```
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=16423
     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_CCG.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 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 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: 7.12s
     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: 0.00s
48
     Solved with dual simplex (primal model)
49
50
     Root relaxation: objective 1.017000e+03, 2112 iterations, 0.30 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
                                                                                   88
               0 1017.00000 0 218
56
         0
                                                   - 1017.00000
                                                                                   85
57
         0
               0 1017.00000 0 212
                                                    - 1017.00000
                                                                                   8s
58
               0 1017.00000 0 257
                                                    - 1017.00000
59
         0
               0 1017.00000 0 254
                                                   - 1017.00000
                                                                                   9s
60
         0
               0 1017.00000 0 18
                                                   - 1017.00000
                                                                             - 11s
               0 1017.00000 0 403
                                                   - 1017.00000
                                                                              - 12s
62
               0 1017.00000 0 366
                                                    - 1017.00000
                                                                               - 12s
                                  3217.0000000 1017.00000 68.4% - 12s
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% - 21s
67 H 0
                0
                                  2257.0000000 1017.00000 54.9%
                                                                                  - 23s
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 23.65 seconds (45.71 work units)
 84 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 2481560 rows, 1955335 columns and 17235839 nonzeros
 97 Model fingerprint: 0x8f6094e5
 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
106
          Consider reformulating model or setting NumericFocus parameter
107
          to avoid numerical issues.
108 Presolve removed 2478308 rows and 1954170 columns
109 Presolve time: 4.82s
110 Presolved: 3252 rows, 1165 columns, 8595 nonzeros
111 Variable types: 8 continuous, 1157 integer (659 binary)
112 Found heuristic solution: objective 4309.8302838
113
114 Root simplex log...
115
116 Iteration Objective
                           Primal Inf. Dual Inf.
        0 8.9802796e+03 8.166827e+03 0.000000e+00
117
       925 5.5971303e+03 0.000000e+00 0.000000e+00
118
119
120 Root relaxation: objective 5.597130e+03, 925 iterations, 0.00 seconds (0.01 work units)
121
                                                      Work
122
       Nodes | Current Node | Objective Bounds
123
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
124
       0 0 5597.13028 0 18 4309.83028 5597.13028 29.9% - 6s
125
126\ H\ 0\ 0
                         5595.3302838 5597.13028 0.03% - 6s
127 *
       0 0
                     0 5596.8302838 5596.83028 0.00%
128
129 Cutting planes:
130
     Learned: 1
131
     MIR: 1
132
     RLT: 1
133
134 Explored 1 nodes (1299 simplex iterations) in 6.35 seconds (7.56 work units)
135 Thread count was 8 (of 8 available processors)
136
137 Solution count 3: 5596.83 5595.33 4309.83
138
139 Optimal solution found (tolerance 1.00e-08)
140 Best objective 5.596830283766e+03, best bound 5.596830283766e+03, gap 0.0000%
141 SP is solved
142 SP's optimal solution is' ☐ 5596
143
144
     Itr = 0
145 Collect_LB = [1017.0]
146 Collect_UB = [12210.660567532992]
147 Collect Hua = [0.0]
148 Collect SPObjVal = [5596.830283766496]
149 Collect_MPObjValNHua = [1017.0]
150
151
152
    Set parameter MIPGap to value 0.05
153 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
154
155 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
156 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
157
158 Optimize a model with 1126481 rows, 303661 columns and 3329693 nonzeros
159 Model fingerprint: 0xc2a3ddbf
160 Variable types: 1 continuous, 303660 integer (292257 binary)
161 Coefficient statistics:
162
     Matrix range [1e-01, 1e+10]
      Objective range [1e+00, 2e+01]
163
```

```
Bounds range
164
                    [1e+00, 1e+00]
165
      RHS range
                    [1e+00, 2e+10]
     Warning: Model contains large matrix coefficients
166
167
     Warning: Model contains large rhs
          Consider reformulating model or setting NumericFocus parameter
168
169
          to avoid numerical issues.
170 Presolve removed 977131 rows and 283914 columns (presolve time = 5s) ...
171 Presolve removed 991673 rows and 285175 columns (presolve time = 10s) ...
    Presolve removed 1059124 rows and 292247 columns
173 Presolve time: 10.90s
174 Presolved: 67357 rows, 11414 columns, 216560 nonzeros
175
     Variable types: 1 continuous, 11413 integer (9486 binary)
176
177 Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
178
     Showing first log only...
