Supplementary B: Experiment Details

This supplementary material provides the experiment details for the manuscript "Optimizing Capacitated Multi-Trip Vehicle Routing with Time Windows: Joint Utilization of Route-Based and Trip-Based Formulations".

1. Detailed Computational Results on Benchmark Instances of CMTVRPTW

Table 1 shows detailed computational information about each step of our algorithm for solving the 54 CMTVRPTW instances. Each row corresponds to an individual instance. For each instance, the table shows the name of the solved instance (Name), the number of customers ($|\mathcal{V}|$), the relative gap between the initial lower bound and the guessed upper bound ($UB_g\%$), the objective value of the optimal integral solution (OBJ), the relative gaps between the lower bounds computed at different steps and the optimal objective value ($\hat{LB}_1\%/LB_1\%/LB_2\%$), the sizes of the route sets obtained at different steps ($|\hat{\mathcal{R}}_1|/|\mathcal{R}_1|/|\mathcal{R}_2|$), the computation time for calculating the integral solution at Step 5 of Algorithm 1 (T_{int}), the sum of the computation time of Step 1 of Algorithm 1 and the computation time from Step 2 to Step 5 of Algorithm 1 under valid upper bound (T_{valid}) and the computation time used by the overall solution procedure (T_{tot})

All the CMTVRPTW instances with 70 customers can be solved to optimality within three hours by both methods. Among the 27 instances with 100 customers, the EPCEM solves 14 of them to optimality, whereas our algorithm can solve all of them but one instance "R206". In fact, the instance "R206" can be solved to optimality within four hours by our algorithm. The computation times reported under "T_{int}" and "T_{tot}" verify that our exact algorithm performs more efficiently than the EPCEM, particularly in the second phase of the price-cut-and-enumerate algorithm. This benefits from the utilization of the trip-based formulation as well as the improved lower bounds.

Table 1: Detailed computational results for CMTVRPTW instances

Name	$\lvert\mathcal{V}\rvert$	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\lvert\hat{\mathcal{R}}_1\rvert$	$LB_1\%$	$\lvert\mathcal{R}_1\rvert$	$LB_2\%$	$\lvert\mathcal{R}_2\rvert$	T_{int}	T_{valid}	T_{tot}
C201	70	1.20	1052.2	0.63	223419	0.00	11755	0.00	7309	0.8	49.8	49.8
C202	70	1.20	1047.7	1.09	227126	0.19	3875	0.19	3704	2.0	350.3	350.3
C203	70	1.20	1040.4	1.05	374431	0.11	3437	0.11	3336	0.9	215.1	215.1
C204	70	1.20	1036.8	1.02	595467	0.09	5939	0.09	5057	0.8	234.9	234.9
C205	70	1.50	1047.9	1.31	596397	0.17	6323	0.15	4725	1.2	137.7	181.0
C206	70	1.20	1042.0	1.07	308048	0.07	1226	0.07	1006	0.3	257.9	257.9
C207	70	1.20	1040.3	1.07	314623	0.16	3027	0.16	2784	1.8	102.7	102.7
C208	70	1.20	1040.3	1.09	284916	0.11	1805	0.11	1613	0.5	184.2	184.2
R201	70	1.20	1118.4	0.67	19628	0.37	8191	0.37	7978	5.3	235.5	235.5
R202	70	1.50	1041.1	1.31	89551	0.97	35885	0.97	34820	40.1	528.2	918.8
R203	70	1.20	958.0	0.68	61950	0.32	22812	0.27	19881	13.4	922.0	922.0
R204	70	1.20	921.8	0.81	142361	0.26	22656	0.25	19884	15.9	736.2	736.2
R205	70	1.50	1033.4	1.44	111260	1.01	36064	0.99	33336	62.7	827.1	1520.6

Name	$\|\mathcal{V}\|$	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
R206	70	1.50	985.9	1.37	169768	0.83	37133	0.81	34354	43.1	1052.1	1813.2
R207	70	1.20	942.0	0.86	79296	0.42	19350	0.42	18880	15.0	702.9	702.9
R208	70	1.20	917.5	0.95	118782	0.37	17754	0.37	16464	8.6	607.2	607.2
R209	70	1.20	955.3	1.02	43175	0.56	8858	0.47	7558	8.1	566.6	566.6
R210	70	1.20	980.4	0.98	70284	0.52	19030	0.45	16162	25.8	1466.4	1466.4
R211	70	1.20	914.8	0.71	87989	0.07	9851	0.06	8812	6.5	855.1	855.1
RC201	70	1.20	1364.5	1.00	9993	0.25	1028	0.19	826	0.3	115.5	115.5
RC202	70	1.20	1284.6	0.89	14719	0.27	2434	0.27	2310	1.1	239.5	239.5
RC203	70	1.20	1230.5	0.53	31552	0.00	9510	0.00	9222	1.5	91.2	91.2
RC204	70	1.20	1206.6	0.94	63649	0.00	2010	0.00	1887	0.2	161.2	161.2
RC205	70	1.20	1335.3	0.86	19015	0.41	6132	0.41	5844	6.2	352.4	352.4
RC206	70	1.50	1285.5	1.34	32954	0.37	3216	0.35	2775	2.2	208.2	353.9
RC207	70	1.50	1236.5	1.27	64523	0.04	1092	0.01	806	0.3	244.6	275.1
RC208	70	1.50	1208.2	1.26	126316	0.21	7620	0.19	6165	15.5	395.7	567.6
C201	100	1.20	1473.3	0.89	741102	0.00	9282	0.00	7450	1.4	181.0	181.0
C202	100	1.20	1464.1	0.89	916312	0.03	26207	0.03	21995	7.3	287.1	287.1
C203	100	1.20	1456.3	1.06	1339713	0.00	3051	0.00	2828	0.3	229.3	229.3
C204	100	1.20	1448.7	0.96	2345203	0.02	9886	0.01	7760	0.7	325.1	325.1
C205	100	1.20	1460.2	1.00	867257	0.00	2303	0.00	1961	0.4	174.6	174.6
C206	100	1.20	1455.1	1.03	967258	0.00	2163	0.00	1945	0.3	141.6	141.6
C207	100	1.20	1454.5	0.81	1176278	0.02	31858	0.01	24800	3.9	215.8	215.8
C208	100	1.20	1451.9	0.95	993160	0.00	4515	0.00	3917	1.1	160.9	160.9
R201	100	1.20	1399.6	1.16	208603	0.88	84866	0.86	74888	262.4	1122.7	1122.7
R202	100	1.20	1304.7	1.12	976035	0.81	317685	0.77	287807	3279.0	5105.5	5105.5
R203	100	1.20	1204.8	0.91	1594226	0.52	355244	0.49	312880	906.4	2964.1	2964.1
R204	100	1.20	1162.2	0.67	3765478	0.13	352035	0.12	333848	229.3	3067.0	3067.0
R205	100	1.20	1267.3	1.08	479352	0.84	203819	0.79	182226	673.0	1958.5	1958.5
R206	100	1.20	1220.9	1.08	1295889	0.70	353431	0.66	275796	10101.1	11322.1	11322.1
R207	100	1.20	1182.5	0.82	2659985	0.34	367009	0.33	348065	568.2	3264.5	3264.5
R208	100	1.20	1157.5	0.63	3952878	0.14	507400	0.13	491585	336.5	3795.1	3795.1
R209	100	1.20	1205.4	0.56	1042074	0.30	436341	0.20	314977	645.8	2673.2	2673.2
R210	100	1.20	1211.8	0.77	1461973	0.39	382356	0.34	326775	856.7	3725.7	3725.7
R211	100	1.20	1160.6	0.84	3816467	0.31	386907	0.28	304425	2653.8	5694.2	5694.2
RC201	100	1.20	1806.8	0.55	110637	0.34	50067	0.34	47055	18.6	316.1	316.1
RC202	100	1.20	1680.2	1.03	221919	0.70	80056	0.68	74027	74.8	601.1	601.1
RC203	100	1.20	1601.0	0.79	706614	0.32	108454	0.24	66433	45.9	1144.2	1144.2
RC204	100	1.20	1574.6	0.78	1289820	0.04	42507	0.04	39637	12.4	970.4	970.4
RC205	100	1.20	1732.6	1.13	279338	0.75	72479	0.74	67526	397.1	1219.5	1219.5
RC206	100	1.50	1698.1	1.30	605242	0.68	92819	0.57	58452	108.8	737.3	1323.7
RC207	100	1.50	1640.7	1.24	1265792	0.38	49855	0.28	37470	70.2	1399.4	2359.8
RC208	100	1.20	1570.7	0.77	1655568	0.00	41888	0.00	32151	31.2	1030.7	1030.7

2. Detailed Computational Results on Four Variants of CMTVRPTW

Like the exact methods of Paradiso et al. (2020) and Yang (2023), our proposed exact algorithm also can be adapted to solve the four variants of the CMTVRPTW, where the labeling algorithm introduced in §2 need to be revised to address additional side constraints. Detailed computational results for the four problem variants of the CMTVRPTW are shown in Tables 2–5, using the same notations introduced in Table 1.

Our reported optimal objective values align with those of Yang (2023), with three exceptions, including the 70-customer CMTVRPTW-LD instance C206 with $\bar{d} = 250$, the 100-customer CMTVRPTW-LD instance C202 with $\bar{d} = 220$ and the 70-customer DRP instance R203. For these three instances claimed to be optimally solved by Yang (2023), our results show slightly lower objective values. Such slight differences in objective values could be attributed to tolerance errors of using the MIP solver during the solution algorithm. For the remaining instances, our reported objective values are equal to or less than those reported by Yang (2023).

