

# Prob 3

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[ ]: from gurobipy import *

# create a model
m = Model()

# create variables
t1 = m.addVar(vtype=GRB.CONTINUOUS, name="t1", lb=0)
t2 = m.addVar(vtype=GRB.CONTINUOUS, name="t2", lb=0)
t3 = m.addVar(vtype=GRB.CONTINUOUS, name="t3", lb=0)
t4 = m.addVar(vtype=GRB.CONTINUOUS, name="t4", lb=0)
t5 = m.addVar(vtype=GRB.CONTINUOUS, name="t5", lb=0)
t6 = m.addVar(vtype=GRB.CONTINUOUS, name="t6", lb=0)
t7 = m.addVar(vtype=GRB.CONTINUOUS, name="t7", lb=0)
t8 = m.addVar(vtype=GRB.CONTINUOUS, name="t8", lb=0)
t9 = m.addVar(vtype=GRB.CONTINUOUS, name="t9", lb=0)
t10 = m.addVar(vtype=GRB.CONTINUOUS, name="t10", lb=0)
t11 = m.addVar(vtype=GRB.CONTINUOUS, name="t11", lb=0)
t12 = m.addVar(vtype=GRB.CONTINUOUS, name="t12", lb=0)
t13 = m.addVar(vtype=GRB.CONTINUOUS, name="t13", lb=0)

# integrate new variables
m.update()

# set objective
m.setObjective(
    -1*(t1 + 2*t2 + 3*t3 + 4*t4 + 2*t5 + t6 + 2*t7 + 6*t8 + 10*t9 + 5*t10 +
    ↪ 3*t11 + 3*t12 + 2*t13),
    GRB.MINIMIZE
)

# add constraints
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m.addConstr(t4 + t3 + t1 == 1)
m.addConstr(t7 - t4 == 0)
m.addConstr(t6 - t2 - t3 == 0)
m.addConstr(t2 + t5 - t1 == 0)
m.addConstr(t10 - t6 - t7 == 0)
m.addConstr(t8 + t9 - t5 == 0)
m.addConstr(t11 + t12 - t10 - t8 == 0)
m.addConstr(t13 - t12 == 0)
m.addConstr(-1*t13 - t11 - t9 == -1)

# optimize
m.optimize()
print("Model status: ", m.status)

# print out decision variables
for v in m.getVars():
    print(v.varName, v.x, "\n")

print("-"*15)
print("Obj Value: ", m.objVal)

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[ ]:

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[ ]: #####
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# Dual

# create a model
m = Model()

# create variables
ys = m.addVar(vtype=GRB.CONTINUOUS, name="ys", lb=-0)
yt = m.addVar(vtype=GRB.CONTINUOUS, name="yt", lb=-0)
ya = m.addVar(vtype=GRB.CONTINUOUS, name="ya", lb=-0)
yb = m.addVar(vtype=GRB.CONTINUOUS, name="yb", lb=-0)
yc = m.addVar(vtype=GRB.CONTINUOUS, name="yc", lb=-0)
yd = m.addVar(vtype=GRB.CONTINUOUS, name="yd", lb=-0)
ye = m.addVar(vtype=GRB.CONTINUOUS, name="ye", lb=-0)
yf = m.addVar(vtype=GRB.CONTINUOUS, name="yf", lb=-0)
yg = m.addVar(vtype=GRB.CONTINUOUS, name="yg", lb=-0)

# integrate new variables
m.update()

# set objective

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m.setObjective(
    yt - ys,
    GRB.MINIMIZE
)

# add constraints
m.addConstr(-1*ys + yc >= 1)
m.addConstr(-1*yc + yb >= 2)
m.addConstr(-1*ys + yb >= 3)
m.addConstr(-1*ys + ya >= 4)
m.addConstr(-1*yc + ye >= 2)
m.addConstr(-1*yb + yd >= 1)
m.addConstr(-1*ya + yd >= 2)
m.addConstr(-1*yc + yf >= 6)
m.addConstr(-1*yc + yt >= 10)
m.addConstr(-1*yd + yf >= 5)
m.addConstr(-1*yf + yt >= 3)
m.addConstr(-1*yf + yg >= 3)
m.addConstr(-1*yg + yt >= 2)

# optimize
m.optimize()
print("Model status: ", m.status)

# print out decision variables
for v in m.getVars():
    print(v.varName, v.x, "\n")

print("-"*15)
print("Obj Value: ", m.objVal)

```

Academic license - for non-commercial use only  
 Optimize a model with 9 rows, 13 columns and 26 nonzeros  
 Coefficient statistics:  
   Matrix range       [1e+00, 1e+00]  
   Objective range    [1e+00, 1e+01]  
   Bounds range       [0e+00, 0e+00]  
   RHS range          [1e+00, 1e+00]  
 Presolve removed 6 rows and 6 columns  
 Presolve time: 0.00s  
 Presolved: 3 rows, 7 columns, 14 nonzeros

Iteration	Objective	Primal Inf.	Dual Inf.	Time
0	-2.1016000e+01	4.008000e+00	0.000000e+00	0s
3	-1.6000000e+01	0.000000e+00	0.000000e+00	0s

Solved in 3 iterations and 0.00 seconds  
 Optimal objective -1.600000000e+01  
 Model status: 2  
 t1 0.0

t2 0.0

t3 0.0

t4 1.0

t5 0.0

t6 0.0

t7 1.0

t8 0.0

t9 0.0

t10 1.0

t11 0.0

t12 1.0

t13 1.0

## Dual Result

Obj Value: -16.0

Optimize a model with 13 rows, 9 columns and 26 nonzeros

Coefficient statistics:

Matrix range [1e+00, 1e+00]

Objective range [1e+00, 1e+00]

Bounds range [0e+00, 0e+00]

RHS range [1e+00, 1e+01]

Presolve removed 8 rows and 5 columns

Presolve time: 0.00s

Presolved: 5 rows, 4 columns, 10 nonzeros

Iteration	Objective	Primal Inf.	Dual Inf.	Time
0	-2.0000000e+30	3.0000000e+30	2.0000000e+00	0s
3	1.6000000e+01	0.0000000e+00	0.0000000e+00	0s

Solved in 3 iterations and 0.00 seconds

Optimal objective 1.600000000e+01

Model status: 2

ys 0.0

yt 16.0

ya 4.0

yb 5.0

yc 1.0

yd 6.0

ye 3.0

yf 11.0

yg 14.0

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Obj Value: 16.0