# ONLINE APPENDIX
# An Iterated Dual Substitution Approach for Binary Integer Programming Problems under the Min–Max Regret Criterion

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**Abstract**

We consider binary integer programming problems with the min–max regret objective function under interval objective coefficients. We propose a heuristic framework, the iterated dual substitution (iDS) algorithm, which iteratively invokes a dual substitution heuristic and excludes from the search space any solution already checked in previous iterations. In iDS, we use a best-scenario-based lemma to improve performance. We apply iDS to four typical combinatorial optimization problems: the knapsack problem, the multidimensional knapsack problem, the generalized assignment problem, and the set covering problem. For the multidimensional knapsack problem, we compare the iDS approach with two algorithms widely used for problems with the min–max regret criterion: a fixed-scenario approach, and a branch-and-cut approach. The results of computational experiments on a broad set of benchmark instances show that the proposed iDS approach performs best on most tested instances. For the knapsack problem, the generalized assignment problem, and the set covering problem, we compare iDS with state-of-the-art results. The iDS algorithm successfully updates best known records for a number of benchmark instances.

## Appendix A. Detailed Results for the Min–Max Regret Multidimensional Knapsack Problem

Tables A.1–A.3 show the results of the algorithms including the branch-and-cut algorithm ("B&C"), the fixed-scenario algorithm ("Fix"), the DS algorithm ("DS"), iDS using Hamming-distance constraints ("iDS-H"), and iDS using best-scenario constraints ("iDS-B"). An MMR-MKP instance denoted by "*wwxxxyy-zz*" is generated from the *zz*th MKP instance with $m = ww$, $n = xxx$, $100\delta = yy$. Concerning the branch-and-cut algorithm, each entry shows the best obtained solution value ("obj"), the CPU time in seconds required to obtain that solution ("time"), the lower-bound value obtained within the time limit ("LB"), and the optimality gap as a percentage ("%gap"), that is, the gap between the solution value and the best lower-bound values. Since the fixed-scenario approach under the median-value scenario provides a solution, half of whose maximum regret is a valid lower bound, the lower-bound value used to compute the percentage optimality gap was the best between such value and the lower bound produced by the branch-and-cut algorithm. For iDS-H and iDS-B, we provide the number of iterations ("iter") required to obtain the best solution. Values in bold signify that the corresponding algorithm(s) obtained the smallest percentage optimality gap among the tested algorithms.

Table A.1: MMR-MKP results with $m = 5, n = 100$

| instance | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 0510010-01 | **662** | 73.7 | 662 | 0.0 | **662** | 0.5 | 0.0 | **662** | 1.2 | 0.0 | **662** | 1.2 | 1 | 0.0 | **662** | 1.2 | 1 | 0.0 |
| 0510010-02 | **663** | 94.9 | 663 | 0.0 | **663** | 1.8 | 0.0 | 676 | 0.7 | 1.9 | **663** | 2.1 | 2 | 0.0 | **663** | 2.6 | 2 | 0.0 |
| 0510010-03 | **426** | 51.7 | 426 | 0.0 | 457 | 2.1 | 6.8 | 441 | 1.3 | 3.4 | **426** | 6.7 | 5 | 0.0 | **426** | 6.3 | 5 | 0.0 |
| 0510010-04 | **809** | 783.7 | 809 | 0.0 | **809** | 1.9 | 0.0 | **809** | 11.3 | 0.0 | **809** | 11.3 | 1 | 0.0 | **809** | 11.3 | 1 | 0.0 |
| 0510010-05 | **737** | 85.9 | 737 | 0.0 | 755 | 3.5 | 2.4 | **737** | 1.7 | 0.0 | **737** | 1.7 | 1 | 0.0 | **737** | 1.7 | 1 | 0.0 |
| 0510010-06 | **482** | 121.8 | 482 | 0.0 | **482** | 0.4 | 0.0 | 541 | 1.7 | 10.9 | **482** | 3.7 | 2 | 0.0 | **482** | 3.3 | 2 | 0.0 |
| 0510010-07 | **603** | 34.0 | 603 | 0.0 | **603** | 0.5 | 0.0 | **603** | 0.8 | 0.0 | **603** | 0.8 | 1 | 0.0 | **603** | 0.8 | 1 | 0.0 |
| 0510010-08 | **406** | 341.7 | 406 | 0.0 | 482 | 1.2 | 15.8 | **406** | 0.8 | 0.0 | **406** | 0.8 | 1 | 0.0 | **406** | 0.8 | 1 | 0.0 |
| 0510010-09 | **469** | 110.4 | 469 | 0.0 | 499 | 1.9 | 6.0 | 499 | 1.3 | 6.0 | **469** | 3.1 | 2 | 0.0 | **469** | 3.2 | 2 | 0.0 |
| 0510010-10 | **587** | 362.3 | 587 | 0.0 | 644 | 2.0 | 8.9 | 604 | 3.0 | 2.8 | **587** | 8.6 | 2 | 0.0 | **587** | 8.2 | 2 | 0.0 |
| 0510010-11 | **422** | 62.2 | 422 | 0.0 | **422** | 0.1 | 0.0 | **422** | 0.4 | 0.0 | **422** | 0.4 | 1 | 0.0 | **422** | 0.4 | 1 | 0.0 |
| 0510010-12 | **667** | 47.3 | 667 | 0.0 | 696 | 0.8 | 4.2 | **667** | 2.5 | 0.0 | **667** | 2.5 | 1 | 0.0 | **667** | 2.5 | 1 | 0.0 |
| 0510010-13 | **618** | 204.2 | 618 | 0.0 | 633 | 1.9 | 2.4 | 633 | 6.9 | 2.4 | **618** | 22.3 | 3 | 0.0 | **618** | 22.4 | 3 | 0.0 |
| 0510010-14 | **442** | 78.7 | 442 | 0.0 | 466 | 1.9 | 5.2 | 476 | 1.8 | 7.1 | **442** | 10.8 | 4 | 0.0 | **442** | 11.3 | 4 | 0.0 |
| 0510010-15 | **409** | 62.4 | 409 | 0.0 | **409** | 0.8 | 0.0 | **409** | 1.0 | 0.0 | **409** | 1.0 | 1 | 0.0 | **409** | 1.0 | 1 | 0.0 |
| 0510010-16 | **507** | 53.0 | 507 | 0.0 | 603 | 0.6 | 15.9 | **507** | 1.0 | 0.0 | **507** | 1.0 | 1 | 0.0 | **507** | 1.0 | 1 | 0.0 |
| 0510010-17 | **413** | 38.1 | 413 | 0.0 | **413** | 0.3 | 0.0 | 417 | 0.6 | 1.0 | **413** | 1.6 | 2 | 0.0 | **413** | 1.5 | 2 | 0.0 |
| 0510010-18 | **579** | 85.3 | 579 | 0.0 | 638 | 3.0 | 9.2 | **579** | 1.6 | 0.0 | **579** | 1.6 | 1 | 0.0 | **579** | 1.6 | 1 | 0.0 |
| 0510010-19 | **646** | 187.7 | 646 | 0.0 | 647 | 0.7 | 0.2 | 647 | 0.9 | 0.2 | **646** | 5.2 | 3 | 0.0 | **646** | 4.4 | 3 | 0.0 |
| 0510010-20 | **525** | 46.8 | 525 | 0.0 | 554 | 0.5 | 5.2 | 554 | 0.9 | 5.2 | **525** | 3.2 | 3 | 0.0 | **525** | 3.3 | 3 | 0.0 |
| 0510010-21 | **326** | 19.6 | 326 | 0.0 | 377 | 0.4 | 13.5 | **326** | 0.2 | 0.0 | **326** | 0.2 | 1 | 0.0 | **326** | 0.2 | 1 | 0.0 |
| 0510010-22 | **413** | 33.0 | 413 | 0.0 | **413** | 0.2 | 0.0 | **413** | 1.4 | 0.0 | **413** | 1.4 | 1 | 0.0 | **413** | 1.4 | 1 | 0.0 |
| 0510010-23 | **488** | 71.6 | 488 | 0.0 | 494 | 1.1 | 1.2 | 494 | 1.9 | 1.2 | **488** | 12.2 | 4 | 0.0 | **488** | 13.9 | 4 | 0.0 |
| 0510010-24 | **417** | 54.8 | 417 | 0.0 | **417** | 0.6 | 0.0 | **417** | 1.2 | 0.0 | **417** | 1.2 | 1 | 0.0 | **417** | 1.2 | 1 | 0.0 |
| 0510010-25 | **363** | 22.2 | 363 | 0.0 | 366 | 3.0 | 0.8 | 380 | 0.6 | 4.5 | **363** | 3.2 | 3 | 0.0 | **363** | 3.1 | 3 | 0.0 |
| 0510010-26 | **497** | 21.9 | 497 | 0.0 | 544 | 1.0 | 8.6 | **497** | 1.4 | 0.0 | **497** | 1.4 | 1 | 0.0 | **497** | 1.4 | 1 | 0.0 |
| 0510010-27 | **350** | 42.3 | 350 | 0.0 | **350** | 0.3 | 0.0 | **350** | 0.4 | 0.0 | **350** | 0.4 | 1 | 0.0 | **350** | 0.4 | 1 | 0.0 |
| 0510010-28 | **363** | 9.5 | 363 | 0.0 | **363** | 0.3 | 0.0 | **363** | 0.4 | 0.0 | **363** | 0.4 | 1 | 0.0 | **363** | 0.4 | 1 | 0.0 |
| 0510010-29 | **381** | 32.0 | 381 | 0.0 | **381** | 0.2 | 0.0 | **381** | 0.4 | 0.0 | **381** | 0.4 | 1 | 0.0 | **381** | 0.4 | 1 | 0.0 |
| 0510010-30 | **340** | 49.7 | 340 | 0.0 | 383 | 1.6 | 11.2 | **340** | 1.0 | 0.0 | **340** | 1.0 | 1 | 0.0 | **340** | 1.0 | 1 | 0.0 |
| 0510020-01 | **1963** | 764.6 | 1963 | 0.0 | 1968 | 1.7 | 0.3 | 1984 | 7.5 | 1.1 | **1963** | 45.3 | 4 | 0.0 | **1963** | 44.0 | 4 | 0.0 |
| 0510020-02 | **1434** | 465.5 | 1434 | 0.0 | **1434** | 1.0 | 0.0 | 1457 | 2.3 | 1.6 | **1434** | 8.6 | 3 | 0.0 | **1434** | 8.7 | 3 | 0.0 |
| 0510020-03 | **1363** | 81.7 | 1363 | 0.0 | 1474 | 2.4 | 7.5 | **1363** | 1.5 | 0.0 | **1363** | 1.5 | 1 | 0.0 | **1363** | 1.5 | 1 | 0.0 |
| 0510020-04 | **2190** | 3418.2 | 1987 | 9.3 | 2240 | 0.4 | 11.3 | **2190** | 11.1 | 9.3 | **2190** | 11.1 | 1 | 9.3 | **2190** | 11.1 | 1 | 9.3 |
| 0510020-05 | **1732** | 1906.1 | 1732 | 0.0 | **1732** | 2.6 | 0.0 | **1732** | 3.0 | 0.0 | **1732** | 3.0 | 1 | 0.0 | **1732** | 3.0 | 1 | 0.0 |
| 0510020-06 | **1364** | 178.8 | 1364 | 0.0 | **1364** | 0.5 | 0.0 | **1364** | 0.4 | 0.0 | **1364** | 0.4 | 1 | 0.0 | **1364** | 0.4 | 1 | 0.0 |
| 0510020-07 | **1679** | 882.1 | 1679 | 0.0 | 1742 | 1.8 | 3.6 | **1679** | 5.6 | 0.0 | **1679** | 5.6 | 1 | 0.0 | **1679** | 5.6 | 1 | 0.0 |
| 0510020-08 | **1577** | 274.9 | 1577 | 0.0 | **1577** | 0.5 | 0.0 | **1577** | 2.2 | 0.0 | **1577** | 2.2 | 1 | 0.0 | **1577** | 2.2 | 1 | 0.0 |
| 0510020-09 | **1393** | 457.5 | 1393 | 0.0 | 1424 | 0.5 | 2.2 | 1424 | 1.3 | 2.2 | **1393** | 2.6 | 2 | 0.0 | **1393** | 2.7 | 2 | 0.0 |
| 0510020-10 | **1707** | 940.0 | 1707 | 0.0 | **1707** | 0.5 | 0.0 | 1717 | 2.9 | 0.6 | **1707** | 5.8 | 2 | 0.0 | **1707** | 5.7 | 2 | 0.0 |
| 0510020-11 | 1615 | 2785.1 | 1301 | 19.4 | 1602 | 2.2 | 18.8 | **1574** | 8.1 | 17.3 | **1574** | 8.1 | 1 | 17.3 | **1574** | 8.1 | 1 | 17.3 |
| 0510020-12 | **1224** | 214.7 | 1224 | 0.0 | **1224** | 0.3 | 0.0 | **1224** | 1.8 | 0.0 | **1224** | 1.8 | 1 | 0.0 | **1224** | 1.8 | 1 | 0.0 |
| 0510020-13 | **1767** | 3286.1 | 1493 | 15.5 | **1767** | 0.5 | 15.5 | **1767** | 7.8 | 15.5 | **1767** | 7.8 | 1 | 15.5 | **1767** | 7.8 | 1 | 15.5 |
| 0510020-14 | **1109** | 484.6 | 1109 | 0.0 | 1123 | 1.2 | 1.2 | **1109** | 1.5 | 0.0 | **1109** | 1.5 | 1 | 0.0 | **1109** | 1.5 | 1 | 0.0 |
| 0510020-15 | **1272** | 990.9 | 1272 | 0.0 | **1272** | 0.8 | 0.0 | **1272** | 2.2 | 0.0 | **1272** | 2.2 | 1 | 0.0 | **1272** | 2.2 | 1 | 0.0 |
| 0510020-16 | **1229** | 191.3 | 1229 | 0.0 | 1346 | 0.7 | 8.7 | **1229** | 1.4 | 0.0 | **1229** | 1.4 | 1 | 0.0 | **1229** | 1.4 | 1 | 0.0 |
| 0510020-17 | **1420** | 100.8 | 1420 | 0.0 | 1446 | 0.2 | 1.8 | **1420** | 0.8 | 0.0 | **1420** | 0.8 | 1 | 0.0 | **1420** | 0.8 | 1 | 0.0 |
| 0510020-18 | **1743** | 791.5 | 1743 | 0.0 | 1761 | 1.1 | 1.0 | **1743** | 5.7 | 0.0 | **1743** | 5.7 | 1 | 0.0 | **1743** | 5.7 | 1 | 0.0 |
| 0510020-19 | 2175 | 299.1 | 1626 | 25.2 | 2135 | 3.6 | 23.8 | **2122** | 21.7 | 23.4 | **2122** | 21.7 | 1 | 23.4 | **2122** | 21.7 | 1 | 23.4 |
| 0510020-20 | **1592** | 746.0 | 1592 | 0.0 | **1592** | 0.4 | 0.0 | **1592** | 1.9 | 0.0 | **1592** | 1.9 | 1 | 0.0 | **1592** | 1.9 | 1 | 0.0 |
| 0510020-21 | **1055** | 137.0 | 1055 | 0.0 | **1055** | 0.3 | 0.0 | **1055** | 0.8 | 0.0 | **1055** | 0.8 | 1 | 0.0 | **1055** | 0.8 | 1 | 0.0 |
| 0510020-22 | **809** | 235.5 | 809 | 0.0 | **809** | 0.4 | 0.0 | **809** | 0.5 | 0.0 | **809** | 0.5 | 1 | 0.0 | **809** | 0.5 | 1 | 0.0 |
| 0510020-23 | **1143** | 245.5 | 1143 | 0.0 | **1143** | 0.4 | 0.0 | **1143** | 2.3 | 0.0 | **1143** | 2.3 | 1 | 0.0 | **1143** | 2.3 | 1 | 0.0 |
| 0510020-24 | **1011** | 287.9 | 1011 | 0.0 | **1011** | 0.1 | 0.0 | **1011** | 0.2 | 0.0 | **1011** | 0.2 | 1 | 0.0 | **1011** | 0.2 | 1 | 0.0 |
| 0510020-25 | **1232** | 79.2 | 1232 | 0.0 | 1354 | 0.8 | 9.0 | **1232** | 1.0 | 0.0 | **1232** | 1.0 | 1 | 0.0 | **1232** | 1.0 | 1 | 0.0 |
| 0510020-26 | **1428** | 343.6 | 1428 | 0.0 | **1428** | 0.4 | 0.0 | 1433 | 3.6 | 0.3 | **1428** | 10.2 | 2 | 0.0 | **1428** | 8.7 | 2 | 0.0 |
| 0510020-27 | **1122** | 1232.4 | 1122 | 0.0 | **1122** | 0.6 | 0.0 | **1122** | 4.8 | 0.0 | **1122** | 4.8 | 1 | 0.0 | **1122** | 4.8 | 1 | 0.0 |
| 0510020-28 | **1003** | 132.6 | 1003 | 0.0 | **1003** | 0.3 | 0.0 | **1003** | 1.0 | 0.0 | **1003** | 1.0 | 1 | 0.0 | **1003** | 1.0 | 1 | 0.0 |
| 0510020-29 | **1214** | 479.6 | 1214 | 0.0 | **1214** | 0.9 | 0.0 | **1214** | 1.1 | 0.0 | **1214** | 1.1 | 1 | 0.0 | **1214** | 1.1 | 1 | 0.0 |
| 0510020-30 | **1101** | 226.3 | 1101 | 0.0 | **1101** | 0.4 | 0.0 | **1101** | 1.0 | 0.0 | **1101** | 1.0 | 1 | 0.0 | **1101** | 1.0 | 1 | 0.0 |
| 0510030-01 | 2774 | 2476.9 | 2134 | 23.1 | 2672 | 0.6 | 20.1 | 2672 | 9.8 | 20.1 | **2666** | 21.9 | 2 | 20.0 | **2666** | 22.2 | 2 | 20.0 |
| 0510030-02 | **3187** | 784.4 | 2752 | 13.6 | 3327 | 2.4 | 17.3 | **3187** | 25.1 | 13.6 | **3187** | 25.1 | 1 | 13.6 | **3187** | 25.1 | 1 | 13.6 |
| 0510030-03 | **2912** | 1075.5 | 2912 | 0.0 | **2912** | 0.4 | 0.0 | 2915 | 2.8 | 0.1 | **2912** | 6.2 | 2 | 0.0 | **2912** | 5.8 | 2 | 0.0 |
| 0510030-04 | 4122 | 2400.7 | 3111 | 24.5 | **3927** | 0.9 | 20.8 | 3979 | 41.7 | 21.8 | **3927** | 89.1 | 2 | 20.8 | **3927** | 85.1 | 2 | 20.8 |
| 0510030-05 | **3046** | 2193.2 | 2659 | 12.7 | 3109 | 2.0 | 14.5 | **3046** | 10.1 | 12.7 | **3046** | 10.1 | 1 | 12.7 | **3046** | 10.1 | 1 | 12.7 |
| 0510030-06 | **3122** | 2503.7 | 2915 | 6.6 | **3122** | 0.3 | 6.6 | **3122** | 10.6 | 6.6 | **3122** | 10.6 | 1 | 6.6 | **3122** | 10.6 | 1 | 6.6 |
| 0510030-07 | **3445** | 1112.6 | 3244 | 5.8 | 3500 | 0.6 | 7.3 | 3500 | 5.0 | 7.3 | **3445** | 13.4 | 2 | 5.8 | **3445** | 13.0 | 2 | 5.8 |
| 0510030-08 | **2556** | 3161.6 | 2375 | 7.1 | 2644 | 1.5 | 10.2 | **2556** | 2.6 | 7.1 | **2556** | 2.6 | 1 | 7.1 | **2556** | 2.6 | 1 | 7.1 |
| 0510030-09 | **2350** | 1641.1 | 2350 | 0.0 | 2423 | 0.8 | 3.0 | **2350** | 1.6 | 0.0 | **2350** | 1.6 | 1 | 0.0 | **2350** | 1.6 | 1 | 0.0 |
| 0510030-10 | 3172 | 1849.5 | 2467 | 22.2 | **3022** | 1.3 | 18.4 | **3022** | 14.9 | 18.4 | **3022** | 14.9 | 1 | 18.4 | **3022** | 14.9 | 1 | 18.4 |
| 0510030-11 | 3591 | 2424.5 | 2778 | 22.6 | 3508 | 0.6 | 20.8 | 3521 | 15.6 | 21.1 | **3488** | 31.5 | 2 | 20.4 | **3488** | 31.6 | 2 | 20.4 |
| 0510030-12 | 3226 | 2388.1 | 2461 | 23.7 | **3055** | 0.3 | 19.4 | **3055** | 14.0 | 19.4 | **3055** | 14.0 | 1 | 19.4 | **3055** | 14.0 | 1 | 19.4 |
| 0510030-13 | 3814 | 112.2 | 2767 | 27.5 | 3697 | 1.6 | 25.2 | 3677 | 94.8 | 24.7 | **3660** | 220.8 | 2 | 24.4 | **3660** | 217.1 | 2 | 24.4 |
| 0510030-14 | 3873 | 775.4 | 3054 | 21.1 | **3771** | 0.7 | 19.0 | **3771** | 13.1 | 19.0 | **3771** | 13.1 | 1 | 19.0 | **3771** | 13.1 | 1 | 19.0 |
| 0510030-15 | 3096 | 199.2 | 2373 | 23.4 | **3001** | 1.1 | 20.9 | **3001** | 7.6 | 20.9 | **3001** | 7.6 | 1 | 20.9 | **3001** | 7.6 | 1 | 20.9 |
| 0510030-16 | **2996** | 283.9 | 2523 | 15.8 | 3058 | 3.0 | 17.5 | 2997 | 14.5 | 15.8 | **2996** | 31.0 | 2 | 15.8 | **2996** | 27.8 | 2 | 15.8 |
| 0510030-17 | 2801 | 137.7 | 2347 | 16.2 | 2878 | 1.4 | 18.5 | 2801 | 6.8 | 16.2 | **2795** | 17.8 | 2 | 16.0 | **2795** | 18.0 | 2 | 16.0 |
| 0510030-18 | 3294 | 3476.8 | 2688 | 18.4 | 3320 | 0.5 | 19.0 | **3249** | 10.8 | 17.3 | **3249** | 10.8 | 1 | 17.3 | **3249** | 10.8 | 1 | 17.3 |
| 0510030-19 | 3170 | 1328.2 | 2406 | 24.1 | **3018** | 0.2 | 20.3 | **3018** | 11.6 | 20.3 | **3018** | 11.6 | 1 | 20.3 | **3018** | 11.6 | 1 | 20.3 |
| 0510030-20 | **2933** | 112.3 | 2821 | 3.8 | **2933** | 0.2 | 3.8 | **2933** | 2.0 | 3.8 | **2933** | 2.0 | 1 | 3.8 | **2933** | 2.0 | 1 | 3.8 |
| 0510030-21 | **2450** | 1193.4 | 2334 | 4.7 | **2450** | 0.5 | 4.7 | **2450** | 9.4 | 4.7 | **2450** | 9.4 | 1 | 4.7 | **2450** | 9.4 | 1 | 4.7 |
| 0510030-22 | **2453** | 1543.9 | 2453 | 0.0 | **2453** | 0.3 | 0.0 | **2453** | 6.7 | 0.0 | **2453** | 6.7 | 1 | 0.0 | **2453** | 6.7 | 1 | 0.0 |
| 0510030-23 | **2257** | 1082.6 | 2140 | 5.2 | **2257** | 0.3 | 5.2 | **2257** | 6.9 | 5.2 | **2257** | 6.9 | 1 | 5.2 | **2257** | 6.9 | 1 | 5.2 |
| 0510030-24 | **2206** | 2703.0 | 2080 | 5.7 | 2265 | 0.5 | 8.2 | 2208 | 4.4 | 5.8 | **2206** | 10.5 | 2 | 5.7 | **2206** | 10.3 | 2 | 5.7 |
| 0510030-25 | **2357** | 70.8 | 2357 | 0.0 | **2357** | 0.6 | 0.0 | **2357** | 5.8 | 0.0 | **2357** | 5.8 | 1 | 0.0 | **2357** | 5.8 | 1 | 0.0 |
| 0510030-26 | **2168** | 1205.5 | 2168 | 0.0 | **2168** | 0.3 | 0.0 | **2168** | 3.7 | 0.0 | **2168** | 3.7 | 1 | 0.0 | **2168** | 3.7 | 1 | 0.0 |
| 0510030-27 | 3202 | 1013.5 | 2685 | 16.1 | **3103** | 0.4 | 13.5 | 3142 | 26.6 | 14.5 | **3103** | 52.5 | 2 | 13.5 | **3103** | 71.2 | 2 | 13.5 |
| 0510030-28 | **2902** | 1462.3 | 2691 | 7.3 | 3006 | 0.3 | 10.5 | 2943 | 6.7 | 8.6 | **2902** | 78.7 | 7 | 7.3 | **2902** | 81.1 | 7 | 7.3 |
| 0510030-29 | **2200** | 1290.5 | 2200 | 0.0 | 2260 | 0.7 | 2.7 | **2200** | 6.4 | 0.0 | **2200** | 6.4 | 1 | 0.0 | **2200** | 6.4 | 1 | 0.0 |
| 0510030-30 | **2194** | 466.5 | 2194 | 0.0 | 2394 | 1.5 | 8.4 | **2194** | 2.4 | 0.0 | **2194** | 2.4 | 1 | 0.0 | **2194** | 2.4 | 1 | 0.0 |

Table A.2: MMR-MKP results with $m = 10, n = 100$

| | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 1010010-01 | **798** | 872.3 | 798 | 0.0 | 847 | 15.1 | 5.8 | **798** | 21.1 | 0.0 | **798** | 21.1 | 1 | 0.0 | **798** | 21.1 | 1 | 0.0 |
| 1010010-02 | **474** | 1170.3 | 474 | 0.0 | **474** | 3.7 | 0.0 | **474** | 3.5 | 0.0 | **474** | 3.5 | 1 | 0.0 | **474** | 3.5 | 1 | 0.0 |
| 1010010-03 | **759** | 3600.0 | 492 | 35.2 | 789 | 9.4 | 37.6 | **759** | 15.3 | 35.2 | **759** | 15.3 | 1 | 35.2 | **759** | 15.3 | 1 | 35.2 |
| 1010010-04 | 1195 | 2648.4 | 650 | 45.6 | 1148 | 47.4 | 43.4 | **1093** | 69.6 | 40.5 | **1093** | 69.6 | 1 | 40.5 | **1093** | 69.6 | 1 | 40.5 |
| 1010010-05 | **753** | 3217.5 | 753 | 0.0 | 881 | 11.7 | 14.5 | 805 | 20.9 | 6.5 | **753** | 44.7 | 2 | 0.0 | **753** | 47.9 | 2 | 0.0 |
| 1010010-06 | **807** | 1633.0 | 451 | 44.1 | **807** | 10.9 | 44.1 | **807** | 33.7 | 44.1 | **807** | 33.7 | 1 | 44.1 | **807** | 33.7 | 1 | 44.1 |
| 1010010-07 | **640** | 515.2 | 640 | 0.0 | 699 | 7.5 | 8.4 | 666 | 10.5 | 3.9 | **640** | 117.0 | 8 | 0.0 | **640** | 113.4 | 8 | 0.0 |
| 1010010-08 | **684** | 1085.3 | 684 | 0.0 | 731 | 6.7 | 6.4 | **684** | 6.8 | 0.0 | **684** | 6.8 | 1 | 0.0 | **684** | 6.8 | 1 | 0.0 |
| 1010010-09 | **611** | 570.1 | 611 | 0.0 | 613 | 3.2 | 0.3 | 613 | 6.2 | 0.3 | **611** | 15.6 | 2 | 0.0 | **611** | 13.5 | 2 | 0.0 |
| 1010010-10 | **593** | 1057.0 | 593 | 0.0 | **593** | 3.5 | 0.0 | **593** | 5.9 | 0.0 | **593** | 5.9 | 1 | 0.0 | **593** | 5.9 | 1 | 0.0 |
| 1010010-11 | **552** | 1912.1 | 552 | 0.0 | **552** | 3.3 | 0.0 | **552** | 4.1 | 0.0 | **552** | 4.1 | 1 | 0.0 | **552** | 4.1 | 1 | 0.0 |
| 1010010-12 | **661** | 3115.1 | 661 | 0.0 | **661** | 1.6 | 0.0 | **661** | 3.0 | 0.0 | **661** | 3.0 | 1 | 0.0 | **661** | 3.0 | 1 | 0.0 |
| 1010010-13 | **523** | 1485.7 | 523 | 0.0 | **523** | 6.0 | 0.0 | **523** | 2.7 | 0.0 | **523** | 2.7 | 1 | 0.0 | **523** | 2.7 | 1 | 0.0 |
| 1010010-14 | 936 | 3445.7 | 305 | 61.0 | **729** | 9.8 | 49.9 | **729** | 10.6 | 58.2 | **729** | 10.6 | 1 | 49.9 | **729** | 10.6 | 1 | 49.9 |
| 1010010-15 | **724** | 3071.9 | 724 | 0.0 | **724** | 7.9 | 0.0 | **724** | 9.7 | 0.0 | **724** | 9.7 | 1 | 0.0 | **724** | 9.7 | 1 | 0.0 |
| 1010010-16 | **721** | 2072.1 | 721 | 0.0 | 774 | 10.5 | 6.8 | 722 | 11.2 | 0.1 | **721** | 23.4 | 2 | 0.0 | **721** | 22.5 | 2 | 0.0 |
| 1010010-17 | 694 | 3546.0 | 112 | 47.6 | 728 | 25.8 | 50.0 | **608** | 17.6 | 81.6 | **608** | 17.6 | 1 | 40.1 | **608** | 17.6 | 1 | 40.1 |
| 1010010-18 | **447** | 2487.3 | 447 | 0.0 | **447** | 9.1 | 0.0 | **447** | 5.6 | 0.0 | **447** | 5.6 | 1 | 0.0 | **447** | 5.6 | 1 | 0.0 |
| 1010010-19 | **553** | 531.1 | 553 | 0.0 | 651 | 8.8 | 15.1 | **553** | 10.0 | 0.0 | **553** | 10.0 | 1 | 0.0 | **553** | 10.0 | 1 | 0.0 |
| 1010010-20 | 768 | 3600.0 | 59 | 60.2 | 611 | 30.5 | 49.9 | 577 | 24.4 | 89.8 | **568** | 477.7 | 10 | 46.1 | **568** | 443.2 | 10 | 46.1 |
| 1010010-21 | **365** | 78.9 | 365 | 0.0 | 386 | 1.0 | 5.4 | 386 | 1.1 | 5.4 | **365** | 3.7 | 2 | 0.0 | **365** | 4.5 | 2 | 0.0 |
| 1010010-22 | **569** | 1834.2 | 569 | 0.0 | 572 | 5.4 | 0.5 | 572 | 13.2 | 0.5 | **569** | 79.5 | 4 | 0.0 | **569** | 77.5 | 4 | 0.0 |
| 1010010-23 | **371** | 714.5 | 371 | 0.0 | **371** | 3.7 | 0.0 | **371** | 3.0 | 0.0 | **371** | 3.0 | 1 | 0.0 | **371** | 3.0 | 1 | 0.0 |
| 1010010-24 | **449** | 527.1 | 449 | 0.0 | **449** | 2.7 | 0.0 | **449** | 3.9 | 0.0 | **449** | 3.9 | 1 | 0.0 | **449** | 3.9 | 1 | 0.0 |
| 1010010-25 | **280** | 183.7 | 280 | 0.0 | 337 | 1.6 | 16.9 | **280** | 1.1 | 0.0 | **280** | 1.1 | 1 | 0.0 | **280** | 1.1 | 1 | 0.0 |
| 1010010-26 | **466** | 1497.9 | 466 | 0.0 | 552 | 9.2 | 15.6 | **466** | 6.8 | 0.0 | **466** | 6.8 | 1 | 0.0 | **466** | 6.8 | 1 | 0.0 |
| 1010010-27 | **512** | 949.7 | 512 | 0.0 | 554 | 6.9 | 7.6 | **512** | 7.4 | 0.0 | **512** | 7.4 | 1 | 0.0 | **512** | 7.4 | 1 | 0.0 |
| 1010010-28 | **335** | 156.9 | 335 | 0.0 | **335** | 0.7 | 0.0 | **335** | 1.0 | 0.0 | **335** | 1.0 | 1 | 0.0 | **335** | 1.0 | 1 | 0.0 |
| 1010010-29 | **396** | 394.4 | 396 | 0.0 | **396** | 1.8 | 0.0 | **396** | 0.9 | 0.0 | **396** | 0.9 | 1 | 0.0 | **396** | 0.9 | 1 | 0.0 |
| 1010010-30 | **310** | 122.5 | 310 | 0.0 | **310** | 1.2 | 0.0 | **310** | 2.0 | 0.0 | **310** | 2.0 | 1 | 0.0 | **310** | 2.0 | 1 | 0.0 |
| 1010020-01 | 1990 | 2696.6 | 1230 | 38.2 | 1877 | 7.0 | 34.5 | 1883 | 36.4 | 34.7 | **1827** | 76.2 | 2 | 32.7 | **1827** | 76.3 | 2 | 32.7 |
| 1010020-02 | 1798 | 3240.1 | 1126 | 37.4 | 1746 | 4.9 | 35.5 | **1666** | 14.3 | 32.4 | **1666** | 14.3 | 1 | 32.4 | **1666** | 14.3 | 1 | 32.4 |
| 1010020-03 | **1671** | 1065.1 | 1671 | 0.0 | **1671** | 7.9 | 0.0 | **1671** | 5.6 | 0.0 | **1671** | 5.6 | 1 | 0.0 | **1671** | 5.6 | 1 | 0.0 |
| 1010020-04 | 2052 | 1063.6 | 1198 | 41.6 | 2074 | 31.3 | 42.2 | 2082 | 92.8 | 42.5 | **2023** | 461.8 | 4 | 40.8 | **2023** | 465.2 | 4 | 40.8 |
| 1010020-05 | 2213 | 1174.4 | 1209 | 45.4 | **1870** | 0.7 | 35.3 | **1870** | 4.9 | 35.3 | **1870** | 4.9 | 1 | 35.3 | **1870** | 4.9 | 1 | 35.3 |
| 1010020-06 | 2514 | 3600.0 | 1361 | 45.9 | 2282 | 7.5 | 40.4 | **2232** | 44.6 | 39.0 | **2232** | 44.6 | 1 | 39.0 | **2232** | 44.6 | 1 | 39.0 |
| 1010020-07 | 2019 | 2043.1 | 1481 | 26.6 | 2019 | 3.8 | 26.6 | 2019 | 7.9 | 26.6 | **1969** | 22.9 | 2 | 24.8 | **1969** | 21.9 | 2 | 24.8 |
| 1010020-08 | 2243 | 2544.7 | 1490 | 33.6 | **1997** | 5.0 | 25.4 | **1997** | 18.4 | 25.4 | **1997** | 18.4 | 1 | 25.4 | **1997** | 18.4 | 1 | 25.4 |
| 1010020-09 | **1652** | 2510.8 | 1652 | 0.0 | 1687 | 1.2 | 2.1 | 1687 | 2.8 | 2.1 | **1652** | 10.4 | 2 | 0.0 | **1652** | 10.1 | 2 | 0.0 |
| 1010020-10 | 2424 | 3276.4 | 1279 | 47.2 | 2318 | 8.8 | 44.8 | **2230** | 27.8 | 42.6 | **2230** | 27.8 | 1 | 42.6 | **2230** | 27.8 | 1 | 42.6 |
| 1010020-11 | 2042 | 2556.9 | 810 | 54.3 | 1866 | 23.3 | 50.0 | 1795 | 74.9 | 54.9 | **1753** | 450.4 | 5 | 46.8 | **1753** | 437.2 | 5 | 46.8 |
| 1010020-12 | 1916 | 3088.7 | 804 | 56.3 | 1675 | 7.8 | 50.0 | 1643 | 63.3 | 51.1 | **1636** | 198.4 | 3 | 48.8 | **1636** | 203.0 | 3 | 48.8 |
| 1010020-13 | 1519 | 3171.3 | 565 | 60.2 | **1210** | 2.3 | 50.0 | **1210** | 2.9 | 53.3 | **1210** | 2.9 | 1 | 50.0 | **1210** | 2.9 | 1 | 50.0 |
| 1010020-14 | 2659 | 3098.9 | 976 | 59.6 | **2148** | 21.6 | 50.0 | 2152 | 71.8 | 54.6 | **2148** | 287.7 | 3 | 50.0 | **2148** | 261.4 | 3 | 50.0 |
| 1010020-15 | 1902 | 1672.3 | 1041 | 45.3 | 1793 | 7.9 | 41.9 | **1656** | 11.0 | 37.1 | **1656** | 11.0 | 1 | 37.1 | **1656** | 11.0 | 1 | 37.1 |
| 1010020-16 | 1892 | 3510.8 | 759 | 54.4 | 1725 | 9.9 | 50.0 | **1595** | 4.8 | 52.4 | **1595** | 4.8 | 1 | 45.9 | **1595** | 4.8 | 1 | 45.9 |
| 1010020-17 | 2583 | 5901.5 | 1063 | 58.8 | 2005 | 2.2 | 47.0 | **1954** | 6.7 | 45.6 | **1954** | 6.7 | 1 | 45.6 | **1954** | 6.7 | 1 | 45.6 |
| 1010020-18 | 1866 | 1591.0 | 1133 | 39.3 | 1826 | 6.5 | 38.0 | **1718** | 6.6 | 34.1 | **1718** | 6.6 | 1 | 34.1 | **1718** | 6.6 | 1 | 34.1 |
| 1010020-19 | 1519 | 4972.5 | 564 | 56.4 | 1324 | 6.9 | 50.0 | **1293** | 7.8 | 56.4 | **1293** | 7.8 | 1 | 48.8 | **1293** | 7.8 | 1 | 48.8 |
| 1010020-20 | 1628 | 5876.1 | 562 | 57.0 | 1399 | 19.7 | 50.0 | **1389** | 10.2 | 59.5 | **1389** | 10.2 | 1 | 49.6 | **1389** | 10.2 | 1 | 49.6 |
| 1010020-21 | **942** | 2277.9 | 789 | 16.2 | 949 | 2.6 | 16.9 | **942** | 3.6 | 16.2 | **942** | 3.6 | 1 | 16.2 | **942** | 3.6 | 1 | 16.2 |
| 1010020-22 | 1625 | 2786.9 | 861 | 47.0 | 1609 | 23.6 | 46.5 | 1540 | 77.6 | 44.1 | **1528** | 169.8 | 2 | 43.7 | **1528** | 169.6 | 2 | 43.7 |
| 1010020-23 | 1045 | 2962.4 | 779 | 25.5 | 1042 | 3.0 | 25.2 | **988** | 3.9 | 21.2 | **988** | 3.9 | 1 | 21.2 | **988** | 3.9 | 1 | 21.2 |
| 1010020-24 | 1563 | 3515.6 | 1081 | 30.8 | **1489** | 1.0 | 27.4 | **1489** | 12.9 | 27.4 | **1489** | 12.9 | 1 | 27.4 | **1489** | 12.9 | 1 | 27.4 |
| 1010020-25 | **901** | 522.9 | 901 | 0.0 | **901** | 0.7 | 0.0 | **901** | 1.1 | 0.0 | **901** | 1.1 | 1 | 0.0 | **901** | 1.1 | 1 | 0.0 |
| 1010020-26 | 1408 | 3237.9 | 1039 | 26.2 | **1352** | 4.9 | 23.2 | 1354 | 4.7 | 23.3 | **1352** | 11.3 | 2 | 23.2 | **1352** | 10.5 | 2 | 23.2 |
| 1010020-27 | 1376 | 1086.5 | 813 | 40.9 | 1235 | 4.0 | 34.2 | **1227** | 8.6 | 33.7 | **1227** | 8.6 | 1 | 33.7 | **1227** | 8.6 | 1 | 33.7 |
| 1010020-28 | **924** | 1032.3 | 924 | 0.0 | 963 | 1.8 | 4.0 | **924** | 2.0 | 0.0 | **924** | 2.0 | 1 | 0.0 | **924** | 2.0 | 1 | 0.0 |
| 1010020-29 | **1396** | 1786.9 | 1396 | 0.0 | **1396** | 1.6 | 0.0 | **1396** | 2.9 | 0.0 | **1396** | 2.9 | 1 | 0.0 | **1396** | 2.9 | 1 | 0.0 |
| 1010020-30 | **981** | 406.6 | 981 | 0.0 | 988 | 1.6 | 0.7 | 988 | 0.9 | 0.7 | **981** | 2.2 | 2 | 0.0 | **981** | 2.1 | 2 | 0.0 |
| 1010030-01 | 3218 | 2668.4 | 2137 | 33.6 | **3027** | 0.8 | 29.4 | **3027** | 16.1 | 29.4 | **3027** | 16.1 | 1 | 29.4 | **3027** | 16.1 | 1 | 29.4 |
| 1010030-02 | 3437 | 3582.6 | 2071 | 39.7 | 3306 | 7.6 | 37.4 | **3219** | 26.7 | 35.7 | **3219** | 26.7 | 1 | 35.7 | **3219** | 26.7 | 1 | 35.7 |
| 1010030-03 | **3200** | 660.3 | 2267 | 29.2 | **3200** | 5.1 | 29.2 | **3200** | 8.5 | 29.2 | **3200** | 8.5 | 1 | 29.2 | **3200** | 8.5 | 1 | 29.2 |
| 1010030-04 | 4224 | 340.3 | 2623 | 37.9 | 4069 | 24.0 | 35.5 | 4068 | 348.7 | 35.5 | **4057** | 2325.0 | 5 | 35.3 | **4057** | 2534.7 | 5 | 35.3 |
| 1010030-05 | 3590 | 1434.4 | 2107 | 41.3 | 3530 | 7.0 | 40.3 | **3336** | 22.7 | 36.8 | **3336** | 22.7 | 1 | 36.8 | **3336** | 22.7 | 1 | 36.8 |
| 1010030-06 | 4557 | 408.8 | 2667 | 41.5 | 4415 | 16.8 | 39.6 | 4328 | 286.0 | 38.4 | **4284** | 883.6 | 2 | 37.7 | **4284** | 864.1 | 2 | 37.7 |
| 1010030-07 | 2790 | 2027.7 | 1660 | 40.5 | 2845 | 4.6 | 41.7 | **2628** | 6.5 | 36.8 | **2628** | 6.5 | 1 | 36.8 | **2628** | 6.5 | 1 | 36.8 |
| 1010030-08 | **3183** | 2124.8 | 2263 | 28.9 | 3268 | 7.9 | 30.8 | 3229 | 18.3 | 29.9 | **3183** | 39.0 | 2 | 28.9 | **3183** | 37.2 | 2 | 28.9 |
| 1010030-09 | 3255 | 2539.4 | 2174 | 33.2 | **2937** | 0.4 | 26.0 | **2937** | 8.3 | 26.0 | **2937** | 8.3 | 1 | 26.0 | **2937** | 8.3 | 1 | 26.0 |
| 1010030-10 | 3773 | 848.0 | 2253 | 40.3 | **3601** | 2.8 | 37.4 | **3601** | 33.5 | 37.4 | **3601** | 33.5 | 1 | 37.4 | **3601** | 33.5 | 1 | 37.4 |
| 1010030-11 | 3375 | 1677.0 | 1861 | 44.9 | 3326 | 8.6 | 44.0 | 3278 | 130.4 | 43.2 | **3263** | 427.1 | 3 | 43.0 | **3263** | 424.0 | 3 | 43.0 |
| 1010030-12 | 3965 | 973.2 | 2152 | 45.7 | 3622 | 9.2 | 40.6 | 3618 | 137.7 | 40.5 | **3608** | 297.6 | 2 | 40.4 | **3608** | 300.7 | 2 | 40.4 |
| 1010030-13 | 3584 | 2495.2 | 1914 | 46.6 | 3623 | 5.3 | 47.2 | **3479** | 173.1 | 45.0 | **3479** | 172.9 | 1 | 45.0 | **3479** | 173.1 | 1 | 45.0 |
| 1010030-14 | 4587 | 475.4 | 2077 | 54.7 | **3937** | 32.8 | 47.2 | **3937** | 825.0 | 47.2 | **3937** | 823.1 | 1 | 47.2 | **3937** | 825.0 | 1 | 47.2 |
| 1010030-15 | 3650 | 1745.7 | 1987 | 45.6 | **3337** | 2.7 | 40.5 | **3337** | 127.5 | 40.5 | **3337** | 127.7 | 1 | 40.5 | **3337** | 127.5 | 1 | 40.5 |
| 1010030-16 | 3386 | 1511.6 | 2054 | 39.3 | 3364 | 7.8 | 38.9 | 3294 | 47.8 | 37.6 | **3273** | 111.7 | 2 | 37.2 | **3273** | 109.2 | 2 | 37.2 |
| 1010030-17 | 3956 | 1830.9 | 1913 | 51.6 | **3384** | 18.6 | 43.5 | **3384** | 137.2 | 43.5 | **3384** | 137.7 | 1 | 43.5 | **3384** | 137.2 | 1 | 43.5 |
| 1010030-18 | 3600 | 729.0 | 1228 | 65.0 | **2522** | 11.2 | 50.0 | **2522** | 17.3 | 51.3 | **2522** | 17.5 | 1 | 50.0 | **2522** | 17.3 | 1 | 50.0 |
| 1010030-19 | 3931 | 3600.0 | 1746 | 55.6 | 3472 | 8.2 | 49.7 | 3471 | 207.1 | 49.7 | **3461** | 902.6 | 4 | 49.6 | **3461** | 910.2 | 4 | 49.6 |
| 1010030-20 | 3422 | 2848.7 | 1611 | 52.9 | 3190 | 11.0 | 49.5 | **3142** | 93.1 | 48.7 | **3142** | 93.8 | 1 | 48.7 | **3142** | 93.1 | 1 | 48.7 |
| 1010030-21 | 2327 | 1393.7 | 1575 | 32.3 | 2264 | 1.5 | 30.4 | 2264 | 10.8 | 30.4 | **2251** | 48.5 | 3 | 30.0 | **2251** | 48.9 | 3 | 30.0 |
| 1010030-22 | **3200** | 3600.0 | 2178 | 31.9 | **3200** | 7.0 | 31.9 | 3243 | 565.3 | 32.8 | 3214 | 3600.0 | 6 | 32.2 | 3214 | 3600.0 | 6 | 32.2 |
| 1010030-23 | 2610 | 2990.7 | 1703 | 34.8 | 2473 | 3.3 | 31.1 | **2380** | 10.7 | 28.4 | **2380** | 10.7 | 1 | 28.4 | **2380** | 10.7 | 1 | 28.4 |
| 1010030-24 | 2638 | 618.9 | 1790 | 32.1 | **2385** | 8.1 | 24.9 | **2385** | 23.4 | 24.9 | **2385** | 23.4 | 1 | 24.9 | **2385** | 23.4 | 1 | 24.9 |
| 1010030-25 | **2059** | 3069.8 | 2059 | 0.0 | **2059** | 0.5 | 0.0 | **2059** | 2.8 | 0.0 | **2059** | 2.8 | 1 | 0.0 | **2059** | 2.8 | 1 | 0.0 |
| 1010030-26 | 2871 | 1071.0 | 1687 | 41.2 | 2677 | 8.3 | 37.0 | 2644 | 26.0 | 36.2 | **2589** | 55.5 | 2 | 34.8 | **2589** | 57.9 | 2 | 34.8 |
| 1010030-27 | 2970 | 937.0 | 1636 | 44.9 | 2673 | 5.7 | 38.8 | **2659** | 85.6 | 38.5 | **2659** | 86.2 | 1 | 38.5 | **2659** | 85.6 | 1 | 38.5 |
| 1010030-28 | 2420 | 3131.4 | 1596 | 34.0 | 2266 | 2.0 | 29.6 | **2099** | 1.2 | 24.0 | **2099** | 1.2 | 1 | 24.0 | **2099** | 1.2 | 1 | 24.0 |
| 1010030-29 | **2092** | 3600.0 | 1855 | 11.3 | **2092** | 1.1 | 11.3 | **2092** | 3.7 | 11.3 | **2092** | 3.7 | 1 | 11.3 | **2092** | 3.7 | 1 | 11.3 |
| 1010030-30 | **2134** | 1998.1 | 2134 | 0.0 | **2134** | 0.4 | 0.0 | **2134** | 1.5 | 0.0 | **2134** | 1.5 | 1 | 0.0 | **2134** | 1.5 | 1 | 0.0 |