Results on CMTVRPTW-LT. The CMTVRPTW-LT differs from the CMTVRPTW in the sense that goods' loading time at the depot is considered. Let lt_i be the time spent at the depot for loading the goods of customer $i \in \mathcal{V}$. For route r, a vehicle needs the amount $\sum_{i \in \mathcal{V}(r)} lt_i$ of time for loading goods before its departure from the depot. Based on the above 54 CMTVRPTW instances, we have the same number of instances for the CMTVRPTW-LT, where goods' loading time is incorporated in each instance. Following Yang (2023), the loading time is fixed as 20% of the service time, i.e., $lt_i = 0.2\theta_i$ for $i \in \mathcal{V}$.

For the CMTVRPTW-LT instances as shown in Table 2, our exact algorithm outperforms the EPCEM, in terms of both solution quality and computation time. Although all the 27 instances with 70 customers can be solved to optimality within three hours by both methods, our algorithm on average requires less time than the EPCEM for computing the optimal solutions. The strength of our algorithm is more remarkable when computing the other 27 instances with 100 customers, for which only 12 instances are solved to optimality by the EPCEM.

Results on CMTVRPTW-LD. The CMTVRPTW-LD differs from the CMTVRPTW-LT in the aspect that a limit $\bar{d}$ is considered for the time that goods can be on board. For each trip, the time length between the vehicle's departure time from the depot and the arrival time at the last customer visited should be no greater than $\bar{d}$. Based on the 54 CMTVRPTW-LT instances which are derived from the type-2 Solomon instances of three groups (i.e., C, R, RC), we consider for each instance two alternative duration time limit values, thus having a total of 108 instances for the CMTVRPTW-LD. Following Yang (2023), we set $\bar{d} \in \{220, 250\}$ for the instances in group C and set $\bar{d} \in \{75, 100\}$ for the instances in group R and group RC. Moreover, we define $lt_i = 0.2\theta_i$ for $i \in \mathcal{V}$. The vehicle capacities are set as $Q = 700$ for the instances in group C and $Q = 1000$ for the instances in groups R and RC.

Computational results on the CMTVRPTW-LD instances in Table 2 reveal that the instances with 70 customers can be solved to optimality very quickly by both methods. For the instances with 100 customers, our algorithm solves to optimality three more instances than the EPCEM. The instance R211 with $\bar{d} = 100$ is not solved by our algorithm, because the number of trips contained in set $\tilde{\mathcal{S}}_2(\mathcal{T})$ exceeds the predefined number (i.e., two million) when performing the dynamic discretization procedure. Moreover, our exact algorithm outperforms the EPCEM in achieving tighter lower bounds and shorter computation time.

Results on CMTVRPTW-R. The CMTVRPTW-R differs from the CMTVRPTW in the sense that each customer has a release date for its demand, and the vehicle must depart from the depot no earlier than the time when demands of the visited customers are released. Following the procedure introduced in Cattaruzza et al. (2016), we set the release dates based on a parameter $\kappa \in \{0.25, 0.5, 0.75\}$ and have a total of 162 benchmark instances for the CMTVRPTW-R.

Computational results on the CMTVRPTW-R instances in Table 2 show that our algorithm can solve all the 162 instances to optimality, outperforming the EPCEM that solves 147 instances. The strength of our algorithm is particularly significant on the instances with 100 customers, in both lower bound tightness and computation time. Note that the average computation time used by our algorithm over the instances with 100 customers is about half of that used by the EPCEM. Such efficiency stems from our fast second-phase computation which only needs 4% of the time used in the EPCEM.

Results on DRP. The DRP considered in Cheng et al. (2020) is another variant of the CMTVRPTW, where each vehicle (or drone) is assigned with a battery capacity and the objective includes an additional energy cost component depending on the loaded goods. Moreover, a drone must return to the depot before running out of its battery power. To address these issues, we adapt the rollback pruning properly to solve the DRP (see §2.4). Cheng et al. (2020) generate two sets of DRP instances with at most 50 customers for the computational test. We do not compare the results based on these instances, because they can be solved to optimality very quickly by both the EPCEM and our algorithm. For this reason, we use the 54 large DRP instances tested in Yang (2023) that are with 70 and 100 customers for comparisons.

The computational results on the DRP instances in Table 2 show that our algorithm can solve all the 54 benchmark instances to optimality very fast. Instead, the EPCEM fails to solve one instance with 70 customers and two instances with 100 customers. For the instances with 100 customers that are solved by the EPCEM, the average times used for the second-phase computation and for the entire exact algorithm are about 21% and 35% of that for the EPCEM, respectively. Furthermore, the average optimality gap provided by our algorithm is about 18% of that provided by the EPCEM. All these results validate the advantage of our algorithm over the EPCEM in solving the DRP.

Table 2: Detailed computational results for CMTVRPTW-LT

Name	$\lvert\mathcal{V}\rvert$	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\lvert\hat{\mathcal{R}}_1\rvert$	$LB_1\%$	$\lvert\mathcal{R}_1\rvert$	$LB_2\%$	$\lvert\mathcal{R}_2\rvert$	T_{int}	T_{valid}	T_{tot}
C201	70	1.20	1052.2	0.63	223419	0.00	11755	0.00	7309	0.8	49.8	49.8
C202	70	1.20	1047.7	1.09	227126	0.19	3875	0.19	3704	2.0	350.3	350.3
C203	70	1.20	1040.4	1.05	374431	0.11	3437	0.11	3336	0.9	215.1	215.1

Name	$\|\mathcal{V}\|$	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C204	70	1.20	1036.8	1.02	595467	0.09	5939	0.09	5057	0.8	234.9	234.9
C205	70	1.50	1047.9	1.31	596397	0.17	6323	0.15	4725	1.2	137.7	181.0
C206	70	1.20	1042.0	1.07	308048	0.07	1226	0.07	1006	0.3	257.9	257.9
C207	70	1.20	1040.3	1.07	314623	0.16	3027	0.16	2784	1.8	102.7	102.7
C208	70	1.20	1040.3	1.09	284916	0.11	1805	0.11	1613	0.5	184.2	184.2
R201	70	1.20	1118.4	0.67	19628	0.37	8191	0.37	7978	5.3	235.5	235.5
R202	70	1.50	1041.1	1.31	89551	0.97	35885	0.97	34820	40.1	528.2	918.8
R203	70	1.20	958.0	0.68	61950	0.32	22812	0.27	19881	13.4	922.0	922.0
R204	70	1.20	921.8	0.81	142361	0.26	22656	0.25	19884	15.9	736.2	736.2
R205	70	1.50	1033.4	1.44	111260	1.01	36064	0.99	33336	62.7	827.1	1520.6
R206	70	1.50	985.9	1.37	169768	0.83	37133	0.81	34354	43.1	1052.1	1813.2
R207	70	1.20	942.0	0.86	79296	0.42	19350	0.42	18880	15.0	702.9	702.9
R208	70	1.20	917.5	0.95	118782	0.37	17754	0.37	16464	8.6	607.2	607.2
R209	70	1.20	955.3	1.02	43175	0.56	8858	0.47	7558	8.1	566.6	566.6
R210	70	1.20	980.4	0.98	70284	0.52	19030	0.45	16162	25.8	1466.4	1466.4
R211	70	1.20	914.8	0.71	87989	0.07	9851	0.06	8812	6.5	855.1	855.1
RC201	70	1.20	1364.5	1.00	9993	0.25	1028	0.19	826	0.3	115.5	115.5
RC202	70	1.20	1284.6	0.89	14719	0.27	2434	0.27	2310	1.1	239.5	239.5
RC203	70	1.20	1230.5	0.53	31552	0.00	9510	0.00	9222	1.5	91.2	91.2
RC204	70	1.20	1206.6	0.94	63649	0.00	2010	0.00	1887	0.2	161.2	161.2
RC205	70	1.20	1335.3	0.86	19015	0.41	6132	0.41	5844	6.2	352.4	352.4
RC206	70	1.50	1285.5	1.34	32954	0.37	3216	0.35	2775	2.2	208.2	353.9
RC207	70	1.50	1236.5	1.27	64523	0.04	1092	0.01	806	0.3	244.6	275.1
RC208	70	1.50	1208.2	1.26	126316	0.21	7620	0.19	6165	15.5	395.7	567.6
C201	100	1.20	1473.3	0.89	741102	0.00	9282	0.00	7450	1.4	181.0	181.0
C202	100	1.20	1464.1	0.89	916312	0.03	26207	0.03	21995	7.3	287.1	287.1
C203	100	1.20	1456.3	1.06	1339713	0.00	3051	0.00	2828	0.3	229.3	229.3
C204	100	1.20	1448.7	0.96	2345203	0.02	9886	0.01	7760	0.7	325.1	325.1
C205	100	1.20	1460.2	1.00	867257	0.00	2303	0.00	1961	0.4	174.6	174.6
C206	100	1.20	1455.1	1.03	967258	0.00	2163	0.00	1945	0.3	141.6	141.6
C207	100	1.20	1454.5	0.81	1176278	0.02	31858	0.01	24800	3.9	215.8	215.8
C208	100	1.20	1451.9	0.95	993160	0.00	4515	0.00	3917	1.1	160.9	160.9
R201	100	1.20	1399.6	1.16	208603	0.88	84866	0.86	74888	262.4	1122.7	1122.7
R202	100	1.20	1304.7	1.12	976035	0.81	317685	0.77	287807	3279.0	5105.5	5105.5
R203	100	1.20	1204.8	0.91	1594226	0.52	355244	0.49	312880	906.4	2964.1	2964.1
R204	100	1.20	1162.2	0.67	3765478	0.13	352035	0.12	333848	229.3	3067.0	3067.0
R205	100	1.20	1267.3	1.08	479352	0.84	203819	0.79	182226	673.0	1958.5	1958.5
R206	100	1.20	1220.9	1.08	1295889	0.70	353431	0.66	275796	10101.1	11322.1	11322.1
R207	100	1.20	1182.5	0.82	2659985	0.34	367009	0.33	348065	568.2	3264.5	3264.5
R208	100	1.20	1157.5	0.63	3952878	0.14	507400	0.13	491585	336.5	3795.1	3795.1
R209	100	1.20	1205.4	0.56	1042074	0.30	436341	0.20	314977	645.8	2673.2	2673.2
R210	100	1.20	1211.8	0.77	1461973	0.39	382356	0.34	326775	856.7	3725.7	3725.7
R211	100	1.20	1160.6	0.84	3816467	0.31	386907	0.28	304425	2653.8	5694.2	5694.2
RC201	100	1.20	1806.8	0.55	110637	0.34	50067	0.34	47055	18.6	316.1	316.1
RC202	100	1.20	1680.2	1.03	221919	0.70	80056	0.68	74027	74.8	601.1	601.1
RC203	100	1.20	1601.0	0.79	706614	0.32	108454	0.24	66433	45.9	1144.2	1144.2
RC204	100	1.20	1574.6	0.78	1289820	0.04	42507	0.04	39637	12.4	970.4	970.4
RC205	100	1.20	1732.6	1.13	279338	0.75	72479	0.74	67526	397.1	1219.5	1219.5
RC206	100	1.50	1698.1	1.30	605242	0.68	92819	0.57	58452	108.8	737.3	1323.7
RC207	100	1.50	1640.7	1.24	1265792	0.38	49855	0.28	37470	70.2	1399.4	2359.8
RC208	100	1.20	1570.7	0.77	1655568	0.00	41888	0.00	32151	31.2	1030.7	1030.7

