```
this paper\Scripts\python.exe" "D:\Python\Pycharm\setroute\PyCharm Community Edition 2021.2.3\plugins\python-ce\helpers\pydev\pydevconsole.py" --mode=
     client --port=10108
     import sys; print('Python %s on %s' % (sys.version, sys.platform))
 4
     6
     PyDev console: starting
     Python 3.9.7 (tags/v3.9.7:1016ef3, Aug 30 2021, 20:19:38) [MSC v.1929 64 bit (AMD64)] on win32
 8
     >>> runfile('E:/1 000/3 0000/1 00000/1 00000/1 00000/1 00000/1 LW_000/4 000/3 python_code/9 Code for this paper/main_RO_BDC.py', wdir='E:/1 0000/3 0000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 000000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 000000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00000/1 00
     this paper')
    Backend TkAgg is interactive backend. Turning interactive mode on.
     Waiting 5s....
     Set parameter MIPGap to value 1e-10
12
     Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
13
15
     CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
     Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
16
17
     Optimize a model with 583306 rows, 52642 columns and 1624240 nonzeros
19
     Model fingerprint: 0x09edb1e3
     Variable types: 1 continuous, 52641 integer (52605 binary)
20
21
     Coefficient statistics:
      Matrix range [1e+00, 1e+10]
       Objective range [1e+00, 2e+01]
23
24
       Bounds range [1e+00, 1e+00]
                           [1e+00, 2e+10]
       RHS range
26
      Warning: Model contains large matrix coefficients
     Warning: Model contains large rhs
27
28
             Consider reformulating model or setting NumericFocus parameter
29
            to avoid numerical issues.
     Presolve removed 399361 rows and 28618 columns (presolve time = 5s) ...
30
31
     Presolve removed 519996 rows and 37419 columns
     Presolve time: 8.44s
     Presolved: 63310 rows, 15223 columns, 224391 nonzeros
34
      Variable types: 0 continuous, 15223 integer (15203 binary)
35
     Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
     Showing first log only...
37
38
39
     Root relaxation presolved: 15223 rows, 78533 columns, 239614 nonzeros
40
41
42
     Root simplex log...
43
44
     Iteration Objective
                                     Primal Inf. Dual Inf.
           0 1.0170000e+03 0.000000e+00 1.056750e+03
45
46
     Concurrent spin time: 0.02s
48
     Solved with dual simplex (primal model)
49
50
     Root relaxation: objective 1.017000e+03, 2112 iterations, 0.31 seconds (0.28 work units)
51
52
         Nodes | Current Node | Objective Bounds
                                                                            Work
53
      Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
54
55
               0 1017.00000 0 18
                                                   - 1017.00000
               0 1017.00000 0 218
56
         0
                                                   - 1017.00000
                                                                              - 10s
57
         0
               0 1017.00000 0 212
                                                   - 1017.00000
                                                                              - 10s
58
               0 1017.00000 0 257
                                                   - 1017.00000
                                                                             - 11s
59
         0
               0 1017.00000 0 254
                                                   - 1017.00000
                                                                         - - 11s
60
         0
               0 1017.00000 0 18
                                                   - 1017.00000
                                                                         - - 13s
               0 1017.00000 0 403
                                                   - 1017.00000
                                                                             - 14s
62
               0 1017.00000 0 366
                                                    - 1017.00000
                                                                                  14s
                                  3217.0000000 1017.00000 68.4% - 14s
63
    H = 0 = 0
              64
         0
