```
"E:\1 □□□□\3 □□□□□\1 □□□□□□\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=4072

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['E:\\1 □□□□\\3 □□□□□\\1 □□□□□□\\1 □□□□□□□□\\1_□□□□□□_□□□□\\1_LW _□□□□\\4 □□□□\\3 python_code\\9 Code for this paper', 'E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/3 python_code/9 Code for this paper'])

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
>>> runfile('E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/3 python_code/9 Code for this paper/main_RO_BDC.py', wdir='E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/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
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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

Optimize a model with 515144 rows, 40692 columns and 1410688 nonzeros
Model fingerprint: 0x09f0577d
Variable types: 1 continuous, 40691 integer (40663 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 310186 rows and 17936 columns (presolve time = 5s) ...
Presolve removed 453674 rows and 28303 columns
Presolve time: 8.13s
Presolved: 61470 rows, 12389 columns, 193706 nonzeros
Variable types: 0 continuous, 12389 integer (12368 binary)

Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
Showing first log only...

Root relaxation presolved: 12389 rows, 73859 columns, 206095 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    7.9800000e+02   0.000000e+00   9.570000e+02      9s
Concurrent spin time: 0.00s

Solved with dual simplex (primal model)

Root relaxation: objective 7.980000e+02, 2935 iterations, 0.31 seconds (0.34 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0  798.00000    0  103          -  798.00000      -     -    9s
     0     0  798.00000    0   90          -  798.00000      -     -    9s
H    0     0                3718.0000000  798.00000  78.5%     -   10s
     0     0  798.00000    0   65 3718.00000  798.00000  78.5%     -   10s
     0     0  798.00000    0   36 3718.00000  798.00000  78.5%     -   18s
H    0     0                2318.0000000  798.00000  65.6%     -   19s
H    0     0                2258.0000000  798.00000  64.7%     -   19s
     0     0  798.00000    0  729 2258.00000  798.00000  64.7%     -   21s
     0     0  798.00000    0  581 2258.00000  798.00000  64.7%     -   22s
H    0     0                1638.0000000  798.00000  51.3%     -   26s
     0     0  798.00000    0  153 1638.00000  798.00000  51.3%     -   27s
     0     0  798.00000    0  173 1638.00000  798.00000  51.3%     -   28s
     0     0  798.00000    0  215 1638.00000  798.00000  51.3%     -   30s
     0     0  798.00000    0  223 1638.00000  798.00000  51.3%     -   30s
     0     0  798.00000    0  203 1638.00000  798.00000  51.3%     -   33s
H    0     0                1518.0000000  798.00000  47.4%     -   34s
     0     0  798.00000    0  218 1518.00000  798.00000  47.4%     -   34s
H    0     0                1018.0000000  798.00000  21.6%     -   35s
     0     0  798.00000    0  246 1018.00000  798.00000  21.6%     -   35s
     0     0  798.00000    0   29 1018.00000  798.00000  21.6%     -   42s
     0     0  798.00000    0  277 1018.00000  798.00000  21.6%     -   45s
     0     0  798.00000    0  656 1018.00000  798.00000  21.6%     -   46s
     0     0  798.00000    0   41 1018.00000  798.00000  21.6%     -   48s
     0     0  798.00000    0  292 1018.00000  798.00000  21.6%     -   49s
     0     0  798.00000    0   51 1018.00000  798.00000  21.6%     -   50s
```

```
     0     0  798.00000    0  113 1018.00000  798.00000  21.6%    -   51s
     0     0  798.00000    0   97 1018.00000  798.00000  21.6%    -   52s
H    0     0                818.0000000  798.00000  2.44%    -   53s
     0     0  798.00000    0  169  818.00000  798.00000  2.44%    -   53s
     0     0  798.00000    0  591  818.00000  798.00000  2.44%    -   54s
     0     0  798.00000    0   26  818.00000  798.00000  2.44%    -   62s
     0     0  798.00000    0  417  818.00000  798.00000  2.44%    -   64s
     0     0  798.00000    0  299  818.00000  798.00000  2.44%    -   64s
H    0     0                798.0000000  798.00000  0.00%    -   65s
     0     0  798.00000    0   35  798.00000  798.00000  0.00%    -   66s

Cutting planes:
  Cover: 67
  Implied bound: 26
  Clique: 504
  MIR: 75
  StrongCG: 64
  GUB cover: 12
  Zero half: 9
  RLT: 63
  Relax-and-lift: 15
