```
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=23695
   import sys; print('Python %s on %s' % (sys.version, sys.platform))
   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 000000/1 000000/1 000000/1 LW 000/3 python_code/9 Code for this paper/main_RO_TWS.py', wdir='E:/1 0000/3 0000/1 000000/1 000000/1 000000/1 000000/1 LW 000/3 python_code/9 Code for
   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
   Optimize a model with 648826 rows, 58701 columns and 1805708 nonzeros
   Model fingerprint: 0x71546b27
   Variable types: 1 continuous, 58700 integer (58660 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
27
   Warning: Model contains large rhs
28
        Consider reformulating model or setting NumericFocus parameter
29
        to avoid numerical issues.
30
   Presolve removed 292891 rows and 15988 columns (presolve time = 5s) ...
   Presolve removed 292891 rows and 15988 columns (presolve time = 10s) ...
31
   Presolve removed 292891 rows and 15988 columns (presolve time = 15s) ...
   Presolve removed 539391 rows and 36153 columns
34
   Presolve time: 17.83s
35
   Presolved: 109435 rows, 22548 columns, 339203 nonzeros
   Variable types: 0 continuous, 22548 integer (22518 binary)
37
   Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
38
39
   Showing first log only...
40
41
   Root relaxation presolved: 22548 rows, 131983 columns, 361751 nonzeros
42
43
44
   Root simplex log...
45
46
   Iteration Objective
                       Primal Inf. Dual Inf.
      0 6.8400000e+02 0.000000e+00 1.054000e+03
     1658 6.8454906e+02 0.000000e+00 1.634750e+04
48
49
   Concurrent spin time: 0.00s
50
51
   Solved with dual simplex (primal model)
52
   Root relaxation: objective 6.840000e+02, 4274 iterations, 1.16 seconds (1.23 work units)
53
54
55
     Nodes | Current Node | Objective Bounds
                                                    Work
56
   Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
57
58
         0 684.00000 0 38
                                - 684.00000
59 H 0 0
                     5844.0000000 684.00000 88.3% - 22s
     0 \quad 0 \quad 684.00000 \quad 0 \quad 104 \quad 5844.00000 \quad 684.00000 \quad 88.3\%
60
         0\ 684.00000\ 0\ 79\ 5844.00000\ 684.00000\ 88.3\%
  H \quad 0 \quad 0
                     4204.0000000 684.00000 83.7% - 24s
62
         0 684.00000 0 77 4204.00000 684.00000 83.7% - 24s
63
64
         0 684.00000 0 18 4204.00000 684.00000 83.7%
                     1544.0000000 684.00000 55.7%
65
   H = 0
         0 684.00000 0 27 1544.00000 684.00000 55.7%
      0
66
67
      0
         0 684.00000 0 60 1544.00000 684.00000 55.7%
                                                        - 27s
68
         0 684.00000 0 112 1544.00000 684.00000 55.7%
      0
                                                           28s
69
         0 684.00000 0 36 1544.00000 684.00000 55.7%
70 H 0
                     1124 0000000 684 00000 39 1%
         0
      0
         0 684.00000 0 75 1124.00000 684.00000 39.1%
         0\ 684.00000\ 0\ 175\ 1124.00000\ 684.00000\ 39.1\%
73
      0
         0 684.00000 0 37 1124.00000 684.00000 39.1%
                                                       - 37s
74
         0 684.00000 0 237 1124.00000 684.00000 39.1%
      0
                                                        - 38s
75
         0 684.00000 0 197 1124.00000 684.00000 39.1%
                                                           38s
76
         0 684.00000
                      0 149 1124.00000 684.00000 39.1%
                                                           38s
                                                       - 42s
         0 684,00000 0 59 1124,00000 684,00000 39.1%
77
      0
         0\ 684.00000\ 0\ 58\ 1124.00000\ 684.00000\ 39.1\%
78
      0
                                                       - 42s
      0
                     1084.0000000 684.00000 36.9% - 42s
79
   Η
```

```
80
          0 684.00000 0 150 1084.00000 684.00000 36.9%
                                                              43s
       0
 81 H 0 0
                        924.0000000 684.00000 26.0% - 43s
       0 0 684.00000 0 206 924.00000 684.00000 26.0% - 45s
 82
 83
       0
           0 684.00000 0 43 924.00000 684.00000 26.0%