               0\ 1017.00000\quad 0\ 134\ 3217.00000\ 1017.00000\ 68.4\%
65
66 H 0 0
                                  2637.0000000 1017.00000 61.4% - 28s
67 H 0
                0
                                  2257.0000000 1017.00000 54.9%
                                                                                  - 29s
68
     Η
          0
                                  1017.0000000 1017.00000 0.00%
                0
70 Cutting planes:
       Gomory: 14
       Cover: 242
73
       Implied bound: 583
74
       Clique: 292
       MIR: 25
76
       StrongCG: 8
       GUB cover: 13
77
78
       Zero half: 6
79
       RLT: 8
```

```
Relax-and-lift: 4
 80
 81
     BQP: 4
 82
 83 Explored 1 nodes (19221 simplex iterations) in 30.56 seconds (45.71 work units)
    Thread count was 8 (of 8 available processors)
 85
 86 Solution count 4: 1017 2257 2637 3217
 87
 88 Optimal solution found (tolerance 1.00e-10)
 89 Best objective 1.017000000000e+03, best bound 1.01700000000e+03, gap 0.0000%
 90 Set parameter MIPGap to value 1e-08
 91
    Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
 93 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
 94
    Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
 96 Optimize a model with 2481755 rows, 1955335 columns and 17236424 nonzeros
 97 Model fingerprint: 0xf2c50956
 98 Variable types: 963295 continuous, 992040 integer (985965 binary)
 99 Coefficient statistics:
100 Matrix range [1e-01, 1e+10]
101
     Objective range [6e-05, 5e+01]
     Bounds range [1e+00, 8e+01]
102
103
     RHS range
                    [8e-01, 1e+10]
104 Warning: Model contains large matrix coefficients
105 Warning: Model contains large rhs
          Consider reformulating model or setting NumericFocus parameter
106
          to avoid numerical issues.
107
108 Presolve removed 2478498 rows and 1954166 columns (presolve time = 5s) ...
109 Presolve removed 2478503 rows and 1954170 columns
110 Presolve time: 5.21s
111 Presolved: 3252 rows, 1165 columns, 8595 nonzeros
112 Variable types: 8 continuous, 1157 integer (659 binary)
113 Found heuristic solution: objective 4309.8302838
114
115 Root simplex log...
116
117 Iteration Objective
                          Primal Inf. Dual Inf.
        0 8.9802796e+03 8.166827e+03 0.000000e+00
118
119
       925 5.5971303e+03 0.000000e+00 0.000000e+00
120
121 Root relaxation: objective 5.597130e+03, 925 iterations, 0.02 seconds (0.01 work units)
122
123
       Nodes | Current Node | Objective Bounds
                                                       Work
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
124
125
       0 0 5597.13028 0 18 4309.83028 5597.13028 29.9%
126
                         5595.3302838 5597.13028 0.03% - 6s
127 H 0 0
128 * 0 0
                     0 5596.8302838 5596.83028 0.00%
129
130 Cutting planes:
131
    Learned: 1
132
     MIR: 1
133
     RLT: 1
134
135 Explored 1 nodes (1299 simplex iterations) in 6.87 seconds (7.57 work units)
136 Thread count was 8 (of 8 available processors)
137
138 Solution count 3: 5596.83 5595.33 4309.83
139
140 Optimal solution found (tolerance 1.00e-08)
141 Best objective 5.596830283766e+03, best bound 5.596830283766e+03, gap 0.0000%
142 SP is solved
143 SP's optimal solution is' ☐ 5596
144
145
     Itr = 0
146 Collect LB = [1017.0]
147 Collect_UB = [12210.660567532992]
148 Collect_Hua = [0.0]
149 Collect_SPObjVal = [5596.830283766496]
150 Collect_MPObjValNHua = [1017.0]
151
152
153 Set parameter TimeLimit to value 12000
154 Set parameter MIPGap to value 0.0005
155 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
156
157 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
158 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
159
160 Optimize a model with 590288 rows, 283978 columns and 1631276 nonzeros
161 Model fingerprint: 0xe1e5281d
162 Variable types: 1 continuous, 283977 integer (283941 binary)
163 Coefficient statistics:
```

```
Matrix range [1e+00, 1e+10]
164
165
     Objective range [1e+00, 2e+01]
     Bounds range [1e+00, 1e+00]
166
167
     RHS range
                 [1e+00, 2e+10]
    Warning: Model contains large matrix coefficients
    Warning: Model contains large rhs
169
170
         Consider reformulating model or setting NumericFocus parameter
171
         to avoid numerical issues.