  BQP: 19

Explored 1 nodes (92122 simplex iterations) in 66.03 seconds (118.48 work units)
Thread count was 8 (of 8 available processors)

Solution count 8: 798 818 1018 ... 3718

Optimal solution found (tolerance 1.00e-10)
Best objective 7.980000000000e+02, best bound 7.980000000000e+02, gap 0.0000%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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

Optimize a model with 1540871 rows, 1208299 columns and 10558810 nonzeros
Model fingerprint: 0xae10b899
Variable types: 592971 continuous, 615328 integer (610603 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 1536002 rows and 1206757 columns
Presolve time: 3.16s
Presolved: 4869 rows, 1542 columns, 12997 nonzeros
Variable types: 4 continuous, 1538 integer (885 binary)
Found heuristic solution: objective 3422.3669629

Root relaxation: objective 5.044132e+03, 1798 iterations, 0.03 seconds (0.04 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 5044.13157    0   69 3422.36696 5044.13157  47.4%    -    4s
H    0     0                4545.2426831 5044.13157  11.0%    -    4s
H    0     0                4549.1315720 5044.13157  10.9%    -    4s
     0     0 5044.13157    0   62 4549.13157 5044.13157  10.9%    -    4s
H    0     0                4980.2426831 5044.13157  1.28%    -    4s
H    0     0                5044.1315720 5044.13157  0.00%    -    4s
     0     0 5044.13157    0   62 5044.13157 5044.13157  0.00%    -    4s

Cutting planes:
  Learned: 5
  Gomory: 7
  Cover: 3
  Implied bound: 1
  MIR: 8
  Flow cover: 7
  RLT: 4

Explored 1 nodes (2816 simplex iterations) in 4.29 seconds (4.63 work units)
Thread count was 8 (of 8 available processors)

Solution count 5: 5044.13 4980.24 4549.13 ... 3422.37

Optimal solution found (tolerance 1.00e-08)
Best objective 5.044131571994e+03, best bound 5.044131571994e+03, gap 0.0000%
SP is solved
```

```
SP's optimal solution is'□5044

  Itr = 0
Collect_LB =   [798.0]
Collect_UB =   [10886.263143987097]
Collect_Hua =   [0.0]
Collect_SPObjVal =   [5044.131571993548]
Collect_MPObjValNHua =   [798.0]


Set parameter TimeLimit to value 12000
Set parameter MIPGap to value 0.0005
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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

Optimize a model with 519185 rows, 180636 columns and 1414764 nonzeros
Model fingerprint: 0x40cc639f
Variable types: 1 continuous, 180635 integer (180607 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 350765 rows and 162961 columns (presolve time = 5s) ...
Presolve removed 470785 rows and 173288 columns
Presolve time: 8.44s
Presolved: 48400 rows, 7348 columns, 122681 nonzeros
Variable types: 0 continuous, 7348 integer (7327 binary)
Root relaxation presolved: 7348 rows, 55748 columns, 130029 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0     handle free variables                         9s
    7000    5.8936053e+03   5.051732e+02   0.000000e+00     10s
    8920    5.8424939e+03   0.000000e+00   0.000000e+00     10s
    8920    5.8424939e+03   0.000000e+00   0.000000e+00     10s

Root relaxation: objective 5.842494e+03, 8920 iterations, 1.68 seconds (3.79 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 5842.49390    0  999          - 5842.49390      -     -   11s
     0     0 5842.49390    0 1003          - 5842.49390      -     -   11s
     0     0 5842.49390    0 1025          - 5842.49390      -     -   11s
     0     0 5842.49390    0 1003          - 5842.49390      -     -   11s
     0     0 5842.54308    0  917          - 5842.54308      -     -   12s
     0     0 5842.54308    0  916          - 5842.54308      -     -   12s
     0     0 5862.13157    0 1981          - 5862.13157      -     -   14s
     0     0 5862.13157    0  800          - 5862.13157      -     -   16s
     0     0 5862.13157    0  786          - 5862.13157      -     -   16s
     0     0 5862.13157    0  960          - 5862.13157      -     -   17s
     0     0 5862.13157    0 1002          - 5862.13157      -     -   18s
     0     0 5862.13157    0  813          - 5862.13157      -     -   21s
     0     0 5862.13157    0  796          - 5862.13157      -     -   22s
     0     0 5862.13157    0  683          - 5862.13157      -     -   23s
     0     0 5862.13157    0  664          - 5862.13157      -     -   24s
     0     0 5862.13157    0  838          - 5862.13157      -     -   25s