           0 684.00000 0 43 924.00000 684.00000 26.0%
 85
           0 684,00000 0 229 924.00000 684.00000 26.0% - 51s
       0
       0 0 684.00000 0 226 924.00000 684.00000 26.0% - 51s
 86
 87
       0 0 684.00000 0 347 924.00000 684.00000 26.0% - 51s
                        684.0000000 684.00000 0.00% - 53s
 88 H 0 0
       0 0 684.00000 0 25 684.00000 684.00000 0.00% - 53s
 89
 90
 91
    Cutting planes:
 92
     Gomory: 2
 93
     Cover: 103
 94
     Implied bound: 977
 95
     Clique: 56
 96
     MIR: 25
 97
     StrongCG: 17
 98
     GUB cover: 21
 99
     RLT: 6
100
     Relax-and-lift: 10
101
     PSD: 2
102
103 Explored 1 nodes (69720 simplex iterations) in 53.60 seconds (80.64 work units)
104 Thread count was 8 (of 8 available processors)
105
106 Solution count 7: 684 924 1084 ... 5844
107
108 Optimal solution found (tolerance 1.00e-10)
109 Best objective 6.840000000000e+02, best bound 6.84000000000e+02, gap 0.0000%
110 Set parameter MIPGap to value 1e-08
111 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
112
113 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
114 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
115
116 Optimize a model with 654199 rows, 16030 columns and 1337705 nonzeros
117 Model fingerprint: 0xac4201cf
118 Variable types: 40 continuous, 15990 integer (9240 binary)
119 Coefficient statistics:
120 Matrix range [1e-01, 1e+10]
121
     Objective range [6e-05, 5e+01]
     Bounds range [1e+00, 1e+00]
122
123
     RHS range
                   [8e-01, 1e+10]
124 Warning: Model contains large matrix coefficients
125 Warning: Model contains large rhs
126
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
127
128 Presolve removed 651695 rows and 15083 columns
129 Presolve time: 0.47s
130 Presolved: 2504 rows, 947 columns, 6695 nonzeros
131 Variable types: 10 continuous, 937 integer (563 binary)
132 Found heuristic solution: objective 3279.6104410
133 Found heuristic solution: objective 3440.6104410
134
Root relaxation: objective 4.894859e+03, 753 iterations, 0.00 seconds (0.01 work units)
136
137
      Nodes | Current Node | Objective Bounds

↓ Work

138
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
139
       0 0 4894.85898 0 58 3440.61044 4894.85898 42.3% - 0s
140
141 H 0 0
                       4862.0258092 4894.85898 0.68% - 0s
                       4891.7251799 4894.85898 0.06%
142 H 0 0
143
       0 0 4893.27025 0 34 4891.72518 4893.27025 0.03% - 0s
       0 0 4893.27025 0 20 4891.72518 4893.27025 0.03% - 0s
144
145
       0 0 4893.27025 0 13 4891.72518 4893.27025 0.03% - 0s
       0 0 4893.27025 0 10 4891.72518 4893.27025 0.03%
146
147 H 0 0
                      4892.3829521 4893.27025 0.02% - 0s
       0 0 4893.27025 0 7 4892.38295 4893.27025 0.02%
148
149
          0 cutoff 0 4892.38295 4892.38295 0.00% - 0s
150
151 Cutting planes:
152
     Gomory: 2
153
     Relax-and-lift: 1
154
155 Explored 1 nodes (1525 simplex iterations) in 0.69 seconds (0.92 work units)
156 Thread count was 8 (of 8 available processors)
157
158 Solution count 5: 4892.38 4891.73 4862.03 ... 3279.61
159
160 Optimal solution found (tolerance 1.00e-08)
161 Best objective 4.892382952071e+03, best bound 4.892382952071e+03, gap 0.0000%
162 SP is solved
163 SP's optimal solution is'□4892
```

```
164
165 Itr = 0
166 Collect_LB = [684.0]
167 Collect_UB = [10468.765904142507]
168 Collect Hua = [0.0]
169 Collect SPObjVal = [4892.382952071253]
170 Collect_MPObjValNHua = [684.0]
171
172
173 Set parameter MIPGap to value 1e-10
174 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
175
176 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
177 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
178
179 Optimize a model with 654151 rows, 344301 columns and 1811078 nonzeros
180 Model fingerprint: 0x0015e6e2
181 Variable types: 1 continuous, 344300 integer (344260 binary)
182 Coefficient statistics:
183
     Matrix range [1e+00, 1e+10]
     Objective range [1e+00, 2e+01]
184
185
     Bounds range [1e+00, 1e+00]
                    [1e+00, 2e+10]
      RHS range
     Warning: Model contains large matrix coefficients
187
188 Warning: Model contains large rhs
189
          Consider reformulating model or setting NumericFocus parameter
190
          to avoid numerical issues.