    Presolve removed 461689 rows and 268157 columns (presolve time = 5s) ...
173 Presolve removed 552239 rows and 276983 columns
174 Presolve time: 6.50s
   Presolved: 38049 rows, 6995 columns, 100890 nonzeros
176 Variable types: 0 continuous, 6995 integer (6976 binary)
177 Root relaxation presolved: 6995 rows, 45044 columns, 107885 nonzeros
178
180 Root simplex log...
181
182 Iteration Objective
                        Primal Inf. Dual Inf.
                                             Time
183
           handle free variables
184
      5945
           7.0313303e+03 0.000000e+00 0.000000e+00
185
      5945 7.0313303e+03 0.000000e+00 0.000000e+00
                                                      7s
186
187 Root relaxation: objective 7.031330e+03, 5945 iterations, 0.50 seconds (0.96 work units)
188
189
      Nodes | Current Node | Objective Bounds | Work
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
191
192
          0.7031.33028 0 24
                                 - 7031.33028
193
          0.7031.33028 \quad 0.232
                                 - 7031.33028
194
       0
          0 7031.33028 0 220
                                  - 7031.33028
                      8511.3302838 7031.33028 17.4% -
195 H 0
          0
196 H
       0
          0
                      8471.3302838 7031.33028 17.0%
197
          0.7031.33028 \quad 0.165.8471.33028.7031.33028.17.0\%
198
          199
          0.7031.33028
                       0 57 8471.33028 7031.33028 17.0%
200
       0
          0 7031.33028
                       0 108 8471.33028 7031.33028 17.0%
          201
          0 7031.33028 0 140 8471.33028 7031.33028 17.0%
202
       0
                                                         - 11s
203
       0
          0.7031.33028 \quad 0.291\ 8471.33028\ 7031.33028\ 17.0\%
                                                         - 11s
204
          0 7031.33028
                       0 142 8471.33028 7031.33028 17.0%
205
       0
          0 7031.33028
                       0 66 8471.33028 7031.33028 17.0%
                                                         - 11s
          0.7031.33028 0.35.8471.33028.7031.33028.17.0%
206
       0
                                                         - 12s
207
       0
          0 7031.33028
                       0 240 8471.33028 7031.33028 17.0%
                                                         - 13s
          0 7031.33028
                       0 231 8471.33028 7031.33028 17.0%
208
       0
                                                           13s
          0 7031.33028 0 249 8471.33028 7031.33028 17.0%
209
       0
                                                         - 13s
                       0 222 8471.33028 7031.33028 17.0%
210
          0 7031.33028
                                                         - 13s
211
       0
          0 7031.33028
                       0 22 8471.33028 7031.33028 17.0%
                                                         - 15s
212
          0 7031.33028
                       0 118 8471.33028 7031.33028 17.0%
                                                         - 15s
          0.7031.33028
                       0 35 8471.33028 7031.33028 17.0%
213
       0
                                                         - 15s
214
       0
          - 16s
          0 7031.33028
                       0 353 8471.33028 7031.33028 17.0%
215
          216
       0
                                                         - 16s
          217
       0
                                                         - 17s
218
          - 17s
219
       0
          2 7031.33028 0 77 8471.33028 7031.33028 17.0%
          36 7031.33028 8 213 8471.33028 7031.33028 17.0% 890 20s
220
      35
221
      238 237 7031.33028 41 152 8471.33028 7031.33028 17.0% 674 26s
222
    H 248 237
                        7511.3302838 7031.33028 6.39% 680 26s
223
     484 614 7031.33028 65 193 7511.33028 7031.33028 6.39% 478 30s
                        7071.3302838 7031.33028 0.57% 336 30s
224 H 732 614
225
    * 1510 323