Table 3: Detailed computational results for CMTVRPTW-LD

Name	$\|\mathcal{V}\|$	d	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C201	70	220.0	1.00	1918.7	0.00	270	0.00	264	0.00	263	0.0	1.8	1.8
C201	70	250.0	1.00	1587.5	0.00	368	0.00	348	0.00	346	0.0	1.8	1.8
C202	70	220.0	1.00	1896.6	0.30	785	0.16	655	0.16	651	0.1	5.2	5.2

Name	$\lvert\mathcal{V}\rvert$	d	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\lvert\hat{\mathcal{R}}_1\rvert$	$LB_1\%$	$\lvert\mathcal{R}_1\rvert$	$LB_2\%$	$\lvert\mathcal{R}_2\rvert$	T_{int}	T_{valid}	T_{tot}
C202	70	250.0	1.00	1582.7	0.03	2003	0.00	1871	0.00	1861	0.0	3.0	3.0
C203	70	220.0	1.00	1835.9	0.27	1708	0.05	1394	0.05	1386	0.1	11.9	11.9
C203	70	250.0	1.00	1571.6	0.77	5095	0.46	3339	0.46	3224	0.4	22.9	22.9
C204	70	220.0	1.00	1774.3	0.43	2846	0.39	2755	0.39	2716	17.4	41.7	41.7
C204	70	250.0	1.00	1557.8	0.96	7588	0.82	6575	0.82	6203	41.8	53.9	53.9
C205	70	220.0	1.00	1846.3	0.98	618	0.79	534	0.79	529	0.1	5.4	5.4
C205	70	250.0	1.00	1580.5	0.26	1011	0.11	903	0.11	896	0.1	6.0	6.0
C206	70	220.0	1.60	1842.3	1.37	1320	1.08	1229	1.08	1229	0.1	6.6	39.9
C206	70	250.0	1.00	1573.0	0.23	1997	0.05	1752	0.05	1752	0.1	16.2	16.2
C207	70	220.0	1.00	1798.6	0.41	1457	0.29	1357	0.29	1343	0.4	9.4	9.4
C207	70	250.0	1.00	1568.6	0.08	3774	0.04	3625	0.04	3618	0.1	7.7	7.7
C208	70	220.0	1.00	1815.5	0.41	1340	0.35	1271	0.35	1269	0.2	5.2	5.2
C208	70	250.0	1.00	1568.6	0.08	3087	0.04	2975	0.04	2975	0.1	5.4	5.4
R201	70	75.0	1.00	1838.1	0.06	807	0.00	768	0.00	731	0.0	3.3	3.3
R201	70	100.0	1.00	1597.0	0.00	1050	0.00	940	0.00	893	0.1	2.4	2.4
R202	70	75.0	1.00	1708.5	0.05	1949	0.00	1782	0.00	1770	0.0	4.1	4.1
R202	70	100.0	1.00	1469.4	0.00	2326	0.00	2198	0.00	1898	0.1	4.0	4.0
R203	70	75.0	1.00	1559.1	0.16	2656	0.00	1935	0.00	1878	0.1	7.5	7.5
R203	70	100.0	1.00	1305.6	0.00	5108	0.00	4270	0.00	3996	0.1	7.9	7.9
R204	70	75.0	1.00	1390.4	0.45	3785	0.29	2886	0.29	2684	7.5	21.7	21.7
R204	70	100.0	1.00	1110.3	0.06	9425	0.00	7850	0.00	7716	0.3	38.5	38.5
R205	70	75.0	1.00	1608.9	0.63	1664	0.00	416	0.00	371	0.1	9.7	9.7
R205	70	100.0	1.00	1358.8	0.22	3110	0.22	2869	0.22	2802	0.1	6.1	6.1
R206	70	75.0	1.00	1531.3	0.22	1965	0.01	1450	0.01	1392	0.3	7.3	7.3
R206	70	100.0	1.00	1278.6	0.49	4914	0.32	3559	0.32	3509	0.5	57.3	57.3
R207	70	75.0	1.00	1454.8	0.21	3587	0.03	2481	0.03	2355	0.1	14.1	14.1
R207	70	100.0	1.00	1186.1	0.66	6045	0.30	2394	0.30	2370	0.5	107.2	107.2
R208	70	75.0	1.00	1376.1	0.41	4546	0.22	3502	0.22	3352	11.4	32.6	32.6
R208	70	100.0	1.00	1087.6	0.09	10040	0.00	6976	0.00	6430	0.3	59.6	59.6
R209	70	75.0	1.00	1476.4	0.43	2853	0.13	1547	0.13	1512	0.2	29.4	29.4
R209	70	100.0	1.00	1211.5	0.59	3985	0.51	3320	0.51	3287	0.6	56.4	56.4
R210	70	75.0	1.00	1543.5	0.76	2437	0.41	1336	0.41	1238	0.5	41.6	41.6
R210	70	100.0	1.00	1299.0	0.45	6226	0.09	2855	0.09	2737	0.3	75.0	75.0
R211	70	75.0	1.00	1375.4	0.77	4988	0.70	4513	0.64	4032	14.4	50.2	50.2
R211	70	100.0	1.00	1082.0	0.10	11822	0.10	8334	0.00	6677	0.4	36.1	36.1
RC201	70	75.0	1.00	2392.0	0.09	407	0.00	362	0.00	343	0.2	4.7	4.7
RC201	70	100.0	1.00	1798.5	0.00	611	0.00	557	0.00	533	0.1	3.1	3.1
RC202	70	75.0	1.00	2167.3	0.50	691	0.43	654	0.43	642	0.3	5.9	5.9
RC202	70	100.0	1.00	1664.8	0.58	1295	0.42	1072	0.42	1058	0.2	25.7	25.7
RC203	70	75.0	1.00	1986.1	0.47	1037	0.18	870	0.18	793	0.1	7.0	7.0
RC203	70	100.0	1.00	1482.0	0.00	3600	0.00	2956	0.00	2891	0.1	9.6	9.6
RC204	70	75.0	1.00	1843.6	0.49	2425	0.20	1697	0.20	1615	3.6	38.2	38.2
RC204	70	100.0	1.00	1290.9	0.83	6764	0.53	3396	0.53	3396	0.8	128.1	128.1
RC205	70	75.0	1.00	2197.3	0.26	702	0.03	548	0.03	513	0.1	7.0	7.0
RC205	70	100.0	1.00	1723.5	0.00	1335	0.00	1170	0.00	1111	0.1	3.7	3.7
RC206	70	75.0	1.00	2095.4	0.79	729	0.35	461	0.35	445	0.3	25.1	25.1
RC206	70	100.0	1.30	1582.4	1.11	3783	0.85	2609	0.84	2404	1.2	49.6	94.0
RC207	70	75.0	1.60	1924.7	1.48	2800	0.86	1710	0.86	1623	0.5	48.4	139.0
RC207	70	100.0	1.60	1367.3	1.45	8060	1.01	3496	1.01	3136	0.1	18.2	35.5
RC208	70	75.0	1.30	1818.1	1.25	3802	0.86	2592	0.72	2196	11.0	60.3	107.6
RC208	70	100.0	1.60	1249.3	1.56	27931	1.04	9829	0.95	8653	40.4	266.4	648.8
C201	100	220.0	1.00	2902.4	0.50	591	0.24	530	0.24	519	0.1	5.8	5.8
C201	100	250.0	1.00	2335.4	0.32	876	0.13	788	0.13	770	0.1	35.0	35.0
C202	100	220.0	1.00	2830.4	0.50	2131	0.46	2051	0.46	2051	0.2	8.6	8.6
C202	100	250.0	1.00	2311.8	0.56	8122	0.40	6386	0.40	6330	1.2	25.5	25.5
C203	100	220.0	1.00	2763.0	0.52	3912	0.45	3679	0.45	3652	18.1	25.6	25.6
C203	100	250.0	1.00	2292.2	0.78	16724	0.56	11612	0.56	11311	15.8	51.7	51.7
C204	100	220.0	1.00	2704.4	0.56	5652	0.27	4560	0.27	4470	63.5	90.7	90.7
C204	100	250.0	1.00	2283.6	0.74	23175	0.64	20489	0.64	19808	188.8	228.8	228.8
C205	100	220.0	1.00	2793.2	0.97	1352	0.63	1156	0.63	1153	0.2	16.6	16.6