     0     0 5862.13157    0  749          - 5862.13157      -     -   26s
     0     0 5862.13157    0  372          - 5862.13157      -     -   31s
     0     0 5862.13157    0  380          - 5862.13157      -     -   31s
     0     0 5862.13157    0  899          - 5862.13157      -     -   34s
     0     0 5862.13157    0  872          - 5862.13157      -     -   34s
     0     0 5862.13157    0  472          - 5862.13157      -     -   43s
     0     0 5862.13157    0  467          - 5862.13157      -     -   43s
     0     0 5862.13157    0  691          - 5862.13157      -     -   45s
H    0     0                6082.1315720 5862.13157  3.62%     -   51s
H    0     0                6042.1315720 5862.13157  2.98%     -   51s
     0     0 5862.13157    0  290 6042.13157 5862.13157  2.98%     -   54s
     0     0 5862.13157    0  273 6042.13157 5862.13157  2.98%     -   54s
     0     0 5862.13157    0  427 6042.13157 5862.13157  2.98%     -   55s
     0     0 5862.13157    0  451 6042.13157 5862.13157  2.98%     -   56s
     0     0 5862.13157    0  453 6042.13157 5862.13157  2.98%     -   56s
     0     0 5862.13157    0  801 6042.13157 5862.13157  2.98%     -   57s
     0     0 5862.13157    0  137 6042.13157 5862.13157  2.98%     -   58s
     0     0 5862.13157    0  458 6042.13157 5862.13157  2.98%     -   58s
```

```
     0     0 5862.13157    0  473 6042.13157 5862.13157  2.98%     -   58s
     0     0 5862.13157    0  462 6042.13157 5862.13157  2.98%     -   58s
H    0     0                    5942.1315720 5862.13157  1.35%     -   58s
     0     0 5862.13157    0  664 5942.13157 5862.13157  1.35%     -   59s
     0     0 5862.13157    0  637 5942.13157 5862.13157  1.35%     -   59s
     0     0 5942.13157    0  597 5942.13157 5942.13157  0.00%     -   59s

Cutting planes:
  Learned: 107
  Gomory: 54
  Cover: 86
  Implied bound: 26
  Clique: 141
  MIR: 84
  StrongCG: 23
  Zero half: 40
  RLT: 11
  Relax-and-lift: 73
  BQP: 1

Explored 1 nodes (111098 simplex iterations) in 59.31 seconds (109.33 work units)
Thread count was 8 (of 8 available processors)

Solution count 3: 5942.13 6042.13 6082.13

Optimal solution found (tolerance 5.00e-04)
Best objective 5.942131571994e+03, best bound 5.942131571994e+03, gap 0.0000%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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

Optimize a model with 1540871 rows, 1208299 columns and 10558810 nonzeros
Model fingerprint: 0xce1b5161
Variable types: 592971 continuous, 615328 integer (610603 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 1535448 rows and 1206637 columns
Presolve time: 3.23s
Presolved: 5423 rows, 1662 columns, 14503 nonzeros
Variable types: 6 continuous, 1656 integer (946 binary)
Found heuristic solution: objective 3592.9885856

Root relaxation: objective 5.142443e+03, 1869 iterations, 0.03 seconds (0.03 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 5142.44341    0   15 3592.98859 5142.44341  43.1%     -    4s
H    0     0                    5139.3211873 5142.44341  0.06%     -    4s
H    0     0                    5140.0989651 5142.44341  0.05%     -    4s
*    0     0               0    5140.2100762 5140.21008  0.00%     -    4s

Cutting planes:
  Cover: 1
  Implied bound: 1
  MIR: 7
  Flow cover: 1
  Zero half: 1
  RLT: 1
  Relax-and-lift: 1

Explored 1 nodes (2657 simplex iterations) in 4.39 seconds (4.62 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 5140.21 5140.1 5139.32 3592.99

Optimal solution found (tolerance 1.00e-08)
Best objective 5.140210076214e+03, best bound 5.140210076214e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5140

 Itr = 1
Collect_LB =   [798.0, 5942.131571993548]
Collect_UB =   [10886.263143987097, 6038.210076213887]
Collect_Hua =   [0.0, 5044.131571993548]
```

```
Collect_SPObjVal =   [5044.131571993548, 5140.210076213887]
Collect_MPObjValNHua =   [798.0, 898.0]


Set parameter TimeLimit to value 12000
Set parameter MIPGap to value 0.0005
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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

Optimize a model with 519186 rows, 180636 columns and 1414779 nonzeros
Model fingerprint: 0x22271cd6
Variable types: 1 continuous, 180635 integer (180607 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 351462 rows and 163046 columns (presolve time = 5s) ...