Table A.3: MMR-MKP results with $m = 5, n = 250$

| instance | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 0525010-01 | 1176 | 3284.8 | 481 | 58.6 | 973 | 9.4 | 49.9 | 976 | 71.8 | 50.7 | **940** | 145.4 | 2 | 48.2 | **940** | 144.1 | 2 | 48.2 |
| 0525010-02 | 1378 | 3600.0 | 501 | 63.6 | 993 | 25.4 | 49.5 | 993 | 59.1 | 49.5 | **978** | 123.6 | 2 | 48.8 | **978** | 129.8 | 2 | 48.8 |
| 0525010-03 | 1288 | 1073.5 | 353 | 62.7 | 959 | 8.3 | 49.9 | 959 | 110.9 | 63.2 | **956** | 530.2 | 4 | 49.8 | **956** | 529.3 | 4 | 49.8 |
| 0525010-04 | 1943 | 574.9 | 600 | 66.0 | **1321** | 121.2 | 50.0 | **1321** | 575.0 | 54.6 | **1321** | 575.0 | 1 | 50.0 | **1321** | 575.0 | 1 | 50.0 |
| 0525010-05 | 1203 | 3133.8 | 311 | 61.0 | 937 | 17.0 | 49.9 | **919** | 65.7 | 66.2 | **919** | 65.7 | 1 | 49.0 | **919** | 65.7 | 1 | 49.0 |
| 0525010-06 | 1554 | 466.3 | 645 | 58.5 | **1209** | 18.1 | 46.7 | **1209** | 202.1 | 46.7 | **1209** | 202.1 | 1 | 46.7 | **1209** | 202.1 | 1 | 46.7 |
| 0525010-07 | 1472 | 1959.1 | 696 | 52.7 | 1263 | 63.8 | 44.9 | **1218** | 298.1 | 42.9 | **1218** | 298.1 | 1 | 42.9 | **1218** | 298.1 | 1 | 42.9 |
| 0525010-08 | 1580 | 3221.4 | 534 | 66.0 | 1073 | 10.5 | 50.0 | 1073 | 88.3 | 50.2 | **1067** | 302.9 | 3 | 49.7 | **1067** | 282.4 | 3 | 49.7 |
| 0525010-09 | 1480 | 2924.7 | 661 | 55.3 | **1154** | 7.6 | 42.7 | **1154** | 97.8 | 42.7 | **1154** | 97.8 | 1 | 42.7 | **1154** | 97.8 | 1 | 42.7 |
| 0525010-10 | 1342 | 3600.0 | 635 | 52.7 | **1086** | 11.2 | 41.5 | **1086** | 84.9 | 41.5 | **1086** | 84.9 | 1 | 41.5 | **1086** | 84.9 | 1 | 41.5 |
| 0525010-11 | 1750 | 3600.0 | 644 | 63.2 | 1240 | 42.7 | 48.1 | **1233** | 347.3 | 47.8 | **1233** | 347.3 | 1 | 47.8 | **1233** | 347.3 | 1 | 47.8 |
| 0525010-12 | 1046 | 2894.1 | 573 | 45.2 | **947** | 7.3 | 39.5 | **947** | 79.7 | 39.5 | **947** | 79.7 | 1 | 39.5 | **947** | 79.7 | 1 | 39.5 |
| 0525010-13 | 1854 | 3600.0 | 504 | 72.8 | **1004** | 9.2 | 49.8 | **1004** | 110.9 | 49.8 | **1004** | 110.9 | 1 | 49.8 | **1004** | 110.9 | 1 | 49.8 |
| 0525010-14 | 1658 | 3600.0 | 535 | 67.7 | **1021** | 7.9 | 47.6 | **1021** | 83.8 | 47.6 | **1021** | 83.8 | 1 | 47.6 | **1021** | 83.8 | 1 | 47.6 |
| 0525010-15 | 2845 | 1111.0 | 531 | 79.6 | 1162 | 19.3 | 50.0 | **1135** | 671.2 | 53.2 | **1135** | 671.2 | 1 | 48.8 | **1135** | 671.2 | 1 | 48.8 |
| 0525010-16 | 1653 | 1389.0 | 581 | 64.9 | 1072 | 50.8 | 45.8 | 1072 | 481.9 | 45.8 | **1061** | 983.6 | 2 | 45.2 | **1061** | 1003.1 | 2 | 45.2 |
| 0525010-17 | 1397 | 3285.8 | 573 | 59.0 | 1103 | 17.1 | 48.1 | **1099** | 155.0 | 47.9 | **1099** | 155.0 | 1 | 47.9 | **1099** | 155.0 | 1 | 47.9 |
| 0525010-18 | 2622 | 942.6 | 648 | 71.5 | 1496 | 82.3 | 50.0 | **1476** | 1028.9 | 56.1 | **1476** | 1028.9 | 1 | 49.3 | **1476** | 1028.9 | 1 | 49.3 |
| 0525010-19 | 2819 | 3600.0 | 311 | 85.3 | **828** | 4.3 | 50.0 | **828** | 33.6 | 62.4 | **828** | 33.6 | 1 | 50.0 | **828** | 33.6 | 1 | 50.0 |
| 0525010-20 | 1355 | 3600.0 | 448 | 66.3 | 911 | 15.7 | 49.9 | 921 | 84.2 | 51.4 | **904** | 311.0 | 3 | 49.6 | **904** | 302.8 | 3 | 49.6 |
| 0525010-21 | 1407 | 3600.0 | 487 | 64.5 | 999 | 79.1 | 49.9 | **968** | 315.2 | 49.7 | **968** | 315.2 | 1 | 48.3 | **968** | 315.2 | 1 | 48.3 |
| 0525010-22 | 579 | 3455.3 | 376 | 35.1 | **543** | 1.2 | 30.8 | **543** | 10.5 | 30.8 | **543** | 10.5 | 1 | 30.8 | **543** | 10.5 | 1 | 30.8 |
| 0525010-23 | 1169 | 2469.9 | 511 | 56.3 | **919** | 36.6 | 44.4 | **919** | 226.3 | 44.4 | **919** | 226.3 | 1 | 44.4 | **919** | 226.3 | 1 | 44.4 |
| 0525010-24 | 908 | 3169.6 | 345 | 61.1 | **706** | 18.5 | 50.0 | 708 | 41.6 | 51.3 | **706** | 208.8 | 3 | 50.0 | **706** | 197.2 | 3 | 50.0 |
| 0525010-25 | 1123 | 5206.2 | 387 | 65.5 | **749** | 13.3 | 48.3 | **749** | 27.4 | 48.3 | **749** | 27.4 | 1 | 48.3 | **749** | 27.4 | 1 | 48.3 |
| 0525010-26 | 959 | 2131.1 | 437 | 54.4 | **712** | 3.3 | 38.6 | **712** | 14.2 | 38.6 | **712** | 14.2 | 1 | 38.6 | **712** | 14.2 | 1 | 38.6 |
| 0525010-27 | 667 | 3167.1 | 242 | 60.0 | 533 | 5.2 | 49.9 | **532** | 34.4 | 54.5 | **532** | 34.4 | 1 | 49.8 | **532** | 34.4 | 1 | 49.8 |
| 0525010-28 | 790 | 3103.4 | 550 | 30.4 | **766** | 3.4 | 28.2 | 790 | 25.4 | 30.4 | **766** | 62.7 | 2 | 28.2 | **766** | 58.0 | 2 | 28.2 |
| 0525010-29 | 771 | 3050.9 | 442 | 42.7 | 703 | 7.4 | 37.1 | 685 | 9.0 | 35.5 | **669** | 24.7 | 2 | 33.9 | **669** | 23.8 | 2 | 33.9 |
| 0525010-30 | **639** | 1752.0 | 543 | 15.0 | 696 | 7.5 | 22.0 | **639** | 12.4 | 15.0 | **639** | 12.4 | 1 | 15.0 | **639** | 12.4 | 1 | 15.0 |
| 0525020-01 | 4758 | 2158.3 | 2057 | 56.8 | **3404** | 3.6 | 39.6 | **3404** | 818.9 | 39.6 | **3404** | 818.9 | 1 | 39.6 | **3404** | 818.9 | 1 | 39.6 |
| 0525020-02 | 4977 | 1013.2 | 1728 | 64.9 | **3492** | 7.7 | 50.0 | **3492** | 1509.9 | 50.5 | **3492** | 1509.9 | 1 | 50.0 | **3492** | 1509.9 | 1 | 50.0 |
| 0525020-03 | 5207 | 1686.4 | 2445 | 53.0 | 4253 | 17.6 | 42.5 | **4205** | 2243.5 | 41.9 | **4205** | 2243.5 | 1 | 41.9 | **4205** | 2243.5 | 1 | 41.9 |
| 0525020-04 | 6016 | 2642.2 | 3034 | 49.6 | **5025** | 50.5 | 39.6 | 5043 | 3600.0 | 39.8 | 5043 | 3600.0 | 1 | 39.8 | 5043 | 3600.0 | 1 | 39.8 |
| 0525020-05 | 6697 | 468.7 | 1720 | 74.3 | 3317 | 7.0 | 48.1 | 3317 | 709.1 | 48.1 | **3302** | 1258.0 | 2 | 47.9 | **3302** | 1181.1 | 2 | 47.9 |
| 0525020-06 | 5263 | 2611.0 | 2316 | 56.0 | 4020 | 83.7 | 42.4 | **3962** | 3600.0 | 41.5 | **3962** | 3600.0 | 1 | 41.5 | **3962** | 3600.0 | 1 | 41.5 |
| 0525020-07 | 4810 | 842.4 | 1605 | 65.5 | 3318 | 12.0 | 50.0 | **3289** | 1888.1 | 51.2 | **3289** | 1888.1 | 1 | 49.6 | **3289** | 1888.1 | 1 | 49.6 |
| 0525020-08 | 4773 | 2593.0 | 2237 | 53.1 | 3837 | 59.4 | 41.7 | **3813** | 3600.0 | 41.3 | **3813** | 3600.0 | 1 | 41.3 | **3813** | 3600.0 | 1 | 41.3 |
| 0525020-09 | 4079 | 3600.0 | 1808 | 55.7 | 3324 | 6.7 | 45.6 | **3288** | 637.7 | 45.0 | **3288** | 637.7 | 1 | 45.0 | **3288** | 637.7 | 1 | 45.0 |
| 0525020-10 | 3805 | 3600.0 | 1770 | 53.5 | **3104** | 9.1 | 43.0 | **3104** | 1457.5 | 43.0 | **3104** | 1457.5 | 1 | 43.0 | **3104** | 1457.5 | 1 | 43.0 |
| 0525020-11 | 7673 | 1684.9 | 2155 | 71.3 | **4408** | 20.3 | 50.0 | 4467 | 3600.0 | 51.8 | 4467 | 3600.0 | 1 | 50.7 | 4467 | 3600.0 | 1 | 50.7 |
| 0525020-12 | 4635 | 387.8 | 2045 | 55.9 | 3477 | 14.5 | 41.2 | **3427** | 2635.2 | 40.3 | **3427** | 2635.2 | 1 | 40.3 | **3427** | 2635.2 | 1 | 40.3 |
| 0525020-13 | 4583 | 3600.0 | 1937 | 57.7 | **3323** | 5.6 | 41.7 | 3346 | 3600.0 | 42.1 | 3346 | 3600.0 | 1 | 42.1 | 3346 | 3600.0 | 1 | 42.1 |
| 0525020-14 | 4671 | 3379.2 | 2406 | 48.5 | 4134 | 16.1 | 41.8 | **4093** | 3600.0 | 41.2 | **4093** | 3600.0 | 1 | 41.2 | **4093** | 3600.0 | 1 | 41.2 |
| 0525020-15 | 5615 | 3600.0 | 2386 | 57.5 | 4390 | 42.0 | 45.6 | **4365** | 3600.0 | 45.3 | **4365** | 3600.0 | 1 | 45.3 | **4365** | 3600.0 | 1 | 45.3 |
| 0525020-16 | 4905 | 3310.5 | 2220 | 54.7 | 3816 | 7.5 | 41.8 | **3774** | 3600.0 | 41.2 | **3774** | 3600.0 | 1 | 41.2 | **3774** | 3600.0 | 1 | 41.2 |
| 0525020-17 | 6666 | 615.2 | 1651 | 75.2 | **3161** | 16.0 | 47.8 | **3161** | 778.0 | 47.8 | **3161** | 778.0 | 1 | 47.8 | **3161** | 778.0 | 1 | 47.8 |
| 0525020-18 | 5722 | 3600.0 | 2398 | 58.1 | 4061 | 18.5 | 41.0 | **4034** | 3600.0 | 40.6 | **4034** | 3600.0 | 1 | 40.6 | **4034** | 3600.0 | 1 | 40.6 |
| 0525020-19 | 7501 | 449.4 | 1770 | 76.4 | 3371 | 4.2 | 47.5 | **3362** | 2077.0 | 47.4 | **3362** | 2077.0 | 1 | 47.4 | **3362** | 2077.0 | 1 | 47.4 |
| 0525020-20 | 6733 | 817.7 | 1661 | 75.3 | **3315** | 2.1 | 49.9 | **3315** | 2196.7 | 49.9 | **3315** | 2196.7 | 1 | 49.9 | **3315** | 2196.7 | 1 | 49.9 |
| 0525020-21 | 4950 | 2804.3 | 2088 | 57.8 | **3516** | 21.1 | 40.6 | 3543 | 3600.0 | 41.1 | 3543 | 3600.0 | 1 | 41.1 | 3543 | 3600.0 | 1 | 41.1 |
| 0525020-22 | 3559 | 2303.4 | 1366 | 61.6 | 2435 | 13.2 | 43.9 | **2411** | 179.0 | 43.3 | **2411** | 179.0 | 1 | 43.3 | **2411** | 179.0 | 1 | 43.3 |
| 0525020-23 | 3593 | 2388.0 | 1708 | 52.5 | 2786 | 7.3 | 38.7 | **2776** | 1204.1 | 38.5 | **2776** | 1204.1 | 1 | 38.5 | **2776** | 1204.1 | 1 | 38.5 |
| 0525020-24 | 3556 | 3390.4 | 1420 | 60.1 | **2405** | 7.5 | 41.0 | **2405** | 1607.5 | 41.0 | **2405** | 1607.5 | 1 | 41.0 | **2405** | 1607.5 | 1 | 41.0 |
| 0525020-25 | 4129 | 3001.2 | 1795 | 56.5 | **3023** | 17.2 | 40.6 | **3023** | 3600.0 | 40.6 | **3023** | 3600.0 | 1 | 40.6 | **3023** | 3600.0 | 1 | 40.6 |
| 0525020-26 | 4075 | 3046.0 | 1578 | 61.3 | 2785 | 50.4 | 43.3 | **2772** | 3600.0 | 43.1 | **2772** | 3600.0 | 1 | 43.1 | **2772** | 3600.0 | 1 | 43.1 |
| 0525020-27 | 3005 | 3057.1 | 1328 | 55.8 | 2254 | 2.6 | 41.1 | 2252 | 338.5 | 41.0 | **2247** | 1622.3 | 5 | 40.9 | **2247** | 1589.9 | 5 | 40.9 |
| 0525020-28 | 2999 | 3541.9 | 1594 | 46.8 | 2550 | 11.3 | 37.5 | **2514** | 2314.7 | 36.6 | **2514** | 2314.7 | 1 | 36.6 | **2514** | 2314.7 | 1 | 36.6 |
| 0525020-29 | 2959 | 1209.4 | 1230 | 58.4 | **2190** | 1.0 | 43.8 | **2190** | 35.3 | 43.8 | **2190** | 35.3 | 1 | 43.8 | **2190** | 35.3 | 1 | 43.8 |
| 0525020-30 | 3547 | 3981.8 | 1292 | 63.6 | **2207** | 3.4 | 41.5 | **2207** | 96.7 | 41.5 | **2207** | 96.7 | 1 | 41.5 | **2207** | 96.7 | 1 | 41.5 |
| 0525030-01 | 9578 | 2959.9 | 4616 | 51.8 | 7806 | 39.4 | 40.9 | **7793** | 3600.0 | 40.8 | **7793** | 3600.0 | 1 | 40.8 | **7793** | 3600.0 | 1 | 40.8 |
| 0525030-02 | 9933 | 3469.1 | 4083 | 58.9 | **7011** | 3.0 | 41.8 | **7011** | 2047.9 | 41.8 | **7011** | 2047.9 | 1 | 41.8 | **7011** | 2047.9 | 1 | 41.8 |
| 0525030-03 | 10528 | 3003.9 | 4956 | 52.9 | 8202 | 19.0 | 39.6 | **8176** | 3600.0 | 39.4 | **8176** | 3600.0 | 1 | 39.4 | **8176** | 3600.0 | 1 | 39.4 |
| 0525030-04 | 8941 | 2415.6 | 4486 | 49.8 | **7601** | 13.5 | 41.0 | 7610 | 3600.0 | 41.1 | 7610 | 3600.0 | 1 | 41.1 | 7610 | 3600.0 | 1 | 41.1 |
| 0525030-05 | 8061 | 2872.0 | 4077 | 49.4 | 6678 | 14.6 | 38.9 | **6668** | 3600.0 | 38.9 | **6668** | 3600.0 | 1 | 38.9 | **6668** | 3600.0 | 1 | 38.9 |
| 0525030-06 | 9247 | 3874.1 | 4283 | 53.7 | **7055** | 7.9 | 39.3 | **7055** | 3600.0 | 39.3 | **7055** | 3600.0 | 1 | 39.3 | **7055** | 3600.0 | 1 | 39.3 |
| 0525030-07 | 9285 | 2391.7 | 3319 | 64.3 | 6754 | 16.7 | 50.9 | **6706** | 3179.0 | 50.5 | **6706** | 3179.0 | 1 | 50.5 | **6706** | 3179.0 | 1 | 50.5 |
| 0525030-08 | 10985 | 2492.1 | 5174 | 52.9 | **8441** | 6.3 | 38.7 | **8441** | 3600.0 | 38.7 | **8441** | 3600.0 | 1 | 38.7 | **8441** | 3600.0 | 1 | 38.7 |
| 0525030-09 | 8741 | 847.9 | 4568 | 47.7 | **7172** | 2.8 | 36.3 | **7172** | 2562.5 | 36.3 | **7172** | 2562.5 | 1 | 36.3 | **7172** | 2562.5 | 1 | 36.3 |
| 0525030-10 | 8110 | 2533.9 | 4172 | 48.6 | 6642 | 11.2 | 37.2 | **6641** | 3600.0 | 37.2 | **6641** | 3600.0 | 1 | 37.2 | **6641** | 3600.0 | 1 | 37.2 |
| 0525030-11 | 12736 | 2330.6 | 4754 | 62.7 | **8338** | 46.4 | 43.0 | 8341 | 3600.0 | 43.0 | 8341 | 3600.0 | 1 | 43.0 | 8341 | 3600.0 | 1 | 43.0 |
| 0525030-12 | 10717 | 3391.2 | 4760 | 55.6 | 7947 | 6.5 | 40.1 | **7885** | 3600.0 | 39.6 | **7885** | 3600.0 | 1 | 39.6 | **7885** | 3600.0 | 1 | 39.6 |
| 0525030-13 | 8479 | 4933.2 | 3926 | 53.7 | 6888 | 32.7 | 43.0 | **6820** | 3600.0 | 42.4 | **6820** | 3600.0 | 1 | 42.4 | **6820** | 3600.0 | 1 | 42.4 |
| 0525030-14 | 10423 | 3844.6 | 4590 | 56.0 | 7616 | 33.9 | 39.7 | **7544** | 3600.0 | 39.2 | **7544** | 3600.0 | 1 | 39.2 | **7544** | 3600.0 | 1 | 39.2 |
| 0525030-15 | 18185 | 1740.9 | 4542 | 75.0 | **9067** | 24.7 | 49.9 | 9093 | 3600.0 | 50.0 | 9093 | 3600.0 | 1 | 50.0 | 9093 | 3600.0 | 1 | 50.0 |
| 0525030-16 | 12987 | 838.5 | 4120 | 68.3 | 7148 | 12.5 | 42.4 | **7114** | 3600.0 | 42.1 | **7114** | 3600.0 | 1 | 42.1 | **7114** | 3600.0 | 1 | 42.1 |
| 0525030-17 | 9429 | 2795.1 | 4584 | 51.4 | **7471** | 7.7 | 38.6 | **7471** | 3600.0 | 38.6 | **7471** | 3600.0 | 1 | 38.6 | **7471** | 3600.0 | 1 | 38.6 |
| 0525030-18 | 9985 | 2914.9 | 5068 | 49.2 | **8644** | 28.7 | 41.4 | **8644** | 3600.0 | 41.4 | **8644** | 3600.0 | 1 | 41.4 | **8644** | 3600.0 | 1 | 41.4 |
| 0525030-19 | 10166 | 2852.4 | 5293 | 47.9 | 8891 | 6.6 | 40.5 | **8851** | 3600.0 | 40.2 | **8851** | 3600.0 | 1 | 40.2 | **8851** | 3600.0 | 1 | 40.2 |
| 0525030-20 | 11712 | 3187.5 | 5262 | 55.1 | **8774** | 79.3 | 40.0 | 8798 | 3600.0 | 40.2 | 8798 | 3600.0 | 1 | 40.2 | 8798 | 3600.0 | 1 | 40.2 |
| 0525030-21 | 6545 | 2734.0 | 3239 | 50.5 | 5418 | 8.8 | 40.2 | **5369** | 679.3 | 39.7 | **5369** | 679.3 | 1 | 39.7 | **5369** | 679.3 | 1 | 39.7 |
| 0525030-22 | 6471 | 2002.1 | 3179 | 50.9 | **5204** | 4.5 | 38.9 | **5204** | 3600.0 | 38.9 | **5204** | 3600.0 | 1 | 38.9 | **5204** | 3600.0 | 1 | 38.9 |
| 0525030-23 | 8702 | 2665.0 | 3833 | 56.0 | 6359 | 22.7 | 39.7 | **6312** | 3600.0 | 39.3 | **6312** | 3600.0 | 1 | 39.3 | **6312** | 3600.0 | 1 | 39.3 |
| 0525030-24 | 6274 | 3412.4 | 3330 | 46.9 | **5246** | 10.9 | 36.5 | **5246** | 3600.0 | 36.5 | **5246** | 3600.0 | 1 | 36.5 | **5246** | 3600.0 | 1 | 36.5 |
| 0525030-25 | 8802 | 1918.8 | 3815 | 56.7 | **6070** | 15.8 | 37.1 | 6080 | 3600.0 | 37.3 | 6080 | 3600.0 | 1 | 37.3 | 6080 | 3600.0 | 1 | 37.3 |
| 0525030-26 | 6501 | 1458.4 | 3618 | 44.3 | 5728 | 12.2 | 36.8 | **5726** | 3600.0 | 36.8 | **5726** | 3600.0 | 1 | 36.8 | **5726** | 3600.0 | 1 | 36.8 |
| 0525030-27 | 6429 | 1461.1 | 2993 | 53.4 | 4813 | 15.9 | 37.8 | **4776** | 3600.0 | 37.3 | **4776** | 3600.0 | 1 | 37.3 | **4776** | 3600.0 | 1 | 37.3 |
| 0525030-28 | 5973 | 2471.4 | 3322 | 44.4 | **5130** | 12.6 | 35.2 | 5134 | 3600.0 | 35.3 | 5134 | 3600.0 | 1 | 35.3 | 5134 | 3600.0 | 1 | 35.3 |
| 0525030-29 | 6226 | 1665.4 | 3359 | 46.0 | **5273** | 8.7 | 36.3 | **5273** | 2141.8 | 36.3 | **5273** | 2141.8 | 1 | 36.3 | **5273** | 2141.8 | 1 | 36.3 |
| 0525030-30 | 6611 | 1034.3 | 3658 | 44.7 | **5747** | 4.4 | 36.3 | 5768 | 3600.0 | 36.6 | 5768 | 3600.0 | 1 | 36.6 | 5768 | 3600.0 | 1 | 36.6 |

## Appendix B. Detailed Results for the Min–Max Regret Knapsack Problem

Tables B.4–B.12 show the results of the branch-and-cut algorithm ("B&C"), the fixed-scenario algorithm ("Fix"), the DS algorithm ("DS"), and iDS algorithms using Hamming-distance constraints ("iDS-H") and best-scenario constraints ("iDS-B") for the MMR-SCP for each instance type. The MMR-KP instances are denoted by "*v-ww-xx-yy-zz*," where type $= f$, $n = ww$, $\bar{R}/1000 = xx$, $100\gamma = yy$, and $100\delta = zz$. Best known lower-bound values ("LB") and solution values ("UB") are the best results as obtained from three heuristic algorithms and three exact algorithms by Furini et al. [1]. Concerning the best solution obtained by each algorithm for each instance, the table shows its objective value ("obj"), required CPU time in seconds ("time"), and optimality gap as a percentage ("%gap"). For the branch-and-cut algorithm, the table also shows the lower bound ("LB") obtained within the time limit (3600 seconds). To compute the percentage optimality gap ("%gap"), we used the better lower bound value between the best known bound by Furini et al. [1], and the value produced by the branch-and-cut algorithm. For the best solution obtained by iDS, the table shows iteration index ("iter") other than "obj," "time" and "%gap." Values in "obj" columns marked by "↓" (or "↑") indicate instances whose objective function obtained by the proposed algorithm were better (or worse) than the best known solution values in "UB" columns. Bold values in "obj" columns indicate better objective values obtained within the time limit (3600 seconds) between iDS-H and iDS-B. Bold values in "iter" columns signify that fewer iterations were needed when iDS-H and iDS-B obtained solutions with the same objective value in "obj" columns.

Table B.4: MMR-KP results for type-1 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 1-50-01-45-10 | 15 | 15 | 15 | 0.0 | 15 | 0.0 | 15 | 0.0 | 0.0 | 15 | 0.0 | 0.0 | 15 | 0.0 | 1 | 0.0 | 15 | 0.0 | 1 | 0.0 |
| 1-50-01-50-10 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| 1-50-01-55-10 | 114 | 114 | 114 | 0.0 | 114 | 0.0 | 124↑ | 0.0 | 8.1 | 114 | 0.0 | 0.0 | 114 | 0.0 | 1 | 0.0 | 114 | 0.0 | 1 | 0.0 |
| 1-60-01-45-10 | 91 | 91 | 91 | 0.0 | 91 | 0.0 | 91 | 0.0 | 0.0 | 91 | 0.0 | 0.0 | 91 | 0.0 | 1 | 0.0 | 91 | 0.0 | 1 | 0.0 |
| 1-60-01-50-10 | 111 | 111 | 111 | 0.0 | 111 | 0.0 | 111 | 0.0 | 0.0 | 111 | 0.0 | 0.0 | 111 | 0.0 | 1 | 0.0 | 111 | 0.0 | 1 | 0.0 |
| 1-60-01-55-10 | 64 | 64 | 64 | 0.0 | 64 | 0.0 | 64 | 0.0 | 0.0 | 64 | 0.0 | 0.0 | 64 | 0.0 | 1 | 0.0 | 64 | 0.0 | 1 | 0.0 |
| 1-70-01-45-10 | 32 | 32 | 32 | 0.0 | 32 | 0.0 | 32 | 0.0 | 0.0 | 32 | 0.0 | 0.0 | 32 | 0.0 | 1 | 0.0 | 32 | 0.0 | 1 | 0.0 |
| 1-70-01-50-10 | 44 | 44 | 44 | 0.0 | 44 | 0.0 | 44 | 0.0 | 0.0 | 44 | 0.0 | 0.0 | 44 | 0.0 | 1 | 0.0 | 44 | 0.0 | 1 | 0.0 |
| 1-70-01-55-10 | 118 | 118 | 118 | 0.0 | 118 | 0.0 | 118 | 0.0 | 0.0 | 127 ↑ | 0.0 | 7.1 | 118 | 0.1 | 5 | 0.0 | 118 | 0.0 | **4** | 0.0 |
| 1-50-01-45-20 | 198 | 198 | 198 | 0.0 | 198 | 0.0 | 198 | 0.0 | 0.0 | 198 | 0.0 | 0.0 | 198 | 0.0 | 1 | 0.0 | 198 | 0.0 | 1 | 0.0 |
| 1-50-01-50-20 | 129 | 129 | 129 | 0.0 | 129 | 0.0 | 129 | 0.0 | 0.0 | 129 | 0.0 | 0.0 | 129 | 0.0 | 1 | 0.0 | 129 | 0.0 | 1 | 0.0 |
| 1-50-01-55-20 | 239 | 239 | 239 | 0.0 | 239 | 0.0 | 242↑ | 0.0 | 1.2 | 242 ↑ | 0.0 | 1.2 | 239 | 0.0 | 3 | 0.0 | 239 | 0.0 | 3 | 0.0 |
| 1-60-01-45-20 | 273 | 273 | 273 | 0.1 | 273 | 0.0 | 327↑ | 0.0 | 16.5 | 273 | 0.0 | 0.0 | 273 | 0.0 | 1 | 0.0 | 273 | 0.0 | 1 | 0.0 |
| 1-60-01-50-20 | 211 | 211 | 211 | 0.0 | 211 | 0.0 | 211 | 0.0 | 0.0 | 211 | 0.0 | 0.0 | 211 | 0.0 | 1 | 0.0 | 211 | 0.0 | 1 | 0.0 |
| 1-60-01-55-20 | 244 | 244 | 244 | 0.1 | 244 | 0.0 | 262↑ | 0.0 | 6.9 | 244 | 0.0 | 0.0 | 244 | 0.0 | 1 | 0.0 | 244 | 0.0 | 1 | 0.0 |
| 1-70-01-45-20 | 109 | 109 | 109 | 0.0 | 109 | 0.0 | 109 | 0.0 | 0.0 | 109 | 0.0 | 0.0 | 109 | 0.0 | 1 | 0.0 | 109 | 0.0 | 1 | 0.0 |
| 1-70-01-50-20 | 239 | 239 | 239 | 0.0 | 239 | 0.0 | 239 | 0.0 | 0.0 | 239 | 0.0 | 0.0 | 239 | 0.0 | 1 | 0.0 | 239 | 0.0 | 1 | 0.0 |
| 1-70-01-55-20 | 297 | 297 | 297 | 0.1 | 297 | 0.0 | 297 | 0.0 | 0.0 | 297 | 0.0 | 0.0 | 297 | 0.0 | 1 | 0.0 | 297 | 0.0 | 1 | 0.0 |
| 1-50-01-45-30 | 445 | 445 | 445 | 0.0 | 445 | 0.0 | 509↑ | 0.0 | 12.6 | 445 | 0.0 | 0.0 | 445 | 0.0 | 1 | 0.0 | 445 | 0.0 | 1 | 0.0 |
| 1-50-01-50-30 | 442 | 442 | 442 | 0.0 | 442 | 0.0 | 442 | 0.0 | 0.0 | 442 | 0.0 | 0.0 | 442 | 0.0 | 1 | 0.0 | 442 | 0.0 | 1 | 0.0 |
| 1-50-01-55-30 | 605 | 605 | 605 | 0.1 | 605 | 0.0 | 606↑ | 0.0 | 0.2 | 606 ↑ | 0.0 | 0.2 | 605 | 0.0 | 2 | 0.0 | 605 | 0.0 | 2 | 0.0 |
| 1-60-01-45-30 | 596 | 596 | 596 | 0.1 | 596 | 0.0 | 602↑ | 0.0 | 1.0 | 596 | 0.0 | 0.0 | 596 | 0.0 | 1 | 0.0 | 596 | 0.0 | 1 | 0.0 |
| 1-60-01-50-30 | 604 | 604 | 604 | 0.0 | 604 | 0.0 | 604 | 0.0 | 0.0 | 604 | 0.0 | 0.0 | 604 | 0.0 | 1 | 0.0 | 604 | 0.0 | 1 | 0.0 |
| 1-60-01-55-30 | 668 | 668 | 668 | 0.1 | 668 | 0.0 | 668 | 0.0 | 0.0 | 668 | 0.0 | 0.0 | 668 | 0.0 | 1 | 0.0 | 668 | 0.0 | 1 | 0.0 |
| 1-70-01-45-30 | 434 | 434 | 434 | 0.0 | 434 | 0.0 | 434 | 0.0 | 0.0 | 434 | 0.0 | 0.0 | 434 | 0.0 | 1 | 0.0 | 434 | 0.0 | 1 | 0.0 |
| 1-70-01-50-30 | 606 | 606 | 606 | 0.1 | 606 | 0.0 | 632↑ | 0.0 | 4.1 | 606 | 0.0 | 0.0 | 606 | 0.0 | 1 | 0.0 | 606 | 0.0 | 1 | 0.0 |
| 1-70-01-55-30 | 770 | 770 | 770 | 0.1 | 770 | 0.0 | 775↑ | 0.0 | 0.6 | 770 | 0.0 | 0.0 | 770 | 0.0 | 1 | 0.0 | 770 | 0.0 | 1 | 0.0 |
| 1-50-10-45-10 | 225 | 225 | 225 | 0.0 | 225 | 0.0 | 225 | 0.0 | 0.0 | 225 | 0.0 | 0.0 | 225 | 0.0 | 1 | 0.0 | 225 | 0.0 | 1 | 0.0 |
| 1-50-10-50-10 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| 1-50-10-55-10 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| 1-60-10-45-10 | 159 | 159 | 159 | 0.0 | 159 | 0.0 | 159 | 0.0 | 0.0 | 159 | 0.0 | 0.0 | 159 | 0.0 | 1 | 0.0 | 159 | 0.0 | 1 | 0.0 |
| 1-60-10-50-10 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| 1-60-10-55-10 | 216 | 216 | 216 | 0.0 | 216 | 0.0 | 216 | 0.0 | 0.0 | 216 | 0.0 | 0.0 | 216 | 0.0 | 1 | 0.0 | 216 | 0.0 | 1 | 0.0 |
| 1-70-10-45-10 | 54 | 54 | 54 | 0.1 | 54 | 0.0 | 54 | 0.0 | 0.0 | 54 | 0.0 | 0.0 | 54 | 0.0 | 1 | 0.0 | 54 | 0.0 | 1 | 0.0 |
| 1-70-10-50-10 | 112 | 112 | 112 | 0.0 | 112 | 0.0 | 112 | 0.0 | 0.0 | 112 | 0.0 | 0.0 | 112 | 0.0 | 1 | 0.0 | 112 | 0.0 | 1 | 0.0 |
| 1-70-10-55-10 | 275 | 275 | 275 | 0.0 | 275 | 0.0 | 275 | 0.0 | 0.0 | 275 | 0.0 | 0.0 | 275 | 0.0 | 1 | 0.0 | 275 | 0.0 | 1 | 0.0 |
| 1-50-10-45-20 | 1902 | 1902 | 1902 | 0.0 | 1902 | 0.0 | 1902 | 0.0 | 0.0 | 1902 | 0.0 | 0.0 | 1902 | 0.0 | 1 | 0.0 | 1902 | 0.0 | 1 | 0.0 |
| 1-50-10-50-20 | 1392 | 1392 | 1392 | 0.0 | 1392 | 0.0 | 1392 | 0.0 | 0.0 | 1392 | 0.0 | 0.0 | 1392 | 0.0 | 1 | 0.0 | 1392 | 0.0 | 1 | 0.0 |
| 1-50-10-55-20 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| 1-60-10-45-20 | 2106 | 2106 | 2106 | 0.0 | 2106 | 0.0 | 2106 | 0.0 | 0.0 | 2106 | 0.0 | 0.0 | 2106 | 0.0 | 1 | 0.0 | 2106 | 0.0 | 1 | 0.0 |
| 1-60-10-50-20 | 1165 | 1165 | 1165 | 0.0 | 1165 | 0.0 | 1165 | 0.0 | 0.0 | 1165 | 0.0 | 0.0 | 1165 | 0.0 | 1 | 0.0 | 1165 | 0.0 | 1 | 0.0 |
| 1-60-10-55-20 | 324 | 324 | 324 | 0.0 | 324 | 0.0 | 324 | 0.0 | 0.0 | 324 | 0.0 | 0.0 | 324 | 0.0 | 1 | 0.0 | 324 | 0.0 | 1 | 0.0 |
| 1-70-10-45-20 | 2561 | 2561 | 2561 | 0.0 | 2561 | 0.0 | 2561 | 0.0 | 0.0 | 2561 | 0.0 | 0.0 | 2561 | 0.0 | 1 | 0.0 | 2561 | 0.0 | 1 | 0.0 |
| 1-70-10-50-20 | 147 | 147 | 147 | 0.0 | 147 | 0.0 | 147 | 0.0 | 0.0 | 147 | 0.0 | 0.0 | 147 | 0.0 | 1 | 0.0 | 147 | 0.0 | 1 | 0.0 |
| 1-70-10-55-20 | 954 | 954 | 954 | 0.0 | 954 | 0.0 | 954 | 0.0 | 0.0 | 954 | 0.0 | 0.0 | 954 | 0.0 | 1 | 0.0 | 954 | 0.0 | 1 | 0.0 |
| 1-50-10-45-30 | 2778 | 2778 | 2778 | 0.0 | 2778 | 0.0 | 2778 | 0.0 | 0.0 | 2778 | 0.0 | 0.0 | 2778 | 0.0 | 1 | 0.0 | 2778 | 0.0 | 1 | 0.0 |
| 1-50-10-50-30 | 3284 | 3284 | 3284 | 0.0 | 3284 | 0.0 | 3284 | 0.0 | 0.0 | 3284 | 0.0 | 0.0 | 3284 | 0.0 | 1 | 0.0 | 3284 | 0.0 | 1 | 0.0 |
| 1-50-10-55-30 | 1043 | 1043 | 1043 | 0.0 | 1043 | 0.0 | 1043 | 0.0 | 0.0 | 1043 | 0.0 | 0.0 | 1043 | 0.0 | 1 | 0.0 | 1043 | 0.0 | 1 | 0.0 |
| 1-60-10-45-30 | 3393 | 3393 | 3393 | 0.0 | 3393 | 0.0 | 3393 | 0.0 | 0.0 | 3393 | 0.0 | 0.0 | 3393 | 0.0 | 1 | 0.0 | 3393 | 0.0 | 1 | 0.0 |
| 1-60-10-50-30 | 2636 | 2636 | 2636 | 0.0 | 2636 | 0.0 | 2636 | 0.0 | 0.0 | 2636 | 0.0 | 0.0 | 2636 | 0.0 | 1 | 0.0 | 2636 | 0.0 | 1 | 0.0 |
| 1-60-10-55-30 | 2090 | 2090 | 2090 | 0.0 | 2090 | 0.0 | 2090 | 0.0 | 0.0 | 2116 ↑ | 0.0 | 1.2 | 2090 | 0.0 | 2 | 0.0 | 2090 | 0.0 | 2 | 0.0 |
| 1-70-10-45-30 | 4103 | 4103 | 4103 | 0.1 | 4103 | 0.0 | 4103 | 0.0 | 0.0 | 4103 | 0.0 | 0.0 | 4103 | 0.0 | 1 | 0.0 | 4103 | 0.0 | 1 | 0.0 |
| 1-70-10-50-30 | 2632 | 2632 | 2632 | 0.0 | 2632 | 0.0 | 2632 | 0.0 | 0.0 | 2754 ↑ | 0.0 | 4.4 | 2632 | 0.0 | 2 | 0.0 | 2632 | 0.0 | 2 | 0.0 |
| 1-70-10-55-30 | 2176 | 2176 | 2176 | 0.0 | 2176 | 0.0 | 2176 | 0.0 | 0.0 | 2176 | 0.0 | 0.0 | 2176 | 0.0 | 1 | 0.0 | 2176 | 0.0 | 1 | 0.0 |

