```
D:\Python\Python\setroute\python.exe "D:\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Python\Pyt
     mode=client --port=21632
 3
     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
    main_DM.py', wdir='E:/1 000/3 00000/1 000000/1 000000/1_000000/1_LW_0001/4 0000/3 python_code/9 Code for this
10
    Backend TkAgg is interactive backend. Turning interactive mode on.
11
     Waiting 5s.....
    Optimize the ./R 10 6.xlsx instance
13
14
15
     Set parameter TimeLimit to value 1200
16
     Set parameter PoolSolutions to value 3
17
18
    Set parameter PoolGap to value 0.05
     Set parameter PoolSearchMode to value 2
19
20
    Gurobi Optimizer version 11.0.0 build v11.0.0rc2 (win64 - Windows 10.0 (19045.2))
21
22
    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
24
     Optimize a model with 260882 rows, 80570 columns and 770550 nonzeros
25
26
    Model fingerprint: 0x00f84147
     Variable types: 0 continuous, 80570 integer (67900 binary)
    Coefficient statistics:
28
29
      Matrix range [1e+00, 5e+05]
30
      Objective range [1e+00, 1e+00]
      Bounds range [1e+00, 1e+00]
31
      RHS range
                         [1e+00, 7e+06]
33
    Presolve removed 192766 rows and 2664 columns
    Presolve time: 0.55s
     Presolved: 68116 rows, 77906 columns, 201404 nonzeros
35
36
     Variable types: 0 continuous, 77906 integer (65246 binary)
     Found heuristic solution: objective 944.0000000
    Root relaxation presolved: 68071 rows, 77951 columns, 201285 nonzeros
38
39
40
    Deterministic concurrent LP optimizer: primal and dual simplex
41
     Showing primal log only...
42
43
    Concurrent spin time: 0.00s
44
45
    Solved with dual simplex
46
47
     Root relaxation: objective 3.321197e+02, 4657 iterations, 0.60 seconds (0.89 work units)
48
49
        Nodes | Current Node | Objective Bounds
                                                                         Work
50
     Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
51
52
             53 H 0 0
                                543.0000000 332.11966 38.8% - 2s
54
    Н
        0
              0
                                542.0000000 338.05754 37.6%
55
             0 338.05754
                              0 3084 542.00000 338.05754 37.6%
56
    H = 0
                                540.0000000 338.46018 37.3% - 18s
              0
             0 364.00000
57
                                0 3080 540.00000 364.00000 32.6%
                                                                                    21s
58
             0 364.00000
                                0 3288 540.00000 364.00000 32.6%
        0
             0 364.00000 0 3288 540.00000 364.00000 32.6%
                                                                                    22s
60
             0 364.00000 0 3288 540.00000 364.00000 32.6%
                                                                                    22s
        0
61
        0
             0 364.77904
                                0 2486 540.00000 364.77904 32.4%
                                                                                    23s
    Η
          0
                                539.0000000 364.77904 32.3%
62
63
             0 365.00000
                              0 3200 539.00000 365.00000 32.3%
                                                                                    28s
        0
             0.365,00000
                              0 3204 539.00000 365.00000 32.3%
                                                                                    288
64
65
             32s
                                0.2279\ 539.00000\ 365.00000\ 32.3\%
66
             0 365.00000
                                                                                    32s
             - 33s
67
        0
68
        0
             0 365.00000
                              0 2914 539.00000 365.00000 32.3%
                                                                                 - 33s
69
        0
             0 365.96531
                                0 2489 539.00000 365.96531 32.1%
                                                                                    35s
70
             0.366,00000
                              0 2255 539.00000 366.00000 32.1%
                              0.2238 539 00000 366 00000 32.1%