Name	$\|\mathcal{V}\|$	d	UB_g%	OBJ	$\hat{LB}_1$%	$\|\hat{\mathcal{R}}_1\|$	LB_1%	$\|\mathcal{R}_1\|$	LB_2%	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C205	100	250.0	1.00	2320.4	0.92	2338	0.49	1570	0.49	1566	0.5	40.1	40.1
C206	100	220.0	1.30	2770.6	1.04	2296	0.88	2179	0.88	2179	0.3	9.8	16.7
C206	100	250.0	1.30	2308.8	1.00	5837	0.68	4365	0.68	4287	1.0	35.5	65.9
C207	100	220.0	1.00	2743.2	0.65	2423	0.26	1851	0.26	1743	0.6	16.2	16.2
C207	100	250.0	1.00	2305.7	0.78	6434	0.43	4573	0.43	4558	1.0	46.9	46.9
C208	100	220.0	1.00	2738.9	0.39	2575	0.22	2424	0.22	2424	0.1	7.8	7.8
C208	100	250.0	1.00	2302.2	0.93	6297	0.75	5514	0.75	5496	1.3	28.0	28.0
R201	100	75.0	1.00	2273.4	0.28	3157	0.10	2274	0.10	2274	0.1	10.3	10.3
R201	100	100.0	1.00	1916.9	0.00	6712	0.00	6189	0.00	5901	0.3	16.1	16.1
R202	100	75.0	1.00	2100.3	0.34	20461	0.12	12540	0.12	12303	0.5	41.5	41.5
R202	100	100.0	1.00	1756.3	0.08	67347	0.00	53038	0.00	52908	3.0	152.2	152.2
R203	100	75.0	1.00	1869.9	0.40	45335	0.30	38890	0.28	37803	2.9	114.3	114.3
R203	100	100.0	1.00	1548.9	0.52	154450	0.36	97060	0.36	97060	19.1	475.4	475.4
R204	100	75.0	1.00	1712.0	0.00	51015	0.00	47407	0.00	46133	12.7	37.5	37.5
R204	100	100.0	1.00	1361.0	0.58	234195	0.44	157994	0.44	154296	81.5	929.9	929.9
R205	100	75.0	1.00	1961.7	0.10	9004	0.03	8134	0.03	8037	0.9	47.2	47.2
R205	100	100.0	1.00	1604.5	0.39	20086	0.22	14304	0.22	14207	3.3	173.9	173.9
R206	100	75.0	1.00	1854.1	0.47	27476	0.25	19756	0.25	19338	6.1	76.2	76.2
R206	100	100.0	1.00	1518.9	0.27	120816	0.20	101143	0.20	100963	14.4	384.0	384.0
R207	100	75.0	1.00	1771.5	0.56	43219	0.40	33542	0.40	33025	5.5	114.0	114.0
R207	100	100.0	1.00	1411.7	0.71	135491	0.38	40078	0.38	39342	13.7	514.1	514.1
R208	100	75.0	1.00	1687.7	0.37	49514	0.27	38382	0.27	37753	178.0	260.9	260.9
R208	100	100.0	1.00	1322.7	0.48	290336	0.22	111228	0.22	111017	53.2	892.7	892.7
R209	100	75.0	1.00	1833.2	0.51	22096	0.42	18959	0.41	18387	2.2	110.5	110.5
R209	100	100.0	1.00	1462.5	0.33	60338	0.02	20640	0.02	19914	3.2	355.8	355.8
R210	100	75.0	1.00	1841.6	0.12	27705	0.06	24384	0.06	24340	1.4	83.5	83.5
R210	100	100.0	1.00	1532.4	0.59	101824	0.40	54526	0.40	54091	10.2	358.0	358.0
R211	100	75.0	1.00	1678.9	0.43	71037	0.29	55799	0.27	51413	297.8	405.1	405.1
R211	100	100.0	-	-	-	-	-	-	-	-	-	-	-
RC201	100	75.0	1.00	3120.3	0.11	1437	0.04	1353	0.04	1277	0.2	9.7	9.7
RC201	100	100.0	1.00	2370.2	0.02	2781	0.00	2452	0.00	2323	0.3	8.4	8.4
RC202	100	75.0	1.00	2819.5	0.63	3263	0.56	2980	0.56	2919	0.8	22.0	22.0
RC202	100	100.0	1.00	2148.6	0.48	7526	0.36	6187	0.36	6146	0.6	56.2	56.2
RC203	100	75.0	1.00	2550.5	0.21	6194	0.06	4715	0.06	4628	0.9	39.9	39.9
RC203	100	100.0	1.00	1896.4	0.21	19718	0.08	13693	0.08	13454	0.9	107.9	107.9
RC204	100	75.0	1.00	2430.3	0.49	12013	0.31	8729	0.31	8572	3.1	74.5	74.5
RC204	100	100.0	1.00	1725.8	0.55	37662	0.35	20507	0.35	20082	5.2	236.8	236.8
RC205	100	75.0	1.00	2874.8	0.13	3338	0.04	2980	0.04	2915	0.8	21.8	21.8
RC205	100	100.0	1.00	2206.2	0.13	8884	0.08	7668	0.08	7382	0.4	40.7	40.7
RC206	100	75.0	1.00	2724.7	0.08	3513	0.00	3076	0.00	2879	0.3	19.7	19.7
RC206	100	100.0	1.00	2064.1	0.35	11184	0.12	7406	0.12	7013	0.5	73.4	73.4
RC207	100	75.0	1.00	2612.7	0.69	8083	0.47	5450	0.47	5139	3.0	57.6	57.6
RC207	100	100.0	1.00	1876.2	0.73	15009	0.20	3265	0.20	3060	0.4	124.6	124.6
RC208	100	75.0	1.00	2381.3	0.23	14429	0.09	11515	0.04	10759	454.2	520.0	520.1
RC208	100	100.0	1.00	1667.7	0.89	41494	0.64	19130	0.53	15453	46.0	466.8	466.8

Table 4: Detailed computational results for CMTVRPTW-R

Name	$\|\mathcal{V}\|$	κ	UB_g%	OBJ	$\hat{LB}_1$%	$\|\hat{\mathcal{R}}_1\|$	LB_1%	$\|\mathcal{R}_1\|$	LB_2%	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C201	70	0.25	1.60	1068.7	1.47	53067	0.00	375	0.00	242	0.0	42.3	77.5
C201	70	0.50	1.30	1072.0	1.24	22309	0.00	93	0.00	81	0.0	28.1	33.8
C201	70	0.75	1.00	1080.9	0.43	9532	0.00	2043	0.00	1979	0.1	19.7	19.7
C202	70	0.25	1.00	1121.0	0.39	18057	0.00	5832	0.00	5790	0.6	38.6	38.6
C202	70	0.50	1.00	1121.0	0.29	10573	0.00	5222	0.00	5070	0.4	15.4	15.4
C202	70	0.75	1.00	1121.0	0.33	7611	0.00	3484	0.00	3293	0.2	22.0	22.0
C203	70	0.25	1.00	1156.3	0.24	55389	0.00	29273	0.00	24775	2.3	93.3	93.3
C203	70	0.50	1.00	1156.3	0.19	61831	0.00	30463	0.00	27900	2.4	90.7	90.7
C203	70	0.75	1.00	1156.3	0.13	65993	0.00	33470	0.00	28751	2.0	44.4	44.4