Table B.5: MMR-KP results for type-2 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 2-50-01-45-10 | 231 | 231 | 231 | 0.0 | 231 | 0.0 | 231 | 0.0 | 0.0 | 231 | 0.0 | 0.0 | 231 | 0.0 | 1 | 0.0 | 231 | 0.0 | 1 | 0.0 |
| 2-50-01-50-10 | 164 | 164 | 164 | 0.1 | 164 | 0.0 | 164 | 0.0 | 0.0 | 164 | 0.0 | 0.0 | 164 | 0.0 | 1 | 0.0 | 164 | 0.0 | 1 | 0.0 |
| 2-50-01-55-10 | 194 | 194 | 194 | 0.1 | 194 | 0.0 | 194 | 0.0 | 0.0 | 194 | 0.0 | 0.0 | 194 | 0.0 | 1 | 0.0 | 194 | 0.0 | 1 | 0.0 |
| 2-60-01-45-10 | 272 | 272 | 272 | 0.2 | 272 | 0.0 | 272 | 0.0 | 0.0 | 278↑ | 0.0 | 2.2 | 272 | 0.1 | 2 | 0.0 | 272 | 0.0 | 2 | 0.0 |
| 2-60-01-50-10 | 240 | 240 | 240 | 0.1 | 240 | 0.0 | 243↑ | 0.0 | 1.2 | 243↑ | 0.0 | 1.2 | 240 | 0.0 | 2 | 0.0 | 240 | 0.0 | 2 | 0.0 |
| 2-60-01-55-10 | 237 | 237 | 237 | 0.0 | 237 | 0.0 | 237 | 0.0 | 0.0 | 237 | 0.0 | 0.0 | 237 | 0.0 | 1 | 0.0 | 237 | 0.0 | 1 | 0.0 |
| 2-70-01-45-10 | 272 | 272 | 272 | 0.2 | 272 | 0.0 | 274↑ | 0.0 | 0.7 | 274↑ | 0.0 | 0.7 | 272 | 0.1 | 4 | 0.0 | 272 | 0.0 | **2** | 0.0 |
| 2-70-01-50-10 | 242 | 242 | 242 | 0.2 | 242 | 0.0 | 242 | 0.0 | 0.0 | 242 | 0.0 | 0.0 | 242 | 0.0 | 1 | 0.0 | 242 | 0.0 | 1 | 0.0 |
| 2-70-01-55-10 | 289 | 289 | 289 | 0.2 | 289 | 0.0 | 290↑ | 0.0 | 0.3 | 289 | 0.0 | 0.0 | 289 | 0.0 | 1 | 0.0 | 289 | 0.0 | 1 | 0.0 |
| 2-50-01-45-20 | 886 | 886 | 886 | 0.3 | 886 | 0.0 | 886 | 0.0 | 0.0 | 886 | 0.0 | 0.0 | 886 | 0.0 | 1 | 0.0 | 886 | 0.0 | 1 | 0.0 |
| 2-50-01-50-20 | 870 | 870 | 870 | 0.3 | 870 | 0.0 | 870 | 0.0 | 0.0 | 870 | 0.0 | 0.0 | 870 | 0.0 | 1 | 0.0 | 870 | 0.0 | 1 | 0.0 |
| 2-50-01-55-20 | 880 | 880 | 880 | 2.5 | 880 | 0.0 | 908↑ | 0.0 | 3.1 | 880 | 0.1 | 0.0 | 880 | 0.1 | 1 | 0.0 | 880 | 0.1 | 1 | 0.0 |
| 2-60-01-45-20 | 1151 | 1151 | 1151 | 5.1 | 1151 | 0.0 | 1184↑ | 0.0 | 2.8 | 1151 | 0.1 | 0.0 | 1151 | 0.1 | 1 | 0.0 | 1151 | 0.1 | 1 | 0.0 |
| 2-60-01-50-20 | 1128 | 1128 | 1128 | 1.3 | 1128 | 0.0 | 1128 | 0.0 | 0.0 | 1128 | 0.1 | 0.0 | 1128 | 0.1 | 1 | 0.0 | 1128 | 0.1 | 1 | 0.0 |
| 2-60-01-55-20 | 1131 | 1131 | 1131 | 18.3 | 1131 | 0.0 | 1154↑ | 0.0 | 2.0 | 1131 | 0.1 | 0.0 | 1131 | 0.1 | 1 | 0.0 | 1131 | 0.1 | 1 | 0.0 |
| 2-70-01-45-20 | 1272 | 1272 | 1272 | 82.5 | 1272 | 0.0 | 1286↑ | 0.0 | 1.1 | 1272 | 0.1 | 0.0 | 1272 | 0.1 | 1 | 0.0 | 1272 | 0.1 | 1 | 0.0 |
| 2-70-01-50-20 | 1274 | 1274 | 1274 | 5.5 | 1274 | 0.0 | 1274 | 0.0 | 0.0 | 1274 | 0.1 | 0.0 | 1274 | 0.1 | 1 | 0.0 | 1274 | 0.1 | 1 | 0.0 |
| 2-70-01-55-20 | 1243 | 1243 | 1243 | 17.4 | 1243 | 0.0 | 1243 | 0.0 | 0.0 | 1243 | 0.1 | 0.0 | 1243 | 0.1 | 1 | 0.0 | 1243 | 0.1 | 1 | 0.0 |
| 2-50-01-45-30 | 2050 | 2050 | 2050 | 35.2 | 2050 | 0.0 | 2050 | 0.0 | 0.0 | 2050 | 0.1 | 0.0 | 2050 | 0.1 | 1 | 0.0 | 2050 | 0.1 | 1 | 0.0 |
| 2-50-01-50-30 | 2090 | 2090 | 2090 | 10.2 | 2090 | 0.0 | 2090 | 0.0 | 0.0 | 2090 | 0.1 | 0.0 | 2090 | 0.1 | 1 | 0.0 | 2090 | 0.1 | 1 | 0.0 |
| 2-50-01-55-30 | 2041 | 2041 | 2041 | 9.3 | 2041 | 0.0 | 2041 | 0.0 | 0.0 | 2041 | 0.1 | 0.0 | 2041 | 0.1 | 1 | 0.0 | 2041 | 0.1 | 1 | 0.0 |
| 2-60-01-45-30 | 2467 | 2467 | 2467 | 258.1 | 2467 | 0.0 | 2467 | 0.0 | 0.0 | 2467 | 0.2 | 0.0 | 2467 | 0.2 | 1 | 0.0 | 2467 | 0.2 | 1 | 0.0 |
| 2-60-01-50-30 | 2505 | 2505 | 2505 | 1437.1 | 2505 | 0.0 | 2508↑ | 0.0 | 0.1 | 2505 | 0.3 | 0.0 | 2505 | 0.3 | 1 | 0.0 | 2505 | 0.3 | 1 | 0.0 |
| 2-60-01-55-30 | 2270 | 2425 | 2425 | 7.0 | 2425 | 0.0 | 2425 | 0.0 | 0.0 | 2425 | 0.1 | 0.0 | 2425 | 0.1 | 1 | 0.0 | 2425 | 0.1 | 1 | 0.0 |
| 2-70-01-45-30 | 2801 | 2801 | 2801 | 2549.2 | 2620 | 0.0 | 2818↑ | 0.0 | 0.6 | 2801 | 0.1 | 0.0 | 2801 | 0.1 | 1 | 0.0 | 2801 | 0.1 | 1 | 0.0 |
| 2-70-01-50-30 | 2814 | 2814 | 2814 | 3171.8 | 2651 | 0.0 | 2827↑ | 0.0 | 0.5 | 2827↑ | 0.1 | 0.5 | 2814 | 0.2 | 2 | 0.0 | 2814 | 0.2 | 2 | 0.0 |
| 2-70-01-55-30 | 2698 | 2698 | 2698 | 9.7 | 2636 | 0.0 | 2698 | 0.0 | 0.0 | 2698 | 0.1 | 0.0 | 2698 | 0.1 | 1 | 0.0 | 2698 | 0.1 | 1 | 0.0 |
| 2-50-10-45-10 | 2678 | 2678 | 2678 | 0.1 | 2678 | 0.0 | 2678 | 0.0 | 0.0 | 2678 | 0.0 | 0.0 | 2678 | 0.0 | 1 | 0.0 | 2678 | 0.0 | 1 | 0.0 |
| 2-50-10-50-10 | 2716 | 2716 | 2716 | 0.2 | 2716 | 0.0 | 2716 | 0.0 | 0.0 | 2716 | 0.0 | 0.0 | 2716 | 0.0 | 1 | 0.0 | 2716 | 0.0 | 1 | 0.0 |
| 2-50-10-55-10 | 2444 | 2444 | 2444 | 0.1 | 2444 | 0.0 | 2444 | 0.0 | 0.0 | 2444 | 0.0 | 0.0 | 2444 | 0.0 | 1 | 0.0 | 2444 | 0.0 | 1 | 0.0 |
| 2-60-10-45-10 | 2694 | 2694 | 2694 | 0.3 | 2694 | 0.0 | 2694 | 0.0 | 0.0 | 2694 | 0.0 | 0.0 | 2694 | 0.0 | 1 | 0.0 | 2694 | 0.0 | 1 | 0.0 |
| 2-60-10-50-10 | 2604 | 2604 | 2604 | 0.3 | 2604 | 0.0 | 2674↑ | 0.0 | 0.0 | 2652↑ | 0.0 | 0.0 | 2604 | 0.1 | 2 | 0.0 | 2604 | 0.1 | 2 | 0.0 |
| 2-60-10-55-10 | 2125 | 2125 | 2125 | 0.1 | 2125 | 0.0 | 2125 | 0.0 | 0.0 | 2125 | 0.0 | 0.0 | 2125 | 0.0 | 1 | 0.0 | 2125 | 0.0 | 1 | 0.0 |
| 2-70-10-45-10 | 3984 | 3984 | 3984 | 0.6 | 3984 | 0.0 | 4062↑ | 0.0 | 1.9 | 4062↑ | 0.1 | 1.9 | 3984 | 0.1 | 2 | 0.0 | 3984 | 0.1 | 2 | 0.0 |
| 2-70-10-50-10 | 3558 | 3558 | 3558 | 0.5 | 3558 | 0.0 | 3702↑ | 0.0 | 3.9 | 3558 | 0.0 | 0.0 | 3558 | 0.0 | 1 | 0.0 | 3558 | 0.0 | 1 | 0.0 |
| 2-70-10-55-10 | 2699 | 2699 | 2699 | 0.0 | 2699 | 0.0 | 2699 | 0.0 | 0.0 | 2699 | 0.0 | 0.0 | 2699 | 0.0 | 1 | 0.0 | 2699 | 0.0 | 1 | 0.0 |
| 2-50-10-45-20 | 8684 | 8684 | 8684 | 0.3 | 8684 | 0.0 | 8684 | 0.0 | 0.0 | 8684 | 0.1 | 0.0 | 8684 | 0.1 | 1 | 0.0 | 8684 | 0.1 | 1 | 0.0 |
| 2-50-10-50-20 | 8070 | 8070 | 8070 | 0.5 | 8070 | 0.0 | 8155↑ | 0.0 | 1.0 | 8155↑ | 0.1 | 1.0 | 8070 | 0.2 | 3 | 0.0 | 8070 | 0.2 | 3 | 0.0 |
| 2-50-10-55-20 | 7172 | 7172 | 7172 | 0.0 | 7172 | 0.0 | 7172 | 0.0 | 0.0 | 7172 | 0.0 | 0.0 | 7172 | 0.0 | 1 | 0.0 | 7172 | 0.0 | 1 | 0.0 |
| 2-60-10-45-20 | 8921 | 8921 | 8921 | 2.4 | 8921 | 0.0 | 8958↑ | 0.0 | 0.4 | 8958↑ | 0.1 | 0.4 | 8921 | 0.1 | 2 | 0.0 | 8921 | 0.1 | 2 | 0.0 |
| 2-60-10-50-20 | 8228 | 8228 | 8228 | 0.3 | 8228 | 0.0 | 8228 | 0.0 | 0.0 | 8228 | 0.0 | 0.0 | 8228 | 0.0 | 1 | 0.0 | 8228 | 0.0 | 1 | 0.0 |
| 2-60-10-55-20 | 7668 | 7668 | 7668 | 0.3 | 7668 | 0.0 | 7668 | 0.0 | 0.0 | 7668 | 0.0 | 0.0 | 7668 | 0.0 | 1 | 0.0 | 7668 | 0.0 | 1 | 0.0 |
| 2-70-10-45-20 | 12238 | 12238 | 12238 | 0.3 | 12238 | 0.0 | 12238 | 0.0 | 0.0 | 12238 | 0.1 | 0.0 | 12238 | 0.1 | 1 | 0.0 | 12238 | 0.1 | 1 | 0.0 |
| 2-70-10-50-20 | 11941 | 11941 | 11941 | 18.0 | 11941 | 0.0 | 11984↑ | 0.0 | 0.4 | 11941 | 0.1 | 0.0 | 11941 | 0.1 | 1 | 0.0 | 11941 | 0.1 | 1 | 0.0 |
| 2-70-10-55-20 | 11428 | 11428 | 11428 | 6.6 | 11428 | 0.0 | 11559↑ | 0.0 | 1.1 | 11428 | 0.1 | 0.0 | 11428 | 0.1 | 1 | 0.0 | 11428 | 0.1 | 1 | 0.0 |
| 2-50-10-45-30 | 9924 | 9924 | 9924 | 0.2 | 9924 | 0.0 | 9924 | 0.0 | 0.0 | 9924 | 0.0 | 0.0 | 9924 | 0.0 | 1 | 0.0 | 9924 | 0.0 | 1 | 0.0 |
| 2-50-10-50-30 | 9242 | 9242 | 9242 | 0.4 | 9242 | 0.0 | 9242 | 0.0 | 0.0 | 9242 | 0.0 | 0.0 | 9242 | 0.0 | 1 | 0.0 | 9242 | 0.0 | 1 | 0.0 |
| 2-50-10-55-30 | 8763 | 8763 | 8763 | 0.1 | 8763 | 0.0 | 8763 | 0.0 | 0.0 | 8763 | 0.0 | 0.0 | 8763 | 0.0 | 1 | 0.0 | 8763 | 0.0 | 1 | 0.0 |
| 2-60-10-45-30 | 11486 | 11486 | 11486 | 1.8 | 11486 | 0.0 | 11486 | 0.0 | 0.0 | 11486 | 0.0 | 0.0 | 11486 | 0.0 | 1 | 0.0 | 11486 | 0.0 | 1 | 0.0 |
| 2-60-10-50-30 | 11324 | 11324 | 11324 | 1.5 | 11324 | 0.0 | 11324 | 0.0 | 0.0 | 11324 | 0.0 | 0.0 | 11324 | 0.0 | 1 | 0.0 | 11324 | 0.0 | 1 | 0.0 |
| 2-60-10-55-30 | 10490 | 10490 | 10490 | 0.2 | 10490 | 0.0 | 10496↑ | 0.0 | 0.1 | 10496↑ | 0.0 | 0.1 | 10490 | 0.1 | 2 | 0.0 | 10490 | 0.0 | 2 | 0.0 |
| 2-70-10-45-30 | 17726 | 17726 | 17726 | 63.1 | 17726 | 0.0 | 17726 | 0.0 | 0.0 | 17726 | 0.1 | 0.0 | 17726 | 0.1 | 1 | 0.0 | 17726 | 0.1 | 1 | 0.0 |
| 2-70-10-50-30 | 17300 | 17300 | 17300 | 90.4 | 17300 | 0.0 | 17300 | 0.0 | 0.0 | 17300 | 0.1 | 0.0 | 17300 | 0.1 | 1 | 0.0 | 17300 | 0.1 | 1 | 0.0 |
| 2-70-10-55-30 | 16239 | 16239 | 16239 | 0.3 | 16239 | 0.0 | 16239 | 0.0 | 0.0 | 16239 | 0.0 | 0.0 | 16239 | 0.0 | 1 | 0.0 | 16239 | 0.0 | 1 | 0.0 |

Table B.6: MMR-KP results for type-3 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 3-50-01-45-10 | 726 | 726 | 726 | 10.1 | 726 | 0.0 | 726 | 0.0 | 0.0 | 726 | 0.1 | 0.0 | 726 | 0.1 | 1 | 0.0 | 726 | 0.1 | 1 | 0.0 |
| 3-50-01-50-10 | 719 | 719 | 719 | 0.3 | 719 | 0.0 | 729↑ | 0.0 | 0.0 | 719 | 0.1 | 0.0 | 719 | 0.1 | 1 | 0.0 | 719 | 0.1 | 1 | 0.0 |
| 3-50-01-55-10 | 714 | 714 | 714 | 0.3 | 714 | 0.0 | 730↑ | 0.0 | 2.2 | 714 | 0.0 | 0.0 | 714 | 0.0 | 1 | 0.0 | 714 | 0.0 | 1 | 0.0 |
| 3-60-01-45-10 | 868 | 868 | 868 | 35.7 | 868 | 0.0 | 868 | 0.0 | 0.0 | 868 | 0.1 | 0.0 | 868 | 0.1 | 1 | 0.0 | 868 | 0.1 | 1 | 0.0 |
| 3-60-01-50-10 | 909 | 909 | 909 | 214.0 | 909 | 0.0 | 909 | 0.0 | 0.0 | 909 | 0.2 | 0.0 | 909 | 0.2 | 1 | 0.0 | 909 | 0.2 | 1 | 0.0 |
| 3-60-01-55-10 | 909 | 909 | 909 | 367.7 | 909 | 0.0 | 909 | 0.0 | 0.0 | 909 | 0.2 | 0.0 | 909 | 0.2 | 1 | 0.0 | 909 | 0.2 | 1 | 0.0 |
| 3-70-01-45-10 | 977 | 977 | 977 | 797.9 | 977 | 0.0 | 977 | 0.0 | 0.0 | 977 | 0.4 | 0.0 | 977 | 0.4 | 1 | 0.0 | 977 | 0.4 | 1 | 0.0 |
| 3-70-01-50-10 | 1008 | 1008 | 1008 | 584.7 | 1000 | 0.0 | 1008 | 0.0 | 0.0 | 1008 | 0.3 | 0.0 | 1008 | 0.3 | 1 | 0.0 | 1008 | 0.3 | 1 | 0.0 |
| 3-70-01-55-10 | 1027 | 1027 | 1027 | 2081.1 | 983 | 0.0 | 1027 | 0.0 | 0.0 | 1027 | 0.3 | 0.0 | 1027 | 0.3 | 1 | 0.0 | 1027 | 0.3 | 1 | 0.0 |
| 3-50-01-45-20 | 2112 | 2112 | 2122↑ | 1340.7 | 2000 | 0.5 | 2122↑ | 0.0 | 0.5 | 2124↑ | 0.3 | 0.6 | 2112 | 2.1 | 5 | 0.0 | 2112 | 2.2 | 5 | 0.0 |
| 3-50-01-50-20 | 2135 | 2135 | 2135 | 1642.4 | 2003 | 0.0 | 2146↑ | 0.0 | 0.5 | 2146↑ | 0.3 | 0.5 | 2135 | 0.7 | 2 | 0.0 | 2135 | 0.7 | 2 | 0.0 |
| 3-50-01-55-20 | 2098 | 2098 | 2098 | 2385.7 | 1956 | 0.0 | 2098 | 0.0 | 0.0 | 2098 | 0.2 | 0.0 | 2098 | 0.2 | 1 | 0.0 | 2098 | 0.2 | 1 | 0.0 |
| 3-60-01-45-20 | 1961 | 2517 | 2517 | 896.8 | 2183 | 13.3 | 2525↑ | 0.0 | 13.5 | 2525↑ | 0.5 | 13.5 | 2517 | 1.8 | 3 | 13.3 | 2517 | 1.5 | 3 | 13.3 |
| 3-60-01-50-20 | 1932 | 2530 | 2530 | 1133.5 | 2196 | 13.2 | 2530 | 0.0 | 13.2 | 2530 | 0.4 | 13.2 | 2530 | 0.4 | 1 | 13.2 | 2530 | 0.4 | 1 | 13.2 |
| 3-60-01-55-20 | 1919 | 2441 | 2441 | 2198.4 | 2167 | 11.2 | 2441 | 0.0 | 11.2 | 2441 | 0.1 | 11.2 | 2441 | 0.1 | 1 | 11.2 | 2441 | 0.1 | 1 | 11.2 |
| 3-70-01-45-20 | 2073 | 2760 | 2760 | 674.1 | 2331 | 15.5 | 2780↑ | 0.0 | 16.2 | 2760 | 0.7 | 15.5 | 2756↓ | 1.9 | 2 | 15.4 | 2756↓ | 1.5 | 2 | 15.4 |
| 3-70-01-50-20 | 2081 | 2786 | 2883↑ | 2656.7 | 2312 | 19.8 | 2801↑ | 0.0 | 17.5 | 2786 | 0.5 | 17.0 | 2786 | 0.5 | 1 | 17.0 | 2786 | 0.5 | 1 | 17.0 |
| 3-70-01-55-20 | 2044 | 2715 | 2715 | 0.3 | 2341 | 13.8 | 2715 | 0.0 | 13.8 | 2715 | 0.4 | 13.8 | 2715 | 0.4 | 1 | 13.8 | 2715 | 0.4 | 1 | 13.8 |
| 3-50-01-45-30 | 2640 | 2640 | 2640 | 464.4 | 2640 | 0.0 | 2640 | 0.0 | 0.0 | 2651↑ | 0.2 | 0.4 | 2640 | 0.5 | 2 | 0.0 | 2640 | 0.4 | 2 | 0.0 |
| 3-50-01-50-30 | 2866 | 2866 | 2879↑ | 1534.6 | 2716 | 0.5 | 2866 | 0.0 | 0.0 | 2866 | 0.5 | 0.0 | 2866 | 0.5 | 1 | 0.0 | 2866 | 0.5 | 1 | 0.0 |
| 3-50-01-55-30 | 2974 | 2974 | 2991↑ | 858.3 | 2742 | 0.6 | 2983↑ | 0.0 | 0.3 | 2974 | 0.4 | 0.0 | 2974 | 0.4 | 1 | 0.0 | 2974 | 0.4 | 1 | 0.0 |
| 3-60-01-45-30 | 3361 | 3361 | 3385↑ | 675.3 | 3094 | 0.7 | 3361 | 0.0 | 0.0 | 3361 | 0.3 | 0.0 | 3361 | 0.3 | 1 | 0.0 | 3361 | 0.3 | 1 | 0.0 |
| 3-60-01-50-30 | 2871 | 3668 | 3670↑ | 3479.0 | 3134 | 14.6 | 3668 | 0.0 | 14.6 | 3670↑ | 0.7 | 14.6 | 3668 | 2.4 | 2 | 14.6 | 3668 | 2.0 | 2 | 14.6 |
| 3-60-01-55-30 | 2851 | 3790 | 3819↑ | 1351.7 | 3127 | 18.1 | 3790 | 0.0 | 17.5 | 3790 | 0.9 | 17.5 | 3790 | 0.9 | 1 | 17.5 | 3790 | 0.9 | 1 | 17.5 |
| 3-70-01-45-30 | 3002 | 3628 | 3667↑ | 1451.1 | 3242 | 11.6 | 3632↑ | 0.0 | 10.7 | 3632↑ | 0.3 | 10.7 | 3628 | 1.1 | 3 | 10.6 | 3628 | 1.0 | 3 | 10.6 |
| 3-70-01-50-30 | 3013 | 3958 | 4018↑ | 0.4 | 3298 | 17.9 | 3958 | 0.0 | 16.7 | 3958 | 0.9 | 16.7 | 3958 | 0.9 | 1 | 16.7 | 3958 | 0.9 | 1 | 16.7 |
| 3-70-01-55-30 | 3023 | 4111 | 4152↑ | 0.4 | 3260 | 21.5 | 4111 | 0.0 | 20.7 | 4111 | 1.2 | 20.7 | 4111 | 1.2 | 1 | 20.7 | 4111 | 1.2 | 1 | 20.7 |
| 3-50-10-45-10 | 3656 | 3656 | 3656 | 0.2 | 3656 | 0.0 | 3829↑ | 0.0 | 4.5 | 3656 | 0.0 | 0.0 | 3656 | 0.0 | 1 | 0.0 | 3656 | 0.0 | 1 | 0.0 |
| 3-50-10-50-10 | 4167 | 4167 | 4167 | 0.3 | 4167 | 0.0 | 4167 | 0.0 | 0.0 | 4167 | 0.0 | 0.0 | 4167 | 0.0 | 1 | 0.0 | 4167 | 0.0 | 1 | 0.0 |
| 3-50-10-55-10 | 4132 | 4132 | 4132 | 0.5 | 4132 | 0.0 | 4132 | 0.0 | 0.0 | 4132 | 0.0 | 0.0 | 4132 | 0.0 | 1 | 0.0 | 4132 | 0.0 | 1 | 0.0 |
| 3-60-10-45-10 | 4500 | 4500 | 4500 | 0.5 | 4500 | 0.0 | 4588↑ | 0.0 | 1.9 | 4500 | 0.0 | 0.0 | 4500 | 0.0 | 1 | 0.0 | 4500 | 0.0 | 1 | 0.0 |
| 3-60-10-50-10 | 5172 | 5172 | 5172 | 0.7 | 5172 | 0.0 | 5381↑ | 0.0 | 0.0 | 5172 | 0.1 | 0.0 | 5172 | 0.1 | 1 | 0.0 | 5172 | 0.1 | 1 | 0.0 |
| 3-60-10-55-10 | 5568 | 5568 | 5568 | 1.3 | 5568 | 0.0 | 5854↑ | 0.0 | 4.9 | 5568 | 0.2 | 0.0 | 5568 | 0.2 | 1 | 0.0 | 5568 | 0.2 | 1 | 0.0 |
| 3-70-10-45-10 | 5816 | 5816 | 5816 | 6.5 | 5816 | 0.0 | 5816 | 0.0 | 0.0 | 5816 | 0.1 | 0.0 | 5816 | 0.1 | 1 | 0.0 | 5816 | 0.1 | 1 | 0.0 |
| 3-70-10-50-10 | 6128 | 6128 | 6128 | 0.4 | 6128 | 0.0 | 6128 | 0.0 | 0.0 | 6128 | 0.1 | 0.0 | 6128 | 0.1 | 1 | 0.0 | 6128 | 0.1 | 1 | 0.0 |
| 3-70-10-55-10 | 6623 | 6623 | 6623 | 0.3 | 6623 | 0.0 | 6718↑ | 0.0 | 1.4 | 6623 | 0.1 | 0.0 | 6623 | 0.1 | 1 | 0.0 | 6623 | 0.1 | 1 | 0.0 |
| 3-50-10-45-20 | 11130 | 11130 | 11130 | 22.6 | 11130 | 0.0 | 11618↑ | 0.0 | 4.2 | 11130 | 0.0 | 0.0 | 11130 | 0.0 | 1 | 0.0 | 11130 | 0.0 | 1 | 0.0 |
| 3-50-10-50-20 | 12264 | 12264 | 12264 | 22.5 | 12264 | 0.0 | 12561↑ | 0.0 | 2.4 | 12264 | 0.1 | 0.0 | 12264 | 0.1 | 1 | 0.0 | 12264 | 0.1 | 1 | 0.0 |
| 3-50-10-55-20 | 12427 | 12427 | 12427 | 13.6 | 12427 | 0.0 | 12602↑ | 0.0 | 0.0 | 12427 | 0.1 | 0.0 | 12427 | 0.1 | 1 | 0.0 | 12427 | 0.1 | 1 | 0.0 |
| 3-60-10-45-20 | 13482 | 13482 | 13482 | 351.4 | 13482 | 0.0 | 13694↑ | 0.0 | 1.5 | 13482 | 0.1 | 0.0 | 13482 | 0.1 | 1 | 0.0 | 13482 | 0.1 | 1 | 0.0 |
| 3-60-10-50-20 | 14384 | 14384 | 14384 | 405.9 | 14384 | 0.0 | 14384 | 0.0 | 0.0 | 14384 | 0.2 | 0.0 | 14384 | 0.2 | 1 | 0.0 | 14384 | 0.2 | 1 | 0.0 |
| 3-60-10-55-20 | 14975 | 14975 | 14975 | 9.5 | 14975 | 0.0 | 14975 | 0.0 | 0.0 | 14975 | 0.3 | 0.0 | 14975 | 0.3 | 1 | 0.0 | 14975 | 0.3 | 1 | 0.0 |
| 3-70-10-45-20 | 16027 | 16027 | 16027 | 601.7 | 15701 | 0.0 | 16572↑ | 0.0 | 3.3 | 16027 | 0.1 | 0.0 | 16027 | 0.1 | 1 | 0.0 | 16027 | 0.1 | 1 | 0.0 |
| 3-70-10-50-20 | 17352 | 17352 | 17352 | 1227.7 | 16305 | 0.0 | 17352 | 0.0 | 0.0 | 17352 | 0.2 | 0.0 | 17352 | 0.2 | 1 | 0.0 | 17352 | 0.2 | 1 | 0.0 |
| 3-70-10-55-20 | 18054 | 18054 | 18155↑ | 0.6 | 16552 | 0.6 | 18054 | 0.0 | 0.0 | 18054 | 0.6 | 0.0 | 18054 | 0.6 | 1 | 0.0 | 18054 | 0.6 | 1 | 0.0 |
| 3-50-10-45-30 | 17258 | 17258 | 17258 | 26.4 | 17258 | 0.0 | 17393↑ | 0.0 | 0.8 | 17271↑ | 0.1 | 0.1 | 17258 | 0.1 | 2 | 0.0 | 17258 | 0.1 | 2 | 0.0 |
| 3-50-10-50-30 | 18954 | 18954 | 18954 | 67.5 | 18954 | 0.0 | 18954 | 0.0 | 0.0 | 18954 | 0.1 | 0.0 | 18954 | 0.1 | 1 | 0.0 | 18954 | 0.1 | 1 | 0.0 |
| 3-50-10-55-30 | 19774 | 19774 | 19774 | 66.7 | 19774 | 0.0 | 19774 | 0.0 | 0.0 | 19798↑ | 0.1 | 0.1 | 19774 | 0.3 | 2 | 0.0 | 19774 | 0.3 | 2 | 0.0 |
| 3-60-10-45-30 | 22057 | 22057 | 22212↑ | 3569.4 | 20690 | 0.7 | 22057 | 0.0 | 0.0 | 22057 | 0.1 | 0.0 | 22057 | 0.1 | 1 | 0.0 | 22057 | 0.1 | 1 | 0.0 |
| 3-60-10-50-30 | 23229 | 23229 | 23229 | 1944.3 | 21593 | 0.0 | 23229 | 0.0 | 0.0 | 23229 | 0.3 | 0.0 | 23229 | 0.3 | 1 | 0.0 | 23229 | 0.3 | 1 | 0.0 |
| 3-60-10-55-30 | 24219 | 24219 | 24219 | 1639.0 | 22218 | 0.0 | 24219 | 0.0 | 0.0 | 24219 | 0.3 | 0.0 | 24219 | 0.3 | 1 | 0.0 | 24219 | 0.3 | 1 | 0.0 |
| 3-70-10-45-30 | 25142 | 25142 | 26078↑ | 1183.4 | 22830 | 3.6 | 25142 | 0.0 | 0.0 | 25142 | 0.3 | 0.0 | 25142 | 0.3 | 1 | 0.0 | 25142 | 0.3 | 1 | 0.0 |
| 3-70-10-50-30 | 20672 | 26380 | 27225↑ | 2793.9 | 23400 | 14.0 | 26390↑ | 0.0 | 11.3 | 26380 | 0.3 | 11.3 | 26380 | 0.3 | 1 | 11.3 | 26380 | 0.3 | 1 | 11.3 |
| 3-70-10-55-30 | 26878 | 26878 | 26931↑ | 0.4 | 23576 | 0.2 | 26878 | 0.0 | 0.0 | 26931↑ | 0.3 | 0.2 | 26878 | 0.7 | 2 | 0.0 | 26878 | 0.7 | 2 | 0.0 |

Table B.7: MMR-KP results for type-4 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 4-50-01-45-10 | 582 | 582 | 582 | 11.2 | 582 | 0.0 | 582 | 0.0 | 0.0 | 582 | 0.1 | 0.0 | 582 | 0.1 | 1 | 0.0 | 582 | 0.1 | 1 | 0.0 |
| 4-50-01-50-10 | 547 | 547 | 547 | 11.4 | 547 | 0.0 | 547 | 0.0 | 0.0 | 547 | 0.1 | 0.0 | 547 | 0.1 | 1 | 0.0 | 547 | 0.1 | 1 | 0.0 |
| 4-50-01-55-10 | 490 | 490 | 490 | 0.3 | 490 | 0.0 | 496↑ | 0.0 | 1.2 | 490 | 0.1 | 0.0 | 490 | 0.1 | 1 | 0.0 | 490 | 0.1 | 1 | 0.0 |
| 4-60-01-45-10 | 710 | 710 | 710 | 21.3 | 710 | 0.0 | 710 | 0.0 | 0.0 | 710 | 0.1 | 0.0 | 710 | 0.1 | 1 | 0.0 | 710 | 0.1 | 1 | 0.0 |
| 4-60-01-50-10 | 668 | 668 | 668 | 8.6 | 668 | 0.0 | 668 | 0.0 | 0.0 | 668 | 0.1 | 0.0 | 668 | 0.1 | 1 | 0.0 | 668 | 0.1 | 1 | 0.0 |
| 4-60-01-55-10 | 603 | 603 | 603 | 18.0 | 603 | 0.0 | 603 | 0.0 | 0.0 | 603 | 0.1 | 0.0 | 603 | 0.1 | 1 | 0.0 | 603 | 0.1 | 1 | 0.0 |
| 4-70-01-45-10 | 754 | 754 | 754 | 8.2 | 746 | 0.0 | 766↑ | 0.0 | 1.6 | 754 | 0.2 | 0.0 | 754 | 0.2 | 1 | 0.0 | 754 | 0.2 | 1 | 0.0 |
| 4-70-01-50-10 | 708 | 708 | 708 | 633.5 | 708 | 0.0 | 708 | 0.0 | 0.0 | 709↑ | 0.2 | 0.1 | 708 | 0.6 | 2 | 0.0 | 708 | 0.5 | 2 | 0.0 |
| 4-70-01-55-10 | 637 | 637 | 637 | 26.0 | 637 | 0.0 | 639↑ | 0.0 | 0.3 | 639↑ | 0.1 | 0.3 | 637 | 0.3 | 2 | 0.0 | 637 | 0.3 | 2 | 0.0 |
| 4-50-01-45-20 | 1532 | 1532 | 1532 | 118.9 | 1532 | 0.0 | 1532 | 0.0 | 0.0 | 1532 | 0.3 | 0.0 | 1532 | 0.3 | 1 | 0.0 | 1532 | 0.3 | 1 | 0.0 |
| 4-50-01-50-20 | 1528 | 1528 | 1528 | 5.3 | 1502 | 0.0 | 1554↑ | 0.0 | 1.7 | 1528 | 0.2 | 0.0 | 1528 | 0.2 | 1 | 0.0 | 1528 | 0.2 | 1 | 0.0 |
| 4-50-01-55-20 | 1456 | 1456 | 1456 | 1262.3 | 1456 | 0.0 | 1474↑ | 0.0 | 1.2 | 1474↑ | 0.2 | 1.2 | 1456 | 0.6 | 2 | 0.0 | 1456 | 0.5 | 2 | 0.0 |
| 4-60-01-45-20 | 1913 | 1913 | 1918↑ | 719.5 | 1715 | 0.3 | 1913 | 0.0 | 0.0 | 1913 | 0.5 | 0.0 | 1913 | 0.5 | 1 | 0.0 | 1913 | 0.5 | 1 | 0.0 |
| 4-60-01-50-20 | 1920 | 1920 | 1938↑ | 1737.2 | 1707 | 0.9 | 1920 | 0.0 | 0.0 | 1920 | 0.4 | 0.0 | 1920 | 0.4 | 1 | 0.0 | 1920 | 0.4 | 1 | 0.0 |
| 4-60-01-55-20 | 1859 | 1859 | 1859 | 1275.1 | 1694 | 0.0 | 1863↑ | 0.0 | 0.2 | 1859 | 0.4 | 0.0 | 1859 | 0.4 | 1 | 0.0 | 1859 | 0.4 | 1 | 0.0 |
| 4-70-01-45-20 | 1674 | 2173 | 2183↑ | 600.7 | 1883 | 13.7 | 2199↑ | 0.0 | 14.4 | 2173 | 0.5 | 13.3 | 2173 | 0.5 | 1 | 13.3 | 2173 | 0.5 | 1 | 13.3 |
| 4-70-01-50-20 | 1650 | 2156 | 2156 | 890.0 | 1876 | 13.0 | 2156 | 0.0 | 13.0 | 2156 | 0.4 | 13.0 | 2156 | 0.4 | 1 | 13.0 | 2156 | 0.4 | 1 | 13.0 |
| 4-70-01-55-20 | 1639 | 2065 | 2065 | 803.6 | 1852 | 10.3 | 2065 | 0.0 | 10.3 | 2065 | 0.3 | 10.3 | 2065 | 0.3 | 1 | 10.3 | 2065 | 0.3 | 1 | 10.3 |
| 4-50-01-45-30 | 2235 | 2235 | 2235 | 190.3 | 2235 | 0.0 | 2235 | 0.0 | 0.0 | 2235 | 0.3 | 0.0 | 2235 | 0.3 | 1 | 0.0 | 2235 | 0.3 | 1 | 0.0 |
| 4-50-01-50-30 | 2144 | 2144 | 2144 | 7.4 | 2144 | 0.0 | 2144 | 0.0 | 0.0 | 2144 | 0.1 | 0.0 | 2144 | 0.1 | 1 | 0.0 | 2144 | 0.1 | 1 | 0.0 |
| 4-50-01-55-30 | 1993 | 1993 | 1993 | 9.1 | 1993 | 0.0 | 2048↑ | 0.0 | 2.7 | 1993 | 0.0 | 0.0 | 1993 | 0.0 | 1 | 0.0 | 1993 | 0.0 | 1 | 0.0 |
| 4-60-01-45-30 | 2749 | 2749 | 2749 | 1496.3 | 2560 | 0.0 | 2773↑ | 0.0 | 0.9 | 2749 | 0.4 | 0.0 | 2749 | 0.4 | 1 | 0.0 | 2749 | 0.4 | 1 | 0.0 |
| 4-60-01-50-30 | 2696 | 2696 | 2743↑ | 2323.8 | 2529 | 1.7 | 2720↑ | 0.0 | 0.9 | 2696 | 0.3 | 0.0 | 2696 | 0.3 | 1 | 0.0 | 2696 | 0.3 | 1 | 0.0 |
| 4-60-01-55-30 | 2546 | 2546 | 2546 | 244.4 | 2421 | 0.0 | 2556↑ | 0.0 | 0.4 | 2556↑ | 0.2 | 0.4 | 2546 | 0.5 | 2 | 0.0 | 2546 | 0.5 | 2 | 0.0 |
| 4-70-01-45-30 | 2992 | 2992 | 2992 | 974.8 | 2693 | 0.0 | 2992 | 0.0 | 0.0 | 2992 | 0.4 | 0.0 | 2992 | 0.4 | 1 | 0.0 | 2992 | 0.4 | 1 | 0.0 |
| 4-70-01-50-30 | 2930 | 2930 | 2954↑ | 2846.8 | 2646 | 0.8 | 2930 | 0.0 | 0.0 | 2930 | 0.7 | 0.0 | 2930 | 0.7 | 1 | 0.0 | 2930 | 0.7 | 1 | 0.0 |
| 4-70-01-55-30 | 2734 | 2734 | 2734 | 961.5 | 2569 | 0.0 | 2734 | 0.0 | 0.0 | 2734 | 0.1 | 0.0 | 2734 | 0.1 | 1 | 0.0 | 2734 | 0.1 | 1 | 0.0 |
| 4-50-10-45-10 | 3623 | 3623 | 3623 | 0.3 | 3623 | 0.0 | 3623 | 0.0 | 0.0 | 3655↑ | 0.0 | 0.9 | 3623 | 0.1 | 3 | 0.0 | 3623 | 0.1 | 3 | 0.0 |
| 4-50-10-50-10 | 3503 | 3503 | 3503 | 0.5 | 3503 | 0.0 | 3503 | 0.0 | 0.0 | 3503 | 0.0 | 0.0 | 3503 | 0.0 | 1 | 0.0 | 3503 | 0.0 | 1 | 0.0 |
| 4-50-10-55-10 | 3363 | 3363 | 3363 | 0.7 | 3363 | 0.0 | 3445↑ | 0.0 | 0.0 | 3363 | 0.1 | 0.0 | 3363 | 0.1 | 1 | 0.0 | 3363 | 0.1 | 1 | 0.0 |
| 4-60-10-45-10 | 4587 | 4587 | 4587 | 0.3 | 4587 | 0.0 | 4587 | 0.0 | 0.0 | 4587 | 0.1 | 0.0 | 4587 | 0.1 | 1 | 0.0 | 4587 | 0.1 | 1 | 0.0 |
| 4-60-10-50-10 | 4016 | 4016 | 4016 | 0.9 | 4016 | 0.0 | 4092↑ | 0.0 | 0.0 | 4016 | 0.0 | 0.0 | 4016 | 0.0 | 1 | 0.0 | 4016 | 0.0 | 1 | 0.0 |
| 4-60-10-55-10 | 3536 | 3536 | 3536 | 0.4 | 3536 | 0.0 | 3681↑ | 0.0 | 3.9 | 3536 | 0.0 | 0.0 | 3536 | 0.0 | 1 | 0.0 | 3536 | 0.0 | 1 | 0.0 |
| 4-70-10-45-10 | 5627 | 5627 | 5627 | 4.1 | 5627 | 0.0 | 5635↑ | 0.0 | 0.1 | 5627 | 0.1 | 0.0 | 5627 | 0.1 | 1 | 0.0 | 5627 | 0.1 | 1 | 0.0 |
| 4-70-10-50-10 | 4672 | 4672 | 4672 | 2.4 | 4672 | 0.0 | 4800↑ | 0.0 | 2.7 | 4672 | 0.0 | 0.0 | 4672 | 0.0 | 1 | 0.0 | 4672 | 0.0 | 1 | 0.0 |
| 4-70-10-55-10 | 4261 | 4261 | 4261 | 3.3 | 4261 | 0.0 | 4261 | 0.0 | 0.0 | 4268↑ | 0.1 | 0.2 | 4261 | 0.2 | 2 | 0.0 | 4261 | 0.2 | 2 | 0.0 |
| 4-50-10-45-20 | 9450 | 9450 | 9450 | 5.7 | 9450 | 0.0 | 9450 | 0.0 | 0.0 | 9450 | 0.1 | 0.0 | 9450 | 0.1 | 1 | 0.0 | 9450 | 0.1 | 1 | 0.0 |
| 4-50-10-50-20 | 9274 | 9274 | 9274 | 3.9 | 9274 | 0.0 | 9286↑ | 0.0 | 0.1 | 9286↑ | 0.1 | 0.1 | 9274 | 0.3 | 3 | 0.0 | 9274 | 0.3 | 3 | 0.0 |
| 4-50-10-55-20 | 8098 | 8098 | 8098 | 0.2 | 8098 | 0.0 | 8208↑ | 0.0 | 0.0 | 8098 | 0.0 | 0.0 | 8098 | 0.0 | 1 | 0.0 | 8098 | 0.0 | 1 | 0.0 |
| 4-60-10-45-20 | 13415 | 13415 | 13415 | 218.1 | 13415 | 0.0 | 13415 | 0.0 | 0.0 | 13415 | 0.2 | 0.0 | 13415 | 0.2 | 1 | 0.0 | 13415 | 0.2 | 1 | 0.0 |
| 4-60-10-50-20 | 12942 | 12942 | 12942 | 292.5 | 12942 | 0.0 | 13009↑ | 0.0 | 0.5 | 13009↑ | 0.3 | 0.5 | 12942 | 0.6 | 2 | 0.0 | 12942 | 0.6 | 2 | 0.0 |
| 4-60-10-55-20 | 11131 | 11131 | 11131 | 0.4 | 11131 | 0.0 | 11131 | 0.0 | 0.0 | 11131 | 0.1 | 0.0 | 11131 | 0.1 | 1 | 0.0 | 11131 | 0.1 | 1 | 0.0 |
| 4-70-10-45-20 | 14202 | 14202 | 14202 | 645.9 | 13525 | 0.0 | 14202 | 0.0 | 0.0 | 14202 | 0.1 | 0.0 | 14202 | 0.1 | 1 | 0.0 | 14202 | 0.1 | 1 | 0.0 |
| 4-70-10-50-20 | 13696 | 13696 | 13696 | 1716.6 | 13455 | 0.0 | 13734↑ | 0.0 | 0.3 | 13696 | 0.3 | 0.0 | 13696 | 0.3 | 1 | 0.0 | 13696 | 0.3 | 1 | 0.0 |
| 4-70-10-55-20 | 12570 | 12570 | 12570 | 198.3 | 12570 | 0.0 | 12581↑ | 0.0 | 0.1 | 12581↑ | 0.1 | 0.1 | 12570 | 0.3 | 2 | 0.0 | 12570 | 0.3 | 2 | 0.0 |
| 4-50-10-45-30 | 22100 | 22100 | 22100 | 6.1 | 22100 | 0.0 | 22100 | 0.0 | 0.0 | 22100 | 0.3 | 0.0 | 22100 | 0.3 | 1 | 0.0 | 22100 | 0.3 | 1 | 0.0 |
| 4-50-10-50-30 | 21724 | 21724 | 21724 | 545.8 | 21407 | 0.0 | 21724 | 0.0 | 0.0 | 21724 | 0.1 | 0.0 | 21724 | 0.1 | 1 | 0.0 | 21724 | 0.1 | 1 | 0.0 |
| 4-50-10-55-30 | 20216 | 20216 | 20216 | 6.4 | 20216 | 0.0 | 20216 | 0.0 | 0.0 | 20216 | 0.1 | 0.0 | 20216 | 0.1 | 1 | 0.0 | 20216 | 0.1 | 1 | 0.0 |
| 4-60-10-45-30 | 25186 | 25186 | 25186 | 756.4 | 23337 | 0.0 | 25201↑ | 0.0 | 0.1 | 25186 | 0.3 | 0.0 | 25186 | 0.3 | 1 | 0.0 | 25186 | 0.3 | 1 | 0.0 |
| 4-60-10-50-30 | 25408 | 25408 | 25408 | 838.8 | 23097 | 0.0 | 25408 | 0.0 | 0.0 | 25441↑ | 0.5 | 0.1 | 25408 | 1.6 | 3 | 0.0 | 25408 | 1.6 | 3 | 0.0 |
| 4-60-10-55-30 | 23982 | 23982 | 24012↑ | 823.2 | 22383 | 0.1 | 23982 | 0.0 | 0.0 | 23982 | 0.3 | 0.0 | 23982 | 0.3 | 1 | 0.0 | 23982 | 0.3 | 1 | 0.0 |
| 4-70-10-45-30 | 28220 | 28220 | 28220 | 660.4 | 24773 | 0.0 | 28220 | 0.0 | 0.0 | 28220 | 0.3 | 0.0 | 28220 | 0.3 | 1 | 0.0 | 28220 | 0.3 | 1 | 0.0 |
| 4-70-10-50-30 | 28298 | 28298 | 28298 | 449.9 | 24436 | 0.0 | 28298 | 0.0 | 0.0 | 28298 | 0.5 | 0.0 | 28298 | 0.5 | 1 | 0.0 | 28298 | 0.5 | 1 | 0.0 |
| 4-70-10-55-30 | 26642 | 26642 | 26642 | 576.1 | 23792 | 0.0 | 26642 | 0.0 | 0.0 | 26642 | 0.4 | 0.0 | 26642 | 0.4 | 1 | 0.0 | 26642 | 0.4 | 1 | 0.0 |

