```
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=43891
     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 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 481534 rows, 46641 columns and 1344872 nonzeros
19
     Model fingerprint: 0x3e7421da
     Variable types: 1 continuous, 46640 integer (46608 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 262377 rows and 19927 columns (presolve time = 5s) ...
30
31
     Presolve removed 424133 rows and 30617 columns
     Presolve time: 8.20s
     Presolved: 57401 rows, 16024 columns, 231304 nonzeros
34
     Variable types: 0 continuous, 16024 integer (16000 binary)
35
     Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
     Showing first log only...
37
38
39
     Root relaxation presolved: 57396 rows, 16029 columns, 231289 nonzeros
40
41
42
     Root simplex log...
43
44
     Iteration Objective
                                    Primal Inf. Dual Inf.
           0 8.4300000e+02 7.187500e+01 1.524365e+08
45
46
     Concurrent spin time: 0.03s
48
     Solved with dual simplex (primal model)
49
50
     Root relaxation: objective 8.430000e+02, 2419 iterations, 0.30 seconds (0.31 work units)
51
        Nodes | Current Node | Objective Bounds
52
                                                                               Work
53
      Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
54
             0 843.00000 0 22
55
                                                 - 843.00000
                                 3883.0000000 843.00000 78.3%
56
    H = 0 = 0
                                                                                    95
57
     Η
         0
                0
                                 2023.0000000 843.00000 58.3%
             0 843.00000 0 148 2023.00000 843.00000 58.3%
59 H 0 0
                                 1963.0000000 843.00000 57.1% - 10s
60
              0 843.00000 0 148 1963.00000 843.00000 57.1%
              0 843.00000 0 86 1963.00000 843.00000 57.1%
62
              0 843.00000 0 80 1963.00000 843.00000 57.1%
                                 1323.0000000 843.00000 36.3% - 12s
63 H 0 0
64
         0
              0 843.00000 0 14 1323.00000 843.00000 36.3% - 14s
              0\ 843.00000\ 0\ 19\ 1323.00000\ 843.00000\ 36.3\%
65
66 H 0 0
                                  883.0000000 843.00000 4.53% - 14s
67
              0 843.00000 0 87 883.00000 843.00000 4.53% - 15s
68
               0 843.00000
                                0 99 883.00000 843.00000 4.53%
69
              0 843.00000 0 25 883.00000 843.00000 4.53%
70
              0 843 00000 0 211 883 00000 843 00000 4 53%
         0
                                                                                    - 20s
71
         0
              0 843.00000 0 279 883.00000 843.00000 4.53%
                                                                                         20s
    H 0
                                  843.0000000 843.00000 0.00% - 21s
73
74
     Cutting planes:
       Gomory: 9
76
       Lift-and-project: 2
       Cover: 46
77
78
       Implied bound: 3
79
       Clique: 21
```

```
80
      MIR: 28
 81
      StrongCG: 18
      GUB cover: 10
 82
 83
      Zero half: 2
      RLT: 17
 85
      Relax-and-lift: 54
 86
      BOP: 3
 87
 88 Explored 1 nodes (30905 simplex iterations) in 21.59 seconds (36.73 work units)
 89 Thread count was 8 (of 8 available processors)
 90
 91 Solution count 6: 843 883 1323 ... 3883
 92
 93 Optimal solution found (tolerance 1.00e-10)
 94 Best objective 8.430000000000e+02, best bound 8.43000000000e+02, gap 0.0000%
    Set parameter MIPGap to value 1e-08
 96 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
 98 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
100
101 Optimize a model with 1983411 rows, 1559473 columns and 13693978 nonzeros
102 Model fingerprint: 0x1145fd22
103 Variable types: 766961 continuous, 792512 integer (787112 binary)
104 Coefficient statistics:
105 Matrix range [1e-01, 1e+10]
106 Objective range [6e-05, 5e+01]
      Bounds range [1e+00, 8e+01]
107
                    [8e-01, 1e+10]
108
      RHS range
109 Warning: Model contains large matrix coefficients
110 Warning: Model contains large rhs
          Consider reformulating model or setting NumericFocus parameter
111
112
          to avoid numerical issues.
113 Presolve removed 1978458 rows and 1557811 columns
114 Presolve time: 4.20s
115 Presolved: 4953 rows, 1662 columns, 13084 nonzeros
116 Variable types: 6 continuous, 1656 integer (953 binary)
117 Found heuristic solution: objective 3879.1111111
118 Found heuristic solution: objective 3899.1111111
119
120 Root simplex log...
121
122 Iteration Objective
                          Primal Inf. Dual Inf.