Name	$\lvert\mathcal{V}\rvert$	κ	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\lvert\hat{\mathcal{R}}_1\rvert$	$LB_1\%$	$\lvert\mathcal{R}_1\rvert$	$LB_2\%$	$\lvert\mathcal{R}_2\rvert$	T_{int}	T_{valid}	T_{tot}
C204	70	0.25	1.00	1145.6	0.25	177052	0.00	52075	0.00	33736	5.5	71.5	71.5
C204	70	0.50	1.00	1145.6	0.25	210293	0.00	44382	0.00	40597	3.1	69.2	69.2
C204	70	0.75	1.00	1145.6	0.14	232237	0.00	89769	0.00	33707	2.7	72.2	72.2
C205	70	0.25	1.60	1063.2	1.40	63549	0.00	766	0.00	632	0.1	51.0	80.4
C205	70	0.50	1.00	1066.6	0.76	15629	0.00	650	0.00	558	0.0	39.9	39.9
C205	70	0.75	1.00	1075.9	0.86	17521	0.00	342	0.00	228	0.0	34.7	34.7
C206	70	0.25	1.60	1053.4	1.39	75712	0.00	722	0.00	642	0.1	39.5	58.5
C206	70	0.50	1.60	1062.3	1.40	60121	0.00	695	0.00	652	0.1	50.9	80.7
C206	70	0.75	1.30	1072.5	1.16	31826	0.00	386	0.00	358	0.0	59.0	76.3
C207	70	0.25	1.00	1047.2	0.88	26349	0.00	259	0.00	239	0.0	35.5	35.5
C207	70	0.50	1.00	1051.9	0.79	23267	0.00	624	0.00	522	0.0	47.1	47.1
C207	70	0.75	1.00	1060.6	0.27	23277	0.00	8604	0.00	8364	0.5	52.9	52.9
C208	70	0.25	1.60	1050.6	1.32	80815	0.00	825	0.00	742	0.1	31.5	49.4
C208	70	0.50	1.30	1055.9	1.24	28461	0.00	195	0.00	156	0.0	35.7	42.7
C208	70	0.75	1.00	1058.5	0.54	21883	0.00	2795	0.00	2425	0.2	67.4	67.4
R201	70	0.25	1.00	1159.1	0.67	6617	0.46	2975	0.46	2926	1.0	82.4	82.4
R201	70	0.50	1.00	1173.9	0.63	5459	0.24	2064	0.24	1835	0.3	80.7	80.7
R201	70	0.75	1.00	1214.4	0.58	6143	0.36	3883	0.36	3700	1.4	129.5	129.5
R202	70	0.25	1.00	1115.4	0.00	20050	0.00	6127	0.00	5389	0.3	93.5	93.5
R202	70	0.50	1.00	1125.5	0.00	14748	0.00	6355	0.00	5217	0.2	75.0	75.0
R202	70	0.75	1.00	1125.5	0.00	4432	0.00	2917	0.00	2859	0.1	5.5	5.5
R203	70	0.25	1.00	1113.0	0.13	19794	0.00	9919	0.00	9551	0.6	125.8	125.8
R203	70	0.50	1.00	1123.8	0.00	24943	0.00	15560	0.00	14412	1.2	102.8	102.8
R203	70	0.75	1.00	1148.1	0.54	32375	0.36	16430	0.36	15734	3.0	247.8	247.8
R204	70	0.25	1.00	1057.7	0.60	46923	0.02	4311	0.02	4227	0.8	382.2	382.2
R204	70	0.50	1.00	1057.7	0.59	48684	0.02	4547	0.02	4296	0.9	607.8	607.8
R204	70	0.75	1.00	1079.8	0.73	52370	0.22	8883	0.22	7890	1.3	383.7	383.7
R205	70	0.25	1.00	1073.5	0.63	13449	0.47	7658	0.47	6977	1.9	104.5	104.5
R205	70	0.50	1.00	1083.0	0.33	10492	0.13	4856	0.13	4639	0.6	104.6	104.6
R205	70	0.75	1.00	1084.6	0.00	11989	0.00	7139	0.00	6980	0.5	131.2	131.2
R206	70	0.25	1.00	1039.6	0.00	20659	0.00	11306	0.00	10517	0.7	373.1	373.1
R206	70	0.50	1.00	1059.3	0.50	21880	0.16	6237	0.16	6077	1.6	427.2	427.2
R206	70	0.75	1.00	1070.6	0.45	26045	0.24	9970	0.24	9006	1.8	335.0	335.0
R207	70	0.25	1.00	1049.3	0.65	38833	0.16	3654	0.16	3619	0.6	217.0	217.0
R207	70	0.50	1.00	1056.5	0.35	30804	0.00	10878	0.00	10498	1.1	220.0	220.0
R207	70	0.75	1.00	1056.5	0.33	32411	0.00	8396	0.00	6529	0.5	286.5	286.5
R208	70	0.25	1.00	997.4	0.00	80757	0.00	32197	0.00	27179	2.1	386.9	386.9
R208	70	0.50	1.00	997.4	0.00	74367	0.00	38141	0.00	32972	2.1	275.8	275.8
R208	70	0.75	1.00	997.4	0.00	76883	0.00	36851	0.00	29443	2.4	251.2	251.2
R209	70	0.25	1.00	995.4	0.90	24796	0.46	5590	0.46	5106	5.1	303.6	303.6
R209	70	0.50	1.00	997.4	0.77	21272	0.35	5183	0.35	4793	2.3	341.7	341.7
R209	70	0.75	1.00	1033.8	0.66	12677	0.39	4778	0.39	4513	2.8	401.2	401.2
R210	70	0.25	1.00	1026.5	0.42	17909	0.22	6683	0.21	6570	1.6	261.3	261.3
R210	70	0.50	1.00	1032.7	0.08	12597	0.00	6958	0.00	6692	0.6	128.9	128.9
R210	70	0.75	1.00	1094.5	0.33	16205	0.00	6128	0.00	5852	1.3	237.6	237.6
R211	70	0.25	1.00	930.4	0.86	29210	0.39	5012	0.38	4697	7.3	747.7	747.7
R211	70	0.50	1.00	930.4	0.83	28574	0.37	5355	0.37	4818	8.1	617.6	617.6
R211	70	0.75	1.30	958.8	1.15	68304	0.65	16164	0.65	15491	39.9	673.3	1166.2
RC201	70	0.25	1.00	1367.5	0.12	2710	0.00	1902	0.00	1696	0.1	31.8	31.8
RC201	70	0.50	1.30	1397.6	1.06	5139	0.38	1767	0.38	1497	0.6	73.8	142.8
RC201	70	0.75	1.00	1434.6	0.83	3289	0.26	932	0.26	841	0.3	113.8	113.8
RC202	70	0.25	1.60	1409.8	1.53	11714	0.76	3454	0.76	3214	1.1	99.1	257.5
RC202	70	0.50	2.20	1413.9	1.99	23541	0.51	3326	0.51	3143	1.4	90.4	279.8
RC202	70	0.75	1.00	1438.3	0.23	2607	0.11	1647	0.11	1475	0.2	65.2	65.2
RC203	70	0.25	1.00	1397.9	0.19	11662	0.00	5415	0.00	4999	0.3	94.1	94.1
RC203	70	0.50	1.00	1407.7	0.86	9927	0.00	305	0.00	113	0.0	147.0	147.0
RC203	70	0.75	1.00	1483.9	0.00	8834	0.00	5343	0.00	4174	0.2	30.5	30.5
RC204	70	0.25	1.00	1354.0	0.97	24805	0.00	353	0.00	203	0.0	115.1	115.1
RC204	70	0.50	1.30	1354.0	1.03	43963	0.00	2227	0.00	1692	0.2	110.5	142.0
RC204	70	0.75	1.00	1409.5	0.75	23133	0.00	1524	0.00	1236	0.2	127.6	127.6