Table B.8: MMR-KP results for type-5 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 5-50-01-45-10 | 731 | 731 | 731 | 17.5 | 731 | 0.0 | 736↑ | 0.0 | 0.7 | 736↑ | 0.1 | 0.7 | 731 | 0.5 | 3 | 0.0 | 731 | 0.4 | 3 | 0.0 |
| 5-50-01-50-10 | 770 | 770 | 770 | 13.8 | 770 | 0.0 | 770 | 0.0 | 0.0 | 770 | 0.3 | 0.0 | 770 | 0.3 | 1 | 0.0 | 770 | 0.3 | 1 | 0.0 |
| 5-50-01-55-10 | 777 | 777 | 777 | 15.0 | 777 | 0.0 | 777 | 0.0 | 0.0 | 777 | 0.1 | 0.0 | 777 | 0.1 | 1 | 0.0 | 777 | 0.1 | 1 | 0.0 |
| 5-60-01-45-10 | 874 | 874 | 874 | 10.4 | 874 | 0.0 | 874 | 0.0 | 0.0 | 874 | 0.2 | 0.0 | 874 | 0.2 | 1 | 0.0 | 874 | 0.2 | 1 | 0.0 |
| 5-60-01-50-10 | 924 | 924 | 924 | 1507.5 | 915 | 0.0 | 924 | 0.0 | 0.0 | 932↑ | 0.6 | 0.9 | 924 | 1.6 | 3 | 0.0 | 924 | 1.6 | 3 | 0.0 |
| 5-60-01-55-10 | 931 | 931 | 931 | 0.2 | 918 | 0.0 | 931 | 0.0 | 0.0 | 931 | 0.3 | 0.0 | 931 | 0.3 | 1 | 0.0 | 931 | 0.3 | 1 | 0.0 |
| 5-70-01-45-10 | 986 | 986 | 986 | 3090.7 | 932 | 0.0 | 991↑ | 0.0 | 0.5 | 993↑ | 0.7 | 0.7 | 986 | 1.2 | 2 | 0.0 | 986 | 1.3 | 2 | 0.0 |
| 5-70-01-50-10 | 1012 | 1012 | 1012 | 0.4 | 955 | 0.0 | 1012 | 0.0 | 0.0 | 1012 | 0.1 | 0.0 | 1012 | 0.1 | 1 | 0.0 | 1012 | 0.1 | 1 | 0.0 |
| 5-70-01-55-10 | 1034 | 1034 | 1045↑ | 1689.8 | 979 | 1.1 | 1034 | 0.0 | 0.0 | 1034 | 0.3 | 0.0 | 1034 | 0.3 | 1 | 0.0 | 1034 | 0.3 | 1 | 0.0 |
| 5-50-01-45-20 | 1566 | 1566 | 1566 | 308.1 | 1566 | 0.0 | 1566 | 0.0 | 0.0 | 1566 | 0.1 | 0.0 | 1566 | 0.1 | 1 | 0.0 | 1566 | 0.1 | 1 | 0.0 |
| 5-50-01-50-20 | 1688 | 1688 | 1688 | 2452.4 | 1688 | 0.0 | 1705↑ | 0.0 | 1.0 | 1705↑ | 0.3 | 1.0 | 1688 | 1.5 | 5 | 0.0 | 1688 | 1.5 | 5 | 0.0 |
| 5-50-01-55-20 | 1726 | 1726 | 1726 | 1534.3 | 1687 | 0.0 | 1726 | 0.0 | 0.0 | 1726 | 0.2 | 0.0 | 1726 | 0.2 | 1 | 0.0 | 1726 | 0.2 | 1 | 0.0 |
| 5-60-01-45-20 | 1951 | 1951 | 1955↑ | 2475.6 | 1833 | 0.2 | 1960↑ | 0.0 | 0.5 | 1951 | 0.4 | 0.0 | 1951 | 0.4 | 1 | 0.0 | 1951 | 0.4 | 1 | 0.0 |
| 5-60-01-50-20 | 2073 | 2073 | 2073 | 410.3 | 1908 | 0.0 | 2086↑ | 0.0 | 0.6 | 2086↑ | 0.4 | 0.6 | 2073 | 0.7 | 2 | 0.0 | 2073 | 0.7 | 2 | 0.0 |
| 5-60-01-55-20 | 2142 | 2142 | 2179↑ | 1050.6 | 1959 | 1.7 | 2179↑ | 0.0 | 1.7 | 2142 | 0.4 | 0.0 | 2142 | 0.4 | 1 | 0.0 | 2142 | 0.4 | 1 | 0.0 |
| 5-70-01-45-20 | 2225 | 2225 | 2253↑ | 2212.9 | 2069 | 1.2 | 2236↑ | 0.0 | 0.5 | 2225 | 0.2 | 0.0 | 2225 | 0.2 | 1 | 0.0 | 2225 | 0.2 | 1 | 0.0 |
| 5-70-01-50-20 | 1951 | 2385 | 2428↑ | 2862.4 | 2134 | 12.1 | 2401↑ | 0.0 | 11.1 | 2399↑ | 0.3 | 11.0 | **2384**↓ | 0.7 | 2 | 10.5 | 2385 | 0.7 | 2 | 10.5 |
| 5-70-01-55-20 | 1917 | 2524 | 2543↑ | 0.4 | 2150 | 15.5 | 2524 | 0.0 | 14.8 | 2524 | 0.8 | 14.8 | 2524 | 0.8 | 1 | 14.8 | 2524 | 0.8 | 1 | 14.8 |
| 5-50-01-45-30 | 2251 | 2251 | 2251 | 912.2 | 2167 | 0.0 | 2251 | 0.0 | 0.0 | 2251 | 0.2 | 0.0 | 2251 | 0.2 | 1 | 0.0 | 2251 | 0.2 | 1 | 0.0 |
| 5-50-01-50-30 | 2200 | 2200 | 2200 | 8.3 | 2147 | 0.0 | 2200 | 0.0 | 0.0 | 2200 | 0.1 | 0.0 | 2200 | 0.1 | 1 | 0.0 | 2200 | 0.1 | 1 | 0.0 |
| 5-50-01-55-30 | 2087 | 2087 | 2087 | 11.7 | 2087 | 0.0 | 2087 | 0.0 | 0.0 | 2087 | 0.1 | 0.0 | 2087 | 0.1 | 1 | 0.0 | 2087 | 0.1 | 1 | 0.0 |
| 5-60-01-45-30 | 2768 | 2768 | 2768 | 987.6 | 2510 | 0.0 | 2768 | 0.0 | 0.0 | 2768 | 0.3 | 0.0 | 2768 | 0.3 | 1 | 0.0 | 2768 | 0.3 | 1 | 0.0 |
| 5-60-01-50-30 | 2752 | 2752 | 2782↑ | 800.4 | 2468 | 1.1 | 2752 | 0.0 | 0.0 | 2752 | 0.3 | 0.0 | 2752 | 0.3 | 1 | 0.0 | 2752 | 0.3 | 1 | 0.0 |
| 5-60-01-55-30 | 2657 | 2657 | 2657 | 843.2 | 2421 | 0.0 | 2657 | 0.0 | 0.0 | 2657 | 0.2 | 0.0 | 2657 | 0.2 | 1 | 0.0 | 2657 | 0.2 | 1 | 0.0 |
| 5-70-01-45-30 | 2621 | 3450 | 3520↑ | 2064.9 | 2931 | 16.7 | 3450 | 0.0 | 15.0 | 3450 | 0.5 | 15.0 | 3450 | 0.5 | 1 | 15.0 | 3450 | 0.5 | 1 | 15.0 |
| 5-70-01-50-30 | 2587 | 3287 | 3414↑ | 910.9 | 2926 | 14.3 | 3415↑ | 0.0 | 14.3 | 3415↑ | 0.4 | 14.3 | 3406↑ | 0.8 | 2 | 14.1 | 3406↑ | 0.8 | 2 | 14.1 |
| 5-70-01-55-30 | 2590 | 3303 | 3387↑ | 0.3 | 2860 | 15.6 | 3303 | 0.0 | 13.4 | 3303 | 0.2 | 13.4 | 3303 | 0.2 | 1 | 13.4 | 3303 | 0.2 | 1 | 13.4 |
| 5-50-10-45-10 | 3322 | 3322 | 3322 | 0.7 | 3322 | 0.0 | 3461↑ | 0.0 | 4.0 | 3322 | 0.1 | 0.0 | 3322 | 0.1 | 1 | 0.0 | 3322 | 0.1 | 1 | 0.0 |
| 5-50-10-50-10 | 3358 | 3358 | 3358 | 0.5 | 3358 | 0.0 | 3358 | 0.0 | 0.0 | 3374↑ | 0.0 | 0.5 | 3358 | 0.1 | 2 | 0.0 | 3358 | 0.1 | 2 | 0.0 |
| 5-50-10-55-10 | 3494 | 3494 | 3494 | 0.7 | 3494 | 0.0 | 3494 | 0.0 | 0.0 | 3494 | 0.0 | 0.0 | 3494 | 0.0 | 1 | 0.0 | 3494 | 0.0 | 1 | 0.0 |
| 5-60-10-45-10 | 3458 | 3458 | 3458 | 0.3 | 3458 | 0.0 | 3461↑ | 0.0 | 0.1 | 3461↑ | 0.0 | 0.1 | 3458 | 0.1 | 2 | 0.0 | 3458 | 0.1 | 2 | 0.0 |
| 5-60-10-50-10 | 3685 | 3685 | 3685 | 1.6 | 3685 | 0.0 | 3816↑ | 0.0 | 0.0 | 3815↑ | 0.1 | 3.4 | 3685 | 0.3 | 3 | 0.0 | 3685 | 0.3 | 3 | 0.0 |
| 5-60-10-55-10 | 3797 | 3797 | 3797 | 1.2 | 3797 | 0.0 | 3797 | 0.0 | 0.0 | 3851↑ | 0.1 | 1.4 | 3797 | 0.1 | 2 | 0.0 | 3797 | 0.1 | 2 | 0.0 |
| 5-70-10-45-10 | 4431 | 4431 | 4431 | 6.5 | 4431 | 0.0 | 4431 | 0.0 | 0.0 | 4431 | 0.1 | 0.0 | 4431 | 0.1 | 1 | 0.0 | 4431 | 0.1 | 1 | 0.0 |
| 5-70-10-50-10 | 4575 | 4575 | 4575 | 8.2 | 4575 | 0.0 | 4575 | 0.0 | 0.0 | 4575 | 0.1 | 0.0 | 4575 | 0.1 | 1 | 0.0 | 4575 | 0.1 | 1 | 0.0 |
| 5-70-10-55-10 | 5061 | 5061 | 5061 | 3.4 | 5061 | 0.0 | 5061 | 0.0 | 0.0 | 5071↑ | 0.1 | 0.2 | 5061 | 0.3 | 3 | 0.0 | 5061 | 0.3 | 3 | 0.0 |
| 5-50-10-45-20 | 7664 | 7664 | 7664 | 0.5 | 7664 | 0.0 | 7664 | 0.0 | 0.0 | 7664 | 0.0 | 0.0 | 7664 | 0.0 | 1 | 0.0 | 7664 | 0.0 | 1 | 0.0 |
| 5-50-10-50-20 | 8764 | 8764 | 8764 | 1.4 | 8764 | 0.0 | 8764 | 0.0 | 0.0 | 8764 | 0.1 | 0.0 | 8764 | 0.1 | 1 | 0.0 | 8764 | 0.1 | 1 | 0.0 |
| 5-50-10-55-20 | 9369 | 9369 | 9369 | 3.5 | 9369 | 0.0 | 9391↑ | 0.0 | 0.0 | 9369 | 0.1 | 0.0 | 9369 | 0.1 | 1 | 0.0 | 9369 | 0.1 | 1 | 0.0 |
| 5-60-10-45-20 | 8020 | 8020 | 8020 | 0.3 | 8020 | 0.0 | 8020 | 0.0 | 0.0 | 8020 | 0.0 | 0.0 | 8020 | 0.0 | 1 | 0.0 | 8020 | 0.0 | 1 | 0.0 |
| 5-60-10-50-20 | 8730 | 8730 | 8730 | 0.3 | 8730 | 0.0 | 8730 | 0.0 | 0.0 | 8730 | 0.0 | 0.0 | 8730 | 0.0 | 1 | 0.0 | 8730 | 0.0 | 1 | 0.0 |
| 5-60-10-55-20 | 9873 | 9873 | 9873 | 0.5 | 9873 | 0.0 | 9932↑ | 0.0 | 0.6 | 9932↑ | 0.1 | 0.6 | 9873 | 0.2 | 2 | 0.0 | 9873 | 0.1 | 2 | 0.0 |
| 5-70-10-45-20 | 11891 | 11891 | 11891 | 0.5 | 11891 | 0.0 | 11891 | 0.0 | 0.0 | 11891 | 0.1 | 0.0 | 11891 | 0.1 | 1 | 0.0 | 11891 | 0.1 | 1 | 0.0 |
| 5-70-10-50-20 | 13582 | 13582 | 13582 | 54.5 | 13582 | 0.0 | 13582 | 0.0 | 0.0 | 13582 | 0.1 | 0.0 | 13582 | 0.1 | 1 | 0.0 | 13582 | 0.1 | 1 | 0.0 |
| 5-70-10-55-20 | 14862 | 14862 | 14862 | 240.5 | 14862 | 0.0 | 14897↑ | 0.0 | 0.2 | 14897↑ | 0.3 | 0.2 | 14862 | 1.0 | 3 | 0.0 | 14862 | 1.1 | 3 | 0.0 |
| 5-50-10-45-30 | 16984 | 16984 | 16984 | 28.2 | 16984 | 0.0 | 17216↑ | 0.0 | 1.3 | 16984 | 0.1 | 0.0 | 16984 | 0.1 | 1 | 0.0 | 16984 | 0.1 | 1 | 0.0 |
| 5-50-10-50-30 | 17680 | 17680 | 17680 | 21.2 | 17680 | 0.0 | 17680 | 0.0 | 0.0 | 17680 | 0.1 | 0.0 | 17680 | 0.1 | 1 | 0.0 | 17680 | 0.1 | 1 | 0.0 |
| 5-50-10-55-30 | 17894 | 17894 | 17894 | 40.5 | 17894 | 0.0 | 17985↑ | 0.0 | 0.5 | 17985↑ | 0.0 | 0.5 | 17894 | 0.1 | 2 | 0.0 | 17894 | 0.1 | 2 | 0.0 |
| 5-60-10-45-30 | 18381 | 18381 | 18381 | 127.9 | 18381 | 0.0 | 18396↑ | 0.0 | 0.1 | 18396↑ | 0.1 | 0.1 | 18381 | 0.2 | 2 | 0.0 | 18381 | 0.2 | 2 | 0.0 |
| 5-60-10-50-30 | 19414 | 19414 | 19414 | 10.9 | 19414 | 0.0 | 19414 | 0.0 | 0.0 | 19414 | 0.1 | 0.0 | 19414 | 0.1 | 1 | 0.0 | 19414 | 0.1 | 1 | 0.0 |
| 5-60-10-55-30 | 19884 | 19884 | 19884 | 697.2 | 19884 | 0.0 | 20066↑ | 0.0 | 0.9 | 19884 | 0.1 | 0.0 | 19884 | 0.1 | 1 | 0.0 | 19884 | 0.1 | 1 | 0.0 |
| 5-70-10-45-30 | 24536 | 24536 | 24536 | 3178.1 | 23694 | 0.0 | 24716↑ | 0.0 | 0.7 | 24536 | 0.1 | 0.0 | 24536 | 0.1 | 1 | 0.0 | 24536 | 0.1 | 1 | 0.0 |
| 5-70-10-50-30 | 26382 | 26382 | 26390↑ | 0.3 | 24549 | 0.0 | 26390↑ | 0.0 | 0.0 | 26382 | 0.3 | 0.0 | 26382 | 0.3 | 1 | 0.0 | 26382 | 0.3 | 1 | 0.0 |
| 5-70-10-55-30 | 27692 | 27692 | 28295↑ | 0.4 | 24866 | 2.1 | 27692 | 0.0 | 0.0 | 27692 | 0.3 | 0.0 | 27692 | 0.3 | 1 | 0.0 | 27692 | 0.3 | 1 | 0.0 |

Table B.9: MMR-KP results for type-6 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 6-50-01-45-10 | 760 | 760 | 768↑ | 18.0 | 724 | 1.0 | 760 | 0.0 | 0.0 | 765↑ | 0.1 | 0.7 | 760 | 0.2 | 2 | 0.0 | 760 | 0.2 | 2 | 0.0 |
| 6-50-01-50-10 | 740 | 740 | 740 | 1655.6 | 724 | 0.0 | 740 | 0.0 | 0.0 | 740 | 0.1 | 0.0 | 740 | 0.1 | 1 | 0.0 | 740 | 0.1 | 1 | 0.0 |
| 6-50-01-55-10 | 743 | 743 | 746↑ | 2584.8 | 718 | 0.4 | 743 | 0.0 | 0.0 | 743 | 0.1 | 0.0 | 743 | 0.1 | 1 | 0.0 | 743 | 0.1 | 1 | 0.0 |
| 6-60-01-45-10 | 775 | 991 | 995↑ | 491.9 | 877 | 11.9 | 991 | 0.0 | 11.5 | 991 | 0.1 | 11.5 | 991 | 0.1 | 1 | 11.5 | 991 | 0.1 | 1 | 11.5 |
| 6-60-01-50-10 | 775 | 998 | 1001↑ | 642.1 | 879 | 12.2 | 999↑ | 0.0 | 12.0 | 999↑ | 0.1 | 12.0 | 998 | 0.5 | 3 | 11.9 | 998 | 0.5 | 3 | 11.9 |
| 6-60-01-55-10 | 780 | 1005 | 1014↑ | 2276.1 | 876 | 13.6 | 1005 | 0.0 | 12.8 | 1005 | 0.2 | 12.8 | 1005 | 0.2 | 1 | 12.8 | 1005 | 0.2 | 1 | 12.8 |
| 6-70-01-45-10 | 828 | 1090 | 1093↑ | 788.7 | 918 | 16.0 | 1093↑ | 0.0 | 16.0 | 1090 | 0.4 | 15.8 | 1090 | 0.4 | 1 | 15.8 | 1090 | 0.4 | 1 | 15.8 |
| 6-70-01-50-10 | 829 | 1109 | 1112↑ | 842.0 | 929 | 16.5 | 1109 | 0.0 | 16.2 | 1109 | 0.4 | 16.2 | 1109 | 0.4 | 1 | 16.2 | 1109 | 0.4 | 1 | 16.2 |
| 6-70-01-55-10 | 828 | 1117 | 1119↑ | 822.8 | 928 | 17.1 | 1117 | 0.0 | 16.9 | 1117 | 0.4 | 16.9 | 1117 | 0.4 | 1 | 16.9 | 1117 | 0.4 | 1 | 16.9 |
| 6-50-01-45-20 | 1691 | 1691 | 1702↑ | 597.4 | 1523 | 0.6 | 1698↑ | 0.0 | 0.4 | 1698↑ | 0.4 | 0.4 | 1691 | 2.5 | 9 | 0.0 | 1691 | 1.3 | **5** | 0.0 |
| 6-50-01-50-20 | 1705 | 1705 | 1705 | 747.4 | 1536 | 0.0 | 1707↑ | 0.0 | 0.1 | 1705 | 0.2 | 0.0 | 1705 | 0.2 | 1 | 0.0 | 1705 | 0.2 | 1 | 0.0 |
| 6-50-01-55-20 | 1706 | 1706 | 1707↑ | 616.9 | 1547 | 0.1 | 1706 | 0.0 | 0.0 | 1706 | 0.3 | 0.0 | 1706 | 0.3 | 1 | 0.0 | 1706 | 0.3 | 1 | 0.0 |
| 6-60-01-45-20 | 1626 | 2213 | 2238↑ | 1055.5 | 1779 | 20.5 | 2213 | 0.0 | 19.6 | 2213 | 0.4 | 19.6 | 2213 | 0.4 | 1 | 19.6 | 2213 | 0.4 | 1 | 19.6 |
| 6-60-01-50-20 | 1638 | 2240 | 2240 | 1940.4 | 1817 | 18.9 | 2240 | 0.0 | 18.9 | 2240 | 0.5 | 18.9 | 2240 | 0.5 | 1 | 18.9 | 2240 | 0.5 | 1 | 18.9 |
| 6-60-01-55-20 | 1634 | 2245 | 2245 | 803.4 | 1824 | 18.8 | 2251↑ | 0.0 | 19.0 | 2245 | 0.5 | 18.8 | 2245 | 0.5 | 1 | 18.8 | 2245 | 0.5 | 1 | 18.8 |
| 6-70-01-45-20 | 1795 | 2556 | 2570↑ | 879.8 | 1983 | 22.8 | 2554↓ | 0.0 | 22.4 | 2556 | 0.8 | 22.4 | 2554↓ | 1.7 | 2 | 22.4 | 2554↓ | 1.8 | 2 | 22.4 |
| 6-70-01-50-20 | 1818 | 2597 | 2599↑ | 1279.2 | 1977 | 23.9 | 2597 | 0.0 | 23.9 | 2597 | 0.8 | 23.9 | 2597 | 0.8 | 1 | 23.9 | 2597 | 0.8 | 1 | 23.9 |
| 6-70-01-55-20 | 1818 | 2601 | 2601 | 914.7 | 1967 | 24.4 | 2601 | 0.0 | 24.4 | 2601 | 0.9 | 24.4 | 2601 | 0.9 | 1 | 24.4 | 2601 | 0.9 | 1 | 24.4 |
| 6-50-01-45-30 | 2559 | 2559 | 2559 | 944.5 | 2428 | 0.0 | 2559 | 0.0 | 0.0 | 2559 | 0.2 | 0.0 | 2559 | 0.2 | 1 | 0.0 | 2559 | 0.2 | 1 | 0.0 |
| 6-50-01-50-30 | 2560 | 2560 | 2590↑ | 650.2 | 2402 | 1.2 | 2560 | 0.0 | 0.0 | 2560 | 0.1 | 0.0 | 2560 | 0.1 | 1 | 0.0 | 2560 | 0.1 | 1 | 0.0 |
| 6-50-01-55-30 | 2535 | 2535 | 2535 | 729.2 | 2405 | 0.0 | 2544↑ | 0.0 | 0.4 | 2535 | 0.3 | 0.0 | 2535 | 0.3 | 1 | 0.0 | 2535 | 0.3 | 1 | 0.0 |
| 6-60-01-45-30 | 2434 | 3157 | 3159↑ | 849.8 | 2707 | 14.3 | 3159↑ | 0.0 | 14.3 | 3159↑ | 0.5 | 14.3 | 3157 | 1.1 | 2 | 14.3 | 3157 | 1.1 | 2 | 14.3 |
| 6-60-01-50-30 | 2437 | 3175 | 3175 | 753.8 | 2727 | 14.1 | 3175 | 0.0 | 14.1 | 3175 | 0.3 | 14.1 | 3175 | 0.3 | 1 | 14.1 | 3175 | 0.3 | 1 | 14.1 |
| 6-60-01-55-30 | 2426 | 3163 | 3194↑ | 704.5 | 2665 | 16.6 | 3163 | 0.0 | 15.7 | 3163 | 0.4 | 15.7 | 3163 | 0.4 | 1 | 15.7 | 3163 | 0.4 | 1 | 15.7 |
| 6-70-01-45-30 | 2587 | 3481 | 3492↑ | 989.0 | 2881 | 17.5 | 3481 | 0.0 | 17.2 | 3481 | 0.7 | 17.2 | 3481 | 0.7 | 1 | 17.2 | 3481 | 0.7 | 1 | 17.2 |
| 6-70-01-50-30 | 2598 | 3501 | 3505↑ | 873.8 | 2847 | 18.8 | 3501 | 0.0 | 18.7 | 3501 | 0.4 | 18.7 | 3501 | 0.4 | 1 | 18.7 | 3501 | 0.4 | 1 | 18.7 |
| 6-70-01-55-30 | 2577 | 3477 | 3487↑ | 901.5 | 2782 | 20.2 | 3478↑ | 0.0 | 20.0 | 3478↑ | 0.6 | 20.0 | 3475↓ | 1.6 | 3 | 19.9 | 3475↓ | 1.1 | **2** | 19.9 |
| 6-50-10-45-10 | 7851 | 7851 | 7851 | 1406.5 | 7409 | 0.0 | 7851 | 0.0 | 0.0 | 7851 | 0.3 | 0.0 | 7851 | 0.3 | 1 | 0.0 | 7851 | 0.3 | 1 | 0.0 |
| 6-50-10-50-10 | 7904 | 7904 | 7962↑ | 572.3 | 7200 | 0.0 | 7919↑ | 0.0 | 0.0 | 7904 | 0.7 | 0.0 | 7904 | 0.7 | 1 | 0.0 | 7904 | 0.7 | 1 | 0.0 |
| 6-50-10-55-10 | 7589 | 7589 | 7652↑ | 1989.8 | 7222 | 0.0 | 7603↑ | 0.0 | 0.0 | 7597↑ | 0.2 | 0.1 | 7589 | 2.6 | 9 | 0.0 | 7589 | 1.6 | **5** | 0.0 |
| 6-60-10-45-10 | 7604 | 9667 | 9667 | 3340.4 | 8379 | 13.3 | 9667 | 0.0 | 13.3 | 9667 | 0.4 | 13.3 | 9667 | 0.4 | 1 | 13.3 | 9667 | 0.4 | 1 | 13.3 |
| 6-60-10-50-10 | 7574 | 9774 | 9797↑ | 1179.7 | 8293 | 0.0 | 9774 | 0.0 | 0.0 | 9774 | 0.6 | 15.2 | 9774 | 0.6 | 1 | 15.2 | 9774 | 0.6 | 1 | 15.2 |
| 6-60-10-55-10 | 9441 | 9441 | 9539↑ | 589.5 | 8280 | 1.0 | 9462↑ | 0.0 | 0.2 | 9462↑ | 0.6 | 0.2 | 9441 | 1.1 | 2 | 0.0 | 9441 | 1.1 | 2 | 0.0 |
| 6-70-10-45-10 | 8217 | 11060 | 11139↑ | 742.8 | 8998 | 19.2 | 11078↑ | 0.0 | 18.8 | 11060 | 1.9 | 18.6 | 11060 | 1.9 | 1 | 18.6 | 11060 | 1.9 | 1 | 18.6 |
| 6-70-10-50-10 | 8197 | 11054 | 11054 | 717.7 | 8852 | 19.9 | 11054 | 0.0 | 19.9 | 11054 | 1.0 | 19.9 | 11054 | 1.0 | 1 | 19.9 | 11054 | 1.0 | 1 | 19.9 |
| 6-70-10-55-10 | 8081 | 10722 | 10851↑ | 864.9 | 8720 | 19.6 | 10722 | 0.0 | 18.7 | 10722 | 0.9 | 18.7 | 10722 | 0.9 | 1 | 18.7 | 10722 | 0.9 | 1 | 18.7 |
| 6-50-10-45-20 | 12921 | 12921 | 12921 | 2351.7 | 12545 | 0.0 | 12993↑ | 0.0 | 0.6 | 12921 | 0.1 | 0.0 | 12921 | 0.1 | 1 | 0.0 | 12921 | 0.1 | 1 | 0.0 |
| 6-50-10-50-20 | 13240 | 13240 | 13262↑ | 2212.7 | 12664 | 0.2 | 13250↑ | 0.0 | 0.1 | 13250↑ | 0.2 | 0.1 | 13240 | 1.0 | 4 | 0.0 | 13240 | 0.8 | **3** | 0.0 |
| 6-50-10-55-20 | 13070 | 13070 | 13136↑ | 2617.6 | 12603 | 0.0 | 13120↑ | 0.0 | 0.0 | 13112↑ | 0.2 | 0.3 | 13070 | 197.3 | 190 | 0.0 | 13070 | 89.6 | **98** | 0.0 |
| 6-60-10-45-20 | 16849 | 16849 | 16878↑ | 596.7 | 15032 | 0.2 | 16878↑ | 0.0 | 0.2 | 16878↑ | 0.4 | 0.2 | 16849 | 3.2 | 9 | 0.0 | 16849 | 1.8 | **5** | 0.0 |
| 6-60-10-50-20 | 13556 | 17333 | 17376↑ | 971.1 | 15177 | 12.7 | 17348↑ | 0.0 | 12.5 | 17348↑ | 0.5 | 12.5 | 17333 | 8.5 | 15 | 12.4 | 17333 | 4.3 | **8** | 12.4 |
| 6-60-10-55-20 | 17123 | 17123 | 17191↑ | 754.9 | 14929 | 0.4 | 17123 | 0.0 | 0.0 | 17148↑ | 0.4 | 0.1 | 17123 | 1.1 | 3 | 0.0 | 17123 | 0.7 | **2** | 0.0 |
| 6-70-10-45-20 | 14104 | 18673 | 18711↑ | 816.7 | 15576 | 16.8 | 18697↑ | 0.0 | 16.7 | 18686↑ | 0.6 | 16.6 | 18673 | 6.7 | 10 | 16.6 | 18673 | 3.9 | **6** | 16.6 |
| 6-70-10-50-20 | 14151 | 18890 | 18917↑ | 919.5 | 15433 | 18.4 | 18959↑ | 0.0 | 18.6 | 18890 | 0.6 | 18.3 | 18890 | 0.6 | 1 | 18.3 | 18890 | 0.6 | 1 | 18.3 |
| 6-70-10-55-20 | 14070 | 18668 | 18712↑ | 792.5 | 15460 | 17.4 | 18759↑ | 0.0 | 17.6 | 18671↑ | 0.3 | 17.2 | 18652↓ | 32.3 | 44 | 17.1 | 18652↓ | 18.7 | **25** | 17.1 |
| 6-50-10-45-30 | 23190 | 23190 | 23277↑ | 1475.4 | 21460 | 0.4 | 23277↑ | 0.0 | 0.4 | 23190 | 0.2 | 0.0 | 23190 | 0.2 | 1 | 0.0 | 23190 | 0.2 | 1 | 0.0 |
| 6-50-10-50-30 | 24190 | 24190 | 24190 | 720.7 | 21943 | 0.0 | 24190 | 0.0 | 0.0 | 24190 | 0.3 | 0.0 | 24190 | 0.3 | 1 | 0.0 | 24190 | 0.3 | 1 | 0.0 |
| 6-50-10-55-30 | 24324 | 24324 | 24324 | 815.3 | 22058 | 0.0 | 24324 | 0.0 | 0.0 | 24324 | 0.3 | 0.0 | 24324 | 0.3 | 1 | 0.0 | 24324 | 0.3 | 1 | 0.0 |
| 6-60-10-45-30 | 21122 | 27417 | 27785↑ | 1284.2 | 23081 | 16.9 | 27518↑ | 0.0 | 16.1 | 27417 | 0.4 | 15.8 | 27417 | 0.4 | 1 | 15.8 | 27417 | 0.4 | 1 | 15.8 |
| 6-60-10-50-30 | 21364 | 28524 | 28649↑ | 584.5 | 23463 | 18.1 | 28524 | 0.0 | 17.7 | 28524 | 0.5 | 17.7 | 28524 | 0.5 | 1 | 17.7 | 28524 | 0.5 | 1 | 17.7 |
| 6-60-10-55-30 | 21371 | 28476 | 28553↑ | 850.8 | 23479 | 17.8 | 28476 | 0.0 | 17.5 | 28476 | 0.5 | 17.5 | 28476 | 0.5 | 1 | 17.5 | 28476 | 0.5 | 1 | 17.5 |
| 6-70-10-45-30 | 22925 | 31130 | 31460↑ | 683.6 | 25231 | 19.8 | 31301↑ | 0.0 | 19.4 | 31130 | 0.5 | 18.9 | 31130 | 0.5 | 1 | 18.9 | 31130 | 0.5 | 1 | 18.9 |
| 6-70-10-50-30 | 23305 | 32207 | 32207 | 892.7 | 25627 | 20.4 | 32230↑ | 0.0 | 20.5 | 32230↑ | 0.6 | 20.5 | 32207 | 1.6 | 2 | 20.4 | 32207 | 1.8 | 2 | 20.4 |
| 6-70-10-55-30 | 23164 | 32067 | 32111↑ | 875.2 | 25455 | 20.7 | 32067 | 0.0 | 20.6 | 32067 | 0.5 | 20.6 | 32067 | 0.5 | 1 | 20.6 | 32067 | 0.5 | 1 | 20.6 |