        0
             2. 366 00000
71
                                                                                    39s
72
             8 366.00000
                              2 2236 539.00000 366.00000 32.1% 295 40s
       390 407 366.00000 92 1608 539.00000 366.00000 32.1% 26.0 45s
       942
             979 366.00000 230 1466 539.00000 366.00000 32.1% 17.8 50s
      1826 1894 390.87947 510 1148 539.00000 366.00000 32.1% 13.2
      2626 2711 434.17123 658 912 539.00000 366.00000 32.1% 16.2 60s
      3667
             3814 376.93557 160 2050 539.00000 366.00000 32.1% 16.4 65s
      3915 3624 449.76826 702 2255 539.00000 366.00000 32.1% 15.9
78
                                                                                           75s
79
      3917 3625 391.38423 320 2035 539.00000 366.00000 32.1% 15.9 82s
80
      3918 3444 525.00000 418 2137 539.00000 525.00000 2.60% 15.9 92s
```

```
3922 3447 529.50818 61 2496 539.00000 529.50818 1.76% 15.9 96s
81
     3923 3447 529.94308 53 2265 539.00000 529.94308 1.68% 15.9 101s
     3927 3450 530.90088 118 2189 539.00000 530.90088 1.50% 15.9 108s
     3929 3451 531.20844 233 2269 539.00000 531.20844 1.45% 15.9 110s
     3930 3452 532.00000 388 2142 539.00000 532.00000 1.30% 15.9 117s
     3934 3455 532.00000 876 2106 539.00000 532.00000 1.30% 15.9 125s
     3938 3457 533.00000 148 1908 539.00000 533.00000 1.11% 15.9 131s
87
88
     3941 3459 534.00000 148 2224 539.00000 534.00000 0.93% 15.8 136s
     3943 3461 534.00000 15 2216 539.00000 534.00000 0.93% 15.8 152s
     3948 3467 534.00000 15 1535 539.00000 534.00000 0.93% 25.3 156s
91
     4012 3514 534.00000 23 1507 539.00000 534.00000 0.93% 30.2 160s
92
     4237 3669 534.00000 48 1375 539.00000 534.00000 0.93% 41.4 165s
     4510 3872 534.00000 78 1505 539.00000 534.00000 0.93% 51.4 170s
94
     4795 4072 534.00000 111 1415 539.00000 534.00000 0.93% 59.5 175s
95
     5067 4262 534.00000 140 1395 539.00000 534.00000 0.93% 68.8 180s
     5382 4454 534.00000 172 1049 539.00000 534.00000 0.93% 76.0 185s
     5659 4643 534.00000 205 1158 539.00000 534.00000 0.93% 83.0 190s
98
     5958 4829 534.00000 236 1147 539.00000 534.00000 0.93% 89.9 196s
99
     6212 5012 534.00000 262 1139 539.00000 534.00000 0.93% 96.3 201s
100
     6434 5145 534.00000 290 1097 539.00000 534.00000 0.93% 101 205s
     6781 5388 534.00000 340 1063 539.00000 534.00000 0.93% 107 211s
101
     7042 5536 534.00000 376 1043 539.00000 534.00000 0.93% 112 216s
102
     7309 5597 534.00000 414 1020 539.00000 534.00000 0.93% 115 222s
103
104
     7416 5650 534.00000 432 1010 539.00000 534.00000 0.93% 117 227s
     7619 5745 534.00000 458 934 539.00000 534.00000 0.93% 118 230s
105
106
     7974 5865 534.00000 513 923 539.00000 534.00000 0.93% 124 236s
     8156 6087 534.00000 532 834 539.00000 534.00000 0.93% 127 242s
     8378 6190 534.00000 563 879 539.00000 534.00000 0.93% 128 245s
108
     8690 6322 534.00000 593 806 539.00000 534.00000 0.93% 133 252s
109
     8843 6363 534.00000 609 789 539.00000 534.00000 0.93% 137 256s
110
111
     8958 6430 534.00000 618 694 539.00000 534.00000 0.93% 139 260s
     9158 6431 infeasible 649 539.00000 534.00000 0.93% 142 265s
112
113
     9522 6523 534.00000 687 673 539.00000 534.00000 0.93% 145 273s
                cutoff 705 539.00000 534.00000 0.93% 146 277s
     9707 6590
     10105 6658 534.00000 742 693 539.00000 534.00000 0.93% 146 282s
115
     10550 6627 534.00000 784 673 539.00000 534.00000 0.93% 146 286s
116
117
     10732 6621 534.00000 796 662 539.00000 534.00000 0.93% 148 291s
    10904 6645 infeasible 810 539.00000 534.00000 0.93% 151 296s
    11280 6562 534.00000 860 594 539.00000 534.00000 0.93% 152 301s
119
120
    11613 6732 534.00000 911 562 539.00000 534.00000 0.93% 151 309s
     12230 6968 534.00000 85 916 539.00000 534.00000 0.93% 149 315s
     12703 7181 534.00000 142 889 539.00000 534.00000 0.93% 152 324s
122
    13083 7211 534.00000 209 839 539.00000 534.00000 0.93% 153 332s
123
124
    13254 7661 534.00000 245 844 539.00000 534.00000 0.93% 154 339s
     13763 7952 534.00000 302 793 539.00000 534.00000 0.93% 159 347s
125
    14247 8508 534.00000 335 738 539.00000 534.00000 0.93% 161 354s
126
     14922 8876 534.00000 396 656 539.00000 534.00000 0.93% 162 360s
127
128
    15331 9359 534.00000 431 612 539.00000 534.00000 0.93% 161 365s