123
         0 1.1382000e+04 5.068677e+03 0.000000e+00
       1590 5.6051111e+03 0.000000e+00 0.000000e+00
124
125
126 Root relaxation: objective 5.605111e+03, 1590 iterations, 0.01 seconds (0.02 work units)
127
128
       Nodes | Current Node | Objective Bounds
129 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
130
                         5605.11111111 15291.7778 173% - 5s
131 H 0 0
                  - 0
                         5605.11111 5605.11111 0.00% - 5s
132
       0 0
133
134 Explored 1 nodes (2002 simplex iterations) in 5.53 seconds (5.93 work units)
135 Thread count was 8 (of 8 available processors)
136
137 Solution count 3: 5605.11 3899.11 3879.11
138
139 Optimal solution found (tolerance 1.00e-08)
140 Best objective 5.6051111111111e+03, best bound 5.605111111111e+03, gap 0.0000%
141 SP is solved
142 SP's optimal solution is' ☐ 5605
143
144 	ext{ Itr} = 0
145 Collect_LB = [843.0]
146 Collect_UB = [12053.222222222222]
147 Collect_Hua = [0.0]
148 Collect SPObjVal = [5605.111111111113]
149 Collect_MPObjValNHua = [843.0]
150
151
152 Set parameter TimeLimit to value 12000
153 Set parameter MIPGap to value 0.0005
154 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
155
156 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
157 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
158
159 Optimize a model with 488881 rows, 229425 columns and 1352263 nonzeros
160 Model fingerprint: 0xf7c9e856
161 Variable types: 1 continuous, 229424 integer (229392 binary)
162 Coefficient statistics:
      Matrix range [1e+00, 1e+10]
163
```

```
164
      Objective range [1e+00, 2e+01]
      Bounds range [1e+00, 1e+00]
165
                   [1e+00, 2e+10]
     RHS range
166
167
     Warning: Model contains large matrix coefficients
168 Warning: Model contains large rhs
169
          Consider reformulating model or setting NumericFocus parameter
170
          to avoid numerical issues.
171 Presolve removed 323492 rows and 211253 columns (presolve time = 5s) ...
172 Presolve removed 466035 rows and 221792 columns
173 Presolve time: 7.86s
174 Presolved: 22846 rows, 7633 columns, 95345 nonzeros
175
    Variable types: 0 continuous, 7633 integer (7609 binary)
176
177 Root simplex log...
178
179 Iteration Objective
                          Primal Inf. Dual Inf.
        0 6.4481111e+03 9.100000e+02 0.000000e+00
180
                                                          8s
181
       3168 6.4481111e+03 0.000000e+00 0.000000e+00
182
Root relaxation: objective 6.448111e+03, 3168 iterations, 0.06 seconds (0.08 work units)
184
185
       Nodes | Current Node | Objective Bounds
                                                      ↓ Work
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
186
187
           0 6448.11111 0 25
188
                                    - 6448.11111
189
       0
           0.6448.11111 \quad 0.130
                                     - 6448.11111
           0.6448.11111 \quad 0.127
190
                                     - 6448.11111
191
           0 6448.11111 0 182
                                     - 6448.11111
       0
                                                          9s
192
       0
           0 6448.11111 0 166
                                     - 6448.11111
                                                       - 9s
193
           0 6448.11111 0 37
                                    - 6448.11111
                                                      - 11s
194
       0
           0 6448.11111 0 72
                                    - 6448.11111
                                                       - 11s
           0 6448.11111 0 25
                                                   - - 12s
195
       0
                                    - 6448.11111
196
       0
           0.6448.11111 \quad 0 \quad 48
                                    - 6448.11111
                                                      - 12s
                                     - 6448.11111
197
       0
           0 6448.11111 0 361
198
       0
           0 6448.11111 0 360
                                    - 6448.11111
                                                   - - 13s
199
           0.6448.11111 \quad 0 \quad 50
                                    - 6448.11111
                                                   - - 13s
       0
200
       0
           0 6448.11111 0 50
                                    - 6448.11111
                                                      - 14s
           2 6448.11111 0 50
                                                   - - 15s
201
                                    - 6448.11111
       23 26 6448.11111 6 407
202
                                     - 6448.11111 - 2894 20s
                                       - 6448.11111 - 1847 26s
203
       88 117 6448.11111 17 270
204
      169 203 6448.11111 36 217
                                        - 6448.11111 - 1350 30s
205 H 226 203
                          6448.1111111 6448.11111 0.00% 1101 30s
206
207 Cutting planes:
208
     Learned: 4
209
     Gomory: 3
     Cover: 509
210
211
      Implied bound: 991
      Clique: 958
212
      MIR: 186
213
214
      StrongCG: 157
215
      GUB cover: 32
     Zero half: 11
216
217
      RLT: 7
218
      Relax-and-lift: 15
219
      BQP: 10
220
221 Explored 281 nodes (346551 simplex iterations) in 30.17 seconds (61.74 work units)
222 Thread count was 8 (of 8 available processors)
223
224 Solution count 1: 6448.11
225
226 Optimal solution found (tolerance 5.00e-04)
227 Best objective 6.448111111111e+03, best bound 6.448111111111e+03, gap 0.0000%
228 Set parameter MIPGap to value 1e-08
229 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
230
231 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
232 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
233
234 Optimize a model with 1983411 rows, 1559473 columns and 13693978 nonzeros
235 Model fingerprint: 0x5c8faad8
236 Variable types: 766961 continuous, 792512 integer (787112 binary)
237 Coefficient statistics:
     Matrix range [1e-01, 1e+10]
238
      Objective range [6e-05, 5e+01]
239
240
     Bounds range [1e+00, 8e+01]
241
     RHS range
                    [8e-01, 1e+10]
242 Warning: Model contains large matrix coefficients
243 Warning: Model contains large rhs
244
          Consider reformulating model or setting NumericFocus parameter
245
          to avoid numerical issues.