Table B.10: MMR-KP results for type-7 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 7-50-01-45-10 | 833 | 833 | 833 | 870.8 | 786 | 0.0 | 833 | 0.0 | 0.0 | 833 | 0.2 | 0.0 | 833 | 0.2 | 1 | 0.0 | 833 | 0.2 | 1 | 0.0 |
| 7-50-01-50-10 | 810 | 810 | 810 | 2864.5 | 773 | 0.0 | 810 | 0.0 | 0.0 | 810 | 0.1 | 0.0 | 810 | 0.1 | 1 | 0.0 | 810 | 0.1 | 1 | 0.0 |
| 7-50-01-55-10 | 803 | 803 | 809↑ | 1961.9 | 774 | 0.7 | 803 | 0.0 | 0.0 | 803 | 0.1 | 0.0 | 803 | 0.1 | 1 | 0.0 | 803 | 0.1 | 1 | 0.0 |
| 7-60-01-45-10 | 820 | 1061 | 1066↑ | 994.2 | 923 | 13.4 | 1061 | 0.0 | 13.0 | 1061 | 0.4 | 13.0 | 1061 | 0.4 | 1 | 13.0 | 1061 | 0.4 | 1 | 13.0 |
| 7-60-01-50-10 | 820 | 1073 | 1073 | 617.7 | 927 | 13.6 | 1073 | 0.0 | 13.6 | 1073 | 0.3 | 13.6 | 1073 | 0.3 | 1 | 13.6 | 1073 | 0.3 | 1 | 13.6 |
| 7-60-01-55-10 | 816 | 1072 | 1080↑ | 576.7 | 912 | 15.6 | 1072 | 0.0 | 14.9 | 1072 | 0.3 | 14.9 | 1072 | 0.3 | 1 | 14.9 | 1072 | 0.3 | 1 | 14.9 |
| 7-70-01-45-10 | 868 | 1157 | 1157 | 609.8 | 968 | 16.3 | 1157 | 0.0 | 16.3 | 1157 | 0.4 | 16.3 | 1157 | 0.4 | 1 | 16.3 | 1157 | 0.4 | 1 | 16.3 |
| 7-70-01-50-10 | 869 | 1179 | 1184↑ | 945.7 | 977 | 17.5 | 1179 | 0.0 | 17.1 | 1179 | 0.4 | 17.1 | 1179 | 0.4 | 1 | 17.1 | 1179 | 0.4 | 1 | 17.1 |
| 7-70-01-55-10 | 868 | 1183 | 1183 | 854.0 | 959 | 18.9 | 1185↑ | 0.0 | 19.1 | 1185↑ | 0.4 | 19.1 | 1183 | 1.3 | 3 | 18.9 | 1183 | 1.2 | 3 | 18.9 |
| 7-50-01-45-20 | 1661 | 1661 | 1670↑ | 954.3 | 1549 | 0.5 | 1669↑ | 0.0 | 0.5 | 1669↑ | 0.3 | 0.5 | 1661 | 0.8 | 3 | 0.0 | 1661 | 0.8 | 3 | 0.0 |
| 7-50-01-50-20 | 1679 | 1679 | 1682↑ | 626.0 | 1557 | 0.2 | 1683↑ | 0.0 | 0.2 | 1679 | 0.2 | 0.0 | 1679 | 0.2 | 1 | 0.0 | 1679 | 0.2 | 1 | 0.0 |
| 7-50-01-55-20 | 1674 | 1674 | 1674 | 703.7 | 1566 | 0.0 | 1674 | 0.0 | 0.0 | 1674 | 0.2 | 0.0 | 1674 | 0.2 | 1 | 0.0 | 1674 | 0.2 | 1 | 0.0 |
| 7-60-01-45-20 | 1635 | 2193 | 2197↑ | 789.9 | 1819 | 17.2 | 2197↑ | 0.0 | 17.2 | 2193 | 0.5 | 17.1 | 2193 | 0.5 | 1 | 17.1 | 2193 | 0.5 | 1 | 17.1 |
| 7-60-01-50-20 | 1642 | 2222 | 2228↑ | 830.7 | 1835 | 17.6 | 2223↑ | 0.0 | 17.5 | 2223↑ | 0.5 | 17.5 | 2222 | 1.4 | 3 | 17.4 | 2222 | 1.5 | 3 | 17.4 |
| 7-60-01-55-20 | 1647 | 2220 | 2220 | 786.6 | 1821 | 18.0 | 2220 | 0.0 | 18.0 | 2224↑ | 0.5 | 18.1 | 2220 | 1.0 | 2 | 18.0 | 2220 | 0.9 | 2 | 18.0 |
| 7-70-01-45-20 | 1809 | 2532 | 2536↑ | 839.8 | 2002 | 21.1 | 2537↑ | 0.0 | 21.1 | 2532 | 0.6 | 20.9 | 2532 | 0.6 | 1 | 20.9 | 2532 | 0.6 | 1 | 20.9 |
| 7-70-01-50-20 | 1827 | 2562 | 2562 | 593.5 | 2004 | 21.8 | 2562 | 0.0 | 21.8 | 2562 | 0.8 | 21.8 | 2562 | 0.8 | 1 | 21.8 | 2562 | 0.8 | 1 | 21.8 |
| 7-70-01-55-20 | 1823 | 2578 | 2578 | 1034.7 | 2004 | 22.3 | 2581↑ | 0.0 | 22.4 | 2582↑ | 0.7 | 22.4 | 2578 | 2.0 | 3 | 22.3 | 2578 | 2.1 | 3 | 22.3 |
| 7-50-01-45-30 | 2346 | 2346 | 2346 | 693.5 | 2254 | 0.0 | 2346 | 0.0 | 0.0 | 2346 | 0.1 | 0.0 | 2346 | 0.1 | 1 | 0.0 | 2346 | 0.1 | 1 | 0.0 |
| 7-50-01-50-30 | 2382 | 2382 | 2382 | 930.1 | 2256 | 0.0 | 2382 | 0.0 | 0.0 | 2382 | 0.2 | 0.0 | 2382 | 0.2 | 1 | 0.0 | 2382 | 0.2 | 1 | 0.0 |
| 7-50-01-55-30 | 2385 | 2385 | 2389↑ | 869.1 | 2240 | 0.2 | 2385 | 0.0 | 0.0 | 2389↑ | 0.1 | 0.2 | 2385 | 0.6 | 3 | 0.0 | 2385 | 0.3 | **2** | 0.0 |
| 7-60-01-45-30 | 2360 | 3059 | 3069↑ | 692.4 | 2643 | 13.9 | 3073↑ | 0.0 | 14.0 | 3059 | 0.4 | 13.6 | 3059 | 0.4 | 1 | 13.6 | 3059 | 0.4 | 1 | 13.6 |
| 7-60-01-50-30 | 2371 | 3117 | 3118↑ | 954.5 | 2651 | 15.0 | 3118↑ | 0.0 | 15.0 | 3118↑ | 0.4 | 15.0 | 3117 | 2.3 | 6 | 15.0 | 3117 | 1.6 | **4** | 15.0 |
| 7-60-01-55-30 | 2368 | 3120 | 3127↑ | 814.5 | 2620 | 16.2 | 3120 | 0.0 | 16.0 | 3120 | 0.3 | 16.0 | 3120 | 0.3 | 1 | 16.0 | 3120 | 0.3 | 1 | 16.0 |
| 7-70-01-45-30 | 2486 | 3326 | 3344↑ | 656.6 | 2766 | 17.3 | 3338↑ | 0.0 | 17.1 | 3326 | 0.5 | 16.8 | 3326 | 0.5 | 1 | 16.8 | 3326 | 0.5 | 1 | 16.8 |
| 7-70-01-50-30 | 2503 | 3399 | 3407↑ | 1070.6 | 2765 | 18.8 | 3399 | 0.0 | 18.7 | 3399 | 0.4 | 18.7 | 3399 | 0.4 | 1 | 18.7 | 3399 | 0.4 | 1 | 18.7 |
| 7-70-01-55-30 | 2496 | 3413 | 3414↑ | 1094.2 | 2704 | 20.8 | 3413 | 0.0 | 20.8 | 3413 | 0.5 | 20.8 | 3412↓ | 0.9 | **2** | 20.8 | 3412↓ | 2.0 | 4 | 20.8 |
| 7-50-10-45-10 | 7519 | 7519 | 7526↑ | 1574.1 | 7211 | 0.1 | 7530↑ | 0.0 | 0.1 | 7529↑ | 0.3 | 0.1 | 7519 | 2.6 | 9 | 0.0 | 7519 | 2.0 | **6** | 0.0 |
| 7-50-10-50-10 | 7600 | 7600 | 7648↑ | 919.6 | 7183 | 0.0 | 7600 | 0.0 | 0.0 | 7600 | 0.3 | 0.0 | 7600 | 0.3 | 1 | 0.0 | 7600 | 0.3 | 1 | 0.0 |
| 7-50-10-55-10 | 7372 | 7372 | 7391↑ | 3360.4 | 7189 | 0.0 | 7377↑ | 0.0 | 0.0 | 7377↑ | 0.3 | 0.1 | 7372 | 0.9 | 3 | 0.0 | 7372 | 0.6 | **2** | 0.0 |
| 7-60-10-45-10 | 9335 | 9335 | 9360↑ | 1164.7 | 8322 | 0.3 | 9355↑ | 0.0 | 0.2 | 9335 | 0.4 | 0.0 | 9335 | 0.4 | 1 | 0.0 | 9335 | 0.4 | 1 | 0.0 |
| 7-60-10-50-10 | 9499 | 9499 | 9520↑ | 908.9 | 8299 | 0.0 | 9502↑ | 0.0 | 0.0 | 9499 | 0.7 | 0.0 | 9499 | 0.7 | 1 | 0.0 | 9499 | 0.7 | 1 | 0.0 |
| 7-60-10-55-10 | 9252 | 9252 | 9252 | 920.6 | 8183 | 0.0 | 9322↑ | 0.0 | 0.8 | 9259↑ | 0.4 | 0.1 | 9252 | 1.9 | 5 | 0.0 | 9252 | 1.1 | **3** | 0.0 |
| 7-70-10-45-10 | 8082 | 10700 | 10700 | 1153.7 | 8930 | 16.5 | 10719↑ | 0.0 | 16.7 | 10700 | 0.6 | 16.5 | 10698↓ | 2.4 | 3 | 16.5 | 10698↓ | 1.7 | **2** | 16.5 |
| 7-70-10-50-10 | 8115 | 10765 | 10765 | 711.0 | 8894 | 17.4 | 10765 | 0.0 | 17.4 | 10765 | 0.6 | 17.4 | 10747↓ | 1.4 | 2 | 17.2 | 10747↓ | 1.4 | 2 | 17.2 |
| 7-70-10-55-10 | 8031 | 10475 | 10518↑ | 700.9 | 8755 | 16.8 | 10475 | 0.0 | 16.4 | 10475 | 0.7 | 16.4 | 10466↓ | 2.2 | 3 | 16.3 | 10466↓ | 1.3 | **2** | 16.3 |
| 7-50-10-45-20 | 13464 | 13464 | 13476↑ | 626.5 | 12716 | 0.1 | 13476↑ | 0.0 | 0.1 | 13485↑ | 0.2 | 0.2 | 13464 | 1.3 | 5 | 0.0 | 13464 | 0.8 | **3** | 0.0 |
| 7-50-10-50-20 | 13920 | 13920 | 13935↑ | 769.1 | 12823 | 0.1 | 13947↑ | 0.0 | 0.2 | 13920 | 0.5 | 0.0 | 13920 | 0.5 | 1 | 0.0 | 13920 | 0.5 | 1 | 0.0 |
| 7-50-10-55-20 | 13728 | 13728 | 13740↑ | 2092.2 | 12841 | 0.0 | 13728 | 0.0 | 0.0 | 13768↑ | 0.3 | 0.3 | 13728 | 2.9 | 8 | 0.0 | 13728 | 1.9 | **5** | 0.0 |
| 7-60-10-45-20 | 13573 | 17262 | 17264↑ | 635.7 | 15037 | 12.9 | 17327↑ | 0.0 | 13.2 | 17287↑ | 0.4 | 13.0 | 17262 | 5.9 | 11 | 12.9 | 17262 | 3.0 | **6** | 12.9 |
| 7-60-10-50-20 | 13789 | 17964 | 18028↑ | 2967.7 | 15218 | 15.6 | 17964 | 0.0 | 15.3 | 17964 | 0.7 | 15.3 | 17964 | 0.7 | 1 | 15.3 | 17964 | 0.7 | 1 | 15.3 |
| 7-60-10-55-20 | 13726 | 17776 | 17791↑ | 777.5 | 15217 | 14.5 | 17780↑ | 0.0 | 14.4 | 17798↑ | 0.4 | 14.5 | 17776 | 3.9 | 9 | 14.4 | 17776 | 2.6 | **6** | 14.4 |
| 7-70-10-45-20 | 14306 | 19238 | 19334↑ | 787.2 | 15692 | 18.8 | 19301↑ | 0.0 | 18.7 | 19238 | 0.8 | 18.4 | 19238 | 0.8 | 1 | 18.4 | 19238 | 0.8 | 1 | 18.4 |
| 7-70-10-50-20 | 14419 | 19557 | 19644↑ | 957.7 | 15725 | 20.0 | 19557 | 0.0 | 19.6 | 19557 | 0.7 | 19.6 | 19557 | 0.7 | 1 | 19.6 | 19557 | 0.7 | 1 | 19.6 |
| 7-70-10-55-20 | 14359 | 19284 | 19391↑ | 761.6 | 15697 | 19.1 | 19373↑ | 0.0 | 19.0 | 19284 | 0.7 | 18.6 | 19273↓ | 238.0 | 135 | 18.6 | 19273↓ | 146.9 | **73** | 18.6 |
| 7-50-10-45-30 | 25515 | 25515 | 25676↑ | 635.4 | 23147 | 0.6 | 25682↑ | 0.0 | 0.7 | 25515 | 0.5 | 0.0 | 25515 | 0.5 | 1 | 0.0 | 25515 | 0.5 | 1 | 0.0 |
| 7-50-10-50-30 | 26163 | 26163 | 26163 | 2556.4 | 22904 | 0.0 | 26163 | 0.0 | 0.0 | 26163 | 0.6 | 0.0 | 26163 | 0.6 | 1 | 0.0 | 26163 | 0.6 | 1 | 0.0 |
| 7-50-10-55-30 | 25509 | 25509 | 25803↑ | 851.6 | 22820 | 1.1 | 25509 | 0.0 | 0.0 | 25509 | 0.6 | 0.0 | 25509 | 0.6 | 1 | 0.0 | 25509 | 0.6 | 1 | 0.0 |
| 7-60-10-45-30 | 22821 | 30203 | 30509↑ | 560.1 | 25065 | 17.8 | 30233↑ | 0.0 | 17.1 | 30203 | 0.7 | 17.0 | 30203 | 0.7 | 1 | 17.0 | 30203 | 0.7 | 1 | 17.0 |
| 7-60-10-50-30 | 23026 | 30978 | 30978 | 874.8 | 25343 | 18.2 | 30978 | 0.0 | 18.2 | 30978 | 0.8 | 18.2 | 30978 | 0.8 | 1 | 18.2 | 30978 | 0.8 | 1 | 18.2 |
| 7-60-10-55-30 | 22939 | 30456 | 30456 | 669.5 | 24753 | 18.7 | 30456 | 0.0 | 18.7 | 30456 | 1.1 | 18.7 | 30456 | 1.1 | 1 | 18.7 | 30456 | 1.1 | 1 | 18.7 |
| 7-70-10-45-30 | 24479 | 33427 | 33764↑ | 967.9 | 26783 | 20.7 | 33606↑ | 0.0 | 20.3 | 33427 | 0.9 | 19.9 | 33427 | 0.9 | 1 | 19.9 | 33427 | 0.9 | 1 | 19.9 |
| 7-70-10-50-30 | 24621 | 34350 | 34357↑ | 771.6 | 26956 | 21.5 | 34357↑ | 0.0 | 21.5 | 34357↑ | 0.9 | 21.5 | 34350 | 1.9 | 2 | 21.5 | 34350 | 3.5 | 2 | 21.5 |
| 7-70-10-55-30 | 24364 | 34054 | 34074↑ | 1183.4 | 26171 | 23.2 | 34054 | 0.0 | 23.1 | 34054 | 2.5 | 23.1 | 34054 | 2.5 | 1 | 23.1 | 34054 | 2.5 | 1 | 23.1 |

Table B.11: MMR-KP results for type-8 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 8-50-01-45-10 | 620 | 620 | 620 | 0.2 | 620 | 0.0 | 620 | 0.0 | 0.0 | 620 | 0.1 | 0.0 | 620 | 0.1 | 1 | 0.0 | 620 | 0.1 | 1 | 0.0 |
| 8-50-01-50-10 | 644 | 644 | 644 | 4.4 | 644 | 0.0 | 646↑ | 0.0 | 0.0 | 646↑ | 0.1 | 0.3 | 644 | 0.2 | 3 | 0.0 | 644 | 0.2 | 3 | 0.0 |
| 8-50-01-55-10 | 632 | 632 | 632 | 0.2 | 632 | 0.0 | 634↑ | 0.0 | 0.3 | 634↑ | 0.0 | 0.3 | 632 | 0.1 | 2 | 0.0 | 632 | 0.1 | 2 | 0.0 |
| 8-60-01-45-10 | 782 | 782 | 782 | 26.7 | 782 | 0.0 | 782 | 0.0 | 0.0 | 782 | 0.1 | 0.0 | 782 | 0.1 | 1 | 0.0 | 782 | 0.1 | 1 | 0.0 |
| 8-60-01-50-10 | 815 | 815 | 815 | 30.1 | 815 | 0.0 | 815 | 0.0 | 0.0 | 815 | 0.1 | 0.0 | 815 | 0.1 | 1 | 0.0 | 815 | 0.1 | 1 | 0.0 |
| 8-60-01-55-10 | 847 | 847 | 847 | 193.1 | 847 | 0.0 | 847 | 0.0 | 0.0 | 847 | 0.2 | 0.0 | 847 | 0.2 | 1 | 0.0 | 847 | 0.2 | 1 | 0.0 |
| 8-70-01-45-10 | 884 | 884 | 884 | 100.7 | 884 | 0.0 | 906↑ | 0.0 | 2.4 | 884 | 0.2 | 0.0 | 884 | 0.2 | 1 | 0.0 | 884 | 0.2 | 1 | 0.0 |
| 8-70-01-50-10 | 927 | 927 | 927 | 556.0 | 927 | 0.0 | 929↑ | 0.0 | 0.2 | 927 | 0.3 | 0.0 | 927 | 0.3 | 1 | 0.0 | 927 | 0.3 | 1 | 0.0 |
| 8-70-01-55-10 | 927 | 927 | 927 | 0.3 | 927 | 0.0 | 927 | 0.0 | 0.0 | 927 | 0.1 | 0.0 | 927 | 0.1 | 1 | 0.0 | 927 | 0.1 | 1 | 0.0 |
| 8-50-01-45-20 | 2098 | 2098 | 2098 | 1956.7 | 2021 | 0.0 | 2098 | 0.0 | 0.0 | 2098 | 0.4 | 0.0 | 2098 | 0.4 | 1 | 0.0 | 2098 | 0.4 | 1 | 0.0 |
| 8-50-01-50-20 | 2112 | 2112 | 2112 | 2108.3 | 2011 | 0.0 | 2112 | 0.0 | 0.0 | 2112 | 0.3 | 0.0 | 2112 | 0.3 | 1 | 0.0 | 2112 | 0.3 | 1 | 0.0 |
| 8-50-01-55-20 | 2054 | 2054 | 2054 | 8.9 | 2002 | 0.0 | 2054 | 0.0 | 0.0 | 2054 | 0.1 | 0.0 | 2054 | 0.1 | 1 | 0.0 | 2054 | 0.1 | 1 | 0.0 |
| 8-60-01-45-20 | 1962 | 2492 | 2492 | 1562.4 | 2194 | 12.0 | 2492 | 0.0 | 12.0 | 2492 | 0.4 | 12.0 | 2492 | 0.4 | 1 | 12.0 | 2492 | 0.4 | 1 | 12.0 |
| 8-60-01-50-20 | 1937 | 2538 | 2544↑ | 1018.0 | 2183 | 14.2 | 2541↑ | 0.0 | 14.1 | 2541↑ | 2.4 | 14.1 | 2538 | 7.2 | 3 | 14.0 | 2538 | 3.9 | 3 | 14.0 |
| 8-60-01-55-20 | 1935 | 2417 | 2485↑ | 853.3 | 2181 | 12.2 | 2484↑ | 0.0 | 12.2 | 2485↑ | 0.4 | 12.2 | 2484↑ | 0.8 | 2 | 12.2 | 2484↑ | 0.8 | 2 | 12.2 |
| 8-70-01-45-20 | 2071 | 2732 | 2732 | 645.6 | 2304 | 15.7 | 2739↑ | 0.0 | 15.9 | 2732 | 0.7 | 15.7 | 2732 | 0.7 | 1 | 15.7 | 2732 | 0.7 | 1 | 15.7 |
| 8-70-01-50-20 | 2070 | 2785 | 2785 | 706.0 | 2357 | 15.4 | 2785 | 0.0 | 15.4 | 2785 | 0.6 | 15.4 | 2785 | 0.5 | 1 | 15.4 | 2785 | 0.5 | 1 | 15.4 |
| 8-70-01-55-20 | 2059 | 2729 | 2758↑ | 0.3 | 2351 | 14.8 | 2729 | 0.0 | 13.9 | 2729 | 0.5 | 13.9 | 2729 | 0.5 | 1 | 13.9 | 2729 | 0.5 | 1 | 13.9 |
| 8-50-01-45-30 | 2542 | 2542 | 2542 | 120.8 | 2542 | 0.0 | 2568↑ | 0.0 | 1.0 | 2542 | 0.1 | 0.0 | 2542 | 0.1 | 1 | 0.0 | 2542 | 0.1 | 1 | 0.0 |
| 8-50-01-50-30 | 2720 | 2720 | 2720 | 2041.5 | 2636 | 0.0 | 2721↑ | 0.0 | 0.0 | 2720 | 0.3 | 0.0 | 2720 | 0.3 | 1 | 0.0 | 2720 | 0.3 | 1 | 0.0 |
| 8-50-01-55-30 | 2759 | 2759 | 2759 | 2947.0 | 2662 | 0.0 | 2759 | 0.0 | 0.0 | 2759 | 0.2 | 0.0 | 2759 | 0.2 | 1 | 0.0 | 2759 | 0.2 | 1 | 0.0 |
| 8-60-01-45-30 | 3074 | 3074 | 3087↑ | 7.4 | 2913 | 0.4 | 3087↑ | 0.0 | 0.4 | 3074 | 0.1 | 0.0 | 3074 | 0.1 | 1 | 0.0 | 3074 | 0.1 | 1 | 0.0 |
| 8-60-01-50-30 | 3255 | 3255 | 3341↑ | 1524.2 | 3017 | 2.6 | 3335↑ | 0.0 | 2.4 | 3284↑ | 0.5 | 0.9 | 3284↑ | 0.5 | 1 | 0.9 | 3284↑ | 0.5 | 1 | 0.9 |
| 8-60-01-55-30 | 3363 | 3363 | 3395↑ | 2169.5 | 3000 | 0.9 | 3363 | 0.0 | 0.0 | 3372↑ | 0.3 | 0.3 | 3363 | 0.8 | 2 | 0.0 | 3363 | 1.0 | 2 | 0.0 |
| 8-70-01-45-30 | 2804 | 3417 | 3435↑ | 1883.0 | 3141 | 8.6 | 3417 | 0.0 | 8.1 | 3417 | 0.2 | 8.1 | 3417 | 0.2 | 1 | 8.1 | 3417 | 0.2 | 1 | 8.1 |
| 8-70-01-50-30 | 2866 | 3619 | 3671↑ | 2851.2 | 3226 | 12.1 | 3619 | 0.0 | 10.9 | 3636↑ | 0.4 | 11.3 | 3619 | 1.6 | 3 | 10.9 | 3619 | 1.5 | 3 | 10.9 |
| 8-70-01-55-30 | 2842 | 3724 | 3813↑ | 878.5 | 3167 | 16.9 | 3724 | 0.0 | 15.0 | 3724 | 0.6 | 15.0 | 3724 | 0.6 | 1 | 15.0 | 3724 | 0.6 | 1 | 15.0 |
| 8-50-10-45-10 | 4205 | 4205 | 4205 | 0.5 | 4205 | 0.0 | 4343↑ | 0.0 | 3.2 | 4205 | 0.0 | 0.0 | 4205 | 0.0 | 1 | 0.0 | 4205 | 0.0 | 1 | 0.0 |
| 8-50-10-50-10 | 4592 | 4592 | 4592 | 0.4 | 4592 | 0.0 | 4592 | 0.0 | 0.0 | 4592 | 0.0 | 0.0 | 4592 | 0.0 | 1 | 0.0 | 4592 | 0.0 | 1 | 0.0 |
| 8-50-10-55-10 | 4911 | 4911 | 4911 | 0.3 | 4911 | 0.0 | 5170↑ | 0.0 | 0.0 | 4911 | 0.1 | 0.0 | 4911 | 0.1 | 1 | 0.0 | 4911 | 0.1 | 1 | 0.0 |
| 8-60-10-45-10 | 4990 | 4990 | 4990 | 0.3 | 4990 | 0.0 | 4990 | 0.0 | 0.0 | 5026↑ | 0.1 | 0.7 | 4990 | 0.1 | 2 | 0.0 | 4990 | 0.1 | 2 | 0.0 |
| 8-60-10-50-10 | 5651 | 5651 | 5651 | 0.4 | 5651 | 0.0 | 5924↑ | 0.0 | 0.0 | 5675↑ | 0.1 | 0.4 | 5651 | 0.2 | 2 | 0.0 | 5651 | 0.1 | 2 | 0.0 |
| 8-60-10-55-10 | 6271 | 6271 | 6271 | 2.0 | 6271 | 0.0 | 6624↑ | 0.0 | 5.3 | 6271 | 0.1 | 0.0 | 6271 | 0.1 | 1 | 0.0 | 6271 | 0.1 | 1 | 0.0 |
| 8-70-10-45-10 | 6203 | 6203 | 6203 | 0.3 | 6203 | 0.0 | 6203 | 0.0 | 0.0 | 6203 | 0.0 | 0.0 | 6203 | 0.0 | 1 | 0.0 | 6203 | 0.0 | 1 | 0.0 |
| 8-70-10-50-10 | 6915 | 6915 | 6915 | 38.2 | 6915 | 0.0 | 6915 | 0.0 | 0.0 | 6915 | 0.1 | 0.0 | 6915 | 0.1 | 1 | 0.0 | 6915 | 0.1 | 1 | 0.0 |
| 8-70-10-55-10 | 7513 | 7513 | 7513 | 0.3 | 7513 | 0.0 | 7644↑ | 0.0 | 1.7 | 7513 | 0.1 | 0.0 | 7513 | 0.1 | 1 | 0.0 | 7513 | 0.1 | 1 | 0.0 |
| 8-50-10-45-20 | 11220 | 11220 | 11220 | 1.0 | 11220 | 0.0 | 11220 | 0.0 | 0.0 | 11220 | 0.1 | 0.0 | 11220 | 0.1 | 1 | 0.0 | 11220 | 0.1 | 1 | 0.0 |
| 8-50-10-50-20 | 11900 | 11900 | 11900 | 7.5 | 11900 | 0.0 | 11900 | 0.0 | 0.0 | 11900 | 0.0 | 0.0 | 11900 | 0.0 | 1 | 0.0 | 11900 | 0.0 | 1 | 0.0 |
| 8-50-10-55-20 | 12756 | 12756 | 12756 | 66.6 | 12756 | 0.0 | 12756 | 0.0 | 0.0 | 12756 | 0.1 | 0.0 | 12756 | 0.1 | 1 | 0.0 | 12756 | 0.1 | 1 | 0.0 |
| 8-60-10-45-20 | 13681 | 13681 | 13681 | 603.4 | 13681 | 0.0 | 13750↑ | 0.0 | 0.5 | 13719↑ | 0.2 | 0.3 | 13681 | 0.5 | 3 | 0.0 | 13681 | 0.4 | 3 | 0.0 |
| 8-60-10-50-20 | 14419 | 14419 | 14419 | 8.2 | 14419 | 0.0 | 14419 | 0.0 | 0.0 | 14419 | 0.1 | 0.0 | 14419 | 0.1 | 1 | 0.0 | 14419 | 0.1 | 1 | 0.0 |
| 8-60-10-55-20 | 15147 | 15147 | 15147 | 8.6 | 15147 | 0.0 | 15147 | 0.0 | 0.0 | 15147 | 0.2 | 0.0 | 15147 | 0.2 | 1 | 0.0 | 15147 | 0.2 | 1 | 0.0 |
| 8-70-10-45-20 | 16111 | 16111 | 16111 | 1293.7 | 16111 | 0.0 | 16330↑ | 0.0 | 1.3 | 16111 | 0.1 | 0.0 | 16111 | 0.1 | 1 | 0.0 | 16111 | 0.1 | 1 | 0.0 |
| 8-70-10-50-20 | 17460 | 17460 | 17595↑ | 0.3 | 16332 | 0.8 | 17460 | 0.0 | 0.0 | 17460 | 0.3 | 0.0 | 17460 | 0.3 | 1 | 0.0 | 17460 | 0.3 | 1 | 0.0 |
| 8-70-10-55-20 | 18295 | 18295 | 18579↑ | 2403.9 | 16789 | 1.5 | 18295 | 0.0 | 0.0 | 18295 | 0.4 | 0.0 | 18295 | 0.4 | 1 | 0.0 | 18295 | 0.4 | 1 | 0.0 |
| 8-50-10-45-30 | 17390 | 17390 | 17390 | 8.2 | 17390 | 0.0 | 17390 | 0.0 | 0.0 | 17390 | 0.1 | 0.0 | 17390 | 0.1 | 1 | 0.0 | 17390 | 0.1 | 1 | 0.0 |
| 8-50-10-50-30 | 18060 | 18060 | 18060 | 9.5 | 18060 | 0.0 | 18154↑ | 0.0 | 0.5 | 18136↑ | 0.1 | 0.4 | 18060 | 0.3 | 4 | 0.0 | 18060 | 0.3 | 4 | 0.0 |
| 8-50-10-55-30 | 18830 | 18830 | 18830 | 37.9 | 18830 | 0.0 | 18966↑ | 0.0 | 0.7 | 18830 | 0.1 | 0.0 | 18830 | 0.1 | 1 | 0.0 | 18830 | 0.1 | 1 | 0.0 |
| 8-60-10-45-30 | 21541 | 21541 | 21541 | 7.7 | 20861 | 0.0 | 21541 | 0.0 | 0.0 | 21580↑ | 0.1 | 0.2 | 21541 | 0.3 | 2 | 0.0 | 21541 | 0.2 | 2 | 0.0 |
| 8-60-10-50-30 | 22592 | 22592 | 22592 | 1902.2 | 21713 | 0.0 | 22592 | 0.0 | 0.0 | 22592 | 0.1 | 0.0 | 22592 | 0.1 | 1 | 0.0 | 22592 | 0.1 | 1 | 0.0 |
| 8-60-10-55-30 | 23212 | 23212 | 23212 | 2982.6 | 21815 | 0.0 | 23337↑ | 0.0 | 0.5 | 23337↑ | 0.3 | 0.5 | 23212 | 0.6 | 2 | 0.0 | 23212 | 0.7 | 2 | 0.0 |
| 8-70-10-45-30 | 25429 | 25429 | 25429 | 868.5 | 23528 | 0.0 | 25515↑ | 0.0 | 0.3 | 25447↑ | 0.3 | 0.1 | 25429 | 0.5 | 2 | 0.0 | 25429 | 0.4 | 2 | 0.0 |
| 8-70-10-50-30 | 26486 | 26486 | 26738↑ | 1280.5 | 24167 | 0.9 | 26539↑ | 0.0 | 0.2 | 26539↑ | 0.3 | 0.2 | 26486 | 0.6 | 2 | 0.0 | 26486 | 0.5 | 2 | 0.0 |
| 8-70-10-55-30 | 26652 | 26652 | 26652 | 3519.0 | 24095 | 0.0 | 26652 | 0.0 | 0.0 | 26652 | 0.1 | 0.0 | 26652 | 0.1 | 1 | 0.0 | 26652 | 0.1 | 1 | 0.0 |

Table B.12: MMR-KP results for type-9 instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| 9-50-01-45-10 | 46 | 46 | 46 | 0.0 | 46 | 0.0 | 46 | 0.0 | 0.0 | 46 | 0.0 | 0.0 | 46 | 0.0 | 1 | 0.0 | 46 | 0.0 | 1 | 0.0 |
| 9-50-01-50-10 | 31 | 31 | 31 | 0.0 | 31 | 0.0 | 31 | 0.0 | 0.0 | 31 | 0.0 | 0.0 | 31 | 0.0 | 1 | 0.0 | 31 | 0.0 | 1 | 0.0 |
| 9-50-01-55-10 | 51 | 51 | 51 | 0.0 | 51 | 0.0 | 51 | 0.0 | 0.0 | 51 | 0.0 | 0.0 | 51 | 0.0 | 1 | 0.0 | 51 | 0.0 | 1 | 0.0 |
| 9-60-01-45-10 | 46 | 46 | 46 | 0.0 | 46 | 0.0 | 46 | 0.0 | 0.0 | 46 | 0.0 | 0.0 | 46 | 0.0 | 1 | 0.0 | 46 | 0.0 | 1 | 0.0 |
| 9-60-01-50-10 | 40 | 40 | 40 | 0.0 | 40 | 0.0 | 40 | 0.0 | 0.0 | 40 | 0.0 | 0.0 | 40 | 0.0 | 1 | 0.0 | 40 | 0.0 | 1 | 0.0 |
| 9-60-01-55-10 | 71 | 71 | 71 | 0.0 | 71 | 0.0 | 71 | 0.0 | 0.0 | 71 | 0.0 | 0.0 | 71 | 0.0 | 1 | 0.0 | 71 | 0.0 | 1 | 0.0 |
| 9-70-01-45-10 | 92 | 92 | 92 | 0.0 | 92 | 0.0 | 92 | 0.0 | 0.0 | 92 | 0.0 | 0.0 | 92 | 0.0 | 1 | 0.0 | 92 | 0.0 | 1 | 0.0 |
| 9-70-01-50-10 | 34 | 34 | 34 | 0.0 | 34 | 0.0 | 34 | 0.0 | 0.0 | 34 | 0.0 | 0.0 | 34 | 0.0 | 1 | 0.0 | 34 | 0.0 | 1 | 0.0 |
| 9-70-01-55-10 | 71 | 71 | 71 | 0.0 | 71 | 0.0 | 71 | 0.0 | 0.0 | 71 | 0.0 | 0.0 | 71 | 0.0 | 1 | 0.0 | 71 | 0.0 | 1 | 0.0 |
| 9-50-01-45-20 | 335 | 335 | 335 | 0.1 | 335 | 0.0 | 335 | 0.0 | 0.0 | 335 | 0.0 | 0.0 | 335 | 0.0 | 1 | 0.0 | 335 | 0.0 | 1 | 0.0 |
| 9-50-01-50-20 | 242 | 242 | 242 | 0.0 | 242 | 0.0 | 242 | 0.0 | 0.0 | 242 | 0.0 | 0.0 | 242 | 0.0 | 1 | 0.0 | 242 | 0.0 | 1 | 0.0 |
| 9-50-01-55-20 | 168 | 168 | 168 | 0.0 | 168 | 0.0 | 168 | 0.0 | 0.0 | 168 | 0.0 | 0.0 | 168 | 0.0 | 1 | 0.0 | 168 | 0.0 | 1 | 0.0 |
| 9-60-01-45-20 | 335 | 335 | 335 | 0.1 | 335 | 0.0 | 335 | 0.0 | 0.0 | 335 | 0.0 | 0.0 | 335 | 0.0 | 1 | 0.0 | 335 | 0.0 | 1 | 0.0 |
| 9-60-01-50-20 | 249 | 249 | 249 | 0.0 | 249 | 0.0 | 249 | 0.0 | 0.0 | 249 | 0.0 | 0.0 | 249 | 0.0 | 1 | 0.0 | 249 | 0.0 | 1 | 0.0 |
| 9-60-01-55-20 | 247 | 247 | 247 | 0.1 | 247 | 0.0 | 247 | 0.0 | 0.0 | 247 | 0.0 | 0.0 | 247 | 0.0 | 1 | 0.0 | 247 | 0.0 | 1 | 0.0 |
| 9-70-01-45-20 | 421 | 421 | 421 | 0.1 | 421 | 0.0 | 421 | 0.0 | 0.0 | 421 | 0.0 | 0.0 | 421 | 0.0 | 1 | 0.0 | 421 | 0.0 | 1 | 0.0 |
| 9-70-01-50-20 | 286 | 286 | 286 | 0.0 | 286 | 0.0 | 286 | 0.0 | 0.0 | 286 | 0.0 | 0.0 | 286 | 0.0 | 1 | 0.0 | 286 | 0.0 | 1 | 0.0 |
| 9-70-01-55-20 | 247 | 247 | 247 | 0.0 | 247 | 0.0 | 247 | 0.0 | 0.0 | 247 | 0.0 | 0.0 | 247 | 0.0 | 1 | 0.0 | 247 | 0.0 | 1 | 0.0 |
| 9-50-01-45-30 | 637 | 637 | 637 | 0.1 | 637 | 0.0 | 637 | 0.0 | 0.0 | 637 | 0.0 | 0.0 | 637 | 0.0 | 1 | 0.0 | 637 | 0.0 | 1 | 0.0 |
| 9-50-01-50-30 | 581 | 581 | 581 | 0.1 | 581 | 0.0 | 581 | 0.0 | 0.0 | 581 | 0.0 | 0.0 | 581 | 0.0 | 1 | 0.0 | 581 | 0.0 | 1 | 0.0 |
| 9-50-01-55-30 | 551 | 551 | 551 | 0.0 | 551 | 0.0 | 551 | 0.0 | 0.0 | 551 | 0.0 | 0.0 | 551 | 0.0 | 1 | 0.0 | 551 | 0.0 | 1 | 0.0 |
| 9-60-01-45-30 | 749 | 749 | 749 | 0.1 | 749 | 0.0 | 749 | 0.0 | 0.0 | 749 | 0.0 | 0.0 | 749 | 0.0 | 1 | 0.0 | 749 | 0.0 | 1 | 0.0 |
| 9-60-01-50-30 | 748 | 748 | 748 | 0.2 | 748 | 0.0 | 748 | 0.0 | 0.0 | 748 | 0.0 | 0.0 | 748 | 0.0 | 1 | 0.0 | 748 | 0.0 | 1 | 0.0 |
| 9-60-01-55-30 | 685 | 685 | 685 | 0.1 | 685 | 0.0 | 685 | 0.0 | 0.0 | 687↑ | 0.0 | 0.3 | 685 | 0.0 | 2 | 0.0 | 685 | 0.0 | 2 | 0.0 |
| 9-70-01-45-30 | 864 | 864 | 864 | 0.1 | 864 | 0.0 | 864 | 0.0 | 0.0 | 864 | 0.0 | 0.0 | 864 | 0.0 | 1 | 0.0 | 864 | 0.0 | 1 | 0.0 |
| 9-70-01-50-30 | 819 | 819 | 819 | 0.2 | 819 | 0.0 | 819 | 0.0 | 0.0 | 819 | 0.0 | 0.0 | 819 | 0.0 | 1 | 0.0 | 819 | 0.0 | 1 | 0.0 |
| 9-70-01-55-30 | 701 | 701 | 701 | 0.1 | 701 | 0.0 | 712↑ | 0.0 | 1.5 | 701 | 0.0 | 0.0 | 701 | 0.0 | 1 | 0.0 | 701 | 0.0 | 1 | 0.0 |
| 9-50-10-45-10 | 124 | 124 | 124 | 0.0 | 124 | 0.0 | 124 | 0.0 | 0.0 | 124 | 0.0 | 0.0 | 124 | 0.0 | 1 | 0.0 | 124 | 0.0 | 1 | 0.0 |
| 9-50-10-50-10 | 298 | 298 | 298 | 0.0 | 298 | 0.0 | 298 | 0.0 | 0.0 | 298 | 0.0 | 0.0 | 298 | 0.0 | 1 | 0.0 | 298 | 0.0 | 1 | 0.0 |
| 9-50-10-55-10 | 259 | 259 | 259 | 0.0 | 259 | 0.0 | 259 | 0.0 | 0.0 | 259 | 0.0 | 0.0 | 259 | 0.0 | 1 | 0.0 | 259 | 0.0 | 1 | 0.0 |
| 9-60-10-45-10 | 245 | 245 | 245 | 0.0 | 245 | 0.0 | 245 | 0.0 | 0.0 | 245 | 0.0 | 0.0 | 245 | 0.0 | 1 | 0.0 | 245 | 0.0 | 1 | 0.0 |
| 9-60-10-50-10 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| 9-60-10-55-10 | 181 | 181 | 181 | 0.0 | 181 | 0.0 | 181 | 0.0 | 0.0 | 181 | 0.0 | 0.0 | 181 | 0.0 | 1 | 0.0 | 181 | 0.0 | 1 | 0.0 |
| 9-70-10-45-10 | 274 | 274 | 274 | 0.0 | 274 | 0.0 | 274 | 0.0 | 0.0 | 274 | 0.0 | 0.0 | 274 | 0.0 | 1 | 0.0 | 274 | 0.0 | 1 | 0.0 |
| 9-70-10-50-10 | 245 | 245 | 245 | 0.0 | 245 | 0.0 | 245 | 0.0 | 0.0 | 245 | 0.0 | 0.0 | 245 | 0.0 | 1 | 0.0 | 245 | 0.0 | 1 | 0.0 |
| 9-70-10-55-10 | 121 | 121 | 121 | 0.0 | 121 | 0.0 | 121 | 0.0 | 0.0 | 121 | 0.0 | 0.0 | 121 | 0.0 | 1 | 0.0 | 121 | 0.0 | 1 | 0.0 |
| 9-50-10-45-20 | 1349 | 1349 | 1349 | 0.0 | 1349 | 0.0 | 1349 | 0.0 | 0.0 | 1349 | 0.0 | 0.0 | 1349 | 0.0 | 1 | 0.0 | 1349 | 0.0 | 1 | 0.0 |
| 9-50-10-50-20 | 907 | 907 | 907 | 0.0 | 907 | 0.0 | 907 | 0.0 | 0.0 | 907 | 0.0 | 0.0 | 907 | 0.0 | 1 | 0.0 | 907 | 0.0 | 1 | 0.0 |
| 9-50-10-55-20 | 927 | 927 | 927 | 0.0 | 927 | 0.0 | 927 | 0.0 | 0.0 | 927 | 0.0 | 0.0 | 927 | 0.0 | 1 | 0.0 | 927 | 0.0 | 1 | 0.0 |
| 9-60-10-45-20 | 905 | 905 | 905 | 0.0 | 905 | 0.0 | 905 | 0.0 | 0.0 | 905 | 0.0 | 0.0 | 905 | 0.0 | 1 | 0.0 | 905 | 0.0 | 1 | 0.0 |
| 9-60-10-50-20 | 562 | 562 | 562 | 0.0 | 562 | 0.0 | 562 | 0.0 | 0.0 | 562 | 0.0 | 0.0 | 562 | 0.0 | 1 | 0.0 | 562 | 0.0 | 1 | 0.0 |
| 9-60-10-55-20 | 959 | 959 | 959 | 0.0 | 959 | 0.0 | 959 | 0.0 | 0.0 | 959 | 0.0 | 0.0 | 959 | 0.0 | 1 | 0.0 | 959 | 0.0 | 1 | 0.0 |
| 9-70-10-45-20 | 1720 | 1720 | 1720 | 0.0 | 1720 | 0.0 | 1720 | 0.0 | 0.0 | 1720 | 0.0 | 0.0 | 1720 | 0.0 | 1 | 0.0 | 1720 | 0.0 | 1 | 0.0 |
| 9-70-10-50-20 | 905 | 905 | 905 | 0.0 | 905 | 0.0 | 905 | 0.0 | 0.0 | 905 | 0.0 | 0.0 | 905 | 0.0 | 1 | 0.0 | 905 | 0.0 | 1 | 0.0 |
| 9-70-10-55-20 | 784 | 784 | 784 | 0.0 | 784 | 0.0 | 784 | 0.0 | 0.0 | 784 | 0.0 | 0.0 | 784 | 0.0 | 1 | 0.0 | 784 | 0.0 | 1 | 0.0 |
| 9-50-10-45-30 | 2376 | 2376 | 2376 | 0.0 | 2376 | 0.0 | 2376 | 0.0 | 0.0 | 2376 | 0.0 | 0.0 | 2376 | 0.0 | 1 | 0.0 | 2376 | 0.0 | 1 | 0.0 |
| 9-50-10-50-30 | 1600 | 1600 | 1600 | 0.0 | 1600 | 0.0 | 1600 | 0.0 | 0.0 | 1600 | 0.0 | 0.0 | 1600 | 0.0 | 1 | 0.0 | 1600 | 0.0 | 1 | 0.0 |
| 9-50-10-55-30 | 590 | 590 | 590 | 0.0 | 590 | 0.0 | 590 | 0.0 | 0.0 | 590 | 0.0 | 0.0 | 590 | 0.0 | 1 | 0.0 | 590 | 0.0 | 1 | 0.0 |
| 9-60-10-45-30 | 2673 | 2673 | 2673 | 0.0 | 2673 | 0.0 | 2673 | 0.0 | 0.0 | 2673 | 0.0 | 0.0 | 2673 | 0.0 | 1 | 0.0 | 2673 | 0.0 | 1 | 0.0 |
| 9-60-10-50-30 | 1492 | 1492 | 1492 | 0.0 | 1492 | 0.0 | 1492 | 0.0 | 0.0 | 1492 | 0.0 | 0.0 | 1492 | 0.0 | 1 | 0.0 | 1492 | 0.0 | 1 | 0.0 |
| 9-60-10-55-30 | 1218 | 1218 | 1218 | 0.0 | 1218 | 0.0 | 1218 | 0.0 | 0.0 | 1218 | 0.0 | 0.0 | 1218 | 0.0 | 1 | 0.0 | 1218 | 0.0 | 1 | 0.0 |
| 9-70-10-45-30 | 3248 | 3248 | 3248 | 0.0 | 3248 | 0.0 | 3248 | 0.0 | 0.0 | 3248 | 0.0 | 0.0 | 3248 | 0.0 | 1 | 0.0 | 3248 | 0.0 | 1 | 0.0 |
| 9-70-10-50-30 | 2673 | 2673 | 2673 | 0.0 | 2673 | 0.0 | 2673 | 0.0 | 0.0 | 2673 | 0.0 | 0.0 | 2673 | 0.0 | 1 | 0.0 | 2673 | 0.0 | 1 | 0.0 |
| 9-70-10-55-30 | 995 | 995 | 995 | 0.0 | 995 | 0.0 | 995 | 0.0 | 0.0 | 995 | 0.0 | 0.0 | 995 | 0.0 | 1 | 0.0 | 995 | 0.0 | 1 | 0.0 |

## Appendix C. Detailed Results for the Min–Max Regret Set Covering Problem

Tables C.13–C.15 show the results of the branch-and-cut algorithm ("B&C"), the fixed-scenario algorithm ("Fix"), the DS algorithm ("DS"), and iDS algorithms using Hamming-distance constraints ("iDS-H") and best-scenario constraints ("iDS-B") for MMR-SCP for each instance type. An MMR-SCP instance denoted by "B$xyyzz$" indicates a Type-B instance whose corresponding SCP instance is the $yy$th instance in family $x$ from the OR-Library with $zz = 100\delta$, while "M$xyy$-$z$" (or "K$xyy$-$z$") stands for the $z$th Type-M (or Type-K) instance whose corresponding SCP instance is the $yy$th instance in family $x$. The best known lower-bound value ("LB") and solution value ("UB") are the results obtained from three heuristic algorithms and three exact algorithms by Pereira and Averbakh [2]. The notations "obj," "time," "ite," "%gap," "LB," and "↓," as well as the bold values in columns "obj" and columns "ite," are the same as in Tables B.4–B.12 for the MMR-KP.