191 Presolve removed 342655 rows and 308396 columns (presolve time = 5s) ...
192 Presolve removed 342655 rows and 308396 columns (presolve time = 10s) ...
193 Presolve removed 342655 rows and 308396 columns (presolve time = 15s) ...
194 Presolve removed 342655 rows and 308396 columns (presolve time = 20s) ...
195 Presolve removed 500437 rows and 327624 columns (presolve time = 25s) ...
196 Presolve removed 577228 rows and 327628 columns
    Presolve time: 26.00s
197
198 Presolved: 76923 rows, 16673 columns, 242083 nonzeros
199
     Variable types: 0 continuous, 16673 integer (16643 binary)
200
201 Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
202 Showing first log only...
203
204 Root relaxation presolved: 16673 rows, 93596 columns, 258756 nonzeros
205
206
207 Root simplex log...
208
209 Iteration Objective
                           Primal Inf. Dual Inf.
        0 5.5810258e+03 0.000000e+00 5.837000e+03
210
211 Concurrent spin time: 0.02s
212
213 Solved with dual simplex (primal model)
214
215 Root relaxation: objective 5.581026e+03, 7662 iterations, 1.30 seconds (1.76 work units)
216
217
       Nodes | Current Node | Objective Bounds
                                                         Work
218
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
219
220
          0.5581.02581 0 29
                                    - 5581.02581
221
           0 5581.02581 0 99
                                    - 5581.02581
                                                       - 31s
222
       0
           0 5581.02581
                         0 211
                                    - 5581.02581
223
           0 5581.02581 0 103
                                     - 5581.02581
       0
                                                       - 35s
                        8281.0258092 5581.02581 32.6% - 35s
224 H 0 0
           0 5581.02581 0 128 8281.02581 5581.02581 32.6%
225
226
           0 5581.02581 0 107 8281.02581 5581.02581 32.6%
227 H 0 0
                        8201.0258092 5581.02581 31.9% - 37s
228 H 0
            0
                        7561.0258092 5581.02581 26.2%
229
           0 5581.02581 0 241 7561.02581 5581.02581 26.2%
                                                               - 40s
230
       0
           0 5581.02581 0 165 7561.02581 5581.02581 26.2%
           0.5581.02581 0.207.7561.02581.5581.02581.26.2%
231
                                                               - 40s
       0
232
           0 5581.02581 0 371 7561.02581 5581.02581 26.2%
                                                               - 41s
233
           0 5581.02581
                         0 221 7561.02581 5581.02581 26.2%
                                                                - 45s
234
           0 5581.02581 0 170 7561.02581 5581.02581 26.2%
       0
                                                               - 45s
                        7181.0258092 5581.02581 22.3%
                                                        - 48s
- 50s
235 H 0 0
236 H 0 0
                        5581.0258092 5581.02581 0.00%
237
       0 0 5581.02581 0 170 5581.02581 5581.02581 0.00% - 50s
238
239 Cutting planes:
240 Learned: 1
241
      Gomory: 1
242
      Cover: 49
243
      Implied bound: 32
244
      Clique: 446
      MIR: 81
245
246
      StrongCG: 54
247
      GUB cover: 7
```

```
248
      Zero half: 3
249
      RLT: 9
250
      Relax-and-lift: 17
251
      BQP: 79
252
     PSD: 1
253
254 Explored 1 nodes (100005 simplex iterations) in 50.47 seconds (79.33 work units)
255 Thread count was 8 (of 8 available processors)
256
257 Solution count 5: 5581.03 7181.03 7561.03 ... 8281.03
258
259 Optimal solution found (tolerance 1.00e-10)
260 Best objective 5.581025809214e+03, best bound 5.581025809214e+03, gap 0.0000%
261 Set parameter MIPGap to value 1e-08
262 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
263
264 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
265 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
266
267 Optimize a model with 654199 rows, 16030 columns and 1337705 nonzeros
268 Model fingerprint: 0xeb8c930a
269 Variable types: 40 continuous, 15990 integer (9240 binary)
270 Coefficient statistics:
271
     Matrix range [1e-01, 1e+10]
272
     Objective range [6e-05, 5e+01]
273
     Bounds range [1e+00, 1e+00]
                   [8e-01, 1e+10]
     RHS range
275 Warning: Model contains large matrix coefficients
276 Warning: Model contains large rhs
277
          Consider reformulating model or setting NumericFocus parameter
278
          to avoid numerical issues.
