```
"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=12456

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_CCG_ExtendedByMe.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.....

Optimize the  ./R_40_1.xlsx  instance by ECCG

      Master protblem status =  2 , is Optimal and MP obj =  1298.0
The initial lb =  -inf       ub =  inf

The current iteration cnt =  0
      The SP model was solved Optimal 2 and SPObj =  1298.0
      Deterministic Sub problem Status=  2 , is Optimal
      Master protblem status =  2 , is Optimal
      lb =  2512.0                  ub =  2512.0
       MPObj =  2512.0       MP_delete_Hua_Obj =  1326.0      Hua =  1186.0        SPObj =  1298.0        Deter_SP_Obj =  1186.0

ub - lb =  0.0

Iteration cycle stopped by termination criterion 1: Because ub - lb <= eps, the iteration stop, and cnt =  0
    i: 0.0  l_i: 3.0  p_i: 9.0  al_i: 3.0       sol_a_i: 3.0  sol_g_i: 0.0  d_i: 15.0  sol_taoi: 3.0  sol_deltai: 12.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 3.0  sol_deltaP: 8.0  sol_deltaP - sol_taoP: 5.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 2504618.0  wasted work: 0.5
    i: 1.0  l_i: 5.0  p_i: 21.0  al_i: 24.0  sol_a_i: 24.0  sol_g_i: 0.0  d_i: 34.0  sol_taoi: 24.0  sol_deltai: 31.0  sol_deltai - sol_taoi: 7.0  sol_taoP: 24.0  sol_deltaP: 26.0  sol_deltaP - sol_taoP: 2.0  cl_i: 1845508.0  sol_c_i: 1845508.0  sol_gp_i: 0.0  total work: 1845508.0  wasted work: 0.0
    i: 2.0  l_i: 3.0  p_i: 4.0  al_i: 5.0  sol_a_i: 5.0  sol_g_i: 0.0  d_i: 17.0  sol_taoi: 5.0  sol_deltai: 14.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 5.0  sol_deltaP: 9.0  sol_deltaP - sol_taoP: 4.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 2372796.0  wasted work: 0.0
    i: 3.0  l_i: 3.0  p_i: 0.0  al_i: 29.0  sol_a_i: 29.0  sol_g_i: 0.0  d_i: 34.0  sol_taoi: 29.0  sol_deltai: 33.0  sol_deltai - sol_taoi: 4.0  sol_taoP: 29.0  sol_deltaP: 31.0  sol_deltaP - sol_taoP: 2.0  cl_i: 1054576.0  sol_c_i: 1054576.0  sol_gp_i: 0.0  total work: 1054576.0  wasted work: 0.0
    i: 4.0  l_i: 3.0  p_i: 14.0  al_i: 60.0  sol_a_i: 60.0  sol_g_i: 0.0  d_i: 64.0  sol_taoi: 60.0  sol_deltai: 62.0  sol_deltai - sol_taoi: 2.0  sol_taoP: 60.0  sol_deltaP: 61.0  sol_deltaP - sol_taoP: 1.0  cl_i: 527288.0  sol_c_i: 527288.0  sol_gp_i: 0.0  total work: 659110.0  wasted work: 0.5
    i: 5.0  l_i: 4.0  p_i: 12.0  al_i: 1.0  sol_a_i: 1.0  sol_g_i: 0.0  d_i: 11.0  sol_taoi: 1.0  sol_deltai: 10.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 1.0  sol_deltaP: 3.0  sol_deltaP - sol_taoP: 2.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 2504618.0  wasted work: 0.5