                     74 7031.3302838 7031.33028 0.00% 212 32s
226
227 Cutting planes:
228
     Learned: 14
229
     Gomory: 7
230
     Lift-and-project: 1
231
     Cover: 502
232
     Implied bound: 2063
233
     Clique: 101
234
     MIR: 151
     StrongCG: 98
235
236
     GUB cover: 57
237
     Zero half: 16
238
     RLT: 13
239
     Relax-and-lift: 34
240
241
242 Explored 1592 nodes (402587 simplex iterations) in 32.99 seconds (65.75 work units)
243 Thread count was 8 (of 8 available processors)
244
245 Solution count 5: 7031.33 7071.33 7511.33 ... 8511.33
246
    Optimal solution found (tolerance 5.00e-04)
247
```

```
248 Best objective 7.031330283766e+03, best bound 7.031330283766e+03, gap 0.0000%
249 Set parameter MIPGap to value 1e-08
250 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
251
252 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
253 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
254
255 Optimize a model with 2481755 rows, 1955335 columns and 17236424 nonzeros
256 Model fingerprint: 0xdc66fb85
257 Variable types: 963295 continuous, 992040 integer (985965 binary)
258 Coefficient statistics:
259
     Matrix range [1e-01, 1e+10]
260 Objective range [6e-05, 5e+01]
     Bounds range [1e+00, 8e+01]
261
262
     RHS range
                   [8e-01, 1e+10]
263 Warning: Model contains large matrix coefficients
264 Warning: Model contains large rhs
          Consider reformulating model or setting NumericFocus parameter
265
266
          to avoid numerical issues.
267 Presolve removed 2476484 rows and 1953532 columns
268 Presolve time: 4.99s
269 Presolved: 5271 rows, 1803 columns, 14076 nonzeros
270 Variable types: 8 continuous, 1795 integer (1042 binary)
271 Found heuristic solution: objective 4233.8302838
272 Found heuristic solution: objective 4253.8302838
273
274 Root simplex log...
275
276 Iteration Objective
                           Primal Inf. Dual Inf.
277
         0 1.1487280e+04 8.733382e+03 0.000000e+00
278
       1576 6.0871303e+03 0.000000e+00 0.000000e+00
279
280 Root relaxation: objective 6.087130e+03, 1576 iterations, 0.02 seconds (0.02 work units)
281
       Nodes | Current Node | Objective Bounds
282
                                                          Work
283
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
284
        0 0 6087.13028 0 17 4253.83028 6087.13028 43.1%
285
                         6086.8302838 6087.13028 0.00% - 6s
286 H 0 0
287
288 Cutting planes:
289
     Learned: 2
290
     Gomory: 1
291
      Cover: 10
292
      Implied bound: 15
293
      MIR: 2
294
295 Explored 1 nodes (2136 simplex iterations) in 6.62 seconds (7.38 work units)
296 Thread count was 8 (of 8 available processors)
297
298 Solution count 3: 6086.83 4253.83 4233.83
299
300 Optimal solution found (tolerance 1.00e-08)
301 Best objective 6.086830283766e+03, best bound 6.086830283766e+03, gap 0.0000%
302 SP is solved
303 SP's optimal solution is' □ 6086
304
305 	ext{ Itr} = 1
306 Collect_LB = [1017.0, 7031.330283766496]
307 Collect_UB = [12210.660567532992, 7521.330283766496]
308 Collect_Hua = [0.0, 5596.830283766496]
309 Collect SPObjVal = [5596.830283766496, 6086.830283766496]
310 Collect MPObjValNHua = [1017.0, 1434.5]
311
312
313 Set parameter TimeLimit to value 12000
314 Set parameter MIPGap to value 0.0005
315 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
316
317 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
318 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
319
320 Optimize a model with 590289 rows, 283978 columns and 1631295 nonzeros
321 Model fingerprint: 0x9da4c12a
322 Variable types: 1 continuous, 283977 integer (283941 binary)
323 Coefficient statistics:
324 Matrix range [1e+00, 1e+10]
325
      Objective range [1e+00, 2e+01]
     Bounds range [1e+00, 1e+00]
326
                    [1e+00, 2e+10]
327
     RHS range
     Warning: Model contains large matrix coefficients
328
    Warning: Model contains large rhs
329
          Consider reformulating model or setting NumericFocus parameter
330
          to avoid numerical issues.