    15929 9782 534.00000 495 582 539.00000 534.00000 0.93% 160 370s
    16528 10119 534.00000 555 537 539.00000 534.00000 0.93% 158 421s
130
     16971 10320 534.00000 598 522 539.00000 534.00000 0.93% 156 428s
131
     17223 10694 534.00000 635 523 539.00000 534.00000 0.93% 156 433s
     17805 11169 534.00000 714 458 539.00000 534.00000 0.93% 155 439s
133
    18557 11601 534.00000 806 306 539.00000 534.00000 0.93% 152 445s
134
135
     19063 12096 534.00000 844 389 539.00000 534.00000 0.93% 150 452s
     19705 12492 534.00000 888 302 539.00000 534.00000 0.93% 147 459s
    20236 12963 534.00000 927 280 539.00000 534.00000 0.93% 145 467s
137
    20865 13587 534.00000 108 1135 539.00000 534.00000 0.93% 142 473s
138
139
     21601 14164 534.00000 322 902 539.00000 534.00000 0.93% 139 478s
    22234 14986 534.00000 525 762 539.00000 534.00000 0.93% 136 484s
    23094 15826 534.00000 740 718 539.00000 534.00000 0.93% 131 490s
141
142
    24296 16589 534.00000 1020 592 539.00000 534.00000 0.93% 126 495s
    25085 17428 534.00000 1263 463 539.00000 534.00000 0.93% 123 500s
144
    25765 17976 534.00000 1428 335 539.00000 534.00000 0.93% 120 505s
    26639 18663 534.00000 286 542 539.00000 534.00000 0.93% 117 510s
145
    27218 19368 534.00000 493 245 539.00000 534.00000 0.93% 114 516s
     27644 19729 534.00000 571 215 539.00000 534.00000 0.93% 113 520s
    28558 20665 534.00000 242 766 539.00000 534.00000 0.93% 110 526s
148
149
    29287 21282 534.00000 417 603 539.00000 534.00000 0.93% 108 532s
    29681 21704 534.00000 534 541 539.00000 534.00000 0.93% 107 535s
150
    30308 22338 534.00000 647 506 539.00000 534.00000 0.93% 105 541s
151
    31201 23014 534.00000 923 405 539.00000 534.00000 0.93% 103 546s
152
153
    31523 23550 534.00000 973 339 539.00000 534.00000 0.93% 102 550s
    32560 24215 534.00000 242 851 539.00000 534.00000 0.93% 99.4 555s
154
155
156 Cutting planes:
157
     Learned: 788
158
     Gomory: 7
159
     Implied bound: 82
160
     Projected implied bound: 15
161
     MIR: 1754
     StrongCG: 205
162
163
     Flow cover: 3539
164
     Inf proof: 25
```

```
unknown
165
       Zero half: 339
166
       RLT: 10
       Relax-and-lift: 8573
167
168
       BOP: 8
169
170
      Explored 33439 nodes (3263882 simplex iterations) in 1201.11 seconds (975.11 work units)
171 Thread count was 8 (of 8 available processors)
172
173
     Solution count 3: 539 539 539
174
175
     Time limit reached
176
      Best objective 5.390000000000e+02, best bound 5.34000000000e+02, gap 0.9276%
177
178
      Output one feasible solution with limited computation time
179
180
     Optimization was stopped with status 9
181
      Number of solution stored: 3
182
183
        539 539 539
184
185 Obj = 539.0
186
187
      Solutions:
188
         The total pi = 154.0
189
         The total duration time in berth stage = 135.0
190
         The total duration time in quay crane scheduling stage = 32.0
191
         The total departure time in berth stage= 321.0
192
         The total departure time in quay crane scheduling stage = 218.0
         The total wasted crane work hour according QC0= 9.491742652971432
193
194
         The last depature time in quay crane scheduling stage = 42.0
195
196 The specific solution are as follows:
197
         Vessel i: 0:
                       li: 7,
                                    pi: 11-18,
                                                             ai-di: 30-53,
                                                                                      taoi-deltai: 30-53,
                                                                                                                       periodi: 23,
                                                                                                                                                     taoPi_SP-
                                                                                                                                                                  fa_i: 2
      deltaPi_SP: 30-37,
                                            periodPi: 7,
                                                                               c_i: 5966545,
                                                                                                                    dowork: 6063812,
198
         Vessel i: 1:
                       li: 5.