180 Root relaxation presolved: 11414 rows, 78771 columns, 227974 nonzeros
181
182
183 Root simplex log...
184
185 Iteration Objective
                           Primal Inf. Dual Inf.
                                                 Time
         0 \quad 7.0313303e + 03 \quad 0.000000e + 00 \quad 3.090231e + 04
186
187
    Concurrent spin time: 0.32s
188
189
     Solved with dual simplex (primal model)
190
191 Root relaxation: objective 7.031330e+03, 7092 iterations, 1.23 seconds (1.43 work units)
192
193
       Nodes | Current Node | Objective Bounds
                                                         Work
194
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
195
196
           0 7031.33028 0 387
                                     - 7031.33028
                                                        - 15s
197
           0 7031.33028
                                     - 7031.33028
                          0 387
                                                        - 15s
198
       0
           0 7031.33028 0 540
                                     - 7031.33028
                                                        - 17s
199
                          0.540
                                     - 7031.33028
           0.7031.33028
                                                        - 17s
200
       0
           0 7031.33028
                          0 540
                                     - 7031.33028
                                                        - 17s
           0 7031.33028 0 555
201
       0
                                     - 7031.33028
                                                        - 18s
           0 7031.33028 0 496
202
       0
                                     - 7031.33028
                                                        - 18s
203
       0
           0 7031.33028 0 347
                                     - 7031.33028
                                                          27s
204
           0 7031.33028
                          0 420
                                     - 7031.33028
                                                          29s
205
       0
           0 7031.33028
                          0 424
                                     - 7031.33028
                                                          29s
                                                       - 37s
           0 7031.33028 0 268
206
                                     - 7031 33028
       0
207
       0
           0 7031.33028 0 352
                                     - 7031.33028
                                                        - 38s
       0
           0 7031.33028 0 219
208
                                     - 7031.33028
                                                        - 45s
           0 7031.33028 0 216
                                                       - 45s
209
       0
                                     - 7031.33028
                                     - 7031.33028
210
       0
           0 7031.33028 0 222
                                                        - 46s
211
       0
           0 7031.33028
                          0 192
                                     - 7031.33028
                                                        - 52s
212
           0 7031.33028 0 231
                                     - 7031.33028
                                                        - 52s
       0
           0.7031.33028 0.342
                                     - 7031.33028
                                                        - 53s
213
       0
214
       0
           0.7031.33028 \quad 0.320
                                     - 7031.33028
                                                       - 53s
215 H 0 0
                        7071.3302838 7031.33028 0.57% - 57s
          216
217
218 Cutting planes:
219
     Learned: 15
220
     Gomory: 4
221
      Cover: 440
222
      Implied bound: 219
223
      Clique: 1654
224
      MIR: 163
225
      StrongCG: 48
226
     Flow cover: 17
227
      GUB cover: 311
228
      Zero half: 63
229
      Network: 1
230
      RLT: 88
231
      Relax-and-lift: 320
232
      BQP: 63
233
234 Explored 1 nodes (117042 simplex iterations) in 57.15 seconds (100.30 work units)
235 Thread count was 8 (of 8 available processors)
236
237 Solution count 1: 7071.33
238
239 Optimal solution found (tolerance 5.00e-02)
240 Best objective 7.071330283766e+03, best bound 7.031330283766e+03, gap 0.5657%
241
     Set parameter MIPGap to value 1e-08
242 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
243
244 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
245 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
246
     Optimize a model with 2481560 rows, 1955335 columns and 17235839 nonzeros
247
```

```
248 Model fingerprint: 0xa71d478b
249 Variable types: 963295 continuous, 992040 integer (985965 binary)
250 Coefficient statistics:
     Matrix range [1e-01, 1e+10]
251
252 Objective range [6e-05, 5e+01]
253
      Bounds range [1e+00, 8e+01]
     RHS range
                    [8e-01, 1e+10]
254
255 Warning: Model contains large matrix coefficients
256 Warning: Model contains large rhs
          Consider reformulating model or setting NumericFocus parameter
257
258
          to avoid numerical issues.
259 Presolve removed 2475686 rows and 1953401 columns
260 Presolve time: 4.84s
261 Presolved: 5874 rows, 1934 columns, 15651 nonzeros
262 Variable types: 8 continuous, 1926 integer (1111 binary)
263 Found heuristic solution: objective 4273.8302838
264
265 Root simplex log...
266
267 Iteration Objective
                           Primal Inf. Dual Inf.