331
```

```
332 Presolve removed 461690 rows and 268157 columns (presolve time = 5s) ...
333 Presolve removed 552240 rows and 276983 columns
334 Presolve time: 6.47s
335 Presolved: 38049 rows, 6995 columns, 100890 nonzeros
   Variable types: 0 continuous, 6995 integer (6976 binary)
337 Root relaxation presolved: 6995 rows, 45044 columns, 107885 nonzeros
338
339
340 Root simplex log...
341
342 Iteration Objective
                         Primal Inf. Dual Inf.
                                              Time
343
           handle free variables
      5945 7.5213303e+03 0.000000e+00 0.000000e+00
344
                                                       7s
      5945 \quad 7.5213303e + 03 \quad 0.000000e + 00 \quad 0.000000e + 00
345
346
347 Root relaxation: objective 7.521330e+03, 5945 iterations, 0.50 seconds (0.96 work units)
348
      Nodes | Current Node | Objective Bounds
                                                 Work
349
350
    Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
351
352
          0.7521.33028 0 24
                                 - 7521.33028
353
       0
          0 7521.33028 0 232
                                  - 7521.33028
                                                      8s
354
       0
          0 7521.33028
                                  - 7521.33028
                       0 220
                                                      8s
355 H 0
                       9001.3302838 7521.33028 16.4% -
356 H 0
                      8961.3302838 7521.33028 16.1%
          0
357
          0.7521.33028 \quad 0.165.8961.33028.7521.33028.16.1\%
358
          0.7521.33028 \quad 0 \quad 69.8961.33028.7521.33028.16.1\%
          0 7521.33028 0 57 8961.33028 7521.33028 16.1%
359
       0
                                                             9s
          360
       0
                                                             99
          0 7521.33028 0 180 8961.33028 7521.33028 16.1%
361
362
       0
          - 11s
          363
       0
                                                           - 11s
364
       0
          0.7521.33028 \quad 0.142\ 8961.33028\ 7521.33028\ 16.1\%
                                                          - 11s
                       0\ \ 66\ 8961.33028\ 7521.33028\ 16.1\%
365
       0
          0 7521.33028
                                                          - 11s
366
          0 7521.33028 0 35 8961.33028 7521.33028 16.1%
                                                          - 13s
       0
                       0\ 240\ 8961.33028\ 7521.33028\ 16.1\%
367
          0.7521.33028
                                                          - 13s
368
       0
          0 7521.33028
                       0 231 8961.33028 7521.33028 16.1%
                                                           - 13s
369
          0 7521.33028 0 249 8961.33028 7521.33028 16.1%
                                                           - 13s
          0 7521.33028 0 222 8961.33028 7521.33028 16.1%
370
       0
                                                          - 13s
371
       0
          0.7521.33028 \quad 0 \quad 22.8961.33028.7521.33028.16.1\%
                                                          - 15s
                       0 118 8961.33028 7521.33028 16.1%
          0 7521.33028
373
          0 7521.33028 0 35 8961.33028 7521.33028 16.1%
       0
                                                          - 15s
374
          0.7521.33028 0.118.8961.33028.7521.33028.16.1%
       0
                                                          - 16s
375
          - 16s
          0.7521.33028 \quad 0.322\ 8961.33028\ 7521.33028\ 16.1\%
376
                                                           - 16s
          377
       0
                                                          - 17s
378
          - 17s
379
       0
          2 7521.33028 0 77 8961.33028 7521.33028 16.1%
380
      19
          21 7521.33028 4 321 8961.33028 7521.33028 16.1% 1492 20s
          58 7521.33028 13 148 8961.33028 7521.33028 16.1% 859 25s
381
      56
382
      238 237 7521.33028 41 152 8961.33028 7521.33028 16.1% 674 30s