                                    pi: 6-11,
                                                           ai-di: 32-66,
                                                                                    taoi-deltai: 32-36,
                                                                                                                    periodi: 4,
                                                                                                                                                taoPi_SP-deltaPi_SP:
                                                                     c_i: 1000124,
                                 periodPi: 1,
                                                                                                          dowork: 1054576,
      32-33.
                                                                                                                                                       fa_i: 4
199
         Vessel i: 2:
                        li: 5,
                                    pi: 28-33,
                                                             ai-di: 41-75,
                                                                                       taoi-deltai: 41-46,
                                                                                                                       periodi: 5,
                                                                                                                                                   taoPi_SP-deltaPi_SP
                                 periodPi: 1,
      : 41-42,
                                                                     c i: 1063680.
                                                                                                          dowork: 1318220,
                                                                                                                                                       fa i: 4
200
         Vessel i: 3:
                       li: 5,
                                                             ai-di: 11-44,
                                                                                      taoi-deltai: 11-25,
                                                                                                                                                     taoPi_SP-
                                    pi: 13-18,
                                                                                                                       periodi: 14,
                                                                               c_i: 3494800,
      deltaPi_SP: 11-14,
                                            periodPi: 3,
                                                                                                                    dowork: 3691016,
                                                                                                                                                                  fa_i: 4
201
         Vessel i: 4:
                      li: 5,
                                                             ai-di: 22-59.
                                                                                      taoi-deltai: 22-39,
                                                                                                                       periodi: 17,
                                                                                                                                                     taoPi_SP-
                                    pi: 23-28,
      deltaPi SP: 22-25,
                                           periodPi: 3,
                                                                               c i: 4279927,
                                                                                                                    dowork: 4350126,
                                                                                                                                                                  fa i: 4
                                                                                                                                                   taoPi_SP-deltaPi_SP
202
                                    pi: 28-34,
                                                             ai-di: 8-44,
                                                                                                                    periodi: 15,
         Vessel i: 5:
                                                                                    taoi-deltai: 8-23,
                       li: 6,
       8-11,
                                 periodPi: 3,
                                                                     c_i: 3934082,
                                                                                                          dowork: 3954660,
                                                                                                                                                       fa_i: 4
                                                                                      taoi-deltai: 13-38,
                                                                                                                       periodi: 25,
         Vessel i: 6:
                       li: 5,
                                    pi: 18-23,
                                                             ai-di: 13-62,
                                                                                                                                                     taoPi_SP-
      deltaPi SP: 13-18,
                                           periodPi: 5,
                                                                                                                    dowork: 6722922,
                                                                               c i: 6531560.
                                                                                                                                                                  fa i: 4
                                                                                                                                                   taoPi_SP-deltaPi_SP
204
                                    pi: 0-6,
         Vessel i: 7:
                       li: 6,
                                                           ai-di: 15-56,
                                                                                    taoi-deltai: 15-33,
                                                                                                                    periodi: 18,
      : 15-20,
                                 periodPi: 5.
                                                                     c_i: 4668515,
                                                                                                          dowork: 5009236,
                                                                                                                                                        fa_i: 4
205
         Vessel i: 8:
                        li: 5,
                                    pi: 19-24,
                                                             ai-di: 6-32,
                                                                                    taoi-deltai: 6-11,
                                                                                                                    periodi: 5,
                                                                                                                                                taoPi SP-deltaPi SP: 6
                                                                                                     dowork: 1581864.
                            periodPi: 1,
                                                                c i: 1186011,
                                                                                                                                                   fa i: 4
                                                                                                                  periodi: 9,
206
        Vessel i: 9:
                                    pi: 8-13,
                                                           ai-di: 8-29,
                                                                                 taoi-deltai: 8-17,
                                                                                                                                             taoPi_SP-deltaPi_SP: 8-
                            periodPi: 3,
                                                                                                     dowork: 3163728,
                                                                                                                                                   fa_i: 4
                                                                c_i: 2282475,
207
     TimeSolveModel: 1212.000000
208
209
     TimeAll: 1216.000000
210
211
```