025, +0.558]	−0.241	[−0.567, +0.084]	−0.088	[−0.431, +0.255]
0.150-00	*+1.086*	[+0.704, +1.468]	*+0.878*	[+0.539, +1.217]	*+0.879*	[+0.524, +1.235]
0.175-00	*+1.575*	[+1.210, +1.939]	*+1.319*	[+0.881, +1.758]	*+1.239*	[+0.877, +1.601]
0.200-00	*+1.647*	[+1.332, +1.963]	*+1.087*	[+0.688, +1.485]	*+1.325*	[+1.006, +1.645]
0.300-00	*+0.964*	[+0.733, +1.196]	*+0.623*	[+0.370, +0.875]	*+0.315*	[+0.006, +0.623]
0.400-00	+0.063	[−0.268, +0.395]	**−0.395**	[−0.681, −0.110]	**−0.691**	[−1.002, −0.381]
0.500-00	**−0.863**	[−1.195, −0.531]	**−1.413**	[−1.643, −1.184]	**−1.665**	[−1.926, −1.403]

	$n^2/1000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050-00	−0.056	[−0.243, +0.130]	−0.129	[−0.363, +0.105]	−0.205	[−0.440, +0.031]
0.075-00	+0.051	[−0.101, +0.202]	+0.033	[−0.144, +0.210]	−0.071	[−0.221, +0.079]
0.100-00	+0.000	[−0.157, +0.157]	−0.123	[−0.358, +0.112]	−0.109	[−0.272, +0.054]
0.150-00	−0.090	[−0.279, +0.099]	−0.021	[−0.180, +0.139]	−0.079	[−0.246, +0.087]
0.175-00	−0.029	[−0.170, +0.112]	+0.089	[−0.044, +0.221]	−0.050	[−0.209, +0.108]
0.200-00	−0.048	[−0.212, +0.117]	−0.066	[−0.224, +0.093]	−0.175	[−0.363, +0.013]
0.300-00	+0.166	[−0.028, +0.359]	*+0.176*	[+0.052, +0.300]	−0.033	[−0.181, +0.115]
0.400-00	−0.097	[−0.255, +0.062]	**−0.311**	[−0.469, −0.154]	**−0.306**	[−0.451, −0.161]
0.500-00	+0.030	[−0.130, +0.189]	**−0.404**	[−0.594, −0.214]	**−0.247**	[−0.400, −0.094]

Table 73: Comparison of the average cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)`, on the clustered instances of size 1000.

	$n^2/10000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	−0.597	[−1.498, +0.303]	*+2.076*	[+1.392, +2.759]	+0.555	[−0.155, +1.264]
0.075	*+0.940*	[+0.425, +1.455]	*+1.590*	[+1.184, +1.996]	+0.481	[−0.023, +0.985]
0.100	*+0.744*	[+0.515, +0.972]	*+0.976*	[+0.809, +1.143]	*+0.487*	[+0.297, +0.676]
0.150	+0.002	[−0.156, +0.160]	+0.096	[−0.050, +0.243]	−0.042	[−0.213, +0.128]
0.175	+0.067	[−0.062, +0.196]	+0.097	[−0.025, +0.218]	−0.125	[−0.261, +0.012]
0.200	−0.018	[−0.181, +0.145]	+0.023	[−0.130, +0.175]	**−0.177**	[−0.307, −0.048]
0.300	−0.119	[−0.262, +0.024]	−0.011	[−0.166, +0.144]	**−0.256**	[−0.415, −0.098]
0.400	**−0.267**	[−0.414, −0.119]	−0.074	[−0.229, +0.082]	**−0.428**	[−0.573, −0.282]
0.500	**−0.185**	[−0.332, −0.037]	**−0.254**	[−0.406, −0.102]	**−0.628**	[−0.757, −0.500]

	$n^2/1000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−0.378**	[−0.592, −0.164]	*+0.635*	[+0.445, +0.826]	**−0.385**	[−0.601, −0.169]
0.075	−0.019	[−0.042, +0.005]	+0.007	[−0.051, +0.064]	**−0.028**	[−0.055, −0.000]
0.100	−0.011	[−0.045, +0.022]	+0.003	[−0.038, +0.045]	−0.012	[−0.039, +0.016]
0.150	−0.003	[−0.060, +0.053]	+0.021	[−0.037, +0.080]	−0.039	[−0.087, +0.008]
0.175	*+0.095*	[+0.020, +0.170]	+0.060	[−0.019, +0.140]	+0.021	[−0.051, +0.092]
0.200	+0.025	[−0.046, +0.096]	−0.072	[−0.161, +0.018]	**−0.098**	[−0.174, −0.021]
0.300	*+0.291*	[+0.212, +0.369]	*+0.186*	[+0.106, +0.266]	+0.016	[−0.078, +0.110]
0.400	+0.071	[−0.017, +0.159]	**−0.149**	[−0.248, −0.051]	**−0.153**	[−0.234, −0.072]
0.500	+0.054	[−0.047, +0.155]	**−0.278**	[−0.378, −0.178]	**−0.198**	[−0.294, −0.102]

Table 74: Comparison of the average cost obtained by `ACS-EE`, `MMAS-EE`, `RAS-EE`, and `BWAS-EE`, on the clustered instances of size 1000.