    i: 6.0  l_i: 3.0  p_i: 0.0  al_i: 49.0  sol_a_i: 49.0  sol_g_i: 0.0  d_i: 55.0  sol_taoi: 49.0  sol_deltai: 55.0  sol_deltai - sol_taoi: 6.0  sol_taoP: 49.0  sol_deltaP: 52.0  sol_deltaP - sol_taoP: 3.0  cl_i: 1581864.0  sol_c_i: 1581864.0  sol_gp_i: 0.0  total work: 1581864.0  wasted work: 0.0
    i: 7.0  l_i: 5.0  p_i: 20.0  al_i: 6.0  sol_a_i: 6.0  sol_g_i: 0.0  d_i: 18.0  sol_taoi: 6.0  sol_deltai: 15.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 6.0  sol_deltaP: 8.0  sol_deltaP - sol_taoP: 2.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 2636440.0  wasted work: 1.0
    i: 8.0  l_i: 6.0  p_i: 0.0  al_i: 24.0  sol_a_i: 24.0  sol_g_i: 0.0  d_i: 29.0  sol_taoi: 24.0  sol_deltai: 27.0  sol_deltai - sol_taoi: 3.0  sol_taoP: 24.0  sol_deltaP: 25.0  sol_deltaP - sol_taoP: 1.0  cl_i: 790932.0  sol_c_i: 790932.0  sol_gp_i: 0.0  total work: 790932.0  wasted work: 0.0
    i: 9.0  l_i: 3.0  p_i: 16.0  al_i: 6.0  sol_a_i: 6.0  sol_g_i: 0.0  d_i: 11.0  sol_taoi: 6.0  sol_deltai: 8.0  sol_deltai - sol_taoi: 2.0  sol_taoP: 6.0  sol_deltaP: 7.0  sol_deltaP - sol_taoP: 1.0  cl_i: 527288.0  sol_c_i: 527288.0  sol_gp_i: 0.0  total work: 527288.0  wasted work: 0.0
    i: 10.0  l_i: 4.0  p_i: 30.0  al_i: 4.0  sol_a_i: 4.0  sol_g_i: 0.0  d_i: 14.0  sol_taoi: 4.0  sol_deltai: 13.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 4.0  sol_deltaP: 6.0  sol_deltaP - sol_taoP: 2.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 2636440.0  wasted work: 1.0
    i: 11.0  l_i: 6.0  p_i: 28.0  al_i: 37.0  sol_a_i: 37.0  sol_g_i: 0.0  d_i: 44.0  sol_taoi: 37.0  sol_deltai: 46.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 37.0  sol_deltaP: 39.0  sol_deltaP - sol_taoP: 2.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 3691016.0  wasted work: 5.0
    i: 12.0  l_i: 5.0  p_i: 9.0  al_i: 27.0  sol_a_i: 27.0  sol_g_i: 0.0  d_i: 32.0  sol_taoi: 27.0  sol_deltai: 29.0  sol_deltai - sol_taoi: 2.0  sol_taoP: 27.0  sol_deltaP: 28.0  sol_deltaP - sol_taoP: 1.0  cl_i: 527288.0  sol_c_i: 527288.0  sol_gp_i: 0.0  total work: 527288.0  wasted work: 0.0
    i: 13.0  l_i: 6.0  p_i: 3.0  al_i: 41.0  sol_a_i: 41.0  sol_g_i: 0.0  d_i: 52.0  sol_taoi: 41.0  sol_deltai: 49.0  sol_deltai - sol_taoi: 8.0  sol_taoP: 41.0  sol_deltaP: 43.0  sol_deltaP - sol_taoP: 2.0  cl_i: 2109152.0  sol_c_i: 2109152.0  sol_gp_i: 0.0  total work: 3427372.0  wasted work: 5.0
