

```

1 "E:\1 \ \ \ \ \3 \ \ \ \ \ \1 \ \ \ \ \ \ \ \ \ \ \1 \ \ \ \ \ \ \ \ \ \ \1 \_LW\_ \ \ \ \ \ \4 \ \ \ \ \ \3 python_code\1 exzample\2 \ \ \ \ \ \ \ \ \ \ \9 Code for
  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=5243
2
3 import sys; print('Python %s on %s' % (sys.version, sys.platform))
4 sys.path.extend(['E:\1 \ \ \ \ \ \3 \ \ \ \ \ \ \ \ \ \ \ \1 \ \ \ \ \ \ \ \ \ \ \1 \_LW\_ \ \ \ \ \ \4 \ \ \ \ \ \3 python_code\9 Code for this
  paper', 'E:/1 \ \ \ \ \ /3 \ \ \ \ \ /1 \ \ \ \ \ \ \ \ \ \ \ /1 \ \ \ \ \ \ \ \ \ \ \ /1 \_LW\_ \ \ \ \ \ /4 \ \ \ \ \ /3 python_code/9 Code for this paper'])
5
6 PyDev console: starting.
7
8 Python 3.9.7 (tags/v3.9.7:1016ef3, Aug 30 2021, 20:19:38) [MSC v.1929 64 bit (AMD64)] on win32
9 >>> runfile('E:/1 \ \ \ \ \ /3 \ \ \ \ \ \ /1 \ \ \ \ \ \ \ \ \ \ \ /1 \ \ \ \ \ \ \ \ \ \ \ /1 \_LW\_ \ \ \ \ \ /4 \ \ \ \ \ /3 python_code/9 Code for this paper/
  main_RO_CCG.py', wdir='E:/1 \ \ \ \ \ /3 \ \ \ \ \ \ /1 \ \ \ \ \ \ \ \ \ \ \ /1 \ \ \ \ \ \ \ \ \ \ \ /1 \_LW\_ \ \ \ \ \ /4 \ \ \ \ \ /3 python_code/9 Code for
  this paper')
10 Backend TkAgg is interactive backend. Turning interactive mode on.
11 Waiting 5s.....
12 Set parameter MIPGap to value 1e-10
13 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
14
15 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
16 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
17
18 Optimize a model with 375969 rows, 34789 columns and 1042007 nonzeros
19 Model fingerprint: 0x36dd4b10
20 Variable types: 1 continuous, 34788 integer (34764 binary)
21 Coefficient statistics:
22 Matrix range [1e+00, 1e+10]
23 Objective range [1e+00, 2e+01]
24 Bounds range [1e+00, 1e+00]
25 RHS range [1e+00, 2e+10]
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 326897 rows and 23704 columns
31 Presolve time: 4.77s
32 Presolved: 49072 rows, 11085 columns, 174856 nonzeros
33 Variable types: 0 continuous, 11085 integer (11070 binary)
34
35 Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
36 Showing first log only...
37
38 Root relaxation presolved: 49072 rows, 11085 columns, 174856 nonzeros
39
40 Concurrent spin time: 0.02s
41
42 Solved with dual simplex (primal model)
43
44 Root relaxation: objective 6.660000e+02, 1309 iterations, 0.16 seconds (0.16 work units)
45
46 Nodes | Current Node | Objective Bounds | Work
47 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
48
49 0 0 666.00000 0 3 - 666.00000 - - 5s
50 H 0 0 1106.0000000 666.00000 39.8% - 5s
51 H 0 0 666.0000000 666.00000 0.00% - 5s
52
53 Cutting planes:
54 Gomory: 1
55 Cover: 1
56 StrongCG: 1
57 GUB cover: 1
58 RLT: 2
59
60 Explored 1 nodes (2694 simplex iterations) in 5.72 seconds (10.09 work units)
61 Thread count was 8 (of 8 available processors)
62
63 Solution count 2: 666 1106
64
65 Optimal solution found (tolerance 1.00e-10)
66 Best objective 6.660000000000000e+02, best bound 6.660000000000000e+02, gap 0.0000%
67 Set parameter MIPGap to value 1e-08
68 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
69
70 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
71 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
72
73 Optimize a model with 1153692 rows, 901813 columns and 7829319 nonzeros
74 Model fingerprint: 0x8c49f5d5
75 Variable types: 441325 continuous, 460488 integer (456438 binary)
76 Coefficient statistics:
77 Matrix range [1e-01, 1e+10]
78 Objective range [6e-05, 5e+01]
79 Bounds range [1e+00, 8e+01]

```

```

80  RHS range      [8e-01, 1e+10]
81  Warning: Model contains large matrix coefficients
82  Warning: Model contains large rhs
83      Consider reformulating model or setting NumericFocus parameter
84      to avoid numerical issues.