246 Presolve removed 1977950 rows and 1557665 columns
247 Presolve time: 3.98s
```

```
248 Presolved: 5461 rows, 1808 columns, 14589 nonzeros
249 Variable types: 6 continuous, 1802 integer (1046 binary)
250
251 Root simplex log...
252
253 Iteration Objective
                          Primal Inf. Dual Inf.
                                                  Time
        0 1.1268000e+04 6.599738e+03 0.000000e+00
254
255
       1429 5.7831111e+03 0.000000e+00 0.000000e+00
256
257 Root relaxation: objective 5.783111e+03, 1429 iterations, 0.01 seconds (0.02 work units)
2.58
259
       Nodes | Current Node | Objective Bounds | Work
260 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
261
262 *
                     0 5783.1111111 5783.11111 0.00% - 5s
263
264 Explored 1 nodes (1957 simplex iterations) in 5.32 seconds (5.50 work units)
265 Thread count was 8 (of 8 available processors)
266
267 Solution count 1: 5783.11
268
269 Optimal solution found (tolerance 1.00e-08)
270 Best objective 5.783111111111e+03, best bound 5.783111111111e+03, gap 0.0000%
271 SP is solved
272 SP's optimal solution is' ☐ 5783
273
274 	ext{ Itr} = 1
275 Collect_LB = [843.0, 6448.111111111113]
276 Collect_UB = [12053.22222222226, 6626.111111111113]
277 Collect_Hua = [0.0, 5605.111111111113]
278 Collect SPObjVal = [5605.111111111113, 5783.111111111113]
279 Collect MPObjValNHua = [843.0, 843.0]
280
281
282 Set parameter TimeLimit to value 12000
283 Set parameter MIPGap to value 0.0005
284 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
285
286 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
287
    Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
288
289 Optimize a model with 488882 rows, 229425 columns and 1352280 nonzeros
290 Model fingerprint: 0x311fa47e
291 Variable types: 1 continuous, 229424 integer (229392 binary)
292 Coefficient statistics:
293 Matrix range [1e+00, 1e+10]
294
      Objective range [1e+00, 2e+01]
295
      Bounds range [1e+00, 1e+00]
296
     RHS range
                   [1e+00, 2e+10]
     Warning: Model contains large matrix coefficients
297
298 Warning: Model contains large rhs
299
          Consider reformulating model or setting NumericFocus parameter
300
          to avoid numerical issues.
301 Presolve removed 323493 rows and 211253 columns (presolve time = 5s) ...
302 Presolve removed 466036 rows and 221792 columns
303 Presolve time: 7.72s
304 Presolved: 22846 rows, 7633 columns, 95345 nonzeros
305 Variable types: 0 continuous, 7633 integer (7609 binary)
306
307 Root simplex log...
308
309 Iteration Objective
                          Primal Inf. Dual Inf.