    i: 14.0  l_i: 3.0  p_i: 17.0  al_i: 12.0  sol_a_i: 12.0  sol_g_i: 0.0  d_i: 21.0  sol_taoi: 12.0  sol_deltai: 21.0  sol_deltai - sol_taoi: 9.0  sol_taoP: 12.0  sol_deltaP: 15.0  sol_deltaP - sol_taoP: 3.0  cl_i: 2372796.0  sol_c_i: 2372796.0  sol_gp_i: 0.0  total work: 2636440.0  wasted work: 1.0
    i: 15.0  l_i: 3.0  p_i: 31.0  al_i: 23.0  sol_a_i: 23.0  sol_g_i: 0.0  d_i: 31.0  sol_taoi: 23.0  sol_deltai: 29.0  sol_deltai - sol_taoi: 6.0  sol_taoP: 23.0  sol_deltaP: 26.0  sol_deltaP - sol_taoP: 3.0  cl_i: 1581864.0  sol_c_i: 1581864.0  sol_gp_i: 0.0  total work: 1581864.0  wasted work: 0.0
    i: 16.0  l_i: 4.0  p_i: 9.0  al_i: 34.0  sol_a_i: 34.0  sol_g_i: 0.0  d_i: 40.0  sol_taoi: 34.0  sol_deltai: 41.0  sol_deltai - sol_taoi: 7.0  sol_taoP: 34.0  sol_deltaP: 36.0  sol_deltaP - sol_taoP: 2.0  cl_i: 1845508.0  sol_c_i: 1845508.0  sol_gp_i: 0.0  total work: 1845508.0  wasted work: 0.0
    i: 17.0  l_i: 3.0  p_i: 6.0  al_i: 30.0  sol_a_i: 30.0  sol_g_i: 0.0  d_i: 36.0  sol_taoi: 30.0  sol_deltai: 32.0  sol_deltai - sol_taoi: 2.0  sol_taoP: 30.0  sol_deltaP: 31.0  sol_deltaP - sol_taoP: 1.0  cl_i: 527288.0  sol_c_i: 527288.0  sol_gp_i: 0.0  total work: 790932.0  wasted work: 1.0
    i: 18.0  l_i: 3.0  p_i: 3.0  al_i: 50.0  sol_a_i: 50.0  sol_g_i: 0.0  d_i: 53.0  sol_taoi: 50.0  sol_deltai: 55.0  sol_deltai - sol_taoi: 5.0  sol_taoP: 50.0  sol_deltaP: 52.0  sol_deltaP - sol_taoP: 2.0  cl_i: 1318220.0  sol_c_i: 1318220.0  sol_gp_i: 0.0  total work: 1581864.0  wasted work: 1.0
    i: 19.0  l_i: 3.0  p_i: 3.0  al_i: 30.0  sol_a_i: 30.0  sol_g_i: 0.0  d_i: 36.0  sol_taoi: 30.0  sol_deltai: 32.0  sol_deltai - sol_taoi: 2.0  sol_taoP: 30.0  sol_deltaP: 31.0  sol_deltaP - sol_taoP: 1.0  cl_i: 527288.0  sol_c_i: 527288.0  sol_gp_i: 0.0  total work: 527288.0  wasted work: 0.0
    i: 20.0  l_i: 3.0  p_i: 18.0  al_i: 30.0  sol_a_i: 30.0  sol_g_i: 0.0  d_i: 34.0  sol_taoi: 30.0  sol_deltai: 34.0  sol_deltai - sol_taoi: 4.0  sol_taoP: 30.0  sol_deltaP: 32.0  sol_deltaP - sol_taoP: 2.0  cl_i: 1054576.0  sol_c_i: 1054576.0  sol_gp_i: 0.0  total work: 1186398.0  wasted work: 0.5
    i: 21.0  l_i: 5.0  p_i: 25.0  al_i: 10.0  sol_a_i: 10.0  sol_g_i: 0.0  d_i: 15.0  sol_taoi: 10.0  sol_deltai: 12.0  sol_deltai - sol_taoi: 2.0  sol_taoP: 10.0  sol_deltaP: 11.0  sol_deltaP - sol_taoP: 1.0  cl_i: 527288.0  sol_c_i: 527288.0  sol_gp_i: 0.0  total work: 1318220.0  wasted work: 3.0
    i: 22.0  l_i: 3.0  p_i: 14.0  al_i: 19.0  sol_a_i: 19.0  sol_g_i: 0.0  d_i: 28.0  sol_taoi: 19.0  sol_deltai: 27.0  sol_deltai - sol_taoi: 8.0  sol_taoP: 19.0  sol_deltaP: 22.0  sol_deltaP - sol_taoP: 3.0  cl_i: 2109152.0  sol_c_i: 2109152.0  sol_gp_i: 0.0  total work: 2636440.0  wasted work: 2.0