Table C.13: MMR-SCP results for type-B instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| B40110 | 21 | 21 | 21 | 4.1 | 21 | 0.0 | 21 | 0.0 | 0.0 | 21 | 0.493 | 0.0 | 21 | 0.05 | 1 | 0.0 | 21 | 0.05 | 1 | 0.0 |
| B40130 | 67 | 67 | 67 | 4.5 | 67 | 0.0 | 71↑ | 0.0 | 5.6 | 67 | 0.516 | 0.0 | 67 | 0.26 | 1 | 0.0 | 67 | 0.26 | 1 | 0.0 |
| B40150 | 124 | 124 | 124 | 12.0 | 124 | 0.0 | 136↑ | 0.0 | 8.8 | 126↑ | 0.124 | 1.6 | 124 | 3.78 | 8 | 0.0 | 124 | 1.60 | **4** | 0.0 |
| B40210 | 23 | 23 | 23 | 5.0 | 23 | 0.0 | 23 | 0.0 | 0.0 | 23 | 0.273 | 0.0 | 23 | 0.12 | 1 | 0.0 | 23 | 0.12 | 1 | 0.0 |
| B40230 | 93 | 93 | 93 | 15.8 | 93 | 0.0 | 95↑ | 0.0 | 2.1 | 94↑ | 0.422 | 1.1 | 93 | 3.88 | 9 | 0.0 | 93 | 2.58 | **5** | 0.0 |
| B40250 | 163 | 163 | 163 | 11.1 | 163 | 0.0 | 175↑ | 0.0 | 6.9 | 164↑ | 0.085 | 0.6 | 163 | 1.71 | 3 | 0.0 | 163 | 2.11 | 3 | 0.0 |
| B40310 | 12 | 12 | 12 | 2.5 | 12 | 0.0 | 14↑ | 0.0 | 14.3 | 12 | 0.268 | 0.0 | 12 | 0.03 | 1 | 0.0 | 12 | 0.03 | 1 | 0.0 |
| B40330 | 86 | 86 | 86 | 17.0 | 86 | 0.0 | 92↑ | 0.0 | 6.5 | 86 | 0.538 | 0.0 | 86 | 0.31 | 1 | 0.0 | 86 | 0.31 | 1 | 0.0 |
| B40350 | 190 | 190 | 190 | 22.7 | 190 | 0.0 | 192↑ | 0.0 | 1.0 | 191↑ | 0.212 | 0.5 | 190 | 5.22 | 7 | 0.0 | 190 | 5.69 | 7 | 0.0 |
| B40410 | 20 | 20 | 20 | 4.4 | 20 | 0.0 | 21↑ | 0.0 | 4.8 | 20 | 0.456 | 0.0 | 20 | 0.07 | 1 | 0.0 | 20 | 0.07 | 1 | 0.0 |
| B40430 | 85 | 85 | 85 | 10.1 | 85 | 0.0 | 87↑ | 0.0 | 2.3 | 85 | 0.557 | 0.0 | 85 | 0.55 | 1 | 0.0 | 85 | 0.55 | 1 | 0.0 |
| B40450 | 160 | 160 | 160 | 20.7 | 160 | 0.0 | 170↑ | 0.0 | 5.9 | 160 | 0.334 | 0.0 | 160 | 0.94 | 1 | 0.0 | 160 | 0.94 | 1 | 0.0 |
| B40510 | 13 | 13 | 13 | 3.7 | 13 | 0.0 | 13 | 0.0 | 0.0 | 13 | 0.349 | 0.0 | 13 | 0.04 | 1 | 0.0 | 13 | 0.04 | 1 | 0.0 |
| B40530 | 73 | 73 | 73 | 8.9 | 73 | 0.0 | 77↑ | 0.0 | 5.2 | 74↑ | 0.868 | 1.4 | 73 | 5.66 | 15 | 0.0 | 73 | 2.65 | **7** | 0.0 |
| B40550 | 165 | 165 | 165 | 29.1 | 165 | 0.0 | 169↑ | 0.0 | 2.4 | 165 | 0.110 | 0.0 | 165 | 0.56 | 1 | 0.0 | 165 | 0.56 | 1 | 0.0 |
| B40610 | 16 | 16 | 16 | 5.6 | 16 | 0.0 | 19↑ | 0.0 | 15.8 | 17↑ | 0.444 | 5.9 | 16 | 0.27 | 3 | 0.0 | 16 | 0.36 | 3 | 0.0 |
| B40630 | 84 | 84 | 84 | 21.8 | 84 | 0.0 | 86↑ | 0.0 | 2.3 | 85↑ | 0.615 | 1.2 | 84 | 3.32 | 8 | 0.0 | 84 | 3.97 | **7** | 0.0 |
| B40650 | 175 | 175 | 175 | 34.0 | 175 | 0.0 | 188↑ | 0.0 | 6.9 | 181↑ | 0.045 | 3.3 | 175 | 199.30 | 165 | 0.0 | 175 | 113.01 | **73** | 0.0 |
| B40710 | 17 | 17 | 17 | 3.2 | 17 | 0.0 | 18↑ | 0.0 | 5.6 | 17 | 0.181 | 0.0 | 17 | 0.09 | 1 | 0.0 | 17 | 0.09 | 1 | 0.0 |
| B40730 | 59 | 59 | 59 | 6.1 | 59 | 0.0 | 68↑ | 0.0 | 13.2 | 60↑ | 0.519 | 1.7 | 59 | 0.82 | 3 | 0.0 | 59 | 0.59 | **2** | 0.0 |
| B40750 | 104 | 104 | 104 | 7.0 | 104 | 0.0 | 115↑ | 0.0 | 9.6 | 106↑ | 0.415 | 1.9 | 104 | 1.13 | 5 | 0.0 | 104 | 0.40 | **2** | 0.0 |
| B40810 | 24 | 24 | 24 | 5.4 | 24 | 0.0 | 27↑ | 0.0 | 11.1 | 24 | 0.835 | 0.0 | 24 | 0.21 | 1 | 0.0 | 24 | 0.21 | 1 | 0.0 |
| B40830 | 54 | 54 | 54 | 8.2 | 54 | 0.0 | 56↑ | 0.0 | 3.6 | 56↑ | 0.864 | 3.6 | 54 | 0.97 | 4 | 0.0 | 54 | 1.03 | **3** | 0.0 |
| B40850 | 155 | 155 | 155 | 19.4 | 155 | 0.0 | 160↑ | 0.0 | 3.1 | 155 | 0.493 | 0.0 | 155 | 0.79 | 1 | 0.0 | 155 | 0.79 | 1 | 0.0 |
| B40910 | 33 | 33 | 33 | 5.2 | 33 | 0.0 | 34↑ | 0.0 | 2.9 | 33 | 0.546 | 0.0 | 33 | 0.36 | 1 | 0.0 | 33 | 0.36 | 1 | 0.0 |
| B40930 | 99 | 99 | 99 | 11.1 | 99 | 0.0 | 103↑ | 0.0 | 3.9 | 100↑ | 0.894 | 1.0 | 99 | 12.93 | 16 | 0.0 | 99 | 2.09 | **4** | 0.0 |
| B40950 | 263 | 263 | 263 | 49.6 | 263 | 0.0 | 267↑ | 0.0 | 1.5 | 263 | 0.081 | 0.0 | 263 | 1.14 | 1 | 0.0 | 263 | 1.14 | 1 | 0.0 |
| B41010 | 17 | 17 | 17 | 3.7 | 17 | 0.0 | 18↑ | 0.0 | 5.6 | 17 | 0.568 | 0.0 | 17 | 0.03 | 1 | 0.0 | 17 | 0.03 | 1 | 0.0 |
| B41030 | 63 | 63 | 63 | 6.6 | 63 | 0.0 | 63 | 0.0 | 0.0 | 63 | 0.592 | 0.0 | 63 | 0.21 | 1 | 0.0 | 63 | 0.21 | 1 | 0.0 |
| B41050 | 141 | 141 | 141 | 16.6 | 141 | 0.0 | 151↑ | 0.0 | 6.6 | 143↑ | 0.157 | 1.4 | 141 | 2.01 | 8 | 0.0 | 141 | 2.09 | 8 | 0.0 |
| B50110 | 24 | 24 | 24 | 15.8 | 24 | 0.0 | 24 | 0.1 | 0.0 | 24 | 0.262 | 0.0 | 24 | 0.55 | 1 | 0.0 | 24 | 0.55 | 1 | 0.0 |
| B50130 | 53 | 53 | 53 | 33.6 | 53 | 0.0 | 57↑ | 0.0 | 7.0 | 54↑ | 0.567 | 1.9 | 53 | 16.80 | 20 | 0.0 | 53 | 17.42 | **16** | 0.0 |
| B50150 | 93 | 93 | 93 | 128.4 | 93 | 0.0 | 95↑ | 0.0 | 2.1 | 95↑ | 0.496 | 2.1 | 93 | 4.77 | 5 | 0.0 | 93 | 4.66 | 5 | 0.0 |
| B50210 | 19 | 19 | 19 | 13.2 | 19 | 0.0 | 22↑ | 0.0 | 13.6 | 19 | 0.902 | 0.0 | 19 | 0.48 | 1 | 0.0 | 19 | 0.48 | 1 | 0.0 |
| B50230 | 69 | 69 | 69 | 27.2 | 69 | 0.0 | 74↑ | 0.2 | 6.8 | 72↑ | 1.219 | 4.2 | 69 | 2.24 | 2 | 0.0 | 69 | 2.33 | 2 | 0.0 |
| B50250 | 121 | 121 | 121 | 109.8 | 121 | 0.0 | 123↑ | 0.1 | 1.6 | 122↑ | 0.12 | 0.8 | 121 | 2.54 | 2 | 0.0 | 121 | 2.48 | 2 | 0.0 |
| B50310 | 12 | 12 | 12 | 11.4 | 12 | 0.0 | 13↑ | 0.0 | 7.7 | 13↑ | 0.38 | 7.7 | 12 | 0.75 | 7 | 0.0 | 12 | 0.41 | **3** | 0.0 |
| B50330 | 24 | 24 | 24 | 9.8 | 24 | 0.0 | 27↑ | 0.0 | 11.1 | 24 | 0.42 | 0.0 | 24 | 0.10 | 1 | 0.0 | 24 | 0.10 | 1 | 0.0 |
| B50350 | 66 | 66 | 66 | 16.9 | 66 | 0.0 | 66 | 0.0 | 0.0 | 67↑ | 0.07 | 1.5 | 66 | 1.43 | 5 | 0.0 | 66 | 0.54 | **2** | 0.0 |
| B50410 | 18 | 18 | 18 | 12.1 | 18 | 0.0 | 18 | 0.0 | 0.0 | 19↑ | 0.67 | 5.3 | 18 | 1.12 | 4 | 0.0 | 18 | 1.47 | 4 | 0.0 |
| B50430 | 50 | 50 | 50 | 50.9 | 50 | 0.0 | 51↑ | 0.0 | 2.0 | 51↑ | 0.10 | 2.0 | 50 | 1.49 | 3 | 0.0 | 50 | 1.23 | **2** | 0.0 |
| B50450 | 84 | 84 | 84 | 61.9 | 84 | 0.0 | 86↑ | 0.0 | 2.3 | 86↑ | 0.17 | 2.3 | 84 | 1.15 | 2 | 0.0 | 84 | 1.21 | 2 | 0.0 |
| B50510 | 10 | 10 | 10 | 7.9 | 10 | 0.0 | 10 | 0.0 | 0.0 | 11↑ | 0.57 | 9.1 | 10 | 0.25 | 2 | 0.0 | 10 | 0.29 | 2 | 0.0 |
| B50530 | 34 | 34 | 34 | 11.1 | 34 | 0.0 | 37↑ | 0.0 | 8.1 | 37↑ | 0.48 | 8.1 | 34 | 1.22 | 4 | 0.0 | 34 | 1.51 | 4 | 0.0 |
| B50550 | 57 | 57 | 57 | 10.0 | 57 | 0.0 | 64↑ | 0.0 | 10.9 | 57 | 0.86 | 0.0 | 57 | 0.42 | 1 | 0.0 | 57 | 0.42 | 1 | 0.0 |
| B50610 | 13 | 13 | 13 | 6.4 | 13 | 0.0 | 13 | 0.0 | 0.0 | 13 | 0.11 | 0.0 | 13 | 0.09 | 1 | 0.0 | 13 | 0.09 | 1 | 0.0 |
| B50630 | 29 | 29 | 29 | 8.9 | 29 | 0.0 | 30↑ | 0.0 | 3.3 | 29 | 0.33 | 0.0 | 29 | 0.27 | 1 | 0.0 | 29 | 0.27 | 1 | 0.0 |
| B50650 | 51 | 51 | 51 | 13.1 | 51 | 0.0 | 51 | 0.0 | 0.0 | 52↑ | 0.44 | 1.9 | 51 | 8.77 | 17 | 0.0 | 51 | 2.08 | **4** | 0.0 |
| B50710 | 17 | 17 | 17 | 7.4 | 17 | 0.0 | 20↑ | 0.0 | 15.0 | 17 | 0.16 | 0.0 | 17 | 0.21 | 1 | 0.0 | 17 | 0.21 | 1 | 0.0 |
| B50730 | 54 | 54 | 54 | 20.7 | 54 | 0.0 | 55↑ | 0.0 | 1.8 | 54 | 0.19 | 0.0 | 54 | 0.46 | 1 | 0.0 | 54 | 0.46 | 1 | 0.0 |
| B50750 | 88 | 88 | 88 | 21.4 | 88 | 0.0 | 97↑ | 0.0 | 9.3 | 88 | 1.04 | 0.0 | 88 | 0.56 | 1 | 0.0 | 88 | 0.56 | 1 | 0.0 |
| B50810 | 24 | 24 | 24 | 14.1 | 24 | 0.0 | 27↑ | 0.0 | 11.1 | 25↑ | 0.32 | 4.0 | 24 | 2.24 | 5 | 0.0 | 24 | 1.13 | **3** | 0.0 |
| B50830 | 57 | 57 | 57 | 28.7 | 57 | 0.0 | 59↑ | 0.0 | 3.4 | 57 | 0.47 | 0.0 | 57 | 0.35 | 1 | 0.0 | 57 | 0.35 | 1 | 0.0 |
| B50850 | 105 | 105 | 105 | 106.5 | 105 | 0.0 | 115↑ | 0.0 | 8.7 | 105 | 0.31 | 0.0 | 105 | 0.87 | 1 | 0.0 | 105 | 0.87 | 1 | 0.0 |
| B50910 | 21 | 21 | 21 | 9.2 | 21 | 0.0 | 21 | 0.0 | 0.0 | 21 | 0.29 | 0.0 | 21 | 0.11 | 1 | 0.0 | 21 | 0.11 | 1 | 0.0 |
| B50930 | 56 | 56 | 56 | 25.0 | 56 | 0.0 | 58↑ | 0.0 | 3.4 | 57↑ | 0.53 | 1.8 | 56 | 1.38 | 3 | 0.0 | 56 | 1.66 | 3 | 0.0 |
| B50950 | 91 | 91 | 91 | 18.0 | 91 | 0.0 | 99↑ | 0.0 | 8.1 | 91 | 0.19 | 0.0 | 91 | 0.62 | 1 | 0.0 | 91 | 0.62 | 1 | 0.0 |
| B51010 | 10 | 10 | 10 | 7.7 | 10 | 0.0 | 10 | 0.0 | 0.0 | 10 | 0.13 | 0.0 | 10 | 0.05 | 1 | 0.0 | 10 | 0.05 | 1 | 0.0 |
| B51030 | 37 | 37 | 37 | 22.2 | 37 | 0.0 | 39↑ | 0.0 | 5.1 | 37 | 0.49 | 0.0 | 37 | 0.18 | 1 | 0.0 | 37 | 0.18 | 1 | 0.0 |
| B51050 | 76 | 76 | 76 | 50.5 | 76 | 0.0 | 82↑ | 0.0 | 7.3 | 76 | 0.25 | 0.0 | 76 | 0.52 | 1 | 0.0 | 76 | 0.52 | 1 | 0.0 |
| B60110 | 17 | 17 | 17 | 11.7 | 17 | 0.0 | 17 | 0.2 | 0.0 | 17 | 0.55 | 0.0 | 17 | 0.42 | 1 | 0.0 | 17 | 0.42 | 1 | 0.0 |
| B60130 | 38 | 38 | 38 | 29.0 | 38 | 0.0 | 39↑ | 0.2 | 2.6 | 39↑ | 0.82 | 2.6 | 38 | 71.73 | 80 | 0.0 | 38 | 17.99 | **18** | 0.0 |
| B60150 | 58 | 58 | 58 | 19.3 | 58 | 0.0 | 66↑ | 0.4 | 12.1 | 58 | 0.90 | 0.0 | 58 | 0.86 | 1 | 0.0 | 58 | 0.86 | 1 | 0.0 |
| B60210 | 15 | 15 | 15 | 7.7 | 15 | 0.0 | 18↑ | 0.2 | 16.7 | 15 | 0.74 | 0.0 | 15 | 0.49 | 1 | 0.0 | 15 | 0.49 | 1 | 0.0 |
| B60230 | 40 | 40 | 40 | 17.2 | 40 | 0.0 | 43↑ | 0.3 | 7.0 | 41↑ | 1.01 | 2.4 | 40 | 1.69 | 3 | 0.0 | 40 | 1.42 | **2** | 0.0 |
| B60250 | 56 | 56 | 56 | 41.6 | 56 | 0.0 | 64↑ | 0.3 | 12.5 | 59↑ | 0.89 | 5.1 | 56 | 1.85 | 2 | 0.0 | 56 | 1.80 | 2 | 0.0 |
| B60310 | 6 | 6 | 6 | 4.6 | 6 | 0.0 | 6 | 0.1 | 0.0 | 6 | 0.29 | 0.0 | 6 | 0.08 | 1 | 0.0 | 6 | 0.08 | 1 | 0.0 |
| B60330 | 33 | 33 | 33 | 12.6 | 33 | 0.0 | 37↑ | 0.2 | 10.8 | 33 | 0.42 | 0.0 | 33 | 0.57 | 1 | 0.0 | 33 | 0.57 | 1 | 0.0 |
| B60350 | 54 | 54 | 54 | 23.9 | 54 | 0.0 | 55↑ | 0.2 | 1.8 | 54 | 0.68 | 0.0 | 54 | 0.59 | 1 | 0.0 | 54 | 0.59 | 1 | 0.0 |
| B60410 | 13 | 13 | 13 | 4.7 | 13 | 0.0 | 13 | 0.0 | 0.0 | 14↑ | 0.18 | 7.1 | 13 | 0.57 | 3 | 0.0 | 13 | 0.49 | **2** | 0.0 |
| B60430 | 31 | 31 | 31 | 9.5 | 31 | 0.0 | 32↑ | 0.0 | 3.1 | 32↑ | 0.70 | 3.1 | 31 | 3.99 | 12 | 0.0 | 31 | 1.66 | **4** | 0.0 |
| B60450 | 46 | 46 | 46 | 18.9 | 46 | 0.0 | 52↑ | 0.1 | 11.5 | 47↑ | 0.62 | 2.1 | 46 | 1.73 | 3 | 0.0 | 46 | 1.47 | 3 | 0.0 |
| B60510 | 13 | 13 | 13 | 7.5 | 13 | 0.0 | 15↑ | 0.3 | 13.3 | 13 | 0.59 | 0.0 | 13 | 0.50 | 1 | 0.0 | 13 | 0.50 | 1 | 0.0 |
| B60530 | 43 | 43 | 43 | 21.6 | 43 | 0.0 | 45↑ | 0.4 | 4.4 | 43 | 0.54 | 0.0 | 43 | 0.90 | 1 | 0.0 | 43 | 0.90 | 1 | 0.0 |
| B60550 | 71 | 71 | 71 | 40.7 | 71 | 0.0 | 76↑ | 0.3 | 6.6 | 71 | 0.35 | 0.0 | 71 | 1.22 | 1 | 0.0 | 71 | 1.22 | 1 | 0.0 |

Table C.14: MMR-SCP results for type-M instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| M401-1 | 3160 | 3160 | 3160 | 58.0 | 3160 | 0.0 | 3304↑ | 0.1 | 4.4 | 3160 | 0.68 | 0.0 | 3160 | 0.68 | 1 | 0.0 | 3160 | 0.68 | 1 | 0.0 |
| M401-2 | 3495 | 3495 | 3495 | 24.4 | 3495 | 0.0 | 3636↑ | 0.0 | 3.9 | 3495 | 0.32 | 0.0 | 3495 | 0.32 | 1 | 0.0 | 3495 | 0.32 | 1 | 0.0 |
| M401-3 | 3382 | 3382 | 3382 | 82.8 | 3382 | 0.0 | 3491↑ | 0.1 | 3.1 | 3382 | 0.93 | 0.0 | 3382 | 0.93 | 1 | 0.0 | 3382 | 0.93 | 1 | 0.0 |
| M402-1 | 3610 | 3610 | 3610 | 57.2 | 3610 | 0.0 | 3787↑ | 0.0 | 4.7 | 3610 | 1.00 | 0.0 | 3610 | 1.00 | 1 | 0.0 | 3610 | 1.00 | 1 | 0.0 |
| M402-2 | 2986 | 2986 | 2986 | 24.0 | 2986 | 0.0 | 3188↑ | 0.0 | 6.3 | 2986 | 0.36 | 0.0 | 2986 | 0.36 | 1 | 0.0 | 2986 | 0.36 | 1 | 0.0 |
| M402-3 | 4294 | 4294 | 4294 | 130.6 | 4294 | 0.0 | 4467↑ | 0.1 | 3.9 | 4294 | 1.12 | 0.0 | 4294 | 1.12 | 1 | 0.0 | 4294 | 1.12 | 1 | 0.0 |
| M403-1 | 3233 | 3233 | 3233 | 22.5 | 3233 | 0.0 | 3375↑ | 0.0 | 4.2 | 3233 | 0.24 | 0.0 | 3233 | 0.24 | 1 | 0.0 | 3233 | 0.24 | 1 | 0.0 |
| M403-2 | 4205 | 4205 | 4205 | 70.4 | 4205 | 0.0 | 4326↑ | 0.0 | 2.8 | 4205 | 0.60 | 0.0 | 4205 | 0.60 | 1 | 0.0 | 4205 | 0.60 | 1 | 0.0 |
| M403-3 | 3589 | 3589 | 3589 | 35.5 | 3589 | 0.0 | 3884↑ | 0.0 | 7.6 | 3594↑ | 0.79 | 0.1 | 3589 | 9.20 | 11 | 0.0 | 3589 | 1.94 | **2** | 0.0 |
| M404-1 | 3628 | 3628 | 3628 | 45.0 | 3628 | 0.0 | 3884↑ | 0.0 | 6.6 | 3628 | 0.28 | 0.0 | 3628 | 0.28 | 1 | 0.0 | 3628 | 0.28 | 1 | 0.0 |
| M404-2 | 3954 | 3954 | 3954 | 58.9 | 3954 | 0.0 | 4148↑ | 0.0 | 4.7 | 3954 | 0.80 | 0.0 | 3954 | 0.80 | 1 | 0.0 | 3954 | 0.80 | 1 | 0.0 |
| M404-3 | 2957 | 2957 | 2957 | 40.1 | 2957 | 0.0 | 3115↑ | 0.0 | 5.1 | 2957 | 0.19 | 0.0 | 2957 | 0.19 | 1 | 0.0 | 2957 | 0.19 | 1 | 0.0 |
| M405-1 | 3546 | 3546 | 3546 | 16.8 | 3546 | 0.0 | 3980↑ | 0.1 | 10.9 | 3546 | 0.70 | 0.0 | 3546 | 0.70 | 1 | 0.0 | 3546 | 0.70 | 1 | 0.0 |
| M405-2 | 3589 | 3589 | 3589 | 54.2 | 3589 | 0.0 | 3931↑ | 0.0 | 8.7 | 3589 | 0.25 | 0.0 | 3589 | 0.25 | 1 | 0.0 | 3589 | 0.25 | 1 | 0.0 |
| M405-3 | 3698 | 3698 | 3698 | 46.5 | 3698 | 0.0 | 3855↑ | 0.1 | 4.1 | 3698 | 0.66 | 0.0 | 3698 | 0.66 | 1 | 0.0 | 3698 | 0.66 | 1 | 0.0 |
| M406-1 | 3549 | 3549 | 3549 | 67.3 | 3549 | 0.0 | 3692↑ | 0.0 | 3.9 | 3549 | 0.98 | 0.0 | 3549 | 0.98 | 1 | 0.0 | 3549 | 0.98 | 1 | 0.0 |
| M406-2 | 2975 | 2975 | 2975 | 7.9 | 2975 | 0.0 | 3000↑ | 0.0 | 0.8 | 2979↑ | 0.18 | 0.1 | 2975 | 1.89 | 9 | 0.0 | 2975 | 1.23 | **4** | 0.0 |
| M406-3 | 3199 | 3199 | 3199 | 30.9 | 3199 | 0.0 | 3296↑ | 0.0 | 2.9 | 3199 | 0.26 | 0.0 | 3199 | 0.26 | 1 | 0.0 | 3199 | 0.26 | 1 | 0.0 |
| M407-1 | 3115 | 3115 | 3115 | 54.2 | 3115 | 0.0 | 3320↑ | 0.0 | 6.2 | 3115 | 0.61 | 0.0 | 3115 | 0.61 | 1 | 0.0 | 3115 | 0.61 | 1 | 0.0 |
| M407-2 | 4674 | 4674 | 4674 | 223.3 | 4674 | 0.0 | 4840↑ | 0.0 | 3.4 | 4680↑ | 0.98 | 0.1 | 4674 | 20.78 | 18 | 0.0 | 4674 | 19.19 | **12** | 0.0 |
| M407-3 | 4136 | 4136 | 4136 | 44.0 | 4136 | 0.0 | 4367↑ | 0.0 | 5.3 | 4136 | 0.41 | 0.0 | 4136 | 0.41 | 1 | 0.0 | 4136 | 0.41 | 1 | 0.0 |
| M408-1 | 3802 | 3802 | 3802 | 68.2 | 3802 | 0.0 | 3882↑ | 0.0 | 2.1 | 3802 | 0.63 | 0.0 | 3802 | 0.63 | 1 | 0.0 | 3802 | 0.63 | 1 | 0.0 |
| M408-2 | 3302 | 3302 | 3302 | 36.4 | 3302 | 0.0 | 3512↑ | 0.0 | 6.0 | 3310↑ | 0.36 | 0.2 | 3302 | 0.61 | 2 | 0.0 | 3302 | 0.89 | 2 | 0.0 |
| M408-3 | 3147 | 3147 | 3147 | 19.1 | 3147 | 0.0 | 3339↑ | 0.0 | 5.8 | 3147 | 0.21 | 0.0 | 3147 | 0.21 | 1 | 0.0 | 3147 | 0.21 | 1 | 0.0 |
| M409-1 | 3602 | 3602 | 3602 | 47.9 | 3602 | 0.0 | 3923↑ | 0.0 | 8.2 | 3602 | 0.21 | 0.0 | 3602 | 0.21 | 1 | 0.0 | 3602 | 0.21 | 1 | 0.0 |
| M409-2 | 4222 | 4222 | 4222 | 180.0 | 4222 | 0.0 | 4436↑ | 0.0 | 4.8 | 4222 | 0.58 | 0.0 | 4222 | 0.58 | 1 | 0.0 | 4222 | 0.58 | 1 | 0.0 |
| M409-3 | 3365 | 3365 | 3365 | 29.7 | 3365 | 0.0 | 3494↑ | 0.0 | 3.7 | 3365 | 0.25 | 0.0 | 3365 | 0.25 | 1 | 0.0 | 3365 | 0.25 | 1 | 0.0 |
| M410-1 | 3000 | 3000 | 3000 | 30.9 | 3000 | 0.0 | 3200↑ | 0.0 | 6.3 | 3000 | 0.11 | 0.0 | 3000 | 0.11 | 1 | 0.0 | 3000 | 0.11 | 1 | 0.0 |
| M410-2 | 4340 | 4340 | 4340 | 124.1 | 4340 | 0.0 | 4439↑ | 0.0 | 2.2 | 4340 | 0.71 | 0.0 | 4340 | 0.71 | 1 | 0.0 | 4340 | 0.71 | 1 | 0.0 |
| M410-3 | 3235 | 3235 | 3235 | 25.3 | 3235 | 0.0 | 3338↑ | 0.0 | 3.1 | 3235 | 0.10 | 0.0 | 3235 | 0.10 | 1 | 0.0 | 3235 | 0.10 | 1 | 0.0 |
| M501-1 | 1864 | 1864 | 1864 | 44.3 | 1864 | 0.0 | 1930↑ | 0.0 | 3.4 | 1864 | 0.28 | 0.0 | 1864 | 0.28 | 1 | 0.0 | 1864 | 0.28 | 1 | 0.0 |
| M501-2 | 1683 | 1683 | 1683 | 43.0 | 1683 | 0.0 | 1757↑ | 0.0 | 4.2 | 1683 | 0.09 | 0.0 | 1683 | 0.09 | 1 | 0.0 | 1683 | 0.09 | 1 | 0.0 |
| M501-3 | 1708 | 1708 | 1708 | 83.7 | 1708 | 0.0 | 1719↑ | 0.0 | 0.6 | 1708 | 0.53 | 0.0 | 1708 | 0.53 | 1 | 0.0 | 1708 | 0.53 | 1 | 0.0 |
| M502-1 | 1972 | 1972 | 1972 | 179.5 | 1972 | 0.0 | 1994↑ | 0.0 | 1.1 | 1972 | 0.88 | 0.0 | 1972 | 0.88 | 1 | 0.0 | 1972 | 0.88 | 1 | 0.0 |
| M502-2 | 1805 | 1805 | 1805 | 11.2 | 1805 | 0.0 | 1936↑ | 0.0 | 6.8 | 1805 | 0.07 | 0.0 | 1805 | 0.07 | 1 | 0.0 | 1805 | 0.07 | 1 | 0.0 |
| M502-3 | 1930 | 1930 | 1930 | 32.5 | 1930 | 0.0 | 1968↑ | 0.0 | 1.9 | 1930 | 0.12 | 0.0 | 1930 | 0.12 | 1 | 0.0 | 1930 | 0.12 | 1 | 0.0 |
| M503-1 | 1889 | 1889 | 1889 | 26.4 | 1889 | 0.0 | 1916↑ | 0.0 | 1.4 | 1889 | 0.38 | 0.0 | 1889 | 0.38 | 1 | 0.0 | 1889 | 0.38 | 1 | 0.0 |
| M503-2 | 2220 | 2220 | 2220 | 43.8 | 2220 | 0.0 | 2389↑ | 0.1 | 7.1 | 2220 | 0.42 | 0.0 | 2220 | 0.42 | 1 | 0.0 | 2220 | 0.42 | 1 | 0.0 |
| M503-3 | 1571 | 1571 | 1571 | 23.4 | 1571 | 0.0 | 1610↑ | 0.0 | 2.4 | 1571 | 0.07 | 0.0 | 1571 | 0.07 | 1 | 0.0 | 1571 | 0.07 | 1 | 0.0 |
| M504-1 | 2179 | 2179 | 2179 | 208.1 | 2179 | 0.0 | 2260↑ | 0.0 | 3.6 | 2184↑ | 0.67 | 0.2 | 2179 | 3.32 | 5 | 0.0 | 2179 | 2.16 | **3** | 0.0 |
| M504-2 | 1902 | 1902 | 1902 | 30.6 | 1902 | 0.0 | 1943↑ | 0.0 | 2.1 | 1902 | 0.10 | 0.0 | 1902 | 0.10 | 1 | 0.0 | 1902 | 0.10 | 1 | 0.0 |
| M504-3 | 1870 | 1870 | 1870 | 104.0 | 1870 | 0.0 | 1977↑ | 0.0 | 5.4 | 1870 | 0.17 | 0.0 | 1870 | 0.17 | 1 | 0.0 | 1870 | 0.17 | 1 | 0.0 |
| M505-1 | 1998 | 1998 | 1998 | 111.6 | 1998 | 0.0 | 2080↑ | 0.0 | 3.9 | 1998 | 0.57 | 0.0 | 1998 | 0.57 | 1 | 0.0 | 1998 | 0.57 | 1 | 0.0 |
| M505-2 | 1781 | 1781 | 1781 | 53.1 | 1781 | 0.0 | 1853↑ | 0.0 | 3.9 | 1781 | 0.48 | 0.0 | 1781 | 0.48 | 1 | 0.0 | 1781 | 0.48 | 1 | 0.0 |
| M505-3 | 1869 | 1869 | 1869 | 225.1 | 1869 | 0.0 | 2046↑ | 0.1 | 8.7 | 1869 | 0.86 | 0.0 | 1869 | 0.86 | 1 | 0.0 | 1869 | 0.86 | 1 | 0.0 |
| M506-1 | 1803 | 1803 | 1803 | 22.0 | 1803 | 0.0 | 1973↑ | 0.0 | 8.6 | 1803 | 0.11 | 0.0 | 1803 | 0.11 | 1 | 0.0 | 1803 | 0.11 | 1 | 0.0 |
| M506-2 | 1943 | 1943 | 1943 | 97.9 | 1943 | 0.0 | 1983↑ | 0.0 | 2.0 | 1943 | 0.33 | 0.0 | 1943 | 0.33 | 1 | 0.0 | 1943 | 0.33 | 1 | 0.0 |
| M506-3 | 2001 | 2001 | 2001 | 73.1 | 2001 | 0.0 | 2238↑ | 0.1 | 10.6 | 2001 | 0.44 | 0.0 | 2001 | 0.44 | 1 | 0.0 | 2001 | 0.44 | 1 | 0.0 |
| M507-1 | 2075 | 2075 | 2075 | 54.5 | 2075 | 0.0 | 2285↑ | 0.0 | 9.2 | 2075 | 0.16 | 0.0 | 2075 | 0.16 | 1 | 0.0 | 2075 | 0.16 | 1 | 0.0 |
| M507-2 | 1878 | 1878 | 1878 | 33.4 | 1878 | 0.0 | 1943↑ | 0.0 | 3.3 | 1878 | 0.19 | 0.0 | 1878 | 0.19 | 1 | 0.0 | 1878 | 0.19 | 1 | 0.0 |
| M507-3 | 1791 | 1791 | 1791 | 208.3 | 1791 | 0.0 | 1864↑ | 0.1 | 3.9 | 1791 | 1.04 | 0.0 | 1791 | 1.04 | 1 | 0.0 | 1791 | 1.04 | 1 | 0.0 |
| M508-1 | 1656 | 1656 | 1656 | 49.7 | 1656 | 0.0 | 1702↑ | 0.0 | 2.7 | 1656 | 0.32 | 0.0 | 1656 | 0.32 | 1 | 0.0 | 1656 | 0.32 | 1 | 0.0 |
| M508-2 | 1570 | 1570 | 1570 | 88.2 | 1570 | 0.0 | 1630↑ | 0.0 | 3.7 | 1570 | 0.47 | 0.0 | 1570 | 0.47 | 1 | 0.0 | 1570 | 0.47 | 1 | 0.0 |
| M508-3 | 1765 | 1765 | 1765 | 57.7 | 1765 | 0.0 | 1785↑ | 0.0 | 1.1 | 1765 | 0.31 | 0.0 | 1765 | 0.31 | 1 | 0.0 | 1765 | 0.31 | 1 | 0.0 |
| M509-1 | 1710 | 1710 | 1710 | 33.1 | 1710 | 0.0 | 1778↑ | 0.0 | 3.8 | 1710 | 0.29 | 0.0 | 1710 | 0.29 | 1 | 0.0 | 1710 | 0.29 | 1 | 0.0 |
| M509-2 | 1769 | 1769 | 1769 | 97.8 | 1769 | 0.0 | 1786↑ | 0.0 | 1.0 | 1769 | 0.53 | 0.0 | 1769 | 0.53 | 1 | 0.0 | 1769 | 0.53 | 1 | 0.0 |
| M509-3 | 2003 | 2003 | 2003 | 56.9 | 2003 | 0.0 | 2096↑ | 0.0 | 4.4 | 2003 | 0.19 | 0.0 | 2003 | 0.19 | 1 | 0.0 | 2003 | 0.19 | 1 | 0.0 |
| M510-1 | 2217 | 2217 | 2217 | 36.9 | 2217 | 0.0 | 2304↑ | 0.0 | 3.8 | 2217 | 0.13 | 0.0 | 2217 | 0.13 | 1 | 0.0 | 2217 | 0.13 | 1 | 0.0 |
| M510-2 | 1937 | 1937 | 1937 | 76.9 | 1937 | 0.0 | 2027↑ | 0.0 | 4.4 | 1937 | 0.49 | 0.0 | 1937 | 0.49 | 1 | 0.0 | 1937 | 0.49 | 1 | 0.0 |
| M510-3 | 1838 | 1838 | 1838 | 55.1 | 1838 | 0.0 | 2011↑ | 0.0 | 8.6 | 1838 | 0.25 | 0.0 | 1838 | 0.25 | 1 | 0.0 | 1838 | 0.25 | 1 | 0.0 |
| M601-1 | 800 | 800 | 800 | 10.1 | 800 | 0.0 | 831↑ | 0.0 | 3.7 | 800 | 0.55 | 0.0 | 800 | 0.55 | 1 | 0.0 | 800 | 0.55 | 1 | 0.0 |
| M601-2 | 1340 | 1340 | 1340 | 7.7 | 1340 | 0.0 | 1547↑ | 0.3 | 13.4 | 1340 | 0.82 | 0.0 | 1340 | 0.82 | 1 | 0.0 | 1340 | 0.82 | 1 | 0.0 |
| M601-3 | 1091 | 1091 | 1091 | 18.9 | 1091 | 0.0 | 1124↑ | 0.1 | 2.9 | 1096↑ | 0.90 | 0.5 | 1091 | 2.73 | 3 | 0.0 | 1091 | 3.18 | 3 | 0.0 |
| M602-1 | 1112 | 1112 | 1112 | 12.8 | 1112 | 0.0 | 1166↑ | 0.1 | 4.6 | 1114↑ | 0.74 | 0.2 | 1112 | 3.55 | 4 | 0.0 | 1112 | 2.55 | **3** | 0.0 |
| M602-2 | 1052 | 1052 | 1052 | 11.2 | 1052 | 0.0 | 1119↑ | 0.0 | 6.0 | 1052 | 1.01 | 0.0 | 1052 | 1.01 | 1 | 0.0 | 1052 | 1.01 | 1 | 0.0 |
| M602-3 | 1264 | 1264 | 1264 | 16.7 | 1264 | 0.0 | 1319↑ | 0.2 | 4.2 | 1268↑ | 0.89 | 0.3 | 1264 | 4.46 | 5 | 0.0 | 1264 | 2.65 | **3** | 0.0 |
| M603-1 | 683 | 683 | 683 | 4.5 | 683 | 0.0 | 718↑ | 0.0 | 4.9 | 683 | 0.29 | 0.0 | 683 | 0.29 | 1 | 0.0 | 683 | 0.29 | 1 | 0.0 |
| M603-2 | 966 | 966 | 966 | 6.9 | 966 | 0.0 | 970↑ | 0.1 | 0.4 | 966 | 0.42 | 0.0 | 966 | 0.42 | 1 | 0.0 | 966 | 0.42 | 1 | 0.0 |
| M603-3 | 1200 | 1200 | 1200 | 9.5 | 1200 | 0.0 | 1223↑ | 0.1 | 1.9 | 1200 | 0.68 | 0.0 | 1200 | 0.68 | 1 | 0.0 | 1200 | 0.68 | 1 | 0.0 |
| M604-1 | 1022 | 1022 | 1022 | 11.4 | 1022 | 0.0 | 1068↑ | 0.1 | 4.3 | 1022 | 0.18 | 0.0 | 1022 | 0.18 | 1 | 0.0 | 1022 | 0.18 | 1 | 0.0 |
| M604-2 | 1055 | 1055 | 1055 | 14.3 | 1055 | 0.0 | 1084↑ | 0.1 | 2.7 | 1055 | 0.70 | 0.0 | 1055 | 0.70 | 1 | 0.0 | 1055 | 0.70 | 1 | 0.0 |
| M604-3 | 971 | 971 | 971 | 14.3 | 971 | 0.0 | 984↑ | 0.0 | 1.3 | 971 | 0.62 | 0.0 | 971 | 0.62 | 1 | 0.0 | 971 | 0.62 | 1 | 0.0 |
| M605-1 | 1083 | 1083 | 1083 | 14.9 | 1083 | 0.0 | 1141↑ | 0.2 | 5.1 | 1083 | 0.59 | 0.0 | 1083 | 0.59 | 1 | 0.0 | 1083 | 0.59 | 1 | 0.0 |
| M605-2 | 1053 | 1053 | 1053 | 17.9 | 1053 | 0.0 | 1091↑ | 0.1 | 3.5 | 1053 | 0.54 | 0.0 | 1053 | 0.54 | 1 | 0.0 | 1053 | 0.54 | 1 | 0.0 |
| M605-3 | 1031 | 1031 | 1031 | 12.4 | 1031 | 0.0 | 1031 | 0.1 | 0.0 | 1031 | 0.35 | 0.0 | 1031 | 0.35 | 1 | 0.0 | 1031 | 0.35 | 1 | 0.0 |