Name	$\lvert\mathcal{V}\rvert$	κ	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\lvert\hat{\mathcal{R}}_1\rvert$	$LB_1\%$	$\lvert\mathcal{R}_1\rvert$	$LB_2\%$	$\lvert\mathcal{R}_2\rvert$	T_{int}	T_{valid}	T_{tot}
RC205	70	0.25	1.00	1361.5	0.45	5505	0.00	1887	0.00	1711	0.1	73.0	73.0
RC205	70	0.50	1.00	1433.0	0.55	5929	0.39	4497	0.39	4264	1.7	157.7	157.7
RC205	70	0.75	1.00	1474.6	0.42	3120	0.22	2088	0.22	1999	0.3	39.7	39.7
RC206	70	0.25	1.00	1309.1	0.49	6438	0.00	1868	0.00	1349	0.1	48.7	48.7
RC206	70	0.50	1.00	1309.9	0.50	4730	0.00	1419	0.00	977	0.1	32.7	32.7
RC206	70	0.75	1.00	1347.7	0.09	4935	0.00	2955	0.00	2634	0.1	51.5	51.5
RC207	70	0.25	1.90	1281.8	1.59	53564	0.31	5358	0.31	5027	2.7	345.4	735.4
RC207	70	0.50	1.60	1281.8	1.48	33860	0.30	2086	0.29	1835	1.1	251.2	422.0
RC207	70	0.75	1.00	1382.5	0.64	10640	0.33	4835	0.33	4035	1.4	171.9	171.9
RC208	70	0.25	1.60	1216.4	1.55	76432	0.44	5158	0.30	3198	2.3	434.8	696.5
RC208	70	0.50	1.60	1216.4	1.44	79264	0.34	5054	0.19	3119	4.0	435.1	726.3
RC208	70	0.75	1.30	1235.3	1.17	32821	0.35	4081	0.34	3830	5.0	469.4	745.4
C201	100	0.25	1.90	1500.6	1.78	256736	0.00	364	0.00	349	0.1	110.6	150.2
C201	100	0.50	1.90	1500.6	1.84	180460	0.00	214	0.00	147	0.0	99.5	129.0
C201	100	0.75	1.30	1504.0	1.21	60718	0.00	373	0.00	215	0.0	66.5	73.8
C202	100	0.25	1.30	1545.4	1.18	136735	0.00	870	0.00	740	0.1	147.4	176.2
C202	100	0.50	1.00	1547.3	0.90	60331	0.00	557	0.00	537	0.1	117.2	117.2
C202	100	0.75	1.30	1552.9	1.12	134134	0.00	1733	0.00	1466	0.2	160.9	209.2
C203	100	0.25	1.00	1577.7	0.93	175473	0.11	3518	0.11	3421	2.5	422.4	422.4
C203	100	0.50	1.30	1578.7	1.11	439431	0.00	4141	0.00	3889	0.7	349.4	401.2
C203	100	0.75	1.30	1579.6	1.02	574744	0.00	8033	0.00	4778	0.5	209.3	258.5
C204	100	0.25	1.00	1560.5	0.57	326790	0.00	30360	0.00	25009	3.7	195.8	195.8
C204	100	0.50	1.00	1560.9	0.60	329153	0.00	19488	0.00	16322	1.1	359.0	359.0
C204	100	0.75	1.00	1569.1	0.57	814916	0.00	52238	0.00	39963	13.1	441.3	441.3
C205	100	0.25	1.90	1488.2	1.75	325203	0.00	722	0.00	573	0.1	96.6	139.8
C205	100	0.50	1.90	1490.0	1.80	235143	0.00	286	0.00	229	0.0	116.7	153.4
C205	100	0.75	1.90	1491.7	1.61	212144	0.00	2801	0.00	1612	0.1	103.8	137.2
C206	100	0.25	1.90	1476.0	1.64	413726	0.00	2002	0.00	1397	0.1	135.9	187.1
C206	100	0.50	2.20	1481.7	1.90	463502	0.00	2759	0.00	2584	0.2	153.6	236.3
C206	100	0.75	1.30	1490.5	1.18	104432	0.00	586	0.00	540	0.1	113.1	131.0
C207	100	0.25	1.60	1472.8	1.35	251367	0.00	2819	0.00	1909	0.1	125.9	157.2
C207	100	0.50	1.60	1474.4	1.32	202128	0.00	3021	0.00	1856	0.1	123.1	156.0
C207	100	0.75	1.60	1480.4	1.42	201820	0.00	865	0.00	800	0.1	149.7	189.7
C208	100	0.25	1.90	1471.2	1.58	497697	0.00	5305	0.00	3660	0.3	120.0	178.5
C208	100	0.50	1.90	1477.4	1.77	322387	0.00	453	0.00	396	0.1	147.8	203.5
C208	100	0.75	1.60	1481.2	1.56	178858	0.00	197	0.00	150	0.1	126.8	159.2
R201	100	0.25	1.00	1435.6	0.65	60740	0.39	24258	0.39	23358	12.7	599.2	599.2
R201	100	0.50	1.00	1442.6	0.63	54911	0.46	26760	0.46	25754	13.1	681.1	681.1
R201	100	0.75	1.00	1483.6	0.63	44812	0.31	16576	0.31	15545	5.9	450.9	450.9
R202	100	0.25	1.00	1401.4	0.55	154654	0.19	42376	0.19	42207	26.0	917.8	917.8
R202	100	0.50	1.00	1413.8	0.68	187036	0.44	91273	0.43	84989	68.3	984.2	984.2
R202	100	0.75	1.00	1429.0	0.38	189322	0.24	121422	0.23	117666	78.1	900.3	900.3
R203	100	0.25	1.00	1370.9	0.14	309371	0.00	203004	0.00	187375	37.3	604.2	604.2
R203	100	0.50	1.00	1372.8	0.14	336727	0.00	216720	0.00	200537	29.5	448.0	448.0
R203	100	0.75	1.00	1394.7	0.26	311601	0.05	145870	0.05	143514	39.7	783.9	783.9
R204	100	0.25	1.00	1324.6	0.78	957157	0.39	154173	0.39	147391	71.8	1866.7	1866.7
R204	100	0.50	1.00	1324.6	0.78	782559	0.38	142067	0.37	128730	59.8	2208.6	2208.6
R204	100	0.75	1.00	1334.6	0.42	719106	0.09	190923	0.08	175417	110.3	1900.1	1900.1
R205	100	0.25	1.00	1314.4	0.61	110177	0.43	56516	0.42	53461	28.9	849.1	849.1
R205	100	0.50	1.00	1332.3	0.67	96390	0.39	36160	0.39	33477	21.7	827.7	827.7
R205	100	0.75	1.00	1361.8	0.56	123052	0.36	54343	0.36	53234	27.0	784.8	784.8
R206	100	0.25	1.00	1274.8	0.01	297683	0.00	233756	0.00	230187	51.0	986.8	986.8
R206	100	0.50	1.00	1298.1	0.35	375427	0.18	169334	0.18	168466	134.5	1491.7	1491.7
R206	100	0.75	1.00	1323.5	0.50	403135	0.17	101079	0.17	96871	52.1	1342.0	1342.0
R207	100	0.25	1.00	1286.7	0.67	522577	0.43	185273	0.42	175409	86.5	1702.8	1702.8
R207	100	0.50	1.00	1297.3	0.51	429299	0.15	107307	0.15	105852	34.4	1784.9	1784.9
R207	100	0.75	1.00	1304.7	0.29	591248	0.04	222598	0.03	213764	156.7	1721.3	1721.3
R208	100	0.25	1.00	1253.1	0.44	947409	0.23	409144	0.21	354361	365.9	2860.7	2860.7
R208	100	0.50	1.00	1253.1	0.47	912942	0.22	318392	0.22	314955	326.0	2312.6	2312.6
R208	100	0.75	1.00	1253.1	0.35	993215	0.15	472540	0.13	423452	299.8	2517.3	2517.3

Name	$\|\mathcal{V}\|$	κ	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
R209	100	0.25	1.00	1255.8	0.93	293896	0.64	104189	0.63	99504	481.4	1914.4	1914.4
R209	100	0.50	1.30	1258.8	1.05	928832	0.83	494667	0.81	454729	1970.4	3440.5	5376.8
R209	100	0.75	1.00	1288.6	0.13	210263	0.00	129041	0.00	117975	29.9	776.6	776.6
R210	100	0.25	1.30	1277.3	1.02	1082407	0.67	406145	0.67	401742	1105.1	2566.8	3968.1
R210	100	0.50	1.00	1283.7	0.58	314162	0.31	139275	0.31	135511	107.3	1592.0	1592.0
R210	100	0.75	1.00	1341.5	0.44	259971	0.28	155487	0.25	138572	108.6	1349.1	1349.1
R211	100	0.25	1.00	1171.4	0.40	527288	0.08	144592	0.04	124031	398.3	2837.5	2837.5
R211	100	0.50	1.00	1175.0	0.64	614643	0.24	92042	0.23	89562	236.2	2750.9	2750.9
R211	100	0.75	1.00	1199.3	0.93	465722	0.40	42877	0.39	39448	95.7	2065.0	2065.0
RC201	100	0.25	1.00	1839.1	0.81	30853	0.50	10600	0.50	10062	5.0	218.1	218.1
RC201	100	0.50	1.00	1849.6	0.45	26189	0.04	6649	0.04	6373	1.0	212.9	212.9
RC201	100	0.75	1.00	1871.2	0.32	23005	0.00	9978	0.00	7868	0.5	94.4	94.4
RC202	100	0.25	1.00	1790.8	0.44	45715	0.31	28249	0.31	27149	11.3	247.3	247.3
RC202	100	0.50	1.00	1813.4	0.43	47465	0.28	29769	0.28	27921	8.9	272.0	272.0
RC202	100	0.75	1.00	1841.7	0.87	44674	0.57	13525	0.57	12738	6.6	255.3	255.3
RC203	100	0.25	1.00	1808.2	0.31	312843	0.10	131207	0.10	122142	49.5	1479.1	1479.1
RC203	100	0.50	1.00	1831.1	0.44	321045	0.26	141757	0.26	140195	59.1	1142.1	1142.1
RC203	100	0.75	1.00	1880.7	0.56	421120	0.42	196375	0.42	192929	122.0	1313.1	1313.1
RC204	100	0.25	1.00	1749.4	0.39	316764	0.05	106512	0.05	99790	26.7	683.9	683.9
RC204	100	0.50	1.00	1749.4	0.36	326068	0.06	118456	0.06	112250	41.6	732.6	732.6
RC204	100	0.75	1.00	1780.4	0.21	385679	0.05	206465	0.05	200333	53.1	841.1	841.1
RC205	100	0.25	1.00	1760.4	0.56	65276	0.27	21591	0.25	18043	15.1	676.5	676.5
RC205	100	0.50	1.00	1819.0	0.81	60924	0.51	23320	0.51	23037	20.0	575.0	575.0
RC205	100	0.75	1.00	1877.8	0.59	54890	0.29	22171	0.28	19242	21.4	402.3	402.3
RC206	100	0.25	1.00	1734.1	0.46	71972	0.06	19021	0.06	17994	6.9	371.3	371.3
RC206	100	0.50	1.00	1746.9	0.57	61198	0.23	19773	0.23	19497	9.7	398.6	398.6
RC206	100	0.75	1.00	1793.6	0.29	44781	0.13	29879	0.13	29293	5.0	191.5	191.5
RC207	100	0.25	1.30	1694.4	1.13	327301	0.31	16756	0.30	14729	22.8	502.5	886.3
RC207	100	0.50	1.30	1694.4	1.10	330583	0.28	15779	0.27	14561	16.1	699.4	1128.9
RC207	100	0.75	1.00	1780.4	0.36	83813	0.07	31990	0.07	30998	17.5	370.2	370.2
RC208	100	0.25	1.30	1595.5	1.08	816396	0.42	75267	0.12	14603	31.3	1472.6	2117.5
RC208	100	0.50	1.60	1602.5	1.51	2043801	0.74	199659	0.51	78017	1105.5	2520.8	4082.4
RC208	100	0.75	1.00	1620.1	0.98	213608	0.26	6053	0.19	3322	6.3	886.3	886.3