                         8001.3302838\ 7521.33028\ 6.00\%\ 680\ 30s
383 H 248 237
                    115 7561.3302838 7521.33028 0.53% 336 34s
384
    * 713 557
                cutoff 127
      987 284
                            7561.33028 7521.33028 0.53% 250 35s
385
386 * 1210 284
                     53 7521.3302838 7521.33028 0.00% 214 35s
387
388 Cutting planes:
389
     Learned: 8
390
     Gomory: 6
391
     Lift-and-project: 1
392
     Cover: 276
393
     Implied bound: 2017
394
     Clique: 66
395
     MIR: 125
396
     StrongCG: 75
397
     GUB cover: 47
398
     Zero half: 9
399
     RLT: 10
400
     Relax-and-lift: 20
401
402
    Explored 1444 nodes (345605 simplex iterations) in 35.75 seconds (61.60 work units)
403
404
    Thread count was 8 (of 8 available processors)
405
406 Solution count 5: 7521.33 7561.33 8001.33 ... 9001.33
407
408 Optimal solution found (tolerance 5.00e-04)
409 Best objective 7.521330283766e+03, best bound 7.521330283766e+03, gap 0.0000%
410 Set parameter MIPGap to value 1e-08
411
    Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
412
413 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
414 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
415
```

```
416 Optimize a model with 2481755 rows, 1955335 columns and 17236424 nonzeros
417 Model fingerprint: 0x9c1c0565
418 Variable types: 963295 continuous, 992040 integer (985965 binary)
419 Coefficient statistics:
420 Matrix range [1e-01, 1e+10]
421
      Objective range [6e-05, 5e+01]
      Bounds range [1e+00, 8e+01]
422
423
     RHS range
                    [8e-01, 1e+10]
424
     Warning: Model contains large matrix coefficients
425 Warning: Model contains large rhs
426
          Consider reformulating model or setting NumericFocus parameter
427
          to avoid numerical issues.
428 Presolve removed 2476578 rows and 1953561 columns
429 Presolve time: 4.91s
430 Presolved: 5177 rows, 1774 columns, 13825 nonzeros
    Variable types: 8 continuous, 1766 integer (1027 binary)
432 Found heuristic solution: objective 4233.8302838
433
434 Root simplex log...
435
436 Iteration Objective
                          Primal Inf. Dual Inf.
         0 1.1287280e+04 8.580382e+03 0.000000e+00
437
438
       1458 6.0871303e+03 0.000000e+00 0.000000e+00
439
440 Root relaxation: objective 6.087130e+03, 1458 iterations, 0.02 seconds (0.02 work units)
441
442
       Nodes | Current Node | Objective Bounds
443
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
444
445
       0 0 6087.13028 0 17 4233.83028 6087.13028 43.8%
446 H 0 0
                         6086.8302838 6087.13028 0.00% - 6s
447
448 Cutting planes:
449
      Learned: 2
450
      Cover: 10
451
      Implied bound: 15
452
      MIR: 2
453
454 Explored 1 nodes (1976 simplex iterations) in 6.52 seconds (7.30 work units)
455 Thread count was 8 (of 8 available processors)
456
457 Solution count 2: 6086.83 4233.83
458
459 Optimal solution found (tolerance 1.00e-08)
460 Best objective 6.086830283766e+03, best bound 6.086830283766e+03, gap 0.0000%
461 SP is solved
462 SP's optimal solution is' □ 6086
463
464 	ext{ Itr} = 2
465 Collect LB = [1017.0, 7031.330283766496, 7521.330283766496]
466 Collect UB = [12210.660567532992, 7521.330283766496, 7521.330283766496]
467 Collect_Hua = [0.0, 5596.830283766496, 6086.830283766496]
468 Collect SPObjVal = [5596.830283766496, 6086.830283766496, 6086.830283766496]
469 Collect_MPObjValNHua = [1017.0, 1434.5, 1434.5]
470
471
472
      Reach the termination conditions, stop iteration
473
     Values adopted from the Itr' th iteration, and Itr = \{2\}, judgeCount = \{2\}
474
475
                \simjudge = 2, SPObj SPF = 6086.830283766496
                  pi: 0-6, ai-di: 7-27, gi_SP-gpi_SP: 0.000000-0.000000, ai_SP-di: 7-27, taoi-deltai: 7-29, taoPi_SP-deltaPi_SP: 7-29, betaNi: 22
476 Vessel i: 0:
         bi: 22
                                                                                 ai SP-di: 9-18, taoi-deltai: 9-18, taoPi SP-deltaPi SP: 9-18, betaNi: 9
     Vessel i: 1:
                  pi: 12-18, ai-di: 9-18,
                                            gi SP-gpi SP: 0.000000-0.000000,
        bi: 9