    i: 23.0  l_i: 3.0  p_i: 0.0  al_i: 19.0  sol_a_i: 19.0  sol_g_i: 0.0  d_i: 22.0  sol_taoi: 19.0  sol_deltai: 23.0  sol_deltai - sol_taoi: 4.0  sol_taoP
```

```
51 : 19.0 sol_deltaP: 21.0 sol_deltaP - sol_taoP: 2.0 cl_i: 1054576.0 sol_c_i: 1054576.0 sol_gp_i: 0.0 total work: 1054576.0 wasted work: 0.0
52 i: 24.0 l_i: 3.0 p_i: 0.0 al_i: 63.0 sol_a_i: 63.0 sol_g_i: 0.0 d_i: 68.0 sol_taoi: 63.0 sol_deltai: 69.0 sol_deltai - sol_taoi: 6.0
sol_taoP: 63.0 sol_deltaP: 66.0 sol_deltaP - sol_taoP: 3.0 cl_i: 1581864.0 sol_c_i: 1581864.0 sol_gp_i: 0.0 total work: 1581864.0 wasted work
: 0.0
53 i: 25.0 l_i: 5.0 p_i: 4.0 al_i: 15.0 sol_a_i: 15.0 sol_g_i: 0.0 d_i: 20.0 sol_taoi: 15.0 sol_deltai: 17.0 sol_deltai - sol_taoi: 2.0
sol_taoP: 15.0 sol_deltaP: 16.0 sol_deltaP - sol_taoP: 1.0 cl_i: 527288.0 sol_c_i: 527288.0 sol_gp_i: 0.0 total work: 790932.0 wasted work: 1.0
54 i: 26.0 l_i: 3.0 p_i: 9.0 al_i: 43.0 sol_a_i: 43.0 sol_g_i: 0.0 d_i: 47.0 sol_taoi: 43.0 sol_deltai: 45.0 sol_deltai - sol_taoi: 2.0
sol_taoP: 43.0 sol_deltaP: 44.0 sol_deltaP - sol_taoP: 1.0 cl_i: 527288.0 sol_c_i: 527288.0 sol_gp_i: 0.0 total work: 527288.0 wasted work: 0.0
55 i: 27.0 l_i: 5.0 p_i: 0.0 al_i: 1.0 sol_a_i: 1.0 sol_g_i: 0.0 d_i: 4.0 sol_taoi: 1.0 sol_deltai: 3.0 sol_deltai - sol_taoi: 2.0 sol_taoP: 1.
0 sol_deltaP: 2.0 sol_deltaP - sol_taoP: 1.0 cl_i: 527288.0 sol_c_i: 527288.0 sol_gp_i: 0.0 total work: 527288.0 wasted work: 0.0
56 i: 28.0 l_i: 4.0 p_i: 12.0 al_i: 45.0 sol_a_i: 45.0 sol_g_i: 0.0 d_i: 51.0 sol_taoi: 45.0 sol_deltai: 50.0 sol_deltai - sol_taoi: 5.0
sol_taoP: 45.0 sol_deltaP: 46.0 sol_deltaP - sol_taoP: 1.0 cl_i: 1318220.0 sol_c_i: 1318220.0 sol_gp_i: 0.0 total work: 1318220.0 wasted work
: 0.0
57 i: 29.0 l_i: 4.0 p_i: 23.0 al_i: 60.0 sol_a_i: 60.0 sol_g_i: 0.0 d_i: 66.0 sol_taoi: 60.0 sol_deltai: 63.0 sol_deltai - sol_taoi: 3.0
sol_taoP: 60.0 sol_deltaP: 61.0 sol_deltaP - sol_taoP: 1.0 cl_i: 790932.0 sol_c_i: 790932.0 sol_gp_i: 0.0 total work: 922754.0 wasted work: 0.5
58 i: 30.0 l_i: 4.0 p_i: 16.0 al_i: 46.0 sol_a_i: 46.0 sol_g_i: 0.0 d_i: 49.0 sol_taoi: 46.0 sol_deltai: 50.0 sol_deltai - sol_taoi: 4.0
sol_taoP: 46.0 sol_deltaP: 47.0 sol_deltaP - sol_taoP: 1.0 cl_i: 1054576.0 sol_c_i: 1054576.0 sol_gp_i: 0.0 total work: 1186398.0 wasted work
: 0.5
59 i: 31.0 l_i: 5.0 p_i: 17.0 al_i: 0.0 sol_a_i: 0.0 sol_g_i: 0.0 d_i: 4.0 sol_taoi: 0.0 sol_deltai: 3.0 sol_deltai - sol_taoi: 3.0 sol_taoP:
0.0 sol_deltaP: 1.0 sol_deltaP - sol_taoP: 1.0 cl_i: 790932.0 sol_c_i: 790932.0 sol_gp_i: 0.0 total work: 1581864.0 wasted work: 3.0
60 i: 32.0 l_i: 5.0 p_i: 26.0 al_i: 24.0 sol_a_i: 24.0 sol_g_i: 0.0 d_i: 35.0 sol_taoi: 24.0 sol_deltai: 33.0 sol_deltai - sol_taoi: 9.0
sol_taoP: 25.0 sol_deltaP: 27.0 sol_deltaP - sol_taoP: 2.0 cl_i: 2372796.0 sol_c_i: 2372796.0 sol_gp_i: 0.0 total work: 2372796.0 wasted work
: 0.0
61 i: 33.0 l_i: 4.0 p_i: 0.0 al_i: 6.0 sol_a_i: 9.0 sol_g_i: 0.6 d_i: 14.0 sol_taoi: 9.0 sol_deltai: 16.0 sol_deltai - sol_taoi: 7.0 sol_taoP:
9.0 sol_deltaP: 12.0 sol_deltaP - sol_taoP: 3.0 cl_i: 1845508.0 sol_c_i: 2240974.0 sol_gp_i: 0.25 total work: 2240974.0 wasted work: 0.0
62 i: 34.0 l_i: 3.0 p_i: 6.0 al_i: 26.0 sol_a_i: 27.0 sol_g_i: 0.125 d_i: 35.0 sol_taoi: 27.0 sol_deltai: 29.0 sol_deltai - sol_taoi: 2.0
sol_taoP: 27.0 sol_deltaP: 28.0 sol_deltaP - sol_taoP: 1.0 cl_i: 527288.0 sol_c_i: 790932.0 sol_gp_i: 0.25 total work: 790932.0 wasted work:
0.0
63 i: 35.0 l_i: 4.0 p_i: 16.0 al_i: 8.0 sol_a_i: 9.0 sol_g_i: 0.1 d_i: 13.0 sol_taoi: 9.0 sol_deltai: 11.0 sol_deltai - sol_taoi: 2.0
sol_taoP: 9.0 sol_deltaP: 10.0 sol_deltaP - sol_taoP: 1.0 cl_i: 527288.0 sol_c_i: 1318220.0 sol_gp_i: 0.75 total work: 1318220.0 wasted work:
0.0
64 i: 36.0 l_i: 5.0 p_i: 3.0 al_i: 53.0 sol_a_i: 59.0 sol_g_i: 0.8571428571428571 d_i: 61.0 sol_taoi: 59.0 sol_deltai: 68.0 sol_deltai -
sol_taoi: 9.0 sol_taoP: 59.0 sol_deltaP: 61.0 sol_deltaP - sol_taoP: 2.0 cl_i: 2372796.0 sol_c_i: 2372796.0 sol_gp_i: 0.0 total work: 2372796.0
wasted work: 0.0
65 i: 37.0 l_i: 4.0 p_i: 17.0 al_i: 17.0 sol_a_i: 21.558333333333177 sol_g_i: 0.6511904761904539 d_i: 23.0 sol_taoi: 22.0 sol_deltai: 29.
0 sol_deltai - sol_taoi: 7.0 sol_taoP: 22.0 sol_deltaP: 24.0 sol_deltaP - sol_taoP: 2.0 cl_i: 1845508.0 sol_c_i: 2372796.0 sol_gp_i: 1.0 total
work: 2372796.0 wasted work: 0.0
66 i: 38.0 l_i: 6.0 p_i: 17.0 al_i: 55.0 sol_a_i: 61.0 sol_g_i: 1.0 d_i: 63.0 sol_taoi: 61.0 sol_deltai: 69.0 sol_deltai - sol_taoi: 8.0
sol_taoP: 61.0 sol_deltaP: 63.0 sol_deltaP - sol_taoP: 2.0 cl_i: 2109152.0 sol_c_i: 3427372.0 sol_gp_i: 1.0 total work: 3427372.0 wasted work
: 0.0
67 i: 39.0 l_i: 6.0 p_i: 8.0 al_i: 46.0 sol_a_i: 52.0 sol_g_i: 0.6666666666666666 d_i: 54.0 sol_taoi: 52.0 sol_deltai: 61.0 sol_deltai -
sol_taoi: 9.0 sol_taoP: 52.0 sol_deltaP: 55.0 sol_deltaP - sol_taoP: 3.0 cl_i: 2372796.0 sol_c_i: 3954660.0 sol_gp_i: 0.75 total work:
5272880.0 wasted work: 5.0
68 Time: 845.000000
69
70
71
72
```