Table C.15: MMR-SCP results for type-K instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| K401-1 | 13365 | 14440 | 14467↑ | 3333.3 | 13860 | 4.2 | 15596↑ | 1.8 | 11.1 | 14440 | 20.403 | 4.0 | 14440 | 20.4 | 1 | 4.0 | 14440 | 20.4 | 1 | 4.0 |
| K401-2 | 14026 | 16372 | 16779↑ | 3512.3 | 13688 | 16.4 | 16863↑ | 2.2 | 16.8 | 16247↓ | 419.292 | 13.7 | 16243↓ | 897.8 | 2 | 13.6 | 16243↓ | 912.1 | 2 | 13.6 |
| K401-3 | 11803 | 12974 | 13079↑ | 3427.3 | 11778 | 9.8 | 13294↑ | 0.4 | 11.2 | 12974 | 45.133 | 9.0 | 12974 | 45.2 | 1 | 9.0 | 12974 | 45.1 | 1 | 9.0 |
| K402-1 | 12628 | 14235 | 14591↑ | 3440.1 | 12589 | 13.5 | 15578↑ | 0.8 | 18.9 | 14235 | 77.207 | 11.3 | 14235 | 77.2 | 1 | 11.3 | 14235 | 77.2 | 1 | 11.3 |
| K402-2 | 14325 | 16335 | 16879↑ | 3041.9 | 14216 | 15.1 | 18522↑ | 2.3 | 22.7 | 16351↑ | 155.660 | 12.4 | 16335 | 496.7 | 3 | 12.3 | 16335 | 488.5 | 3 | 12.3 |
| K402-3 | 12445 | 14306 | 14506↑ | 3581.1 | 12428 | 14.2 | 15158↑ | 1.5 | 17.9 | 14306 | 351.183 | 13.0 | 14306 | 351.2 | 1 | 13.0 | 14306 | 351.4 | 1 | 13.0 |
| K403-1 | 14031 | 15139 | 15180↑ | 2872.2 | 14273 | 6.0 | 15968↑ | 0.3 | 10.6 | 15139 | 28.780 | 5.7 | 15139 | 28.8 | 1 | 5.7 | 15139 | 28.8 | 1 | 5.7 |
| K403-2 | 14349 | 16523 | 17066↑ | 3264.5 | 14147 | 15.9 | 17286↑ | 1.6 | 17.0 | 16523 | 176.895 | 13.2 | 16523 | 177.3 | 1 | 13.2 | 16523 | 177.6 | 1 | 13.2 |
| K403-3 | 12436 | 13613 | 13613 | 2468.9 | 12756 | 6.3 | 14831↑ | 0.5 | 14.0 | 13613 | 30.240 | 6.3 | 13613 | 30.2 | 1 | 6.3 | 13613 | 30.2 | 1 | 6.3 |
| K404-1 | 13046 | 13472 | 13472 | 1895.2 | 13472 | 0.0 | 15069↑ | 0.3 | 10.6 | 13472 | 9.412 | 0.0 | 13472 | 9.4 | 1 | 0.0 | 13472 | 9.4 | 1 | 0.0 |
| K404-2 | 13291 | 15871 | 16347↑ | 3510.2 | 13249 | 18.7 | 17252↑ | 1.8 | 23.0 | 15820↓ | 580.562 | 16.0 | 15820↓ | 580.6 | 1 | 16.0 | **15813**↓ | 3600.0 | 7 | 15.9 |
| K404-3 | 13255 | 14898 | 15216↑ | 2512.3 | 13039 | 12.9 | 15494↑ | 0.4 | 14.5 | 14954↑ | 38.057 | 11.4 | 14881↓ | 152.8 | 4 | 10.9 | 14881↓ | 146.6 | 4 | 10.9 |
| K405-1 | 13518 | 16242 | 16784↑ | 2391.4 | 13612 | 18.9 | 17670↑ | 1.8 | 23.0 | 16242 | 296.749 | 16.2 | 16242 | 297.8 | 1 | 16.2 | 16242 | 296.7 | 1 | 16.2 |
| K405-2 | 14204 | 16311 | 16596↑ | 1653.6 | 14290 | 13.9 | 17223↑ | 1.6 | 17.0 | 16355↑ | 77.639 | 12.6 | 16311 | 372.7 | 4 | 12.4 | 16311 | 348.7 | 4 | 12.4 |
| K405-3 | 12933 | 14549 | 14655↑ | 3247.5 | 12916 | 11.8 | 15568↑ | 1.2 | 16.9 | 14549 | 71.876 | 11.1 | 14539↓ | 147.4 | 2 | 11.0 | 14539↓ | 167.1 | 2 | 11.0 |
| K406-1 | 12885 | 14067 | 14067 | 2826.2 | 13051 | 7.2 | 15259↑ | 1.1 | 14.5 | 14067 | 90.892 | 7.2 | 14067 | 91.1 | 1 | 7.2 | 14067 | 90.9 | 1 | 7.2 |
| K406-2 | 12522 | 14551 | 15202↑ | 2599.6 | 12411 | 17.6 | 16319↑ | 4.2 | 23.3 | 14555↑ | 199.734 | 14.0 | 14551 | 427.5 | 2 | 13.9 | 14551 | 390.6 | 2 | 13.9 |
| K406-3 | 12312 | 13941 | 14110↑ | 3225.6 | 12113 | 12.7 | 14915↑ | 1.2 | 17.5 | 13941 | 177.886 | 11.7 | 13941 | 178.4 | 1 | 11.7 | 13941 | 177.9 | 1 | 11.7 |
| K407-1 | 13055 | 14928 | 15533↑ | 1224.7 | 13021 | 16.0 | 15627↑ | 0.9 | 16.5 | 14908↓ | 123.242 | 12.4 | 14908↓ | 123.9 | 1 | 12.4 | 14908↓ | 123.2 | 1 | 12.4 |
| K407-2 | 13509 | 15875 | 16118↑ | 2995.0 | 13865 | 14.0 | 16735↑ | 2.0 | 17.1 | 15901↑ | 380.145 | 12.8 | 15875 | 1166.1 | 3 | 12.7 | 15875 | 1151.9 | 3 | 12.7 |
| K407-3 | 13465 | 15262 | 15958↑ | 2586.2 | 13476 | 15.6 | 16411↑ | 1.1 | 17.9 | 15268↑ | 41.457 | 11.7 | 15262 | 246.8 | 5 | 11.7 | 15262 | 108.8 | **2** | 11.7 |
| K408-1 | 12193 | 13752 | 13654↓ | 2178.6 | 12177 | 10.7 | 14547↑ | 0.9 | 16.2 | 13654↓ | 91.841 | 10.7 | 13654↓ | 91.8 | 1 | 10.7 | 13654↓ | 92.0 | 1 | 10.7 |
| K408-2 | 13907 | 15843 | 16464↑ | 3273.1 | 13901 | 15.5 | 17413↑ | 1.2 | 20.1 | 15843 | 47.826 | 12.2 | 15843 | 47.9 | 1 | 12.2 | 15843 | 47.8 | 1 | 12.2 |
| K408-3 | 12430 | 13566 | 13731↑ | 3344.7 | 12591 | 8.3 | 14096↑ | 0.3 | 10.7 | 13566 | 34.834 | 7.2 | 13566 | 34.8 | 1 | 7.2 | 13566 | 34.8 | 1 | 7.2 |
| K409-1 | 13283 | 14872 | 15282↑ | 1428.6 | 12991 | 13.1 | 15680↑ | 1.5 | 15.3 | 14872 | 160.887 | 10.7 | 14872 | 161.2 | 1 | 10.7 | 14872 | 160.9 | 1 | 10.7 |
| K409-2 | 12285 | 14020 | 14037↑ | 3471.0 | 12450 | 11.3 | 14963↑ | 1.6 | 16.8 | 13971↓ | 117.825 | 10.9 | 13971↓ | 117.8 | 1 | 10.9 | 13971↓ | 117.8 | 1 | 10.9 |
| K409-3 | 12949 | 14414 | 14414 | 3550.9 | 12948 | 10.2 | 15399↑ | 0.6 | 15.9 | 14414 | 50.856 | 10.2 | 14414 | 50.9 | 1 | 10.2 | 14414 | 50.9 | 1 | 10.2 |
| K410-1 | 13049 | 15367 | 15996↑ | 2464.7 | 13213 | 17.4 | 16495↑ | 0.7 | 19.9 | 15287↓ | 93.437 | 13.6 | 15254↓ | 316.7 | 3 | 13.4 | 15254↓ | 291.5 | 3 | 13.4 |
| K410-2 | 14265 | 15903 | 15903 | 2990.0 | 14345 | 9.8 | 17072↑ | 1.6 | 16.0 | 15903 | 168.399 | 9.8 | 15903 | 168.4 | 1 | 9.8 | 15903 | 168.7 | 1 | 9.8 |
| K410-3 | 13983 | 16635 | 17334↑ | 3352.4 | 13976 | 19.3 | 16922↑ | 0.7 | 17.4 | 16635 | 344.680 | 15.9 | 16635 | 346.0 | 1 | 15.9 | 16635 | 346.3 | 1 | 15.9 |
| K501-1 | 10925 | 11743 | 11824↑ | 2822.8 | 11277 | 4.6 | 12012↑ | 1.0 | 6.1 | 11743 | 36.964 | 4.0 | 11743 | 37.0 | 1 | 4.0 | 11743 | 37.0 | 1 | 4.0 |
| K501-2 | 10997 | 11899 | 11899 | 2034.0 | 11226 | 5.7 | 12528↑ | 0.5 | 10.4 | 11899 | 16.887 | 5.7 | 11899 | 16.9 | 1 | 5.7 | 11899 | 16.9 | 1 | 5.7 |
| K501-3 | 11328 | 11631 | 11631 | 1974.4 | 11631 | 0.0 | 12195↑ | 1.3 | 4.6 | 11631 | 12.344 | 0.0 | 11631 | 12.3 | 1 | 0.0 | 11631 | 12.3 | 1 | 0.0 |
| K502-1 | 9891 | 10144 | 10144 | 2570.6 | 10144 | 0.0 | 10641↑ | 0.3 | 4.7 | 10152↑ | 15.681 | 0.1 | 10144 | 67.2 | 3 | 0.0 | 10144 | 58.5 | 3 | 0.0 |
| K502-2 | 11450 | 12422 | 12422 | 3084.1 | 11689 | 5.9 | 13232↑ | 2.6 | 11.7 | 12422 | 125.340 | 5.9 | 12422 | 125.3 | 1 | 5.9 | 12422 | 125.3 | 1 | 5.9 |
| K502-3 | 10465 | 11016 | 11016 | 2824.6 | 10668 | 3.2 | 11858↑ | 1.9 | 10.0 | 11016 | 18.901 | 3.2 | 11016 | 18.9 | 1 | 3.2 | 11016 | 18.9 | 1 | 3.2 |
| K503-1 | 10263 | 10265 | 10265 | 74.2 | 10265 | 0.0 | 10486↑ | 0.9 | 2.1 | 10291↑ | 4.596 | 0.3 | 10265 | 9.2 | 2 | 0.0 | 10265 | 9.5 | 2 | 0.0 |
| K503-2 | 11305 | 12321 | 12321 | 2744.5 | 11657 | 5.4 | 13362↑ | 1.0 | 12.8 | 12321 | 22.899 | 5.4 | 12321 | 22.9 | 1 | 5.4 | 12321 | 22.9 | 1 | 5.4 |
| K503-3 | 10650 | 11957 | 11912↓ | 3549.9 | 10876 | 8.7 | 12205↑ | 0.6 | 10.9 | 11919↓ | 69.742 | 8.8 | 11912↓ | 134.9 | 2 | 8.7 | 11912↓ | 128.8 | 2 | 8.7 |
| K504-1 | 10931 | 11429 | 11496↑ | 3346.2 | 11229 | 2.3 | 12612↑ | 0.6 | 11.0 | 11429 | 7.445 | 1.7 | 11429 | 7.4 | 1 | 1.7 | 11429 | 7.4 | 1 | 1.7 |
| K504-2 | 12234 | 13388 | 13599↑ | 3106.7 | 12311 | 9.5 | 14208↑ | 1.0 | 13.4 | 13388 | 30.963 | 8.0 | 13388 | 31.0 | 1 | 8.0 | 13388 | 31.0 | 1 | 8.0 |
| K504-3 | 11281 | 11943 | 11943 | 2447.6 | 11453 | 4.1 | 12923↑ | 1.2 | 11.4 | 11943 | 22.659 | 4.1 | 11943 | 22.7 | 1 | 4.1 | 11943 | 22.7 | 1 | 4.1 |
| K505-1 | 11342 | 12102 | 12102 | 2531.4 | 11454 | 5.4 | 12485↑ | 1.9 | 8.3 | 12116↑ | 10.666 | 5.5 | 12102 | 20.6 | 2 | 5.4 | 12102 | 21.4 | 2 | 5.4 |
| K505-2 | 11847 | 13663 | 13848↑ | 2253.3 | 11849 | 14.4 | 14360↑ | 0.8 | 17.5 | 13663 | 342.522 | 13.3 | 13663 | 342.5 | 1 | 13.3 | 13663 | 342.7 | 1 | 13.3 |
| K505-3 | 10815 | 12159 | 12614↑ | 3029.9 | 10964 | 13.1 | 13213↑ | 2.9 | 17.0 | 12159 | 253.301 | 9.8 | 12159 | 253.3 | 1 | 9.8 | 12159 | 253.3 | 1 | 9.8 |
| K506-1 | 10047 | 10232 | 10232 | 400.9 | 10232 | 0.0 | 11180↑ | 1.0 | 8.5 | 10232 | 10.340 | 0.0 | 10232 | 10.3 | 1 | 0.0 | 10232 | 10.3 | 1 | 0.0 |
| K506-2 | 11645 | 12236 | 12236 | 3443.6 | 11795 | 3.6 | 12399↑ | 3.7 | 4.9 | 12237↑ | 31.781 | 3.6 | 12236 | 64.9 | 2 | 3.6 | 12236 | 63.6 | 2 | 3.6 |
| K506-3 | 9858 | 10291 | 10291 | 2281.8 | 10291 | 0.0 | 10804↑ | 0.5 | 4.7 | 10291 | 10.506 | 0.0 | 10291 | 10.5 | 1 | 0.0 | 10291 | 10.5 | 1 | 0.0 |
| K507-1 | 10605 | 10661 | 10661 | 450.8 | 10661 | 0.0 | 11034↑ | 0.3 | 3.4 | 10661 | 3.128 | 0.0 | 10661 | 3.1 | 1 | 0.0 | 10661 | 3.1 | 1 | 0.0 |
| K507-2 | 11591 | 12200 | 12200 | 2732.5 | 11738 | 3.8 | 12570↑ | 0.6 | 6.6 | 12200 | 27.002 | 3.8 | 12200 | 27.0 | 1 | 3.8 | 12200 | 27.0 | 1 | 3.8 |
| K507-3 | 10506 | 11105 | 11105 | 3512.5 | 10948 | 1.4 | 11945↑ | 0.8 | 8.3 | 11105 | 16.122 | 1.4 | 11105 | 16.1 | 1 | 1.4 | 11105 | 16.1 | 1 | 1.4 |
| K508-1 | 10641 | 11095 | 11095 | 3293.7 | 10803 | 2.6 | 12169↑ | 0.6 | 11.2 | 11095 | 4.337 | 2.6 | 11095 | 4.3 | 1 | 2.6 | 11095 | 4.3 | 1 | 2.6 |
| K508-2 | 11352 | 12557 | 12561↑ | 3411.4 | 11508 | 8.4 | 13377↑ | 1.1 | 14.0 | 12527↓ | 74.643 | 8.1 | 12514↓ | 158.0 | 2 | 8.0 | 12514↓ | 138.8 | 2 | 8.0 |
| K508-3 | 11179 | 11554 | 11554 | 2487.6 | 11554 | 0.0 | 12643↑ | 0.9 | 8.6 | 11554 | 9.094 | 0.0 | 11554 | 9.1 | 1 | 0.0 | 11554 | 9.1 | 1 | 0.0 |
| K509-1 | 11362 | 12151 | 12187↑ | 3580.7 | 11402 | 6.4 | 12750↑ | 1.0 | 10.6 | 12111↓ | 49.222 | 5.9 | 12111↓ | 49.2 | 1 | 5.9 | 12111↓ | 49.2 | 1 | 5.9 |
| K509-2 | 12101 | 13236 | 13353↑ | 3396.9 | 12154 | 9.0 | 14498↑ | 1.5 | 16.2 | 13246↑ | 66.195 | 8.2 | 13236 | 197.6 | 3 | 8.2 | 13236 | 168.0 | 3 | 8.2 |
| K509-3 | 11061 | 11862 | 11862 | 3356.1 | 11495 | 3.1 | 13085↑ | 0.7 | 12.2 | 11871↑ | 9.010 | 3.2 | 11862 | 36.8 | 3 | 3.1 | 11862 | 26.2 | 3 | 3.1 |
| K510-1 | 10443 | 10969 | 10969 | 3467.5 | 10730 | 2.2 | 11088↑ | 0.6 | 3.2 | 11006↑ | 23.418 | 2.5 | 10969 | 256.6 | 9 | 2.2 | 10969 | 201.6 | 9 | 2.2 |
| K510-2 | 11437 | 12298 | 12300↑ | 3069.1 | 11463 | 6.8 | 13234↑ | 1.7 | 13.4 | 12300↑ | 39.650 | 6.8 | 12298 | 128.0 | 3 | 6.8 | 12298 | 116.1 | 3 | 6.8 |
| K510-3 | 11276 | 12253 | 12253 | 3149.2 | 11628 | 5.1 | 12588↑ | 0.5 | 7.6 | 12253 | 41.684 | 5.1 | 12253 | 41.7 | 1 | 5.1 | 12253 | 41.7 | 1 | 5.1 |
| K601-1 | 7099 | 7127 | 7127 | 534.8 | 7127 | 0.0 | 7455↑ | 1.2 | 4.4 | 7136↑ | 110.892 | 0.1 | 7127 | 208.5 | 2 | 0.0 | 7127 | 199.3 | 2 | 0.0 |
| K601-2 | 7190 | 7242 | 7242 | 851.2 | 7242 | 0.0 | 7319↑ | 1.6 | 1.1 | 7242 | 344.573 | 0.0 | 7242 | 344.6 | 1 | 0.0 | 7242 | 344.6 | 1 | 0.0 |
| K601-3 | 5834 | 5834 | 5834 | 380.8 | 5834 | 0.0 | 6030↑ | 1.4 | 3.3 | 5834 | 73.339 | 0.0 | 5834 | 73.3 | 1 | 0.0 | 5834 | 73.3 | 1 | 0.0 |
| K602-1 | 6640 | 6640 | 6640 | 196.9 | 6640 | 0.0 | 6852↑ | 2.7 | 3.1 | 6640 | 77.797 | 0.0 | 6640 | 77.8 | 1 | 0.0 | 6640 | 77.8 | 1 | 0.0 |
| K602-2 | 7146 | 7146 | 7146 | 205.8 | 7146 | 0.0 | 7165↑ | 10.4 | 0.3 | 7165↑ | 41.927 | 0.3 | 7146 | 81.3 | 2 | 0.0 | 7146 | 74.1 | 2 | 0.0 |
| K602-3 | 6605 | 6733 | 6733 | 382.4 | 6733 | 0.0 | 7520↑ | 4.8 | 10.5 | 6733 | 72.275 | 0.0 | 6733 | 72.3 | 1 | 0.0 | 6733 | 72.3 | 1 | 0.0 |
| K603-1 | 6986 | 6986 | 6986 | 173.6 | 6986 | 0.0 | 7140↑ | 2.4 | 2.2 | 7023↑ | 43.893 | 0.5 | 6986 | 98.3 | 2 | 0.0 | 6986 | 81.9 | 2 | 0.0 |
| K603-2 | 7404 | 7828 | 7828 | 1185.3 | 7828 | 0.0 | 8364↑ | 7.9 | 6.4 | 7828 | 108.521 | 0.0 | 7828 | 108.5 | 1 | 0.0 | 7828 | 108.5 | 1 | 0.0 |
| K603-3 | 6943 | 6943 | 6943 | 175.8 | 6943 | 0.0 | 7622↑ | 5.7 | 8.9 | 6943 | 64.947 | 0.0 | 6943 | 64.9 | 1 | 0.0 | 6943 | 64.9 | 1 | 0.0 |
| K604-1 | 6343 | 6343 | 6343 | 119.4 | 6343 | 0.0 | 6862↑ | 6.1 | 7.6 | 6343 | 53.900 | 0.0 | 6343 | 53.9 | 1 | 0.0 | 6343 | 53.9 | 1 | 0.0 |
| K604-2 | 7271 | 7822 | 7822 | 2695.0 | 7651 | 2.2 | 8022↑ | 12.5 | 4.6 | 7822 | 616.776 | 2.2 | 7822 | 616.8 | 1 | 2.2 | 7822 | 616.8 | 1 | 2.2 |
| K604-3 | 5673 | 5673 | 5673 | 43.1 | 5673 | 0.0 | 6009↑ | 1.6 | 5.6 | 5673 | 4.224 | 0.0 | 5673 | 4.2 | 1 | 0.0 | 5673 | 4.2 | 1 | 0.0 |
| K605-1 | 6641 | 6641 | 6641 | 67.5 | 6641 | 0.0 | 7190↑ | 1.8 | 7.6 | 6641 | 34.390 | 0.0 | 6641 | 34.4 | 1 | 0.0 | 6641 | 34.4 | 1 | 0.0 |
| K605-2 | 7589 | 7674 | 7674 | 541.3 | 7674 | 0.0 | 7999↑ | 6.3 | 4.1 | 7674 | 146.931 | 0.0 | 7674 | 146.9 | 1 | 0.0 | 7674 | 146.9 | 1 | 0.0 |
| K605-3 | 7189 | 7462 | 7462 | 2086.8 | 7462 | 0.0 | 7686↑ | 3.1 | 2.9 | 7462 | 216.769 | 0.0 | 7462 | 216.8 | 1 | 0.0 | 7462 | 216.8 | 1 | 0.0 |

## Appendix D. Detailed Results for the Min–Max Regret Generalized Assignment Problem

Tables D.16–D.19 show the results of the branch-and-cut algorithm ("B&C"), the fixed-scenario algorithm ("Fix"), the DS algorithm ("DS"), and iDS algorithms using Hamming-distance constraints ("iDS-H") and best-scenario constraints ("iDS-B") for the MMR-GAP for each instance type. An MMR-GAP instance denoted by "*T xxyyzz-i*" indicates the *i*th instance of the $(T, xx, yy, zz)$ combination, where type $= T$, $m = xx$, $n = yy$, and $100\delta = zz$. The best known lower-bound value ("LB") and solution value ("UB") are the results obtained from two heuristic algorithms and two exact algorithms by Wu et al. [3]. The notations "obj," "time," "ite," "%gap," "LB," "↓," and "↑," as well as the bold values in columns "obj" and "ite," are the same as those in Tables B.4–B.12 for the MMR-KP.

Table D.16: MMR-GAP results for type-A instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| a0504010-1 | 16 | 16 | 16 | 0.2 | 16 | 0.0 | 16 | 0.0 | 0.0 | 16 | 0.0 | 0.0 | 16 | 0.0 | 1 | 0.0 | 16 | 0.0 | 1 | 0.0 |
| a0504010-2 | 18 | 18 | 18 | 0.1 | 18 | 0.0 | 18 | 0.0 | 0.0 | 18 | 0.0 | 0.0 | 18 | 0.0 | 1 | 0.0 | 18 | 0.0 | 1 | 0.0 |
| a0504010-3 | 5 | 5 | 5 | 0.1 | 5 | 0.0 | 5 | 0.0 | 0.0 | 5 | 0.0 | 0.0 | 5 | 0.0 | 1 | 0.0 | 5 | 0.0 | 1 | 0.0 |
| a0504010-4 | 18 | 18 | 18 | 0.1 | 18 | 0.0 | 18 | 0.0 | 0.0 | 18 | 0.0 | 0.0 | 18 | 0.0 | 1 | 0.0 | 18 | 0.0 | 1 | 0.0 |
| a0504010-5 | 12 | 12 | 12 | 0.1 | 12 | 0.0 | 13↑ | 0.0 | 7.7 | 12 | 0.0 | 0.0 | 12 | 0.0 | 1 | 0.0 | 12 | 0.0 | 1 | 0.0 |
| a0504025-1 | 80 | 80 | 80 | 5.5 | 80 | 0.0 | 81↑ | 0.0 | 1.2 | 81↑ | 0.1 | 1.2 | 80 | 0.1 | 2 | 0.0 | 80 | 0.1 | 2 | 0.0 |
| a0504025-2 | 67 | 67 | 67 | 0.7 | 67 | 0.0 | 67 | 0.0 | 0.0 | 67 | 0.0 | 0.0 | 67 | 0.0 | 1 | 0.0 | 67 | 0.0 | 1 | 0.0 |
| a0504025-3 | 59 | 59 | 59 | 0.4 | 59 | 0.0 | 59 | 0.0 | 0.0 | 59 | 0.0 | 0.0 | 59 | 0.0 | 1 | 0.0 | 59 | 0.0 | 1 | 0.0 |
| a0504025-4 | 71 | 71 | 71 | 1.0 | 71 | 0.0 | 71 | 0.0 | 0.0 | 71 | 0.1 | 0.0 | 71 | 0.1 | 1 | 0.0 | 71 | 0.1 | 1 | 0.0 |
| a0504025-5 | 84 | 84 | 84 | 4.0 | 84 | 0.0 | 89↑ | 0.0 | 5.6 | 86↑ | 0.2 | 2.3 | 84 | 0.5 | 2 | 0.0 | 84 | 0.4 | 2 | 0.0 |
| a0504050-1 | 235 | 261 | 261 | 1164.8 | 261 | 0.0 | 261 | 0.0 | 0.0 | 261 | 0.2 | 0.0 | 261 | 0.2 | 1 | 0.0 | 261 | 0.2 | 1 | 0.0 |
| a0504050-2 | 182 | 204 | 204 | 447.1 | 204 | 0.0 | 205↑ | 0.0 | 0.5 | 204 | 0.1 | 0.0 | 204 | 0.1 | 1 | 0.0 | 204 | 0.1 | 1 | 0.0 |
| a0504050-3 | 153 | 164 | 164 | 44.5 | 164 | 0.0 | 164 | 0.0 | 0.0 | 164 | 0.0 | 0.0 | 164 | 0.0 | 1 | 0.0 | 164 | 0.0 | 1 | 0.0 |
| a0504050-4 | 215 | 227 | 227 | 39.3 | 227 | 0.0 | 227 | 0.0 | 0.0 | 227 | 0.1 | 0.0 | 227 | 0.1 | 1 | 0.0 | 227 | 0.1 | 1 | 0.0 |
| a0504050-5 | 198 | 219 | 219 | 59.5 | 219 | 0.0 | 219 | 0.0 | 0.0 | 219 | 0.2 | 0.0 | 219 | 0.2 | 1 | 0.0 | 219 | 0.2 | 1 | 0.0 |
| a0508010-1 | 23 | 23 | 23 | 0.4 | 23 | 0.0 | 23 | 0.0 | 0.0 | 23 | 0.0 | 0.0 | 23 | 0.0 | 1 | 0.0 | 23 | 0.0 | 1 | 0.0 |
| a0508010-2 | 29 | 29 | 29 | 1.3 | 29 | 0.0 | 29 | 0.0 | 0.0 | 29 | 0.0 | 0.0 | 29 | 0.0 | 1 | 0.0 | 29 | 0.0 | 1 | 0.0 |
| a0508010-3 | 19 | 19 | 19 | 0.2 | 19 | 0.0 | 20↑ | 0.0 | 5.0 | 20↑ | 0.1 | 5.0 | 19 | 0.2 | 3 | 0.0 | 19 | 0.1 | **2** | 0.0 |
| a0508010-4 | 27 | 27 | 27 | 0.3 | 27 | 0.0 | 28↑ | 0.0 | 3.6 | 27 | 0.0 | 0.0 | 27 | 0.0 | 1 | 0.0 | 27 | 0.0 | 1 | 0.0 |
| a0508010-5 | 27 | 27 | 27 | 0.4 | 27 | 0.0 | 27 | 0.0 | 0.0 | 27 | 0.1 | 0.0 | 27 | 0.1 | 1 | 0.0 | 27 | 0.1 | 1 | 0.0 |
| a0508025-1 | 118 | 141 | 143↑ | 38.3 | 131 | 8.4 | 141 | 0.0 | 7.1 | 141 | 0.1 | 7.1 | 141 | 0.2 | 1 | 7.1 | 141 | 0.2 | 1 | 7.1 |
| a0508025-2 | 100 | 108 | 108 | 256.1 | 108 | 0.0 | 108 | 0.0 | 0.0 | 108 | 0.1 | 0.0 | 108 | 0.1 | 1 | 0.0 | 108 | 0.1 | 1 | 0.0 |
| a0508025-3 | 83 | 91 | 91 | 108.6 | 91 | 0.0 | 93↑ | 0.0 | 2.2 | 91 | 0.2 | 0.0 | 91 | 0.2 | 1 | 0.0 | 91 | 0.2 | 1 | 0.0 |
| a0508025-4 | 104 | 116 | 116 | 516.9 | 116 | 0.0 | 116 | 0.0 | 0.0 | 116 | 0.1 | 0.0 | 116 | 0.1 | 1 | 0.0 | 116 | 0.1 | 1 | 0.0 |
| a0508025-5 | 96 | 105 | 105 | 132.3 | 105 | 0.0 | 105 | 0.0 | 0.0 | 105 | 0.1 | 0.0 | 105 | 0.1 | 1 | 0.0 | 105 | 0.1 | 1 | 0.0 |
| a0508050-1 | 300 | 427 | 436↑ | 3563.4 | 336 | 22.9 | 427 | 0.0 | 21.3 | 427 | 1.0 | 21.3 | 427 | 1.0 | 1 | 21.3 | 427 | 1.0 | 1 | 21.3 |
| a0508050-2 | 291 | 388 | 396↑ | 91.9 | 324 | 18.2 | 388 | 0.0 | 16.5 | 388 | 0.3 | 16.5 | 388 | 0.3 | 1 | 16.5 | 388 | 0.3 | 1 | 16.5 |
| a0508050-3 | 348 | 487 | 493↑ | 136.0 | 391 | 20.7 | 487 | 0.0 | 19.7 | 487 | 1.2 | 19.7 | 487 | 1.2 | 1 | 19.7 | 487 | 1.2 | 1 | 19.7 |
| a0508050-4 | 307 | 390 | 394↑ | 630.4 | 344 | 12.7 | 395↑ | 0.0 | 12.9 | 390 | 0.2 | 11.8 | 390 | 0.2 | 1 | 11.8 | 390 | 0.2 | 1 | 11.8 |
| a0508050-5 | 307 | 418 | 438↑ | 2952.9 | 337 | 23.1 | 421↑ | 0.0 | 20.0 | 418 | 0.5 | 19.4 | 418 | 0.5 | 1 | 19.4 | 418 | 0.5 | 1 | 19.4 |
| a1004010-1 | 14 | 14 | 14 | 0.3 | 14 | 0.0 | 15↑ | 0.0 | 6.7 | 14 | 0.0 | 0.0 | 14 | 0.0 | 1 | 0.0 | 14 | 0.0 | 1 | 0.0 |
| a1004010-2 | 16 | 16 | 16 | 0.4 | 16 | 0.0 | 16 | 0.0 | 0.0 | 16 | 0.0 | 0.0 | 16 | 0.0 | 1 | 0.0 | 16 | 0.0 | 1 | 0.0 |
| a1004010-3 | 14 | 14 | 14 | 0.3 | 14 | 0.0 | 14 | 0.0 | 0.0 | 14 | 0.0 | 0.0 | 14 | 0.0 | 1 | 0.0 | 14 | 0.0 | 1 | 0.0 |
| a1004010-4 | 13 | 13 | 13 | 0.3 | 13 | 0.0 | 13 | 0.0 | 0.0 | 13 | 0.0 | 0.0 | 13 | 0.0 | 1 | 0.0 | 13 | 0.0 | 1 | 0.0 |
| a1004010-5 | 16 | 16 | 16 | 0.3 | 16 | 0.0 | 17↑ | 0.0 | 5.9 | 17↑ | 0.1 | 5.9 | 16 | 0.1 | 3 | 0.0 | 16 | 0.1 | **2** | 0.0 |
| a1004025-1 | 78 | 78 | 78 | 11.9 | 78 | 0.0 | 80↑ | 0.0 | 2.5 | 78 | 0.2 | 0.0 | 78 | 0.2 | 1 | 0.0 | 78 | 0.2 | 1 | 0.0 |
| a1004025-2 | 54 | 54 | 54 | 1.4 | 54 | 0.0 | 56↑ | 0.0 | 3.6 | 54 | 0.0 | 0.0 | 54 | 0.0 | 1 | 0.0 | 54 | 0.0 | 1 | 0.0 |
| a1004025-3 | 64 | 64 | 64 | 5.0 | 64 | 0.0 | 64 | 0.0 | 0.0 | 64 | 0.1 | 0.0 | 64 | 0.1 | 1 | 0.0 | 64 | 0.1 | 1 | 0.0 |
| a1004025-4 | 45 | 45 | 45 | 0.4 | 45 | 0.0 | 45 | 0.0 | 0.0 | 45 | 0.0 | 0.0 | 45 | 0.0 | 1 | 0.0 | 45 | 0.0 | 1 | 0.0 |
| a1004025-5 | 73 | 73 | 73 | 1.4 | 73 | 0.0 | 74↑ | 0.0 | 1.4 | 75↑ | 0.2 | 2.7 | 73 | 0.7 | 4 | 0.0 | 73 | 0.8 | 4 | 0.0 |
| a1004050-1 | 184 | 211 | 210↓ | 1657.0 | 200 | 4.8 | 214↑ | 0.0 | 6.5 | 211 | 0.2 | 5.2 | 210↓ | 2.1 | 9 | 4.8 | 210↓ | 2.4 | 9 | 4.8 |
| a1004050-2 | 165 | 182 | 182 | 616.0 | 182 | 0.0 | 184↑ | 0.0 | 1.1 | 182 | 0.1 | 0.0 | 182 | 0.1 | 1 | 0.0 | 182 | 0.1 | 1 | 0.0 |
| a1004050-3 | 181 | 206 | 206 | 1175.6 | 197 | 4.4 | 209↑ | 0.0 | 5.7 | 206 | 0.3 | 4.4 | 206 | 0.3 | 1 | 4.4 | 206 | 0.3 | 1 | 4.4 |
| a1004050-4 | 161 | 169 | 169 | 145.7 | 169 | 0.0 | 170↑ | 0.0 | 0.6 | 169 | 0.1 | 0.0 | 169 | 0.1 | 1 | 0.0 | 169 | 0.1 | 1 | 0.0 |
| a1004050-5 | 178 | 206 | 205↓ | 2423.1 | 197 | 3.9 | 208↑ | 0.0 | 5.3 | 206 | 0.6 | 4.4 | 205↓ | 1.9 | 3 | 3.9 | 205↓ | 1.9 | 3 | 3.9 |
| a1008010-1 | 22 | 22 | 22 | 4.4 | 22 | 0.0 | 23↑ | 0.0 | 4.3 | 22 | 0.0 | 0.0 | 22 | 0.0 | 1 | 0.0 | 22 | 0.0 | 1 | 0.0 |
| a1008010-2 | 34 | 34 | 34 | 1.4 | 34 | 0.0 | 34 | 0.0 | 0.0 | 34 | 0.1 | 0.0 | 34 | 0.1 | 1 | 0.0 | 34 | 0.1 | 1 | 0.0 |
| a1008010-3 | 36 | 39 | 39 | 4.4 | 39 | 0.0 | 39 | 0.0 | 0.0 | 39 | 0.2 | 0.0 | 39 | 0.2 | 1 | 0.0 | 39 | 0.2 | 1 | 0.0 |
| a1008010-4 | 16 | 16 | 16 | 0.8 | 16 | 0.0 | 18↑ | 0.0 | 11.1 | 16 | 0.0 | 0.0 | 16 | 0.0 | 1 | 0.0 | 16 | 0.0 | 1 | 0.0 |
| a1008010-5 | 29 | 29 | 29 | 2.2 | 29 | 0.0 | 29 | 0.0 | 0.0 | 29 | 0.1 | 0.0 | 29 | 0.1 | 1 | 0.0 | 29 | 0.1 | 1 | 0.0 |
| a1008025-1 | 77 | 87 | 87 | 3524.3 | 84 | 3.4 | 87 | 0.0 | 3.4 | 87 | 0.1 | 3.4 | 87 | 0.1 | 1 | 3.4 | **86**↓ | 0.2 | 3 | 2.3 |
| a1008025-2 | 103 | 117 | 117 | 710.7 | 113 | 3.4 | 120↑ | 0.0 | 5.8 | 117 | 0.1 | 3.4 | 117 | 0.1 | 1 | 3.4 | 117 | 0.1 | 1 | 3.4 |
| a1008025-3 | 102 | 126 | 129↑ | 3595.5 | 111 | 14.0 | 126 | 0.0 | 11.9 | 126 | 0.7 | 11.9 | 126 | 0.7 | 1 | 11.9 | 126 | 0.7 | 1 | 11.9 |
| a1008025-4 | 98 | 113 | 113 | 3563.6 | 107 | 5.3 | 114↑ | 0.0 | 6.1 | 113 | 0.1 | 5.3 | 113 | 0.1 | 1 | 5.3 | 113 | 0.1 | 1 | 5.3 |
| a1008025-5 | 91 | 109 | 109 | 362.2 | 101 | 7.3 | 111↑ | 0.0 | 9.0 | 109 | 0.1 | 7.3 | 109 | 0.1 | 1 | 7.3 | 109 | 0.1 | 1 | 7.3 |
| a1008050-1 | 248 | 367 | 369↑ | 150.7 | 286 | 22.5 | 367 | 0.0 | 22.1 | 367 | 0.3 | 22.1 | 366↓ | 164.8 | 275 | 21.9 | 366↓ | 459.2 | 275 | 21.9 |
| a1008050-2 | 296 | 433 | 436↑ | 805.6 | 339 | 22.2 | 438↑ | 0.0 | 22.6 | 433 | 2.6 | 21.7 | 433 | 2.6 | 1 | 21.7 | 433 | 2.6 | 1 | 21.7 |
| a1008050-3 | 306 | 419 | 425↑ | 546.0 | 341 | 19.8 | 428↑ | 0.0 | 20.3 | 419 | 8.6 | 18.6 | 418↓ | 291.9 | 27 | 18.4 | 418↓ | 221.9 | 27 | 18.4 |
| a1008050-4 | 240 | 321 | 326↑ | 114.4 | 267 | 18.1 | 324↑ | 0.0 | 17.6 | 321 | 0.1 | 16.8 | 321 | 0.1 | 1 | 16.8 | 321 | 0.1 | 1 | 16.8 |
| a1008050-5 | 264 | 376 | 381↑ | 597.3 | 301 | 21.0 | 390↑ | 0.0 | 22.8 | 376 | 0.2 | 19.9 | 376 | 0.2 | 1 | 19.9 | 376 | 0.2 | 1 | 19.9 |