                                                   Time
         0 1.1567280e+04 6.736059e+03 0.000000e+00
268
       1911 6.0871303e+03 0.000000e+00 0.000000e+00
269
270
271 Root relaxation: objective 6.087130e+03, 1911 iterations, 0.03 seconds (0.02 work units)
272
273
       Nodes | Current Node | Objective Bounds | Work
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
275
276
       0 0 6087.13028 0 17 4273.83028 6087.13028 42.4% - 6s
277 H 0 0
                         6086.8302838 6087.13028 0.00% - 6s
278
279 Cutting planes:
280 Learned: 2
      Cover: 10
281
282
      Implied bound: 10
283
      MIR: 2
284
285 Explored 1 nodes (2436 simplex iterations) in 6.37 seconds (7.52 work units)
286 Thread count was 8 (of 8 available processors)
287
288 Solution count 2: 6086.83 4273.83
289
290 Optimal solution found (tolerance 1.00e-08)
291 Best objective 6.086830283766e+03, best bound 6.086830283766e+03, gap 0.0000%
292 SP is solved
293 SP's optimal solution is' □ 6086
294
295
296 Collect LB = [1017.0, 7071.330283766496]
297 Collect_UB = [12210.660567532992, 7561.330283766496]
298 Collect_Hua = [0.0, 5596.830283766496]
299 Collect_SPObjVal = [5596.830283766496, 6086.830283766496]
300 Collect MPObjValNHua = [1017.0, 1474.5]
301
302
303 Set parameter MIPGap to value 0.05
304 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
305
306 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
307 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
308
309 Optimize a model with 1662675 rows, 323344 columns and 5028129 nonzeros
310 Model fingerprint: 0xddc6c696
311 Variable types: 1 continuous, 323343 integer (300573 binary)
312 Coefficient statistics:
313 Matrix range [1e-01, 1e+10]
      Objective range [1e+00, 2e+01]
314
      Bounds range [1e+00, 1e+00]
315
                    [1e+00, 2e+10]
316
     RHS range
     Warning: Model contains large matrix coefficients
317
318 Warning: Model contains large rhs
319
          Consider reformulating model or setting NumericFocus parameter
320
          to avoid numerical issues.
321 Presolve removed 1469762 rows and 298513 columns (presolve time = 5s) ...
322 Presolve removed 1501741 rows and 300551 columns (presolve time = 10s) ...
323 Presolve removed 1564235 rows and 307490 columns
324 Presolve time: 14.40s
325 Presolved: 98440 rows, 15854 columns, 334414 nonzeros
326 Variable types: 1 continuous, 15853 integer (12018 binary)
327
328 Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
329 Showing first log only...
330
    Root relaxation presolved: 15854 rows, 114276 columns, 350152 nonzeros
331
```

```
332
333
334 Root simplex log...
335
                          Primal Inf. Dual Inf.
336 Iteration Objective
        0 7.5213303e+03 0.000000e+00 1.605501e+05
337
                                                         15s
      23521 7.5213303e+03 0.000000e+00 0.000000e+00 17s
338
339
      23521 7.5213303e+03 0.000000e+00 0.000000e+00
      23521 \quad 7.5213303e + 03 \quad 0.000000e + 00 \quad 0.000000e + 00
340
341 Concurrent spin time: 1.09s
342
343 Solved with primal simplex
344
345 Root relaxation: objective 7.521330e+03, 23521 iterations, 2.97 seconds (4.07 work units)
346
    Total elapsed time = 20.81s
347
348
                                  Objective Bounds
                                                        Work
      Nodes | Current Node |
349
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
350
351
           0 7521.33028 0 630
                                    - 7521.33028
352
          0.7521.33028 0.641
                                    - 7521.33028
                                                      - 23s
       0
                                                       - 29s
353
       0
           0 7521.33028
                         0 1301
                                    - 7521.33028
354
       0
           0 7521.33028
                                     - 7521.33028
                                                         29s
                         0 1159
                                                       - 33s
355
       0
           0 7521.33028 0 1030
                                    - 7521.33028
                                    - 7521.33028
                                                      - 33s
356
           0 7521.33028 0 1023
       0
                                                      - 46s
357
       0
           0 7521.33028
                         0 574
                                    - 7521.33028
                         0 914
                                    - 7521.33028
358
           0 7521.33028
359
           0 7521.33028 0 338
                                    - 7521.33028
                                                      - 59s
       0
                                                      - 60s
360
       0
           0 7521.33028 0 640
                                    - 7521.33028
361
           0 7521.33028
                         0 630
                                    - 7521.33028
                                                      - 60s
362
       0
           0 7521.33028
                         0 465