279 Presolve removed 649536 rows and 14510 columns
280 Presolve time: 0.48s
281 Presolved: 4663 rows, 1520 columns, 12447 nonzeros
282 Variable types: 10 continuous, 1510 integer (884 binary)
283 Found heuristic solution: objective 3772.3644878
284 Found heuristic solution: objective 3801.2533767
285
286 Root relaxation: objective 5.409944e+03, 1893 iterations, 0.03 seconds (0.04 work units)
287
288
       Nodes | Current Node | Objective Bounds
289 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
290
291
       0 0 5409.94444 0 4 3801.25338 5409.94444 42.3% - 0s
292 H 0 0
                         5407.9005126 5409.94444 0.04% - 0s
293 *
                     0 5409.9444444 5409.94444 0.00% - 0s
       0 0
294
295 Cutting planes:
296
     Gomory: 1
297
      GUB cover: 1
298
      RLT: 1
299
300 Explored 1 nodes (2544 simplex iterations) in 0.73 seconds (0.92 work units)
301 Thread count was 8 (of 8 available processors)
302
303 Solution count 4: 5409.94 5407.9 3801.25 3772.36
304
305 Optimal solution found (tolerance 1.00e-08)
306 Best objective 5.40994444444e+03, best bound 5.40994444444e+03, gap 0.0000%
307 SP is solved
308 SP's optimal solution is' ☐ 5409
309
310 Itr = 1
311 Collect LB = [684.0, 5581.02580921411]
312 Collect_UB = [10468.765904142507, 6098.587301587302]
313 Collect_Hua = [0.0, 4892.382952071253]
314 Collect SPObjVal = [4892.382952071253, 5409.944444444445]
315 Collect MPObjValNHua = [684.0, 688.6428571428569]
316
318 Set parameter MIPGap to value 1e-10
319 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
320
321 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
322 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
323
324 Optimize a model with 654151 rows, 344301 columns and 1811078 nonzeros
325 Model fingerprint: 0x81a87e59
326 Variable types: 1 continuous, 344300 integer (344260 binary)
327 Coefficient statistics:
328
     Matrix range [1e+00, 1e+10]
329
     Objective range [1e+00, 2e+01]
330
     Bounds range [1e+00, 1e+00]
      RHS range
                    [1e+00, 2e+10]
331
```

```
Warning: Model contains large matrix coefficients
332
333 Warning: Model contains large rhs
334
          Consider reformulating model or setting NumericFocus parameter
335
          to avoid numerical issues.
336 Presolve removed 343648 rows and 308501 columns (presolve time = 5s) ...
337 Presolve removed 343648 rows and 308501 columns (presolve time = 10s) ...
338 Presolve removed 343648 rows and 308501 columns (presolve time = 15s) ...
339 Presolve removed 343648 rows and 308501 columns (presolve time = 20s) ...
340 Presolve removed 518051 rows and 327685 columns (presolve time = 25s) ...
341 Presolve removed 583689 rows and 327685 columns
342 Presolve time: 25.75s
343 Presolved: 70462 rows, 16616 columns, 235024 nonzeros
344 Variable types: 0 continuous, 16616 integer (16586 binary)
345
346 Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
347 Showing first log only...
348
349 Root relaxation presolved: 16616 rows, 87078 columns, 251640 nonzeros
350
351
352 Root simplex log...
353
                           Primal Inf. Dual Inf.