85  Presolve removed 1152265 rows and 901330 columns
86  Presolve time: 2.66s
87  Presolved: 1427 rows, 483 columns, 3802 nonzeros
88  Variable types: 0 continuous, 483 integer (274 binary)
89  Found heuristic solution: objective 2803.6666667
90
91  Root relaxation: objective 3.220667e+03, 293 iterations, 0.00 seconds (0.00 work units)
92
93  Nodes | Current Node | Objective Bounds | Work
94  Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
95
96  H   0   0           3220.6666667 6180.66667 91.9%  - 3s
97    0   0   -   0    3220.66667 3220.66667 0.00%  - 3s
98
99  Explored 1 nodes (445 simplex iterations) in 3.39 seconds (3.65 work units)
100 Thread count was 8 (of 8 available processors)
101
102 Solution count 2: 3220.67 2803.67
103
104 Optimal solution found (tolerance 1.00e-08)
105 Best objective 3.220666666667e+03, best bound 3.220666666667e+03, gap 0.0000%
106 SP is solved
107 SP's optimal solution is'□3220
108
109 Itr = 0
110 Collect_LB = [666.0]
111 Collect_UB = [7107.3333333333285]
112 Collect_Hua = [0.0]
113 Collect_SPObjVal = [3220.6666666666642]
114 Collect_MPObjValNHua = [666.0]
115
116
117 Set parameter MIPGap to value 0.05
118 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
119
120 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
121 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
122
123 Optimize a model with 634702 rows, 150727 columns and 1865101 nonzeros
124 Model fingerprint: 0xda7a6469
125 Variable types: 1 continuous, 150726 integer (143124 binary)
126 Coefficient statistics:
127   Matrix range      [1e-01, 1e+10]
128   Objective range   [1e+00, 2e+01]
129   Bounds range      [1e+00, 1e+00]
130   RHS range         [1e+00, 2e+10]
131 Warning: Model contains large matrix coefficients
132 Warning: Model contains large rhs
133     Consider reformulating model or setting NumericFocus parameter
134     to avoid numerical issues.
135 Presolve removed 547726 rows and 138921 columns (presolve time = 5s) ...
136 Presolve removed 591872 rows and 143227 columns
137 Presolve time: 6.19s
138 Presolved: 42830 rows, 7500 columns, 132585 nonzeros
139 Variable types: 0 continuous, 7500 integer (6236 binary)
140 Root relaxation presolved: 7500 rows, 50330 columns, 140085 nonzeros
141
142
143 Root simplex log...
144
145 Iteration Objective Primal Inf. Dual Inf. Time
146    0 handle free variables 7s
147   7587 4.0666667e+03 0.000000e+00 0.000000e+00 7s
148   7587 4.0666667e+03 0.000000e+00 0.000000e+00 7s
149
150 Root relaxation: objective 4.066667e+03, 7587 iterations, 0.81 seconds (1.22 work units)
151
152 Nodes | Current Node | Objective Bounds | Work
153 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
154
155   0   0 4066.66667   0 74    -4066.66667  -  - 7s
156   0   0 4066.66667   0 102   -4066.66667  -  - 8s
157   0   0 4066.66667   0 63    -4066.66667  -  - 8s
158  H   0   0           4686.6666667 4066.66667 13.2%  - 9s
159   0   0 4066.66667   0 4 4686.66667 4066.66667 13.2%  - 9s
160 *   0   0           0 4066.6666667 4066.66667 0.00%  - 10s
161
162 Cutting planes:
163 Learned: 15

```

```

164 Gomory: 14
165 Cover: 250
166 Implied bound: 108
167 Clique: 1026
168 MIR: 201
169 StrongCG: 56
170 Flow cover: 2
171 GUB cover: 294
172 Zero half: 18
173 RLT: 9
174 Relax-and-lift: 188
175 BQP: 7
176
177 Explored 1 nodes (20003 simplex iterations) in 10.10 seconds (17.19 work units)
178 Thread count was 8 (of 8 available processors)
179
180 Solution count 2: 4066.67 4686.67
181
182 Optimal solution found (tolerance 5.00e-02)
183 Best objective 4.066666666667e+03, best bound 4.066666666667e+03, gap 0.0000%
184 Set parameter MIPGap to value 1e-08
185 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
186
187 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
188 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
189
190 Optimize a model with 1153692 rows, 901813 columns and 7829319 nonzeros
191 Model fingerprint: 0x5e3e0d87
192 Variable types: 441325 continuous, 460488 integer (456438 binary)
193 Coefficient statistics:
194 Matrix range [1e-01, 1e+10]
195 Objective range [6e-05, 5e+01]
196 Bounds range [1e+00, 8e+01]
197 RHS range [8e-01, 1e+10]
198 Warning: Model contains large matrix coefficients
199 Warning: Model contains large rhs
200 Consider reformulating model or setting NumericFocus parameter
201 to avoid numerical issues.