                                    - 7521.33028
                                                      - 68s
           0.7521.33028 0.420
                                                      - 68s
363
       0
                                    - 7521.33028
364
       0
           0.7521.33028 \quad 0.440
                                    - 7521.33028
                                                      - 69s
       0
           0 7521.33028
                         0 599
                                    - 7521.33028
365
                                                         75s
366
       0
           0 7521.33028 0 648
                                    - 7521.33028
                                                  - - 75s
367
           0.7521.33028
                                    - 7521.33028
                                                      - 79s
       0
                         0.810
368
       0
           0 7521.33028
                         0 567
                                    - 7521.33028
                                                      - 85s
                                                  - - 87s
369
           0 7521.33028 0 454
                                    - 7521.33028
370
       0
           2 7521.33028 0 454
                                    - 7521.33028
                                                  - - 95s
371
       3
           8 7521.33028 2 572
                                    - 7521.33028
                                                  - 6444 101s
           16 7521.33028 3 1114
                                     - 7521.33028 - 6404 108s
372
373
           24 7521.33028 5 707
                                     - 7521.33028
                                                   - 4880 119s
       19
                                                   - 5922 122s
374
       23
           29 7521 33028 6 605
                                     - 7521 33028
375
       28
           40 7521.33028 8 600
                                     - 7521.33028
                                                    - 5882 127s
       39
376
           59 7521.33028 10 798
                                     - 7521.33028
                                                    - 5261 136s
           97 7521.33028 17 997
377
      64
                                     - 7521.33028
                                                     - 4469 155s
378
      111 180 7521.33028 23 718
                                      - 7521.33028
                                                     - 4451 178s
379
      257
           253 7561.33028 53 769
                                       - 7521.33028
                                                      - 2820 194s
380
      413 369 7561.33028 121 676
                                      - 7521.33028
                                                     - 2018 210s
     613 491 7561.33028 205 356
                                       - 7521.33028
                                                      - 1522 222s
381
382 H 774 295
                          7561.3302838 7521.33028 0.53% 1305 234s
383
384 Cutting planes:
385
     Learned: 26
386
     Gomory: 5
387
     Cover: 768
     Implied bound: 725
388
389
     Clique: 3771
390
     MIR: 324
391
     StrongCG: 70
392
     Flow cover: 34
393
     GUB cover: 471
394
     Zero half: 53
395
     RLT: 177
396
     Relax-and-lift: 316
397
     BQP: 159
398
399
400 Explored 928 nodes (1350217 simplex iterations) in 234.86 seconds (775.17 work units)
    Thread count was 8 (of 8 available processors)
401
402
403 Solution count 1: 7561.33
404
405 Optimal solution found (tolerance 5.00e-02)
406 Best objective 7.561330283766e+03, best bound 7.521330283766e+03, gap 0.5290%
407
    Warning: linear constraint 590288 and linear constraint 1126482 have the same name "ConSP25 1[0,0]"
408 Set parameter MIPGap to value 1e-08
409 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
410
411 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
412
    Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
413
414 Optimize a model with 2481560 rows, 1955335 columns and 17235839 nonzeros
415 Model fingerprint: 0x5fae8a5d
```

```
416 Variable types: 963295 continuous, 992040 integer (985965 binary)
417 Coefficient statistics:
          Matrix range [1e-01, 1e+10]
418
419
          Objective range [6e-05, 5e+01]
          Bounds range [1e+00, 8e+01]
420
421
          RHS range
                                  [8e-01, 1e+10]
        Warning: Model contains large matrix coefficients
422
423 Warning: Model contains large rhs
424
                 Consider reformulating model or setting NumericFocus parameter
425
                 to avoid numerical issues.
426 Presolve removed 2475620 rows and 1953381 columns
427 Presolve time: 4.80s
428 Presolved: 5940 rows, 1954 columns, 15773 nonzeros
429 Variable types: 8 continuous, 1946 integer (1121 binary)
430 Found heuristic solution: objective 4320.8302838
431 Found heuristic solution: objective 4340.8302838
432
433 Root simplex log...
434
435 Iteration Objective
                                              Primal Inf. Dual Inf.