        0 6.6261111e+03 9.100000e+02 0.000000e+00
310
311
       3168 6.6261111e+03 0.000000e+00 0.000000e+00
312
313 Root relaxation: objective 6.626111e+03, 3168 iterations, 0.06 seconds (0.08 work units)
314
315
       Nodes | Current Node | Objective Bounds
                                                         Work
316
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
317
           0 6626.11111 0 25
                                    - 6626.11111
318
319
       0
           0.6626.11111 0.130
                                    - 6626.11111
                                                          95
320
       0
           0 6626.11111
                         0 127
                                     - 6626.11111
                                                          9s
321
           0 6626.11111
                         0 182
                                     - 6626.11111
322
           0.6626.11111 0.166
                                    - 6626 11111
                                                       - 9s
       0
                                                      - 11s
323
       0
           0 6626.11111
                         0 37
                                    - 6626.11111
324
           0 6626.11111
                         0 72
                                    - 6626.11111
325
       0
           0 6626.11111
                         0 25
                                    - 6626.11111
                                                       - 12s
326
           0 6626.11111
                         0 48
                                    - 6626.11111
                                                      - 12s
       0
327
       0
           0 6626.11111
                         0 361
                                     - 6626.11111
                                                       - 12s
328
       0
           0 6626.11111
                         0 360
                                     - 6626.11111
                                                       - 12s
                                                   - - 13s
329
       0
           0 6626.11111 0 50
                                    - 6626.11111
                                                   - - 13s
330
       0
           0 6626.11111 0 50
                                    - 6626.11111
       0
           2 6626.11111
                         0 50
                                    - 6626.11111
                                                       - 15s
331
```

```
332
       39 42 6626.11111 9 408
                                     - 6626.11111 - 1906 20s
333
      120 145 6635.58480 24 246
                                      - 6626.11111 - 1634 26s
      219 279 8466.11111 61 370
                                                     - 1227 30s
334
                                       - 6626.11111
335
      679 595 6626.11111 8 550
                                       - 6626.11111
                                                      - 556 35s
      992 708 6626.11111 36 193
                                       - 6626.11111
                                                      - 479 41s
336
337
      1068 1017 6626.11111 51 491
                                        - 6626.11111
                                                       - 523 45s
338 * 1470 793
                      186 7086.1111111 6626.11111 6.49% 449 49s
339
     1954 559 6626.11111 98 50 7086.11111 6626.11111 6.49% 399 58s
            561 6626.11111 52 203 7086.11111 6626.11111 6.49% 398 61s
340
      1957
      1959 562 6766.11111 120 194 7086.11111 6626.11111 6.49% 398 65s
341
     1962 564 6626.11111 52 627 7086.11111 6626.11111 6.49% 397 70s
342
343 H 1962 535
                           7026.1111111 6626.11111 5.69% 397 72s
344 H 1963 509
                           6626.11111111 6626.11111 0.00% 397 73s
345
346 Cutting planes:
347
     Gomory: 11
348
      Cover: 345
      Implied bound: 58
349
350
     Projected implied bound: 15
351
      Clique: 54
352
      MIR: 20
353
      StrongCG: 8
354
      Flow cover: 16
355
      GUB cover: 67
356
      Zero half: 19
357
      RLT: 17
      Relax-and-lift: 39
358
359
      BOP: 3
360
361 Explored 1963 nodes (879924 simplex iterations) in 73.88 seconds (145.47 work units)
362 Thread count was 8 (of 8 available processors)
363
364 Solution count 3: 6626.11 7026.11 7086.11
365
366 Optimal solution found (tolerance 5.00e-04)
367 Best objective 6.6261111111111e+03, best bound 6.626111111111e+03, gap 0.0000%
368
    Set parameter MIPGap to value 1e-08
369 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
370
371 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
372 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
373
374 Optimize a model with 1983411 rows, 1559473 columns and 13693978 nonzeros
375 Model fingerprint: 0x6bd04ca5
    Variable types: 766961 continuous, 792512 integer (787112 binary)
376
377 Coefficient statistics:
     Matrix range [1e-01, 1e+10]
378
379
      Objective range [6e-05, 5e+01]
380 Bounds range [1e+00, 8e+01]
                    [8e-01, 1e+10]
381
     RHS range
    Warning: Model contains large matrix coefficients
382
383 Warning: Model contains large rhs
384
         Consider reformulating model or setting NumericFocus parameter
385
         to avoid numerical issues.
386 Presolve removed 1977523 rows and 1557586 columns
387 Presolve time: 4.15s
388 Presolved: 5888 rows, 1887 columns, 15718 nonzeros
389 Variable types: 6 continuous, 1881 integer (1082 binary)
390
391 Root simplex log...
392
393 Iteration Objective
                          Primal Inf. Dual Inf.