Presolve removed 471155 rows and 173336 columns
Presolve time: 8.66s
Presolved: 48031 rows, 7300 columns, 121757 nonzeros
Variable types: 1 continuous, 7299 integer (7278 binary)
Root relaxation presolved: 7300 rows, 55331 columns, 129057 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0      handle free variables                         9s
    6498    6.0082101e+03   0.000000e+00   0.000000e+00     10s
    6498    6.0082101e+03   0.000000e+00   0.000000e+00     10s

Root relaxation: objective 6.008210e+03, 6498 iterations, 1.07 seconds (2.29 work units)
Total elapsed time = 11.20s

     Nodes    |    Current Node    |     Objective Bounds      |     Work
  Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 6008.21008    0  179          - 6008.21008      -     -   11s
     0     0 6008.21008    0  178          - 6008.21008      -     -   11s
     0     0 6008.21008    0 1020          - 6008.21008      -     -   13s
     0     0 6008.21008    0 1123          - 6008.21008      -     -   14s
     0     0 6008.21008    0 1098          - 6008.21008      -     -   14s
     0     0 6008.21008    0 1097          - 6008.21008      -     -   14s
     0     0 6008.21008    0  820          - 6008.21008      -     -   15s
     0     0 6008.21008    0  812          - 6008.21008      -     -   15s
     0     0 6008.21008    0  226          - 6008.21008      -     -   18s
     0     0 6008.21008    0  631          - 6008.21008      -     -   19s
     0     0 6008.21008    0  628          - 6008.21008      -     -   19s
     0     0 6008.21008    0  356          - 6008.21008      -     -   24s
     0     0 6008.21008    0  355          - 6008.21008      -     -   24s
     0     0 6008.21008    0  497          - 6008.21008      -     -   25s
     0     0 6008.21008    0  386          - 6008.21008      -     -   32s
     0     0 6008.21008    0  368          - 6008.21008      -     -   32s
     0     0 6008.21008    0  368          - 6008.21008      -     -   34s
     0     2 6008.21008    0  364          - 6008.21008      -     -   43s
     1     4 6008.21008    1  465          - 6008.21008      -  8006   45s
    11    16 6008.21008    4  693          - 6008.21008      -  4248   52s
    19    24 6008.21008    6 1427          - 6008.21008      -  4476   55s
    32    41 6008.21008    9 1236          - 6008.21008      -  3485   61s
    44    53 infeasible   10              - 6008.21008      -  3400   65s
    71    82 6008.21008   11  489          - 6008.21008      -  2616   71s
   135   143 infeasible   17              - 6008.21008      -  1931   76s
   202   257 6008.21008   34  459          - 6008.21008      -  1598   81s
   357   406 6008.21008    4 1015          - 6008.21008      -  1071   85s
*  420   367             167    7108.2100762 6008.21008  15.5%   912   85s
   546   301 6008.21008    5 1404 7108.21008 6008.21008  15.5%   761   91s
*  581   301              38    7088.2100762 6008.21008  15.2%   733   91s
*  692   301              38    7068.2100762 6008.21008  15.0%   655   91s
*  704   301              44    7028.2100762 6008.21008  14.5%   644   91s
   720   433 6008.21008    6 1339 7028.21008 6008.21008  14.5%   651  106s
H  722   359                    6508.2100762 6008.21008  7.68%   681  106s
   936   548 6168.21008    8  956 6508.21008 6008.21008  7.68%   605  112s
H 1103   490                    6268.2100762 6008.21008  4.15%   529  112s
H 1114   488                    6188.2100762 6008.21008  2.91%   524  112s
H 1213   488                    6068.2100762 6008.21008  0.99%   506  112s
H 1300   127                    6048.2100762 6008.21008  0.66%   484  114s
  1301   110 6028.21008  109  368 6048.21008 6008.21008  0.66%   483  117s
```

```
Cutting planes:
  Learned: 65
  Gomory: 11
  Cover: 493
  Implied bound: 86
  Projected implied bound: 71
  Clique: 279
  MIR: 16
  StrongCG: 4
  Flow cover: 326