                                                                                      Time
436
               0 1.2007280e+04 8.760652e+03 0.000000e+00
            2042 6.0871303e+03 0.000000e+00 0.000000e+00
437
438
439 Root relaxation: objective 6.087130e+03, 2042 iterations, 0.03 seconds (0.03 work units)
440
441
            Nodes | Current Node | Objective Bounds
                                                                                            Work
442
         Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
443
             0 0 6087.13028 0 17 4340.83028 6087.13028 40.2% - 6s
444
445 H 0 0
                                           6086.8302838 6087.13028 0.00% - 6s
446
447 Cutting planes:
448
          Learned: 2
449
          Cover: 10
450
          Implied bound: 10
451
          MIR: 2
452
453 Explored 1 nodes (2811 simplex iterations) in 6.38 seconds (7.54 work units)
454 Thread count was 8 (of 8 available processors)
455
456 Solution count 3: 6086.83 4340.83 4320.83
457
458 Optimal solution found (tolerance 1.00e-08)
459 Best objective 6.086830283766e+03, best bound 6.086830283766e+03, gap 0.0000%
460
       SP is solved
461 SP's optimal solution is' ☐ 6086
462
463
464 Collect LB = [1017.0, 7071.330283766496, 7561.330283766496]
465 Collect_UB = [12210.660567532992, 7561.330283766496, 7561.330283766496]
466 Collect Hua = [0.0, 5596.830283766496, 6086.830283766496]
467 Collect_SPObjVal = [5596.830283766496, 6086.830283766496, 6086.830283766496]
468 Collect MPObjValNHua = [1017.0, 1474.5, 1474.5]
469
470
471
          Reach the termination conditions, stop iteration
472
         Values adopted from the Itr' th iteration, and Itr = \{2\}, judgeCount = \{2\}
473
474
                           ~judge = 2, SPObj_SPF = 6086.830283766496
                               pi: 0-6, \quad ai-di: \overline{7-27}, \quad gi\_SP-gpi\_SP: 0.0000000-0.000000, \quad ai\_SP-di: \overline{7-27}, \quad taoi-deltai: \overline{7-29}, \quad taoPi\_SP-deltaPi\_SP: \overline{7-29}, \quad taoPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-deltaPi\_SP-d
475
       Vessel i: 0:
                                                                                                                                                                                                                                            betaNi: 22
               bi: 22
476
        Vessel i: 1:
                               pi: 14-20,
                                                 ai-di: 9-18,
                                                                          gi SP-gpi SP: 0.000000-0.000000,
                                                                                                                                       ai SP-di: 9-18,
                                                                                                                                                                   taoi-deltai: 9-18,
                                                                                                                                                                                                  taoPi SP-deltaPi SP: 9-18, betaNi: 9
               bi: 9
        Vessel i: 2:
                               pi: 8-14,
                                                ai-di: 11-40,
                                                                          gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                                                                       ai_SP-di: 11-40,
                                                                                                                                                                     taoi-deltai: 11-42,
                                                                                                                                                                                                      taoPi_SP-deltaPi_SP: 11-42,
                                                                                                                                                                                                                                                        betaNi
          31, bi: 31
        Vessel i: 3:
                               pi: 21-27,
                                                                            gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                                                                                                       taoi-deltai: 17-27,
                                                                                                                                                                                                        taoPi_SP-deltaPi_SP: 17-27,
                                                    ai-di: 17-31,
                                                                                                                                        ai_SP-di: 17-31,
        betaNi: 10,
                               bi: 10
        Vessel i: 4:
                               pi: 14-20,
                                                    ai-di: 18-23,
                                                                            gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                                                                         ai SP-di: 18-23,
                                                                                                                                                                       taoi-deltai: 19-24.
                                                                                                                                                                                                        taoPi_SP-deltaPi_SP: 19-24,
        betaNi: 5,
                             bi: 5
        Vessel i: 5:
                               pi: 27-34,
                                                    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: 18-24,
                                                    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,
                             bi: 9
        Vessel i: 7:
                              pi: 14-20,
                                                    ai-di: 37-68,
                                                                            gi_SP-gpi_SP: 1.000000-0.600000,
                                                                                                                                         ai SP-di: 47-68,
                                                                                                                                                                       taoi-deltai: 47-77,
                                                                                                                                                                                                        taoPi SP-deltaPi SP: 47-77,
        betaNi: 30
                               bi: 30
483
        Vessel i: 8:
                               pi: 28-34,
                                                    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
484
485 round LB = [1017, 7071, 7561]
486 round UB = [12211, 7561, 7561]
487 round Hua = [0, 5597, 6087]
488 round SPObjVal = [5597, 6087, 6087]
489 round MPObjValNHua = [1017, 1474, 1474]
490
```

unknown

| 401 | Time: 770.000000 |
|-----|------------------|
| 491 | Time. 779.00000 |
| 493 | |
| 494 | Time: 779.000000 |
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