354 Iteration Objective
355
        0 6.1084444e+03 0.000000e+00 5.838000e+03
356 Concurrent spin time: 0.23s
357
358 Solved with dual simplex (primal model)
359
360 Root relaxation: objective 6.108444e+03, 7058 iterations, 1.46 seconds (1.98 work units)
361
362
       Nodes | Current Node |
                                   Objective Bounds
                                                          Work
363
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
364
           0\ 6108.44444\ \ 0\ \ 44
                                     - 6108.44444
365
366
       0
           0 6108.44444 0 47
                                     - 6108.44444
367
                                     - 6108.44444
       0
           0.6108.44444
                          0 114
                                                        - 31s
368
       0
           0 6108.44444
                          0 112
                                     - 6108.44444
369
           0 6108.44444 0 142
                                     - 6108.44444
                                                        - 32s
370
                                     - 6108.44444
       0
           0.6108.44444 0.200
                                                        - 36s
371
       0
           0\ 6108.44444 \quad 0\ \ 249
                                     - 6108.44444
                                                        - 37s
           0\ 6108.44444\quad 0\ 166
                                     - 6108.44444
                                                        - 42s
372
373
       0
           0 6108.44444 0 333
                                     - 6108.44444
                                                        - 43s
374
           0 6108.44444 0 178
                                     - 6108.44444
                                                        - 47s
       0
375 H 0
            0
                        12528.444444 6108.44444 51.2% - 47s
       0 0 6108.44444 0 178 12528.4444 6108.44444 51.2%
376
377 H 0 0
                     8408.4444444 6108.44444 27.4% - 49s
378 H 0 0
                         6108.4444444 6108.44444 0.00% - 51s
379
       0 0 6108.44444 0 178 6108.44444 6108.44444 0.00%
380
381 Cutting planes:
382
      Gomory: 2
383
      Cover: 72
      Implied bound: 24
384
385
      Clique: 1837
386
      MIR: 109
387
      StrongCG: 67
388
      GUB cover: 32
389
      Zero half: 3
390
      RLT: 8
391
      Relax-and-lift: 13
392
      BOP: 71
393
      PSD: 1
394
395 Explored 1 nodes (73307 simplex iterations) in 51.94 seconds (64.68 work units)
396
    Thread count was 8 (of 8 available processors)
397
398 Solution count 3: 6108.44 8408.44 12528.4
399
400 Optimal solution found (tolerance 1.00e-10)
     Best objective 6.10844444444e+03, best bound 6.1084444444e+03, gap 0.0000%
402 Set parameter MIPGap to value 1e-08
403 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
404
405 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
406 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
407
408 Optimize a model with 654199 rows, 16030 columns and 1337705 nonzeros
409 Model fingerprint: 0xcc24e1f7
410 Variable types: 40 continuous, 15990 integer (9240 binary)
411 Coefficient statistics:
412
     Matrix range [1e-01, 1e+10]
413
     Objective range [6e-05, 5e+01]
414
      Bounds range [1e+00, 1e+00]
      RHS range
                    [8e-01, 1e+10]
415
```

```
416 Warning: Model contains large matrix coefficients
417
     Warning: Model contains large rhs
418
          Consider reformulating model or setting NumericFocus parameter
419
          to avoid numerical issues.
420 Presolve removed 649935 rows and 14593 columns
421 Presolve time: 0.39s
422 Presolved: 4264 rows, 1437 columns, 11446 nonzeros
423 Variable types: 10 continuous, 1427 integer (841 binary)
424 Found heuristic solution: objective 3740.9042488
425 Found heuristic solution: objective 3780.9042488
426
427 Root relaxation: objective 5.424944e+03, 1595 iterations, 0.02 seconds (0.03 work units)
428
429
       Nodes | Current Node | Objective Bounds

↓ Work

430 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
431
432 * 0 0
                      0 5424.9444444 5424.94444 0.00% - 0s
433
434 Explored 1 nodes (2055 simplex iterations) in 0.59 seconds (0.80 work units)
435 Thread count was 8 (of 8 available processors)
436
437 Solution count 3: 5424.94 3780.9 3740.9
438
439 Optimal solution found (tolerance 1.00e-08)
440 Best objective 5.42494444444e+03, best bound 5.4249444444e+03, gap 0.0000%
441 SP is solved
442 SP's optimal solution is' ☐ 5424
443
444 	ext{ Itr} = 2
445 Collect_LB = [684.0, 5581.02580921411, 6108.44444444445]
446 Collect_UB = [10468.765904142507, 6098.587301587302, 6098.587301587302]
447 Collect_Hua = [0.0, 4892.382952071253, 5409.944444444445]
448 Collect_SPObjVal = [4892.382952071253, 5409.94444444445, 5424.94444444445]
449 Collect_MPObjValNHua = [684.0, 688.6428571428569, 698.5]
450
451
      Ops, stop iteration
452
453
     Values adopted from the Itr-1' th iteration, and Itr = \{2\}, judgeCount = \{1\}
454
                 ~judgeCount = 1, SPObj_SPF = 5409.944444444445
455
456 Vessel i: 0:
                   pi: 0-5,
                            ai-di: 28-81,
                                           gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                 ai_SP-di: 28-81,
                                                                                                   taoi-deltai: 28-35,
                                                                                                                       taoPi_SP-deltaPi_SP: 28-35,
                                                                                                                                                      betaNi:
         bi: 7
457
                   pi: 0-5,
                             ai-di: 15-45,