Table 5: Detailed computational results for DRP

Name	$\|\mathcal{V}\|$	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C201	70	1.00	1862.8	0.48	10372	0.00	2959	0.00	2509	0.4	8.5	8.5
C202	70	1.00	1856.9	0.28	12198	0.00	6112	0.00	5910	0.3	5.9	5.9
C203	70	1.00	1852.1	0.34	17155	0.00	7527	0.00	7176	0.3	6.3	6.3
C204	70	1.00	1851.6	0.34	24308	0.00	11135	0.00	6629	65.8	75.0	75.0
C205	70	1.00	1853.0	0.30	12103	0.00	6234	0.00	4687	0.6	5.5	5.5
C206	70	1.00	1851.9	0.29	13931	0.00	6040	0.00	5296	0.7	5.3	5.3
C207	70	1.00	1851.9	0.36	13317	0.00	6270	0.00	5204	1.6	8.4	8.4
C208	70	1.00	1851.9	0.36	12660	0.00	6398	0.00	4875	1.4	6.0	6.0
R201	70	1.00	1531.5	0.59	4286	0.42	2798	0.42	2608	1.5	59.2	59.2
R202	70	1.00	1462.2	0.13	7931	0.02	5149	0.02	5089	1.1	70.6	70.6
R203	70	1.00	1412.9	0.39	14401	0.19	8705	0.16	7968	3.4	103.9	103.9
R204	70	1.00	1393.1	0.49	21066	0.27	11744	0.27	11490	8.6	76.9	76.9
R205	70	1.00	1458.7	0.39	7326	0.39	5852	0.39	5392	0.6	26.1	26.1
R206	70	1.00	1429.2	0.38	12692	0.26	8462	0.09	6080	1.4	56.3	56.3
R207	70	1.00	1403.0	0.64	18359	0.15	3719	0.14	3242	6.1	115.9	115.9
R208	70	1.00	1390.4	0.64	23120	0.21	5949	0.21	5700	63.8	153.9	153.9
R209	70	1.00	1417.8	0.95	9746	0.38	2045	0.36	1712	1.8	103.5	103.5
R210	70	1.00	1433.9	0.45	14109	0.23	8001	0.21	7227	3.0	112.5	112.5
R211	70	1.00	1390.2	0.64	18297	0.19	5123	0.19	4846	4.6	74.5	74.5
RC201	70	1.30	2328.5	1.18	3658	0.67	2019	0.36	1029	0.8	69.5	133.2
RC202	70	1.00	2253.2	0.93	3415	0.26	803	0.08	404	0.2	12.4	12.4

Name	$\|\mathcal{V}\|$	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
RC203	70	1.00	2227.5	0.67	5756	0.00	2004	0.00	1919	0.1	13.8	13.8
RC204	70	1.00	2225.4	0.73	6142	0.00	1735	0.00	1348	8.0	41.1	41.1
RC205	70	1.00	2270.7	0.76	3642	0.16	1315	0.02	714	0.3	44.8	44.8
RC206	70	1.00	2259.0	0.54	3700	0.12	1773	0.03	1424	0.4	41.1	41.1
RC207	70	1.00	2233.0	0.76	4630	0.01	1248	0.00	934	1.5	36.5	36.5
RC208	70	1.00	2225.4	0.74	7808	0.00	2052	0.00	1484	3.5	20.8	20.8
C201	100	1.00	2733.4	0.91	33523	0.00	524	0.00	473	0.1	43.9	43.9
C202	100	1.00	2729.1	0.84	62500	0.00	1560	0.00	1280	0.1	22.8	22.8
C203	100	1.00	2725.8	0.84	95547	0.00	2087	0.00	1972	0.2	45.8	45.8
C204	100	1.00	2720.8	0.82	114333	0.00	2695	0.00	1942	26.6	61.4	61.4
C205	100	1.00	2726.9	0.91	47572	0.00	478	0.00	424	0.1	25.3	25.3
C206	100	1.00	2722.3	0.79	51895	0.00	2325	0.00	2121	0.2	23.7	23.7
C207	100	1.00	2720.9	0.80	49924	0.00	2058	0.00	1998	0.2	16.7	16.7
C208	100	1.00	2720.7	0.81	52824	0.00	2557	0.00	2419	0.2	22.9	22.9
R201	100	1.00	1974.3	0.34	39814	0.22	27119	0.21	25562	7.0	153.5	153.5
R202	100	1.00	1919.0	0.80	92080	0.59	42506	0.46	24748	27.3	231.7	231.7
R203	100	1.00	1845.7	0.54	234648	0.37	123800	0.36	115292	515.5	801.8	801.8
R204	100	1.00	1819.2	0.16	377567	0.02	255167	0.02	246755	43.1	354.2	354.2
R205	100	1.00	1884.4	0.40	90585	0.24	53342	0.20	45416	78.0	275.3	275.3
R206	100	1.00	1852.8	0.40	173142	0.17	81846	0.17	71998	198.6	413.6	413.6
R207	100	1.00	1831.5	0.35	263208	0.15	122763	0.15	120924	325.5	511.5	511.5
R208	100	1.00	1815.5	0.14	424055	0.00	272221	0.00	269705	29.2	136.1	136.1
R209	100	1.00	1846.0	0.53	143066	0.27	57906	0.26	52291	59.5	296.1	296.1
R210	100	1.00	1853.6	0.53	188061	0.34	99351	0.32	87776	429.3	650.9	650.9
R211	100	1.00	1815.5	0.20	456949	0.00	224523	0.00	216033	775.2	944.8	944.8
RC201	100	1.00	2960.3	0.62	24133	0.44	15320	0.18	5888	10.6	124.4	124.4
RC202	100	1.00	2870.7	0.40	51077	0.08	29168	0.08	27518	26.6	140.9	140.9
RC203	100	1.00	2853.0	0.38	94424	0.07	47590	0.07	47348	61.9	222.0	222.0
RC204	100	1.00	2847.0	0.41	109283	0.03	42012	0.03	40919	546.5	644.8	644.8
RC205	100	1.00	2898.2	0.52	39793	0.25	22801	0.21	20383	11.1	136.6	136.6
RC206	100	1.00	2886.3	0.38	44160	0.16	27769	0.08	22345	9.1	112.5	112.5
RC207	100	1.00	2854.6	0.38	60465	0.04	31813	0.03	29840	218.0	347.2	347.2
RC208	100	1.00	2846.7	0.37	123931	0.03	59773	0.03	57667	433.1	542.2	542.2

3. Detailed Computational Results on Large-Scale Instances of CMTVRPTW

Detailed computational results for the large-scale CMTVRPTW instances are shown in Table 6, using the same notations introduced in Table 1. Moreover, column "K" indicates the number of available vehicles for each instance. Note that we are able to solve all 30 instances with 120 customers to optimality within one hour on average. For the 60 instances with 140 customers, we could find optimal solutions for 49 instances within three hours.

Table 6: Detailed Computational Results on New Large-Scale CMTVRPTW Instances

Name	$\|\mathcal{V}\|$	K	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C2_2_1	120	10	1.00	3049.8	0.71	152535	0.10	13616	0.10	12435	6.2	515.4	515.4
C2_2_2	120	10	1.00	2973.9	0.85	493616	0.32	44564	0.32	43399	78.7	706.4	706.4
C2_2_3	120	10	1.00	2904.2	0.46	1164188	0.00	175737	0.00	169789	36.0	423.4	423.4
C2_2_4	120	10	1.00	2894.8	0.66	2174454	0.03	71829	0.03	69590	129.4	823.5	823.5
C2_2_5	120	10	1.30	3003.5	1.00	639403	0.48	148814	0.45	118050	148.9	714.7	1112.1
C2_2_6	120	10	1.30	2980.6	1.02	968174	0.50	231587	0.44	177225	427.6	1116.1	1620.0
C2_2_7	120	10	1.30	2967.1	1.07	1240246	0.39	115661	0.34	87675	305.4	959.1	1376.8
C2_2_8	120	10	1.30	2961.5	1.23	1254761	0.42	62899	0.40	48146	264.1	1003.9	1555.5