        0 1.1388000e+04 7.654648e+03 0.000000e+00
394
395
       1510 5.7831111e+03 0.000000e+00 0.000000e+00
396
397
    Root relaxation: objective 5.783111e+03, 1510 iterations, 0.02 seconds (0.02 work units)
398
       Nodes | Current Node | Objective Bounds
399
                                                     ↓ Work
400 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
401
402 H 0 0
                        5783.1111111 16897.7778 192% - 5s
403
       0 0
                 - 0 5783.11111 5783.11111 0.00% - 5s
404
405 Explored 1 nodes (2001 simplex iterations) in 5.62 seconds (5.69 work units)
406 Thread count was 8 (of 8 available processors)
407
408 Solution count 1: 5783.11
409
410 Optimal solution found (tolerance 1.00e-08)
411 Best objective 5.783111111111e+03, best bound 5.783111111111e+03, gap 0.0000%
412 SP is solved
413 SP's optimal solution is' □ 5783
414
     Itr = 2
415
```

```
416 Collect_LB = [843.0, 6448.111111111113, 6626.111111111113]
417 Collect_UB = [12053.22222222226, 6626.1111111111113, 6626.11111111113]
418 Collect_Hua = [0.0, 5605.111111111113, 5783.111111111113]
419 Collect_SPObjVal = [5605.1111111111113, 5783.111111111113, 5783.111111111113]
420 Collect MPObjValNHua = [843.0, 843.0, 843.0]
421
422
423 Reach the termination conditions, stop iteration
424
     Values adopted from the Itr' th iteration, and Itr = \{2\}, judgeCount = \{2\}
425
               ~~judge = 2, SPObj_SPF = 5783.111111111111
426 ~
427 Vessel i: 0:
                  pi: 0-7, ai-di: 3-34, gi_SP-gpi_SP: 0.000000-0.000000,
                                                                              ai_SP-di: 3-34, taoi-deltai: 3-32, taoPi_SP-deltaPi_SP: 3-32, betaNi: 29
        bi: 29
428 Vessel i: 1:
                   pi: 7-12, ai-di: 12-22,
                                            gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                 ai_SP-di: 12-22,
                                                                                                   taoi-deltai: 12-20,
                                                                                                                       taoPi_SP-deltaPi_SP: 12-20,
                                                                                                                                                     betaNi
     : 8,
          bi: 8
     Vessel i: 2:
                              ai-di: 27-35,
                                              gi SP-gpi SP: 0.000000-0.000000,
                                                                                  ai SP-di: 27-35,
                                                                                                    taoi-deltai: 27-33,
                                                                                                                        taoPi SP-deltaPi SP: 27-33,
                  pi: 14-19,
     betaNi: 6.
                 bi: 6
430
                                             gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                                                       taoPi_SP-deltaPi_SP: 24-58,
    Vessel i: 3:
                  pi: 7-14,
                              ai-di: 24-60,
                                                                                 ai_SP-di: 24-60,
                                                                                                   taoi-deltai: 24-58,
                                                                                                                                                     betaNi
     : 34, bi: 34
     Vessel i: 4:
                  pi: 15-20,
                               ai-di: 35-41,
                                              gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                  ai_SP-di: 35-41,
                                                                                                    taoi-deltai: 35-39,
                                                                                                                        taoPi_SP-deltaPi_SP: 35-39,
     betaNi: 4,
                 bi: 4
                  pi: 28-34,
     Vessel i: 5:
                               ai-di: 31-60,
                                              gi_SP-gpi_SP: 0.000000-1.000000,
                                                                                  ai_SP-di: 31-60,
                                                                                                     taoi-deltai: 31-46,
                                                                                                                        taoPi_SP-deltaPi_SP: 31-46,
     betaNi: 15,
                  bi: 15
                                              gi_SP-gpi_SP: 1.000000-0.600000,
    Vessel i: 6:
                  pi: 15-21,
                               ai-di: 40-80,
                                                                                  ai SP-di: 48-80,
                                                                                                    taoi-deltai: 48-72,
                                                                                                                        taoPi SP-deltaPi SP: 48-72,
     betaNi: 24,
                  bi: 24
434
    Vessel i: 7:
                  pi: 28-34,
                               ai-di: 43-72,
                                             gi_SP-gpi_SP: 0.800000-0.200000,
                                                                                  ai_SP-di: 51-72,
                                                                                                    taoi-deltai: 51-64,
                                                                                                                        taoPi_SP-deltaPi_SP: 51-64,
     betaNi: 13,
                  bi: 13
435
436 round LB = [843, 6448, 6626]
437 round UB = [12053, 6626, 6626]
438 round Hua = [0, 5605, 5783]
439 round SPObjVal = [5605, 5783, 5783]
440 round MPObjValNHua = [843, 843, 843]
441
442 OptimalObj = 6626.111111111111
443 Time: 486.000000
444
445
446
447
```