  GUB cover: 15
  Zero half: 87
  RLT: 20
  Relax-and-lift: 229
  BQP: 1

Explored 1305 nodes (716427 simplex iterations) in 119.96 seconds (363.10 work units)
Thread count was 8 (of 8 available processors)

Solution count 9: 6048.21 6068.21 6188.21 ... 7108.21

Optimal solution found (tolerance 5.00e-04)
Best objective 6.048210076214e+03, best bound 6.048210076214e+03, gap 0.0000%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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

Optimize a model with 1540871 rows, 1208299 columns and 10558810 nonzeros
Model fingerprint: 0x86bfa3d9
Variable types: 592971 continuous, 615328 integer (610603 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 1535678 rows and 1206683 columns
Presolve time: 3.32s
Presolved: 5193 rows, 1616 columns, 13838 nonzeros
Variable types: 6 continuous, 1610 integer (923 binary)
Found heuristic solution: objective 3625.7982387

Root relaxation: objective 5.162443e+03, 1983 iterations, 0.04 seconds (0.03 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 5162.44341    0   14 3625.79824 5162.44341  42.4%     -    4s
H    0     0                    5159.3211873 5162.44341  0.06%     -    4s
H    0     0                    5160.0989651 5162.44341  0.05%     -    4s
*    0     0               0    5160.2100762 5160.21008  0.00%     -    4s

Cutting planes:
  Cover: 1
  Implied bound: 2
  MIR: 8
  Flow cover: 1
  Zero half: 1
  RLT: 1
  Relax-and-lift: 1

Explored 1 nodes (2554 simplex iterations) in 4.47 seconds (4.63 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 5160.21 5160.1 5159.32 3625.8

Optimal solution found (tolerance 1.00e-08)
Best objective 5.160210076214e+03, best bound 5.160210076214e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5160

 Itr = 2
Collect_LB =   [798.0, 5942.131571993548, 6048.210076213887]
Collect_UB =   [10886.263143987097, 6038.210076213887, 6038.210076213887]
Collect_Hua =   [0.0, 5044.131571993548, 5140.210076213887]
Collect_SPObjVal =   [5044.131571993548, 5140.210076213887, 5160.210076213887]
Collect_MPObjValNHua =   [798.0, 898.0, 908.0]
```

```
500
501  Ops, stop iteration
502  Values adopted from the Itr-1' th iteration, and Itr = {2}, judgeCount = {1}
503
504  ~~~~~~~~~~judgeCount = 1, SPObj_SPF = 5140.210076213887
505  Vessel i: 0:    pi: 0-7,    ai-di: 6-39,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 6-39,    taoi-deltai: 6-37,    taoPi_SP-deltaPi_SP: 6-37,    betaNi: 31
     ,    bi: 31
506  Vessel i: 1:    pi: 14-21,    ai-di: 5-22,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 5-22,    taoi-deltai: 5-20,    taoPi_SP-deltaPi_SP: 5-20,    betaNi: 15
     ,    bi: 15
507  Vessel i: 2:    pi: 7-14,    ai-di: 8-41,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 8-41,    taoi-deltai: 8-39,    taoPi_SP-deltaPi_SP: 8-39,    betaNi: 31
     ,    bi: 31
508  Vessel i: 3:    pi: 27-34,    ai-di: 15-28,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 15-28,    taoi-deltai: 15-26,    taoPi_SP-deltaPi_SP: 15-26,
     betaNi: 11,    bi: 11
509  Vessel i: 4:    pi: 14-20,    ai-di: 11-41,    gi_SP-gpi_SP: 0.900000-0.343013,    ai_SP-di: 15-41,    taoi-deltai: 21-37,    taoPi_SP-deltaPi_SP: 21-37,
     betaNi: 16,    bi: 16
510  Vessel i: 5:    pi: 20-27,    ai-di: 29-53,    gi_SP-gpi_SP: 0.500000-1.000000,    ai_SP-di: 33-53,    taoi-deltai: 33-41,    taoPi_SP-deltaPi_SP: 33-41,
     betaNi: 8,    bi: 8
511  Vessel i: 6:    pi: 14-20,    ai-di: 44-65,    gi_SP-gpi_SP: 0.400000-0.456987,    ai_SP-di: 48-65,    taoi-deltai: 46-51,    taoPi_SP-deltaPi_SP: 48-51,
     betaNi: 5,    bi: 5
512
513  round LB =   [798, 5942, 6048]
514  round UB =   [10886, 6038, 6038]
515  round Hua =   [0, 5044, 5140]
516  round SPObjVal =   [5044, 5140, 5160]
517  round MPObjValNHua =   [798, 898, 908]
518
519  OptimalObj = 6048.210076213887
520  Time: 550.000000
521
522
523
524
```