Table D.17: MMR-GAP results for type-B instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| b0504010-1 | 18 | 18 | 18 | 1.1 | 18 | 0.0 | 18 | 0.0 | 0.0 | 24↑ | 0.1 | 25.0 | 18 | 0.2 | 2 | 0.0 | 18 | 0.2 | 2 | 0.0 |
| b0504010-2 | 19 | 19 | 19 | 0.6 | 19 | 0.0 | 22↑ | 0.0 | 13.6 | 19 | 0.1 | 0.0 | 19 | 0.1 | 1 | 0.0 | 19 | 0.1 | 1 | 0.0 |
| b0504010-3 | 12 | 12 | 12 | 0.4 | 12 | 0.0 | 13↑ | 0.0 | 7.7 | 12 | 0.1 | 0.0 | 12 | 0.1 | 1 | 0.0 | 12 | 0.1 | 1 | 0.0 |
| b0504010-4 | 25 | 25 | 25 | 0.3 | 25 | 0.0 | 28↑ | 0.0 | 10.7 | 28↑ | 0.1 | 10.7 | 25 | 0.4 | 4 | 0.0 | 25 | 0.3 | 4 | 0.0 |
| b0504010-5 | 22 | 22 | 22 | 1.0 | 22 | 0.0 | 23↑ | 0.1 | 4.3 | 22 | 0.1 | 0.0 | 22 | 0.1 | 1 | 0.0 | 22 | 0.1 | 1 | 0.0 |
| b0504025-1 | 84 | 84 | 84 | 3.4 | 84 | 0.0 | 84 | 0.0 | 0.0 | 84 | 0.3 | 0.0 | 84 | 0.3 | 1 | 0.0 | 84 | 0.3 | 1 | 0.0 |
| b0504025-2 | 64 | 64 | 64 | 4.1 | 64 | 0.0 | 64 | 0.0 | 0.0 | 64 | 0.1 | 0.0 | 64 | 0.1 | 1 | 0.0 | 64 | 0.1 | 1 | 0.0 |
| b0504025-3 | 38 | 38 | 38 | 0.7 | 38 | 0.0 | 45↑ | 0.0 | 15.6 | 38 | 0.1 | 0.0 | 38 | 0.1 | 1 | 0.0 | 38 | 0.1 | 1 | 0.0 |
| b0504025-4 | 66 | 66 | 66 | 0.7 | 66 | 0.0 | 66 | 0.0 | 0.0 | 68↑ | 0.1 | 2.9 | 66 | 1.9 | 11 | 0.0 | 66 | 1.6 | **10** | 0.0 |
| b0504025-5 | 77 | 77 | 77 | 6.8 | 77 | 0.0 | 77 | 0.1 | 0.0 | 77 | 0.2 | 0.0 | 77 | 0.2 | 1 | 0.0 | 77 | 0.2 | 1 | 0.0 |
| b0504050-1 | 248 | 248 | 248 | 29.6 | 248 | 0.0 | 252↑ | 0.0 | 1.6 | 248 | 0.6 | 0.0 | 248 | 0.6 | 1 | 0.0 | 248 | 0.6 | 1 | 0.0 |
| b0504050-2 | 227 | 227 | 227 | 2.1 | 227 | 0.0 | 227 | 0.0 | 0.0 | 227 | 1.1 | 0.0 | 227 | 1.1 | 1 | 0.0 | 227 | 1.1 | 1 | 0.0 |
| b0504050-3 | 108 | 108 | 108 | 2.1 | 108 | 0.0 | 108 | 0.0 | 0.0 | 108 | 0.1 | 0.0 | 108 | 0.1 | 1 | 0.0 | 108 | 0.1 | 1 | 0.0 |
| b0504050-4 | 215 | 215 | 215 | 2.4 | 215 | 0.0 | 215 | 0.0 | 0.0 | 215 | 0.7 | 0.0 | 215 | 0.7 | 1 | 0.0 | 215 | 0.7 | 1 | 0.0 |
| b0504050-5 | 191 | 191 | 191 | 2.9 | 191 | 0.0 | 200↑ | 0.0 | 4.5 | 191 | 0.4 | 0.0 | 191 | 0.4 | 1 | 0.0 | 191 | 0.4 | 1 | 0.0 |
| b0508010-1 | 31 | 31 | 31 | 5.4 | 31 | 0.0 | 33↑ | 0.1 | 6.1 | 31 | 0.9 | 0.0 | 31 | 0.9 | 1 | 0.0 | 31 | 0.9 | 1 | 0.0 |
| b0508010-2 | 29 | 29 | 29 | 1.2 | 29 | 0.0 | 29 | 0.0 | 0.0 | 29 | 0.2 | 0.0 | 29 | 0.2 | 1 | 0.0 | 29 | 0.2 | 1 | 0.0 |
| b0508010-3 | 30 | 30 | 30 | 3.1 | 30 | 0.0 | 30 | 0.0 | 0.0 | 30 | 0.1 | 0.0 | 30 | 0.1 | 1 | 0.0 | 30 | 0.1 | 1 | 0.0 |
| b0508010-4 | 45 | 45 | 45 | 18.1 | 45 | 0.0 | 47↑ | 0.1 | 4.3 | 45 | 2.2 | 0.0 | 45 | 2.2 | 1 | 0.0 | 45 | 2.2 | 1 | 0.0 |
| b0508010-5 | 31 | 31 | 31 | 1.5 | 31 | 0.0 | 31 | 0.0 | 0.0 | 31 | 0.2 | 0.0 | 31 | 0.2 | 1 | 0.0 | 31 | 0.2 | 1 | 0.0 |
| b0508025-1 | 94 | 111 | 111 | 1493.1 | 111 | 0.0 | 111 | 0.1 | 0.0 | 111 | 15.3 | 0.0 | 111 | 33.6 | 2 | 0.0 | 111 | 34.3 | 2 | 0.0 |
| b0508025-2 | 113 | 122 | 122 | 68.5 | 122 | 0.0 | 122 | 0.0 | 0.0 | 122 | 4.2 | 0.0 | 122 | 4.2 | 1 | 0.0 | 122 | 4.2 | 1 | 0.0 |
| b0508025-3 | 123 | 147 | 147 | 1111.7 | 138 | 6.1 | 151↑ | 0.2 | 8.6 | 147 | 10.6 | 6.1 | 147 | 10.6 | 1 | 6.1 | 147 | 10.6 | 1 | 6.1 |
| b0508025-4 | 113 | 131 | 131 | 2613.5 | 131 | 0.0 | 134↑ | 0.4 | 2.2 | 131 | 8.0 | 0.0 | 131 | 49.0 | 1 | 0.0 | 131 | 8.0 | 1 | 0.0 |
| b0508025-5 | 95 | 107 | 107 | 284.0 | 107 | 0.0 | 110↑ | 0.0 | 2.7 | 107 | 3.4 | 0.0 | 107 | 3.4 | 1 | 0.0 | 107 | 3.4 | 1 | 0.0 |
| b0508050-1 | 258 | 346 | 352↑ | 774.8 | 302 | 14.2 | 346 | 0.0 | 12.7 | 346 | 54.1 | 12.7 | 345↓ | 99.6 | 3 | 12.5 | 345↓ | 135.3 | 3 | 12.5 |
| b0508050-2 | 298 | 415 | 423↑ | 1314.3 | 362 | 14.4 | 416↑ | 0.0 | 13.0 | 415 | 49.2 | 12.8 | 415 | 49.2 | 1 | 12.8 | 415 | 49.2 | 1 | 12.8 |
| b0508050-3 | 292 | 402 | 432↑ | 3387.7 | 351 | 18.8 | 406↑ | 0.2 | 13.5 | 402 | 63.7 | 12.7 | 402 | 63.7 | 1 | 12.7 | 402 | 63.7 | 1 | 12.7 |
| b0508050-4 | 293 | 421 | 433↑ | 2516.4 | 355 | 18.0 | 426↑ | 0.1 | 16.7 | 421 | 71.0 | 15.7 | 421 | 71.0 | 1 | 15.7 | 421 | 71.0 | 1 | 15.7 |
| b0508050-5 | 269 | 398 | 417↑ | 1489.0 | 335 | 19.7 | 398 | 0.0 | 15.8 | 398 | 55.1 | 15.8 | 398 | 55.1 | 1 | 15.8 | 398 | 55.1 | 1 | 15.8 |
| b1004010-1 | 21 | 21 | 21 | 0.6 | 21 | 0.0 | 22↑ | 0.0 | 4.5 | 24↑ | 0.2 | 12.5 | 21 | 0.6 | 4 | 0.0 | 21 | 0.7 | 4 | 0.0 |
| b1004010-2 | 16 | 16 | 16 | 0.5 | 16 | 0.0 | 16 | 0.0 | 0.0 | 18↑ | 0.1 | 11.1 | 16 | 0.3 | 3 | 0.0 | 16 | 0.3 | 3 | 0.0 |
| b1004010-3 | 16 | 16 | 16 | 1.2 | 16 | 0.0 | 16 | 0.0 | 0.0 | 16 | 0.2 | 0.0 | 16 | 0.2 | 1 | 0.0 | 16 | 0.2 | 1 | 0.0 |
| b1004010-4 | 14 | 14 | 14 | 0.8 | 14 | 0.0 | 14 | 0.0 | 0.0 | 14 | 0.1 | 0.0 | 14 | 0.1 | 1 | 0.0 | 14 | 0.1 | 1 | 0.0 |
| b1004010-5 | 28 | 28 | 28 | 0.6 | 28 | 0.0 | 28 | 0.1 | 0.0 | 31↑ | 0.3 | 9.7 | 28 | 0.9 | **3** | 0.0 | 28 | 1.1 | 4 | 0.0 |
| b1004025-1 | 100 | 103 | 102↓ | 58.1 | 102 | 0.0 | 108↑ | 0.0 | 5.6 | 103 | 2.4 | 1.0 | 102↓ | 7.8 | 3 | 0.0 | 102↓ | 9.5 | 3 | 0.0 |
| b1004025-2 | 71 | 71 | 71 | 3.4 | 71 | 0.0 | 72↑ | 0.0 | 1.4 | 72↑ | 0.4 | 1.4 | 71 | 1.0 | 3 | 0.0 | 71 | 1.1 | 3 | 0.0 |
| b1004025-3 | 63 | 63 | 63 | 1.2 | 63 | 0.0 | 63 | 0.0 | 0.0 | 69↑ | 0.3 | 8.7 | 63 | 0.8 | 2 | 0.0 | 63 | 0.7 | 2 | 0.0 |
| b1004025-4 | 58 | 58 | 58 | 3.1 | 58 | 0.0 | 65↑ | 0.1 | 10.8 | 58 | 0.3 | 0.0 | 58 | 0.3 | 1 | 0.0 | 58 | 0.3 | 1 | 0.0 |
| b1004025-5 | 76 | 76 | 76 | 6.8 | 76 | 0.0 | 76 | 0.1 | 0.0 | 79↑ | 1.2 | 3.8 | 76 | 4.1 | 3 | 0.0 | 76 | 3.9 | 3 | 0.0 |
| b1004050-1 | 184 | 194 | 193↓ | 190.6 | 193 | 0.0 | 194 | 0.0 | 0.5 | 194 | 3.5 | 0.5 | 193↓ | 6.9 | 2 | 0.0 | 193↓ | 7.2 | 2 | 0.0 |
| b1004050-2 | 189 | 189 | 189 | 40.9 | 189 | 0.0 | 198↑ | 0.0 | 4.5 | 189 | 0.7 | 0.0 | 189 | 0.7 | 1 | 0.0 | 189 | 0.7 | 1 | 0.0 |
| b1004050-3 | 186 | 188 | 187↓ | 21.8 | 187 | 0.0 | 197↑ | 0.1 | 5.1 | 192↑ | 5.5 | 2.6 | 187↓ | 39.9 | 7 | 0.0 | 187↓ | 40.0 | 7 | 0.0 |
| b1004050-4 | 190 | 199 | 199 | 379.1 | 199 | 0.0 | 203↑ | 0.1 | 2.0 | 199 | 4.2 | 0.0 | 199 | 4.2 | 1 | 0.0 | 199 | 4.2 | 1 | 0.0 |
| b1004050-5 | 185 | 197 | 195↓ | 46.6 | 195 | 0.0 | 200↑ | 0.1 | 2.5 | 197 | 9.6 | 1.0 | 195↓ | 21.8 | 2 | 0.0 | 195↓ | 18.9 | 2 | 0.0 |
| b1008010-1 | 24 | 24 | 24 | 1.5 | 24 | 0.0 | 24 | 0.0 | 0.0 | 24 | 0.3 | 0.0 | 24 | 0.3 | 1 | 0.0 | 24 | 0.3 | 1 | 0.0 |
| b1008010-2 | 40 | 40 | 40 | 21.6 | 40 | 0.0 | 40 | 0.2 | 0.0 | 41↑ | 4.0 | 2.4 | 40 | 10.2 | 2 | 0.0 | 40 | 10.1 | 2 | 0.0 |
| b1008010-3 | 42 | 42 | 42 | 34.2 | 42 | 0.0 | 44↑ | 0.1 | 4.5 | 44↑ | 3.6 | 4.5 | 42 | 130.4 | 19 | 0.0 | 42 | 123.7 | **18** | 0.0 |
| b1008010-4 | 25 | 25 | 25 | 4.3 | 25 | 0.0 | 28↑ | 0.1 | 10.7 | 26↑ | 0.6 | 3.8 | 25 | 1.5 | 2 | 0.0 | 25 | 1.3 | 2 | 0.0 |
| b1008010-5 | 25 | 25 | 25 | 5.6 | 25 | 0.0 | 29↑ | 0.1 | 13.8 | 25 | 0.7 | 0.0 | 25 | 0.7 | 1 | 0.0 | 25 | 0.7 | 1 | 0.0 |
| b1008025-1 | 83 | 91 | 91 | 322.0 | 91 | 0.0 | 95↑ | 0.0 | 4.2 | 91 | 5.0 | 0.0 | 91 | 5.1 | 1 | 0.0 | 91 | 5.1 | 1 | 0.0 |
| b1008025-2 | 123 | 171 | 171 | 1452.2 | 136 | 20.5 | 175↑ | 0.1 | 22.3 | 171 | 829.7 | 20.5 | 170↓ | 1967.5 | 2 | 20.0 | 170↓ | 1785.7 | 2 | 20.0 |
| b1008025-3 | 113 | 124 | 124 | 515.4 | 124 | 0.0 | 124 | 0.0 | 0.0 | 125↑ | 5.8 | 0.8 | 124 | 11.9 | 2 | 0.0 | 124 | 13.0 | 2 | 0.0 |
| b1008025-4 | 97 | 116 | 116 | 3318.6 | 104 | 10.3 | 119↑ | 0.0 | 12.6 | 116 | 23.3 | 10.3 | 116 | 23.3 | 1 | 10.3 | 116 | 23.3 | 1 | 10.3 |
| b1008025-5 | 96 | 116 | 116 | 2745.5 | 102 | 12.1 | 116 | 0.0 | 12.1 | 116 | 29.2 | 12.1 | 116 | 29.2 | 1 | 12.1 | 116 | 29.2 | 1 | 12.1 |
| b1008050-1 | 236 | 338 | 355↑ | 3137.3 | 270 | 23.9 | 338 | 0.0 | 20.1 | 338 | 1083.2 | 20.1 | 338 | 1083.2 | 1 | 20.1 | 338 | 1083.2 | 1 | 20.1 |
| b1008050-2 | 293 | 444 | 506↑ | 2822.9 | 349 | 31.0 | 444 | 0.1 | 21.4 | 445↑ | 3600.0 | 21.6 | 445↑ | 3600.0 | 1 | 21.6 | 445↑ | 3600.0 | 1 | 21.6 |
| b1008050-3 | 291 | 409 | 478↑ | 3420.5 | 338 | 29.3 | 422↑ | 0.4 | 19.9 | 409 | 2621.9 | 17.4 | 409 | 2621.9 | 1 | 17.4 | 409 | 2621.9 | 1 | 17.4 |
| b1008050-4 | 259 | 381 | 410↑ | 1444.5 | 293 | 28.5 | 381 | 0.0 | 23.1 | 381 | 3600.0 | 23.1 | 381 | 3600.0 | 1 | 23.1 | 381 | 3600.0 | 1 | 23.1 |
| b1008050-5 | 238 | 346 | 392↑ | 1237.2 | 282 | 28.1 | 356↑ | 0.1 | 20.8 | 346 | 3600.0 | 18.5 | 346 | 3600.0 | 1 | 18.5 | 346 | 3600.0 | 1 | 18.5 |

Table D.18: MMR-GAP results for type-C instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| c0504010-1 | 18 | 18 | 18 | 0.8 | 18 | 0.0 | 18 | 0.1 | 0.0 | 18 | 0.1 | 0.0 | 18 | 0.1 | 1 | 0.0 | 18 | 0.1 | 1 | 0.0 |
| c0504010-2 | 16 | 16 | 16 | 0.6 | 16 | 0.0 | 16 | 0.0 | 0.0 | 16 | 0.1 | 0.0 | 16 | 0.1 | 1 | 0.0 | 16 | 0.1 | 1 | 0.0 |
| c0504010-3 | 14 | 14 | 14 | 1.3 | 14 | 0.0 | 14 | 0.1 | 0.0 | 14 | 0.1 | 0.0 | 14 | 0.1 | 1 | 0.0 | 14 | 0.1 | 1 | 0.0 |
| c0504010-4 | 17 | 17 | 17 | 0.6 | 17 | 0.0 | 17 | 0.1 | 0.0 | 17 | 0.1 | 0.0 | 17 | 0.1 | 1 | 0.0 | 17 | 0.1 | 1 | 0.0 |
| c0504010-5 | 23 | 23 | 23 | 0.8 | 23 | 0.0 | 23 | 0.0 | 0.0 | 23 | 0.2 | 0.0 | 23 | 0.2 | 1 | 0.0 | 23 | 0.2 | 1 | 0.0 |
| c0504025-1 | 47 | 47 | 47 | 1.6 | 47 | 0.0 | 47 | 0.0 | 0.0 | 47 | 0.2 | 0.0 | 47 | 0.2 | 1 | 0.0 | 47 | 0.2 | 1 | 0.0 |
| c0504025-2 | 60 | 60 | 60 | 1.9 | 60 | 0.0 | 60 | 0.0 | 0.0 | 60 | 0.2 | 0.0 | 60 | 0.2 | 1 | 0.0 | 60 | 0.2 | 1 | 0.0 |
| c0504025-3 | 103 | 103 | 103 | 13.1 | 103 | 0.0 | 103 | 0.1 | 0.0 | 103 | 0.3 | 0.0 | 103 | 0.3 | 1 | 0.0 | 103 | 0.3 | 1 | 0.0 |
| c0504025-4 | 83 | 83 | 83 | 0.4 | 83 | 0.0 | 83 | 0.0 | 0.0 | 83 | 0.2 | 0.0 | 83 | 0.2 | 1 | 0.0 | 83 | 0.2 | 1 | 0.0 |
| c0504025-5 | 85 | 85 | 85 | 3.4 | 85 | 0.0 | 93↑ | 0.1 | 8.6 | 85 | 0.3 | 0.0 | 85 | 0.3 | 1 | 0.0 | 85 | 0.3 | 1 | 0.0 |
| c0504050-1 | 160 | 160 | 160 | 19.9 | 160 | 0.0 | 160 | 0.0 | 0.0 | 160 | 1.4 | 0.0 | 160 | 1.4 | 1 | 0.0 | 160 | 1.4 | 1 | 0.0 |
| c0504050-2 | 202 | 202 | 202 | 28.9 | 202 | 0.0 | 212↑ | 0.0 | 4.7 | 202 | 2.9 | 0.0 | 202 | 2.9 | 1 | 0.0 | 202 | 2.9 | 1 | 0.0 |
| c0504050-3 | 217 | 217 | 217 | 35.3 | 217 | 0.0 | 232↑ | 0.1 | 6.5 | 217 | 2.8 | 0.0 | 217 | 2.8 | 1 | 0.0 | 217 | 2.8 | 1 | 0.0 |
| c0504050-4 | 173 | 173 | 173 | 0.9 | 173 | 0.0 | 176↑ | 0.0 | 1.7 | 173 | 0.5 | 0.0 | 173 | 0.5 | 1 | 0.0 | 173 | 0.5 | 1 | 0.0 |
| c0504050-5 | 244 | 269 | 269 | 504.7 | 269 | 0.0 | 269 | 0.1 | 0.0 | 269 | 3.6 | 0.0 | 269 | 3.6 | 1 | 0.0 | 269 | 3.6 | 1 | 0.0 |
| c0508010-1 | 25 | 25 | 25 | 2.1 | 25 | 0.0 | 27↑ | 0.1 | 7.4 | 25 | 0.7 | 0.0 | 25 | 0.7 | 1 | 0.0 | 25 | 0.7 | 1 | 0.0 |
| c0508010-2 | 28 | 28 | 28 | 1.5 | 28 | 0.0 | 28 | 0.1 | 0.0 | 28 | 0.2 | 0.0 | 28 | 0.2 | 1 | 0.0 | 28 | 0.2 | 1 | 0.0 |
| c0508010-3 | 35 | 35 | 35 | 8.7 | 35 | 0.0 | 35 | 0.1 | 0.0 | 35 | 0.7 | 0.0 | 35 | 0.7 | 1 | 0.0 | 35 | 0.7 | 1 | 0.0 |
| c0508010-4 | 39 | 39 | 39 | 2.7 | 39 | 0.0 | 39 | 0.1 | 0.0 | 39 | 0.9 | 0.0 | 39 | 0.9 | 1 | 0.0 | 39 | 0.9 | 1 | 0.0 |
| c0508010-5 | 28 | 28 | 28 | 3.1 | 28 | 0.0 | 28 | 0.1 | 0.0 | 28 | 0.3 | 0.0 | 28 | 0.3 | 1 | 0.0 | 28 | 0.3 | 1 | 0.0 |
| c0508025-1 | 118 | 132 | 132 | 747.9 | 132 | 0.0 | 132 | 0.0 | 0.0 | 132 | 0.9 | 0.0 | 132 | 0.9 | 1 | 0.0 | 132 | 0.9 | 1 | 0.0 |
| c0508025-2 | 107 | 112 | 112 | 60.7 | 112 | 0.0 | 112 | 0.1 | 0.0 | 112 | 2.4 | 0.0 | 112 | 2.4 | 1 | 0.0 | 112 | 2.4 | 1 | 0.0 |
| c0508025-3 | 114 | 131 | 131 | 4.6 | 131 | 0.0 | 131 | 0.1 | 0.0 | 131 | 5.6 | 0.0 | 131 | 5.7 | 1 | 0.0 | 131 | 5.7 | 1 | 0.0 |
| c0508025-4 | 119 | 142 | 141↓ | 527.1 | 136 | 3.5 | 149↑ | 0.1 | 8.7 | 142 | 20.8 | 4.2 | 141↓ | 62.3 | 3 | 3.5 | 141↓ | 72.2 | 3 | 3.5 |
| c0508025-5 | 103 | 116 | 113↓ | 146.2 | 113 | 0.0 | 120↑ | 0.1 | 5.8 | 116 | 3.8 | 2.6 | 113↓ | 9.4 | 2 | 0.0 | 113↓ | 8.9 | 2 | 0.0 |
| c0508050-1 | 275 | 402 | 418↑ | 602.7 | 338 | 19.1 | 412↑ | 0.1 | 18.0 | 402 | 59.7 | 15.9 | 402 | 59.7 | 1 | 15.9 | 402 | 59.7 | 1 | 15.9 |
| c0508050-2 | 283 | 389 | 416↑ | 1822.9 | 336 | 19.2 | 393↑ | 0.0 | 14.5 | 389 | 18.8 | 13.6 | 389 | 18.8 | 1 | 13.6 | 389 | 18.8 | 1 | 13.6 |
| c0508050-3 | 284 | 418 | 434↑ | 3199.1 | 351 | 19.1 | 418 | 0.1 | 16.0 | 419↑ | 41.2 | 16.2 | 418 | 96.1 | 2 | 16.0 | 418 | 107.6 | 2 | 16.0 |
| c0508050-4 | 326 | 503 | 532↑ | 1724.4 | 410 | 22.9 | 503 | 0.0 | 18.5 | 503 | 88.7 | 18.5 | 503 | 88.7 | 1 | 18.5 | 503 | 88.7 | 1 | 18.5 |
| c0508050-5 | 261 | 365 | 388↑ | 3374.6 | 315 | 18.8 | 365 | 0.0 | 13.7 | 365 | 15.0 | 13.7 | 365 | 15.1 | 1 | 13.7 | 365 | 15.1 | 1 | 13.7 |
| c1004010-1 | 20 | 20 | 20 | 1.0 | 20 | 0.0 | 23↑ | 0.0 | 13.0 | 21↑ | 0.2 | 4.8 | 20 | 2.1 | 9 | 0.0 | 20 | 1.8 | **8** | 0.0 |
| c1004010-2 | 15 | 15 | 15 | 1.6 | 15 | 0.0 | 17↑ | 0.0 | 11.8 | 15 | 0.2 | 0.0 | 15 | 0.2 | 1 | 0.0 | 15 | 0.2 | 1 | 0.0 |
| c1004010-3 | 24 | 24 | 24 | 1.3 | 24 | 0.0 | 24 | 0.1 | 0.0 | 28↑ | 0.2 | 14.3 | 24 | 0.5 | 2 | 0.0 | 24 | 0.5 | 2 | 0.0 |
| c1004010-4 | 26 | 26 | 26 | 1.3 | 26 | 0.0 | 26 | 0.0 | 0.0 | 26 | 0.1 | 0.0 | 26 | 0.1 | 1 | 0.0 | 26 | 0.1 | 1 | 0.0 |
| c1004010-5 | 25 | 25 | 25 | 1.8 | 25 | 0.0 | 28↑ | 0.1 | 10.7 | 25 | 0.1 | 0.0 | 25 | 0.1 | 1 | 0.0 | 25 | 0.1 | 1 | 0.0 |
| c1004025-1 | 67 | 67 | 67 | 3.9 | 67 | 0.0 | 72↑ | 0.0 | 6.9 | 68↑ | 0.3 | 1.5 | 67 | 1.8 | 5 | 0.0 | 67 | 1.8 | 5 | 0.0 |
| c1004025-2 | 58 | 58 | 58 | 4.1 | 58 | 0.0 | 59↑ | 0.1 | 1.7 | 61↑ | 0.3 | 4.9 | 58 | 1.2 | 4 | 0.0 | 58 | 1.1 | 4 | 0.0 |
| c1004025-3 | 70 | 70 | 70 | 2.3 | 70 | 0.0 | 75↑ | 0.0 | 6.7 | 70 | 0.4 | 0.0 | 70 | 0.4 | 1 | 0.0 | 70 | 0.4 | 1 | 0.0 |
| c1004025-4 | 65 | 65 | 65 | 3.1 | 65 | 0.0 | 73↑ | 0.1 | 11.0 | 66↑ | 0.3 | 1.5 | 65 | 7.8 | 17 | 0.0 | 65 | 8.4 | 17 | 0.0 |
| c1004025-5 | 83 | 83 | 83 | 5.8 | 83 | 0.0 | 85↑ | 0.0 | 2.4 | 85↑ | 0.6 | 2.4 | 83 | 4.6 | 6 | 0.0 | 83 | 4.6 | 6 | 0.0 |
| c1004050-1 | 202 | 212 | 212 | 109.8 | 212 | 0.0 | 212 | 0.1 | 0.0 | 216↑ | 5.5 | 1.9 | 212 | 318.0 | 34 | 0.0 | 212 | 343.7 | 34 | 0.0 |
| c1004050-2 | 219 | 219 | 219 | 50.5 | 219 | 0.0 | 219 | 0.0 | 0.0 | 219 | 1.6 | 0.0 | 219 | 1.6 | 1 | 0.0 | 219 | 1.6 | 1 | 0.0 |
| c1004050-3 | 189 | 199 | 197↓ | 58.7 | 197 | 0.0 | 199 | 0.1 | 1.0 | 201↑ | 6.2 | 2.0 | 197↓ | 18.0 | 3 | 0.0 | 197↓ | 17.4 | 3 | 0.0 |
| c1004050-4 | 187 | 187 | 187 | 22.8 | 187 | 0.0 | 187 | 0.0 | 0.0 | 187 | 1.3 | 0.0 | 187 | 1.3 | 1 | 0.0 | 187 | 1.3 | 1 | 0.0 |
| c1004050-5 | 202 | 226 | 225↓ | 728.3 | 225 | 0.0 | 227↑ | 0.1 | 0.9 | 230↑ | 14.7 | 2.2 | 225↓ | 1013.4 | 48 | 0.0 | 225↓ | 1056.1 | **46** | 0.0 |
| c1008010-1 | 29 | 29 | 29 | 4.1 | 29 | 0.0 | 32↑ | 0.1 | 9.4 | 29 | 0.7 | 0.0 | 29 | 0.7 | 1 | 0.0 | 29 | 0.7 | 1 | 0.0 |
| c1008010-2 | 40 | 40 | 40 | 196.1 | 40 | 0.0 | 43↑ | 0.4 | 7.0 | 43↑ | 19.6 | 7.0 | 40 | 913.5 | 28 | 0.0 | 40 | 889.4 | **27** | 0.0 |
| c1008010-3 | 33 | 33 | 33 | 3.4 | 33 | 0.0 | 38↑ | 0.1 | 13.2 | 34↑ | 0.6 | 2.9 | 33 | 1.3 | 2 | 0.0 | 33 | 1.3 | 2 | 0.0 |
| c1008010-4 | 37 | 37 | 37 | 12.6 | 37 | 0.0 | 37 | 0.2 | 0.0 | 41↑ | 2.4 | 9.8 | 37 | 11.1 | 3 | 0.0 | 37 | 7.8 | 3 | 0.0 |
| c1008010-5 | 32 | 32 | 32 | 10.4 | 32 | 0.0 | 32 | 0.1 | 0.0 | 32 | 1.1 | 0.0 | 32 | 1.1 | 1 | 0.0 | 32 | 1.1 | 1 | 0.0 |
| c1008025-1 | 85 | 87 | 87 | 111.5 | 87 | 0.0 | 89↑ | 0.1 | 2.2 | 87 | 4.7 | 0.0 | 87 | 4.7 | 1 | 0.0 | 87 | 4.7 | 1 | 0.0 |
| c1008025-2 | 121 | 157 | 158↑ | 3344.5 | 134 | 15.2 | 157 | 0.3 | 14.6 | 159↑ | 329.8 | 15.7 | 155↓ | 1024.1 | 3 | 13.5 | 155↓ | 908.1 | 3 | 13.5 |
| c1008025-3 | 111 | 129 | 128↓ | 3275.7 | 121 | 5.5 | 132↑ | 0.1 | 8.3 | 129 | 52.7 | 6.2 | 128↓ | 146.6 | 3 | 5.5 | 128↓ | 135.1 | 3 | 5.5 |
| c1008025-4 | 112 | 120 | 120 | 504.6 | 120 | 0.0 | 129↑ | 0.1 | 7.0 | 120 | 7.2 | 0.0 | 120 | 7.2 | 1 | 0.0 | 120 | 7.2 | 1 | 0.0 |
| c1008025-5 | 111 | 142 | 144↑ | 2722.3 | 120 | 16.7 | 149↑ | 0.2 | 19.5 | 142 | 257.1 | 15.5 | 142 | 257.1 | 1 | 15.5 | 142 | 257.1 | 1 | 15.5 |
| c1008050-1 | 250 | 346 | 384↑ | 2125.1 | 286 | 25.5 | 356↑ | 0.1 | 19.7 | 346 | 804.5 | 17.3 | 346 | 805.6 | 1 | 17.3 | 346 | 805.6 | 1 | 17.3 |
| c1008050-2 | 285 | 436 | 492↑ | 1648.6 | 340 | 30.9 | 444↑ | 0.3 | 23.4 | 436 | 3600.0 | 22.0 | 436 | 3600.0 | 1 | 22.0 | 436 | 3600.0 | 1 | 22.0 |
| c1008050-3 | 283 | 393 | 418↑ | 1125.4 | 326 | 22.0 | 410↑ | 0.1 | 20.5 | 393 | 1335.0 | 17.0 | 393 | 1335.0 | 1 | 17.0 | 393 | 1335.0 | 1 | 17.0 |
| c1008050-4 | 293 | 418 | 460↑ | 2114.3 | 341 | 25.9 | 440↑ | 0.2 | 22.5 | 418 | 1355.0 | 18.4 | 418 | 1355.0 | 1 | 18.4 | 418 | 1355.0 | 1 | 18.4 |
| c1008050-5 | 264 | 390 | 423↑ | 1904.6 | 304 | 28.1 | 396↑ | 0.2 | 23.2 | 390 | 3600.0 | 22.1 | 390 | 3600.0 | 1 | 22.1 | 390 | 3600.0 | 1 | 22.1 |

Table D.19: MMR-GAP results for type-E instances

| | Best Known | | B&C | | | | Fix | | | DS | | | iDS-H | | | | iDS-B | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| instance | LB | UB | obj | time | LB | %gap | obj | time | %gap | obj | time | %gap | obj | time | iter | %gap | obj | time | iter | %gap |
| e0504010-1 | 224 | 224 | 224 | 7.3 | 224 | 0.0 | 229↑ | 0.1 | 2.2 | 224 | 0.4 | 0.0 | 224 | 0.4 | 1 | 0.0 | 224 | 0.4 | 1 | 0.0 |
| e0504010-2 | 184 | 184 | 184 | 4.2 | 184 | 0.0 | 191↑ | 0.2 | 3.7 | 184 | 0.7 | 0.0 | 184 | 0.7 | 1 | 0.0 | 184 | 0.7 | 1 | 0.0 |
| e0504010-3 | 133 | 133 | 133 | 0.4 | 133 | 0.0 | 133 | 0.0 | 0.0 | 133 | 0.2 | 0.0 | 133 | 0.2 | 1 | 0.0 | 133 | 0.2 | 1 | 0.0 |
| e0504010-4 | 190 | 190 | 190 | 3.4 | 190 | 0.0 | 190 | 0.0 | 0.0 | 190 | 0.8 | 0.0 | 190 | 0.8 | 1 | 0.0 | 190 | 0.8 | 1 | 0.0 |
| e0504010-5 | 221 | 221 | 221 | 11.8 | 221 | 0.0 | 237↑ | 0.2 | 6.8 | 225↑ | 2.9 | 1.8 | 221 | 12.4 | 4 | 0.0 | 221 | 14.8 | 4 | 0.0 |
| e0504025-1 | 826 | 826 | 826 | 55.7 | 826 | 0.0 | 860↑ | 0.1 | 4.0 | 826 | 11.0 | 0.0 | 826 | 11.0 | 1 | 0.0 | 826 | 11.0 | 1 | 0.0 |
| e0504025-2 | 706 | 706 | 706 | 42.1 | 706 | 0.0 | 707↑ | 0.1 | 0.1 | 706 | 6.5 | 0.0 | 706 | 6.5 | 1 | 0.0 | 706 | 6.5 | 1 | 0.0 |
| e0504025-3 | 659 | 659 | 659 | 71.8 | 659 | 0.0 | 663↑ | 0.1 | 0.6 | 660↑ | 3.6 | 0.2 | 659 | 77.9 | 13 | 0.0 | 659 | 79.4 | 13 | 0.0 |
| e0504025-4 | 639 | 639 | 639 | 75.4 | 639 | 0.0 | 690↑ | 0.1 | 7.4 | 639 | 7.4 | 0.0 | 639 | 7.4 | 1 | 0.0 | 639 | 7.4 | 1 | 0.0 |
| e0504025-5 | 670 | 670 | 670 | 286.0 | 670 | 0.0 | 670 | 0.1 | 0.0 | 670 | 15.9 | 0.0 | 670 | 15.9 | 1 | 0.0 | 670 | 15.9 | 1 | 0.0 |
| e0504050-1 | 1689 | 2056 | 2056 | 3338.7 | 1882 | 8.5 | 2092↑ | 0.1 | 10.0 | 2056 | 20.7 | 8.5 | 2056 | 20.7 | 1 | 8.5 | 2056 | 20.7 | 1 | 8.5 |
| e0504050-2 | 1562 | 2028 | 2028 | 3070.0 | 1786 | 11.9 | 2028 | 0.3 | 11.9 | 2028 | 129.1 | 11.9 | 2028 | 129.1 | 1 | 11.9 | 2028 | 129.1 | 1 | 11.9 |
| e0504050-3 | 1312 | 1519 | 1519 | 2560.7 | 1436 | 5.5 | 1519 | 0.0 | 5.5 | 1519 | 4.4 | 5.5 | 1519 | 4.4 | 1 | 5.5 | 1519 | 4.4 | 1 | 5.5 |
| e0504050-4 | 1365 | 1689 | 1670↓ | 1498.3 | 1501 | 10.1 | 1754↑ | 0.2 | 14.4 | 1689 | 18.4 | 11.1 | 1670↓ | 362.7 | 9 | 10.1 | 1670↓ | 358.7 | 9 | 10.1 |
| e0504050-5 | 1420 | 1731 | 1744↑ | 2593.9 | 1556 | 10.8 | 1778↑ | 0.0 | 12.5 | 1731 | 13.6 | 10.1 | 1731 | 13.6 | 1 | 10.1 | 1731 | 13.6 | 1 | 10.1 |
| e0508010-1 | 290 | 331 | 331 | 2489.7 | 303 | 8.5 | 331 | 0.1 | 8.5 | 337↑ | 19.5 | 10.1 | 331 | 124.8 | 3 | 8.5 | 331 | 105.9 | 3 | 8.5 |
| e0508010-2 | 240 | 314 | 309↓ | 1938.0 | 260 | 15.9 | 316↑ | 0.2 | 17.7 | 318↑ | 29.2 | 18.2 | 309↓ | 113.6 | 3 | 15.9 | 309↓ | 79.9 | 3 | 15.9 |
| e0508010-3 | 274 | 343 | 334↓ | 3066.4 | 290 | 13.2 | 347↑ | 0.7 | 16.4 | 343 | 31.2 | 15.5 | 334↓ | 68.4 | 2 | 13.2 | 334↓ | 77.3 | 2 | 13.2 |
| e0508010-4 | 282 | 400 | 407↑ | 3259.6 | 326 | 19.9 | 418↑ | 0.3 | 22.0 | 400 | 154.0 | 18.5 | 400 | 154.0 | 1 | 18.5 | 400 | 154.0 | 1 | 18.5 |
| e0508010-5 | 264 | 264 | 264 | 80.6 | 264 | 0.0 | 277↑ | 0.5 | 4.7 | 264 | 3.4 | 0.0 | 264 | 3.4 | 1 | 0.0 | 264 | 3.4 | 1 | 0.0 |
| e0508025-1 | 833 | 1230 | 1321↑ | 2694.2 | 980 | 25.8 | 1248↑ | 0.1 | 21.5 | 1230 | 1897.3 | 20.3 | 1230 | 1905.6 | 1 | 20.3 | 1230 | 1905.6 | 1 | 20.3 |
| e0508025-2 | 775 | 1254 | 1293↑ | 1534.3 | 950 | 26.5 | 1272↑ | 0.2 | 25.3 | 1251↓ | 3600.0 | 24.1 | 1251↓ | 3600.0 | 1 | 24.1 | 1251↓ | 3600.0 | 1 | 24.1 |
| e0508025-3 | 828 | 1271 | 1340↑ | 1479.4 | 1028 | 23.3 | 1282↑ | 0.1 | 19.8 | 1271 | 268.2 | 19.1 | 1271 | 269.3 | 1 | 19.1 | 1271 | 269.3 | 1 | 19.1 |
| e0508025-4 | 941 | 1529 | 1649↑ | 3196.9 | 1167 | 29.2 | 1555↑ | 0.3 | 25.0 | 1541↑ | 3600.0 | 24.3 | 1541↑ | 3600.0 | 1 | 24.3 | 1541↑ | 3600.0 | 1 | 24.3 |
| e0508025-5 | 783 | 1122 | 1131↑ | 2983.1 | 941 | 16.8 | 1167↑ | 0.3 | 19.4 | 1122 | 31.6 | 16.1 | 1122 | 31.6 | 1 | 16.1 | 1122 | 31.6 | 1 | 16.1 |
| e0508050-1 | 2447 | 3985 | 4228↑ | 715.9 | 3026 | 28.4 | 4025↑ | 0.1 | 24.8 | 4009↑ | 3600.0 | 24.5 | 4009↑ | 3600.0 | 1 | 24.5 | 4009↑ | 3600.0 | 1 | 24.5 |
| e0508050-2 | 2173 | 3596 | 3872↑ | 1265.9 | 2659 | 31.3 | 3608↑ | 0.3 | 26.3 | 3603↑ | 3600.0 | 26.2 | 3603↑ | 3600.0 | 1 | 26.2 | 3603↑ | 3600.0 | 1 | 26.2 |
| e0508050-3 | 2194 | 3655 | 3932↑ | 648.3 | 2736 | 30.4 | 3696↑ | 0.1 | 26.0 | 3655 | 3600.0 | 25.1 | 3655 | 3600.0 | 1 | 25.1 | 3655 | 3600.0 | 1 | 25.1 |
| e0508050-4 | 2337 | 3711 | 4059↑ | 622.2 | 2862 | 29.5 | 3822↑ | 0.3 | 25.1 | 3711 | 3600.0 | 22.9 | 3711 | 3600.0 | 1 | 22.9 | 3711 | 3600.0 | 1 | 22.9 |
| e0508050-5 | 2103 | 3448 | 3706↑ | 2215.5 | 2629 | 29.1 | 3548↑ | 0.4 | 25.9 | 3448 | 1899.9 | 23.8 | 3448 | 1899.9 | 1 | 23.8 | 3448 | 1899.9 | 1 | 23.8 |
| e1004010-1 | 257 | 266 | 266 | 155.0 | 266 | 0.0 | 285↑ | 1.2 | 6.7 | 273↑ | 94.4 | 2.6 | 272↑ | 1757.5 | 14 | 2.2 | 272↑ | 1678.9 | 14 | 2.2 |
| e1004010-2 | 223 | 223 | 223 | 93.0 | 223 | 0.0 | 251↑ | 1.0 | 11.2 | 278↑ | 21.4 | 19.8 | 278↑ | 21.4 | 1 | 19.8 | 278↑ | 21.4 | 1 | 19.8 |
| e1004010-3 | 259 | 270 | 270 | 844.8 | 270 | 0.0 | 270 | 1.0 | 0.0 | 277↑ | 58.9 | 2.5 | 270 | 190.8 | 3 | 0.0 | 270 | 190.6 | 3 | 0.0 |
| e1004010-4 | 250 | 250 | 250 | 263.6 | 250 | 0.0 | 255↑ | 2.1 | 2.0 | 255↑ | 21.0 | 2.0 | 255↑ | 21.0 | 1 | 2.0 | 255↑ | 21.0 | 1 | 2.0 |
| e1004010-5 | 191 | 191 | 191 | 66.1 | 191 | 0.0 | 198↑ | 0.3 | 3.5 | 201↑ | 4.8 | 5.0 | 201↑ | 4.8 | 1 | 5.0 | 201↑ | 4.8 | 1 | 5.0 |
| e1004025-1 | 629 | 778 | 780↑ | 3390.0 | 673 | 13.7 | 778 | 0.4 | 13.5 | 793↑ | 708.8 | 15.1 | 779↑ | 2102.1 | 2 | 13.6 | 779↑ | 2488.2 | 2 | 13.6 |
| e1004025-2 | 573 | 674 | 631↓ | 1202.4 | 631 | 0.0 | 677↑ | 1.2 | 6.8 | 674 | 113.5 | 6.4 | 642↓ | 1030.1 | 5 | 1.7 | 642↓ | 844.2 | 5 | 1.7 |
| e1004025-3 | 566 | 676 | 676 | 3542.1 | 604 | 10.7 | 689↑ | 0.9 | 12.3 | 676 | 1029.3 | 10.7 | 676 | 1029.3 | 1 | 10.7 | 676 | 1029.3 | 1 | 10.7 |
| e1004025-4 | 690 | 829 | 832↑ | 911.1 | 750 | 9.9 | 832↑ | 0.2 | 9.9 | 829 | 515.0 | 9.5 | 824↓ | 957.7 | 2 | 9.0 | 824↓ | 1126.3 | 2 | 9.0 |
| e1004025-5 | 562 | 629 | 629 | 2076.5 | 629 | 0.0 | 654↑ | 0.4 | 3.8 | 629 | 187.3 | 0.0 | 629 | 187.3 | 1 | 0.0 | 629 | 187.3 | 1 | 0.0 |
| e1004050-1 | 1312 | 1651 | 1686↑ | 3347.6 | 1422 | 15.7 | 1706↑ | 0.1 | 16.6 | 1651 | 1005.9 | 13.9 | 1651 | 1005.9 | 1 | 13.9 | **1647**↓ | 3600.0 | 4 | 13.7 |
| e1004050-2 | 1318 | 1656 | 1680↑ | 2865.5 | 1443 | 14.1 | 1734↑ | 1.0 | 16.8 | 1656 | 836.7 | 12.9 | 1656 | 836.7 | 1 | 12.9 | 1656 | 836.7 | 1 | 12.9 |
| e1004050-3 | 1289 | 1667 | 1786↑ | 1727.9 | 1401 | 21.6 | 1737↑ | 1.0 | 19.3 | 1667 | 1963.4 | 16.0 | 1667 | 1963.4 | 1 | 16.0 | 1667 | 1963.4 | 1 | 16.0 |
| e1004050-4 | 1470 | 1988 | 2037↑ | 3503.0 | 1649 | 19.0 | 1988 | 0.5 | 17.1 | 2006↑ | 3600.0 | 17.8 | 2006↑ | 3600.0 | 1 | 17.8 | 2006↑ | 3600.0 | 1 | 17.8 |
| e1004050-5 | 1222 | 1456 | 1456 | 2894.8 | 1340 | 8.0 | 1580↑ | 0.6 | 15.2 | 1456 | 136.9 | 8.0 | 1456 | 136.9 | 1 | 8.0 | 1456 | 136.9 | 1 | 8.0 |
| e1008010-1 | 391 | 572 | 614↑ | 3515.6 | 407 | 33.7 | 590↑ | 1.9 | 31.0 | 577↑ | 3600.0 | 29.5 | 577↑ | 3600.0 | 1 | 29.5 | 577↑ | 3600.0 | 1 | 29.5 |
| e1008010-2 | 362 | 574 | 654↑ | 1442.4 | 386 | 41.0 | 579↑ | 7.5 | 33.3 | 578↑ | 3600.0 | 33.2 | 578↑ | 3600.0 | 1 | 33.2 | 578↑ | 3600.0 | 1 | 33.2 |
| e1008010-3 | 312 | 427 | 515↑ | 2140.4 | 328 | 36.3 | 427 | 0.6 | 23.2 | 428↑ | 3600.0 | 23.4 | 428↑ | 3600.0 | 1 | 23.4 | 428↑ | 3600.0 | 1 | 23.4 |
| e1008010-4 | 396 | 578 | 690↑ | 3379.9 | 418 | 39.4 | 609↑ | 1.4 | 31.4 | 583↑ | 3600.0 | 28.3 | 583↑ | 3600.0 | 1 | 28.3 | 583↑ | 3600.0 | 1 | 28.3 |
| e1008010-5 | 370 | 538 | 533↓ | 2946.7 | 389 | 27.0 | 547↑ | 1.5 | 28.9 | 534↓ | 3600.0 | 27.2 | 534↓ | 3600.0 | 1 | 27.2 | 534↓ | 3600.0 | 1 | 27.2 |
| e1008025-1 | 1210 | 1893 | 2198↑ | 2850.4 | 1330 | 39.5 | 1903↑ | 1.0 | 30.1 | 1889↓ | 3600.0 | 29.6 | 1889↓ | 3600.0 | 1 | 29.6 | 1889↓ | 3600.0 | 1 | 29.6 |
| e1008025-2 | 1107 | 1867 | 2613↑ | 2889.0 | 1227 | 53.0 | 1879↑ | 4.2 | 34.7 | 1895↑ | 3600.0 | 35.3 | 1895↑ | 3600.0 | 1 | 35.3 | 1895↑ | 3600.0 | 1 | 35.3 |
| e1008025-3 | 1012 | 1616 | 1792↑ | 2565.0 | 1115 | 37.8 | 1616 | 0.5 | 31.0 | 1616 | 3600.0 | 31.0 | 1616 | 3600.0 | 1 | 31.0 | 1616 | 3600.0 | 1 | 31.0 |
| e1008025-4 | 1058 | 1713 | 2015↑ | 3419.0 | 1160 | 42.4 | 1732↑ | 0.7 | 33.0 | 1713 | 3600.0 | 32.3 | 1713 | 3600.0 | 1 | 32.3 | 1713 | 3600.0 | 1 | 32.3 |
| e1008025-5 | 1090 | 1726 | 2081↑ | 3593.2 | 1188 | 42.9 | 1776↑ | 1.1 | 33.1 | 1726 | 3600.0 | 31.2 | 1726 | 3600.0 | 1 | 31.2 | 1726 | 3600.0 | 1 | 31.2 |
| e1008050-1 | 2775 | 4588 | 5823↑ | 3067.1 | 3230 | 44.5 | 4681↑ | 0.7 | 31.0 | 4660↑ | 3600.0 | 30.7 | 4660↑ | 3600.0 | 1 | 30.7 | 4660↑ | 3600.0 | 1 | 30.7 |
| e1008050-2 | 2707 | 4349 | 5064↑ | 2047.9 | 3106 | 38.7 | 4461↑ | 9.2 | 30.4 | 4351↑ | 3600.0 | 28.6 | 4351↑ | 3600.0 | 1 | 28.6 | 4351↑ | 3600.0 | 1 | 28.6 |
| e1008050-3 | 2581 | 4233 | 5243↑ | 1757.2 | 2983 | 43.1 | 4283↑ | 2.5 | 30.4 | 4239↑ | 3600.0 | 29.6 | 4239↑ | 3600.0 | 1 | 29.6 | 4239↑ | 3600.0 | 1 | 29.6 |
| e1008050-4 | 2390 | 3947 | 5120↑ | 239.2 | 2763 | 46.0 | 3987↑ | 1.0 | 30.7 | 3953↑ | 3600.0 | 30.1 | 3953↑ | 3600.0 | 1 | 30.1 | 3953↑ | 3600.0 | 1 | 30.1 |
| e1008050-5 | 2394 | 4040 | 4667↑ | 126.5 | 2822 | 39.5 | 4093↑ | 7.5 | 31.1 | 4062↑ | 3600.0 | 30.5 | 4062↑ | 3600.0 | 1 | 30.5 | 4062↑ | 3600.0 | 1 | 30.5 |

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