                                                                                                                       taoPi_SP-deltaPi_SP: 11-42, betaNi
     Vessel i: 2:
                  pi: 6-12,
                             ai-di: 11-40,
                                            gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                 ai_SP-di: 11-40,
                                                                                                   taoi-deltai: 11-42,
     : 31, bi: 31
     Vessel i: 3:
                  pi: 18-24,
                                             gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                  ai_SP-di: 17-31,
                                                                                                    taoi-deltai: 17-27,
                                                                                                                        taoPi SP-deltaPi SP: 17-27,
                               ai-di: 17-31.
                  bi: 10
     betaNi: 10.
     Vessel i: 4:
                  pi: 28-34,
                               ai-di: 18-23,
                                              gi SP-gpi SP: 0.000000-0.000000,
                                                                                  ai SP-di: 18-23,
                                                                                                    taoi-deltai: 18-23,
                                                                                                                        taoPi SP-deltaPi SP: 18-23,
     betaNi: 5,
                 bi: 5
                 pi: 27-34,
     Vessel i: 5:
                               ai-di: 26-30.
                                             gi_SP-gpi_SP: 0.025000-1.000000,
                                                                                  ai_SP-di: 26-30,
                                                                                                    taoi-deltai: 27-32.
                                                                                                                        taoPi_SP-deltaPi_SP: 27-32,
     betaNi: 5,
                 bi: 5
     Vessel i: 6:
                  pi: 16-22,
                               ai-di: 33-42,
                                             gi_SP-gpi_SP: 0.375000-0.200000,
                                                                                  ai_SP-di: 36-42,
                                                                                                    taoi-deltai: 36-45,
                                                                                                                        taoPi_SP-deltaPi_SP: 36-45,
     betaNi: 9,
                 hi: 9
                  pi: 14-20,
                                             gi_SP-gpi_SP: 1.000000-0.600000,
                                                                                  ai SP-di: 47-68,
                                                                                                                        taoPi SP-deltaPi SP: 47-77,
     Vessel i: 7:
                               ai-di: 37-68.
                                                                                                    taoi-deltai: 47-77.
     betaNi: 30,
                  bi: 30
     Vessel i: 8:
                  pi: 22-28,
                               ai-di: 46-64,
                                             gi_SP-gpi_SP: 1.000000-0.600000,
                                                                                  ai_SP-di: 53-64,
                                                                                                    taoi-deltai: 53-74,
                                                                                                                        taoPi_SP-deltaPi_SP: 53-74,
     betaNi: 21.
                  bi: 21
485
486 round LB = [1017, 7031, 7521]
487 round UB = [12211, 7521, 7521]
488 round Hua = [0, 5597, 6087]
489 round SPObjVal = [5597, 6087, 6087]
490 round MPObjValNHua = [1017, 1434, 1434]
```

unknown

491	
492	OptimalObj = 7521.330283766496 Time: 556.000000
493 494	11me: 556.000000
495	
496	
497	