	$n^2/100$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−0.165**	[−0.258, −0.071]	*+0.155*	[+0.102, +0.208]	*+0.087*	[+0.046, +0.128]
0.075	**−0.014**	[−0.027, −0.000]	+0.016	[−0.002, +0.034]	*+0.019*	[+0.007, +0.031]
0.100	**−0.028**	[−0.049, −0.007]	−0.044	[−0.113, +0.025]	−0.018	[−0.044, +0.007]
0.150	−0.035	[−0.078, +0.007]	+0.020	[−0.010, +0.050]	−0.050	[−0.114, +0.015]
0.175	−0.071	[−0.147, +0.006]	−0.001	[−0.072, +0.070]	−0.040	[−0.120, +0.040]
0.200	+0.003	[−0.084, +0.091]	−0.053	[−0.140, +0.034]	−0.013	[−0.121, +0.096]
0.300	+0.001	[−0.068, +0.070]	**−0.148**	[−0.239, −0.058]	**−0.094**	[−0.170, −0.018]
0.400	*+0.094*	[+0.012, +0.175]	**−0.334**	[−0.471, −0.197]	−0.034	[−0.127, +0.059]
0.500	+0.016	[−0.086, +0.119]	**−0.483**	[−0.618, −0.348]	−0.058	[−0.135, +0.018]

Table 75: Comparison of the average cost obtained by `ACS-EE(t)`, `MMAS-EE(t)`, `RAS-EE(t)`, and `BWAS-EE(t)` over 50 uniform instances of size 1000.

	$n^2/10000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	−0.184	[−0.676, +0.308]	*+1.395*	[+0.990, +1.799]	+0.339	[−0.028, +0.705]
0.075	*+0.439*	[+0.279, +0.599]	*+0.810*	[+0.663, +0.958]	*+0.268*	[+0.118, +0.417]
0.100	*+0.808*	[+0.661, +0.955]	*+0.934*	[+0.738, +1.130]	*+0.659*	[+0.502, +0.815]
0.150	+0.094	[−0.063, +0.250]	+0.129	[−0.041, +0.300]	−0.058	[−0.244, +0.128]
0.175	+0.002	[−0.185, +0.189]	−0.033	[−0.196, +0.131]	−0.164	[−0.353, +0.025]
0.200	+0.150	[−0.017, +0.317]	+0.141	[−0.063, +0.345]	**−0.353**	[−0.596, −0.109]
0.300	+0.027	[−0.148, +0.201]	+0.038	[−0.114, +0.190]	**−0.414**	[−0.639, −0.189]
0.400	−0.084	[−0.255, +0.087]	**−0.230**	[−0.406, −0.054]	**−0.642**	[−0.814, −0.469]
0.500	+0.042	[−0.129, +0.212]	**−0.532**	[−0.697, −0.368]	**−0.749**	[−0.917, −0.581]

	$n^2/1000$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	−0.125	[−0.287, +0.038]	*+0.280*	[+0.112, +0.448]	−0.071	[−0.283, +0.141]
0.075	−0.043	[−0.133, +0.047]	−0.008	[−0.099, +0.083]	*+0.059*	[+0.001, +0.116]
0.100	+0.039	[−0.032, +0.110]	−0.029	[−0.148, +0.090]	*+0.117*	[+0.026, +0.207]
0.150	+0.095	[−0.013, +0.203]	+0.003	[−0.116, +0.122]	−0.079	[−0.197, +0.039]
0.175	+0.030	[−0.054, +0.114]	−0.056	[−0.188, +0.076]	−0.069	[−0.192, +0.053]
0.200	+0.043	[−0.089, +0.176]	**−0.125**	[−0.242, −0.007]	−0.100	[−0.220, +0.020]
0.300	+0.108	[−0.015, +0.230]	−0.080	[−0.218, +0.058]	**−0.233**	[−0.340, −0.125]
0.400	+0.010	[−0.108, +0.129]	**−0.450**	[−0.576, −0.324]	**−0.350**	[−0.463, −0.237]
0.500	+0.054	[−0.057, +0.166]	**−0.598**	[−0.738, −0.457]	**−0.330**	[−0.463, −0.197]

	$n^2/100$ CPU seconds					
	`ACS-EE(t)` vs. `MMAS-EE(t)`		`ACS-EE(t)` vs. `RAS-EE(t)`		`ACS-EE(t)` vs. `BWAS-EE(t)`	
p	Difference	95% CI	Difference	95% CI	Difference	95% CI
0.050	**−0.211**	[−0.342, −0.080]	+0.089	[−0.007, +0.184]	+0.051	[−0.078, +0.180]
0.075	+0.016	[−0.075, +0.107]	+0.059	[−0.054, +0.172]	+0.065	[−0.027, +0.157]
0.100	+0.045	[−0.101, +0.190]	−0.079	[−0.275, +0.116]	+0.016	[−0.163, +0.194]
0.150	−0.027	[−0.244, +0.189]	−0.097	[−0.233, +0.039]	+0.004	[−0.149, +0.156]
0.175	*+0.195*	[+0.064, +0.327]	−0.043	[−0.224, +0.138]	+0.134	[−0.012, +0.280]
0.200	+0.129	[−0.066, +0.324]	−0.037	[−0.246, +0.173]	+0.017	[−0.173, +0.207]
0.300	+0.082	[−0.084, +0.248]	**−0.366**	[−0.572, −0.159]	**−0.157**	[−0.305, −0.008]
0.400	*+0.232*	[+0.096, +0.368]	**−0.392**	[−0.588, −0.197]	+0.028	[−0.120, +0.176]
0.500	+0.077	[−0.089, +0.244]	**−0.805**	[−1.010, −0.601]	−0.052	[−0.197, +0.092]