                                            gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                                                       taoPi_SP-deltaPi_SP: 15-21,
     Vessel i: 1:
                                                                                 ai_SP-di: 15-45,
                                                                                                   taoi-deltai: 15-21,
                                                                                                                                                      betaNi:
          bi: 6
     Vessel i: 2:
                   pi: 5-10,
                              ai-di: 19-50,
                                             gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                  ai_SP-di: 19-50,
                                                                                                    taoi-deltai: 19-28,
                                                                                                                         taoPi_SP-deltaPi_SP: 19-28,
                                                                                                                                                       betaNi
     : 9. bi: 9
459
    Vessel i: 3:
                   pi: 10-16,
                               ai-di: 9-55,
                                             gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                  ai_SP-di: 9-55,
                                                                                                   taoi-deltai: 9-35,
                                                                                                                      taoPi_SP-deltaPi_SP: 9-35,
                                                                                                                                                  betaNi: 26
         bi: 26
     Vessel i: 4:
                   pi: 22-27,
                               ai-di: 20-42,
                                              gi_SP-gpi_SP: 0.000000-0.000000,
                                                                                   ai SP-di: 20-42,
                                                                                                     taoi-deltai: 20-25,
                                                                                                                          taoPi SP-deltaPi SP: 20-25,
     betaNi: 5.
                 bi: 5
461
     Vessel i: 5:
                   pi: 17-22,
                               ai-di: 3-61,
                                             gi SP-gpi SP: 0.000000-1.000000,
                                                                                  ai SP-di: 3-61,
                                                                                                    taoi-deltai: 4-12,
                                                                                                                      taoPi SP-deltaPi SP: 4-12, betaNi: 8
         bi: 8
    Vessel i: 6:
                   pi: 16-22,
                                                                                                                         taoPi SP-deltaPi SP: 16-33,
                               ai-di: 9-72,
                                             gi_SP-gpi_SP: 0.875000-0.200000,
                                                                                  ai SP-di: 16-72,
                                                                                                     taoi-deltai: 16-33,
                                                                                                                                                       betaNi
           bi: 17
     : 17,
463
     Vessel i: 7:
                   pi: 24-29,
                               ai-di: 2-77,
                                             gi_SP-gpi_SP: 0.800000-0.800000,
                                                                                  ai_SP-di: 10-77,
                                                                                                     taoi-deltai: 6-12,
                                                                                                                       taoPi_SP-deltaPi_SP: 10-12,
                                                                                                                                                     betaNi:
         bi: 6
                   pi: 28-34,
                               ai-di: 22-62,
                                              gi SP-gpi SP: 0.325000-1.000000,
                                                                                   ai SP-di: 24-62,
                                                                                                     taoi-deltai: 26-36,
                                                                                                                          taoPi SP-deltaPi SP: 26-36,
     Vessel i: 8:
     betaNi: 10,
                   bi: 10
465
     Vessel i: 9:
                   pi: 17-24,
                               ai-di: 28-79,
                                              gi_SP-gpi_SP: 1.000000-0.000000,
                                                                                   ai_SP-di: 35-79,
                                                                                                     taoi-deltai: 35-58,
                                                                                                                          taoPi_SP-deltaPi_SP: 35-58,
     betaNi: 23,
                   bi: 23
466
467
    round LB = [684, 5581, 6108]
468 round UB = [10469, 6099, 6099]
469 round Hua = [0, 4892, 5410]
470 round SPObjVal = [4892, 5410, 5425]
471 round MPObjValNHua = [684, 689, 698]
472
473 OptimalObj = 6108.44444444445
474 Time: 239.000000
475
476
477
478
```