202 Presolve removed 1151411 rows and 901028 columns
203 Presolve time: 2.58s
204 Presolved: 2281 rows, 785 columns, 6036 nonzeros
205 Variable types: 4 continuous, 781 integer (448 binary)
206 Found heuristic solution: objective 2808.3818887
207
208 Root relaxation: objective 3.722667e+03, 644 iterations, 0.00 seconds (0.00 work units)
209
210 Nodes | Current Node | Objective Bounds | Work
211 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
212
213 0 0 3722.66667 0 14 2808.38189 3722.66667 32.6% - 3s
214 H 0 0 2918.6666667 3722.66667 27.5% - 3s
215 H 0 0 3252.6666667 3722.66667 14.4% - 3s
216 0 0 3722.66667 0 4 3252.66667 3722.66667 14.4% - 3s
217 H 0 0 3722.6666667 3722.66667 0.00% - 3s
218 0 0 3722.66667 0 4 3722.66667 3722.66667 0.00% - 3s
219
220 Cutting planes:
221 Gomory: 1
222 Clique: 4
223 RLT: 1
224
225 Explored 1 nodes (939 simplex iterations) in 3.48 seconds (3.21 work units)
226 Thread count was 8 (of 8 available processors)
227
228 Solution count 4: 3722.67 3252.67 2918.67 2808.38
229
230 Optimal solution found (tolerance 1.00e-08)
231 Best objective 3.722666666667e+03, best bound 3.722666666667e+03, gap 0.0000%
232 SP is solved
233 SP's optimal solution is'□3722
234
235 Itr = 1
236 Collect_LB = [666.0, 4066.66666666666642]
237 Collect_UB = [7107.3333333333285, 4568.6666666666664]
238 Collect_Hua = [0.0, 3220.66666666666642]
239 Collect_SPObjVal = [3220.66666666666642, 3722.66666666666642]
240 Collect_MPObjValNHua = [666.0, 846.0]
241
242
243 Set parameter MIPGap to value 0.05
244 Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
245
246 CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
247 Thread count: 4 physical cores, 8 logical processors, using up to 8 threads

```

```

248
249 Optimize a model with 887260 rows, 163849 columns and 2682005 nonzeros
250 Model fingerprint: 0x928f4c29
251 Variable types: 1 continuous, 163848 integer (148668 binary)
252 Coefficient statistics:
253   Matrix range   [1e-01, 1e+10]
254   Objective range [1e+00, 2e+01]
255   Bounds range   [1e+00, 1e+00]
256   RHS range      [1e+00, 2e+10]
257 Warning: Model contains large matrix coefficients
258 Warning: Model contains large rhs
259   Consider reformulating model or setting NumericFocus parameter
260   to avoid numerical issues.
261 Presolve removed 791336 rows and 149706 columns (presolve time = 5s) ...
262 Presolve removed 829808 rows and 153437 columns
263 Presolve time: 9.15s
264 Presolved: 57452 rows, 10412 columns, 193926 nonzeros
265 Variable types: 0 continuous, 10412 integer (7900 binary)
266
267 Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
268 Showing first log only...
269
270 Root relaxation presolved: 10412 rows, 67864 columns, 204338 nonzeros
271
272
273 Root simplex log...
274
275 Iteration   Objective      Primal Inf.   Dual Inf.    Time
276      0  4.5686667e+03  0.000000e+00  2.884902e+04  10s
277 Concurrent spin time: 0.04s
278
279 Solved with dual simplex (primal model)
280
281 Root relaxation: objective 4.568667e+03, 4742 iterations, 0.51 seconds (0.47 work units)
282
283   Nodes | Current Node | Objective Bounds | Work
284 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
285
286   0   0  4568.66667   0   71   - 4568.66667   -   - 10s
287   0   0  4568.66667   0  421   - 4568.66667   -   - 13s
288   0   0  4568.66667   0  405   - 4568.66667   -   - 13s
289   0   0  4568.66667   0   19   - 4568.66667   -   - 15s
290   0   0  4568.66667   0  206   - 4568.66667   -   - 16s
291 H   0   0           4648.6666667 4568.66667 1.72%   - 17s
292
293 Cutting planes:
294   Learned: 8
295   Gomory: 14
296   Lift-and-project: 2
297   Cover: 296
298   Implied bound: 176
299   Clique: 1663
300   MIR: 185
301   StrongCG: 23
302   Flow cover: 247
303   GUB cover: 22
304   Zero half: 36
305   RLT: 57
306   Relax-and-lift: 331
307   BQP: 12
308   PSD: 2
309
310 Explored 1 nodes (26421 simplex iterations) in 17.40 seconds (26.25 work units)
311 Thread count was 8 (of 8 available processors)
312
313 Solution count 1: 4648.67
314
315 Optimal solution found (tolerance 5.00e-02)
316 Best objective 4.648666666667e+03, best bound 4.568666666667e+03, gap 1.7209%
317 Warning: linear constraint 382145 and linear constraint 634703 have the same name "ConSP25_1[0,0]"
318 Set parameter MIPGap to value 1e-08
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 1153692 rows, 901813 columns and 7829319 nonzeros
325 Model fingerprint: 0x0eda2133
326 Variable types: 441325 continuous, 460488 integer (456438 binary)
327 Coefficient statistics:
328   Matrix range   [1e-01, 1e+10]
329   Objective range [6e-05, 5e+01]
330   Bounds range   [1e+00, 8e+01]
331   RHS range      [8e-01, 1e+10]

```

```
332 Warning: Model contains large matrix coefficients
333 Warning: Model contains large rhs
334     Consider reformulating model or setting NumericFocus parameter
335     to avoid numerical issues.