Name	$\lvert\mathcal{V}\rvert$	K	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\lvert\hat{\mathcal{R}}_1\rvert$	$LB_1\%$	$\lvert\mathcal{R}_1\rvert$	$LB_2\%$	$\lvert\mathcal{R}_2\rvert$	T_{int}	T_{valid}	T_{tot}
C2_2_9	120	10	1.30	2944.0	1.14	1750805	0.40	95057	0.32	65309	155.8	847.0	1312.1
C2_2_10	120	10	1.30	2940.8	1.13	1698992	0.33	68330	0.27	47161	60.1	758.7	1258.4
R2_2_1	120	10	1.00	3504.4	0.76	136558	0.63	84605	0.60	73247	88.9	759.3	759.3
R2_2_2	120	10	1.00	3257.3	0.70	307914	0.51	147237	0.51	142451	180.2	1256.2	1256.2
R2_2_3	120	10	1.00	3109.0	0.75	673890	0.42	132693	0.42	128315	112.8	956.9	956.9
R2_2_4	120	10	1.00	3009.8	0.57	900894	0.16	144203	0.16	140474	30.9	740.3	740.3
R2_2_5	120	10	1.00	3376.2	0.83	174632	0.67	100095	0.67	98099	595.7	1249.7	1249.7
R2_2_6	120	10	1.00	3179.8	0.53	319904	0.25	102525	0.25	98514	80.0	955.2	955.2
R2_2_7	120	10	1.00	3069.3	0.36	741364	0.10	215307	0.09	205336	69.9	996.3	996.3
R2_2_8	120	10	1.00	3009.8	0.56	962058	0.16	159399	0.16	152698	64.8	810.6	810.6
R2_2_9	120	10	1.00	3293.6	0.97	244189	0.64	58852	0.64	55008	363.6	1136.6	1136.6
R2_2_10	120	10	1.00	3195.7	0.73	331524	0.39	77228	0.38	69600	75.9	1102.5	1102.5
RC2_2_1	120	10	1.00	3270.3	0.51	248779	0.08	34545	0.08	33154	10.7	910.3	910.3
RC2_2_2	120	10	1.00	3083.1	0.39	519157	0.00	117778	0.00	114481	33.5	1645.7	1645.7
RC2_2_3	120	10	1.00	3008.9	0.63	1830578	0.14	123128	0.13	118094	85.6	2162.2	2162.2
RC2_2_4	120	10	1.00	2976.2	0.60	3484787	0.00	78980	0.00	76951	12.3	1149.1	1149.1
RC2_2_5	120	10	1.30	3157.3	1.08	1958837	0.45	267578	0.45	260289	243.3	1866.9	2933.1
RC2_2_6	120	10	1.00	3168.6	0.93	478479	0.34	25668	0.34	24076	19.6	919.5	919.5
RC2_2_7	120	10	1.30	3110.6	1.12	2744051	0.38	160959	0.37	153426	591.7	2653.3	4083.7
RC2_2_8	120	10	1.00	3076.9	0.96	1169751	0.30	33523	0.30	33258	54.7	2611.5	2611.5
RC2_2_9	120	10	1.30	3082.4	1.16	2967322	0.50	298306	0.49	272243	1055.9	3607.9	4951.0
RC2_2_10	120	10	1.00	3050.2	0.70	1227069	0.18	86322	0.18	83674	286.2	2073.8	2073.8
C2_2_1	140	12	1.00	3436.2	0.86	721443	0.20	26795	0.20	24158	21.7	870.2	870.2
C2_2_2	140	12	1.00	3380.3	0.90	2231726	0.29	76226	0.29	75210	106.8	923.4	923.4
C2_2_3	140	12	1.00	3304.6	0.72	7517374	0.12	182589	0.12	174588	103.6	1347.8	1347.8
C2_2_4	140	12	1.00	3289.5	0.70	14742871	0.03	167120	0.03	160975	379.1	2036.4	2036.4
C2_2_5	140	12	1.30	3382.9	1.02	2781054	0.31	200403	0.30	168302	142.2	847.2	1188.5
C2_2_6	140	12	1.30	3367.4	1.05	4004431	0.42	387342	0.39	304098	808.2	1600.8	2237.0
C2_2_7	140	12	1.30	3362.5	1.01	5682914	0.30	305279	0.27	248925	214.4	1244.8	1711.0
C2_2_8	140	12	1.30	3354.6	1.15	4733990	0.42	339600	0.39	232720	1039.1	1946.7	2500.5
C2_2_9	140	12	1.30	3345.1	1.20	9151846	0.44	373258	0.42	292732	1350.6	2735.5	3429.9
C2_2_10	140	12	1.30	3337.4	1.18	8867498	0.41	312725	0.39	243788	1089.0	2238.3	2866.5
R2_2_1	140	12	1.00	3998.9	0.79	373014	0.64	207834	0.64	200474	1356.3	2228.5	2228.5
R2_2_2	140	12	1.00	3734.7	0.53	900085	0.36	462946	0.34	419496	755.8	2509.9	2509.9
R2_2_3	140	12	1.00	3601.9	0.82	2565404	0.53	636144	0.53	622507	9943.4	12631.3	12631.3
R2_2_4	140	12	1.00	3473.3	0.36	3828889	0.17	1565391	0.17	1540561	537.9	2553.0	2553.0
R2_2_5	140	12	1.00	3859.3	0.76	606210	0.64	375458	0.64	372186	1985.1	2843.9	2843.9
R2_2_6	140	12	1.00	3671.9	0.77	1272741	0.55	474515	0.52	412491	5814.3	7487.4	7487.4
R2_2_7	140	12	-	-	-	-	-	-	-	-	-	-	-
R2_2_8	140	12	1.00	3468.4	0.31	3667138	0.17	2043471	0.17	2025124	957.3	2934.1	2934.1
R2_2_9	140	12	1.00	3779.6	0.79	753762	0.64	385975	0.64	371296	6348.3	7890.3	7890.3
R2_2_10	140	12	1.00	3693.5	0.91	903877	0.70	380195	0.68	324917	4395.9	5623.0	5623.0
RC2_2_1	140	12	1.30	3718.2	1.02	1458048	0.49	370208	0.49	349064	743.6	2060.5	3202.1
RC2_2_2	140	12	-	-	-	-	-	-	-	-	-	-	-
RC2_2_3	140	12	1.00	3487.5	0.91	10686438	0.35	607602	0.34	531311	3950.9	8023.3	8023.4
RC2_2_4	140	12	1.00	3449.3	0.63	14502589	0.12	1233234	0.12	1220740	651.2	7328.9	7328.9
RC2_2_5	140	12	1.30	3598.7	1.24	5084317	0.48	397997	0.47	352198	3874.2	5278.8	6229.2
RC2_2_6	140	12	-	-	-	-	-	-	-	-	-	-	-
RC2_2_7	140	12	1.30	3565.6	1.11	6504537	0.29	403605	0.28	353177	408.4	2204.7	3481.4
RC2_2_8	140	12	1.30	3539.1	1.24	8390395	0.53	1127029	0.53	1084792	13216.0	16425.1	18468.0
RC2_2_9	140	12	1.30	3532.4	1.14	8333191	0.44	1104080	0.44	1025095	7878.4	10781.4	12812.6
RC2_2_10	140	12	-	-	-	-	-	-	-	-	-	-	-
C2_2_1	140	13	1.00	3426.2	0.99	709056	0.32	28726	0.30	23396	42.0	801.5	801.5
C2_2_2	140	13	1.00	3376.3	0.95	2361724	0.31	64578	0.31	60945	153.3	1049.1	1049.1
C2_2_3	140	13	1.00	3304.6	0.68	7756965	0.13	275871	0.12	257097	148.6	1423.1	1423.1
C2_2_4	140	13	1.00	3289.5	0.70	14869058	0.03	159449	0.03	152295	49.6	1827.5	1827.5
C2_2_5	140	13	1.00	3369.7	0.92	1083879	0.16	12649	0.16	11035	8.5	628.5	628.5
C2_2_6	140	13	1.00	3356.7	0.91	1516373	0.25	41968	0.24	34507	32.2	840.6	840.6
C2_2_7	140	13	1.30	3356.6	1.02	4851720	0.30	316678	0.27	244925	577.1	1476.3	2034.2
C2_2_8	140	13	1.30	3351.2	1.19	5033977	0.44	277629	0.42	228774	1329.2	2330.5	3166.9

Name	$\|\mathcal{V}\|$	K	$UB_g\%$	OBJ	$\hat{LB}_1\%$	$\|\hat{\mathcal{R}}_1\|$	$LB_1\%$	$\|\mathcal{R}_1\|$	$LB_2\%$	$\|\mathcal{R}_2\|$	T_{int}	T_{valid}	T_{tot}
C2_2_9	140	13	1.30	3341.5	1.21	9903031	0.40	323122	0.40	295791	4042.6	5367.1	6422.0
C2_2_10	140	13	1.30	3333.0	1.15	8287717	0.30	169028	0.30	162585	981.1	2139.6	2878.3
R2_2_1	140	13	1.00	3960.7	0.74	386369	0.56	171599	0.55	164804	644.0	1425.9	1425.9
R2_2_2	140	13	1.00	3717.5	0.60	922198	0.45	518715	0.43	461049	469.5	1888.3	1888.3
R2_2_3	140	13	1.00	3593.3	0.74	2590414	0.49	835187	0.49	818631	6774.2	9504.6	9504.6
R2_2_4	140	13	1.00	3473.3	0.36	3828889	0.21	1856081	0.21	1848094	861.6	2835.4	2835.4
R2_2_5	140	13	1.00	3835.2	0.65	661583	0.55	408924	0.55	403471	3231.7	4022.4	4022.4
R2_2_6	140	13	1.00	3657.4	0.72	1278196	0.53	604051	0.50	495669	3104.2	4759.2	4759.2
R2_2_7	140	13	1.00	3551.9	0.56	2907993	0.36	1171649	0.34	1047507	3008.3	5599.6	5599.6
R2_2_8	140	13	1.00	3468.4	0.31	3667138	0.19	2332072	0.19	2289422	1000.3	2976.5	2976.5
R2_2_9	140	13	1.00	3755.8	0.66	749721	0.51	410904	0.51	387538	3257.4	4982.3	4982.3
R2_2_10	140	13	1.00	3677.3	0.87	924806	0.65	371466	0.63	328234	7941.2	9034.1	9034.1
RC2_2_1	140	13	1.00	3689.9	0.93	588100	0.34	45035	0.34	44650	84.1	1230.5	1230.5
RC2_2_2	140	13	-	-	-	-	-	-	-	-	-	-	-
RC2_2_3	140	13	1.00	3485.2	0.85	10432669	0.33	666732	0.31	576342	4643.8	9542.3	9542.3
RC2_2_4	140	13	1.00	3449.3	0.63	14502589	0.12	1233234	0.12	1220740	695.9	7207.8	7207.8
RC2_2_5	140	13	1.30	3583.1	1.00	5319414	0.33	692845	0.32	653019	1146.9	2593.7	3580.2
RC2_2_6	140	13	1.60	3602.6	1.38	8144580	0.59	1579934	0.59	1524447	6858.5	8913.6	11859.9
RC2_2_7	140	13	1.30	3559.6	1.10	6528744	0.32	473034	0.31	451331	1721.6	3752.5	5077.5
RC2_2_8	140	13	1.30	3535.6	1.20	8540104	0.51	1218919	0.51	1160435	6919.0	9875.9	12880.8
RC2_2_9	140	13	1.00	3524.8	0.98	2990721	0.30	100711	0.30	98214	730.1	2599.4	2599.4
RC2_2_10	140	13	-	-	-	-	-	-	-	-	-	-	-

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