336 Presolve removed 1151297 rows and 901015 columns
337 Presolve time: 2.39s
338 Presolved: 2395 rows, 798 columns, 6324 nonzeros
339 Variable types: 4 continuous, 794 integer (449 binary)
340 Found heuristic solution: objective 2907.9278404
341
342 Root relaxation: objective 3.722667e+03, 524 iterations, 0.00 seconds (0.00 work units)
343
344   Nodes | Current Node | Objective Bounds | Work
345 Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
346
347 H  0  0           3722.6666667 9040.00000 143% - 3s
348   0  0   -  0    3722.66667 3722.66667 0.00% - 3s
349
350 Explored 1 nodes (722 simplex iterations) in 3.17 seconds (3.20 work units)
351 Thread count was 8 (of 8 available processors)
352
353 Solution count 2: 3722.67 2907.93
354
355 Optimal solution found (tolerance 1.00e-08)
356 Best objective 3.72266666667e+03, best bound 3.72266666667e+03, gap 0.00000%
357 SP is solved
358 SP's optimal solution is'□3722
359
360 Itr = 2
361 Collect_LB = [666.0, 4066.6666666666642, 4648.666666666664]
362 Collect_UB = [7107.3333333333285, 4568.666666666664, 4568.666666666664]
363 Collect_Hua = [0.0, 3220.6666666666642, 3722.6666666666642]
364 Collect_SPObjVal = [3220.6666666666642, 3722.6666666666642, 3722.6666666666642]
365 Collect_MPObjValNHua = [666.0, 846.0, 926.0]
366
367
368 Ops, stop iteration
369 Values adopted from the Itr-1' th iteration, and Itr = {2}, judgeCount = {1}
370
371 ~~~~~judgeCount = 1, SPObj_SPF = 3722.6666666666642
372 Vessel i: 0: pi: 14-20, ai-di: 2-23, gi_SP-gpi_SP: 0.000000-0.000000, ai_SP-di: 2-23, taoi-deltai: 2-25, taoPi_SP-deltaPi_SP: 2-25, betaNi: 23
373 , bi: 23
374 Vessel i: 1: pi: 7-14, ai-di: 8-17, gi_SP-gpi_SP: 0.000000-0.000000, ai_SP-di: 8-17, taoi-deltai: 8-16, taoPi_SP-deltaPi_SP: 8-16, betaNi: 8
375 , bi: 8
376 Vessel i: 2: pi: 7-14, ai-di: 34-42, gi_SP-gpi_SP: 0.000000-0.000000, ai_SP-di: 34-42, taoi-deltai: 34-41, taoPi_SP-deltaPi_SP: 34-41, betaNi: 7, bi: 7
377 Vessel i: 3: pi: 16-23, ai-di: 40-58, gi_SP-gpi_SP: 0.000000-0.000000, ai_SP-di: 40-58, taoi-deltai: 40-56, taoPi_SP-deltaPi_SP: 40-56, betaNi: 16, bi: 16
378 Vessel i: 4: pi: 8-14, ai-di: 47-59, gi_SP-gpi_SP: 0.200000-1.000000, ai_SP-di: 48-59, taoi-deltai: 48-61, taoPi_SP-deltaPi_SP: 48-61, betaNi: 13, bi: 13
379 Vessel i: 5: pi: 14-21, ai-di: 50-67, gi_SP-gpi_SP: 1.000000-0.200000, ai_SP-di: 58-67, taoi-deltai: 58-77, taoPi_SP-deltaPi_SP: 58-77, betaNi: 19, bi: 19
380
381 round LB = [666, 4067, 4649]
382 round UB = [7107, 4569, 4569]
383 round Hua = [0, 3221, 3723]
384 round SPObjVal = [3221, 3723, 3723]
385 round MPObjValNHua = [666, 846, 926]
386
387 Time: 271.000000
388
389
```